NISTEP REPORT No. 73

Science and Technology
Indicators: 2004

A Systematic Analysis of
Science and Technology Activities in Japan

April 2004

Science and Technology Indicator Project Team
National Institute of Science and Technology Policy (NISTEP)
Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan

Science and Technology Indicators: 2004
A Systematic Analysis of Science and Technology
Activities in Japan

April 2004

Science and Technology Indicators Team,
National Institute of Science and Technology Policy
(NISTEP)
Ministry of Education, Culture, Sports, Science
and Technology(MEXT), Japan

Preface

In Japan, science and technology are increasingly expected to serve as the driving force to improve the international competitiveness of the Japanese economy in the globalizing world economy and to promote the overall development of the global community in harmony with the environment. While there is wide recognition of the need to make an accurate assessment of the state of domestic science and technology activities, it is not an easy task to acquire an overview of such extensive and diverse activities.

In response to such needs, the National Institute of Science and Technology Policy (NISTEP) first published in 1991 the 'Science and Technology Indicators' report as a systematic analysis of Japan's science and technology activities based on objective and quantitative data. Since then, NISTEP has published updated editions, each consisting of a revised set of indicators, approximately every three years. Here we present the 2004 edition of Science and Technology Indicators, which has been compiled under a new scheme.

While broadening the scope of the report with particular emphasis on knowledge, we improved the composition of the indicators used for the report, based on the realization that activities to produce, distribute, and utilize cutting-edge knowledge of science and technology will become increasingly important as the foundations of future society.

We hope that the report will be widely used by science and technology policymakers as basic information for policymaking. We will review feedback from parties concerned to further refine and improve future Science and Technology Indicators.

Finally, we would like to sincerely thank the experts from many different fields who helped prepare this report, particularly Professor Fujio Niwa of the National Graduate Institute for Policy Studies, who gave us detailed advice as the NISTEP's Visiting Researcher in Chief.

April 2004

Yukihiro Hirano
Head of the Science and Technology Indicators Team
Deputy Director General
National Institute of Science and Technology Policy,
Ministry of Education, Culture, Sports, Science
and Technology

(This is an English version of the report published in March 2005)

[Adviser]

NIWA, Fujio	Visiting Researcher in Chief; Professor, National Graduate Institute for Policy Studies	

[Authors]

HIRANO, Yukihiro	Deputy Director General	[Summarization and total coordination]
IMAI, Kan	Director, 1st Policy-Oriented Research Group (since July 2002)	[Summarization and total coordination]
KOJIMA, Norio	Former Director, 1st Policy-Oriented Research Group (until July 2002)	[Summarization and total coordination]
TOMIZAWA, Hiroyuki	Senior Research Fellow, 2nd Theory-Oriented Research Group	[Summarization; Chapters 1-3; 6-10]
MATSUMURO, Kanji	Senior Research Fellow, 1st Policy-Oriented Research Group (until July 2004)	[Total coordination]
ABE,Koichi	Senior Research Fellow, 1st Policy-Oriented Research Group (since July 2004)	[Total coordination]
FUKASAWA, Nobuyuki	Director, Information Analysis Division	[Chapter 11]
EBIHARA, Hiroko	Chief, Information Section, Information Analysis Division	[Chapter 2 (Section 4), Chapter 7 (Section 3), Chapter 11]
KANDA, Yumiko	Information Analysis Division	[Chapter 2 (Section 4), Chapter 6 (Sections 1-2), Chapter 7, Chapter 9, (Sections1-2), Chapter 10]
IJICHI, Tomohiro	Visiting Researcher (formerly Senior Research Fellow), 1st Theory-Oriented Research Group	[Chapter 12 (Section 2)]
KOGA, Tadahisa	Researcher, 1st Theory-Oriented Research Group	[Chapter 12 (Sections1, 3, and 4)]
KAWASAKI, Hirotsugu	Senior Research Fellow, 2nd Theory-Oriented Research Group (until Sept 2004)	[Chapter 9 (Section 1)]
SAITO, Yoshiko	Visiting Researcher (formerly Researcher), 2nd Theory-Oriented Research Group	[Chapter 1 (Section 2), Chapter 3 (Section 2), Chapter 10 (Section 3)]
ISHII, Masamichi	Senior Research Fellow, 2nd Theory-Oriented Research Group	[Chapter 4]
SHIMOMURA, Tomoko	Researcher, 1st Policy-Oriented Research Group	[Chapters 5 (Sections 2-4)]
WADA, Yukio	Former Senior Research Fellow, 1st Policy-Oriented Research Group (until Nov. 2002)	[Chapter 5]
WATANABE, Masataka	Senior Research Fellow, 2nd Policy-Oriented Research Group	[Chapter 5 (Section 1), Chapter 13]

NAKAMURA, Takashi	Senior Research Fellow, 2nd Policy-Oriented Research Group	[Chapter 13]
OHNUMA, Kiyohito	Former Senior Research Fellow, 2nd Policy-Oriented Research Group (until Aug. 2003)	[Chapter 5 (Section 1), Chapter 13]

[Collaborators]

YAMAGUCHI, Takashi	Researcher, Research and Coordination Division, Science and Technology Policy Bureau	[Provision of information]
HARADA, Daichi	Subsection Chief, Research and Coordination Division, Science and Technology Policy Bureau	[Provision of information]
Kwon Hyeog Ug	Hitotsubashi University Graduate School	[Chapter 12]
OHNUKI, Sachiko	1st Policy-Oriented Research Group	[Overall adjustment]
FUJII, Yuki	Former member of 1st Policy-Oriented Research Group (Jun. 2003-Jan. 2004)	[Overall adjustment]
NOGUCHI,Kaori	1st Policy-Oriented Research Group (Nov.-Dec. 2004)	[Overall adjustment]
KAWANO, Junko	1st Policy-Oriented Research Group (since Jan. 2004)	[Overall adjustment]
KAKINUMA, Emi	Former member of 1st Policy-Oriented Research Group (Mar.-Oct. 2003)	[Overall adjustment]

[Proofreaders]

FUKASAWA, Nobuyuki	Director, Information Analysis Division (until Mar. 2004)	[Chapter 3 (Section 2), Chapters 4, 5, and 12]
IIJIMA,Kunio	Director, Information Analysis Division (since July 2004)	[Chapter 3 (Section 2), Chapters 4, 5, and 12]
EBIHARA, Hiroko	Chief, Information Section, Information Analysis Division	[Chapter 3 (Section 2), Chapters 4-5]
KANDA, Yumiko	Information Analysis Division	[Chapter 3 (Section 2), Chapter 4]
IJICHI, Tomohiro	Visiting Researcher (formerly Senior Research Fellow), 1st Theory-Oriented Research Group	[Chapter 1]
KOGA, Tadahisa	Researcher, 1st Theory-Oriented Research Group	[Chapter 7]
ISHII, Masamichi	Senior Research Fellow, 2nd Theory-Oriented Research Group	[Chapter 8]
MATSUMURO, Kanji	1st Policy-Oriented Research Group (until July 2004)	[Chapter 3 (Section 1)]
SHIMOMURA, Tomoko	Senior Research Fellow,1st Policy-Oriented Research Group	[Chapter 13]
OHNUKI, Sachiko	1st Policy-Oriented Research Group	[Chapter 2]
KAKINUMA, Emi	Former member of 1st Policy-Oriented Research Group (Mar.-Oct. 2003)	[Chapter 3 (Section 1)]
WATANABE, Masataka	Senior Research Fellow, 2nd Policy-Oriented Research Group	[Chapter 10]
NAKAMURA, Takashi	Senior Research Fellow, 2nd Policy-Oriented Research Group	[Chapter 6]

KEIRA, Hidemi	Senior Research Fellow, 3rd Policy-Oriented Research Group (until Mar. 2004)	[Chapter 9]
UENO,Sen	2nd Theory-Oriented Research Group (since April 2004)	[Chapter 9 (Section 1)]

Table of Contents

Chapter 9 The Role of the Government

Chapter 10 Universities: Their Production of Science Knowledge and Collaboration with Other Sectors

Chapter 11 R&D in the Business Sector

Part IV Science & Technology and Society

Chapter 12 Innovation and the Japanese Economy and Society

Chapter 13　Public Interest in Science and Technology

Boxed Articles

List of Figures for Science and Technology Indicators (5th edition)

Explanatory Notes

1. The National Institute of Science and Technology Policy compiled all descriptions, figures, tables and so on, unless the source is otherwise noted.

2. The information sources listed underneath individual figures and tables in this report are defined as follows:

   Source: This is used to note the original source of the indicator data or the original provider of the data. This means the figure or table has been prepared on the basis of the data from the indicated source. Where the original data have been manipulated by NISTEP, the source note contains phrases such as 'created from' and 'based on the data from.' Where new data have been compiled based on the original data, the source note contains the phrases 'compiled from' or the like.

   Reprinted from: This means the figure or table has been reproduced without change from another source.

3. Annotations to text are provided in the form of footnotes that are numbered to match the superscript numbers, such as [1], added to the corresponding part of the text.

4. References are listed at the end of each chapter.

5. The time or period covered by yearly data sometimes differs depending on the country or the type of statistics. Therefore the calendar year and the fiscal year noted in this report are, rather than always strictly following those of the original data, expressed in a manner optimized for the intended purposes such as identifying the trends in data or making an international comparison.

Introduction:
About Science and Technology Indicators

The Purpose of Science and Technology Indicators

The National Institute of Science and Technology Policy (NISTEP) herein presents the 'Science and Technology Indicators' report, which marks the fifth edition since it was first published in 1991. The Science and Technology Indicators series has been utilized by those interested in science and technology at home and abroad as a source of quantitative and systematic information regarding science and technology activity in Japan. Amid the intensifying international competition among developed countries, the global science and technology environment is experiencing revolutionary changes which nobody had predicted when the first report was published, such as many governments aggressively addressing the promotion of science and technology as a priority issue.

To keep up with these international trends, the Japanese government has been striving to increase the national capabilities in science and technology through the institution of the Basic Law on Science and Technology in 1995 and the formulation of the First Basic Plan for Science and Technology in 1996. The government further strengthened its science and technology policy by establishing the Second Basic Plan for Science and Technology in 2001. Such moves have raised the need to develop an objective picture of the national science and technology capacity, thereby increasing the significance of Science and Technology Indicators, for which we have been receiving a variety of requests for improvement. Taking these requests and our experiences in the previous editions into account, the present version of the report clarifies the recent state of science and technology activities.

Funded by the Special Coordination Funds for Promoting Science and Technology, NISTEP is now conducting a 'survey for the evaluation of the effects achieved through the Basic Plan for Science and Technology' for the First and Second Plans. Combined with the survey results, this Science and Technology Indicators report enables a better understanding ofoverall science and technology trends in Japan.

Composition of this report

The Science and Technology Indicators report consists of the following contents.

Part I Global Science and Technology Trends and the Position of Japan

To understand the science and technology state of Japan, we consider two aspects: global science and technology trends and Japan's competitiveness.

○ *Chapter 1 : International Trends in Science and Technology*

As an introduction to the report, this chapter provides an overview of major trends in post-Cold War science and technology activities in the world, with particular focus on changes seen across the world.

○ *Chapter 2 : Performance of Japan's National Innovation System*

Japan's science and technology competitiveness is discussed by examining the performance of its innovation system.

Part II Knowledge Base, Human Resources and Training

Part II focuses on human resources as the critical foundations of science and technology activity.

○ *Chapter 3 : Human Resources Devoted to Science and Technology in a Knowledge-based Society*

The chapter examines the knowledge society, transition to which is happening in Japan, and human resources that support such a society.

○ *Chapter 4 : The Researcher in a knowledge-based society*

This chapter discusses the current state and challenges regarding researchers, who play the leading role in producing science and technology knowledge and are assuming increasingly important roles in a knowledge society.

○ *Chapter 5 : Development of S&T Human Resources in School Education*

This chapter explains how science and technology human resources are developed in schools, a fundamental issue in the promotion of science and technology.

Part III Knowledge Production

In Part III, we survey R&D activities in Japan and other major developed countries primarily based on statistics on R&D expenditure and human resources.

○ *Chapter 6 : International Comparison of R&D systems*

This chapter looks at how well a country's different aspects of R&D, including the roles of the business, government, university, and private non-profit sectors and the relationships between them, work as a single system and investigates indicators to identify the characteristics of such a system.

○ *Chapter 7 : R&D Performance*

As indicators of the results of science and technology knowledge production, we analyze changes in the performance of international science and technology activities on the basis of statistics on scientific papers and patents.

○ *Chapter 8 : Transformation of Knowledge Production*

To address the issue of how researchers produce science and technology knowledge, this chapter analyzes and identifies changes seen in the way scientific papers are produced.

○ *Chapter 9：The Role of the Government*

This chapter explores what kind of role the government assumes in the national science and technology system by focusing on government funding to individual sectors and activities of governmental research institutes.

○ *Chapter 10：The Universities: Their Production of Science Knowledge and* Collaboration with Other Sectors

This chapter clarifies the functionality and activities of higher education institutions by comparing and analyzing statistics of selected countries.

○ *Chapter 11：R&D in the Business Sector*

This chapter analyzes trends in the business sector, which is for many of the selected countries the largest sector in terms of both R&D expenditure and the number of researchers.

Part IV Science & Technology and Society

In Part IV, we explore the position of science and technology activities in Japanese society from the two perspectives of economy/society and public interest

○ *Chapter 12：Innovation and the Japanese Economy and Society*

This chapter provides an overview of the impact that science and technology activities can have on the Japanese economy/society from the viewpoints of macroeconomics and microeconomics.

○ *Chapter 13：Public Interest in Science and Technology*

From the perspective that raising public interest in and understanding of science and technology is essential for improving the national science and technology capacity, this chapter intends to measure the level of public interest and understanding of science and technology.

Important Features of Science and Technology Indicators

By further improving usefulness in policymaking, the direction first set by the fourth edition, the fifth edition of Science and Technology Indicators aims at becoming more policy-oriented, or to be more specific, providing indicators that contribute to policymaking in a broad sense and discussion for policymaking.

As was done for the fourth edition, we discuss what kinds of indicators are needed for policymaking and, based on the results, investigate individual indicators. In this process, we build a link between indicators development and policymaking by having the personnel responsible for developing indicators participate in working groups for various policy debates.

Funded by the Special Coordination Funds for Promoting Science and Technology, NISTEP is now conducting a 'survey for the evaluation of the effects achieved through the Basic Plan for Science and Technology' in the timeframe of fiscal 2003 to 2004. The purpose of this survey is to review the First and Second Basic Plans for Science and Technology.

Unlike the above survey, this repot is not intended for identifying the achievement towards the individual goals set in the Basic Plans for Science and Technology. Instead, it is designed to help the readers understand the overall state of science and technology in Japan, which is advancing under these plans, and that of other countries. Consequently, the report describes the level of Japan's science and technology capabilities in a global context.

In addition, to improve the usefulness of the indicators, we emphasize the following aspects in the present edition of Science and Technology Indicators.

- We introduce indicators that show signs of Japan's transition to a knowledge society mainly in Part II, especially Chapters 3 and 4.

- Chapter 8 'Transformation of Knowledge Production' presents a quantitative description of the fundamental change in the ways that researchers produce knowledge, from the viewpoint of advancements in networking, interdisciplinarity, and internationalization.

- We present extra data in two areas that have recently been the center of attention— industry-academia collaboration and venture businesses—to reinforce the report's conventionally sparse coverage of these areas. For Chapter 10 'The Universities: Their Production of Science Knowledge and Collaboration with Other Sectors,' we present new sets of data on industry-academia collaboration. We also include in Chapter 12 'Innovation and the Japanese Economy and Society' new indicators that represent the environments surrounding start-ups and the innovation activities of small to medium-sized companies.

Furthermore, we identify the kinds of science and technology statistics that are missing. Despite growing awareness of the significance of science and technology statistics, Japan is not making sufficient efforts to fill such gaps. We hope that this report contributes to solving this problem.

Finally, we welcome frank feedback from all parties concerned to further improve Science and Technology Indicators.

Part I

Global Science and Technology Trends, and the Position of Japan

Chapter 1
International Trends in Science and Technology

In this paper, Part I discusses the state of science and technology in Japan from two aspects: global science and technology trends and Japan's competitiveness. Chapter 1 provides an overview of major trends in post-Cold War science and technology activities in the world, with particular focus on changes seen across the world. Chapter 2 investigates Japan's science and technology competitiveness by looking at the performance of its national innovation system.

1.1 Post-Cold War science and technology

The most remarkable phenomenon observed in today's science and technology would be the rapid growth of science and technology knowledge. Price, a pioneer in the sociological analysis of science, once confirmed the exponential increase of scientific literature based on statistics on scientific papers, while predicting such 'scientific growth' would have limitations and eventually level off.

Although there is no doubt that science will reach its growth limit someday, a variety of indicators reported herein show evidence of a continued increase in science and technology knowledge in terms of production, distribution and utilization. In particular, qualitative changes in science and technology activities since the end of the Cold War appear to drive this constant growth in science and technology.

Various indicators presented in this report illustrate many different changes concurrent with the growth, such as increased investments in science and technology, changes in the style of knowledge production, and the expansion of the international distribution of science and technology knowledge, driven by a global economy and the development of information technology. Another feature of this report is the creation of the 'General Indicator of Science and Technology.' Our specific aim, as described in Chapter 2, is to develop a single indicator that can represent all major aspects of science and technology activities. The General Indicator of Science and Technology is useful for understanding at least how science and technology activity expanded in scale in the post-Cold War period.

1.1.1 Investment in science and technology

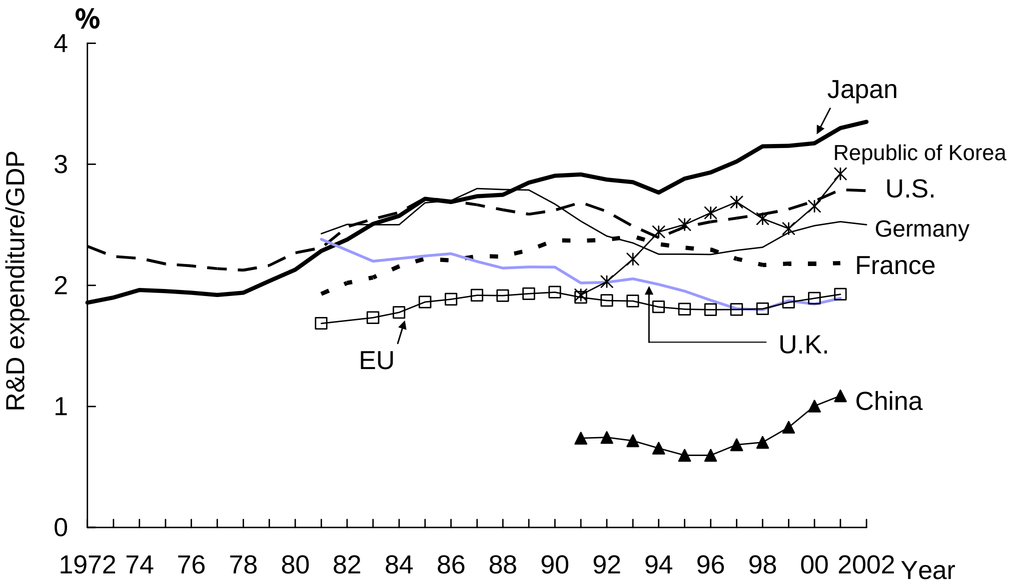
The amount of investment in science and technology is a fundamental indicator to identify trends in science and technology activities. Among others, R&D expenditure per gross domestic product (GDP) is often used to compare investment levels of counties varying in economic size (Figure 1-1-1). The total R&D expenditure of each selected country was experiencing a slowdown or decline from the latter half of the 1980s to the first half of the 1990s. The figures for Japan and the U.S. turned upward in the mid-1990s, followed by Germany, the U.K. and the European Union a few years later. France's figure has remained at the same level since 1998. All selected countries but France have been experiencing an increase in R&D investment during the past few years.

We are aware that a detailed analysis of this indicator and a comparison with other related indicators must be conducted before we can discuss the statistics, but this issue will be discussed in Chapter 6. Described below are considerations concerning the indicator.

Investment in R&D is considered a key driving force for economic growth. In this context, some may say that GDP per R&D expenditure is more appropriate as an indicator than R&D expenditure per GDP. Such an indicator may be used to conclude that Japan's high R&D investment is not correlated with economic growth. However, let us remind you that R&D is not always directly linked to economic growth and that investment in R&D is not the only engine for economic growth.

One of the essential goals of this report is to explore the link between R&D and economic growth. Answering this question is not easy however. Nations worldwide are addressing this problem using different approaches. Among them, attention has recently been paid to the industry-academia cooperation system and a concept called the national innovation system (to be described in Chapter 2), which is a more comprehensive system than the former. Adopting this concept, this report intends to address science and technology activities from a broad perspective, rather than confining itself within the conventional narrow definitions of R&D and science and technology activities.

Figure 1-1-1: Trends in R&D expenditure per GDP for selected countries



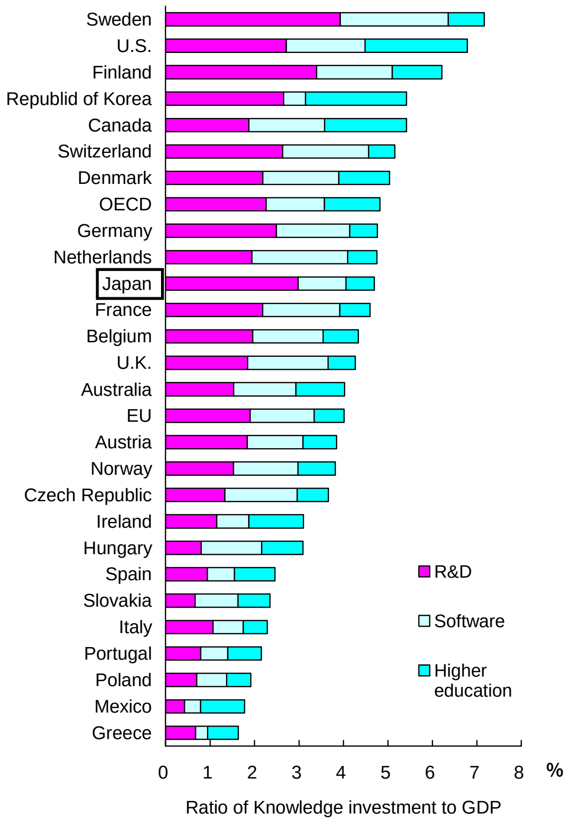
Note: For notes on R&D expenditure, see Table 6-1-1. For notes on GDP, see those on Reference Statistics C.
Sources: For R&D expenditure, the same as Table 6-1-1; For FDP, the same as Reference Statistics C
See: Table 1-1-1

1.1.2 Investment in knowledge

Human resources and social infrastructure serve as an important driving force for economic growth, but in terms of a science and technology policy, a critical question is what elements should be combined with R&D. Analyzing investments in knowledge could identify one of the elements. The OECD performs country-by-country comparison of the levels of investment using the ratio of knowledge investment to GDP, where knowledge investment is an indicator deriving from the total investment in R&D, software and higher education. Since detailed data are shown in Chapter 3 (Figure 3-1-2), this section focuses on the meaning of the indicator, rather than the definitions and measurement methodology, which will be mentioned later.

The data show that Japan's knowledge investment ranks in the middle range of values for members of the OECD. However, Japan's investment in higher education is rather low and so is its software investment. While the significance of R&D investment is widely recognized across the world, R&D investment should be positioned not as an absolute element, but as part of investment in knowledge. It is recommended that Japan make future R&D investment from the viewpoint of linking it with higher education and information technology.

Figure 1-1-2: Investment in knowledge



Note: Data for 1999 are used for the OECD, Denmark, Belgium, Greece, Slovakia, and Mexico. Data for 2000 are used for the rest of the countries
<Japan, U.S, and Canada> Data for higher education refer to post-secondary school education rather than post-high school education.
<OECD> Not including Hungary, Poland, and Slovakia
<Belgium> Data for higher education refer to direct public expenditure only.
<EU> Not including Belgium, Denmark, and Greece
Source: OECD, "STI Scoreboard 2003"
See: Table 1-1-2

1.2 Science and technology activities across national boundaries

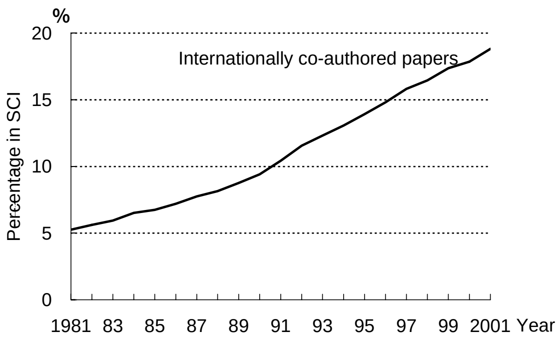
The greatest change that has occurred in the science and technology community since the 1990s is globalization of science and technology. Indeed, there is nothing remarkable about the distribution of science and technology knowledge across national boundaries, since science and technology are embraced openly on a global scale. The current globalization of science and technology, however, apparently differs from the conventional one in quality. It is a move toward production of science and technology knowledge in an international framework based on economic globalization, and driven by the rapid proliferation of the Internet and information technology. The recent globalization of science and technology is also receiving worthwhile attention for its high rate of progress. Explained in this section, indicators to measure the progress of science and technology globalization are the percentage of internationally co-authored papers, the number of patents filed in foreign countries, imports, and exports of technology, and imports and exports of high technology products.

1.2.1 Internationally co-authored papers

Internationally co-authored papers are the results of joint research projects conducted by scientists based in different countries, or more precisely, scientists belonging to facilities located in different countries. The number of such papers serves as an indicator of the state of international R&D activities.

Figure 1-2-1 shows the trends in the percentage of internationally co-authored papers among the total papers listed in the Science Citation Index (SCI). Internationally co-authored papers accounted for about 5% of the total scientific papers contained in the SCI in 1981. Ten years later, in 1990, the figure doubled to reach 10%, followed by an additional increase to 20% in the next 10 years by 2001. This shows that the percentage of internationally co-authored papers grew almost four-fold in 20 years. In relation to this topic, statistical analysis results of the papers listed in SCI will be described in Chapter 7 and a further explanation of the changes in the style of co-authoring papers, including the issue of increasing international co-authorship, as mentioned above, will be presented in Chapter 8 (Section 8.1).

Figure 1-2-1: Increasing international co-authorship of scientific papers:
Trends in the percentage of internationally co-authored papers in SCI



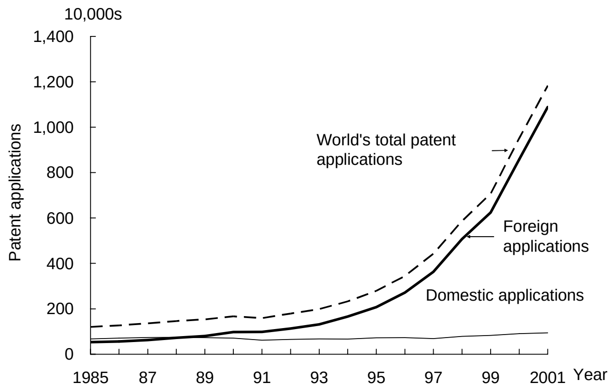
Note: (Co-authorship) = (Domestic co-authorship) + (Co-authorship in the same institute) + (International co-authorship)
Source: Compiled by NISTEP based on Thomson ISI's "Science Citation Index, Compact Disk Edition"
See: Table 1-2-1

1.2.2 Patents filed abroad

The number of patents filed abroad has been on the sharp rise since the 1990s. Figure 1-2-2 shows the total number of patent applications in all the member nations (175 as of July 2000) of the World Intellectual Property Organization (WIPO). In addition to the total patent filings in the world, the plot illustrates the number of domestic and foreign patent applications.

The figure below shows that the worldwide patent applications have been surging, and since the latter half of the 1990s, patents filed in foreign countries have come to account for a large part of them. An increase in the number of patents filed abroad does not mean a rise in the number of inventions or significant growth in the knowledge of science and technology, but does mean a move toward securing technology rights beyond national boundaries. In this sense, the number of foreign patent applications is an indicator of the speed of globalization in science and technology.

Figure 1-2-2: Increasing foreign patent applications
Trends in the number of global patent applications

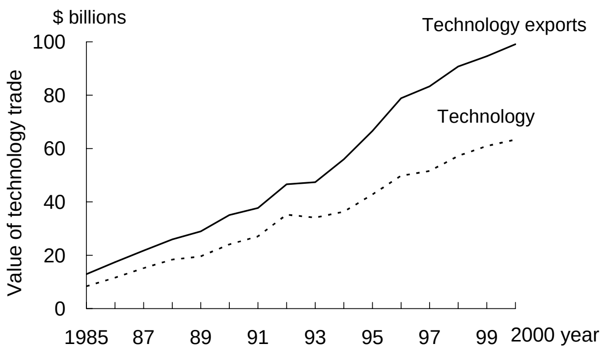


Sources: Patent Office and WIPO for data in or before 1993; WIPO's "Industrial Property Statistics 1994-2001" for later data
See: Table 1-2-2

1.2.3 Technology Trade

The technology trade involves international trading of the rights to use specific technologies. Data concerning the technology trade, which show the state of international distribution of technological knowledge, covers the technology rights that are granted for a fee, or in other words, technologies for practical use. This point is what makes these data valuable. Figure 1-2-3 shows the total values of technology imports and exports of 11 OECD countries for which technology trade statistics were available over a certain time period.

Figure 1-2-3: Trends in the total value of technology trade for selected 11 OECD countries



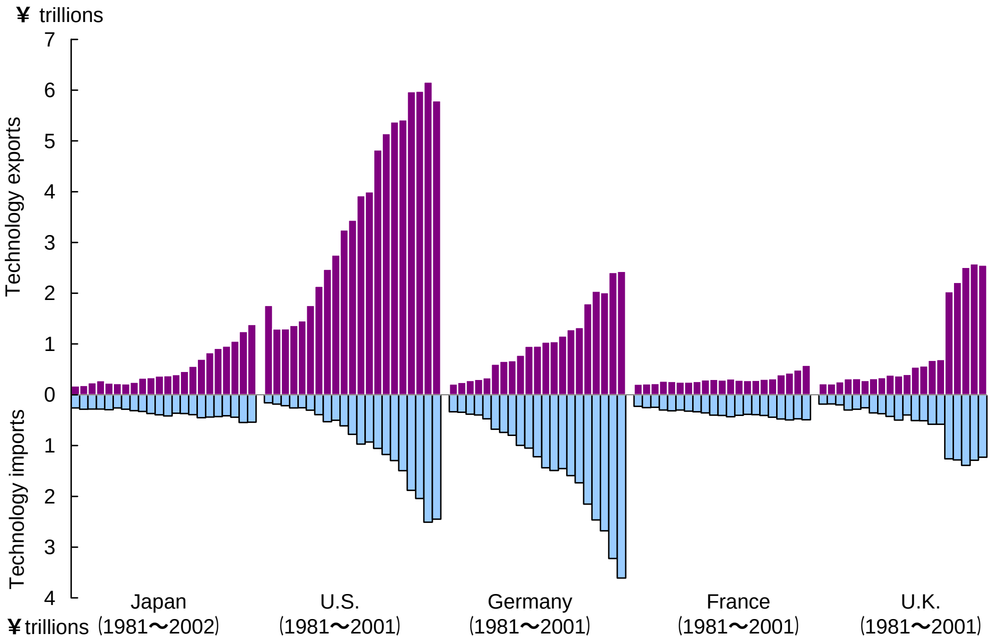
Note: Of the OECD countries, 11 countries for which continuous trade statistics were available were selected and their values of technology imports and exports were summed up. The selected countries are the U.S., Japan, Germany, the U.K., France, Italy, Canada, Austria, Belgium, Switzerland, and Norway.
Source: OECD, "Main Science and Technology Indicator 2003/1"
See: Table 1-2-3

In the 15 years from 1985 to 2000, the total technology exports for the 11 nations increased 7.7 times, while the total technology imports grew 7.6 times. Although not adjusted for inflation, these figures are the evidence of a surge in the international trading of technological knowledge over the past 15 years. Meanwhile, the fact that the total value of technology exports exceeded the total value of technology imports indicates that the selected 11 countries had a positive trade balance with other countries.

Figure 1-2-4 illustrates the trends in the technology trade in five developed countries. The upper half shows the value of technology exports and the lower half the value of technology imports. While each country indicated a different trend for the selected period, the overall data shows that there was an increase in the international flow of technology rights. In particular, the U.S. and Germany experienced a sharp rise in both technology imports and exports. Japan has shown a rapid growth in technology exports since the mid-1990s.

Data concerning the technology trade serve not only as an indicator of globalization in science and technology, but also as an indicator to measure the technology level or the international technological competitiveness of a nation. An analysis of technology trade in this context will be provided in Chapter 2. Data on the technology trade will also be mentioned in Chapter 11 as an indicator of R&D activities in the Japanese industry.

Figure 1-2-4: Trends in the value of technology trade for selected countries



Notes: <Japan> Data refer to patents, expertise, and technical assistance.
Data involves some inconsistency due to the addition of industries to be surveyed in 1996 and 2001
<U.S.> Data refer to loyalties and licenses only
<Germany> Data refer to West Germany until 1990 and to patents, licenses, trademarks, and designs until 1985. Additionally including technical services, computer services, and private-sector R&D since 1986.
<France> No definition available
<U.K.> Including data for the petroleum industry since 1984. Including patents, inventions, licenses, trademarks, designs, technology-related services and R&D since 1996.
Based on the same purchasing power parity as for Reference Statistics E
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts, and Telecommunications, "Survey of Research and Development"
<U.S., Germany, France and U.K.> OECD, "Main Science and Technology Indicators 2003/1"
See: Table 1-2-4

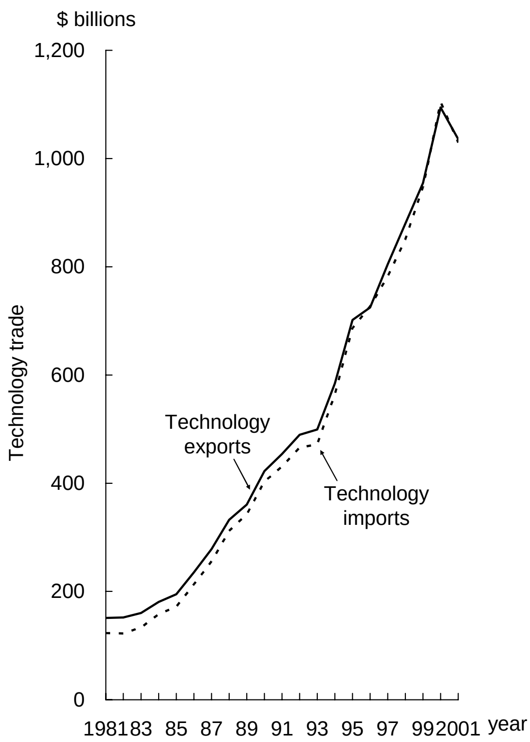
1.2.4 Foreign trade of high technology products

The foreign trade value of high technology products can also serve as an indicator of science and technology globalization. The total value of high technology products imported or exported, although not directly indicating the flow of science and technology knowledge as the technology trade value does, is an indirect indicator of the science and technology knowledge which has been used for developing the commercial products.

Figure 1-2-5 shows trends in the total foreign trade value (imports and exports) of high technology products across all OECD countries. Imports and exports of high technology products were on a steady rise throughout the two decades from 1981 to 2000, before posting a year-on-year decline in 2001..

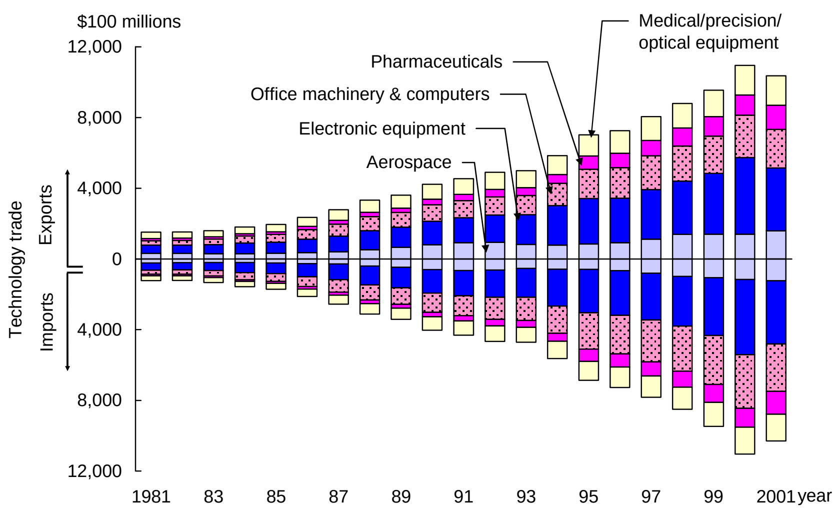
Figure 1-2-6 shows a breakdown of the total high technology product trade of all OECD countries by industry. The 'electronic equipment' industry dominated in both imports and exports, followed by 'office machinery and computers.'

Figure 1-2-5: Trends in the total foreign trade in the high technology industries of all OECD countries



Source: OECD, "Main Science and Technology Indicator 2003/1"
See: Table 1-2-5

Figure 1-2-6: Trends in the total foreign trade in the high technology industries of all OECD countries: A breakdown by industry



Source: OECD, "Main Science and Technology Indicator 2003/1"
See: Table 1-2-6

1.3 Change in the mode of knowledge production

Some researchers point out that there has recently been a significant change in the mode in which science and technology activity or knowledge production is conducted. While it is sometimes difficult to find quantitative indicators to represent such a change, some have proven effective.

Figure 1-3-1 shows a breakdown of academic papers by author listed in SCI, together with the trends over the years.

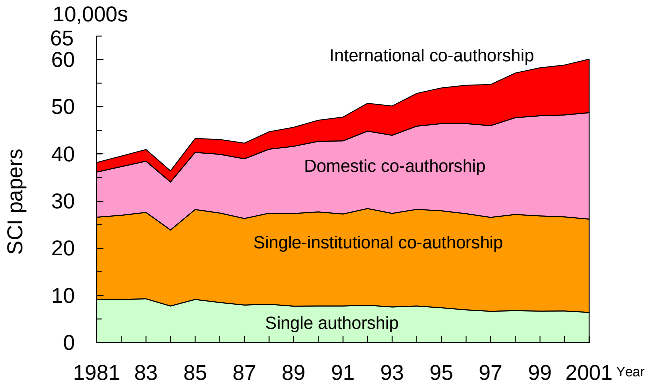
The total number of listed papers increased from approximately 390,000 to roughly 600,000, indicating a 1.6-fold growth in the 21 years from 1981 to 2001. We divided these papers into four authorship categories: (1) single authorship (papers written by one person), (2) single-institutional co-authorship (papers written by multiple persons belonging to the same institution), (3) domestic co-authorship (papers written by multiple persons belonging to different institutions in the same country), and (4) international co-authorship (papers written by multiple persons belonging to different institutions in different countries).

Throughout the selected period for the plot, single authorship and single-institutional co-authorship showed a downward trend for the last few years, although the latter's decline was slower.

By contrast, domestic and international co-authorship has been on the steady rise since 1985, indicating a total increase of approximately 220,000 papers in the 21 years from 1981 to 2001. This means that the major factor behind the growth in the total number of SCI papers is an increase in co-authorship beyond institutional boundaries.

On the basis that co-authorship is proliferating as a style of authoring papers, while single-authorship and single-institutional co-authorship are on the decline, we can argue that external partnership is becoming a more common practice in producing scientific knowledge. Changes in the style of knowledge production are elaborated in Chapter 8, whose primary subject is this topic through approaches such as country-based and sector-based analyses of trends in the authorship of papers.

Figure 1-3-1: Change in authorship of papers (Trends in the number of SCI papers by authorship)



Source: Compiled by NISTEP based on Thomson ISI's "Science Citation Index, Compact Disk Edition"
See: Table 1-3-1

Reference
[1] D. Price
"Little Science, Big Science"
(translated by Nagayasu Shimao), Sogensha, 1970

Chapter 2
Performance of Japan's National Innovation System

Innovation means new ideas or methods or the act of introducing them. In general, the concept of innovation refers primarily to the introduction of new products or services by businesses, development of new markets, or implementation of a new business structure. In other words, innovation is considered the primary engine for economic development. In recent years, being aware that innovation based on innovative technologies can help the country's economic growth and strengthen national competitiveness, many countries have been launching national-level activities to create innovations, instead of simply leaving it to the private sector.

While businesses play the leading role in innovation, the creation of knowledge as the basis of innovation, and the development of human resources who can create innovations often take place in a variety of organizations or locations. The framework for combining these different elements to bring about innovation is known as the innovation system. Since the way in which innovation is produced varies by the national socio-economic structure, the overall innovation system for a country is called the national innovation system.

This chapter reviews the performance of Japan's national innovation system and how science and technology contribute to it.

2.1 Japan's competitiveness

In Japan, amid the prolonged economic doldrums, more and more expectations are being placed on science and technology. Science and technology are positioned not only as the facilitator of the resolution of many problems associated with society and human beings, but also as the driving force for economic growth or even as the source of creative activity. With such expectations, the government has been intensifying its efforts in the area of science and technology, while the private sector has continued its R&D activities. The aim of these efforts is nothing other than strengthening Japan's innovation system. This section addresses the issue of Japan's national innovation system from the viewpoint of international competitiveness.

First, let us look at economic competitiveness. As a basic indicator of economic power, trends in per capita GDP for selected countries are shown in Figure 2-1-1 (A). These countries are those with particularly high per capita GDP figures or those that are important in terms of comparison with Japan. Among the several different versions of the standard GDP calculation method in the world, 68SNA was used for compiling these data, instead of 93SNA, which is used for identifying long-term trends.

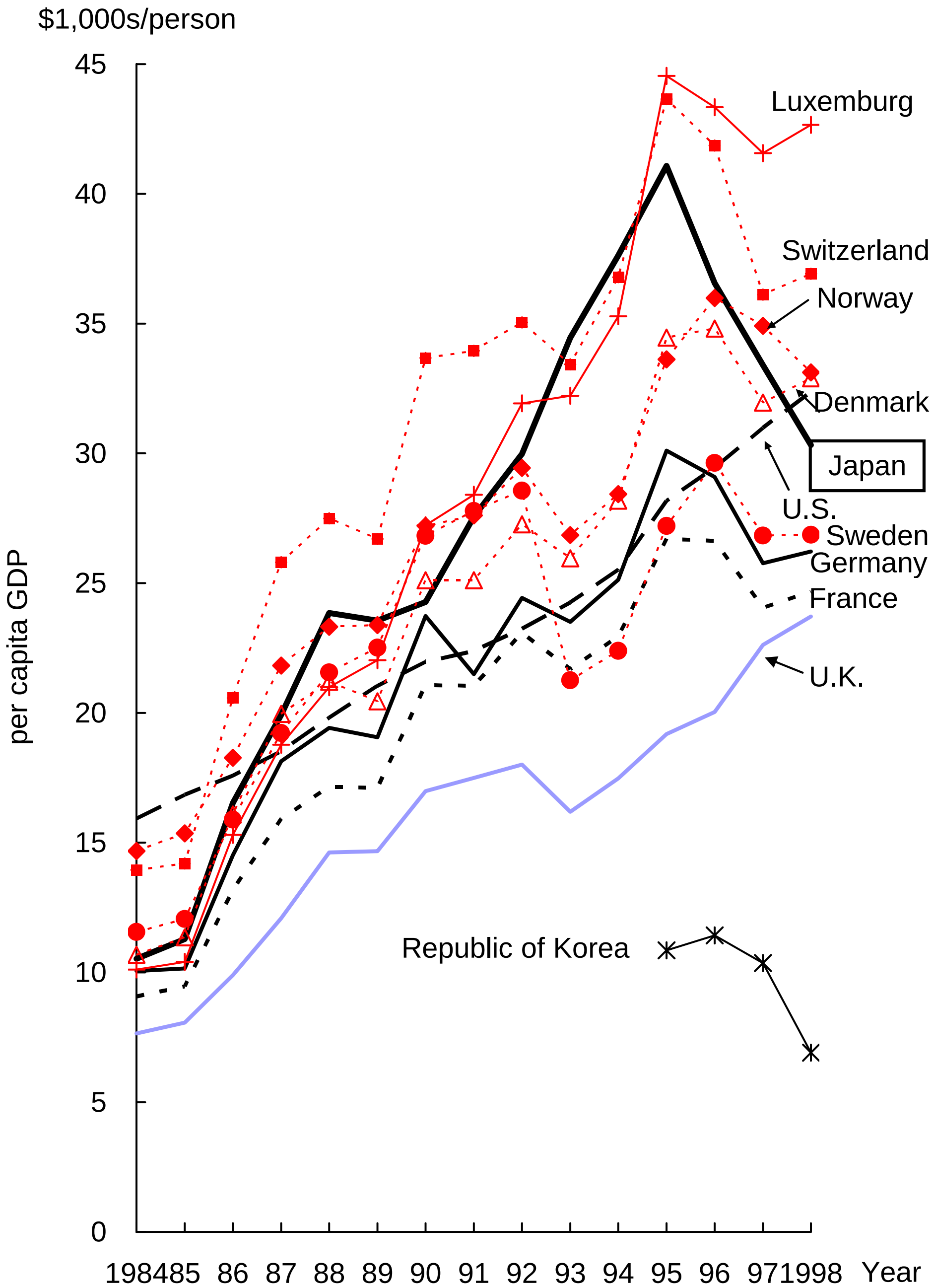
Japan's per capita GDP, which had ranked low among the selected countries in 1984, gradually improved the relative position until it became the highest in the world in 1993 and 1994. After this peak, Japan's per capita GDP figures as well as its world rank declined.

Figure 2-1-1 (B) shows the change in Japan's position in the global GDP ranking in the 39-year period from 1969 to 1998. It clearly illustrates that Japan continued to improve its ranking until the first half of the 1990s and then started to decrease.

International comparison of GDP requires converting GDP to a common currency. There are two methods to do this: the first method uses exchange rates for conversion and the second method uses purchasing power parities (PPPs). Since GDP figures and ranking results differ depending on the method to be used, we employed both methods for the analysis in this chapter. Figure 2-1-1 shows the GDP resulting from a conversion using exchange rates, the method which has long been common in Japan. This calculation technique tends to yield a higher GDP for Japan when the yen is stronger. Also, it must be taken into consideration that a decline in Japan's per capita GDP since the latter half of the 1990s was posted under the strong influence of the yen's depreciation.

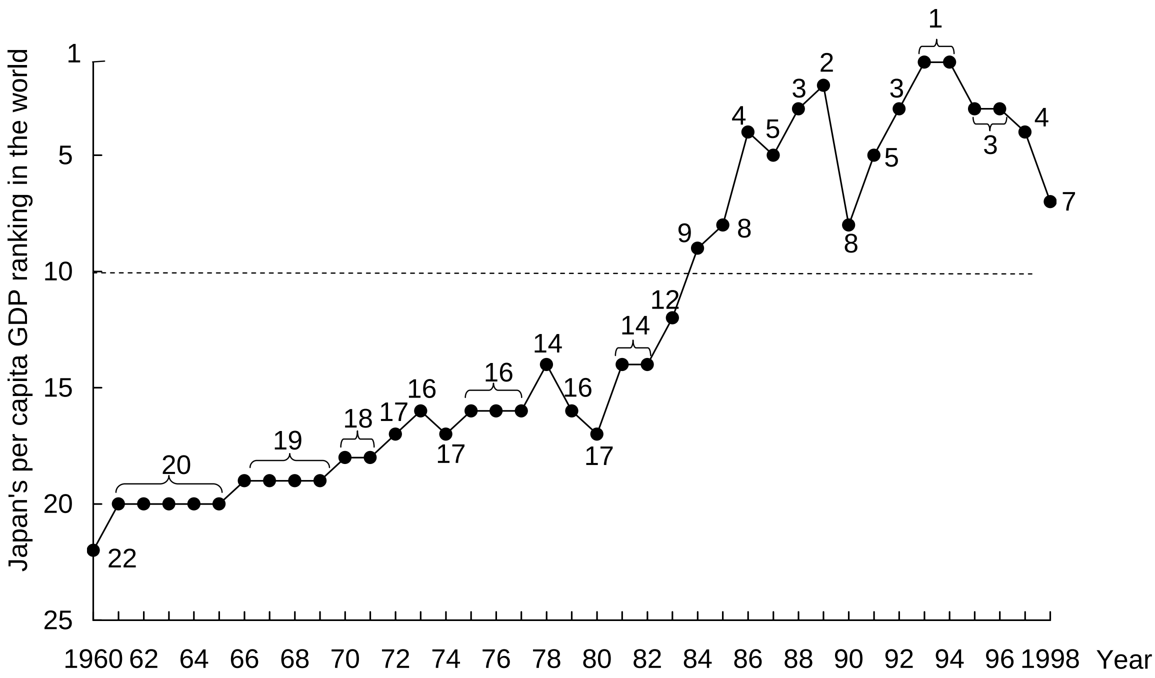
Figure 2-1-1: Trends in per capita GDP

(A) Nominal figures



Note: Nominal GDP is based on the 68SNA standard. All GDP figures except the ones for the U.S are converted using exchange rates.
Source: Economic and Social Research Institute, Cabinet Office, "(long-term retroactive and primary) National Economic Accounts Quarterly (1955-1998)"
See: Table 2-1-1 (A)

Figure 2-1-1: Trends in per capita GDP
(B) Japan's ranking



Note: Same as Figure 2-1-1 (A)
Source Same as Figure 2-1-1 (A)
See: Table 2-1-1 (B)

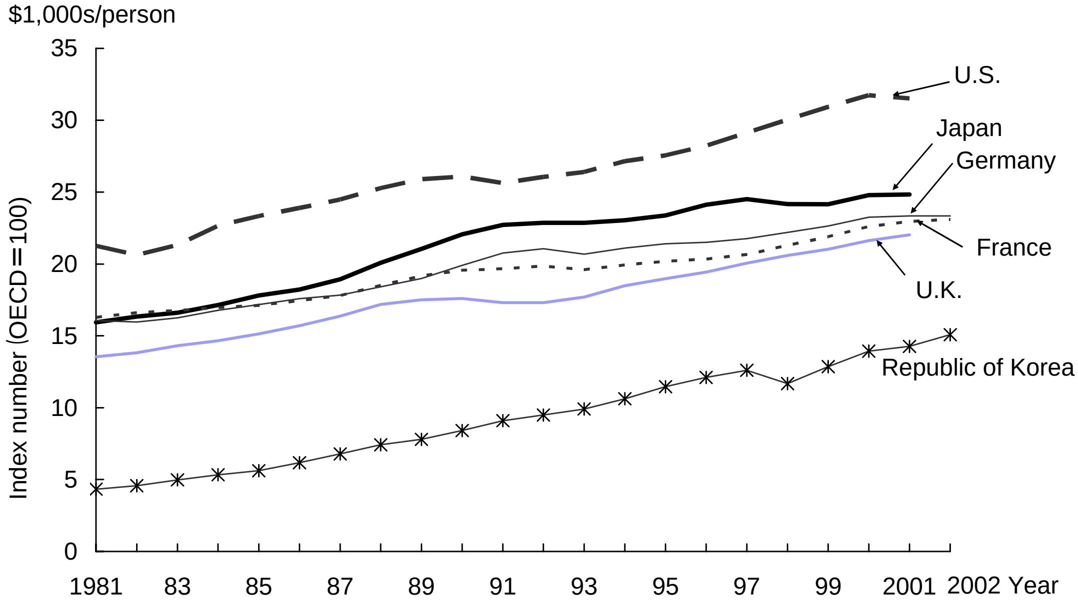
An important issue, aside from that of currency conversion, in performing international comparisons of per capita GDP is how to handle the impact of price increases. In Figure 2-1-2 (A) below, we attempted to conduct an international comparison in real terms, based on real GDP figures which are free from the impact of price increases, while using PPPs instead of exchange rates for currency conversion. To compile the data, GDP in 1995 prices was converted to U.S. dollars using PPPs and the results were divided by the population of each country. The figure shows the results for six countries including Japan.

As a result of a currency conversion free from the direct influence of variation in exchange rates, these data show more steady trends than those in Figure 2-1-1 (A), with each country's relative position staying almost the same throughout the selected period. One remarkable characteristics of this figure is that the U.S. remained dominant without being exceeded by Japan as it did in Figure 2-2-1 (A). With respect to Japan's trend, its per capita GDP marked a significant rise during the period from the late 1980's to 1990, followed by a leveling-off for a long term.

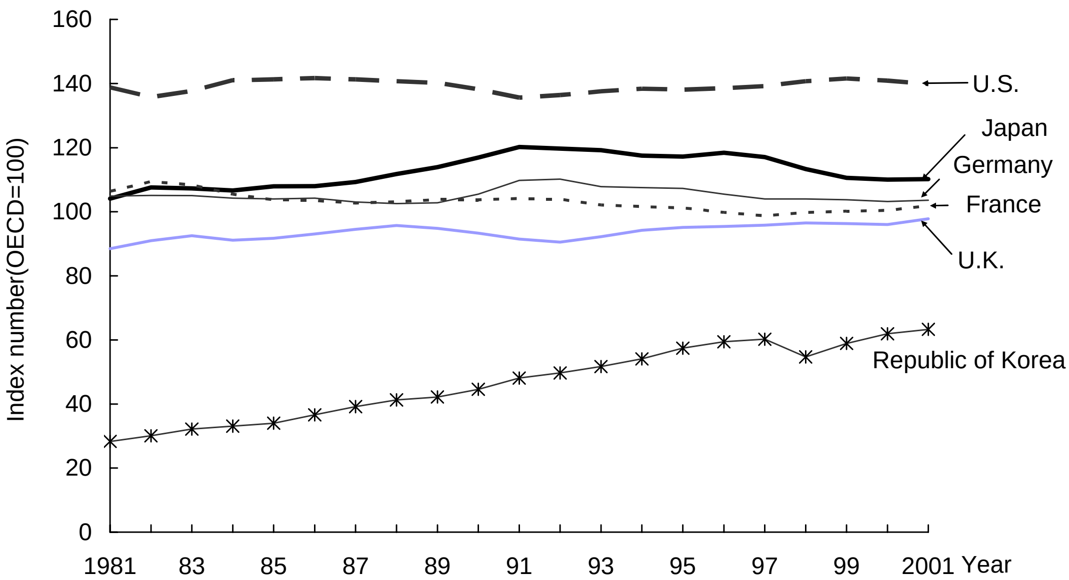
Figure 2-1-2 (B) shows index numbers for the same data as in Figure 2-1-2 (A), assuming the OECD average equals 100, and illustrates how the position of Japan changed among OECD countries. The figure indicates that in relative terms, Japan's per capita GDP peaked in 1991, followed by a gradual decline for several years and a small peak in 1996 before it decreased and continued to diminish for the rest of the period.

The above data demonstrate that Japan's economic competitiveness peaked in the early 1990s, followed by a persistent slowdown.

Figure 2-1-2: Trends in per capita GDP in selected countries (real figures)
(A) Real figures (in 1995 prices)



(B) Index number (OECD average=100)



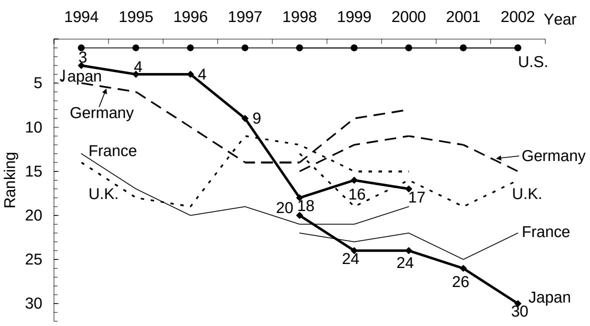
Notes: 1) The OECD average refer to 15 member countries which does not include the Czech Republic, Hungary, Poland, and Slovakia.
2) GDP figures are in real terms in 1995 prices, based on 93SNA. GDP for all countries except the U.S. is converted using PPPs.
Source: OECD, "Annual National Accounts – Comparative tables based on exchange rates and PPPs"
See: Table 2-1-2

National Competitiveness Measured by the 'World Competitiveness Yearbook'

One of the renowned reports on the competitiveness of counties across the world is the World Competitiveness Yearbook (WCY) published annually by the Institute for Management Development (IMD), a Swiss business school and research organ. Japan's competitiveness, which was ranked No. 3 in the world in the WCY 1994, gradually dropped to 30th place in 2002. It must be taken into consideration, however, that IMD has changed the ranking calculation methodology for the WCY in and after 2001, resulting in some loss of consistency in the ranking as an indicator.

Although we are aware that the WCY ranking does not necessarily reflect the overall national competitiveness because it compares the environments for business or organizational activities, the WCY results indicate that Japan's competitiveness weakened in the latter half of the 1990s (Figure 1).

Figure 1: Selected countries' competitiveness rankings in the World Competitiveness Yearbook (1994-2002)

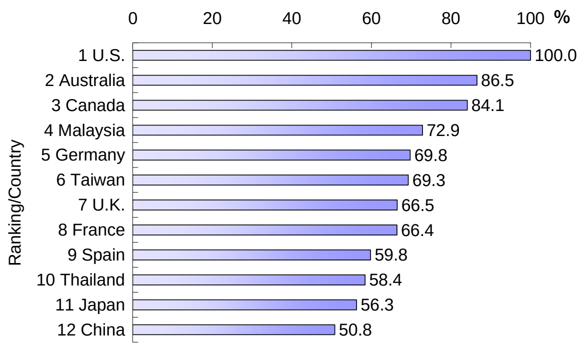


Note: There is inconsistency in national rankings for the selected period because of a change in the ranking calculation methodology in 2001. This is why each country indicates two separate lines referring to 1994 to 2000 and 1998 to 2002 respectively.
Sources: Data for the continuous 1994-2000 period and for the continuous 1998-2002 period are based on the following (1) and (2) respectively.
(1) IMD (Institute for Management Development), "The World Competitiveness Yearbook" (1994 to 2000 editions)
(2) IMD (Institute for Management Development), "The World Competitiveness Yearbook 2002"

There was a change in the methodology used to calculate the competitiveness indicator in the World Competitiveness Yearbook 2003, the latest edition available, so that countries were ranked in two groups according to whether their total populations were larger or smaller than 20 million. Since it is not appropriate to compare competitiveness indicators based on the new methodology with those calculated in earlier years, the competitiveness ranking for 2003 is shown separately in Figure 2.

Japan ranked 11th among the countries with a population greater than 20 million. For comparison purposes, we ranked the countries that fall in the same population category by their competitiveness indicators for 2002. The result for Japan was the same as in 2003, No. 11. Therefore, it can be assumed that the level of Japan's competitiveness in the world for 2003 remained unchanged from the previous year.

Figure 2: National competitiveness by the



World Competitiveness Yearbook (2003)

Note: Rankings only for the top 12 countries where the population is greater than 20 million
Source: IMD (Institute for Management Development), the Web page on "The World Competitiveness Year Book 2003"

Up until the 2000 edition, IMD's World Competitiveness Yearbook had contained the evaluation of national competitiveness in science and technology. We analyzed in detail the evaluation data, and it is seen in the separate column 'An In-Depth Analysis of IMD's Science and Technology Competitiveness Ranking' at the end of this chapter.

(Hiroyuki Tomizawa)

The next topic is Japan's competitiveness in trade. Presented below is a review of change in the competitiveness of Japan's manufacturing sector based on the trade balance in the manufacturing and high technology industries.

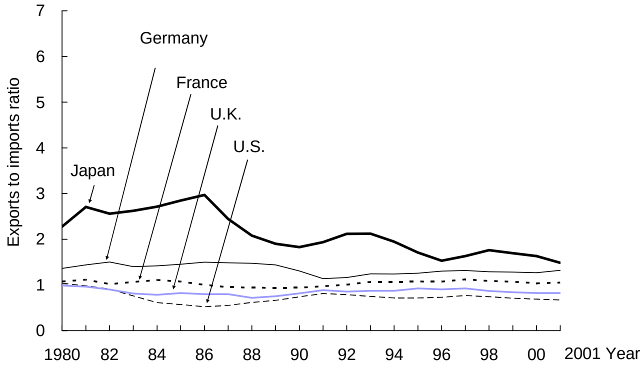
Figure 2-1-3 shows the trends in the overall manufacturing sector's exports to imports ratio for the selected five countries. In this figure, if the exports to imports ratio, which was calculated by dividing the manufacturing sector's exports by its imports, is 1, it implies that exports and imports are in balance, while if the ratio exceeds 1, it indicates an export surplus and therefore strong trade competitiveness.

Throughout the period shown in the figure, Japan's exports to imports ratio was greater than 1 and remained higher than the rest of the selected countries, indicating Japan's high trade competitiveness in the manufacturing industries. However, since the peak in 1986, Japan's exports to imports ratio has been on the continuous decline except for two small peaks around 1993 and in 1998.

We also conducted a comparison of the amount of trade in the high technology industry. The high technology industry refers to industries that are particularly R&D-intensive among those constituting the manufacturing sector. In this report, they are divided into five categories in accordance with the classification by the OECD, namely, 'aerospace,' 'electronic equipment,' 'office machinery and computers,' 'medical, precision and optical equipment,' and 'pharmaceuticals.'

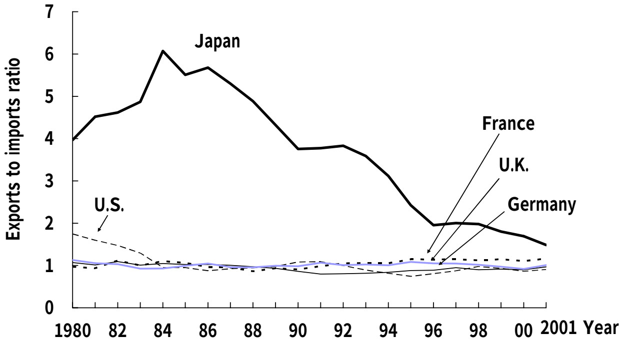
Figure 2-1-4 shows the total exports to imports ratio across the high technology industry for the selected five countries. Japan dominated with even higher ratios than it had for the overall manufacturing sector. However, after reaching a peak in 1984, Japan's ratios have been declining over the long term. These data demonstrate that Japan's overwhelming competitiveness in the high technology industry up to the first half of the 1990s has gradually been weakening.

Figure 2-1-3: Trade balance in the manufacturing sector for selected countries



Source: OECD, "STAN database for Industrial Analysis 2003/4"
See: Table 2-1-3

Figure 2-1-4: Trade balance in the high technology industry for selected countries



Source: Same as Table 2-1-3
See: Table 2-1-4

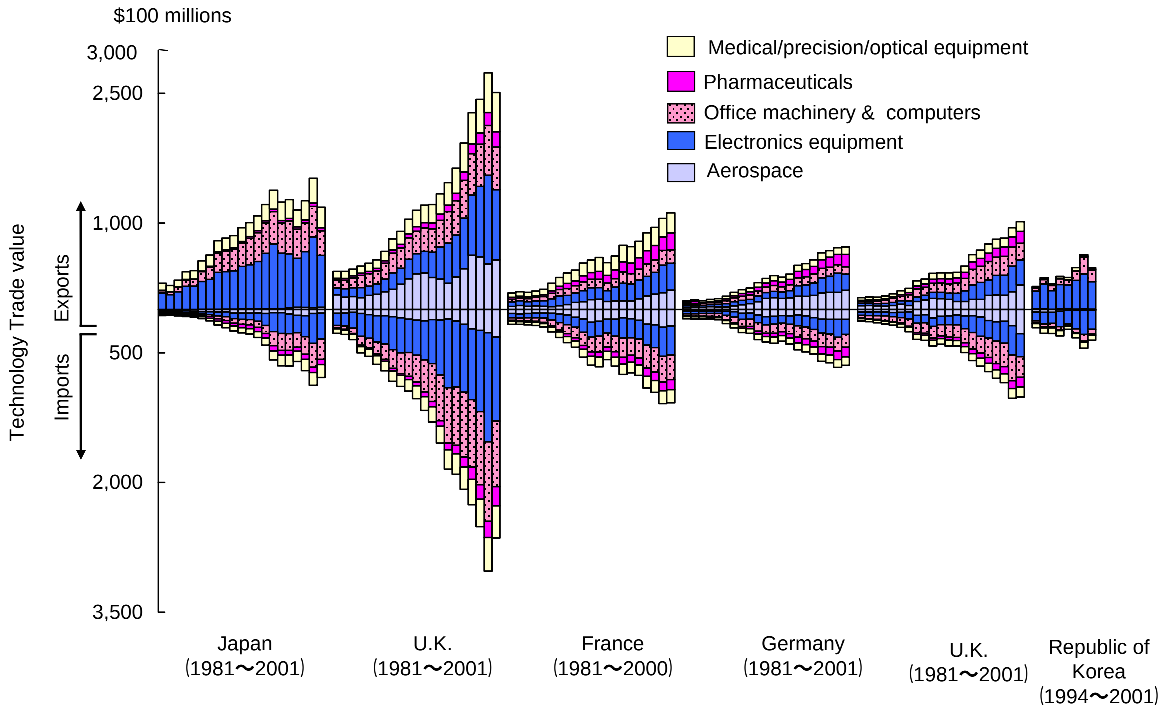
To understand the reasons behind the declining trade balance in Japan's high technology industry sector, we examined each category in detail. Figure 2-1-5 shows the selected countries' total trade values in the high technology industry, including the proportion of the five categories.

One characteristic that the trade value indicated of the Japanese high technology industry is its strong dependence on electronics-related industries. In other words, the high technology sector's favorable trade balance is attributable to, in addition to the largest contribution by the 'electronic equipment' industry, the 'office machinery and computers' and 'medical, precision and optical equipment' categories. These three industries primarily deal with products that leverage electronics technology. By contrast, Japan's 'aerospace' and 'pharmaceuticals' industries have an import surplus and are therefore considered less competitive in the world.

Unlike Japan, the competitiveness of the U.S., Germany, France, and the U.K. do not derive specifically from electronics technology, as they had a favorable trade balance in the aerospace industry in the last year of the selected period.

If the deterioration of the Japanese high technology industry's trade balance is a sign of weakened competitiveness of this sector or even the manufacturing sector as a whole, it can probably be attributed partly to Japanese industry's heavy dependence on the electronics-related business. This suggests the need for the Japanese industrial structure to achieve a better balance.

Figure 2-1-5: Trends in the trade value in the high technology industry for selected countries



Source: OECD, "Main Science and Technology Indicators 2003/1"
See: Table 2-1-5

2.2 R&D level and technological competitiveness

Research and development is one of the key elements that determine the performance of an innovation system. What is essential in measuring the R&D level is to identify individual sectors' actual R&D levels rather than evaluating the investment alone. From this point of view, a project was conducted between 1999 and 2000 to measure the level of Japan's R&D level, results of which were used as basic references for formulating the Second Basic Plan for Science and Technology. In this evaluation effort, researchers used statistics to develop indicators that represent Japan's R&D levels in the individual fields defined. Experts in each field then subjected these indicators to comprehensive assessment before being finalized.

Figures 2-2-1 and 2-2-2 summarize the evaluation results. Each figure compares the R&D levels in the seven selected fields using seven indicators on R&D input and their total rating, as well as five indicators on R&D output and their total rating. There are some blanks in the figures because some indicators were unavailable in some of the seven fields.

Figure 2-2-1 is a comparison of Japan's R&D levels with those of the U.S.

In the life science field, Japan's levels were found to be below the U.S. levels in terms of both total input and total output. The fact that all output indicators were rated low should be a matter of debate.

In the information and communications field, Japan stood at the same level as the U.S. in three input indicators, while falling behind the U.S. in four out of the five output indicators. Japan's total results stood equal to those of the U.S. in areas of both input and output.

With respect to the environment field, Japan rivaled the U.S. only in one indicator out of the 10 that were available, resulting in the U.S. outnumbering Japan in all of the remaining indicators.

In the energy category, for which only limited indicators were available, Japan outperformed the U.S. in all three input indicators as well as in total input rating, an outcome which reflects Japan's traditional emphasis on the energy sector. Meanwhile, Japan's total output level was equal to that of the U.S.

In the area of materials, Japan's total input level exceeded the U.S. standard, while Japan was rated lower than the U.S. in three output indicators. Japan equaled the U.S. in total output.

Japan's total input and output levels in the manufacturing technology field were comparable to the U.S.

In the field of social infrastructure, Japan was rated lower than the U.S. in both total input and total output.

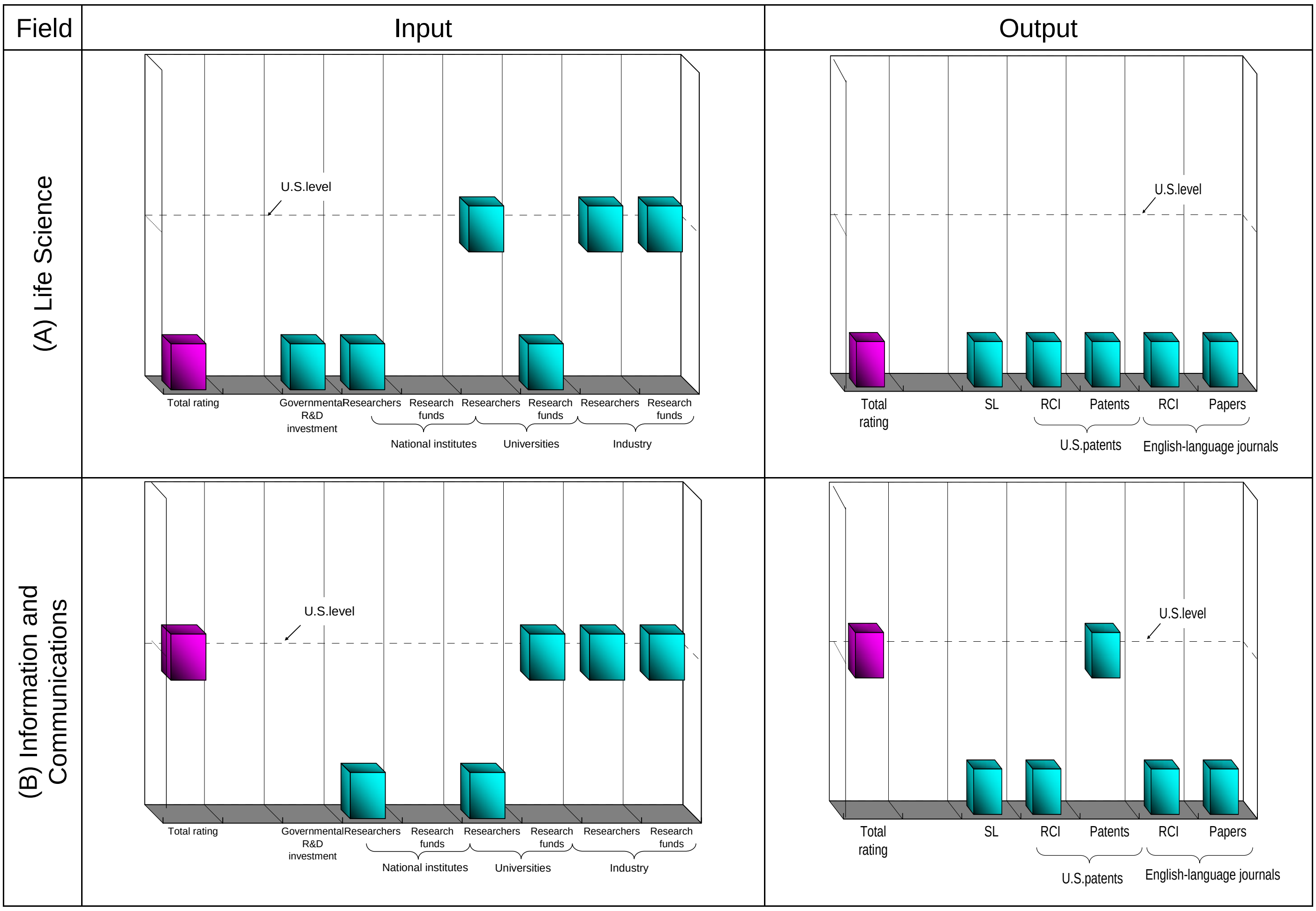
Of the seven fields explained above, the total R&D level of Japan was rated higher than that of the U.S. only in the fields of energy and materials in terms of input, and none in output.

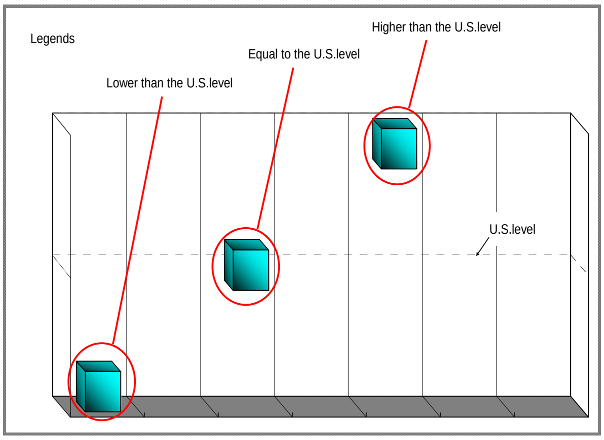
In Figure 2-2-2, which compares Japan's R&D levels with those of Europe, the European results are based on data referring only to Germany, France, and the U.K. because of the lack of data covering the entire of Europe or the EU.

As far as the total input and output are concerned, the results were the same as the Japan vs. U.S. comparison in three fields, namely, information and communications, environment, and energy. In the fields of life science and social infrastructure, in which Japan was rated lower than the U.S., Japan equaled Europe. With regard to the materials field, Japan surpassed Europe in terms of both input and output. The results on manufacturing technology was different from the Japan-U.S. comparison in that Japan's input was rated higher than Europe's.

As a whole, Japan's R&D levels were found to be outstanding in the categories of materials and energy. The fields where Japan's R&D levels were comparable to those of the U.S. and Europe were in manufacturing technology and information and communications. The comparison results, on the other hand, indicate that Japan's standard of R&D is relatively low in the remaining three fields, namely, life science, environment, and social infrastructure.

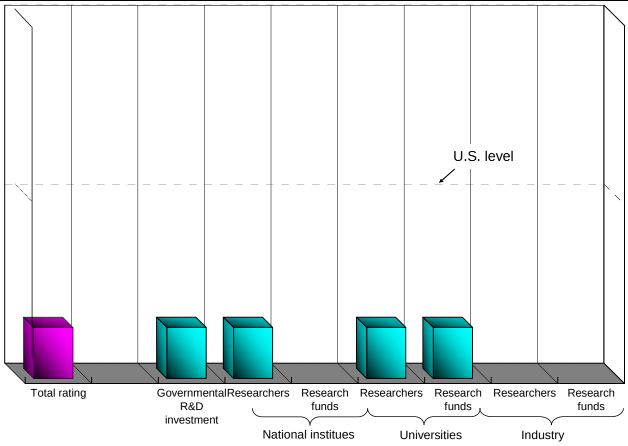
Figure 2-2-1: Japan's R&D levels in comparison with the U.S.

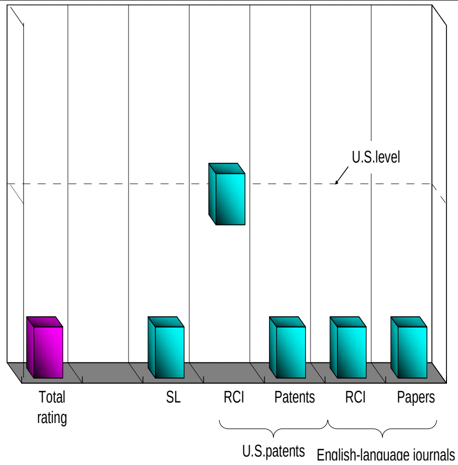




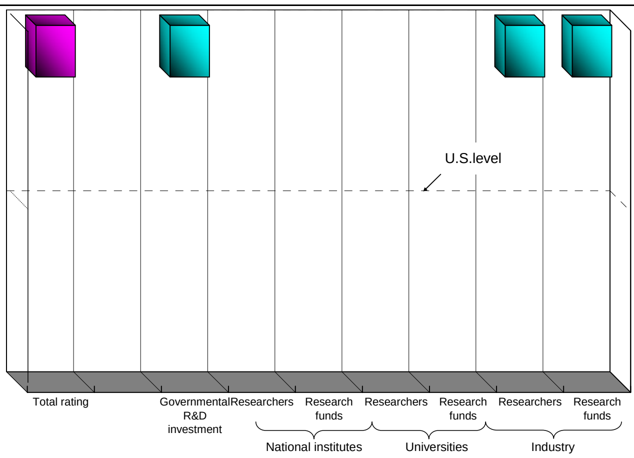
Field | Input | Output

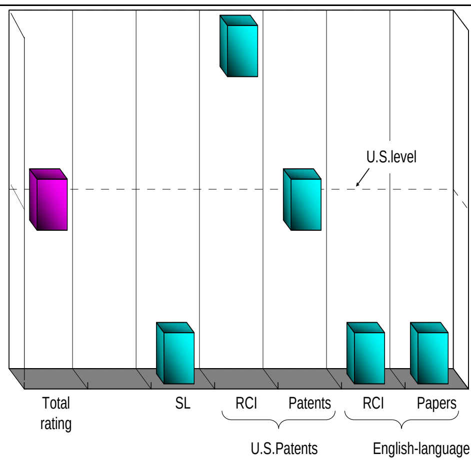
(C) Environment



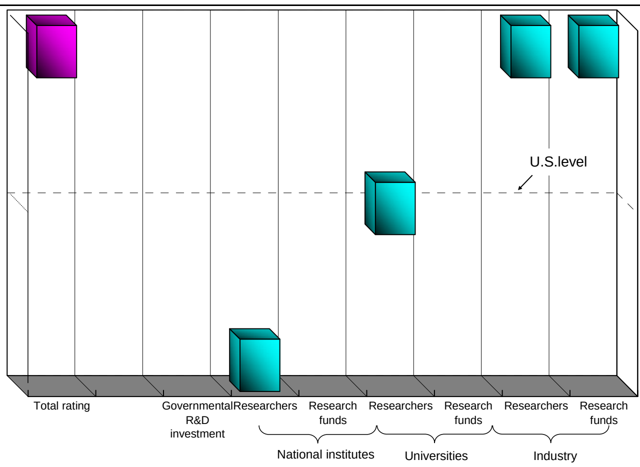


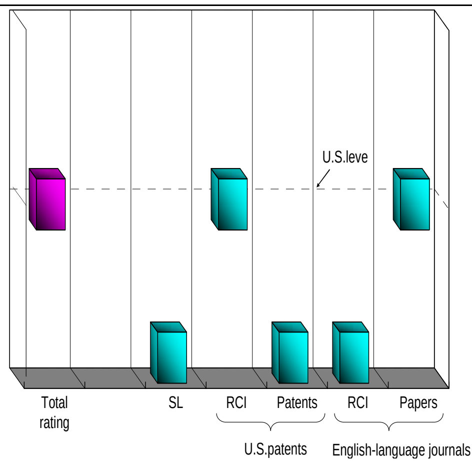
(D) Energy

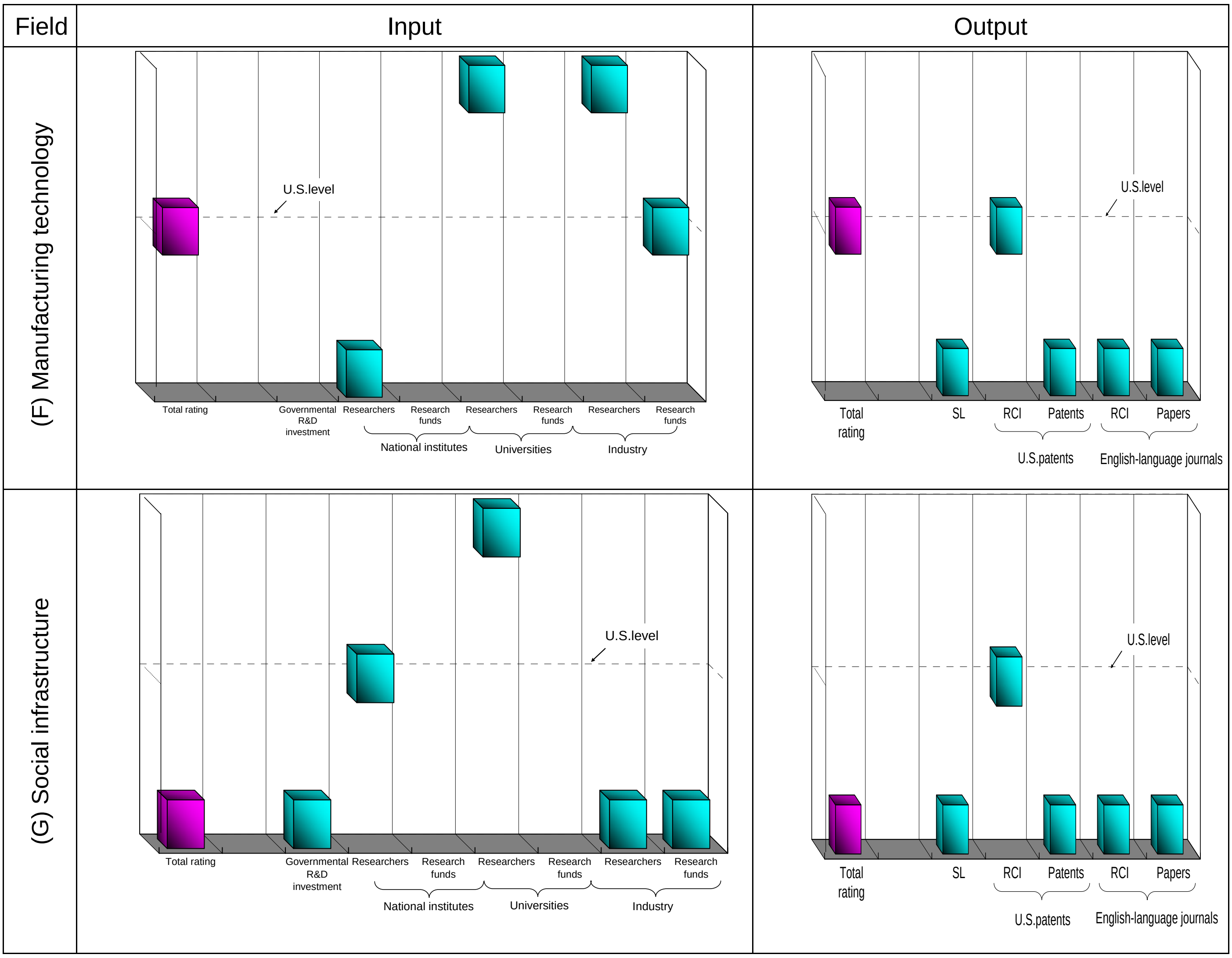




(E) Materials

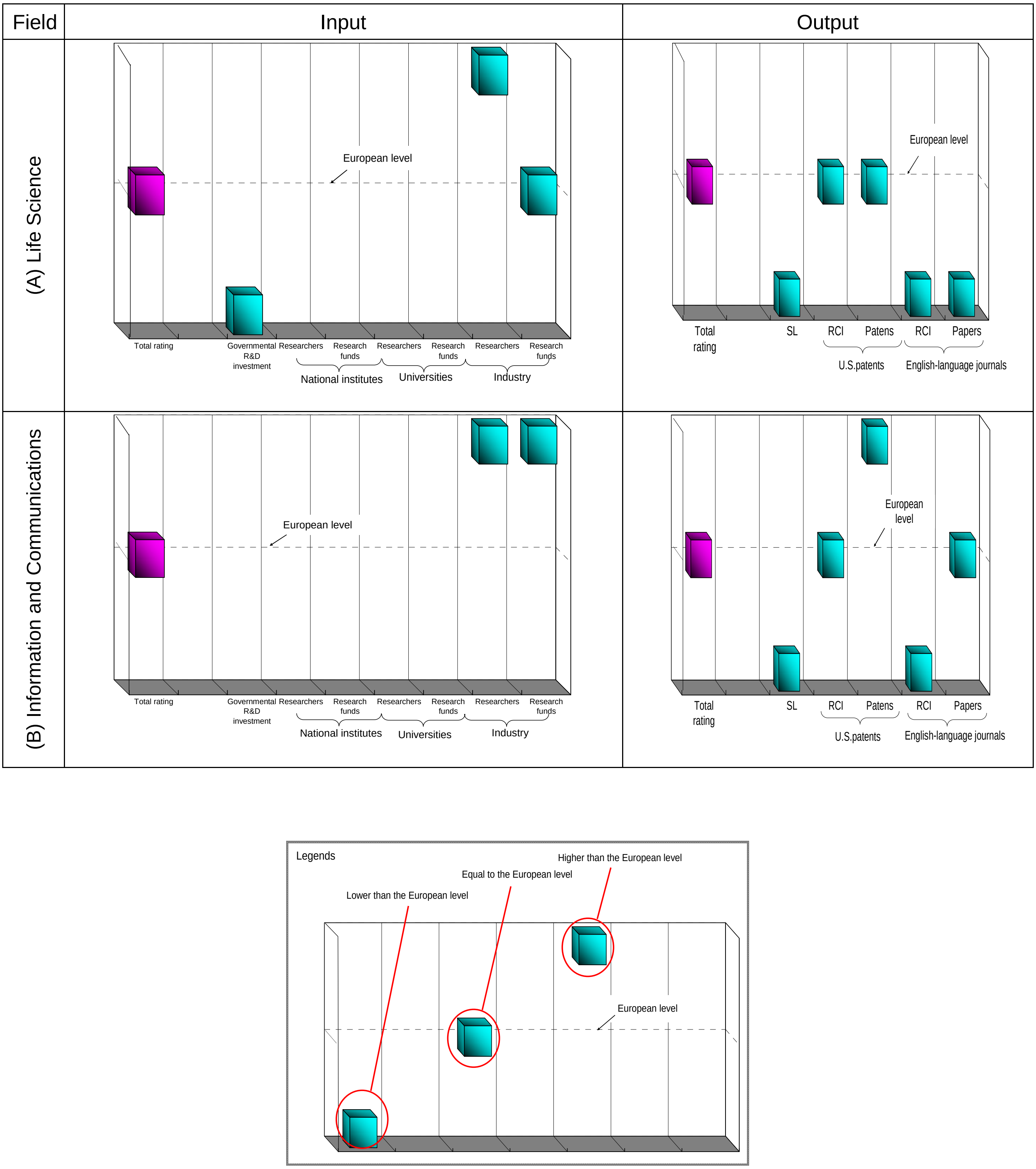


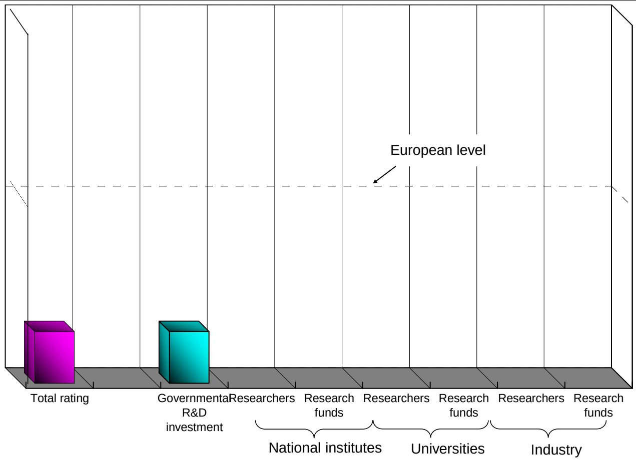
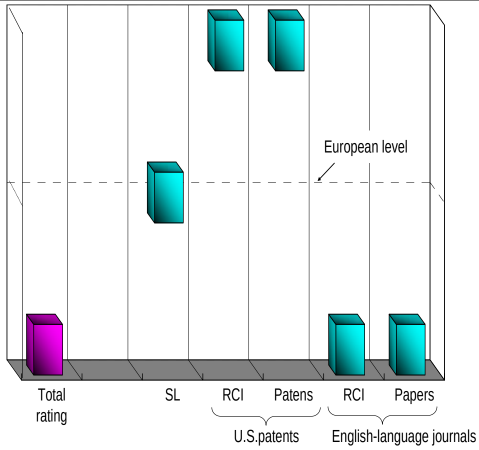
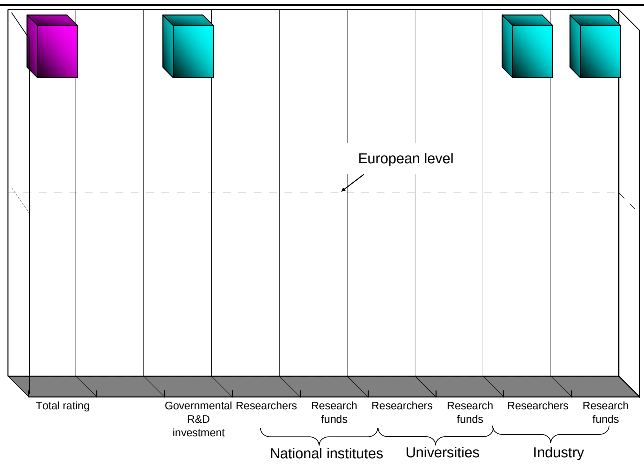
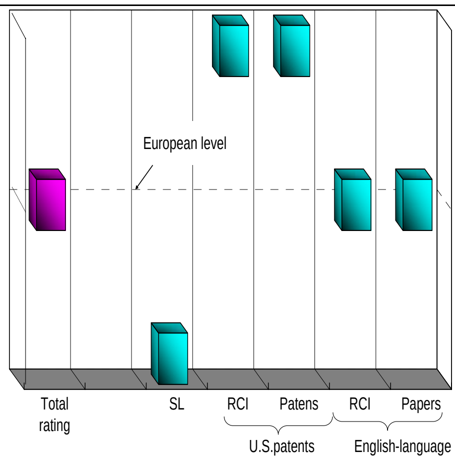
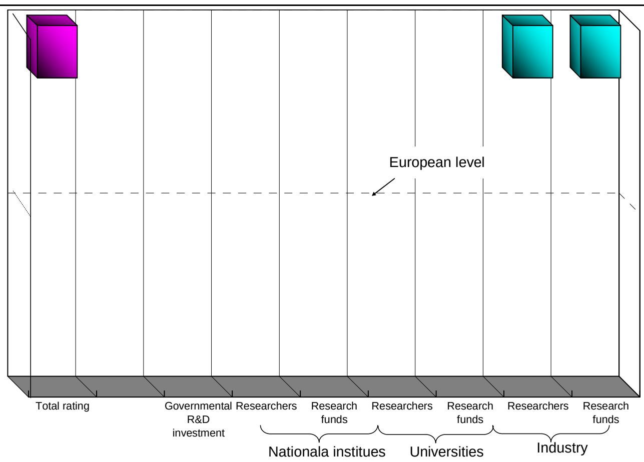
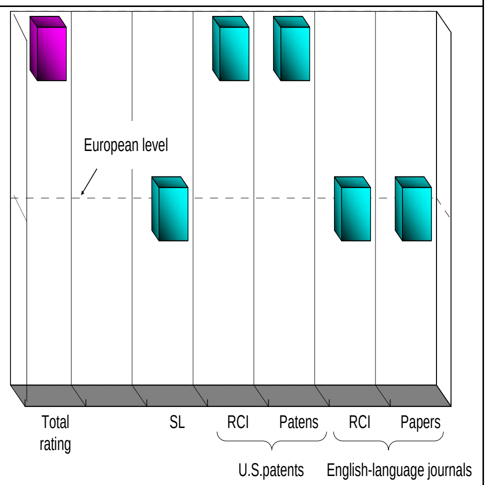


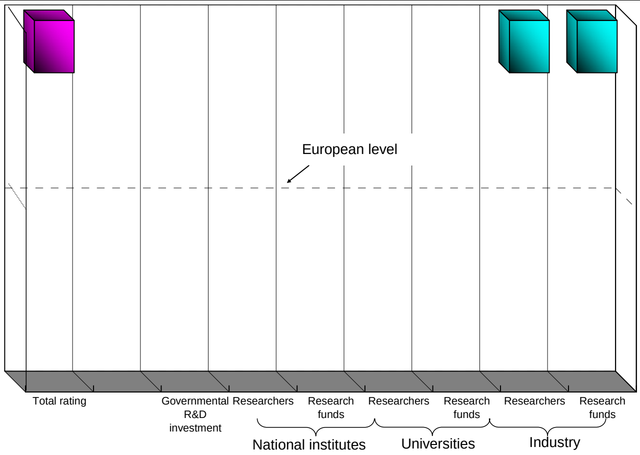
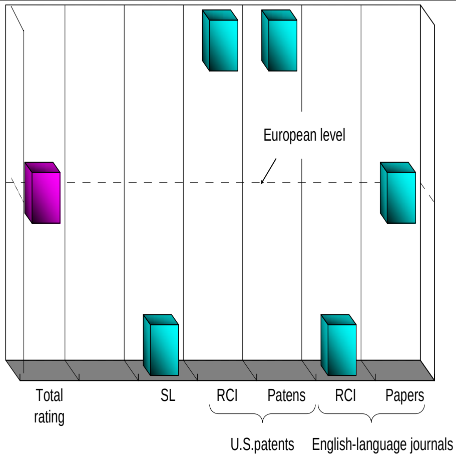
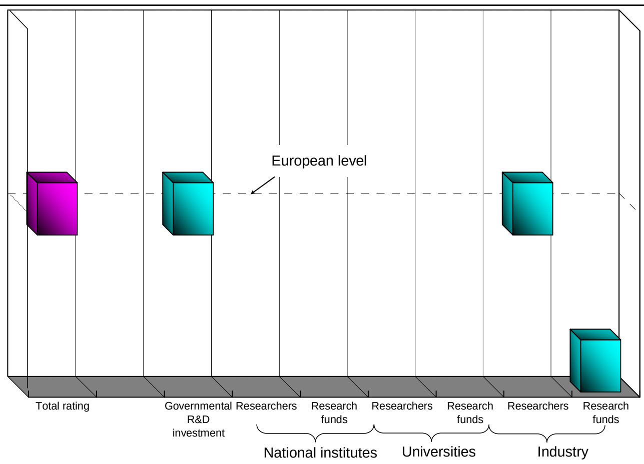
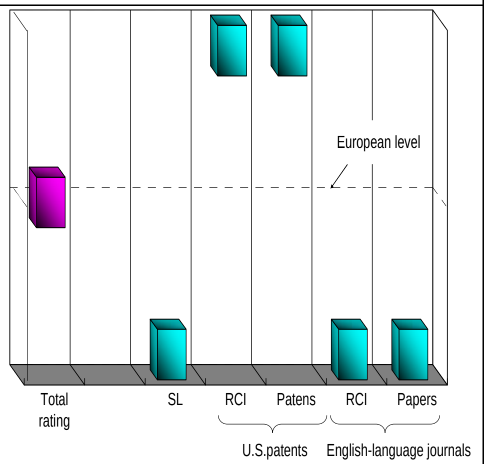


Note: ‘SL’ represents science linkage and ‘RCI’ the relative citation index.
Source: The Japan Research Institute, Limited, and the National Institute of Science and Technology Policy of the Science and Technology Agency, “International Benchmarking of Japan’s Science and Engineering Research” (March 2000)
See: Table 2-2-1

Figure 2-2-2: Japan’s R&D level in comparison with Europe



<table>
<tr><th>Field</th><th>Input</th><th>Output</th></tr>
<tr><td>(C) Environment</td><td>
</td><td>
</td></tr>
<tr><td>(D) Energy</td><td>
</td><td>
</td></tr>
<tr><td>(E) Materials</td><td>
</td><td>
</td></tr>
</table>

<table>
<tr><th>Field</th><th>Input</th><th>Output</th></tr>
<tr><td>(F) Manufacturing technology</td><td>
</td><td>
</td></tr>
<tr><td>(G) Social infrastructure</td><td>
</td><td>
</td></tr>
</table>

Note: 'SL' represents science linkage and 'RCI' the relative citation Index.
Source: Same as Figure 2-2-1
See: Table 2-2-2

2.3 The General Indicator of Science and Technology

Having reviewed the competitiveness of Japan's national innovation system from a number of viewpoints in the previous sections, we now focus only on the science and technology aspect and explore Japan's total capacity in science and technology. We use the 'General Indicator of Science and Technology' (GIST) developed by NISTEP for comparing the five selected countries' total capacities in science and technology.

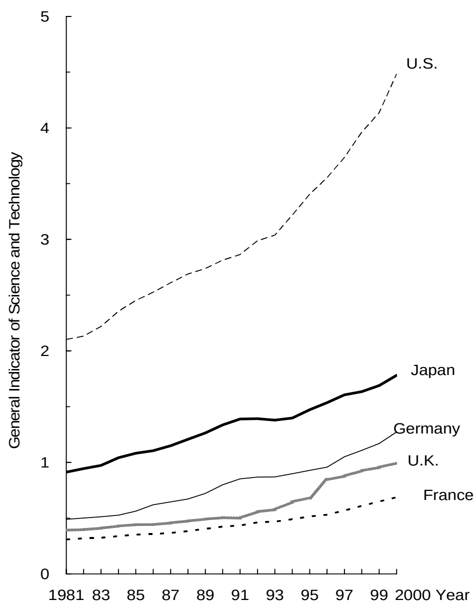
GIST is an indicator that has been developed by summarizing the information contained in many science and technology indicators using a statistical technique known as principal component analysis. Here is its concept. Since science and technology activities in a country involve various aspects, quantitatively expressing the state of these activities would require a large number of indicators. These individual indicators could help us understand the state of activities in specific areas but might not be effective in seeing the big picture. GIST is an effort to integrate different indicators into a composite indicator using a statistical technique to allow for comprehensive international comparison or time series analysis of national science and technology activities.

Principal component analysis is a kind of multivariate analysis technique, a technique designed for analyzing multiple variables (many different sets of quantitative data). The general indicator obtained by principal component analysis can not only be expressed as a few numeric values with which people can see the whole picture at a glance, but also allow people to review the individual component indicators as required. That is, there is a complementary relationship between the general indicator and individual indicators. In other words, people can use the general indicator to grasp the overall trends, while they are given the option to investigate its component indicators whenever they find a specific area (or period) indicating a significant change. This allows researchers to better understand the trends in question.

Based on the above perspective, trends in GIST for the selected five countries are shown in Figure 2-3-1. These GIST figures are the almost perfect representation of the size of each nation measured by population or GDP. Among the five, the U.S. dominated, followed by Japan, while France and the U.K. stood at similar levels.

The figure below shows that Japan's GIST was on the steady rise in the latter half of the 1980s, leveled off in the early 1990s, and then turned upward again in the second half of the 1990s. On the other hand, the U.S. GIST, which was approximately twice the figure of Japan in 1991, increased to a figure about 2.5 times larger than Japan's, thereby widening the gap between the two countries in the 1990s.

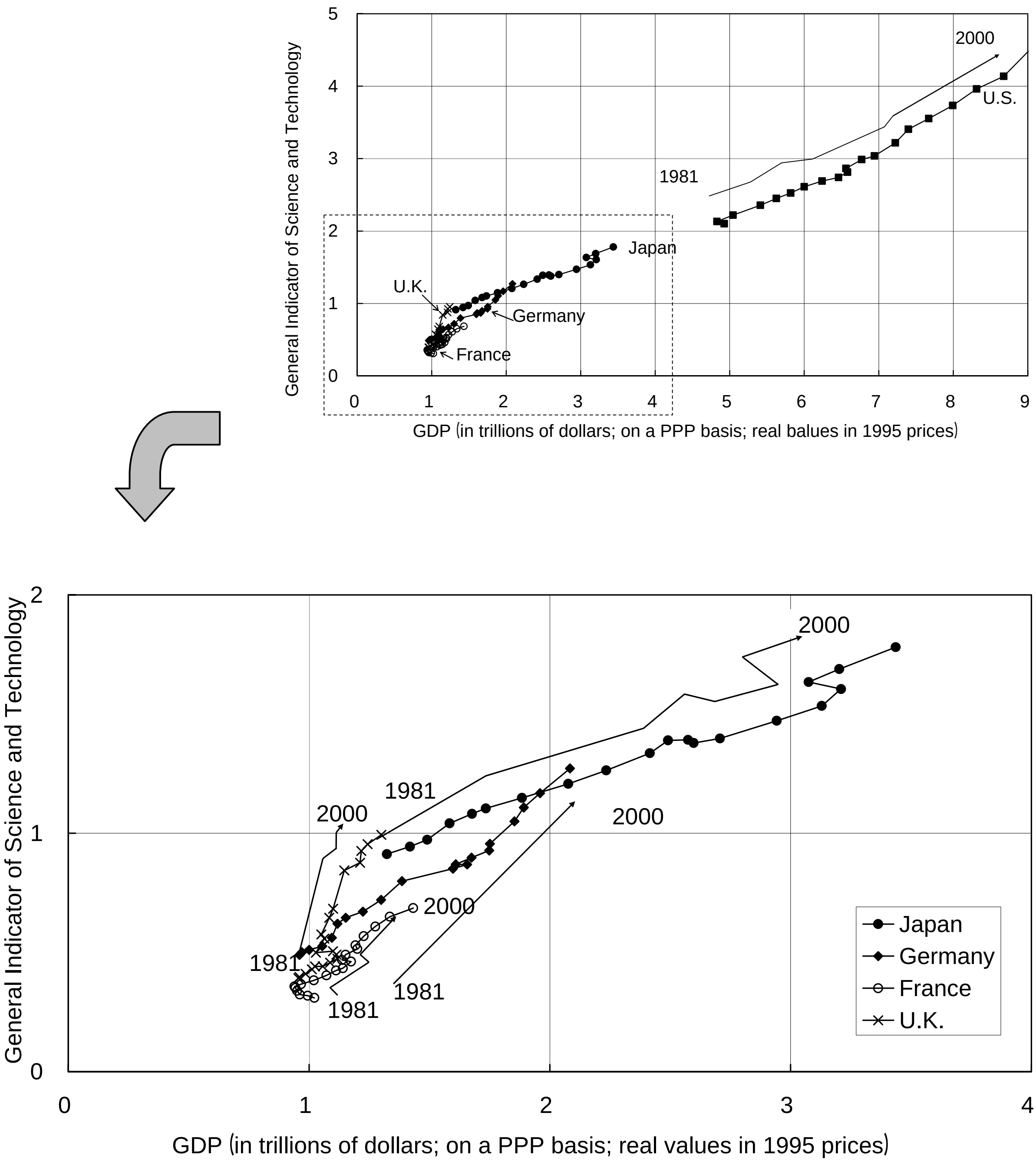
Figure 2-3-1: Trends in the General Indicator of Science and Technology for selected countries



Notes: (1) The above figure is based on the first principal component score (eigenvalue = 8.38, variance explained = 69.8%) obtained by principal component analysis.
(2) A constant (= 1.233) was added to the first principal component to make the first principal component score equal to zero if all the variables are equal to zero.
Source: Calculated by NISTEP based on various data (see Table 2-3-5)
See: Table 2-3-1

It is assumed that the science and technology capacity of a nation has a close relationship with its economic strength. To confirm this assumption, we compared the selected countries in Figure 2-3-2, where the x-axis represents GDP and the y-axis GIST. The results indicate a linear distribution as a whole, suggesting a correlation between GDP and GIST. Another finding from the figure is that each country's trend is generally upward, demonstrating continuous growth of science and technology activities as well as GDP.

Figure 2-3-2: Trends in GIST and GDP for selected countries



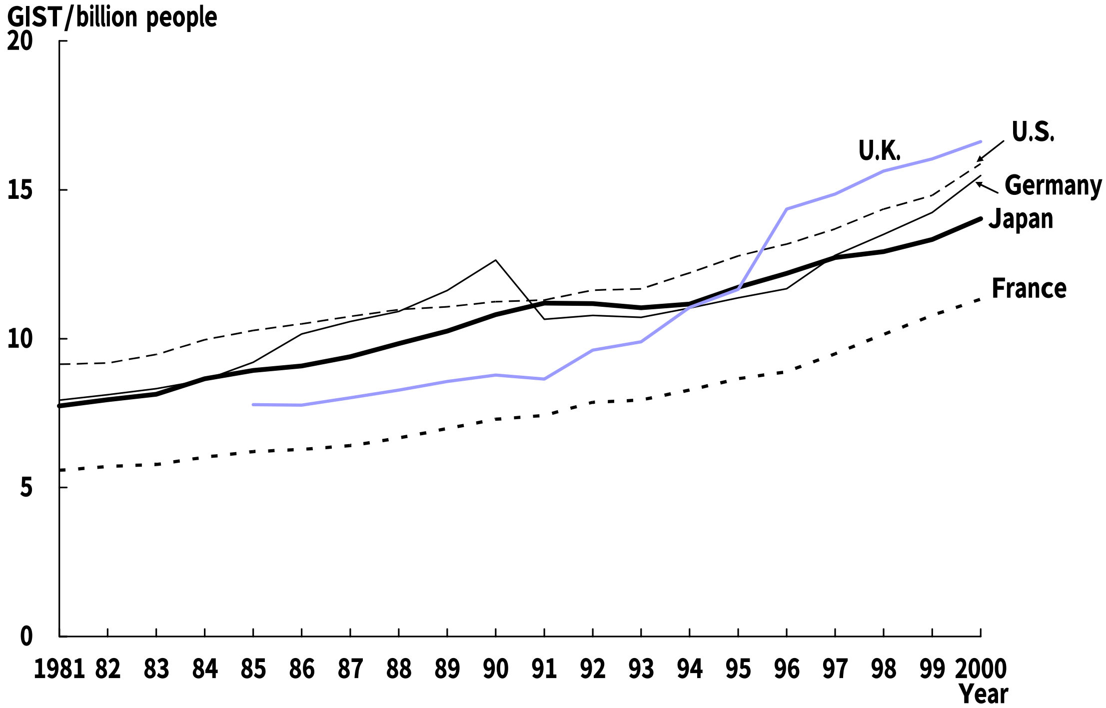
Note: GDP for the selected countries is in trillions of dollars (real values in 1995 prices; on a PPP basis). GIST is on the same basis as Figure 2-3-1 and real GDP is on the same basis as Reference Statistics C, D and E.
Source: For GIST, same as Figure 2-3-1; For real GDP, same as Reference Statistics C, D and E
See: Table 2-3-2

As mentioned earlier, GIST almost perfectly reflects the size of a country because each of the 12 variables used for compiling it is a representation of the size of a country. In order to perform a comparison outside the influence of the country size, it is appropriate to use per capita GIST.

Figure 2-3-3 shows per capita GIST for selected countries. Among the five countries, Japan ranked third to fourth.

As far as the GIST in this figure is concerned, the overall science and technology activities in Japan appeared to be in the doldrums in the first half of the 1990s. In 1991, in the aftermath of the reunification of East and West Germany, Germany, whose GIST had been the highest for a while, reduced its GIST to a level close to the levels of Japan and the U.S., resulting in the three counties sharing the top position. In the following years, when other countries' GIST figures were on the rise, Japan's GIST was slow to increase, a trend that widened the gap between Japan and the U.S./Germany. The U.K., which had been showing a significant growth since the early 1990s, also outstripped Japan in 1997, causing Japan to fall to fourth place among the five countries.

Figure 2-3-3: Trends in per capita GIST for selected countries



Note: For GIST, same as Figure 2-3-1; For population, same as Reference Statistics A
Source: For GIST, same as Figure 2-3-1; For population, same as Reference Statistics A
See: Table 2-3-3

What are the factors behind the relatively slow growth of Japan's GIST in recent years and the large increase in the U.S. GIST? To answer this question, we performed the following analysis. Since GIST is calculated by 'normalizing' individual indicators (variables), multiplying the normalized indicators by the coefficients obtained using a specific formula, and aggregating the results, allows us to calculate each indicator's contribution to GIST. Figure 2-3-4 shows the contribution, in percent, of each indicator to GIST, assuming the GIST of each country is 100%.

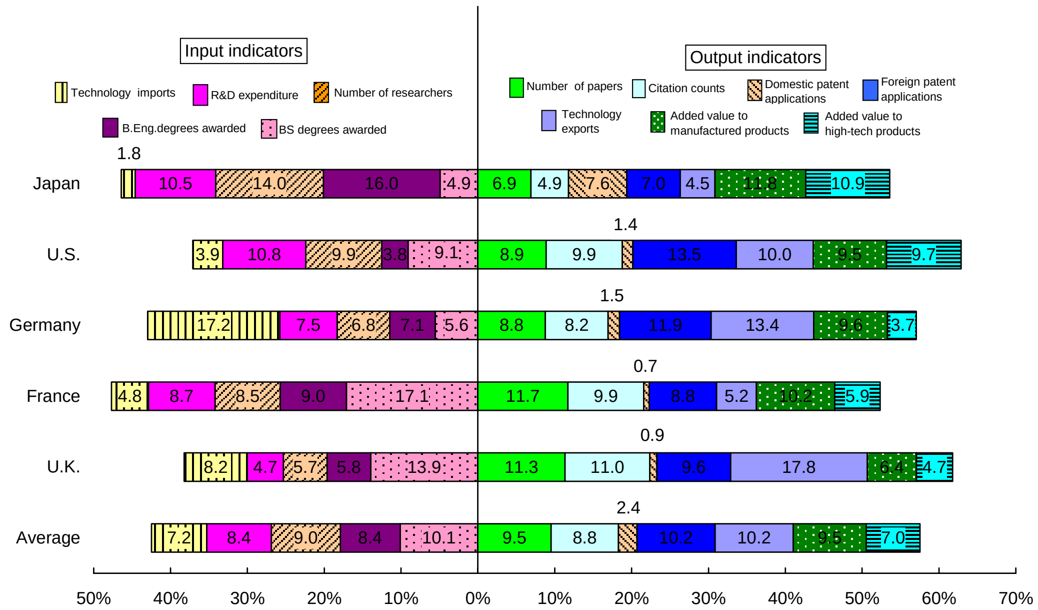
For the U.S., output indicators, especially 'foreign patent applications' and 'technology exports,' accounted for large parts of GIST. Of the input indicators, 'R&D expenditure' and 'the number of researchers' were relatively large elements.

One characteristic seen in Japan's results was that the shares of input indicators are large while the shares of output indicators are small. Of the input indicators, 'Bachelor of Engineering degrees awarded' and 'the number of researchers' and 'R&D expenditure' accounted for over 10% respectively. In contrast, all output indicators related to scientific papers, patents (other than 'domestic patent applications') and technology exports represented small shares, although output indicators such as 'added value to manufactured products' and 'added value to high technology products' showed high percentages. From these results, we can conclude that Japan's indicators regarding global or strategic deployment of intellectual property represent small portions of the nation's GIST.

For further analysis, Figure 2-3-5 shows long-term trends in GIST with a breakdown by variable type. In the figure, Japan demonstrated significant growth in output indicators since 1996. This can mainly be attributed to an increase in 'foreign patent applications' and 'the number of papers.' Of these two indicators, the former, or the number of foreign patent applications, was seen to soar from around 1997 onwards, while being small in percentage to the total.

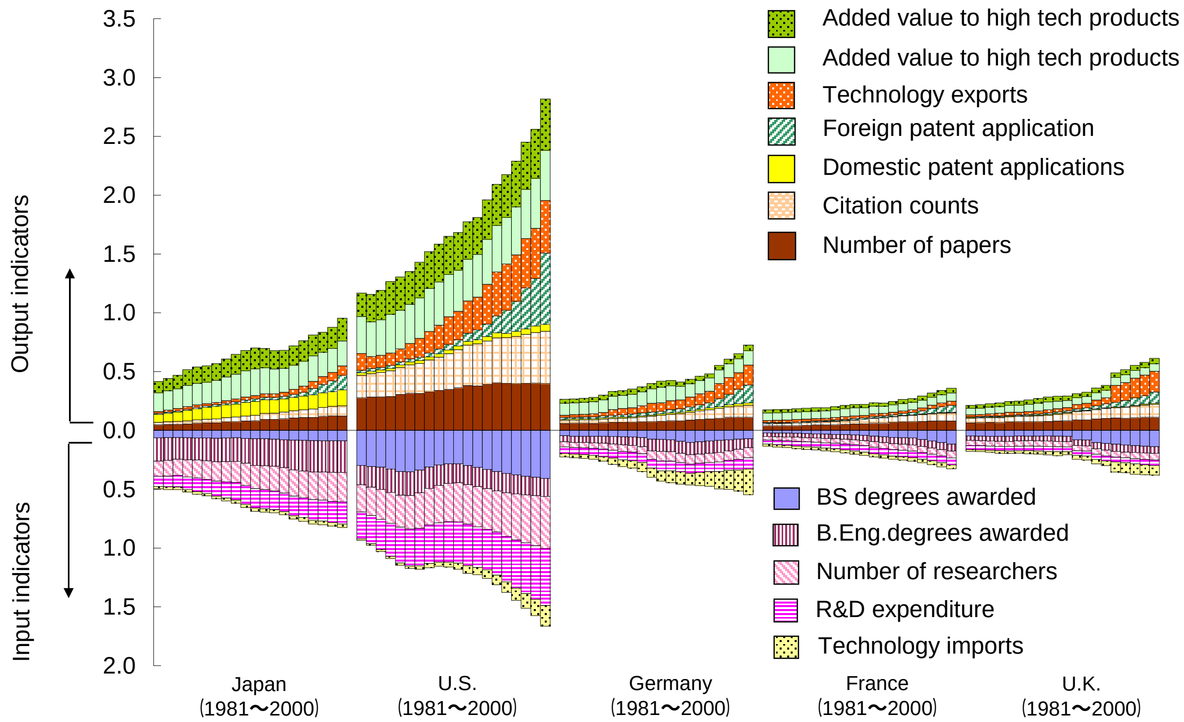
The U.S. showed the largest growth in 'foreign patent applications,' followed by 'technology exports' and 'citation counts.' These three variables contributed to the U.S. GIST increase. Interestingly, these three variables are deeply related to global or strategic deployment of intellectual property.

Figure 2-3-4: Individual variables' contributions to GIST (2000)



Note: The above shows the percentage of each component (calculated by multiplying each variable by the principal component score coefficient) of the first principal component score for 2000 shown in Table 2-3-1.
Source: Same as Table 2-3-1
See: Table 2-3-4

Figure 2-3-5: Trends in GIST with a breakdown by variable



Note: The above shows each component (calculated by multiplying each variable by the principal component score coefficient) of the first principal component score shown in Table 2-3-1.
Source: Compiled by NISTEP based on various data (see Table 2-3-5)
See: Table 2-3-5

The total science and technology capacity of Japan can be summarized as follows. While Japan's overall capacity in science and technology is the world's highest after the U.S., the gap between the two countries has been widening recently. A closer look at the statistics reveals one major characteristic of science and technology activities in Japan: large input and small output. However, there has been an increase in output since the latter half of the 1990s. Another finding is that Japan has strength in areas close to industrial production but demonstrates a relative weakness in the production of basic knowledge and the international deployment of such knowledge.

We are aware that these findings are the results of limited data and that international comparison cannot always be performed accurately because the quality of statistics on science and technology is often low. Nevertheless, the results shown above can serve as a quantitative confirmation, to some extent, of the challenges to Japan's science and technology that have been discussed based on qualitative grounds, and should be highly suggestive.

Integrating Indicators by Multivariate Analysis

Multivariate analysis is the collective name for a variety of methods to analyze a large number of variables (many different sets of quantitative data). Of this variety of methods, we used for this report principal component analysis to integrate science and technology indicators. Principal component analysis is a technique that attempts to reduce complex data sets consisting of many different variables to a smaller set of new variables that can reflect the overall characteristics of the original data sets.

Aside from the above-mentioned analysis technique, we also used factor analysis to investigate the structure of science and technology activities and confirmed the validity of our choice of variables, although nothing about this is mentioned in the main body of the report. Factor analysis is a method that intends to explain information contained in many different variables using a small set of potential factors (factors which cannot be directly observed but are assumed to be common contributors to the different sets of data observed). Details of this analysis technique and the analysis results are described in Reference [1].

Source data sets

We performed analysis for five countries, namely, Japan, the U.S., France, Germany and the U.K., for the 20 years from 1981 to 2000, a period for which reliable data were available.

The variables (indicators used for the analysis) are the following 12 indicators that typically represent the state of science and technology activities in each country. Of these 12, data for [4], [5], [10], [11], and [12] are figures in real terms in 1995 prices based on purchasing power parities.

[1] Bachelor of Science degrees awarded (number of persons who obtained a bachelor's degree in science-related faculties of universities)
[2] Bachelor of Engineering degrees awarded (number of persons who obtained a bachelor's degree in engineering-related faculties of universities)
[3] Number of researchers (see Section 1, Chapter 6)
[4] R& D expenditure (see Section 1, Chapter 6)
[5] Technology imports (see Section 3, Chapter 7)
[6] Number of scientific papers (number of scientific papers listed in SCI; see Section 1, Chapter 7)
[7] Citation counts (frequency of citation for SCI papers; see Section 1, Chapter 7)
[8] Domestic patent applications (number of patents filed by residents; see Section 2, Chapter 7)
[9] Foreign patent applications (number of patents filed abroad; see Section 2, Chapter 7)
[10] Technology exports (see Section 3, Chapter 7)
[11] Added value to industrial products (added value to the secondary industry)
[12] Output of high-tech products (added value to the high-tech industry)

While conditions and survey methods applied for these data vary from country to country, and therefore their reliability may be somewhat questionable, our analysis results should be reliable because they are heavily dependent on chronological trends.

The General Indicator of Science and Technology: results of principal component analysis

The first principal component obtained by principal component analysis had an eigenvalue of 8.48 and made a contribution of 69.8%, which means the component explained almost 70% of the total variance. We have adopted this component as the indicator to measure the overall state of science and technology activities in a country and named it the General Indicator of Science and Technology (GIST).

Since individual variables reflect the size of the country, GIST, which is generated from these variables, is also under the influence of the country size. For the purpose of expressing a nation's science and technology

activities with a single numeric value, a composite indicator like GIST is preferable in that it allows for the investigation of trends in science and technology activities free from the impact of

other factors. In the case where an international comparison needs to be made without the influence of the country size, GIST figures may be normalized by GDP or population, as shown in

Figures 2-3-2 and 2-3-3.

According to the GIST trends in Figure 2-3-1, each county has been experiencing a long-term growth, with some temporary declines. Since any reduction in GIST is worthwhile attention, we investigated the possible causes of each decline. The 1993 drop for Japan was mainly attributable to falls in ‘R&D expenditure,’ ‘added value to industrial products,’ and ‘added value to high-tech products.’ In the same year, Japan also declined in ‘the number of scientific papers,’ ‘domestic patent applications,’ ‘foreign patent applications,’ ‘technology imports,’ and ‘technology exports.’ This indicates an overall degradation of Japan’s science and technology capacity throughout 1993.

The U.K. also experienced a fall in GIST in 1991. Factors that contributed to the decline were reductions in ‘R&D expenditure,’ ‘the number of researchers,’ ‘technology imports,’ ‘domestic patent applications,’ ‘added value to industrial products,’ and ‘added value to high-tech products.’ In 1993 Germany, too, saw drops in ‘R&D expenditure,’ ‘the number of researchers,’ ‘the number of scientific papers,’ ‘added value to industrial products,’ and ‘added value to high-tech products,’ resulting in a leveling-off in GIST.

This way the General Indicator of Science and Technology can help identify characteristic variances seen across different variables. Moreover, a complementary relationship between the composite indicator and its component indicators is working effectively, because the variance in each component indicator and the overall trend are linked with each other on a numerical basis through principal component analysis.

(Hiroyuki Tomizawa)

An In-Depth Analysis of IMD's Science and Technology Competitiveness

The world competitiveness released annually by IMD (see earlier explanation) is an interesting report and has been attracting wide attention in Japan. While the ranking results have pleased or disappointed many people, there has been little effort to get an in-depth perspective on the report. In addition, too much focus on the results has sometimes led to superficial or misleading use of the ranking. Meanwhile, IMD stopped publishing the world competitiveness in the area of science and technology (S&T) after a change in the component variables in the 2001 report. We assume that many of the Japanese audience are still interested in the S&T world competitiveness in S&T. To provide them with basic information, we explain below the structure of S&T competitiveness, its time series trends in S&T competitiveness, and notes in reading IMD's World Competitiveness Yearbook based on our analysis results. This is why this column is titled 'an in-depth analysis.'

The variables used

Until the 2000 yearbook, IMD had been using the following 26 variables to measure the S&T competitiveness (see Table 1). IMD calls them 'criteria.' These criteria or variables are grouped into two types by their nature: (1) 'hard' variables, which are represented by statistics, and (2) 'soft' variables, which are measured by surveys conducted by IDM and its partner organizations. Hard variables are further categorized into two subgroups: variables that are expressed with absolute values such as the number of researchers, and variables that are expressed with relative values obtained by dividing absolute values by population, GDP, and so forth. Such differences in nature are listed in the 'nature' column of Table 1. We found that, of the 26 variables, eight are hard variables based on absolute values and seven are hard variables based on relative values, while 11 are soft variables.

We assumed that two variables out of the 26 were inappropriate for our analysis. The first one was 'the number of patents in force,' which appeared dissimilar to the rest of the variables with the same nature. Not only having low statistical correlation with other variables, the variable apparently had no direct relation with S&T activities. The second variable we decided to exclude was 'changes in patents granted to residents.' Although consisting of relative values, this variable was dissimilar to other relative data. Unlike other relative values, which were related to density because of division by population or GDP, this variable was associated with growth. In addition, from a statistical point of view, it had a small or even inverse correlation with other variables based on relative values. These are the reasons why our analysis excluded the two variables and covered the remaining 24. The data used for the following analysis derive from the 2001 Yearbook because, among very similar analysis results we obtained for different years, those for 2001 were most recognizable.

Table 1: Variables used to measure S&T competitiveness

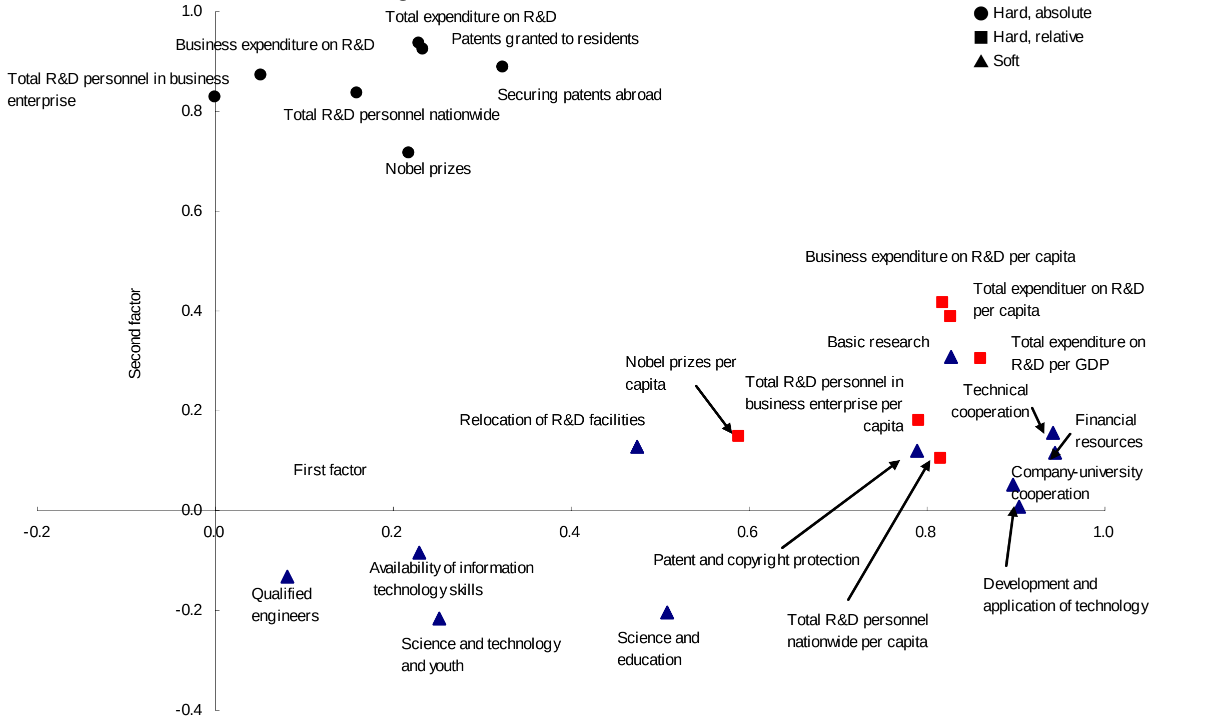
No.	Variable	Nature
1	Total expenditure on R&D	hard, absolute
2	Total expenditure on R&D per capita	hard, relative
3	Total expenditure on R&D per GDP	hard, relative
4	Business expenditure on R&D	hard, absolute
5	Business expenditure on R&D per capita	hard, relative
6	Total R&D personnel nationwide	hard, absolute
7	Total R&D personnel nationwide per capita	hard, relative
8	Total R&D personnel in business enterprise	hard, absolute
9	Total R&D personnel in business enterprise per capita	hard, relative
10	Qualified engineers	soft
11	Availability of information technology skills	soft
12	Technical cooperation between businesses	soft
13	Company-university cooperation	soft
14	Development and application of technology	soft
15	Overseas relocation of R&D facilities	soft
16	Nobel prizes	hard, absolute
17	Nobel prizes per capita	hard, relative
18	Basic research	soft
19	Science and education	soft
20	Science and technology and youth	soft
21	Patents granted to residents	hard, absolute
22	Changes patents granted to residents	hard, relative
23	Securing patents abroad	hard, absolute
24	Patent and copyright protection	soft
25	Number of patents in force	hard, absolute
26	Financial resources	soft

Structure of variables

Factor analysis is a useful technique one can use to grasp the overall relationship among variables. It can also help identify the structure of a group of variables. Further explanation of factor analysis is provided elsewhere in this report. Figure 1 shows the two-dimensional plot of factor loadings consisting of the first and second factor. The percentages of the variance explained by the first and second factors were 45.5% and 19.2% respectively, which totaled 65.7%. In the figure, '●' represents hard variables based on absolute values, '■' hard variables based on relative values, and '▲' soft variables. Factor analysis has the function of grouping variables with similar nature. From this perspective, we can say that the results shown in Figure 1 are highly adequate because hard variables based on absolute values are located in the upper part, indicating their clear difference in nature from other variables. In fact, soft variables, or the values obtained from surveys using questionnaires, were measured on a scale from -5 to +5 and thus essentially have the relative nature. In other words, the horizontal axis represents the relative variables and the vertical axis refers to the absolute variables.

In the plot below, a concentration of hard relative values is formed near the right end of the horizontal axis. This demonstrates that the plot is in the structure that splits the hard variables into absolute values and relative values. A piece of information which is not shown in the figure is that the 'changes in patents granted to residents,' a variable which was excluded from the analysis, would be placed near the left end of the horizontal axis, isolated from any other hard relative values. This is the evidence that this relative value had the nature which was statistically dissimilar to the one shared across the rest of the hard relative values, a finding that justifies the exclusion. Meanwhile, soft variables showed a distribution along the horizontal axis. This demonstrates that the nature of these variables is different from that of hard relative variables. In other words, we found that soft variables are dissimilar to hard variables statistically as well as substantially. This means IMD has been using variables with different natures to calculate world competitiveness. Such an attempt is indeed permissible but it still requires analysis of the differences in nature.

Figure 1: Structure of variables



Structure of soft variables

Now that we have found soft variables are statistically different from hard variables in nature, we performed factor analysis tests on soft variables to identify the relationship between soft variables (see the structure of soft variables in Figure 2). The analysis yielded the second factor again, with the variance explained by the first and second factors being 49.4% and 21.2% respectively, which totaled 70.7%. This demonstrates that the soft variables also consist of two factors. The figure illustrates that major variables constituting the first factor, which are concentrated in the right end of the plot, share the same nature, which is related to social technology management. Similarly, we have found that major variables contained in the second factor, which are located in the upper part of the plot somewhat dispersedly, all have close connection with science and technology human resources. The ‘overseas relocation of R&D facilities’ variable, which positions between the two groups, is assumed to have a mixture of the two different natures.

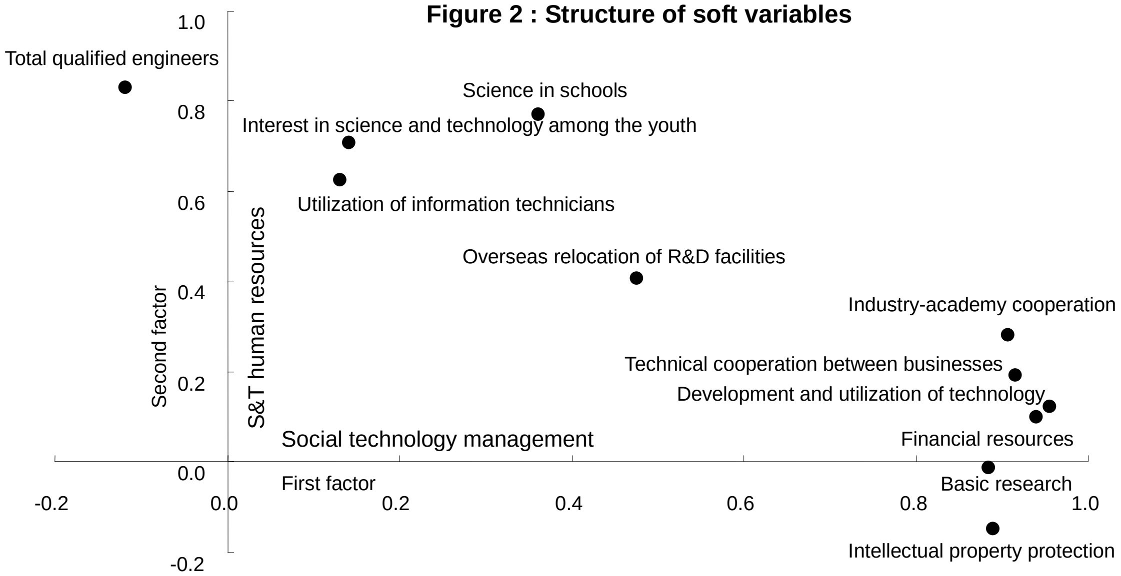
World competitiveness in science and technology

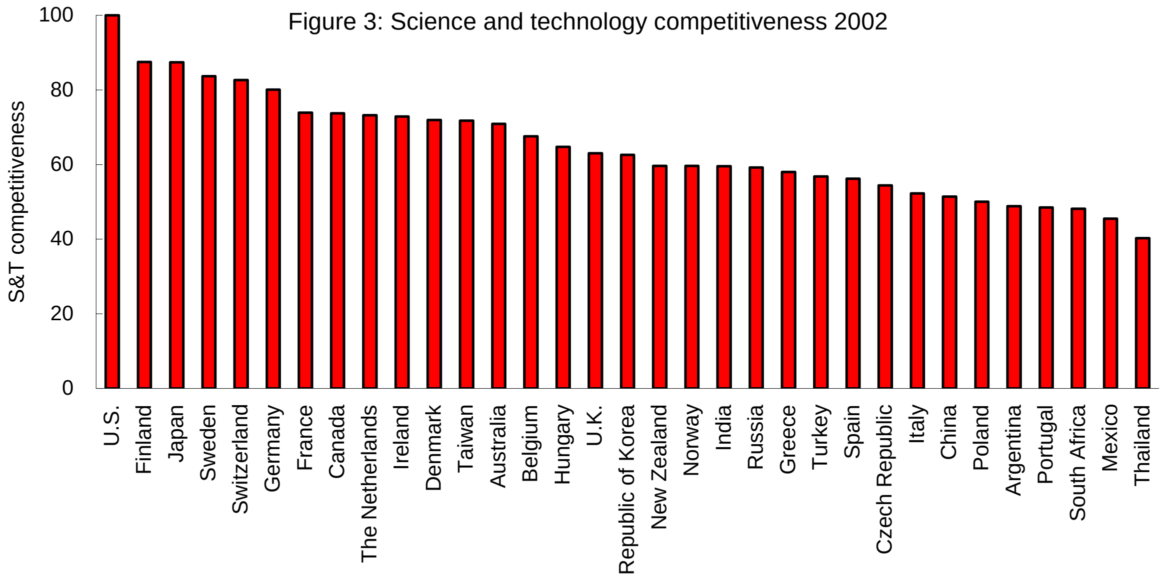
IMD discloses the methodology it uses to calculate world competitiveness. However, we doubt it is actually used. Shown below is the estimated real calculation method for world competitiveness. Another problem we found is that IMD uses the world average where statistics are unavailable; a process we believe fails to take into account the condition of individual countries. Figure 3 shows the results of the world competitiveness in science and technology. Japan was a close third to Finland.

$C_j = k_h \Sigma x_{hij}/\sigma_{hi} + k_s \Sigma x_{sij}/\sigma_{si}$

- C_j: S&T competitiveness of Country j
- k_h: coefficient of the hard variable group, the reciprocal of the hard variable used
- k_s: coefficient of the soft variable group, the reciprocal of the soft variable used
- x_{hij}: the value of *i*, where *i* is the hard variable of Country j
- x_{sij}: the value of *i*, where *i* is the soft variable of Country j
- σ_{hi}: standard deviation of hard variable *i*
- σ_{si}: standard deviation of soft variable *i*

Figure 2 : Structure of soft variables





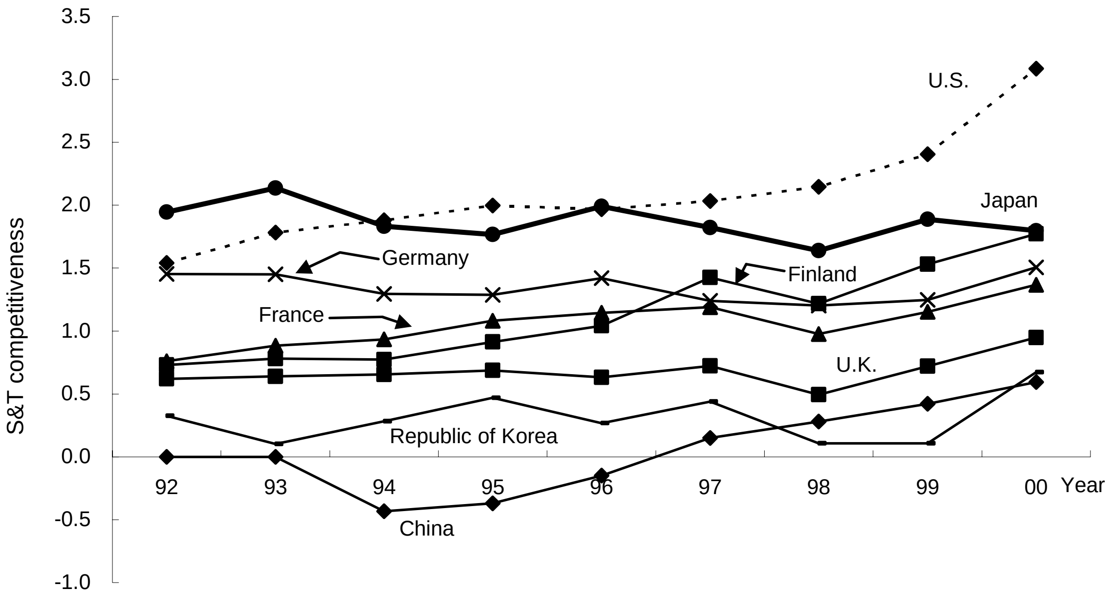
Time trends of A&T world competitiveness

Next, we analyzed time series trends in science and technology competitiveness. IMD's report uses the latest statistics available at the time of preparation, resulting in a difference of up to two years between the newest and the oldest data. To eliminate the variation, we measured the competitiveness for the same year using the following formula.

$C_j = k_h\Sigma(x_{hij}-\mu_{hi})/\sigma_{hi} + k_s\Sigma(x_{sij}-5)/\sigma_{si}$

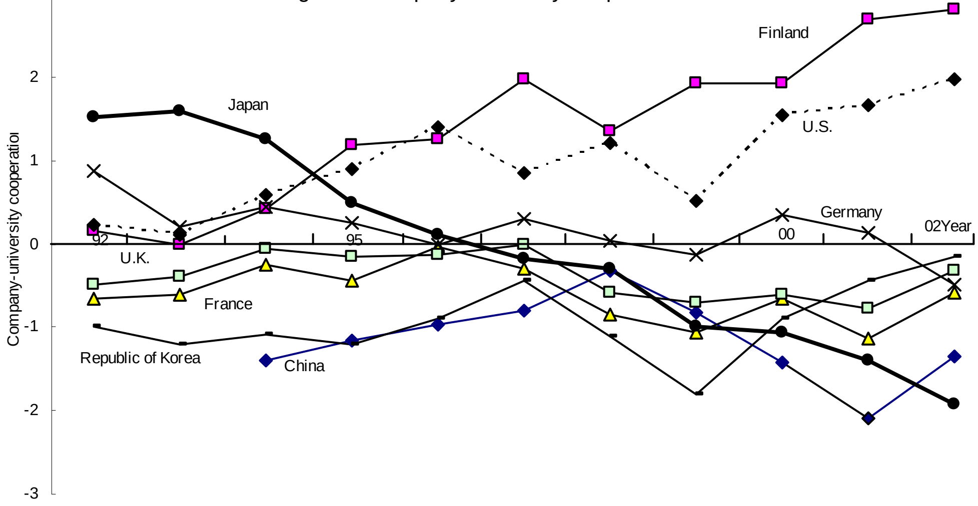
μ_{hi}: average of hard variable *i*

Figure 4 : Trends in science and technology competitiveness



The above figure shows trends in science and technology competitiveness for selected countries. What is noticeable is that the U.S. competitiveness indicated a significant increase since the mid-1990s to reach an overwhelming level by 2000. The General Indicator of Science and Technology also demonstrated this trend.. Japan, ranking second to the U.S., showed a downward trend toward the end of the selected period. This narrowed the gap between Japan and third-placed Finland.

Figure 5: Company-university cooperation



Trends in soft variables

The major reason that Japan's science and technology competitiveness rated by IMD reduced in comparison with other countries is due to a decline in the value of soft variables. Our analysis indicates that the indicators of hard variables for all selected countries but the U.S. and Finland remained almost flat. On the other hand, the indicators of soft variables soared for many countries, although those for Japan and Germany declined (the analysis chart is omitted due to paper width restrictions). Japan appeared to be pessimistic in sentiment or perception despite its moderate performance measured by the statistics.

As an example to illustrate that, let us look at the trends in the 'industry-academia cooperation' variable. This variable is based on the answers to the question 'Is there sufficient cooperation between businesses and universities?' (1992-1998) or 'Is there sufficient technology transfer between businesses and universities?' (1999-2000). While two different questions were used, we considered their results as the same variable because they shared the same intention. The results deriving from Japanese respondents resulted in a constant and sharp decline as shown in Figure 5. However, the reality is that industry-academia cooperation in Japan, including activities of Technology Licensing Organizations (TLOs), has actually been improving rather than shrinking. We also point out that Japan's levels of industry-academia cooperation in the early years in Figure 5 seem higher than the actual levels. Such deviations from reality in ratings must be primarily stemming from a change in the concept or the content of industry-academia cooperation.

Another factor that should contribute is respondents' dissatisfaction with the current state, such as a feeling of being outperformed by other countries, especially other developed countries, and a feeling of not measuring up to the expectations. The misleading results may also be reflecting the Japanese respondents' tendency to be strict with themselves or their country and their sense of frustration over the whole society.

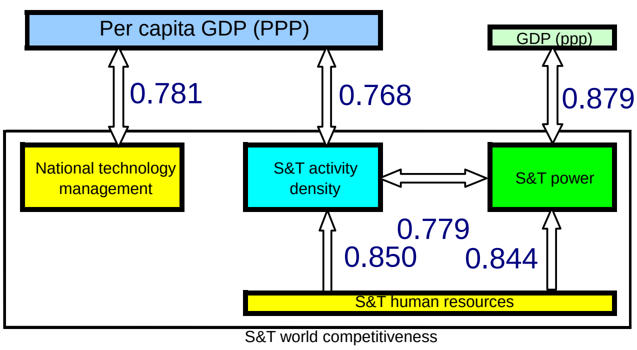
Relations between indicators

The above analyses illustrate that IMD's four variable groups, which are statistically independent of one another and are based on the concepts of different nature, measure science and technology competitiveness. The four groups are:

1. Science and technology capacity: hard variables based on absolute values
2. Density of science and technology activities: hard variables based on relative values
3. Social technology management: part of soft variables
4. Science and technology human resources: part of soft variables

How do these indicators relate to one another? While it is impossible to identify cause-and-effect relations between them, we can infer that there are relations as illustrated in Figure 6 from their correlation coefficients. The indicator that has a close link with absolute GDP values based on purchasing power parities (PPPs) is the science and technology capacity, which is also measured by absolute values. Similarly, per capita GDP, a set of relative values, is closely related to the density of science and technology activities and social technology management, both of which are relative values, too. This indicates that per capita GDP is depending on not only the density of science and technology activities but also technology management in overall society. In addition, the two hard indicators of science and technology activities have a strong correlation with science and technology human resources.

Figure 6: Relations between indicators of science and technology competitiveness



Summary

An in-depth analysis of the science and technology competitiveness measured by IMD yielded the following conclusions.

1. We value highly IMD's world competitiveness report. While there are various aspects to be taken into consideration in using or analyzing it, the report is particularly effective for raising the awareness of the usefulness and the importance of statistics.
2. To fully understand the report, structural analysis is necessary because statistics within the report are not limited to those concerning science and technology, but also include statistics on many different fields. In particular, the relationship between hard and soft variables should be analyzed.
3. In comparison with the General Indicator of Science and Technology, discussed in this report, IMD's world competitiveness does not cover as many indicators as GIST does, as far as hard variables are concerned, but does contain a larger number of countries.
4. The growth rates of IMD's variables have been discovered to be dissimilar to those of other variables. It would be possible to develop a new indicator based on an appropriate set of growth rate variables.
5. We hope that IMD discloses data concerning their soft variable surveys, for example, target groups, sample counts, and response counts for each country surveyed.
6. A problem lies in the way the world competitiveness ranking is used. Too much attention is often paid to the ranking itself. This can sometimes be misleading because the rankings of middle range countries may change depending on the variables used.
7. Our ongoing challenge is to perform structural analysis of all variables. Since many other variables exist within science and technology, this will require a tremendous amount of time and energy spent.

(Fujio Niwa)

Part II

Knowledge Base, Human Resources and Training

Chapter 3
Human Resources in Science and Technology in a Knowledge-based Society

Part II focuses on human resources, the most important foundation in the promotion of science and technology (S&T). In order to give a precise picture of this ever-diversifying, ever-complex field, Chapter 3 expands its focus from human resources for research and development (manpower for S&T in the narrow sense) to include a broader base of human resources that supports the knowledge-based society into which Japan is evolving. Section 1 considers the advances toward a knowledge-based society and into the background of the country that inevitably propels its advances in this direction. Section 2 briefly considers the changes taking place in manpower recruitment and training alongside growth of a knowledge-based society and lastly gives an outlook into the future for human resources in S&T in the society of the future.

3.1 Growth of Knowledge-based Society and Human Resources

3.1.1 Transition into a knowledge-based society

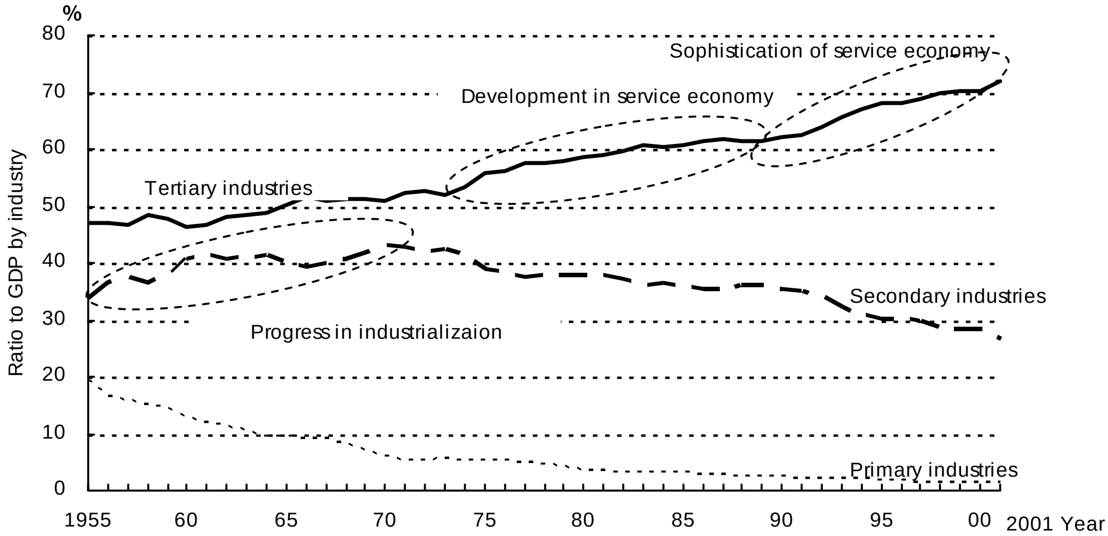
Japan and other industrialized nations are advancing from the industrialization stage and evolving into knowledge-based societies. The term 'knowledge-based society' is a widely used term describing a society in which knowledge becomes the core factor in propelling social and economic growth(1). There are many views and theories regarding the term, as well as concepts pertaining to the term. In fact, opinion is split on whether such a society is actually emerging, and there are criticisms of the ambiguity of the concept. Notwithstanding the above, many statistical data and many indicators point to change in this direction, namely, transition into a service economy, consolidation of knowledge and progress in the digitization of society. The importance of abilities to create, disseminate and utilize knowledge is in fact growing.

Based on this understanding, this section will look into the conceptual image of manpower necessary in the knowledge-based society of the future. In view of the diversification and expansion in the scope of S&T activities, it is necessary to assess the state of human resources from a perspective broader than the conventional framework employed in this field.

Before studying the conceptual image of human resources necessary for a knowledge-based society, we will briefly examine progress in this direction. Although evidence pointing to Japan's transition into a knowledge-based society is difficult to find, there are indicators substantiating growth of the service economy and consolidation of knowledge in this country. Figure 3-1-1 shows the changes in the breakdown of Japan's GDP by industry. Until the early 1970s, the country experienced rapid industrialization. This phase was followed, as in other industrialized nations, by growth of service industries in terms of share of the economy. Around 1990, as the Cold War ended, Japan's industrial structure grew in sophistication, with the further rise of tertiary industries (service industries) vis-à-vis the scale of the national economy.

(1) The term "knowledge-based society" was coined by Peter F. Drucker and has become widely used. Daniel Bell's concept of "post-industrial society" is in essence a concept roughly equivalent to the "knowledge-based society."

Figure 3-1-1: Trends in the breakdown of Japan's GDP by industry



Note: Data for 1955-1989 based on 68 SNA; data for 1990-1991 based on 93 SNA.
Sources: Cabinet Office, 'Report on National Accounts (Processed Statistics) – Retroactive Long-term Indicators (1990 Revision)'; Cabinet Office, 'Annual Report on National Accounts 2003'
See: Table 3-1-1

Although there are a number of indicators that point to the consolidation of knowledge, attention will be directed here toward investment into knowledge and toward comparison of various countries regarding activities in this area.

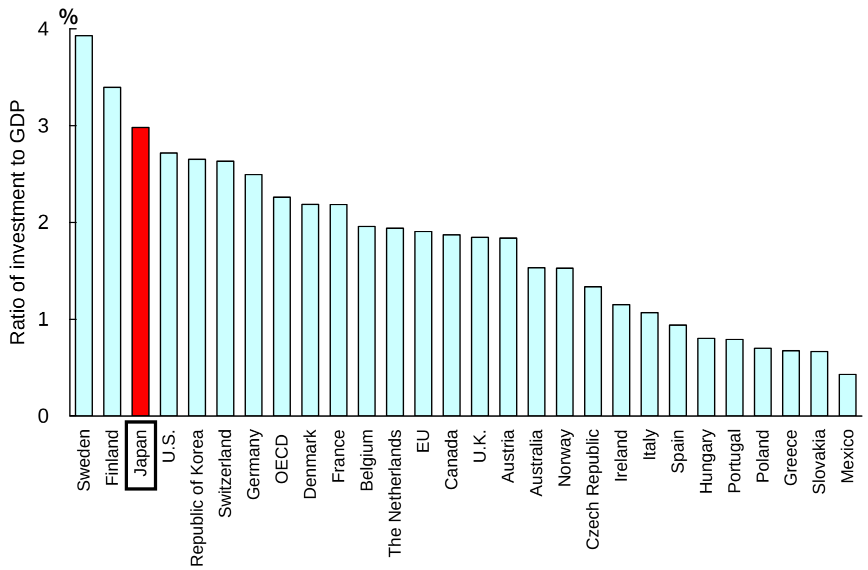
The indicator on investment in knowledge that has been developed by OECD is a standardized measure of a nation's total investment into research and development, software and higher education vis-à-vis GDP (Figure 3-1-2). The three areas are regarded important in these countries and have seen dramatic rise in investment, especially in the area of research and development and in software.

This indicator shows that Japan's investment in research and development is high among OECD member nations. However, investment in higher education is low, and investment in software is likewise not very high.

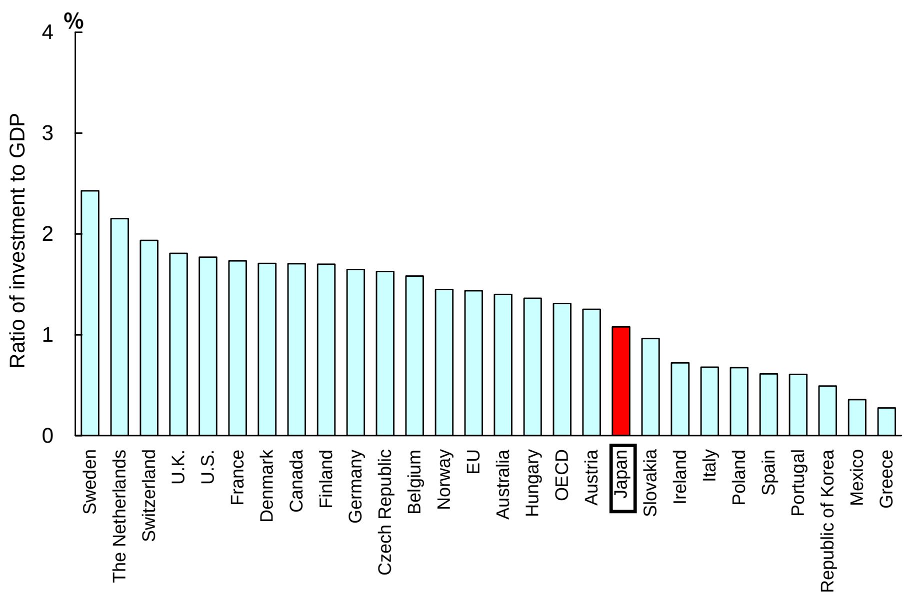
In order to improve and solidify the foundation for a knowledge society, investment into R&D remains important. However, greater attention must be paid to software (information technology) and higher education.

Figure 3-1-2: Investment in knowledge

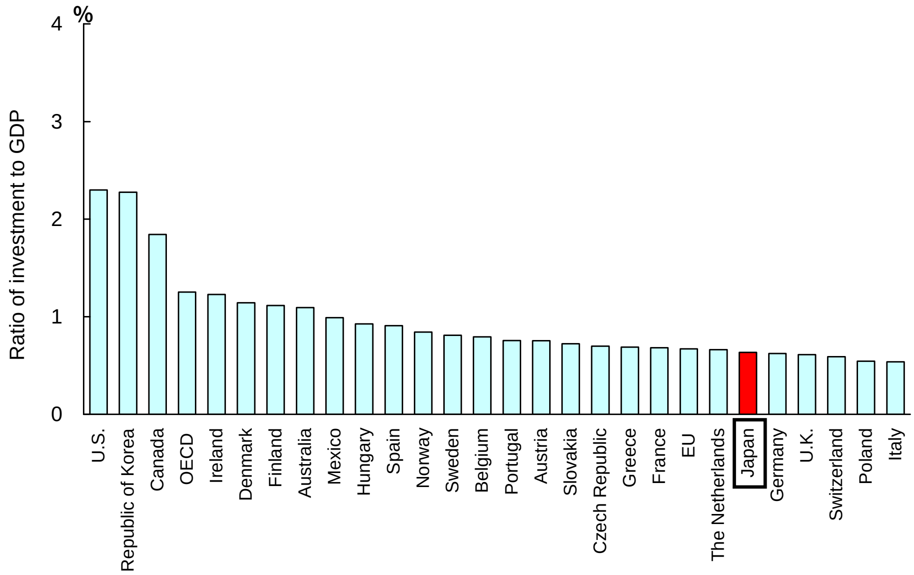
(A) Research & Development



(B) Software



(C) Higher education



Note: 1999 data used for Denmark, Belgium, Greece, Slovakia and Mexico; 2000 data used for all other countries.
<Japan, United States & Canada> Data for higher education includes data for education continuing after secondary education.
<Greece & Denmark> Average annual growth from 1992 to 1999.
<OECD> Excludes Hungary, Poland and Slovakia; average annual growth from 1992 to 1999 for the organization excludes Belgium, Czech Republic, Hungary, Republic of Korea, Mexico, Poland & Slovakia.
<Belgium> Data for higher education based only on direct public spending.
<European Union> Excludes Belgium, Denmark & Greece; average annual growth from 1992 to 1999, excluding Belgium.
Source: OECD, "STI Scoreboard 2003"
See: Table 3-1-2

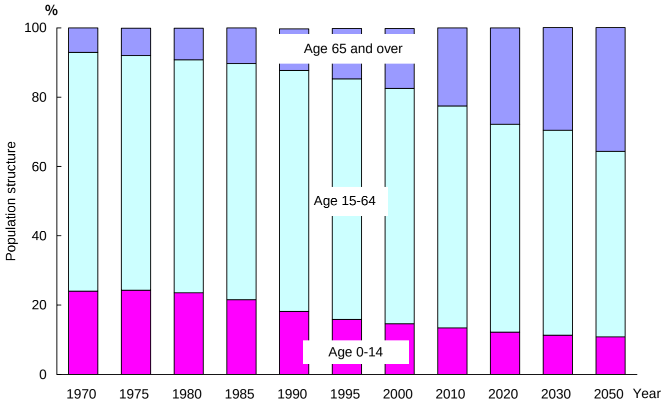
3.1.2 Social changes regarding human resources

Changes taking place in the work forces and demographic structures of Japan and other industrialized nations are summarized as follows. The changes taking place are regarded the driving force of transition into a knowledge-based society. For this reason, this section considers the inevitability of advance in this direction, leading subsequently to an examination into the impact of a knowledge-based society on manpower.

First, drastic changes are taking place in demography. Figure 3-1-3 shows the changes in Japan's population structure by age group and projections of future changes. With society aging and the birthrate falling, the working population aged between 15 and 64 is expected to decline rapidly from 67.9% in 2000 to 59.2% in 2003, declining further to 53.6% in 2050.

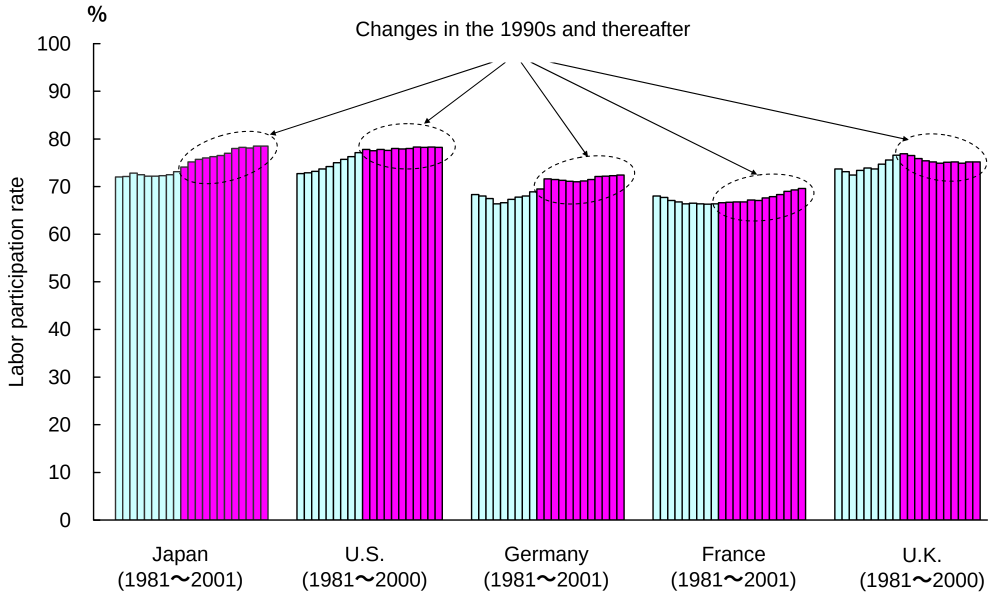
Furthermore, the labor participation rate has already peaked in various countries in the 1990s, as shown in Figure 3-1-4. Urgent action must be taken to address the issue of the declining working population.

Figure 3-1-3: Trends in and projections of Japan's population structure by age group



Notes: 1. Data for 1970 to 2000 based on 'Population Census,' Statistics Bureau, Ministry of Public Management, Home Affairs, Posts and Telecommunications; Projected data for 2010 and thereafter based on 'Population Projections for Japan, January 2002,' National Institute of Population and Social Security Research, Ministry of Health, Welfare and Labor.
2. Total includes persons whose age groups are unknown.
Source: Ministry of Health, Welfare and Labor, Labor Statistics, Statistical Database System (http://wwwdbtk.mhlw.go.jp/toukei/youran/index-roudou.html)
See: Table 3-1-3

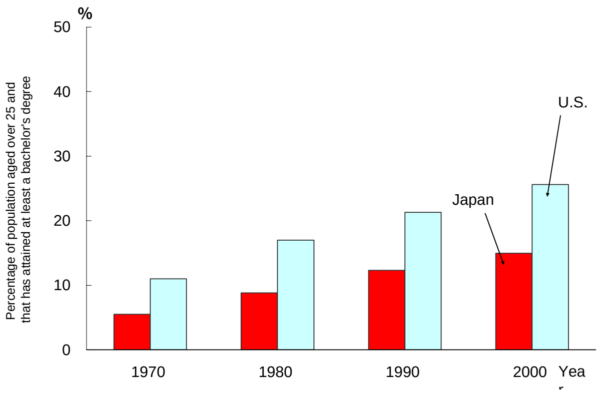
Figure 3-1-4: Trends in labor participation rates of 5 nations



Notes: 1. Labor participation rate = (Working population ÷ Population aged 15-64) x 100
2. Figures for former West Germany until 1990; Figures for united Germany from 1991.
Source: Ministry of Health, Welfare and Labor, Labor Statistics, Statistical Database System (http://wwwdbtk.mhlw.go.jp/toukei/youran/index-roudou.html)
See: Table 3-1-4

Concurrent with these changes, the level of education is rising. Figure 3-1-5 shows the growth in the percentage of population in Japan and the United States aged over 25 that has attained at least a bachelor's degree.

Figure 3-1-5: Growth in the percentage of population in Japan and the United States aged over 25 and with educational attainment of bachelor's degree or higher



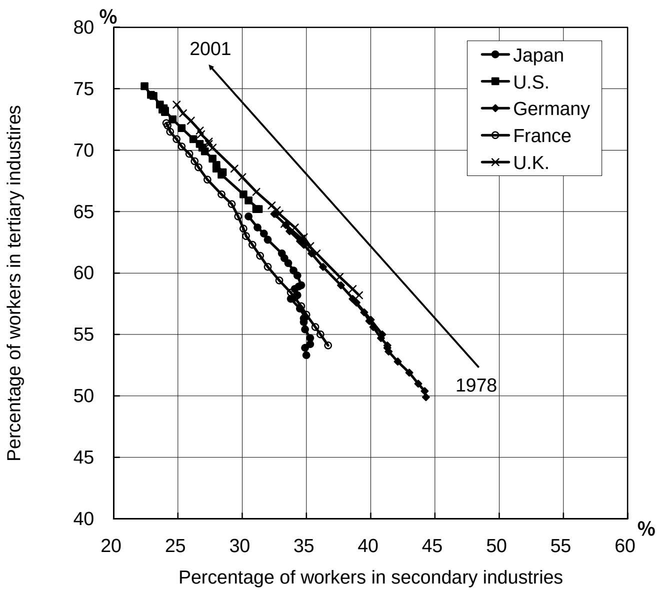
Note: Data on Japan does not include students currently enrolled in graduate schools.
Sources: Statistics Bureau, Ministry of Public Management, Home Affairs, Posts and Telecommunications, Japan 'Population Census,' 1970, 1980, 1990 & 2000
National Center for Education Statistics, US Department of Education, United States "Educational Statistics"
See: Table 3-1-5

Because of the differences in quality of education and enrollment rate in various countries, simple comparison of college-level educational attainment is not easy. However, it can be said that the percentage of those with college education or higher is rising both in Japan and the United States, showing a general rise in the educational attainment in the two countries.

Notwithstanding the decline in the number of workers, higher educational attainment will minimize the impact of the decline in the working population as a whole. This factor that is highlighted in the deliberations into the image of the knowledge-based society anticipated in the future. This new type of labor founded on knowledge is called 'knowledge labor.'

A look into the industrial structure of five major countries (Figure 3-1-6), for example, shows a continuing decline in the percentage of workers in secondary industries in inverse proportion to the rise of those in tertiary industries. The emergence of the tertiary industries is due to classification of knowledge industries, including IT and health care, as tertiary industries.

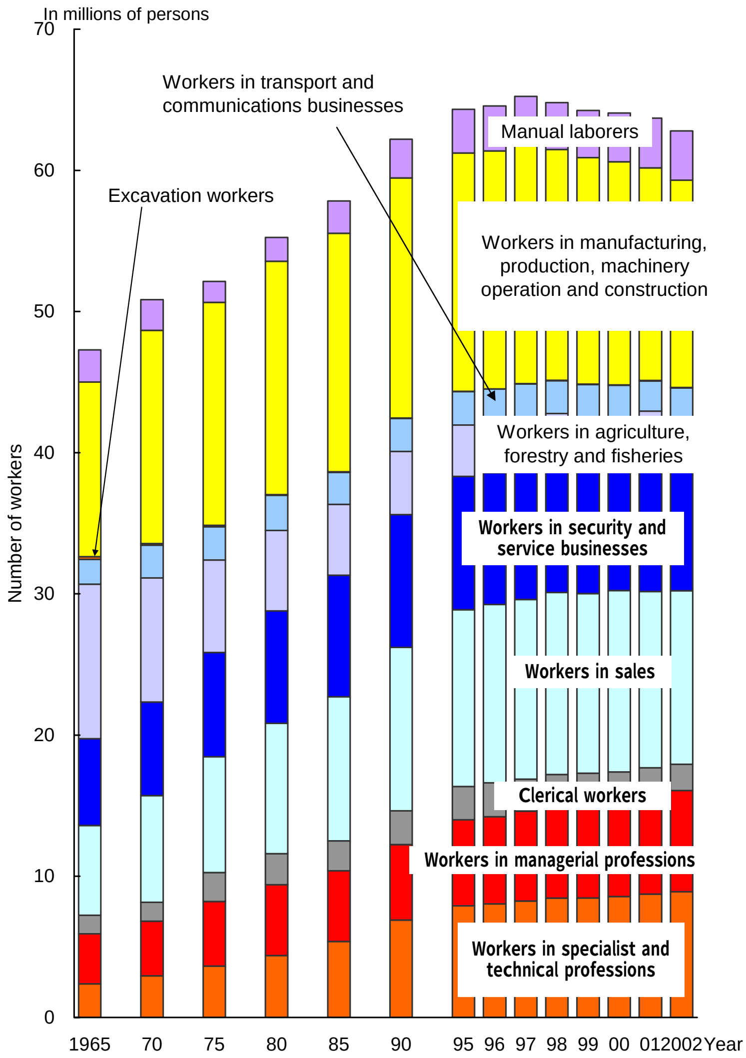
Figure 3-1-6 Trends in the breakdown of work forces in five major countries by industry



Source: OECD, "Labor for Statistics 1981-2001"
See: Table 3-1-6

Changes in the number of workers in Japan by profession are also shown in Figure 3-1-7. The increase in knowledge labor can be seen in the marked rise in number of workers in specialist and technical professions, as well as those in security and service businesses.

Figure 3-1-7 Trends in the breakdown of workers in Japan by profession



Notes: With the revision of classification of occupational categories in the 1980 National Census, the Labor Survey has been revised in January 1981 as follows.
1. 'Workers in mining' have been renamed 'excavation workers.'
2. 'Simple manual laborers' have been renamed 'manual laborers.'
3. 'Sanitation workers' who have been included in 'workers in security and service businesses' have been reclassified into 'manual laborers.'
Source: Ministry of Health, Welfare and Labor, Labor Statistics, Statistical Database System (http://wwwdbtk.mhlw.go.jp/toukei/youran/index-roudou.html)
See: Table 3-1-7

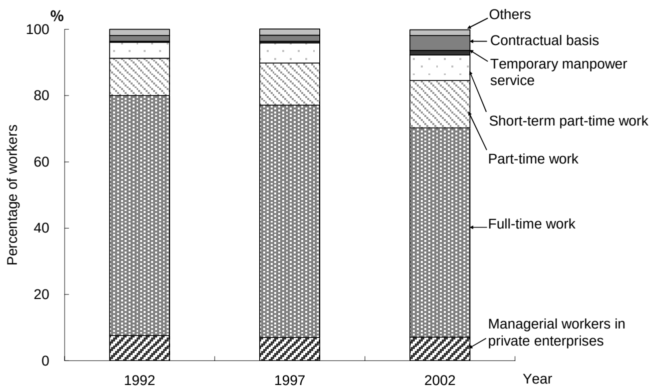
3.2 Changes in Human Resources Accompanying Transition into Knowledge-based Society

3.2.1 Changes in employment

As seen in the preceding section, knowledge labor is increasing in size concurrent with the transition into a knowledge-based society. Knowledge is undergoing greater segmentation and sophistication. As a result, business enterprises have opted to spin off business divisions and outsource business operations. This change appears to have affected employment, in particular the form of employment, work schemes and recruitment of foreign nationals. However, the influence of transition into knowledge-based society cannot be measured easily from these developments because of the serious impact of recent economic developments in the employment market, especially in Japan. The changes in the employment situation in recent years will be examined based on this understanding.

In Japan, the number of full-time workers is declining, while the number of workers employed on a part-time or temporary basis or under contract is on the rise. (Figure 3-2-1)

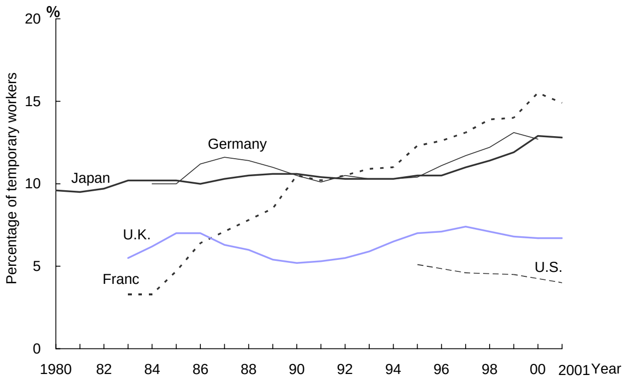
Figure 3-2-1: Trends in the breakdown of workers in Japan by form of employment



Source: Ministry of Health, Welfare and Labor, Labor Statistics, Statistical Database System (http://wwwdbtk.mhlw.go.jp/toukei/youran/index-roudou.html)
See: Table 3-2-1

The percentages of temporary workers in the total working populations in five major countries (Figure 3-2-2) show that temporary workers are similarly on the increase in France and Germany. It must be noted here that a temporary worker is defined here as a person working under a finite employment contract (not under a lifetime contract), whether they be engaged in full-time or part-time work.

Figure 3-2-2 Trends in the ratio of temporary workers in the total working populations in five selected countries



Source: OECD, "Labor Market Statistics 1981-2001"
See: Table 3-2-2

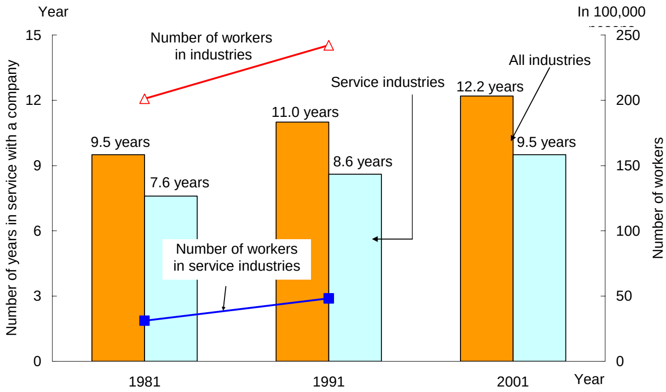
Changes shown in Figure 3-2-1 and 3-2-2 appear to be caused directly by economic developments. However, some believe that once the number of temporary workers increases or transition in the job market takes root, temporary workers will not diminish in number even with economic improvement. In other words, business enterprises and workers will most likely embrace a work scheme by which employers select workers that supply the knowledge needed at a particular time and workers choose to work at enterprises that make good use (or evaluate highly) the knowledge they can offer.

Although an increase in the number of temporary workers is, as a matter of course, expected to spur decline in the number of years of service with a company, the number is actually rising both in service industries and industries in general (Figure 3-2-3). This suggests that job-hopping by full-time workers is on the decline. With business enterprises turning their attention to core competence in business activity alongside segmentation of knowledge, opportunities for individuals to make use of their respective knowledge have likewise become segmented and specialized. This is believed to be the reason behind the decline in job turnover. In addition, workers in temporary manpower services are classified as working at their manpower service companies, regardless of where they are during specific job assignments. Thus, they are not regarded as job hoppers.

The decline in job turnover is also seen in the decrease in the ratio of mid-career recruitment, regardless of profession type (Figure 3-2-4).

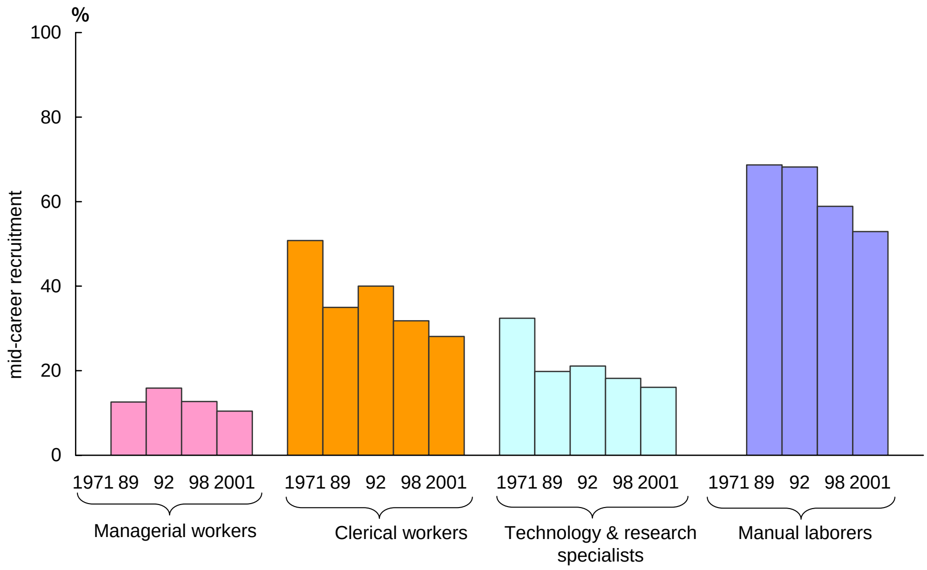
If this relationship between business enterprises and private individuals undergoes change to adapt to a knowledge-based society, wage and compensation schemes that reflect job function, job performance capability and accomplishments are likely to be introduced as well (Figure 3-2-5). Present attention is on future developments.

Figure 3-2-3: Trends in the number of years in service with a company in Japan (Total figures for all industries and service industries)



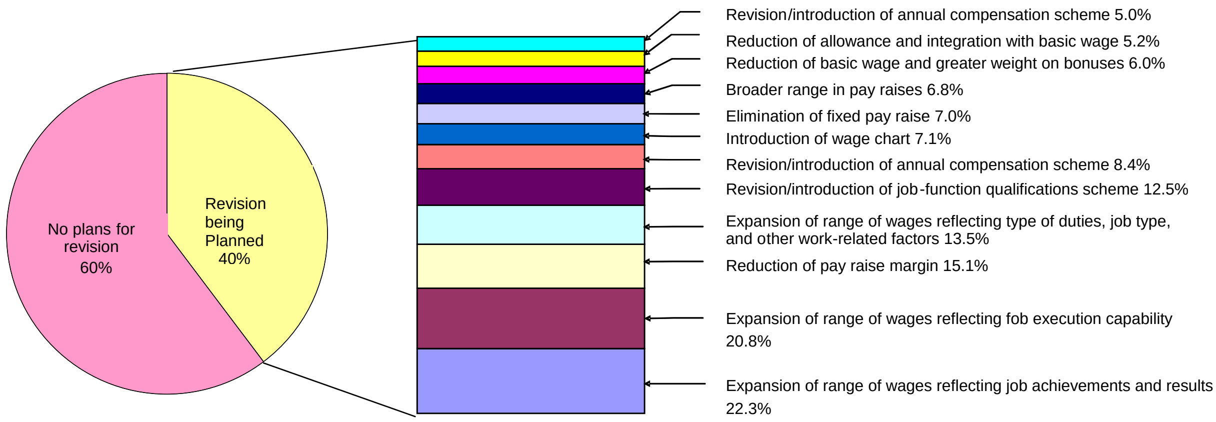
Source: Ministry of Health, Welfare and Labor, 'Basic Survey of Wage Structure'
See: Table 3-2-3

Figure 3-2-4: Trends in ratio of mid-career recruitment in Japan by profession type



Source: Ministry of Health, Welfare and Labor, 'Survey on Labor Management'
See: Table 3-2-4

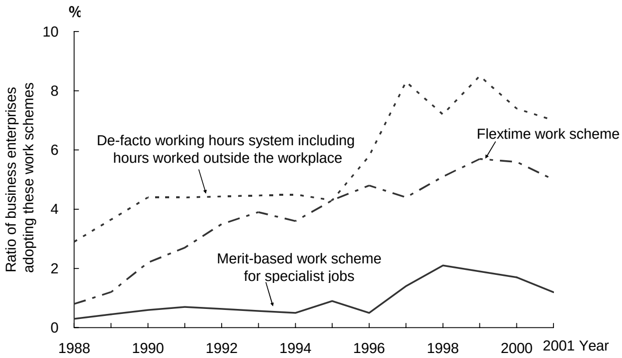
Figure 3-2-5: Possibility of wage schemes revision in the next three years and breakdown of business enterprises by type of revision



Note: As multiple answers were allowed for the items to be revised, the total ratio is not 100%.
Source: Minister's Secretariat, Policy Planning and Research Department, Labor Ministry, 'General Study of Wage and Working Hours System 1999'
See: Table 3-2-5

Regarding work schemes, a growing number of business enterprises are adopting merit-based work schemes, de-facto working hours system including hours worked outside the workplace, flextime work schemes and other schemes. (Figure 3-2-5). Merit-based work schemes are defined here as work schemes in which management and labor agree to designate types of jobs in which workers are allowed to exercise discretion on the method of job execution, time allocation, etc., and such workers are deemed to have worked the designated working hours, regardless of the number of hours actually worked. The De-facto working hours system including hours worked outside the workplace is a work scheme in which a worker is deemed to have worked the designated working hours, applied in cases in which calculation of working hours is difficult because work takes place outside the workplace. Flextime work scheme defines the total number of working hours for a designated period of less than one month and allows workers to decide voluntarily their own respective starting and closing hours for each workday while satisfying the quota of working hours.

Figure 3-2-6: Ratio of the Japanese business enterprises adopting merit-based work schemes and flextime work schemes



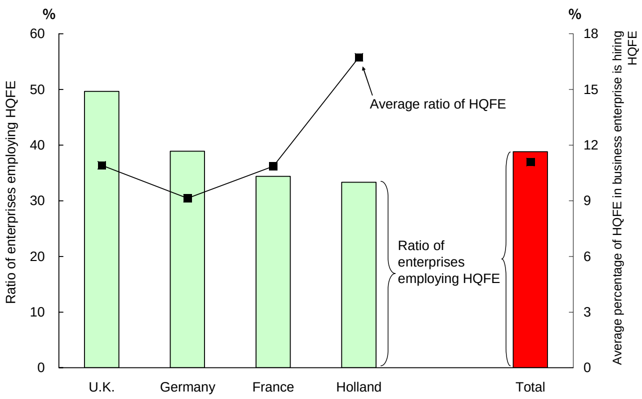
Note: Data for 1999 and earlier based on surveys as of December 31. Survey not conducted in 2000. Surveys for 2001 and 2002 conducted as of January 1. For this reason, data is shown as of the year of survey.
Sources: Former Ministry of Labor, 'General Survey on Wages and Working Hours System' for FY1999 and earlier.
Ministry of Health, Welfare and Labor, 'General Survey on Working Conditions' for FY2000 and later
See: Table 3-2-6

When a person is employed as a knowledge worker, the person does not execute his or her job according to a work schedule specified by the employer. Rather, the person is allowed to manage his or her own duties.

The strength of a business enterprise is tested in how successfully it is able to attract and assign manpower with advanced level of knowledge. This includes the possibility of active recruitment of foreign workers.

Figure 3-2-6 shows how highly qualified foreign employees are recruited in principal European countries. This survey covers 340 companies in Germany and 170 each in France, United Kingdom and the Netherlands. Of the 850 surveyed, 20% of the business enterprises belong in the chemical industry, while 31% are in manufacturing, 22% in finance, 16% in IT and 9% in R&D. Of these, more than 30% are hiring highly trained workers from other countries, and the ratio approaches 50% in the case of the United Kingdom. Of those recruiting talented foreign nationals, the percentage of such workers in their respective workforces averages 10%. In the case of the Netherlands, the ratio is as high as 17%.

Figure 3-2-7: Employment of highly qualified foreign employees (HQFE) in high-tech enterprises

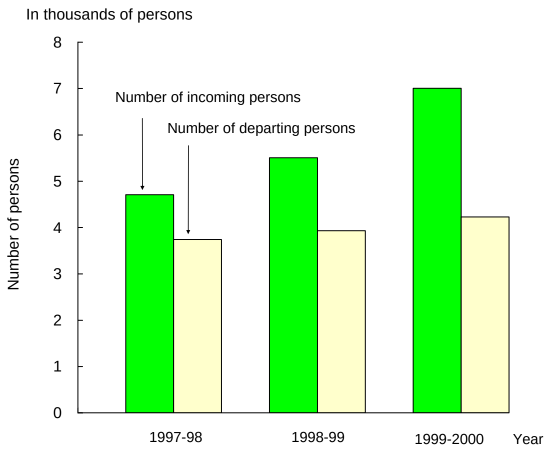


Note: HQFE stands for highly qualified foreign employees
Sources: IZA, "International Mobility of the Highly Skilled" (2002), OECD, and "International Employer Survey 2000"
See: Table 3-2-7

Although similar statistical data is not available in Japan, there are signs of foreign workers being accepted in Japan in recent years, for instance, in the transnational recruitment of IT workers in the manpower service industry. However, the trend has not gained momentum viewed from the perspective of government policy.

In some countries overseas, the employment of highly skilled workers by business enterprises is being promoted under government policy. As shown in Figure 3-2-7, the number of foreign nationals entering Australia for IT-related work has consistently exceeded the number of those leaving the country since 1995. This trend is being supported by Australia's aggressive integration policy since the 1970s to accept highly qualified manpower.

Figure 3-2-8: Influx and outflow of IT-related workers in Australia



Source: OECD, "International Mobility of the Highly Skilled" (2002)
See: Table 3-2-8

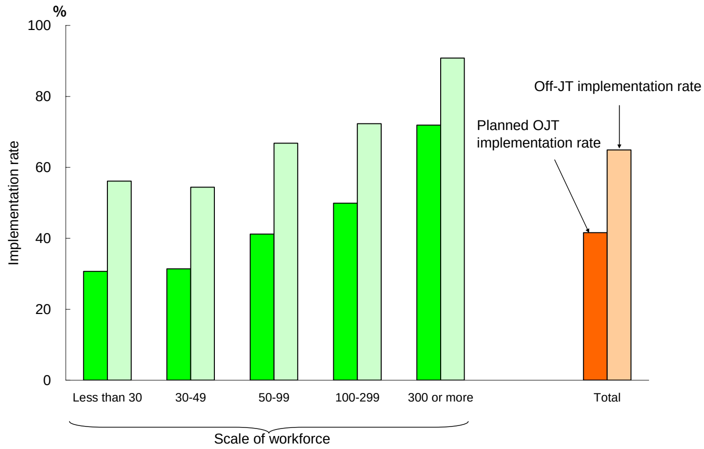
As a result of segmentation and sophistication of knowledge, business enterprises are being forced into defining their core competence (key capabilities and suitability of each business enterprise) and triggering spin-offs and outsourcing of services and operations. In turn, highly skilled manpower is being selected discriminately in business fields that are regarded as the core of each enterprise. Companies are changing to create work environment that encourage such highly qualified workers to demonstrate their skills and talents. If this trend continues, it is highly likely that areas of work where knowledge of an individual can be truly utilized effectively will be defined more clearly. Therefore, each worker will be required to show either the ability to identify areas where his or her knowledge can be utilized actively or the ability to create such areas. Moreover, the corporate organization will be redefined by knowledge workers as a place where knowledge gathers and is exchanged among individual workers.

3.2.2 Change in employee training

Knowledge labor requires advanced knowledge, which is progressing every day. Employees who have completed school education must continue to acquire new knowledge after completion of academic study and to make effective use of the knowledge in order to satisfy the requirements of knowledge labor.

Figure 3-2-8 shows the implementation rates for planned on-the-job training (OJT) and off-the-job training (Off-JT) at business enterprises, broken down by size of full-time workforce in FY2000. Regardless of business scale, Off-JT constantly exceeds OJT in implementation, suggesting that work is being built by absorbing new knowledge from outside the organization, rather than 'learning the trade' by emulating workers that are more experienced.

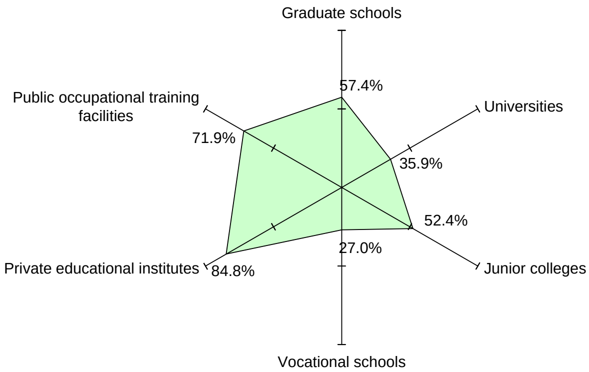
Figure 3-2-9: Implementation rates of planned OJT and Off-JT programs at Japanese business enterprises by scale of full-time workforce (FY2000)



Notes:1. 'Planned OJT' is defined as employee training implemented while executing day to day duties, under an established training plan detailing the officers in charge of training, the employees to be trained, term and content of the training program, etc., conducted in phases or on continuing basis.
2. 'Off-JT' he is defined as employee training implemented by taking away trainees from their daily duties for a period of time.
Source: Ministry of Health, Labor and Welfare, 'Survey on Professional Ability Development' (June 2002)
See: Table 3-2-9

As shown in Figure 3-2-9, adult training programs are organized by a variety of educational institutions. For instance, 57.4% of 829 advanced research courses at 'graduate schools' have organized entrance examinations for working adults. These programs are growing in importance in the drive to adapt to the growing complexities in society and technological advances, as well as to adapt to changes in specialized knowledge and skills that the society requires.

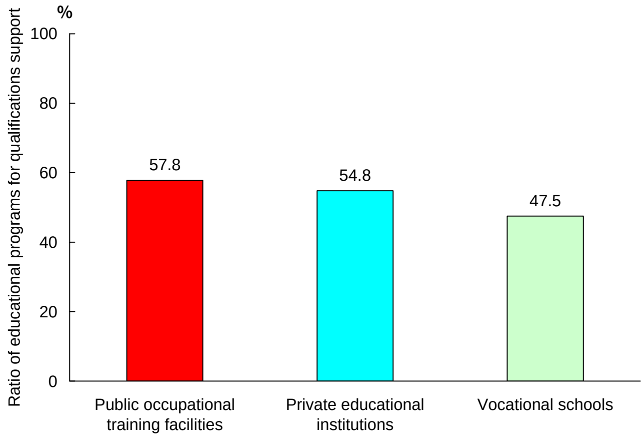
Figure 3-2-10: Ratio of adult/continuing education programs at Japanese educational institutions (2000)



Sources: Human Resources Needs Research Committee, Japan Chamber of Commerce and Industry, 'Survey on Supply and Demand in Working Adult Education' (2000)
See: Table 3-2-10

Amid the progressive segmentation and sophistication of knowledge, situations are expected to emerge in which the necessary acquisition of knowledge is not in the form of a large body provided by academic systems, but rather as more finely segmented and sophisticated knowledge. Acquisition of such specialized and advanced knowledge can be certified with accredited qualifications. With growth in demand among working adults to acquire accredited qualifications, support educational programs are being organized by many institutions (Figure 3-2-10). In the ongoing current of globalization, accredited qualifications that assure mutual recognition with other countries are expected to gain greater acceptance and spread in application.

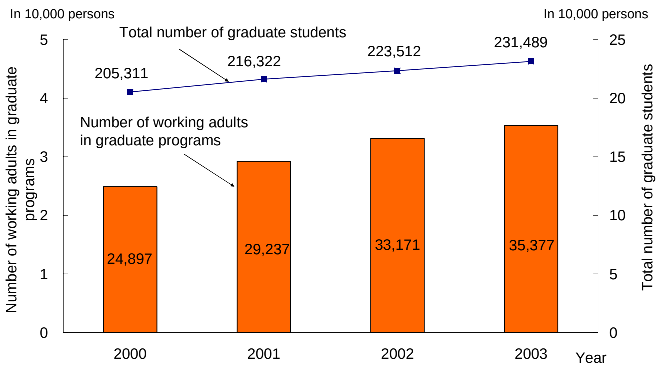
Figure 3-2-11: Ratio of educational programs supporting acquisition of qualifications organized by Japanese adult education institutions (2000)



Source: Human Resources Needs Research Committee, 'Survey on Supply and Demand in Working Adult Education' (2000)
See: Table 3-2-11

The ratio of working adults is also rising at graduate schools (Figure 3-2-11). Working adults are defined as working persons as of the date of survey, that is, persons who are working for the purpose of receiving continuing income in the form of wages, salary or compensation. This also includes persons who have left their jobs with business enterprises, as well as homemakers. The increase in number is expected to accelerate with the increase in specialized graduate programs in the future.

Figure 3-2-12: Growth in the number of working adults in graduate programs in Japan



Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'School Basic Survey'
See: Table 3-2-12

As seen above, knowledge labor is a continuous process of undergoing education to acquire new knowledge, even after completion of school education, and of promoting and publicizing one's knowledge by obtaining accredited qualifications, etc.

3.2.3 Human resources in science and technology

This section has presented an overview of the changes that are taking place in human resources in general, amid the transition to a knowledge-based society. The trends examined here are viewed to be applicable to S&T activities as well. This is because S&T activities are of themselves knowledge labor that creates new intellect by utilizing advanced knowledge.

For instance, continuing adult education and internationally accredited qualifications are reaching into the area of S&T. Typical examples are the registered engineer system that offers continuing education under Article 55 of the Registered Engineer Law and the Japan engineer education certification system under the Japan Accreditation Board for Engineering Education (JABEE), which has been developed for international accreditation in engineer training in the future.

It must be noted here that 'human resources in S&T' do not exclusively point to researchers and engineers. As mentioned earlier, the distinctive characteristic of knowledge in a knowledge-based society is the specialization and segmentation of knowledge on a highly advanced level. This applies in the area of research and development. The scope of activity conducted by researchers and engineers is likely to become more specific, opening up possibility of new job functions to fill the gap.

Examples of such new job functions are assessors, program directors, science, technology and society (STS) researchers, and science & technology non-profit organizations (NPOs). Other human resources in the area include people engaged in patent and S&T journalism and in the public understanding of science (PUS), as well as technocrats (bureaucrats who possess specialized knowledge in the area of S&T).

Notwithstanding the above, the framework for defining 'human resources in science and technology' had not been established clearly in Japan until now. In fact, statistical data and indicators regarding human resources in this area remain underdeveloped.

Looking globally, the "Canberra Manual" developed by OECD (Organization for Economic Cooperation and Development) for tabulating human resources statistical data had been reviewed in 2002, with the presentation of a new definition for 'Human Resources in Science and Technology.' According to this definition, a person belonging to this category is 'a worker who has completed an advanced level of education in science and technology or who is engaged in work related to science and technology.' In particular, 'the worker who has completed an advanced level of education in science and technology and at the same time is engaged in work related to science and technology' is regarded the core of human resources in this area.

If this definition is applied, the core of human resources in science and technology is not necessarily restricted to researchers and engineers. The new OECD definition reflects the developments today in which personnel with advanced knowledge who are capable of communicating, verifying and managing S&T knowledge are regarded equally important as those who create knowledge.

However, the importance of researchers and engineers for production of new S&T knowledge remains solid. With growth of manpower in these new job functions, researchers and engineers will in fact be required to focus all the more in production of knowledge.

References

1. Drucker, Peter F., "Post-Capitalist Society: Changes in Organization and Man in the 21st Century" (transl. Atsuo Ueda, Masami Tashiro & Michio Sasaki), Diamond, Inc., 1993
2. Bell, Daniel, "Coming of Post-Industrial Society" (transl. Tadao Uchida), Diamond, Inc., 1975
3. Shoudokawa, Yuko, "Advancing Manpower Service Industry: New Role in the Age of Greater Job Turnover," NLI Research Institute Report, Sept. 2001 issue

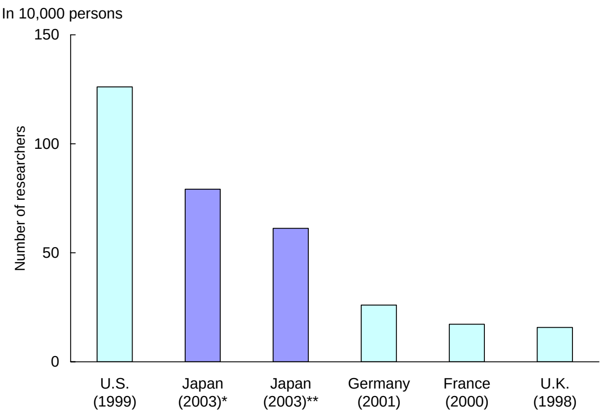
Chapter 4
The Researcher in a knowledge-based society

The researcher plays a major role in the production of knowledge in S&T. Because the production and application of knowledge carries greater weight in a knowledge-based society, the role of the researcher is expected to become all the more important. This chapter reriews the conditions surrounding the researcher in a knowledge-based society and the issues that must be addressed.

4.1 Change in the number of researchers

Presently, there are 791,000 researchers in Japan (as of 2003), ranking second in number after the United States with 1,261,000 in 1999 (Figure 4-1-1). However, it must be noted that there are differences in statistical method regarding the number of researchers, and various conditions must be taken into consideration in the comparison.

Figure 4-1-1: The number of researchers in selected countries



Notes: 1. 2003* data on Japan is based on head count (HC); 2003** data on Japan is based on full-time equivalent (FTE).
2. See Table 6-1-4, Chapter 6, for details on other countries'data.
Sources:
Japan: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research &Development 2003'
Science and Technology Policy Bureau, Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Survey on Full-Time Equivalent Data for Universities' (Nov. 2003)
US: National Science Foundation, "National Patterns of R&D Resources 2002 Data Update"
Germany, France & UK: OECD, "Main Science and Technology Indicators 2003/1"
See: Table 4-1-1

The ratio of researchers, who make up the principal driving force in knowledge production, is an important indicator of a society's human resources infrastructure in knowledge production.

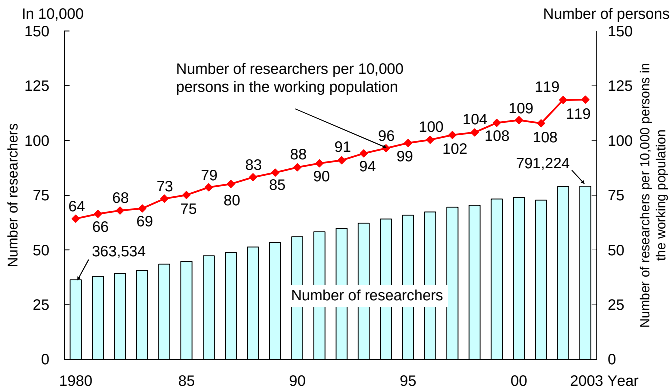
This chapter begins with the ratio of researchers to the working population (total of employed and unemployed persons) and the transition in the ratio in the past.

4.1.1 The transition in the number of researchers to the working population

The number of researchers per every 10,000 persons in Japan's working population stands at 119 (as of 2003). During the past two decades the number has nearly doubled from 64 in 1980 (Figure 4-1-2).

This indicates that the role of researchers has become more important in knowledge production, with the transition into knowledge-based society.

Figure 4-1-2: Trends in the number of researchers per 10,000 persons in the working population



Notes: 1. The working population is the total of the number of employed and unemployed persons.
2. Number of researchers based on head count.
3. Researcher in the 'Report on the Survey of Research & Development' of the Ministry of Public Management, Home Affairs, Posts and Telecommunications used as data source, is defined by the following qualifications.
<Before 2001>
(i) A person who has completed a course of study at college or university (excluding junior college) or person who possesses equivalent specialized knowledge.
(ii) A person with research experience of more than two years.
(iii) A person engaged in research on a specific theme.
<From 2002> (ii) deleted from the above criteria.
Additionally, researchers were classified separately into full researcher (person engaged chiefly in research inside the organization) and part-time researcher (person who has principal workplace outside the organization) until 2001. Starting in 2002, researchers are counted in number only and not classified into these categories. The category of research in this data consists of full researchers until 2001 and all researchers starting in 2002.
4. Includes natural science, social science and humanities.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research & Development'
Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Labor Force Survey'
See: Table 4-1-2

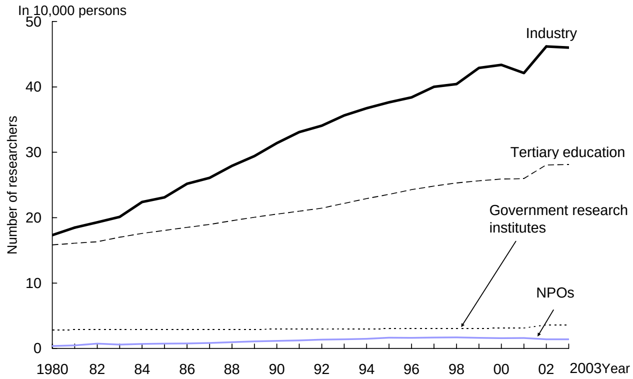
In which sectors did researchers begin to increase? The number of researchers stood at 363,534 in 1980 and rose by 427,690 to 791,224 in 2003. The largest margin of increase is found in the industrial sector (Figure 4-1-3 (A)). For this reason, the breakdown of researchers by sector underwent a drastic shift to the industrial sector. In 1980, 47.7% of researchers worked in the industrial sector, 43.6% at tertiary education institutions, 7.7% at government research institutes and 1.0% at NPOs. In 2003, 58.1% worked in the industrial sector, 35.6% at tertiary education institutions, 4.5% at government research institutes and 1.7% at NPOs in 2003.

Next, the breakdown of researchers in the industrial sector that accounted for the largest margin of growth will be examined (Figure 4-1-3 (B)). In this sector, the manufacturing industry is the most prominent in the number of researchers. In 2003, 404,961 of the 460,053 researchers (or 88% of the researchers) in the entire industrial sector belonged in manufacturing industries. The number of researchers in this sector grew by 286,809 from 173,244 in 1980 to 460,053 in 2003. 84.1% of this margin of the increase (241,094) came from manufacturing industries. This figure accounts for 56.4% of the total number of increase (427,690).

A look into the manufacturing industries by type of industry shows that the telecommunications, electronic and electrical measuring instruments industry, automobile industry, and machinery industry are responsible for the majority of the increase in the number of researchers (Figure 4-1-3 (C)). In the telecommunications, the electronic and electrical measuring instruments industry accounted for the largest growth, with numbers nearly quadrupling from 30,997 in 1980 to 133,762 in 2003, an increase of 102,765. This industry accounts for 42.6% of increase in the entire manufacturing category. This industry is the principal segment that supplies the information-related equipment and systems that build a knowledge-based society, and the number of researchers in this industrial segment may have grown concurrently with advances in a knowledge-based society.

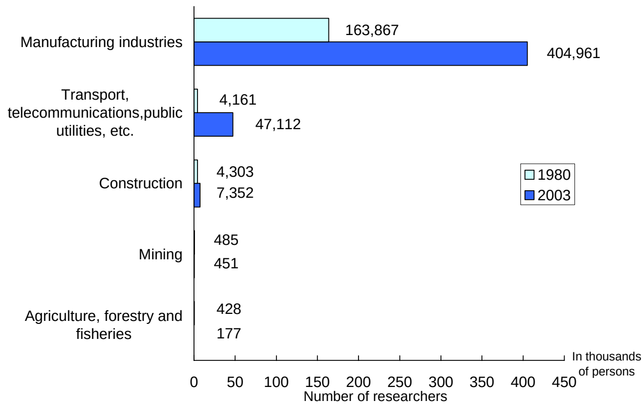
Figure 4-1-3: Trends in the number of researchers (1980-2003)

(A) Trends in the number of researchers by sector



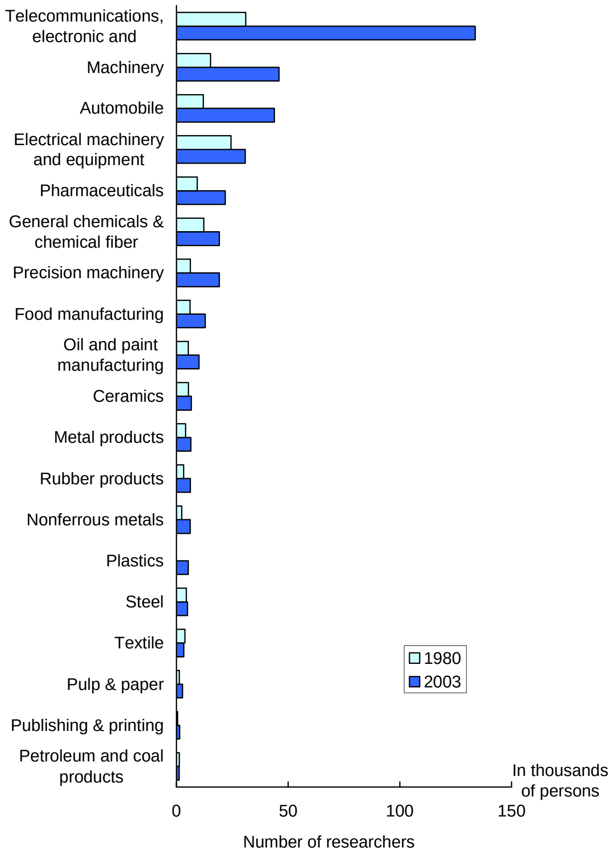
Notes:1. The total number of researchers based on head count.
2. 'Industry' had been 'companies, etc.' in the Report on the Survey of Research & Development until 2001. From 2002 and later, data on 'business enterprises, etc.' has been used.
3. 'Nonprofit organizations (NPOs)' had been classified as 'private research institutions' until 2001.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research & Development'
Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Labor Force Survey'
See: Table 4-1-3(A)

(B) Change in the number of researchers by industrial sector



Note: The category of transport, telecommunications, public utilities, etc., includes the software industry. However, data had not been tabulated for the software industry in 1980.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research & Development'
See: Table 4-1-3 (B)

(C) Change in the number of researchers among manufacturing industries



Notes: 1. Data for the plastic products industry not tabulated in 1980.
2. 'Telecommunications, electronic and electric measuring instruments industries' in 2003 refers to the total of 'electronic applications and electrical measuring instruments industry,' 'information & communication machinery and equipment industries' and 'electronic component and device industries.'
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research & Development'
See: Table 4-1-3 (C)

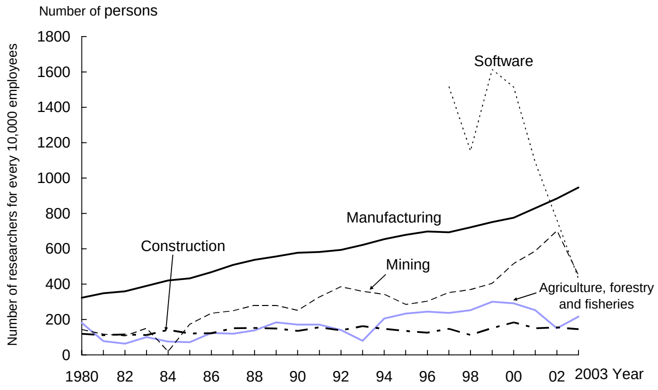
4.1.2 Growth in the ratio of researchers to employees

(1) Growth in the ratio of researchers to employees in each industry

In an industry, the ratio of researchers to the work force can be regarded an indicator of the scale of the importance of knowledge production in that industry. This ratio is expected to grow with transition into a knowledge-based society where knowledge production carries greater weight.

As of 2003, the number of researchers for every 10,000 employees is highest in the manufacturing industries with 946. This is followed by 450 in mining, 430 in software (including information processing), 216 in agriculture, forestry and fisheries and 145 in construction (Figure 4-1-4). Changes between 1980 and 2003 show that the number of researchers to every 10,000 employees is on the rise in manufacturing and mining, while the number has not grown significantly in agriculture, forestry and fisheries or in construction. (Tabulation of statistical data for the software industry began only in 1997; For this reason, data for 1980 is not available.)

Figure 4-1-4: Trends in the number of researchers for every 10,000 employees in principal industrial sectors (1980-2003)



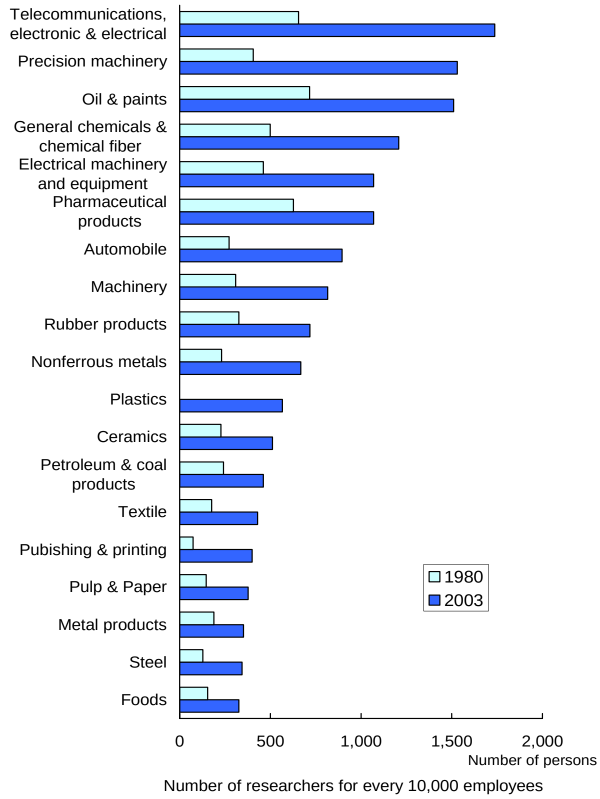
Notes: 1. Data for the software industry gathered as statistical information from 1997.
2. Software industry has been renamed software & information processing industry since in 2002.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research & Development'
See: Table 4-1-4

(2) Changes in the ratio of researchers to employees by type of manufacturing industry

Changes in the ratio of researchers to employees are examined here by type of manufacturing industry (Figure 4-1-5). The number of researchers for every 10,000 employees varies widely by industry type. The figures show that the number is highest in the telecommunications, electronic and electrical measuring instruments industry in 2003, with 1737 researchers. This is followed by 1531 in the precision machinery industry and 1511 in the oil and paint manufacturing industry. On the other hand, the number is smallest in the food manufacturing industry with 327, steel industry with 344 and metal products industry with 352. Transition in the ratio of researchers to employees from 1980 to 2003 shows that the widest margin of change took place in the publishing & printing industry with the ratio multiplying by 5.4. Change was smallest in the pharmaceutical industry (1.7 fold increase) and in the petroleum and coal products industry and metal products industry (1.9-fold increase).

As the data attests, the rate of growth in ratio of researchers to employees during the span of roughly two decades differ widely by industry. However, growth is seen in all manufacturing industries, suggesting the rising importance of knowledge production.

Figure 4-1-5: Changes in the number of researchers for every 10,000 employees in leading manufacturing industries (1980-2003)



Notes: 1. Data for plastics industry is not available as of 1980.
2. Data for 'telecommunications, electronic and electrical measuring instruments industry' for 2003 refers to the total of 'applied electronics & electrical measuring instruments industry,' 'information communications machinery and equipment industry' and 'electronic component & device industry' described in the Report on the Survey of Research & Development.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research & Development'
See: Table 4-1-5

4.2 Effective utilization of researchers in improving knowledge production and progress in research development

With the development of a knowledge-based society, greater productivity in knowledge becomes increasingly important. In order to achieve this goal, better talent must be recruited, without regard to gender, nationality or any other personal attributes. Moreover, diversity in the researcher pool and improvement in the personal capabilities of each researcher now carries greater weight. Conditions surrounding effective utilization of researchers and researcher education, issues in this area, will be examined.

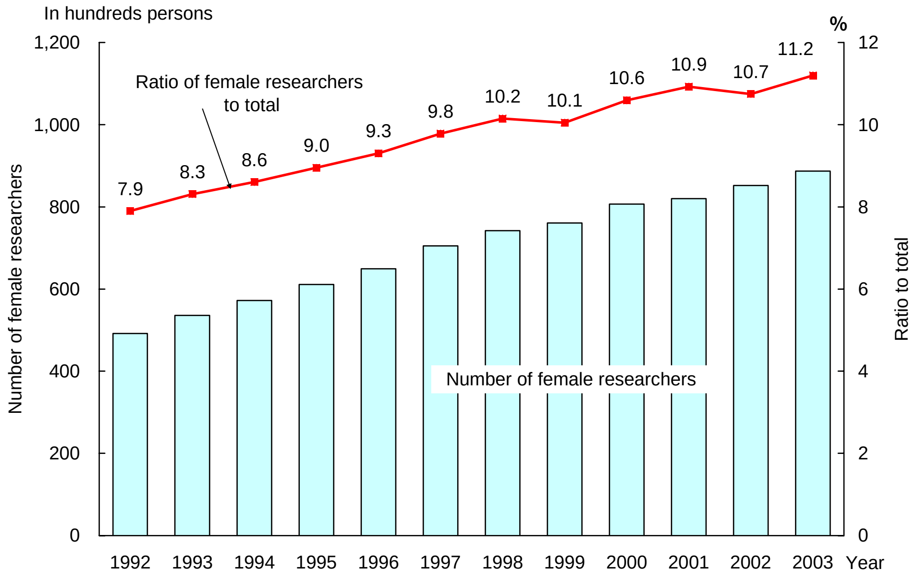
4.2.1 Recruitment of female researchers

(1) Changes in the number of female researchers in Japan and their ratio to the total number of researchers

In a knowledge-based society, female researchers must be regarded an important source of researcher talent. With greater diversity in the talent pool, female researchers are expected to make contributions to greater knowledge of productivity.

In Japan, the number of female researchers as of March 2003 stands at 88,674, or 11.2% of the total number of researchers (Figure 4-2-1). Earlier changes show that the number and the percentage had been on the rise, suggesting that the role of female researchers is growing with advances towards a knowledge-based society.

Figure 4-2-1: Trends in the number and ratio of female researchers

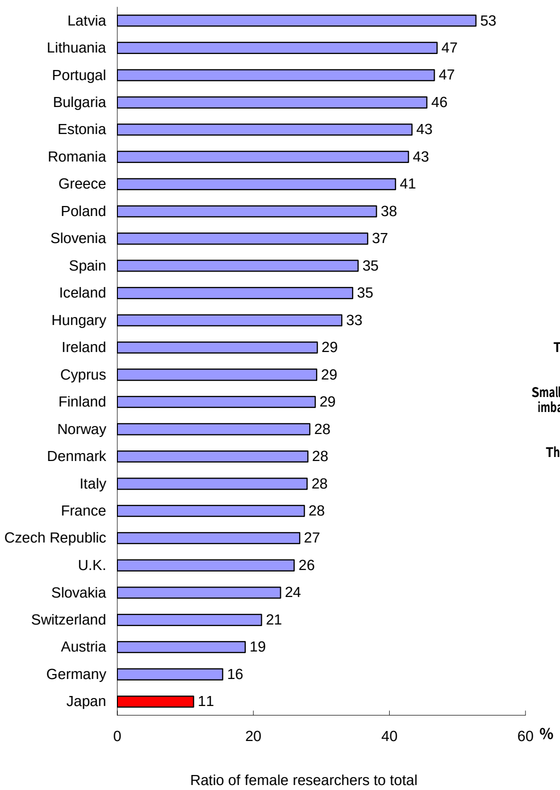


Note: The ratio of women reported in the Report on the Survey of Research & Development of the Ministry of Public Management, Home Affairs, Posts and Telecommunications has been used here. The number of researchers up to 2001 is based on the number of full-time researchers at business enterprises, nonprofit organizations and public institutes and researchers, including part-time researchers, at tertiary education institutions. The breakdown of researchers by gender in 2002 and thereafter is based on head count.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research & Development 2002 & 2003'
See: Table 4-2-1

(2) International comparison of ratio of female researchers

The ratio of female researchers in Japan will be compared with those of major European countries. The figure in Japan is roughly 11% - even smaller than 16% in Germany (Figure 4-2-2). Japan lags behind European countries in the advancement of women in the field of research and has not been able to utilize the potential of women effectively. Seen from a different perspective, the figure suggests that the chances are high that the number of female researchers will grow in Japan.

Figure 4-2-2: International comparison in the ratio of female researchers

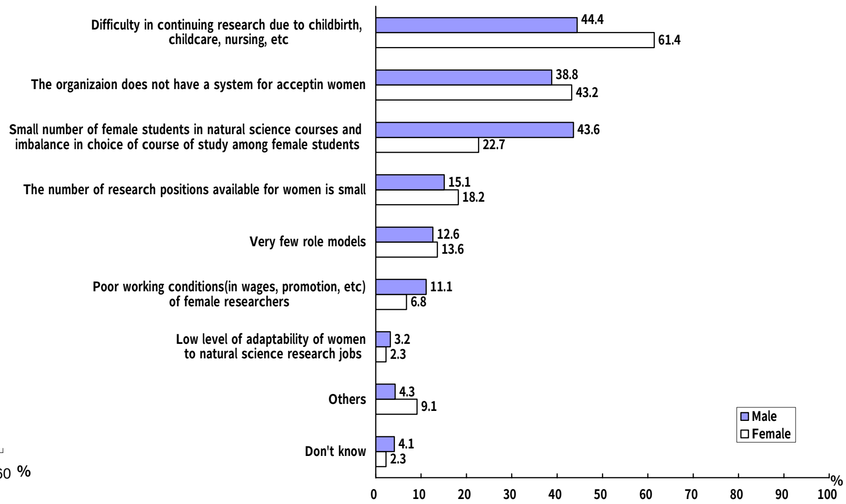


Notes: 1. 2003 data used for Japan; 2002 data used for Iceland; 2000 data used for Denmark, France, Ireland, Italy, Poland, Switzerland and United Kingdom; 1999 data used for Greece and Portugal; 1998 data used for Austria; and 2001 data for other countries.
2. Percentage figures rounded off to the nearest whole number.
Sources:
Data for Japan - Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research & Development 2003'
Data for UK - European Commission, "Key Figures 2002"
Data for other European countries - European Commission, "Key Figures 2003-4,"

(3) The reason for the small number of female researchers

In the 'FY2002 Survey of Research and Development of Japan' of the Ministry of Education, Culture, Sports, Science and Technology (based on random sampling of 2000 currently active researchers with valid responses from 1355), the leading reason for the small number of female researchers was 'childbirth, childcare and nursing of the elderly' (Figure 4-2-3). This is a problem that cannot be resolved by the individual or the organization alone but must be addressed by the entire society. Another reason is 'the small number of female students in natural science courses,' which is related to women's choices of specialization. Other major reasons include 'absence of a system for accepting women,' referring to problems in organizational management. Therefore, reasons for the small number of female researchers are complicated. In addition, the problem has been more complicated by differences in opinion between men and women.

Figure 4-2-3: The reason for the small number of female researchers



Notes: 1. Responses by gender (multiple choice of up to two choices).
2. Survey targets are 2000 currently active researchers in the industrial, academic and government sectors who have been listed as either first or second author in an S&T paper registered as JSTPlus files* in 2001, selected by random sampling at the ratio of 50% from private enterprises, 30% from tertiary education institutions, 15% from public research institutes and 5% from other organizations. Valid responses came from 1355. JSTPlus files* are database files of research papers in the area of science and technology (including medicine) included in JST Online Information Systems (JOIS) of the Japan Science and Technology Agency (JST). The survey was conducted from December 2002 to February 2003.
Source: Ministry of Education, Culture, Sports, Science and Technology, 'FY2002 Survey of Research and Development of Japan,'
See: Table 4-2-3

4.2.2 The utilization of foreign researchers

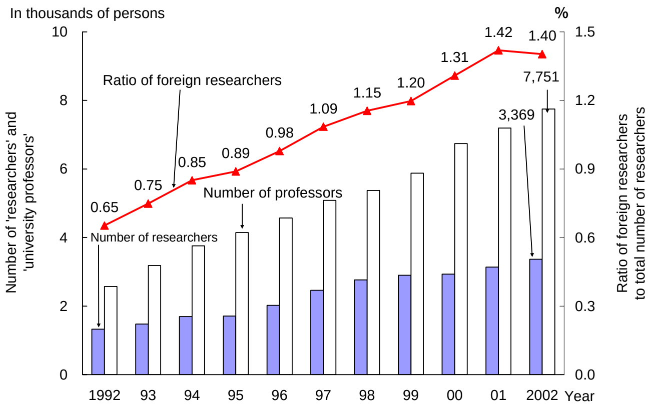
Economic globalization has brought about not only movement of goods, services, capital and information but also of people. In recent years, the flow of manpower with advanced technological expertise has increased particularly in the area of IT. The world is now entering a new age of global competition in human resources. Under these conditions, corporate demand for highly talented researchers is growing regardless of nationality in the drive to upgrade knowledge productivity.

In addition, '2000 Survey on R&D Globalization in National Research Institutes, Special R&D Organizations and Japanese Companies' from National Institute of Science and Technology Policy reports that participation of foreign researchers has led to contributions in research findings. The dissimilar approach in culture and thinking, as well as differences in experience and other factors, has spurred intellectual stimulation in research groups and led to better knowledge productivity. The role of foreign researchers is likely to expand with advances towards a knowledge-based society.

(1) Rise in the number of foreign researchers in Japan and their ratio to the total number of researchers

As of 2002, the number of foreign researchers in Japan stands at 10,337 (Figure 4-2-4). The number of foreign researchers here is the sum total of registered foreign nationals, classified by visa status in the Ministry of Justice's Statistics for Foreign Residents in Japan, who possess qualifications as professors (research, research guidance or education at a university or equivalent institution or a specialized institution of advanced learning) or as researchers (involvement in research based on contract with public or private institutions).

Figure 4-2-4: Rise in the number of foreign researchers and ratio to total number of researchers



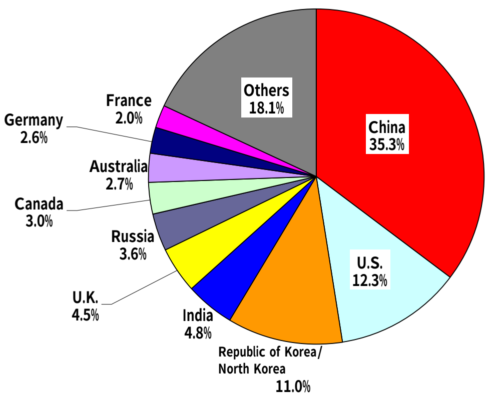
Note: The number of foreign researchers is the total of foreign nationals who possess qualifications as professors (research, research guidance or education at a university or equivalent institution or a specialized institution of advanced learning) or as researchers (involvement in research based on contract with public or private institutions).
Sources: Ministry of Justice, 'Statistics for Foreign Residents in Japan'; Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research & Development'
See: Table 4-2-4

Looking at changes over time, the ratio of foreign nationals to the total number of researchers in Japan is growing, increasing from 0.7% in 1992 to 1.4% in 2002. In the breakdown of foreign researchers for the year 2002, researchers with 'professor' qualifications number 7751, more than doubled the number of researchers with 'researcher' qualifications (3369). Between 1992 and 2002, 'professors' tripled, while 'researchers' multiplied 2.5 times.

These figures demonstrate the expanding role of foreign researchers with advancement of a knowledge-based society.

In the breakdown by nationality, 35.3% of foreign researchers in Japan as of end of 2002 came from China, 12.3% from the United States, 11.0% from the Republic of Korea and the Democratic People's Republic of Korea, 4.8% from India, and 4.5% from the United Kingdom (Figure 4-2-5).

Figure 4-2-5: The breakdown of foreign researchers in Japan by nationality (as of end of 2002)



Note: The number of foreign researchers is the total of foreign nationals who possess qualifications as university professors (research, research guidance or education at a university or equivalent institution or a specialized institution of advanced learning) or as researchers (involvement in research based on contract with public or private institutions).
Sources: Ministry of Justice, 'Statistics for Foreign Residents in Japan 2003,'
See: Table 4-2-5

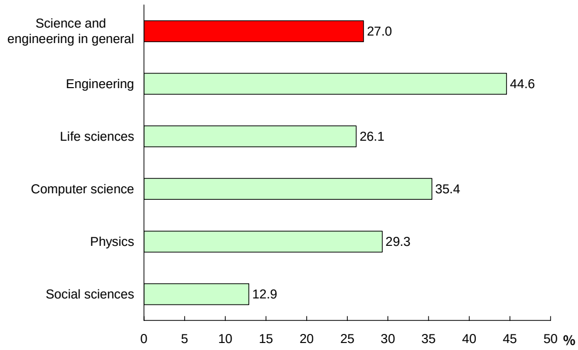
The relatively high number of foreign nationals with 'professor' qualifications suggests that acceptance of foreign researchers is comparatively active at tertiary education institutions.

(2) The state of foreign researchers in the United States

Of doctorate degree holders in the United States, 192,000 (27% of the total) are foreign-born (Figure 4-2-6 (A)). In classification by academic discipline, the largest number (44.6%) hold degrees in engineering, followed by computer science (45.4%), physics (29.3%) and life sciences (26.1%). In terms of distribution by place of birth, China, India, United Kingdom and Taiwan were ranked at the top with 20, 16, 7 and 6 percent, respectively. Japanese-born doctorate degree holders account for 1% of the total. (Figure 4-2-6 (B)).

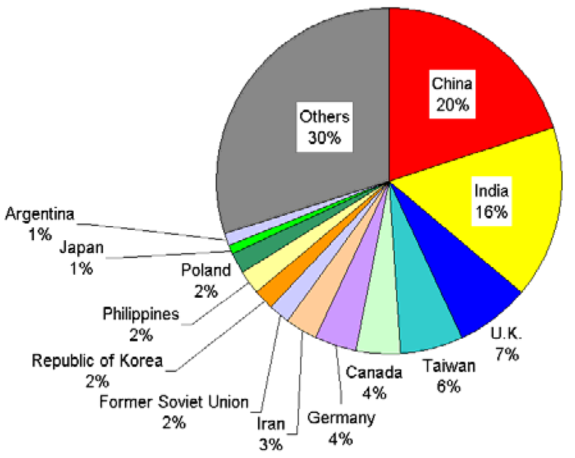
Figure 4-2-6: Foreign-born doctorate degree holders in the US in the area of science and engineering (1999)

(A) Ratio of foreign nationals by academic discipline



Note: 'Physics' includes the areas of chemistry, geoscience, physics and astronomy and others.
Source: National Science Foundation, "Science and Engineering Indicators 2002"
See: Table 4-2-6 (A)

(B) Distribution by place of birth

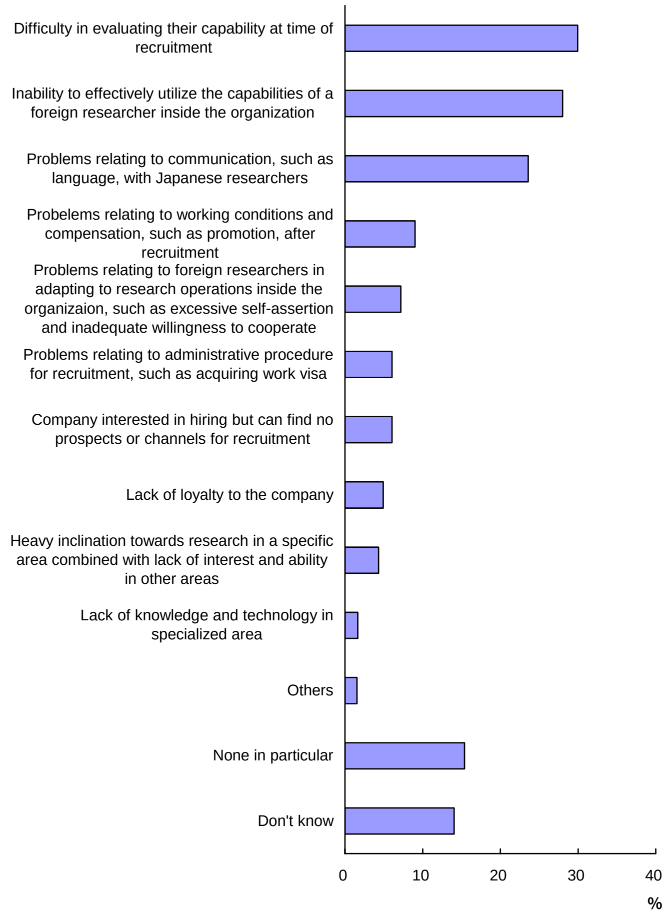


Source: National Science Foundation, "Science and Engineering Indicators 2002"
See: Table 4-2-6 (B)

(3) Problems pertaining to foreign researchers

Although the number of foreign researchers are on the rise in Japan, they account for only 1% of the total number of researchers (Figure 4-2-4). In an inquiry of private enterprises pertaining to problems relating to the recruitment of foreign researchers (Figure 4-2-7), the major sources of problems were found to be 'difficulty in evaluating their capability at time of employment,' 'inability to utilize the capabilities of a foreign researcher effectively inside the organization,' 'problems in communication, such as language, with Japanese researchers,' etc. These reasons suggest that Japanese enterprises face problems in the initial phase of recruiting foreign researchers, such as evaluation of foreign researcher performance and communication problems.

Figure 4-2-7: Problems pertaining to foreign researchers (FY2002)

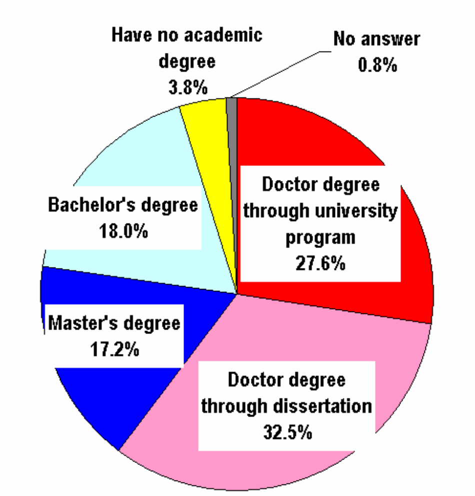


Note: Multiple choice of up to two choices
Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Survey on Research and Development Activities of Private Businesses FY2002'
See: Table 4-2-7

4.2.3 Utilization of graduate school education

Respondents in the 'FY2002 Survey of Research and Development of Japan' conducted by the Ministry of Education, Culture, Sports, Science and Technology, mentioned in Figure 4-2-3 are active researchers chiefly in cutting-edge technologies (in life-sciences, information and communication, environmental science, new materials and nanotechnology and energy). The distribution of highest academic attainment among the respondents was as follows: doctorate degree holders accounted for 60.1%, and graduate degree holders for 17.2%. In all, 77.3% have been educated to the postgraduate level (Figure 4-2-8). It is clear that postgraduate education is extremely important for researchers in the area of advanced sciences and technology.

Figure 4-2-8: Highest academic attainment for researchers in advanced sciences and technology (FY2002)



Note: A breakdown by area of research of the 1355 researchers who responded to the survey shows that 21.2% are in life sciences, 17.2% in new materials and nanotechnology, 13.2% in information and communication, 12.6% in social infrastructure 8.6% in environmental science, 7.3% in energy, 6.1% in manufacturing technology, and 13.8% in other areas. In breakdown by organizational affiliation, 43.1% are in private enterprises, 36.5% in universities and 15.6% in public research institutes. In the breakdown by academic department during university, 55.3% were in engineering, 10.6% in physical sciences, 9.2% in agriculture and 6.0% in health science.
Source: Ministry of Education, Culture, Sports, Science and Technology, 'FY2002 Survey of Research and Development of Japan'
See: Table 4-2-8

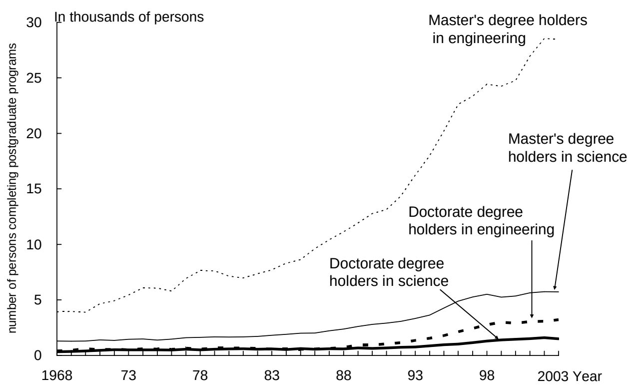
(1) Changes in the number of graduates from S&T postgraduate programs

The number of graduates as of 2003 stands at 28,498 for holders of a master's degree in engineering, 3212 for holders of doctorate degrees in engineering, 5722 for holders of master's degree in sciences and 1500 for holders of doctorate degrees in sciences. The change in the number of graduates from science and engineering graduate programs are examined (Figure 4-2-9).

The rate of growth from 1968 to 2003 shows that the number of doctorate degree holders in the area of engineering increased by 7.9 times, master's degree holders in engineering increased 7.3 times, master's degree holders in sciences increased 4.4 times and doctorate degree holders in sciences increased 4.7 times.

It is clear that the demand for graduate education is growing with the transition to a knowledge-based society.

Figure 4-2-9: Trends in the number of graduates from S&T graduate programs



Source: Ministry of Education, Culture, Sports, Science and Technology, 'School Basic Survey'
See: Table 4-2-9

(2) Rise in working adults in postgraduate programs

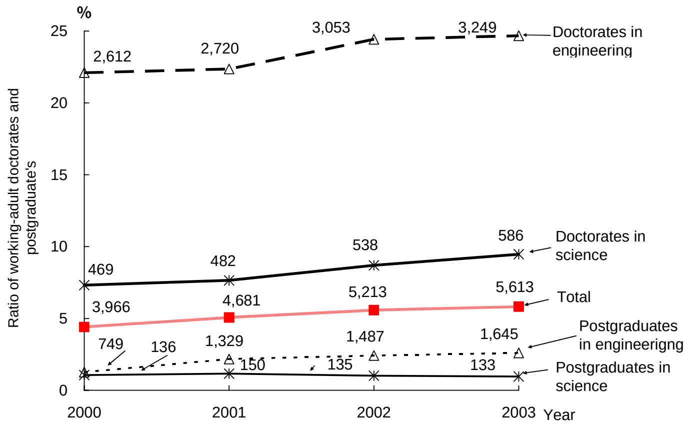
Of the respondents (chiefly researchers in the area of advanced science and technology) in the aforementioned 'FY2002 Survey of Research and Development of Japan', 60.1% held doctorate degrees. Of these, 20.6% gained doctoral degree through school programs, and 32.5% gained doctoral degree through dissertation (Figure 4-2-8). Doctorate degrees based on dissertation are commonly acquired by working adults. In other words, more than half of doctorate degree holders in the figure acquired the academic degree after starting a career.

As the speed of knowledge production and the sophistication/segmentation of the knowledge-based society continue to increase, the demand for graduate education is expected to grow in order to supply new knowledge to working adults, including researchers.

In 2003, working adults accounted for 5.8% (5613) of all students in S&T graduate programs. In the year 2000 when statistical data gathering began, the number stood at 3966, or 4.4%. The ratio of working-adult students in S&T graduate programs, as well as the absolute number of such students, has been rising over the past several years (Figure 4-2-10).

Next, the ratio of working-adult students by academic level will be examined further. In 2003, working adult students in doctorate courses in engineering, numbered 3249, or 24.7% of all students in engineering doctorate courses. This percentage is significantly higher than 9.5% for doctorate in science, 2.6% for master program in engineering and 1.0% for master programs in science.

Figure 4-2-10: Number of working-adult students in S&T graduate programs and trends in the ratio of such students



Source: Ministry of Education, Culture, Sports, Science and Technology, 'School Basic Survey'
See: Table 4-2-10

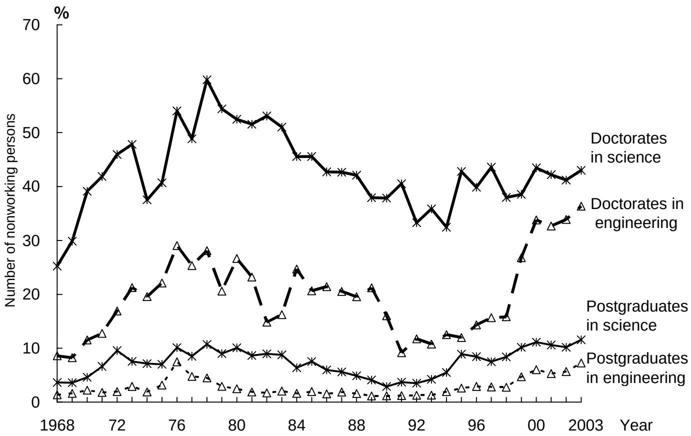
(3) Issues in students completing doctorate courses

This section considers the changes in the ratio of nonworking persons among those who completed graduate and doctorate courses in science and engineering (Figure 4-2-11). The number of nonworking persons among those who completed doctorate courses is constantly higher than that for those who have completed graduate programs. This characteristic is found in both in science and engineering.

Common sense leads us to believe that persons who have undergone highly advanced and intellectual training and completed doctorate courses should be utilized more effectively in a knowledge-based society. However, reality tells otherwise.

One of the reasons for this is believed to be inadequacies in adjustment between supply and demand. For instance, the ratio of nonworking persons with engineering doctorate degrees is high every year (at one time reaching 60%) (Figure 4-2-11). However, there has been a constant supply of those who have completed doctorate courses, and the number has been on the rise (Figure 4-2-9). Adjustment between supply and demand has not been sufficient.

Figure 4-2-11: Trends in ratio of nonworking persons by type of S&T degree

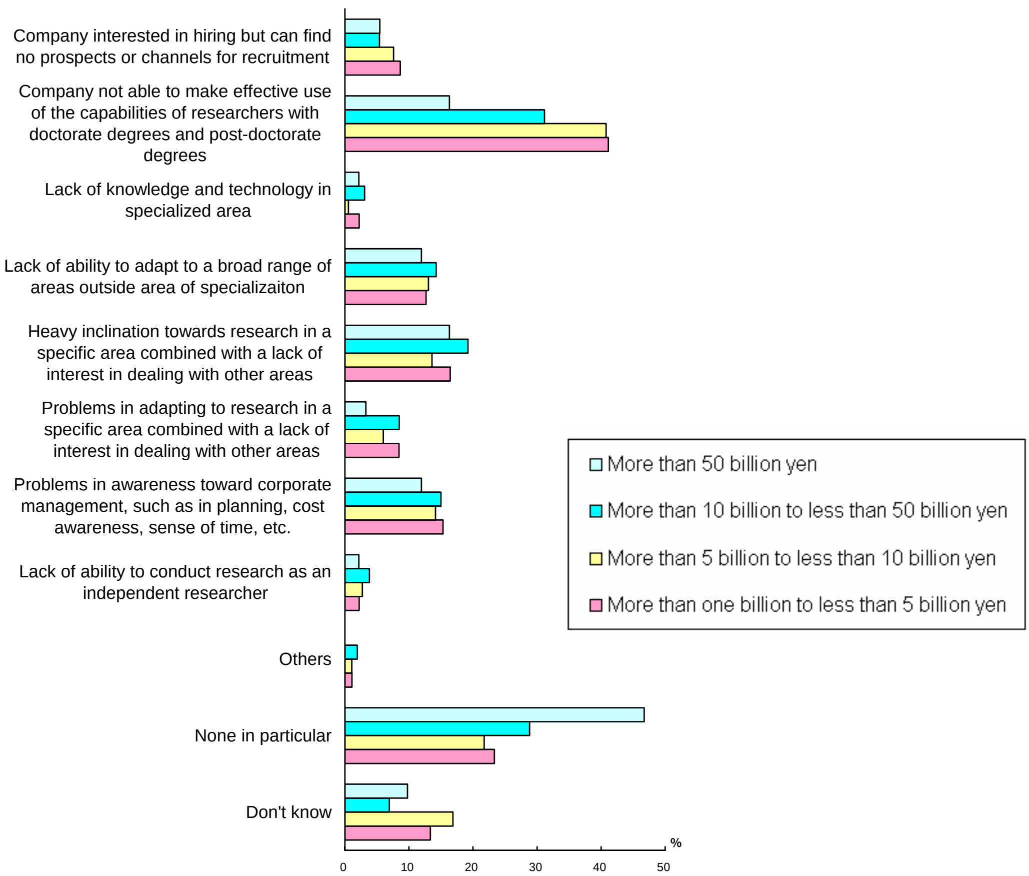


Note: A nonworking person is defined as a person who has completed either doctorate or postgraduate program and who is neither a 'person who has been admitted to an institution of higher learning', a 'person who has gained employment' nor a 'person who has died or whose whereabouts are unknown.'
Source: Ministry of Education, Culture, Sports, Science and Technology, 'School Basic Survey'
See: Table 4-2-11

The next question is how employers of persons who have completed doctorate courses are thinking. According to 'Survey on Research and Development Activities of Private Businesses FY2002' by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) (covering 2007 business enterprises from which 1061 valid responses were received), the problems relating to researchers who have completed doctorate courses (including those completing post-doctorates) differ according to the scale of the companies (Figure 4-2-12). The top problem for businesses is 'inability to make effective use of the capabilities of those with doctorate and post-doctorate degrees.' This problem is found in approximately 40% of businesses with capital of less than ¥10 billion. On the other hand, the ratio falls to 16.3% for businesses with capital of more than ¥50 billion. In addition, 46.7% of businesses of this scale report no problems with researchers who have completed doctorate courses (including post-doctorate degree holders). The problem of not being able to utilize doctorate degree holders appears in business enterprises with capital of less than ¥50 billion.

In a knowledge-based society where knowledge production and utilization become important, failure to effectively use doctorate degree holders amounts to a serious loss. Measures to correct this situation are essential.

Figure 4-2-12: Problems about researchers with doctorate degrees (including post-doctorate degrees)



Notes:1. Multiple-choice answers for up to two choices.
2. The survey covered private businesses with capital of more than ¥1 billion, believed to be conducting R&D activities. 2007 companies were selected from a list compiled by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), based on 'Survey of Research and Development of Japan' by the Ministry of Public Management, Home Affairs, Posts and Telecommunications. Valid responses were received from 1061 companies. The survey was conducted from January to March 2003.

Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Survey on Research and Development Activities of Private Businesses 2002' See: Table 4 -2-12

4.2.4 Greater diversity in academic background of university faculty members

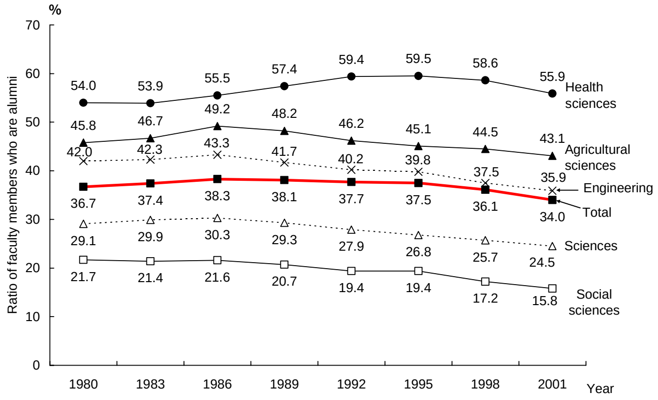
In a knowledge-based society, the role of the university is expected to become increasingly important in the area of education and research. Diversification in academic background of university faculty members is believed to be a factor in upgrading creativity in these areas. For this reason, the range of universities from which university faculty members are appointed is expected to widen as knowledge-based society expands. The ratio of faculty members who graduated from the university in which they work is believed to be a yardstick in measuring diversification in academic background.

Changes in the ratio of faculty members who are alumni of the university have dropped on average from 36.7% in 1980 to 34.0% in 2001 (Figure 4-2-13 (A)).

In the breakdown by area of specialization, decline is seen in engineering, sciences and social sciences. A slight drop is seen in agriculture. However, the ratio has risen from 54.0% (1980) to 55.9% (2001) in the area of health sciences.

Figure 4-2-13: Ratio of faculty members who are alumni of the university where they work

(A) Changes by area of specialization

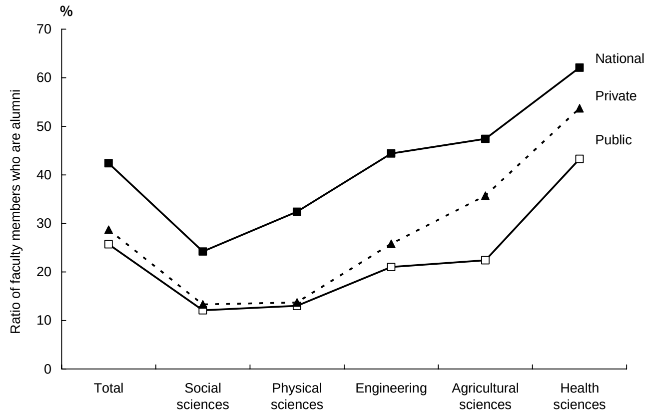


Note: Health sciences include medicine.
Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'School Teachers Survey'
See: Table 4-2-13 (A)

Classifying by type of university, the ratio of alumni becoming faculty members is high for national universities in all areas of specialization and lowest for public universities. Comparatively, there is still significantly room for improvement in national universities (Figure 4-2-13 (B)).

Figure 4-2-13: Ratio of faculty members who are alumni

(B) Breakdown by type of university (FY2001)

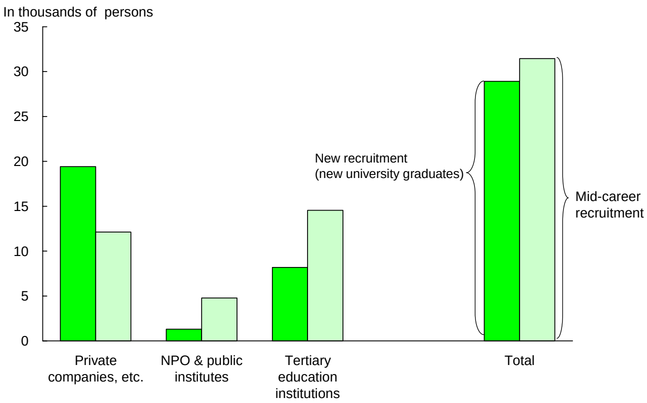


Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'School Teachers Survey FY2001'
See: Table 4-2-13 (B)

4.2.5 The state of turnover in the researcher employment market

Effective utilization of researchers and their capabilities will become increasingly important in a knowledge-based society. Turnover in the researcher employment market is also expected to impact seriously effective use of researcher capabilities. In FY2001, the Ministry of Public Management, Home Affairs, Posts and Telecommunications has made full-scale data on researcher job transfer for the first time. Only two years of data is available at this point in time, and change over time cannot be studied for this reason. Nevertheless, liquidity in the researcher employment market in FY2002 will be analyzed here.

Figure 4-2-14: Number of new and mid-career researchers recruited in FY2002

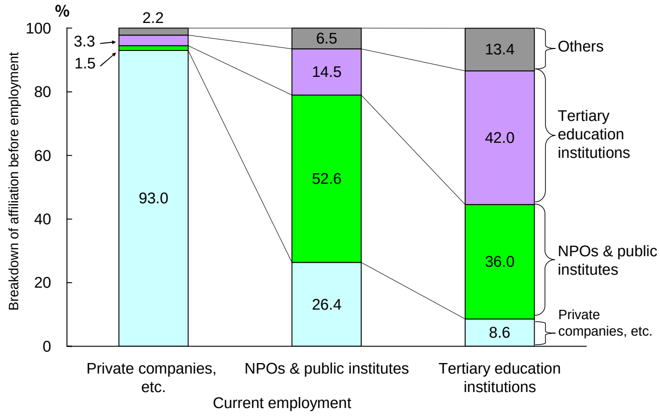


Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'FY2003 Survey of Research and Development of Japan'
See: 4-2-14

The state of researcher recruitment is examined by type of organization (Figure 4-2-14). Recruitment takes the form of hiring new university graduates and mid-career researchers. The number of researchers who had been recruited in FY2002 stood at 60,371 for the entire country. Of these, 31, 462, or 52.1% of total recruits, were mid-career recruits. In the breakdown by organization, 38.4% were employed at private companies, etc., 78.5 at NPOs and public institutes, and 64.0% at tertiary education institutions. The percentage is lowest for private companies.

Next, these newly employed researchers will be studied on where they had been before employment (Figure 4-2-15). By type of industry, it is clear that mid-career recruits come from the same type of organization, despite differences in ratio. In other words, 93.0% of researchers recruited by private companies, etc., come from other private companies, etc. Of those who have been hired by NPOs and public institutes, 52.6% came from similar organizations. 42.0% of researchers who joined tertiary education institutions, had previously worked at such institutions.

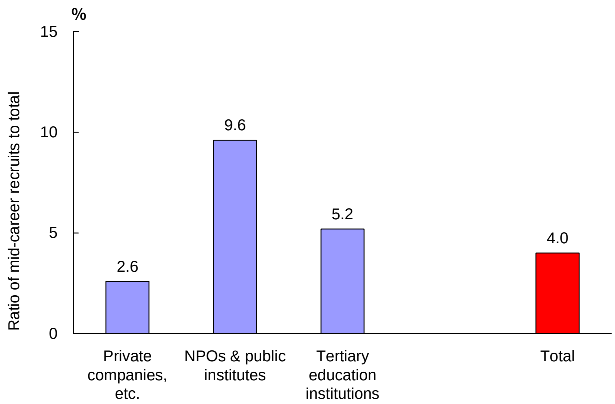
Figure 4-2-15: Distribution of researcher affiliation before employment by type of organization of current employment (FY2002)



Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'FY2003 Survey of Research and Development of Japan'
See: Table 4-2-15

The mid-career recruits are now examined in ratio to total number of researchers. In breakdown by organization, there are 2.6% in private companies, etc., 9.6% in NPOs and public institutes and 5.2% at tertiary education institutions. (Figure 4-2-16). They account for 4.0% of the total. The ratio of job transfer is low at private companies, and high at NPOs and public institutes.

Figure 4-2-16: The ratio of mid-career recruits to number of researchers by type of organization (FY2002)



Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'FY2003 Survey of Research and Development of Japan'
See: Table 4-2-16

4.3 Organizational management for knowledge creation

How has corporate management been changing with advances toward a knowledge-based society?

4.3.1 Corporate strategy on R&D

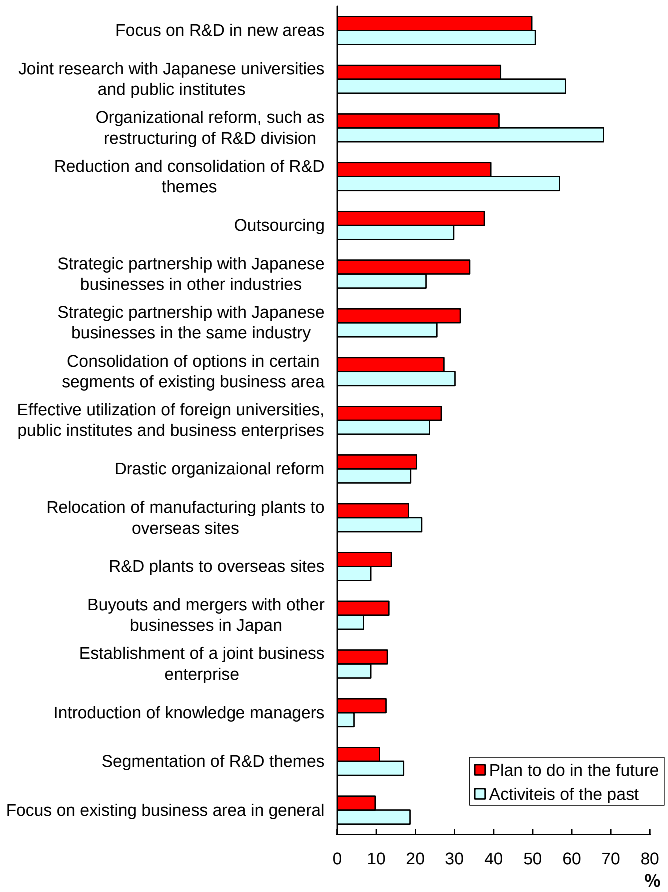
In the 'Survey on Research and Development Activities of Private Businesses FY2001' by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) (covering 1993 private companies from which 1026 valid responses were received), respondents were asked about past activities and future plans focusing on their R&D strategies. Based on the data, corporate focus in the strategy alongside advances in knowledge-based society will be examined.

Both in the past and in the future, the important themes for private companies are 'focus on R&D in new areas,' 'joint research with Japanese universities and public institutes,' 'organizational reform, such as are indeed division restructuring' and 'reduction and consolidation of R&D themes' (Figure 4-3-1).

Chiefly, in relationships with external organizations, more private companies are expected to adopt 'outsourcing,' 'strategic partnerships with Japanese businesses in other industries,' 'active utilization of foreign universities, public institutes, business partners etc.' Also, the highest rate of growth, although small in percentage of respondents, was 'introduction of knowledge managers.'

These trends show the distinctive characteristics of R&D strategy management by private companies in a knowledge-based society. In other words, accelerating the speed of technological innovation in a knowledge-based society, combined with growth in complexity and diversity of innovation, has made it impossible for business enterprises to operate independently in all areas of technological innovation. Moreover, greater emphasis on intellectual property has made the value of such assets extremely high. Under these circumstances, how a business enterprise is able to utilize external R&D organizations effectively and how many new technologies and products they can develop ahead of competitors have become important management issues.

Figure 4-3-1: Past performance and future of R&D strategy



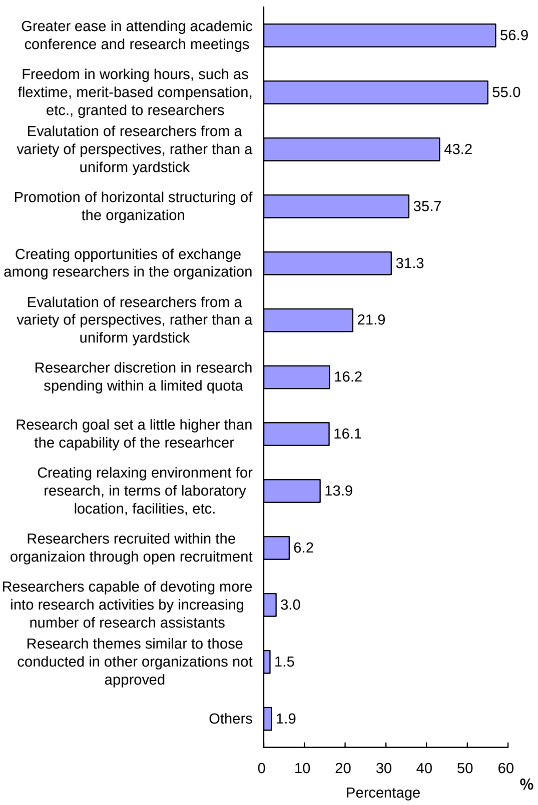
Notes: 1. Respondent choice of all appropriate items.
2. The survey covered private businesses with capital of more than ¥1 billion, believed to be conducting R&D activities. 1993 companies were selected from a list compiled by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), based on 'Survey of Research and Development of Japan' by the Ministry of Public Management, Home Affairs, Posts and Telecommunications. Valid responses were received from 1026 companies. Survey was conducted from January to March 2002.
Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Survey on Research and Development Activities of Private Businesses FY2001'
See: Table 4-3-1

4.3.2 Management of research manpower

Next, what specifically are business enterprises doing to improve the knowledge productivity of researchers? The findings on corporate ideas in promoting knowledge production by researchers conducting the 'Survey on Research and Development Activities of Private Businesses FY2002' by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) (covering 2007 business enterprises from which 1061 valid responses were received) shown in Figure 4-2-12 have been examined.

According to the survey, the highest ratings went to 'greater ease in attending academic conference and research meetings,' 'Freedom in working hours, such as flextime, merit-based compensation, etc., is granted to researchers' and 'easier access to research facilities and equipment belonging to other divisions in the company' (Figure 4-3-2). These items share in common the idea of increasing freedom and self-reliance of researchers and therefore encouraging their creativity.

Figure 4-3-2: Ideas to encourage creativity



Note: Respondent choice of all appropriate items.
Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Survey on Research and Development Activities of Private Businesses FY2002' See: Table 4-3-2

4.3.3 Education for researchers in private companies

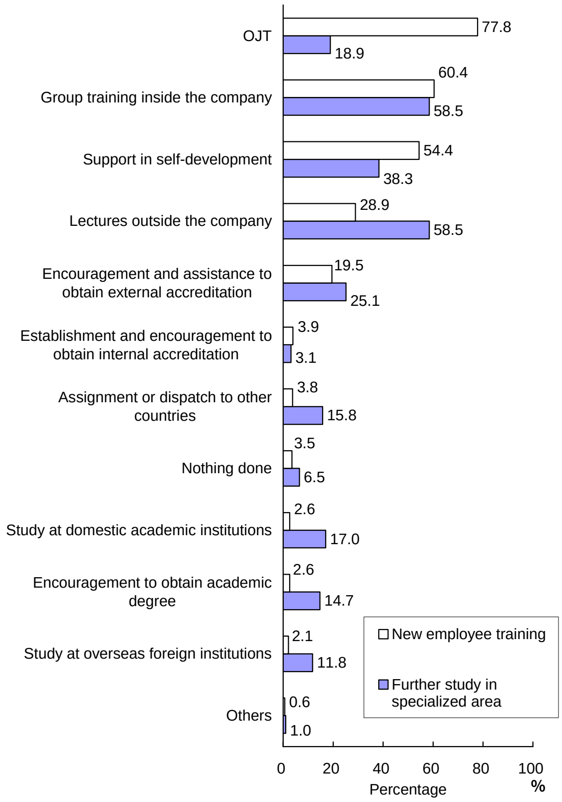
This section reviews education provided to researchers by private companies. Here, employee training is compared with programs organized for deeper understanding of specialized areas. Viewed from this perspective, it is clear that the approaches taken for these two types differ considerably. (Figure 4-3-3).

Compared to new employee training which uses internal resources, employee training organized for deeper understanding of specialized areas very often uses external organizations. The methods are lectures outside the company, assignment to other organizations, study at Japanese academic institutions, study at foreign academic institutions, support in gaining academic degrees, etc.

This shows that, in face of growing speed in knowledge production and greater sophistication and segmentation of knowledge in a knowledge-based society, training within the organization is no longer adequate. Moreover, contact with environment outside the company and different approaches in thinking are believed to stimulate creativity and result in improvement in knowledge productivity.

Figure 4-3-3: Education targeted to researchers

Note: Multiple choice of up to three items.

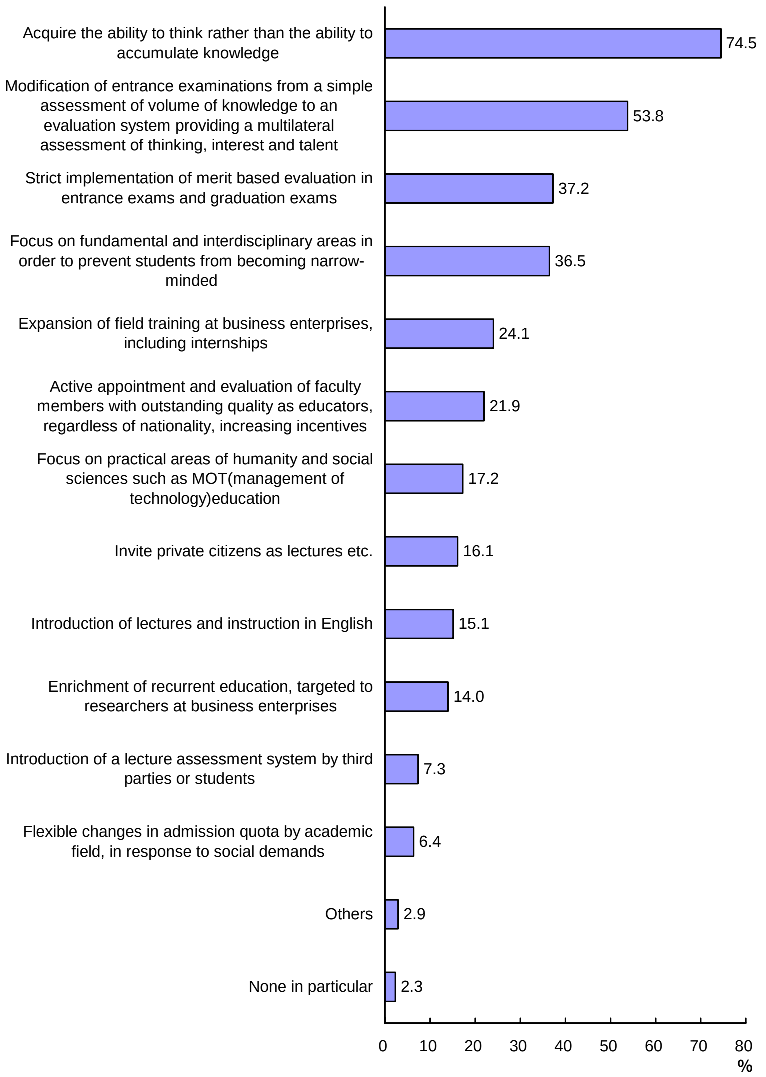


Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Survey on Research and Development Activities of Private Businesses FY2002' See: Table 4-3-3

4.3.4 Private companies' demand toward universities and graduate schools

Companies' demand toward universities and graduate schools is examined here. Their expectations toward universities and graduate schools focus on 'acquiring the ability to think, rather than the ability to accumulate knowledge.' This was the choice of 74.5% of the business enterprises, followed by 53.8% hoping for the 'modification of entrance examinations from a simple assessment of volume of knowledge to an evaluation system providing multilateral assessment of thinking, interest and talent' (Figure 4-3-4). This shows that demand is high for ability to create new knowledge.

Figure 4-3-4: Private companies' demand toward universities and graduate schools



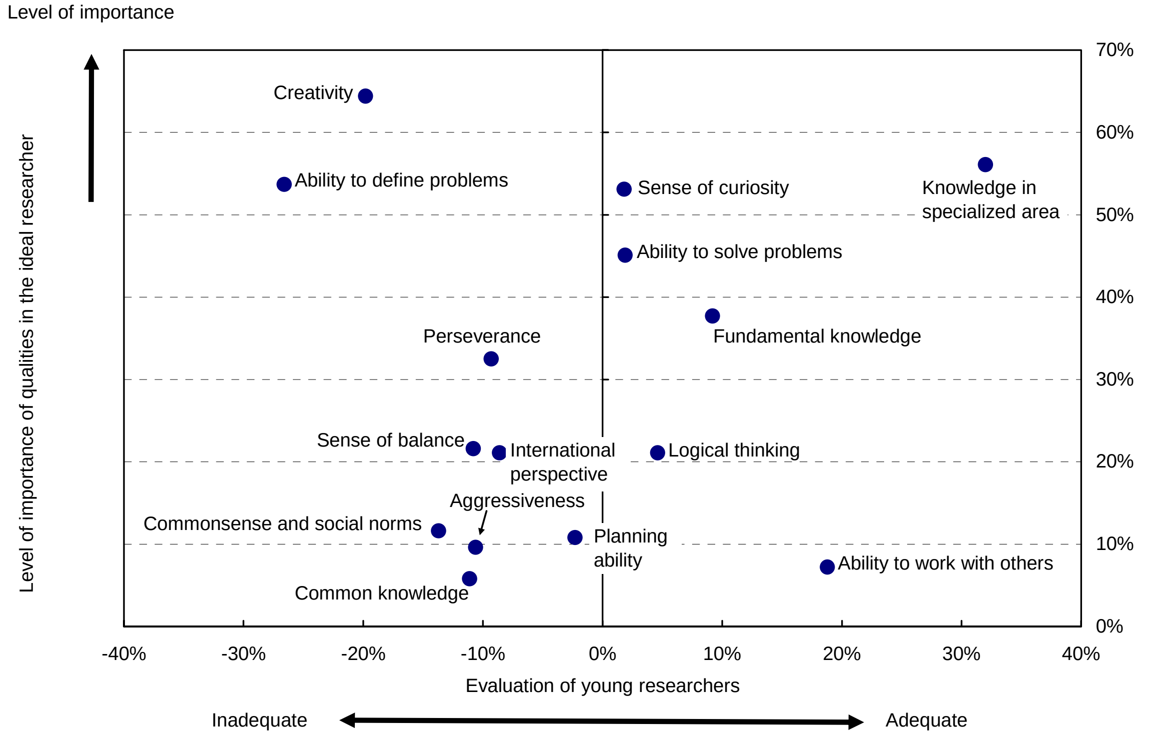
Note: Multiple choices of up to four items
Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Survey on Research and Development Activities of Private Businesses FY2002'
See: Table 4-3-4

4.4 The ideal researcher

What type of researcher is ideal in a knowledge-based society? In the aforementioned 'FY2002 Survey of Research and Development of Japan' by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), 1355 active researchers were questioned on the 'qualities and capabilities of the ideal researcher.' According to the findings, the qualities and capabilities that the ideal researcher must possess are, in declining order, creativity (64.4%), knowledge in specialized area (56.1%), the ability to define problems (53.7%), a sense of curiosity (53.1%), problem-solving ability (45.1%), fundamental knowledge (37.7%), perseverance (32.5%) and sense of balance and all-around perspective (21.6%) (Figure 4-4-1). The researcher who possesses these qualities is regarded the ideal researcher needed in a knowledge-based society.

Research has examined how young researchers are evaluated today against these criteria. In the graph, the horizontal axis represents an evaluation of young researchers for each of these qualities. This shows that they are rated highly for knowledge in specialized area, ability to work with others and fundamental knowledge. Qualities that are believed lacking are creativity and ability to define problems. These items are qualities and capabilities that many researchers have chosen as ideal. When training researchers in the future, these items must be closely addressed.

Figure 4-4-1: Importance of each quality required in the ideal researcher and evaluation of young researchers



Note: 1355 active researchers were asked to choose one of the following -- 'extremely high,' 'high,' 'average,' 'low,' 'very low,' or 'don't know' -- for each item in the evaluation of young researchers. The ratio of the total respondents who selected 'extremely high' and 'high' was deducted from the ratio of the total respondents who selected 'low' and 'very low' for each item. In addition, multiple-choice answers were given for the qualities and capabilities that the ideal researcher must possess. The level of importance was calculated by dividing the number of responses to each item by the number of respondents (1355).
Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'FY2002 Survey of Research and Development of Japan'
See: Table 4-4-1

4.5 Further development of a knowledge-based society

The current state of and issues regarding researchers in a knowledge-based society have been examined through statistical data. These figures clearly show the development of researchers and their environment as a human resources infrastructure for a knowledge-based society. At the same time, many issues were uncovered including those regarding female researchers, foreign researchers and doctorate degree holders. By resolving these problems, the human resources foundation for a knowledge-based society that is growing today will be upgraded and lead ultimately to dramatic development of this new society.

References

1. Pelz D.C. & Andrews F.M., "Scientists in Organizations: Productive Climates for Research and Development," (transl. by Ai Kaneko) Diamond Inc., 1971
2. Tanaka Shigeru, Negishi Hirokazu & Sakakibara Kiyonori, "2000 Survey on R&D Globalization in National Research Institutes, Special R&D Organizations and Japanese Companies," National Institute of Science and Technology Policy Survey 67, March 2000
3. Kobayashi Shinichi & Yoshiko Saito, "International Mobility of Highly-Skilled Personnel," National Institute of Science and Technology Policy Survey 94, March 2003
4. Strategic Council on Intellectual Property, "Intellectual Property Policy Outline," July 3, 2002
5. Committee on Human Resources, Council for Science and Technology, "Development of Research Human Resources to Upgrade International Competitiveness," June 2003

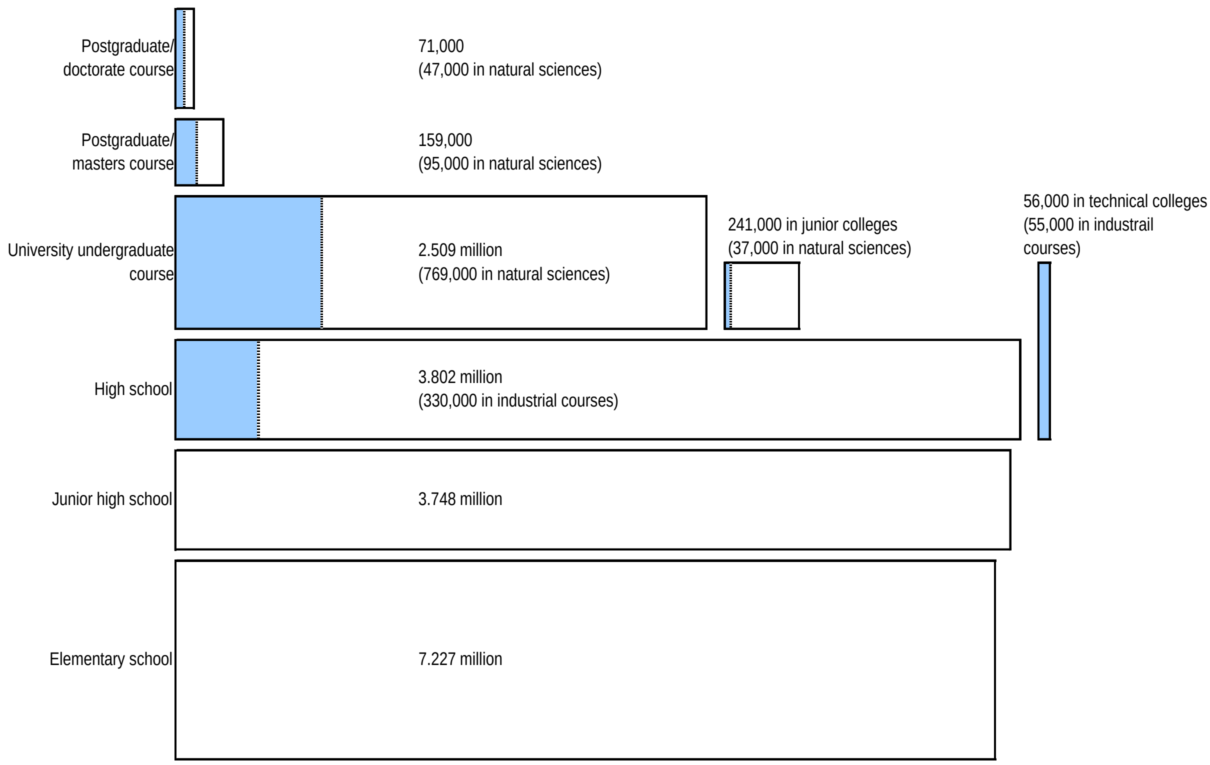
Chapter 5
Development of Human Resources in Science and Technology in School Education

Development of Human Resources in Science and Technology (S&T) is one of the most important foundations in promoting S&T development. This chapter presents development of human resources in S&T in school education, through a comparison of the current state of mathematics and science education on the elementary, junior high and high school levels in Japan and other countries, the state of application and enrollment broken down by academic department at universities, employment trends for university graduates by industry and type of occupation and the state of enrollment in postgraduate programs.

Figure 5-0-1 presents a conceptual image of the number of students in Japanese school education, to give a general idea of the system in general. The number of elementary school students currently stands at 7.227 million, junior school students at 3.748 million and high school students at 3.802 million (full-time students only).

The advancement rate from high school to university or junior college (full-time courses) is presently at 44.6%, with 2.509 million enrolled in universities and 240,000 in junior colleges. In natural sciences, 950,000 are in postgraduate programs and 470,000 in doctorate courses.

Figure 5-0-1: The current state of students in school education (FY2003; conceptual chart)



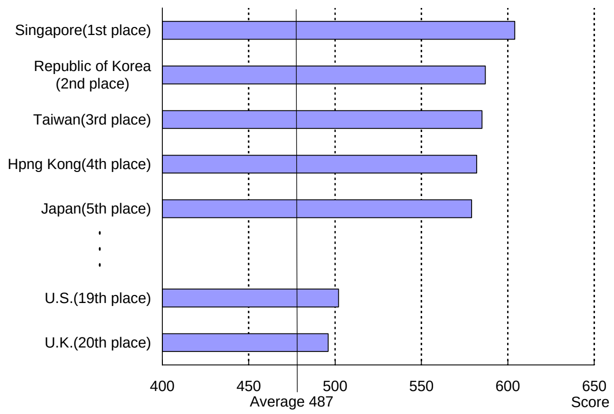
Notes:1. Conceptual chart breaking down the number of all full-time students in the various types of academic institutions and the ratio of those in science and engineering (shaded segment). At undergraduate and postgraduate levels, 'natural sciences' represent the total of students in science, engineering, agricultural science and health sciences (including medicine, dentistry and pharmacology).
2. 'Natural sciences' in junior colleges represent the total of students in industrial courses, agriculture and health care.
3. The width of the bar graph represents the number of years required for completion of study. Bar area represents the number of students enrolled in such schools.
4. The number of graduate students excludes those in specialized academic courses.
Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'School Basic Survey'

5.1 International comparison of mathematics and science education on elementary, junior high and high school levels

5.1.1 The Third International Mathematics and Science Study (TIMSS)--Repeat survey

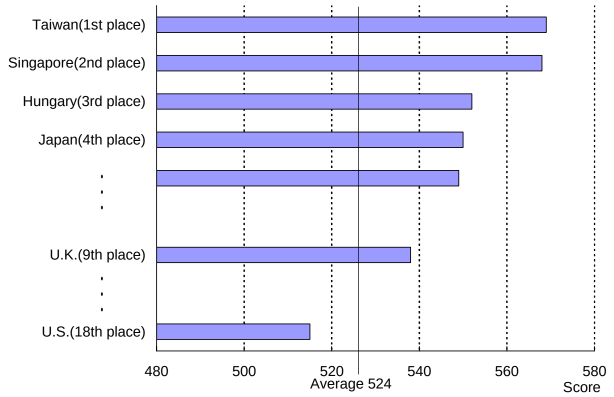
The Third International Mathematics and Science Study-Repeat (TIMSS-R) was conducted, under the auspices of the International Association for the Evaluation of Educational Achievement, in 38 countries and territories around the world at the end of the 1998 academic year. It was based on the first survey conducted in 1995. In Japan, the survey was conducted in February 1999, covering approximately 5,000 second-year junior high school students in 140 schools nationwide.

Figure 5-1-1: TIMSS-R average scores in mathematics



Source: Data compiled by National Institute of Science and Technology Policy (NISTEP), based on 'International Comparison of Mathematics and Science Education -- Trends in International Mathematics and Science Study' (Gyosei 2001) edited by National Institute for Educational Policy Research
Source: Table 5-1-1

Figure 5-1-2: TIMSS-R average scores for science



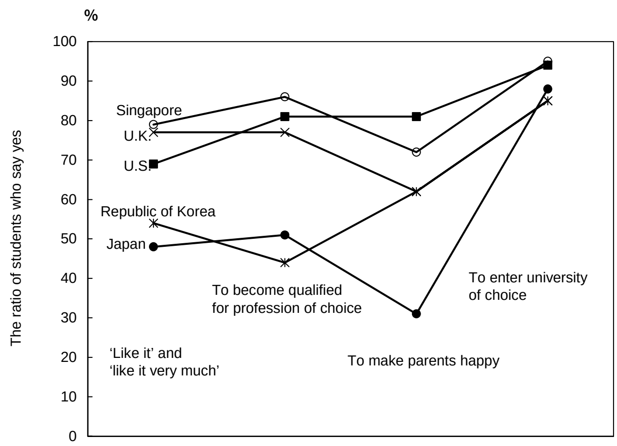
Source: Same as Figure 5-1-1.
See: Table 5-1-2

The international average for mathematics for second-year junior high school students was 487. The top five nations and territories are shown in Figure 5-1-1. However, there is no significant difference in scores between Japan, Taiwan and Hong Kong.

In science, the average score is 524, and the top five nations and territories are shown in Figure 5-1-2. Japan also ranks among the top countries in science.

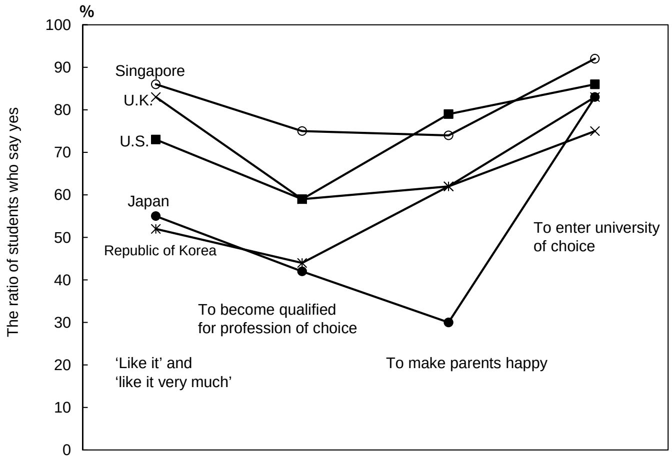
Regarding enthusiasm and awareness toward study, however, more than half of the students in Japan study science and mathematics, starting from the junior high school level, only for the purpose of gaining admittance to the university of their choice (in addition to the fact that study is not for the purpose of becoming qualified for the professions of their choice).

Figure 5-1-3: Awareness toward mathematics



Source: Same as Figure 5-1-1.
See: Table 5-1-4

Figure 5-1-4: Awareness toward science



Source: Same as Figure 5-1-1.
See: Table 5-1-4

5.1.2 OECD Program for International Student Assessment (PISA)

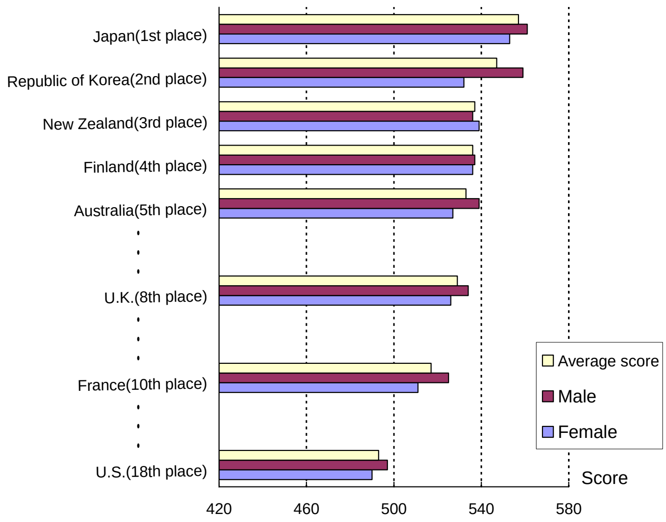
PISA is conducted by OECD. It aims to assess the level of knowledge or skill required in the future, at the point of completion of compulsory education. PISA 2000 was conducted in 32 countries around the world to examine literacy in reading comprehension, mathematics and science (27 countries covered for international comparison). In Japan, 5,300 first-year high school students in 133 schools nationwide participated in the survey.

All-around reading comprehension measures the student's ability to understand, use and think with text presented for reading. In the comparison of participating nations with median score set at 500, Finland ranked first with 546, followed by Canada, New Zealand, Australia, Ireland, South Korea and the United Kingdom. Japan ranked 522. However, there was no significant difference in average score for nations ranking between second to eighth places.

Mathematical literacy (Figure 5-1-5) and scientific literacy (Figure 5-1-6) both examine student ability to understand and use knowledge in mathematics and science. However, it is correlated to all-around reading comprehension to a certain extent. Although Japan ranks at the top in mathematical literacy, there is no significant difference with nations in second and third places. There was no significant difference between South Korea, which placed at the top in science literacy, with Japan at second place.

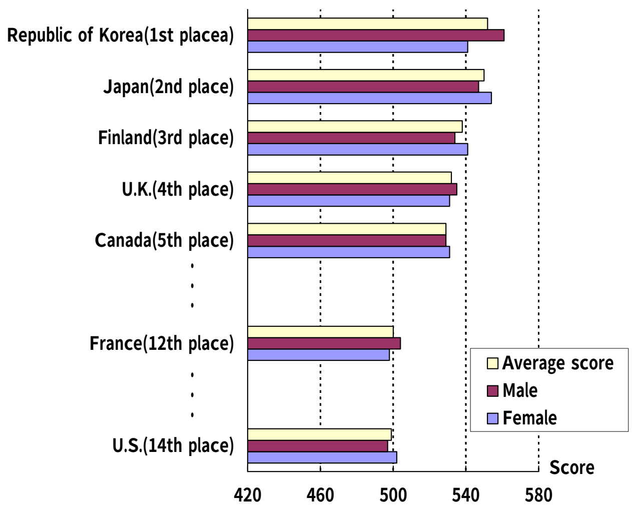
Figure 5-1-7 shows the relationship between the average score of reading score, mathematical literacy score and scientific literacy score (with median score of 500) with GDP of the nation. It shows that academic achievement, or study results, rises with the scale of GDP, an indicator of economic affluence. The findings conform to the general expectation that wealth of the nation is correlated with educational attainment. However, the United States has the highest GDP in the world but is positioned towards the lower end of the regression line; while South Korea, which does not rank very high in GDP, is positioned considerably higher on the regression line. Finland and Japan are also found to be significantly higher position on the regression line.

Figure 5-1-5: Mathematical literacy



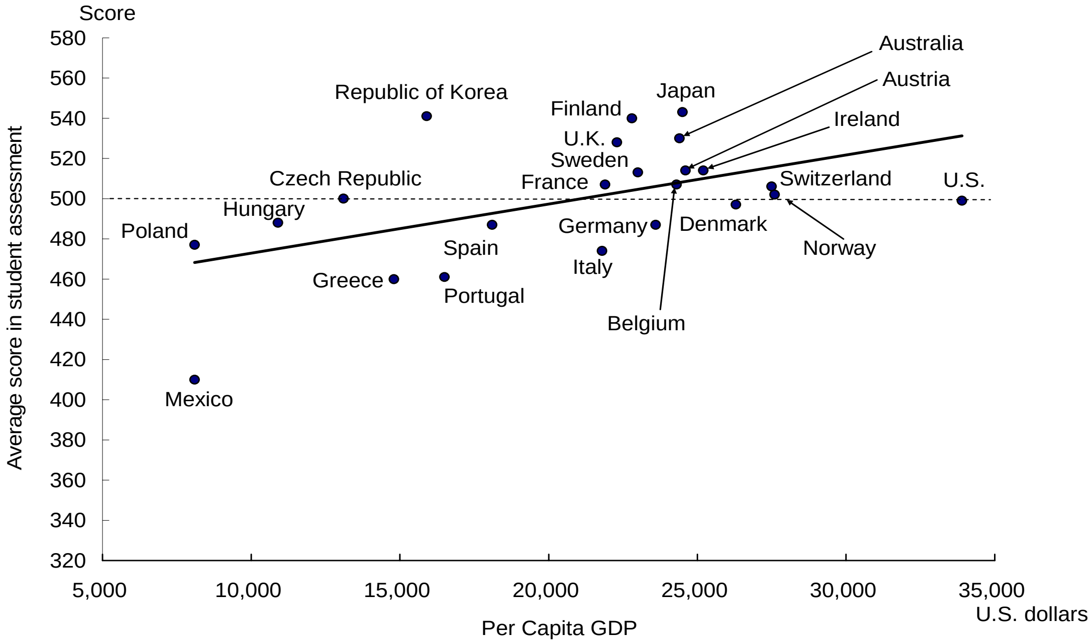
Note: Bars represent from the top, the average score for both genders, average for males and average for females.
Source: Data compiled by National Institute of Science and Technology Policy (NISTEP), based on 'Knowledge and Skills for Living -- Report on the 2000 OECD Program for International Student Assessment' (Gyosei 2001) edited by National Institute for Educational Policy Research
See: Table 5-1-5

Figure 5-1-6: Scientific literacy



Note: Same as Figure 5-1-5.
Source: Same as Figure 5-1-5.
See: Table 5-1-6

Figure 5-1-7 Average scores in student assessment and relationship with GDP



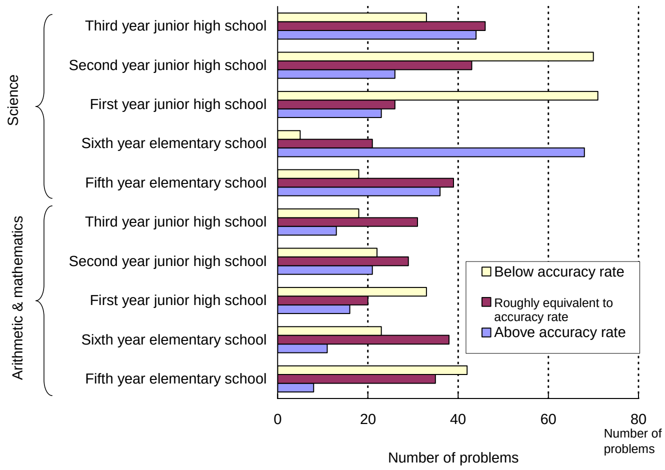
Note: GDP based on FY1999 data. Score of 500 is the median educational attainment level for entire survey. The inclined straight line is the regression line based on the least square method for data on 23 OECD member nations (1% significance level).
Source: Same as Figure 5-1-5.
See: Table 5-1-7

5.1.3 FY2001 Survey on Curriculum for Elementary and Secondary Schools

From January to February 2002, the National Institute for Educational Policy Research conducted a survey to assess how the goals and content of each subject in the Course of Study are being executed. The survey includes approximately 208,000 elementary school students (in their fifth and sixth years) in 3,532 schools and 243,000 junior high school students (in their third-year) in 2,539 schools. The survey results for arithmetic/mathematics and science will be shown here.

The designated accuracy rate described in Figure 5-1-8 is the rate of accuracy that I student is expected to achieve after undergoing standard teaching. A comparison of the rates is shown here. Although the science ratings are good for elementary school students in their fifth and sixth years, the science ratings for first year and second year junior high school students are below the accuracy rate. In arithmetic/mathematics, fifth-year elementary school students and first-year junior high school students failed to achieve the accuracy rate level. The students surveyed satisfied the accuracy rate in virtually all other subjects.

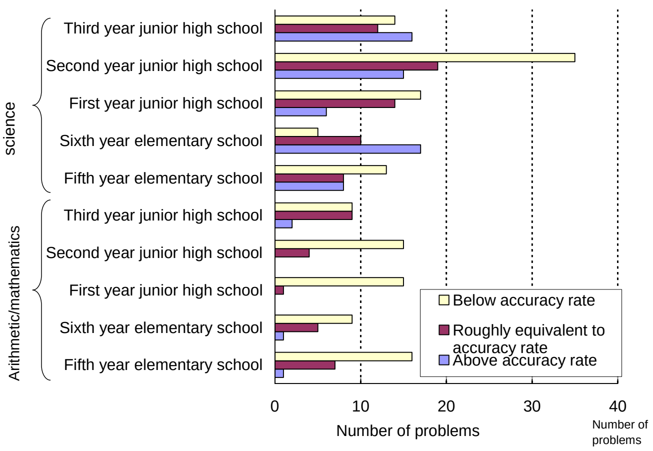
Figure 5-1-8: Comparison of designated accuracy rate per problem



Note: According to National Institute for Educational Policy Research, the designated accuracy rate is defined as the expected total percentage of accurate and close answers for each problem, when study activities designated by the national government Course of Study are executed over a standard period of time for educational content specified by the Course of Study.
Source: Data compiled by National Institute of Science and Technology Policy (NISTEP), based on 'Report on the FY2001 Survey Curriculum for Elementary and Secondary Schools' by the National Information Center for Educational Resources (NICER)
See: Table 5-1-8

Figure 5-1-9 shows a comparison of accuracy rates for the same problem in a previous survey conducted between 1994 and 1996.

Figure 5-1-9: Comparison of accuracy rates for the same problem in a previous survey



Source: Same as figure 5-1-8
See: Table 5-1-9

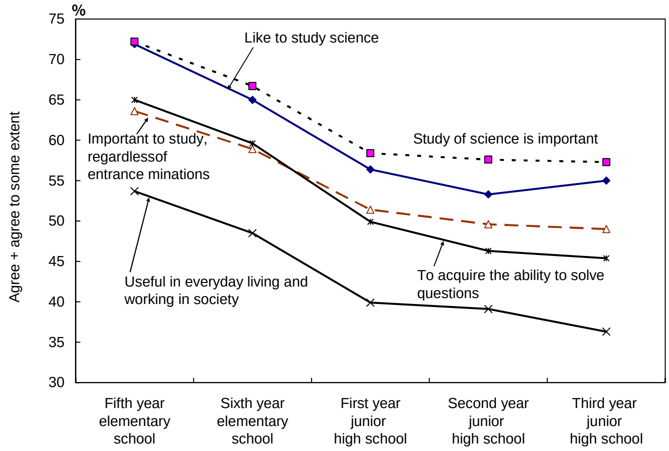
In science, sixth-year elementary school students exceeded the accuracy level of the previous survey. In the case of third-year junior high school students, the number of problems in which the accuracy rate exceeded the level of the previous survey was slightly higher than the number of problems in which the accuracy rate fell slightly compared to the previous survey. On the other hand, in the case of second year junior high school students, the number of problems in which the accuracy rate fell below the level of the previous survey nearly doubled the number of problems in which the accuracy rate rose over the level of the previous survey. Among first-year junior high school students, the number of problems in which the accuracy rate rose over the level of the previous survey was small.

In arithmetic/science, the number of problems in which the accuracy rate fell below the previous survey was larger in number than the number of problems in which the accuracy level rose above the level of the previous survey in all grades.

The survey was conducted not only to assess academic aptitude but also to look at students' motivation for studying. Figure 5-1-10 through 12 show the responses of the students regarding awareness of and motivation for studying science.

Figure 5-1-10: Reason for studying science

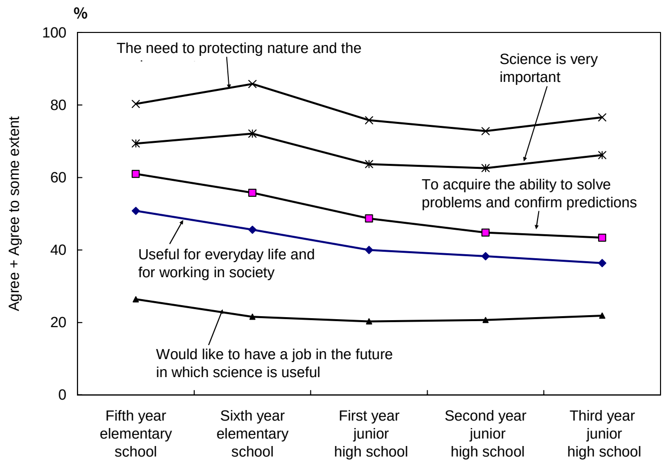
Source: Same as Figure 5-1-8.



See: Table 5-1-10

Figure 5-1-10 shows the students' study motivation for studying science. Generally speaking, enthusiasm declines with advancement in years. There are a relatively large number of students who think study of science is important and students who like science. However, it shows that few students believe that study of science is useful for everyday life and for society.

Figure 5-1-11: Purpose of studying science

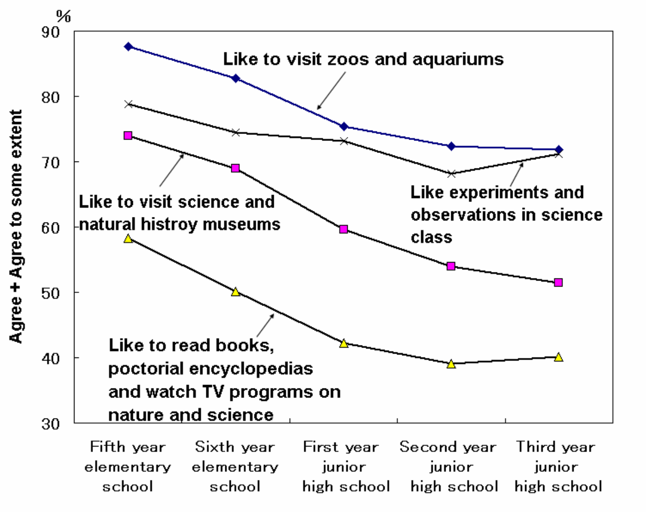


Source: Same as Figure 5-1-8.
See: Table 5-1-11

Figure 5-1-11 shows the responses to the question regarding purpose of studying science. Although the majority of students (70 to 80%) said that science is important for addressing environmental issues and for growth of the country, the findings show that students have little personal motivation, such as finding science useful in everyday life or considering science as a possible future occupation. Also, a significant finding is that very few students think that science is useful in building a scientific approach to thinking.

Figure 5-1-12 shows responses regarding the use of science study facilities and media and on experiments and observations. While more than 70% of junior high school students in their third-year like to visit zoos and aquariums, the ratio of students who like to visit science and natural history museums drops from 74% for elementary school students in their fifth-year to 52% among junior high school students in their third year.. On the other hand, the proportion of students who like experiments and observations exceed 70% for all grades.

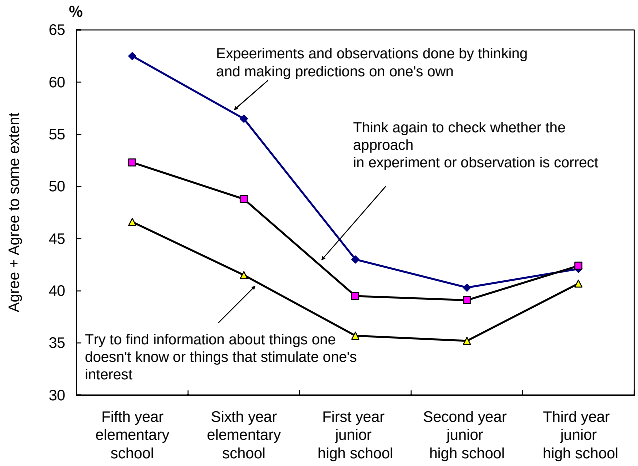
Figure 5-1-12: Things you like to do related to science



Source: Same as Figure 5-1-8.
See: Table 5-1-12

Figure 5-1-13 shows the level of student attitudes toward science. The disparity in level among elementary school students in their fifth year tends toward uniformity by the third year of junior high school.

Figure 5-1-13: Student attitude toward science



Source: Same as Figure 5-1-8.
See: Table 5-1-13

The current state of mathematics (arithmetic) and science education at the primary and secondary levels has been examined with focus on international surveys. Although student performance is generally good in Japan, study motivation is not necessarily high. In addition, as students get older, voluntary study declines together with student attitudes toward study.

5.2 University Departments

5.2.1 Trends in the number of applicants and number of students admitted to universities

(1) Trends in the number of applicants

The prospective candidate for advancement to university commonly submits applications to a number of academic departments at various universities. Each applications submitted by one applicant counts towards the total number of applications.

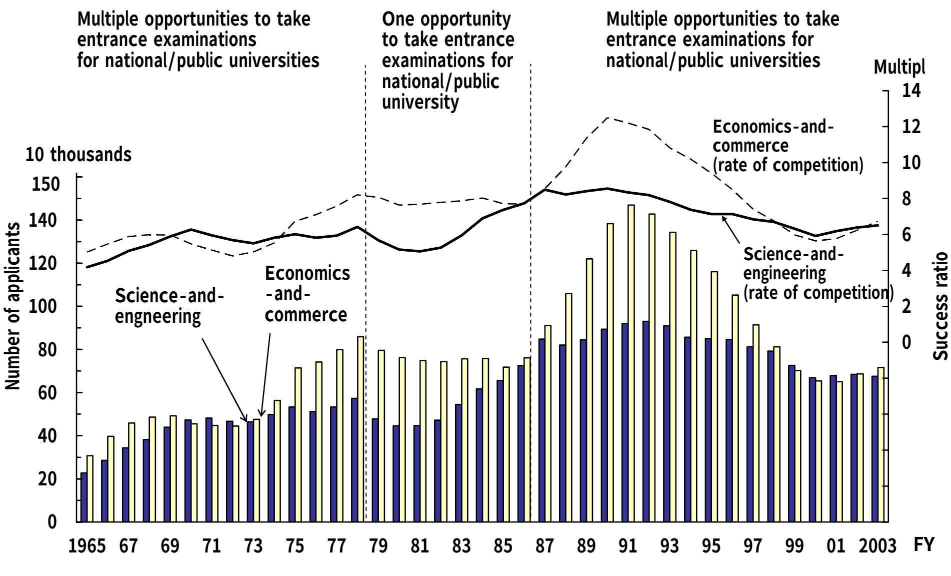
The number of applicants stood at nearly 1.203 million in FY1965. This number increased consistently through the 1970s against the background of a rise in enthusiasm for higher learning and reaching 3.127 million in FY1978.

With the revision of national university entrance examinations system in FY1979 from 'one-round and two-round entrance examinations' to 'the common first-stage university entrance examination system,' the possibility of applying for entrance to international universities was narrowed down to one university, resulting in the decline in the number of applicants to a level short of 3 million. With the modification of entrance examinations system for national and public universities in FY1987 to once again enable applicants to apply for a number of institutions, as well as rising in enthusiasm for college education, the number of applicants rose rapidly, reaching 5.063 million in FY1992. The common first-stage university entrance examination system was also replaced in FY1989 by 'the university entrance examination given by the National center'

However, recent declines in the population of 18-year-olds have prompted a decline in the number of university applicants, which fell below 4 million in FY1989. In FY2001, however, the number began to increase once again, reaching 3.797 million in FY2003.

Figure 5-2-1 shows trends in the number of applicants and the ratio of competition for academic departments in the area of science -and-engineering and economics-and-commerce. The data shows that the number of applicants and the success ratio for science-and-engineering departments fell in the late 1970s, although economics-and-commerce departments did not exhibit a significant drop. From FY1987 to the early part of the 1990s, the number of applicants and successful application ratio for economics-and-commerce departments roses dramatically but recently this ratio has begun to decline. In science-and-engineering departments, major fluctuations comparable to departments in the area of economics-and-commerce cannot be seen. Since FY1998, the number of applicants and the successful application ratio for these departments has remained roughly constant.

Figure 5-2-1: Trends in the total number of applicants and ratio of successful admission for academic departments at universities

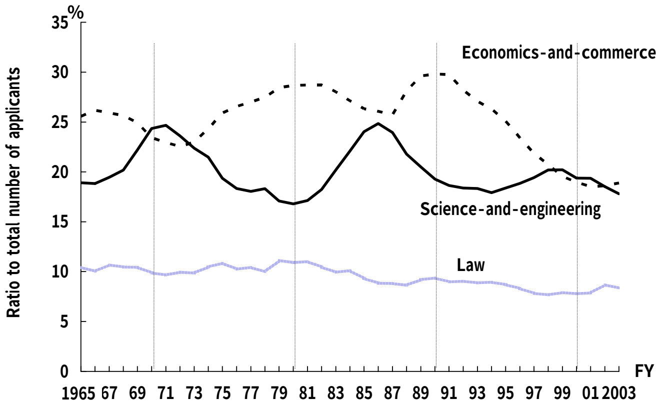


Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-2-1

Figure 5-2-2 shows trends in the ratio of total applicants by academic department. The data shows that the ratio of science-and-engineering departments declined and the ratio of economics-and-commerce departments rose vis-à-vis the total number of applicants in the 1970s and the late 1980s. This trend is called "departure from science-and-engineering." In the early 1980s and the middle of 1990s, however, a reverse trend occurs. The departure from science-and-engineering in the 1970s appears to have been prompted by business decline in the manufacturing industries, which had been hit hard by the oil crises. The same trend that occurred in the latter half of the 1980s was caused by the bubble economy, triggering a shift toward economics. However, both science-and-engineering and economics-and-commerce are on the decline in recent years. On the other hand, law-related academic departments continue to maintain roughly 10% of the total number of applicants, despite minor fluctuations.

As mentioned earlier, the total number of applicants to universities had been affected by changes in the university entrance examinations system. In the breakdown by academic department, the choice of department appears to be influenced significantly by the current economic situation.

Figure 5-2-2: Trends in the ratio of the total number of applicants



Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-2-2

(2) Trends in the number of enrollments

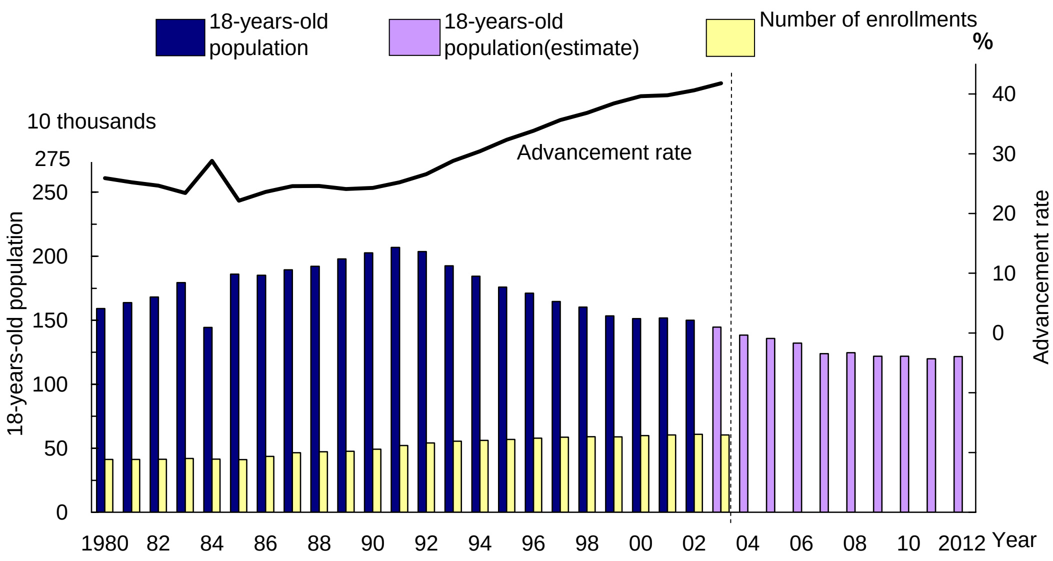
According to the estimates of the National Institute of Population and Social Security Research in the Ministry of Health, Labor and Welfare, the population of Japan, which stood at 126,93 million in 2000, is expected to peak at 127,74 million in 2006 and enter a phase of protracted decline thereafter. This will be caused by a dramatic drop in birthrate (around 2.08 in total special birthrate) that had maintained the population since the mid-1970s. The 18-years-old population has already peaked in 1991 at 2.068 million and is already dwindling in number. The decline is expected to continue, for instance, to 1.219 million in 2010, reaching a level that is only 59% of the peak population (Figure 5-2-3).

Under these circumstances, the number all university applicants increased by roughly 1.5 times from 412,000 in FY1980 to 605,000 in FY2003, spurred by rising enthusiasm for college education and wider admission of students. As a result, the advancement rate (the ratio of university enrollments to the 18-years-old population) rose from 25.9% to 41.8% during the same span of time, rising by 15.9 percentage points.

Figure 5-2-4 examines trends in the number of university enrollments over the longer term and by principal courses of study in. This shows that the largest number of enrollments in FY2003 were in the social sciences, with 233,000 or 38.5% of the total number of enrollments. This is followed by 104,000 (17.1%) in engineering and 99,000 (68.4%) in the humanities. Enrollments in the area of science number 21, 000, or 3.4%.

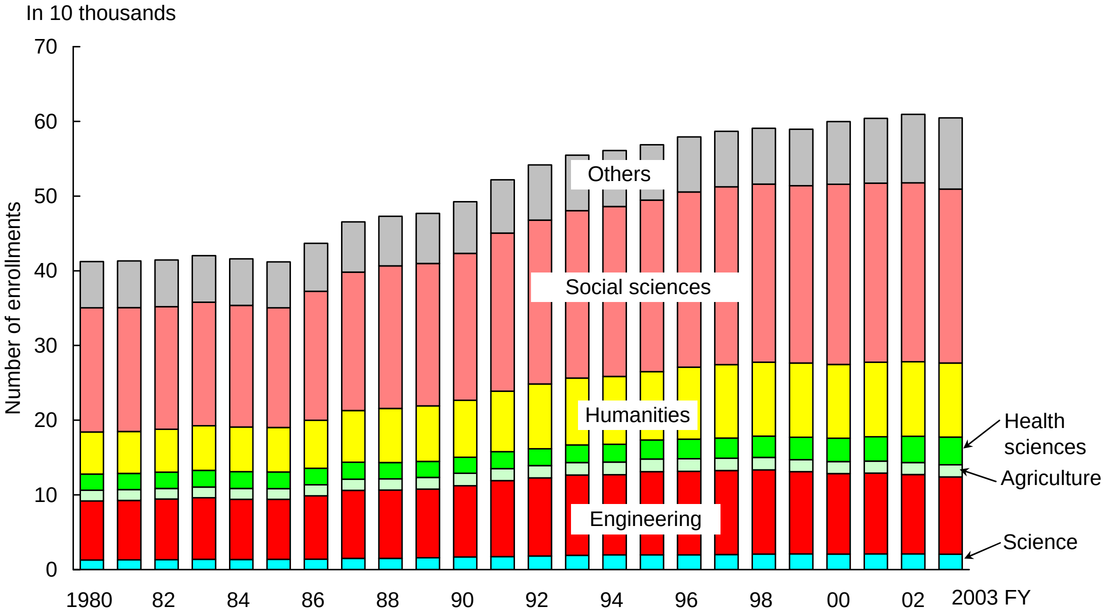
If the breakdown by courses of study, those in social sciences and science-and-engineering both increased by roughly 1.4 times, health sciences by approximately 1.7 times and humanities by approximately 1.8 times. In contrast to these increases, the area of agriculture shows little growth, increasing only 1.1 times. No major changes were seen in the breakdown by major courses of study.

Figure 5-2-3: Trends in population of 18-years-old and university enrollments



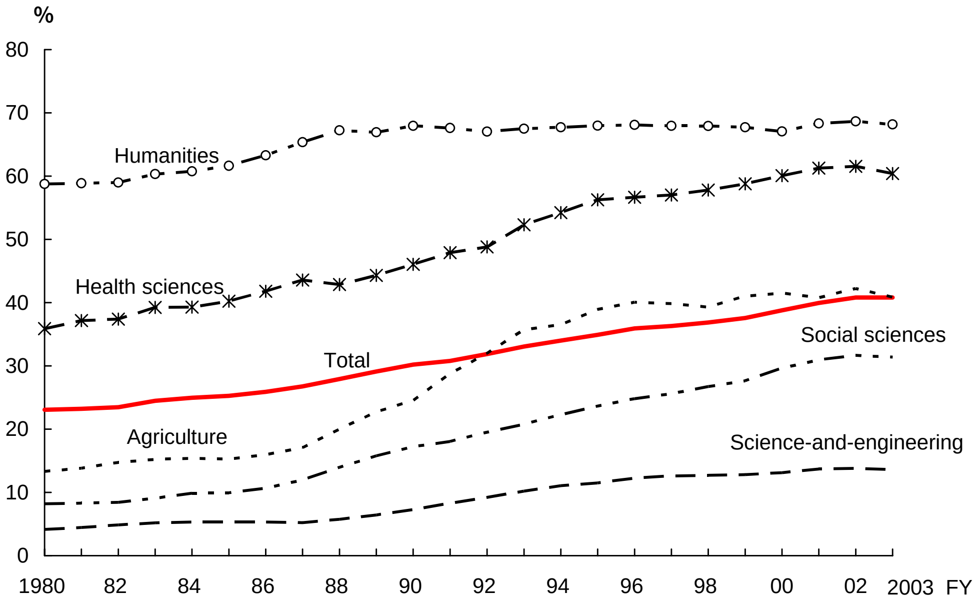
Notes: 1. Population of 18-years-old aged 18 is based on media estimates.
2. Advancement rate is percentage of university enrollments to the 18-years-old population.
Sources:
1. 18-years-old population:
<Data up to 2002> 'Population Estimates,' Statistics Bureau, Ministry of Public Management, Home Affairs, Posts and Telecommunications (as of October each year)
<Data from 2003> 'Future Population Estimates of Japan' (estimate as of January 2002), National Institute of Population and Social Security Research, Ministry of Health, Labor and Welfare
2. Number of university enrollments:
Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-2-3

Figure 5-2-4: Trends in the number of university enrollments



Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-2-4

Figure 5-2-5: Trends in the ratio of female students to the total number of university enrollments



Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-2-5

Trends in the number of university enrollments are characterized by a marked rise in the number of female students. In FY1980, there were only 95,000 females admitted to university. This figure increased by roughly 2.6 times to 247,000 in FY2003. As a result, the ratio of female students to the total university enrollments grew dramatically from 23.1% to 40.8% (Figure 5-2-5).

In the breakdown by academic department, the number of women enrolled in science-and-engineering departments increased approximately 4.4 times from 4000 in FY1980 to 17,000 in FY2003. Although the number of female students in this field rose from 4.1% to 13.6% during this period, the percentage remains low compared to other departments. Moreover, the ratio of female students admitted to science-and-engineering departments, which had been rising until the early 1990s, has recently reached a plateau.

5.2.2 Career paths of university graduates in natural sciences

The number of students who graduated from university in March 2003 was 545,000. Of these, 62,000 (11.4%) advanced to postgraduate studies, 300,000 (55.1%) took jobs, a thousand (1.5%) became clinical interns and 148,000 (27.1%) either landed temporary jobs or were unemployed people who were neither working nor engaged in further study. In addition, there are 27,000 (4.9%) whose career path remains unknown.

In the natural sciences (science-and-engineering, agriculture and health sciences), 46,000 (27.7%) of the 167,000 who graduated from university advanced to pursue higher learning. 84,000 (50.3%) began to work, 8000 (4.9%) became clinical interns, and 29,000 (17.2%) were unemployed (including those who took up temporary jobs or whose career paths remain unknown; this definition is the same throughout this section). Compared to the general average for all academic departments, the ratio of graduates going on further study is higher, and ratio of unemployed graduates is lower.

The following are observations of career paths of graduates in natural sciences.

(1) Trends in the ratio of graduates advancing to higher learning and those starting to work

The number of graduates in science-and-engineering in March 2003 stood at 121, 000, of which 38,000 (31.5%) advanced to higher learning, 61,000 (50.7%) took up jobs and 22,000 (17.9%) were unemployed. Graduates in agriculture sciences numbered 16,000, of with 4,000 (26.1%) advanced to higher learning, 8,000 (51.7%) took up jobs and 4,000 (22.2%) were unemployed. On the other hand, graduates in health sciences numbered 30,000 of which 4000 (13.5%) advanced to higher learning, 15,000 (47.9%) took up jobs, 8000 (26.9%) became clinical interns and 4,000 (11.7%) were unemployed. The percentage of unemployed graduates in health sciences was lower than in other areas of natural sciences.

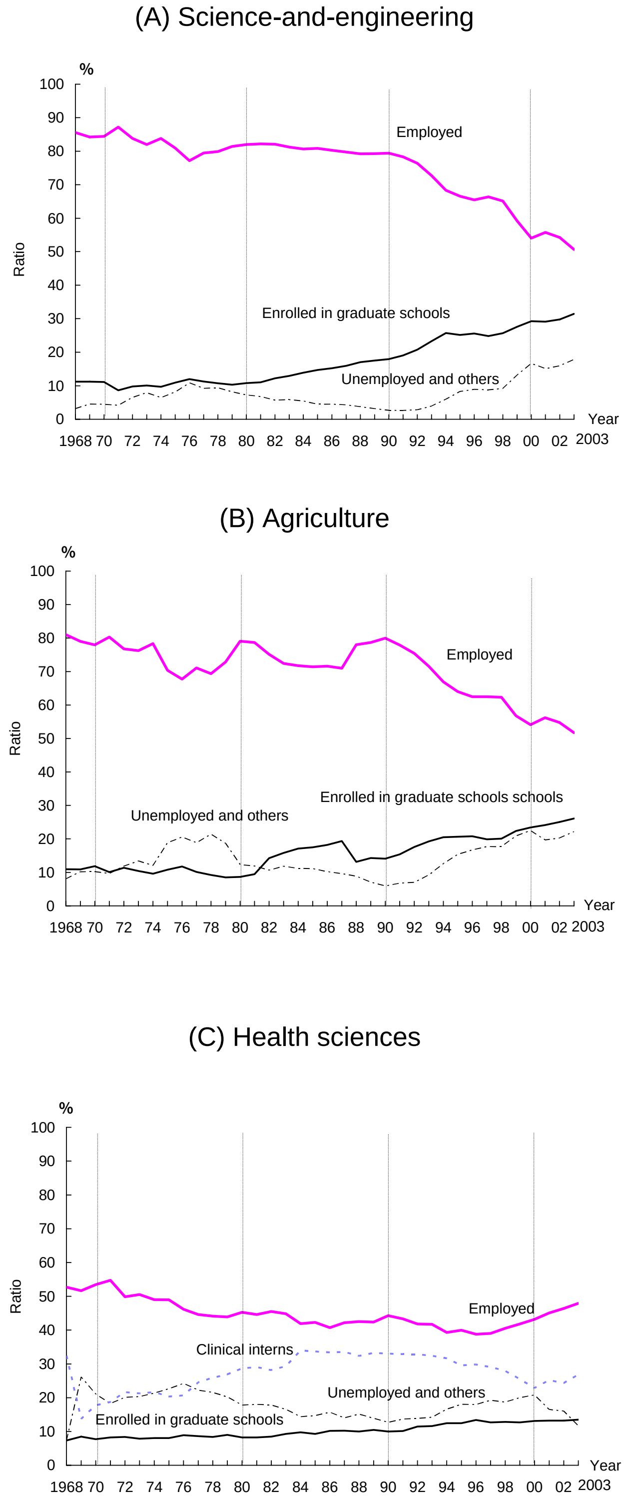
Figure 5-2-6 (A), (B) and (C) show trends in career paths of graduates, classified by those in science-and-engineering, agriculture and health sciences.

In science-and-engineering departments, the ratio of graduates taking up jobs fell slightly in the mid-1970s with the impact of the first oil crisis. This fluctuation corresponds to the rise in ratio of unemployed graduates during the same period. In subsequent years, the ratio of those who took up jobs remained constant at roughly 80% in the 1980s, but began to fall dramatically in the 1990s. Trends in the ratio of unemployed graduates during the same period shows that the ratio of them, which had been declining in the 1980s due to the ‘bubble economy’, began to rise in the 1990s with the collapse of the ‘bubble economy’ and the onset of recession. The ratio of those who take up jobs and those who are unemployed fluctuates in response to economic conditions. However, the ratio of those who continue to pursue higher learning has consistently increased since the 1970.

The trend is the same for agriculture, with the ratio of those who advancing to higher learning on the rise in the long term, the ratio of those who take up jobs falling dramatically in the 1990s concurrent with a rise in ratio of unemployed graduates at the same time. However, a closer look into the changes in the ratio of those who took up jobs shows that the effect of economic conditions is more serious compared to those in science-and-engineering, with the rapid drop after the second oil crisis and sharper rise during the ‘bubble economy’.

Meanwhile, the ratio of graduates who are advancing to higher learning is steadily rising in health sciences, showing similar trends in other areas of natural sciences. However, the percentage of those taking up jobs rose starting in the latter half of the 1990s, and the ratio of unemployed graduates has dropped sharply since 2000, showing trends unlike other areas of natural science.

Figure 5-2-6: Career paths of university graduates



Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-2-6

(2) The ratio of university graduates finding employment by industry

The number of students graduating from courses in natural sciences as of March 2003 stood at 84,000. In the breakdown of employment by type of industry, those who joined the service-related industries (including 'information and communications,' 'eating and drinking places and accommodations,' 'medical, health care and welfare' 'education and learning support,' 'compound services' and 'services n.e.c' in the revised Japan Standard Industrial Classification in March 2002; same hereafter) accounted for 45.3% of this number, with 24.3% entering manufacturing and 1.4% entering finance and insurance.

Changes in employment by industry for students in science-and-engineering, agriculture and health sciences are shown in Figure 5-2-7 (A), (B) and (C). With the major revision of the Japan Standard Industrial Classification carried out in March 2002 (enforced from October 1 of the same year), industrial classification for School Basic Survey likewise underwent a dramatic modification. For this reason, ratio by industry will be examined for the period between 1968 and 2002.

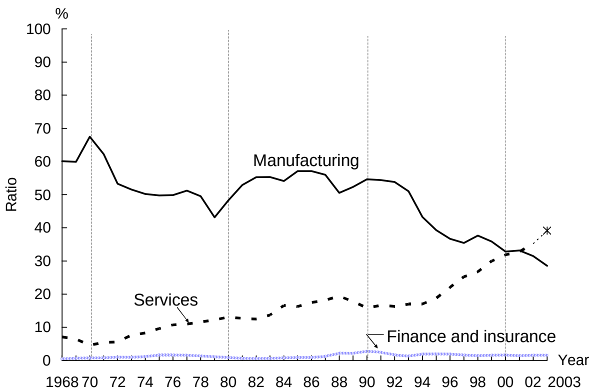
In the area of science-and-engineering, 67.5% joined manufacturing in 1970. After falling to 43.2% in 1979, the ratio continued to exceed 50% in the 1980s and the early 1990s. In the mid-1990s, however, the ratio fell dramatically once again and stood at 31.5% in 2002. On the other hand, the ratio of those entering services continued to rise during the same period, with a sharper rise beginning in 1995. These developments show that the ratio of employment in services exceeded those entering manufacturing for the first time in 2002. This change is believed to be affected by the transition of industrial structure toward services and the rising ratio of those finding employment in information services. Also, the ratio of employment in finance and insurance was 2.8% in 1990 but fell further to 1.6% in 2002.

In the agriculture, the ratios of those joining manufacturing and services show trends similar to those in science-and-engineering, with the ratio of those joining services exceeding those who joined manufacturing in 2002.

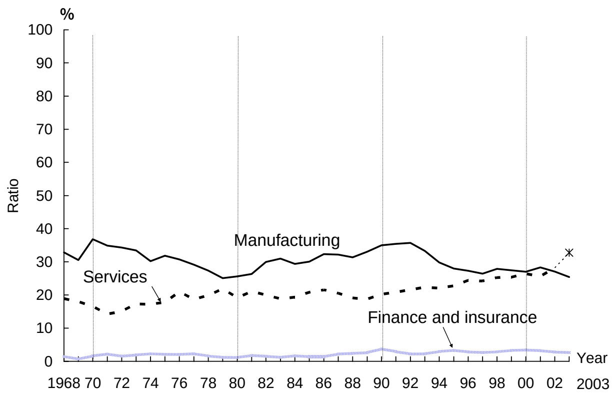
In health sciences, however, the ratio of those entering services has been consistently higher than that of those entering manufacturing, in contrast to those in other areas of natural sciences. This is due to the large number of students joining medical and health-related businesses. Especially after the 1990s, the ratio of those entering manufacturing dropped sharply and those entering services rose rapidly, widening the gap between the two industries further.

Figure 5-2-7: Trends in employment rate of university graduates by industry

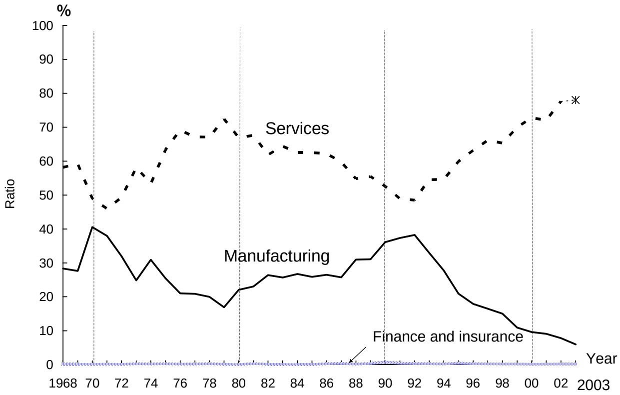
(A) Science-and-engineering



(B) Agriculture



(C) Health sciences



Notes: <Services>
2003 data is based on the total of the major groups ('information and communications,' 'eating and drinking places and accommodations,' 'medical, health care and welfare,' 'education and learning support,' 'compound services' and 'services,n.e.c.) similar to those in "services industries" prior to the major revision of the Japan Standard Industrial Classification. These six categories are classified as 'service-related industries' herein.
Also, 'service-related industries' include 'communications business' and 'eating and drinking places' categories that were not included in 'services' in the past.
<Manufacturing & finance and insurance>
These industries that did not undergo modification after revision of the classification system are shown in the pre-modification categories of 'manufacturing ' and 'finance and insurance' for 2003.
However, the sub-categories of 'newspaper business' and 'publishing' which were included in manufacturing in the past have now moved into the category of 'information and communications' following the modification.
Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-2-7

(3) Ratio of employment by occupation

Of the 84,000 graduates from various areas of natural sciences in March 2003, the breakdown by type of occupation shows that the vast majority (73.7%) took up professional and technical workers. This is followed by 10.3% in sales workers and 7.2% in clerical and related workers. In the breakdown of those in professional and technical workers (specialist), 53.9% are engineers and technicians in machine or electric engineering or in information processing. 16.0% are public health and medical workers, 1.5% are professors and teachers and 0.5% are scientific researchers.

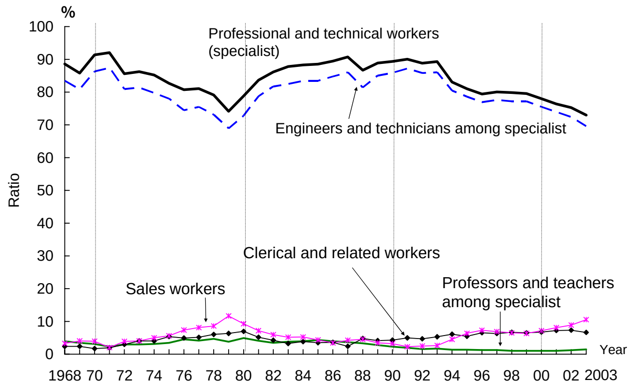
The ratios of graduates in science-and-engineering, agriculture and health sciences by type of occupation are shown in Figure 5-2-8 (A), (B) and (C).

Among science-and-engineering graduates in professional and technical workers (specialist), the ratio remains constantly high. However, the employment ratio in this area, which reached 92.2% in 1971, fell sharply during the decade to under 80% in the latter half of the 1990s. Although the ratio rose again in the 1980s, it is declined once again in the 1990s. As of 2003, the employment ratio is 73.0%. The ratio of engineers and technicians shows similar patterns as those in professional and technical workers (specialist). On the other hand, the ratio of professors and teachers has consistently remained low from the mid-1980s, despite a slight rise in the 1970s. As data shows, the ratio of those in professional and technical workers (specialist) is declining in recent years, in contrast to rise in the ratio of those in sales workers, which exceeded 10% in 2003.

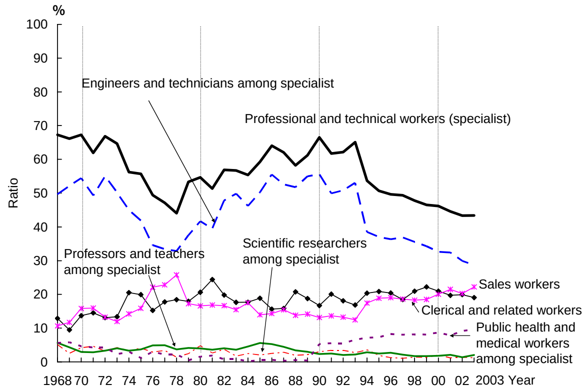
In agriculture, the ratio of those in professional and technical workers (specialist) is consistently lower than those in other areas of natural sciences. The ratio has remained under 50% since 1996, while those in clerical and related workers or sales workers have remained around 20% each. However, it must be noted that the ratio of engineers and technicians among is the highest those in professional and technical workers (specialist), and the ratio of professors and teachers has been constantly low since the mid-1980s, as for in science-and-engineering.

Figure 5-2-8: Trends in employment rate of university graduates by occupation

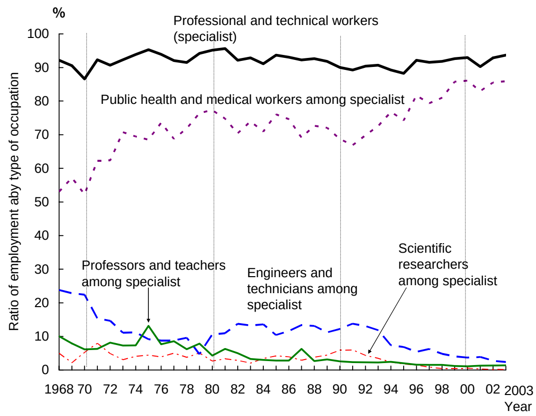
(A) Science-and-engineering



(B) Agricultural sciences



(C) Health sciences



Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-2-8

In health sciences, the ratio of those in professional and technical workers (specialist) has remained constantly higher than 90% throughout the period. Of these, the ratio of professors and teachers has been on a steady decline since the latter half of the 1970, a trend has seen in other areas of natural sciences as well. Unlike other natural science fields, however, the ratio of public health and medical workers is the highest, exceeding 80% in recent years.

5.2.3 Cultivating of human resources in S&T university education (conclusion)

Findings from the data related to number of enrollments in natural science courses and on students' career paths after graduation can be summarized as follows.

First, the rise in the number of students enrolled in universities (all academic departments) year by year reflects the growing expectations of university education in the growing complexity and sophistication of today's society and economy.

Next, looking at the career paths of university graduates in the areas of natural sciences, the ratio of those who continue postgraduate studies is significantly higher than the average for all academic fields. This is believed to suggest a strong inclination for more advanced and specialized knowledge and skills in natural sciences.

Also, the ratio of employment of university graduates in the areas of natural sciences in manufacturing has continued to decline, especially for science-and-engineering and agriculture, with transition in industrial structure into services. It has fallen to a level below that of service industries in 2002 (see Figure 5-2-7). Section 5.3 shows that the ratio of employment of those completing graduate courses in science-and-engineering and agriculture joining manufacturing remain high. While the ratio of employment in manufacturing remains high for holders of master's degrees in science-and-engineering and in agriculture, the ratio of employment of graduates in this industry with a bachelor's degree falls below the level for service industries. This stems from the fact that advanced and specialized knowledge and skills are required in the manufacturing for new product development, etc., alongside the rapid technological innovations and advancement in S&T research in recent years.

These findings show that cultivating of human resources in S&T for advanced and specialized knowledge and skills take place at the graduate level in the fields of natural sciences. In contrast, undergraduate education provides general education and basic education in specialized fields, placing emphasis on cultivation of basic elements in specialization.

5.3 Graduate schools

5.3.1 Trends in the number of enrollments

(1) Master's courses

The number of enrollments in master's courses in FY2003 totaled 76,000. Breaking down by major courses of study, the largest number was in engineering, with 31,000 (41.5%). This is followed by 10,000 (12.6%) in social sciences and 7,000 (9.1%) in sciences.

Trends in the number of enrollments in master's courses are shown in Figure 5-3-1. The number that stood at 17,000 in FY1980 rose to 24,000 in FY1985. In FY1990, the number or rose dramatically to 31,000. The rate of increase grew further in the 1990s but has somehow slowed down in recent years.

Examining the growth starting in FY1990, the total number of enrollments from FY1990 to FY2003 increased by 2.5 times. Classified by major courses of study, the largest margin of growth was seen in health sciences, increasing by 3.7 times. The growth rate for health science and engineering was slightly lower than general growth, increasing by 2.1 times.

However, the ratio of contribution to growth in the total number of students during this period reveals that the fields of science and engineering accounts for roughly half of total growth, with 37% in engineering, which attracts the largest number of enrollments, and 8% in science.

(2) Doctorate courses

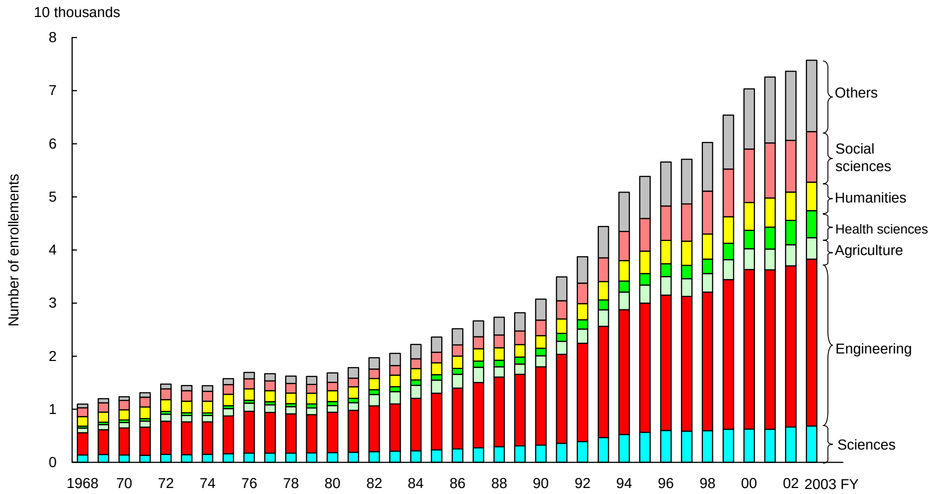
Looking into the number of enrollments in doctorate courses, the total number in FY2003 stood at 18,000. Breaking down by major courses of study, the largest number was in health sciences with 6,000 (32.9%), followed by 4,000 in engineering (19.6%), 2,000 in social sciences (9.3%) and 2,000 in science (9.1%).

Figure 5-3-2 shows the trends in the number of enrolled in doctorate courses. The data shows that the number grew rapidly, as for those in master's courses, from 5000 in FY1980 to 6000 in FY1985 and 8000 in FY1990. The growth rate increased further in the 1990s but has slowed down slightly in recent years, showing trends similar to that of enrollments in master's courses.

The number of enrollments in FY2003 was 2.3 times larger than the number in FY1990, an increase roughly comparable to those in master's courses. By major courses of study, the growth rate was largest in social science, increasing by 2.8 times. This is followed by 2.6-fold increase in engineering and 1.8-fold increase in science.

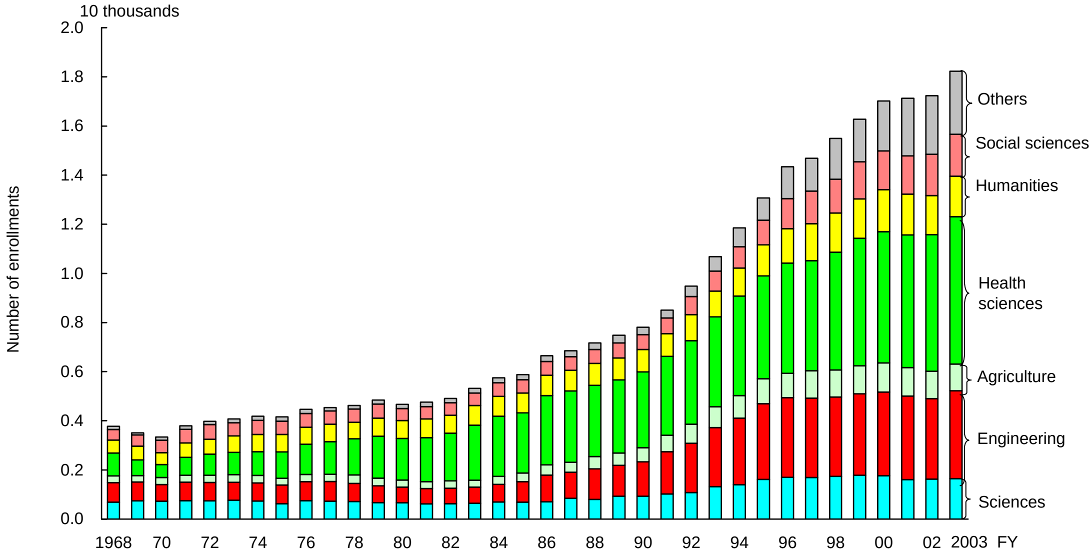
Also, the contribution rate to the growth rate during this period shows that science and engineering accounts for roughly 30%, with 21% in engineering and 7% in science.

Figure 5-3-1: Trends in the number of enrollments by major (master's courses)



Note: Data for FY2003 does not include number of enrollments in professional degree courses of graduate schools.
Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-3-1

Figure 5-3-2: Trends in the number of enrollments by major (doctorate dourses)



Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-3-2

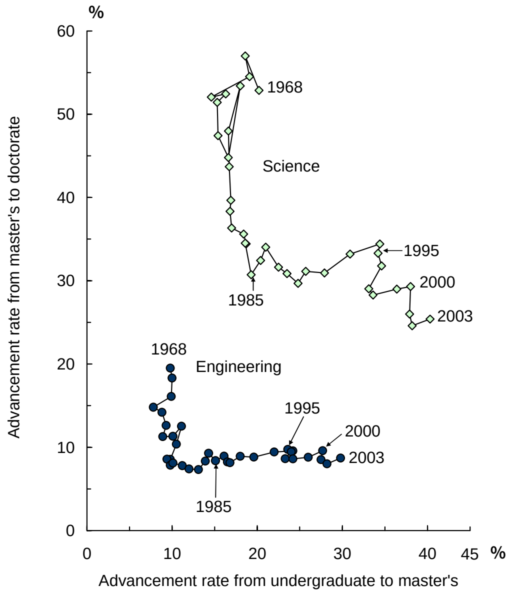
5.3.2 Trends in advancement rate to graduate schools

As described above, the number of enrollments in postgraduate courses has grown markedly in recent years. The following shows the trends in advancement rate for science-and-engineering students.

In the area of science, the advancement rate from undergraduate to graduate courses (advancement rate to master’s courses) from the 1970s until the middle of the 1980s had stayed roughly around 15 to 20%. The advancement rate from master's courses to doctorate courses (advancement rate to doctorate courses) was previously as high as over 50%, but then fell to roughly 30%. In the subsequent years until 1995, the advancement rate to doctorate courses remained at around 30%, while the advancement rate to doctorate courses rose from roughly 20% to around 35%. In the latter half of the 1990s, the advancement rate to doctorate courses fell once again, reaching around 25% in 2002-2003. On the other hand, the advancement rate to master’s courses rose further, reaching the 40% level. These developments are believed to have been propelled by the rising corporate needs in recent years for master's graduates as immediately effective workers in new-product development, etc.

In engineering, the advancement rate is lower compared to those of science. However, the trends are similar, with the advancement rate to doctorate courses falling in the 1970s and the advancement rate to master’s courses rising in the 1980s and thereafter.

Figure 5-3-3: Trends in advancement rate to graduate schools



Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), ‘Report on School Basic Survey’
See: Table 5-3-3

5.3.3 The state of employment for graduates of graduate schools

(1) Employment by type of industry
(i) Master's courses

The number of graduates from master's courses in natural sciences stood at 41,000 in March 2003. In the breakdown of these graduates, 5000 (13.1%) moved on to higher level of learning, while 32,000 (76.4%) took up jobs and 4000 (8.8%) were unemployed. Career paths are unknown for 1000 (1.7%).

Of the 32,000 who took up jobs, 56.7% went into manufacturing, accounting for the largest majority of such graduates. This is followed by 27.3% entering service-related industries and 4.5% going into construction.

Trends in the ratio of employment by type of industry for graduates in the fields of science-and-engineering, agriculture and health sciences are shown in Figure 5-3-4 (A), (B) and (C).

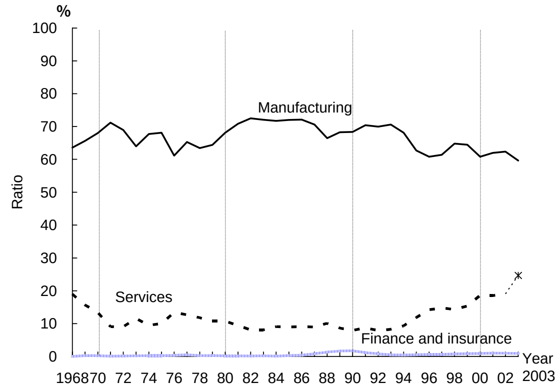
Looking into the trends for graduates in the field of science-and-engineering, the ratio of employment in manufacturing remained roughly on the 70% level until 1994, except for the mid-1970s following the first oil crisis. From 1995, the level fell to a little over 60%. Corresponding to this trend, the ratio of employment in service industries is growing in recent years. Since 2000, the ratio has exceeded 18%.

Graduates in the field of agriculture show no significant differences with those in the field of science-and-engineering, regarding the ratio of employment in manufacturing and ratio of employment in services. In the mid-1980s, the ratio of employment in these two areas remained roughly equivalent. As seen here, the ratio of employment in service industries in the mid-1980s is believed to be caused by the dramatic rise in the number of graduates in veterinary medical sciences and the employment of many of these graduates in the service industry by companies classified as 'businesses providing veterinary medical service'. In response to the rapid rise in the ratio of employment in manufacturing in the early 1990s, employment in service industries fell sharply. For this reason, the difference in employment ratio between the two areas has grown in recent years.

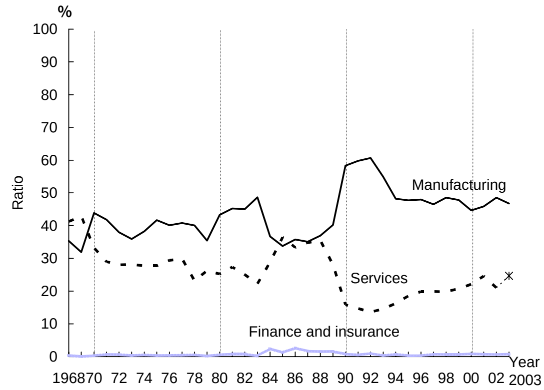
In health sciences, the largest portion of graduates used to enter manufacturing. In the 1990s, however, employment in manufacturing fell sharply, and employment in services rose rapidly. In 2000, the ratio of employment in services exceeded the ratio for manufacturing.

Figure 5-3-4: Trends in employment rate of graduates in master's courses by industry

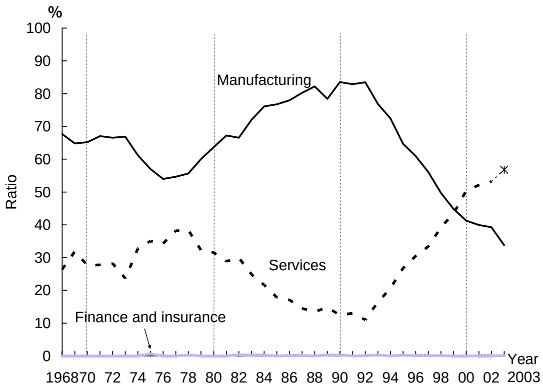
(A) Science-and-engineering



(B) Agriculture



(C) Health sciences



Notes:<Services>
2003 data is based on the total of the major groups ('information and communications,' 'eating and drinking places and accommodations,' 'medical, health care and welfare,' 'education and learning support,' 'compound services' and 'services,n.e.c.') similar to those in "services" prior to the major revision of the Japan Standard Industrial Classification. These six categories are classified as 'service-related industries' herein.
Also, 'service-related industries' include' communications and 'eating and drinking places' categories that were not included in 'services' in the past.
<Manufacturing & finance and insurance>
These industries that did not undergo modification after revision of the classification system are shown in the pre-modification categories of 'manufacturing' and 'finance and insurance' for 2003.
However, the sub-categories of 'newspaper business' and 'publishing' which were included in manufacturing in the past have now moved into the category of 'information and communications' following the modification.
Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-3-4

(ii) Doctorate courses

The number of graduates from doctorate courses in natural sciences in March 2003 totaled 10, 000, of which 6000 (60.9%) found employment and 3000 (31.2%) were unemployed (compared by course of study in Figure 5-3-6).

Of the 6000 who took up jobs, the largest majority (77.0%) joined the service-related industries, unlike the breakdown for graduates of master's courses. This is followed by 14.1% in manufacturing.

Trends in employment ratio by type of industry for graduates in the fields of science-and-engineering, agriculture and health sciences, are seen in Figure 5-3-5 (A), (B) and (C).

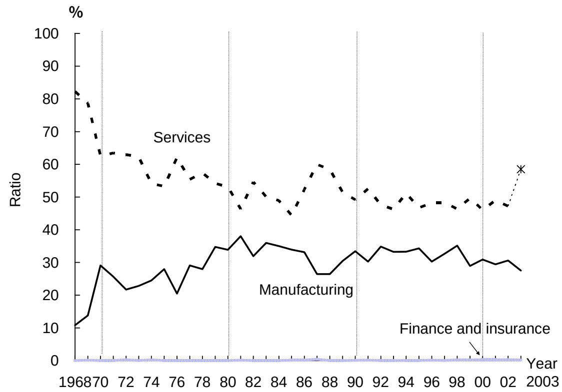
Looking into the developments for graduates of science-and-engineering programs, employment in services is on the decline in the long-term, staying under 50% in recent years, despite some fluctuations. On the other hand, employment in manufacturing was rose steadily from the 1970s to the early half of the 1980s. However, the ratio has remained roughly constant thereafter. In fact, the number of graduates from doctorate courses joining manufacturing is increasing steadily, with the increase in the number of students in doctorate courses.

In agriculture, employment in services fell from the 1970s to the early 1980s, while employment in manufacturing rose during the same period. Since the latter half of the 1990s, employment in services is on the rise.

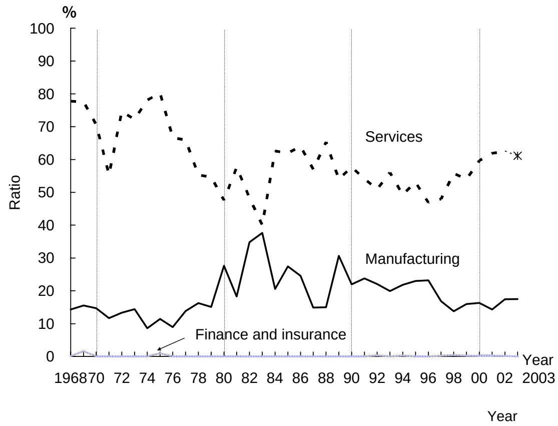
On the other hand, employment of health sciences in services, such as medical service, education, etc., has consistently exceeded 90%.

Figure 5-3-5: Trends in employment rate of graduates in doctorate courses by industry

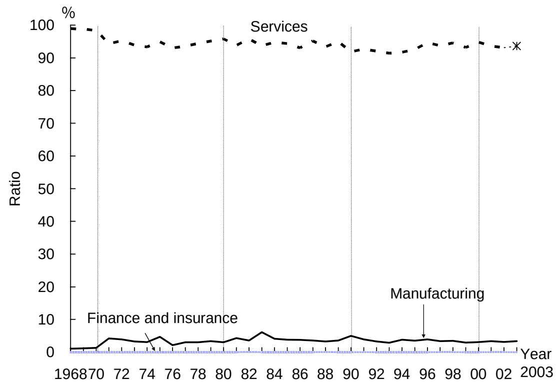
(A) Science-and-engineering



(B) Agriculture



(C) Health sciences



Note: Same as Figure 5-3-4.
Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-3-5

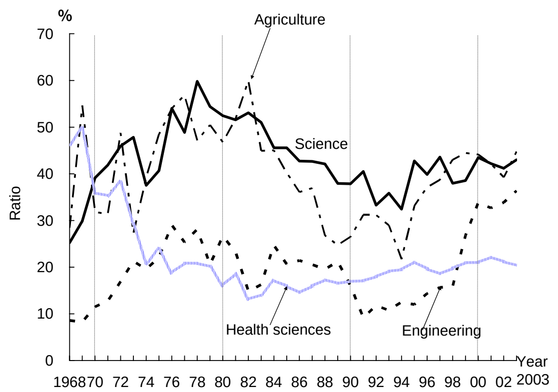
(iii) The ratio of unemployed to graduates in doctorate courses

Looking into the trends in the ratio of unemployed to graduates in doctorate courses, the level was temporarily high in the latter half of the 1970s, with approximately 60% for science, 55% for agriculture, and 30% for engineering. Later, the general level has declined (Figure 5-3-6). With the deterioration in economic situation in the latter half of the 1990s, however, the ratio of unemployed graduates has been rising again.

In health sciences, the ratio of unemployed graduates fell drastically in the 1970s but rose up again later. Still, the level remains relatively low compared to those in natural sciences.

According to the 2002 school basic survey, the number of unemployed graduates from doctorate courses (of which classification by course of study is not known) includes 38% who 'had enrolled in school overseas or remain in school as trainee' or 'are preparing for advancement in higher learning or for employment.' This group of people is believed to include a large number of postdoctorates.

Figure 5-3-6: Trends in the ratio of unemployed to graduates in doctorate courses



Note: 'Unemployed' is a person who has finished a doctorate course, excluding 'enrolled in higher education', 'employed', or 'deceased and unknown'.
Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-3-6

(2) Employment by type of occupation
(i) Master's courses

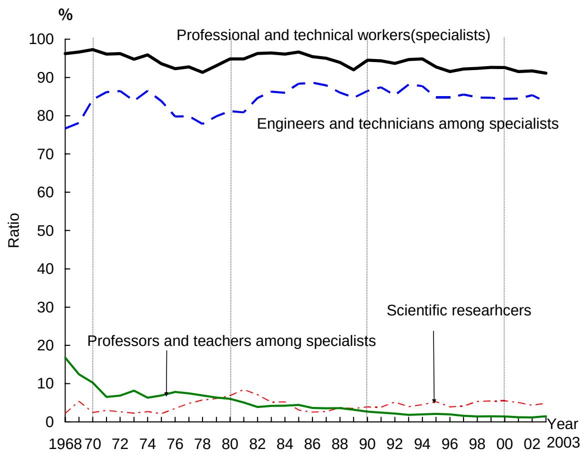
The number of students who have completed master's courses in natural sciences in March 2003 totaled 32,000. Classified by type of occupation, the overwhelming majority of 90.2% took up professional and technical workers (specialist). Of these, 76.4% are engineers and technicians in machinery or electronic engineering or in information processing.

The trends in employment ratio by type of occupation for the fields of science-and-engineering, agriculture and health sciences are shown in Figure 5-3-7 (A), (B) and (C).

Among science-and-engineering graduates in professional and technical workers (specialist), the employment ratio is constantly high, and the number of workers in this category are steadily increasing. Of these, the ratio of engineers and technicians has constantly stayed around 80% throughout the entire period of survey. In contrast, the ratio of professors and teachers is steadily on the decline, becoming as low as around 2% in recent years. Regarding the ratio of scientific researchers, the percentage had risen between the latter half of the 1970s and the early half of 1980s but fell thereafter. Subsequently, the level has remained constant.

Figure 5-3-7: Trends in employment rate of graduates in master's courses by occupation

(A) Science-and-engineering



Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-3-7

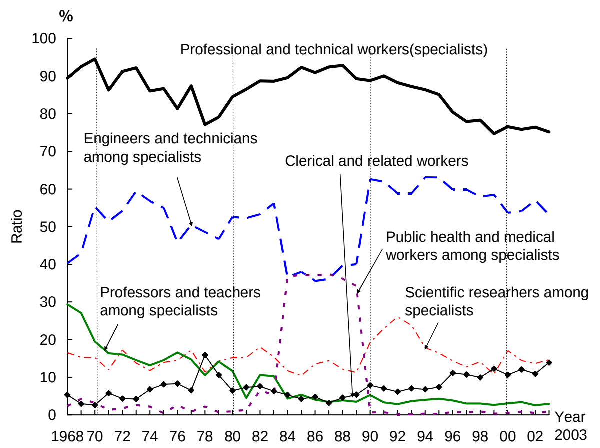
In agriculture, the ratio of those in professional and technical workers (specialists) has been consistently low compared to those in other areas of natural sciences. Especially since 1997, the ratio has fallen below 80%. In the breakdown by type of occupation, engineers and technicians who had accounted for roughly 50% from the 1970s to the early 1980s fell to 40% in the 1984-1989 period. The level has recovered to around 60% but has remained there since. On the other hand, the employment rate for public health and medical workers has been high only from 1984 to 1989. The reason for this level is caused by the dramatic rise in the number of students who have completed master's courses in veterinary medical sciences, and a large number of these graduates becoming veterinarians, etc. (public health and medical workers). This was a temporary trend brought on by the revision of the School Education Law enforced from April 1, 1984, with the number of years of study for veterinary medicine becoming six years. The master's courses for veterinary research was abolished with revision of the Standards for the Establishment of Graduate Schools from April 1, 1999, thus revising the number of years of study for the doctorate courses to four years. In contrast to the recent decline in the ratio of those in professional and technical workers (specialists), the ratio of clerical and related workers is growing, exceeding 10% in recent years.

In health sciences, the ratio of professional and technical workers (specialists) has consistently exceeded 95% for the entire period of study. In breakdown of these workers, engineers and technicians are on a long-term decline, while public health and medical workers are growing. Also, the ratio of scientific researchers, which had been growing from the 1980s until the middle of the 1990s, is rapidly declining in recent years.

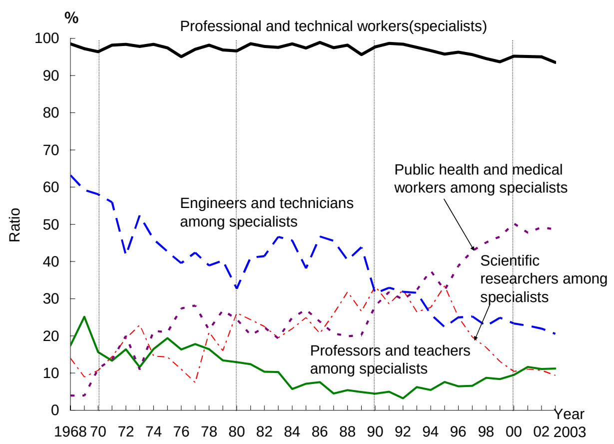
Regarding professors and teachers, the ratio is falling for all areas of natural science. In health sciences, however, the ratio has risen slightly in recent years.

Figure 5-3-7: Trends in employment rate of graduates in master's courses by occupation

(B) Agriculture



(C) Health sciences



Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-3-7

(ii) Doctorate courses

The number of students who completed doctorate courses in natural sciences in March 2003 totaled 6000. Breaking down by type of employment, the vast majority (96.5%) took up professional and technical workers (specialists). This ratio has consistently remained at this high level.

Trends in employment ratio by type of occupation for science-and-engineering, agriculture and health sciences are shown in Figure 5-3-8 (A), (B) and (C).

In the ratio of professional and technical workers (specialists) among science – and – engineering graduates in doctorate courses, it has remained above 90%, except in 1974 and 1975. A closer look at the breakdown shows that the ratio of professors and teachers exceeded 70% in the 1960s but has declined steadily since the latter half of the 1970s. On the other hand, the ratios of scientific researchers and engineers and technicians have increased steadily upward. For this reason, the ratios of engineers and technicians and scientific researchers have exceeded that of professors and teachers. This is believed to be the result of the number of university faculty vacancies remaining static while the number of doctorate graduates has increased dramatically in recent years.

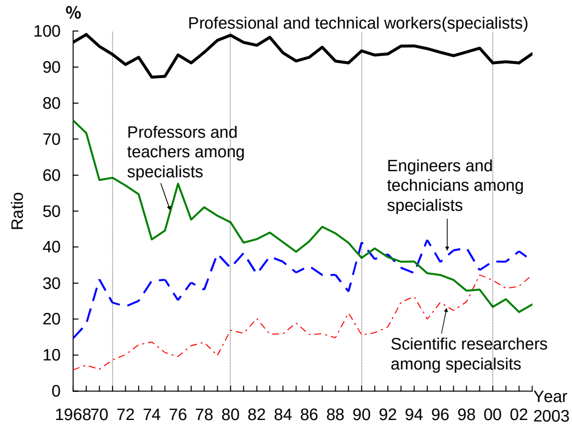
In agriculture, the small number of doctorate graduates before 1990 had affected in part the rapid fluctuations in employment ratio. From 1990 and thereafter, the ratio of scientific researchers has been on the rise, and the ratio of engineers and technicians has remained roughly constant.

In health sciences, the overwhelming majority consists of public health and medical workers, which has stayed at roughly 70% in recent years. The ratio of engineers and technicians is extremely low, at around 1 to 2%. The ratio of scientific researchers is on the rise but has stayed at around 10% in 2003.

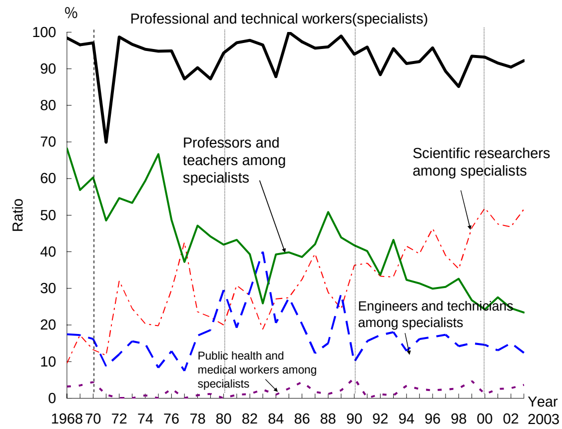
The ratio of professors and teachers is on the declined steadily for all fields of natural science.

Figure 5-3-8: Trends in employment rate of graduates in doctorate courses by occupation

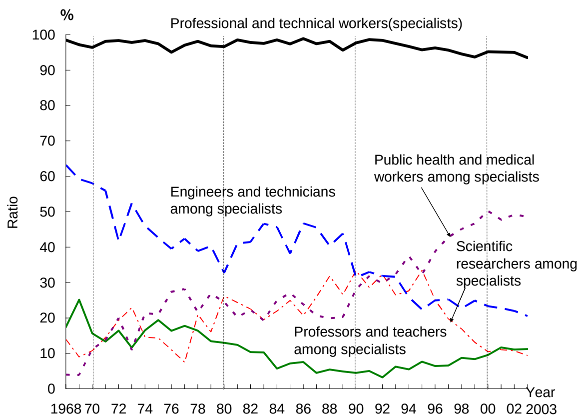
(A) Science-and-engineering



(B) Agricultural sciences



(C) Health sciences



Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), 'Report on School Basic Survey'
See: Table 5-3-8

5.3.4 Cultivating of human resources in S&T in graduate schools (conclusion)

The analysis of data related to the number of enrollments in master's and doctorate courses in natural sciences and on the state of employment after completion of study is summarized below separately for master's courses and doctorate degree program.

(1) Master's courses

In master's courses, the number of enrollments and advancement rate to this level of advanced learning has consistently grown for the most part. With the rapid advances in S&T and academic research and sophistication in economic and social structure, social expectations are high for specialized education on the postgraduate level.

In the employment of graduates from master's courses in natural sciences, employment in manufacturing remains high, unlike employment for university graduates, excluding the area of health sciences (see Figure 5-3-4). The employment ratio in professional and technical workers (specialist) is also high, except in agriculture (see Figure 5-3-7). Alongside rapid advances in technological innovation and industrial restructuring in recent years, the demand for master's graduates appears to be high among business enterprises, in areas such as product development.

For this reason, the role of the master's courses has grown in importance for cultivating of human resources with the specialized knowledge and skills in natural sciences.

(2) Doctorate courses

In the doctorate degree programs for natural sciences, the demand for sophisticated education and research, especially in the areas of advanced science and technology, has led to steady increase in the number of enrollments, in a trend similar to those enrolling in master's courses.

However, career paths of those who have completed doctorate in natural sciences show that the ratio of unemployed is extremely high, in sharp contrast to the ratio for master's graduates. Although this number includes postdoctorates, the fact remains that the ratio is high.

In contrast to master's graduates, the employment ratio for doctorate graduates in natural sciences is the highest in services, such as education and health care, rather than in manufacturing. However, a closer look at science-and-engineering degree holders shows that the employment rate in manufacturing remains roughly constant since the 1990s (see Figure 5-3-5 (A)), the number of students being employed in this industry has continued to increase. This shows that the demand for doctorate graduates is growing with sophistication of R&D at business enterprises and other organizations.

5.4 The number of doctorate recipients

5.4.1 Trends in the number of doctorates conferred

The number of doctorates conferred is an important indicator in assessing the quality of human resources in S&T.

Figure 5-4-1 shows the trends in the number of degrees conferred according to major courses of study. The number of degrees conferred described herein represents the number of degrees (so-called new doctorates) granted during that fiscal year based on accreditation standards. The number of degrees that remained around 4000 in the first half of 1970s rose steadily from the latter half of the decade, exceeding 8000 in FY1986. The growth has continued thereafter, reaching 16,183 in FY2001.

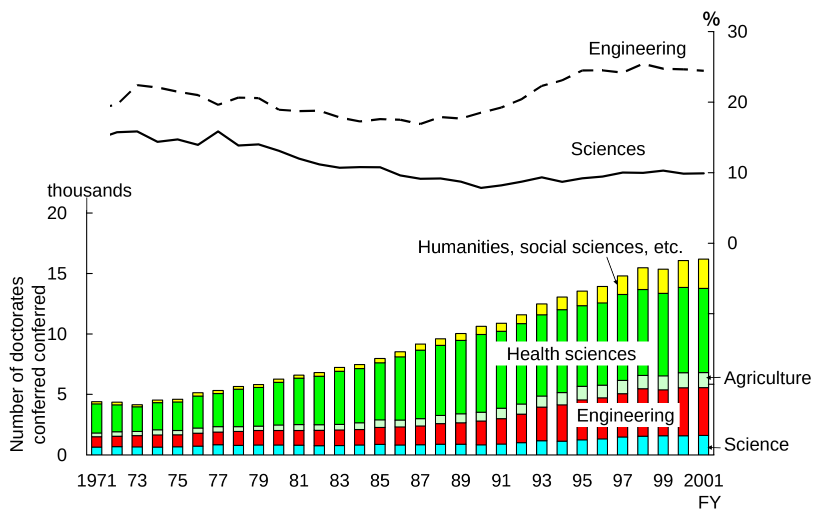
In the breakdown of degrees granted in FY2001 by course of study, health sciences (medicine, dentistry, pharmacology and health care) accounted for 43.0%, or 6962 doctorates. The number for physical sciences is 1602 (9.9%); the number for engineering is 3955 (24.4%).

Looking into the makeup of science and engineering degrees, the ratio has remains slightly low since FY1970. However, degrees in engineering have grown from around FY1988, and those in science began to increase in FY1991.

Figure 5-4-2 shows the number of degrees in science and engineering and the trends in breakdown by number of doctorates based on doctorate courses and dissertation. The number of doctorate degrees conferred in science has remained roughly constant until the 1980s but began to increase in FY1991. In the breakdown of the award of them by doctorate courses and by dissertation in the number of the former has constantly exceeded that of the latter throughout the entire period of study. In particular, the recent rise in number of doctorate degrees has been the result of growth in the number of doctorates based on doctorate courses. The ratio of such doctorates rose to 85.9% in FY2001.

On the other hand, degrees conferred in engineering have been increasing in number steadily. From the latter half of the 1980s in particular, this increasing tendency has become much stronger. In breakdown of the degrees, the number of dissertation doctorates have consistently exceeded the number of course doctorates, in sharp contrast to the trends in science. However, the number of course doctorates has grown rapidly in recent years, in a trend similar to that of science. In FY1992, doctorate courses degrees have exceeded those based on dissertation, accounting for 74.2% of all doctorates granted in FY2001. This trend is believed to be the result of rising advancement rate to graduate schools recent years, as seen in Section 5.3.

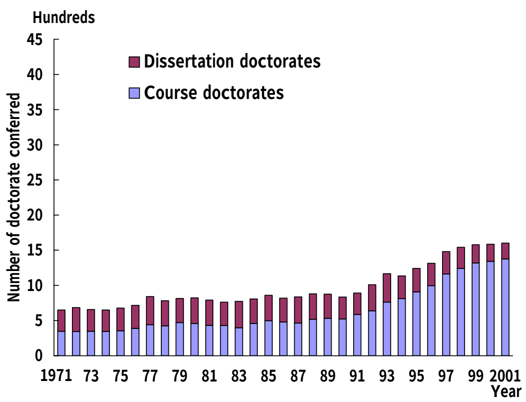
Figure 5-4-1: Trends in the number of doctorates conferred



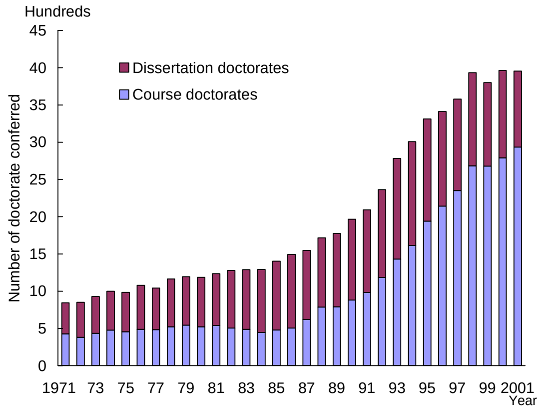
Notes:1. 'Health sciences' consist of medicine, dentistry, pharmacology and health care.
2. 'Humanities, social science, etc.,' include education, arts and home economics.
Sources: Hiroshima University Educational Research Center, 'Advanced Education Statistical Data (1989)' for data up to FY1986; data for FY1987 and later from the Ministry of Education, Culture, Sports, Science and Technology (MEXT)
See: Table 5-4-1

Figure 5-4-2: Trends in the number of doctorate conferred (by course/by dissertation)

(A) Science



(B) Engineering



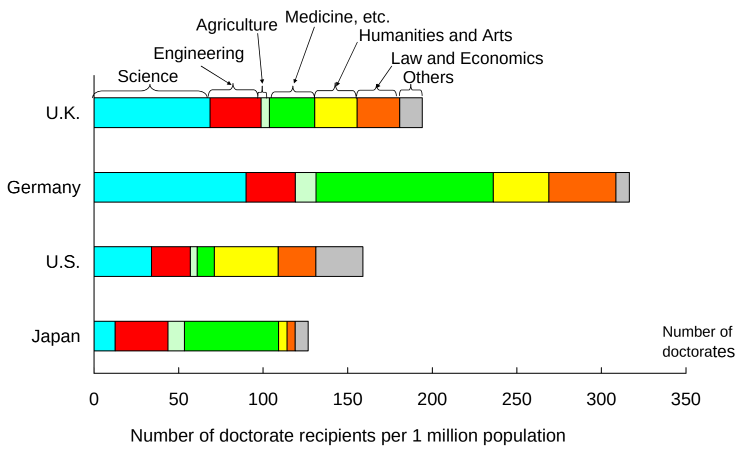
Source: Same as Figure 5-4-1.
See: Table 5-4-2

5.4.2 International comparison of the number of doctorate

Figure 5-4-3 is a comparison of the number of doctorate recipients per million people in FY2000, organized on an international scale. Although attention must be paid on the differences in the content, etc., of doctorate degrees by country, the figures show that the number of doctorates per million is highest in Germany with 317. This is followed by 192 in the United Kingdom and 159 in the United States. In Japan, the number of doctorates per million is 127, roughly 40% of the number in Germany, 70% of the United Kingdom and 80% of the number in the United States.

In the breakdown by major for each nation, the ratio is high in humanities, arts and science in the United States, medicine and science in Germany and science in the United Kingdom. In Japan, the ratio is particularly high for doctorates in medicine and engineering, compared to the other three nations.

Figure 5-4-3: International comparison of the number of doctorate recipients per 1 million population (FY2000)



Notes:<Japan> Number of doctorates conferred from April 2000 2 March 2001.
<U. S.> Number of doctorates conferred from the academic year starting in September 2000. The number includes holders of Ph.D. (Doctor of Philosophy) and D.Sc. (Doctor of Science), Reference statistics such as M.D. (Doctor of Medicine).
<Germany> Number of persons who qualified in doctorate examinations during the winter semester of 2000 and summer semester of the following year.
<UK> Number of doctorates conferred in the calendar year of 2000.
Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), '2004 International Comparison of Education Indicators' Appendix A
See: Table 5-4-3, reference statistics

5.4.3 Fostering of human resources in S&T (conclusion)

The data in this section shows that the number of doctorate conferred is growing steadily, especially with the recent growth in number of course doctorates.

This trend is believed to reflect the growing importance of the doctorate courses for fostering of creative and innovative human resources in S&T, chiefly in the area of advanced science and technology, in face of the recent advances in S&T/ and academic research and rapid technological innovation.

As seen in 5.3, however, demand among business enterprises is growing for master's graduates, who have adaptable fighting potential in new-product development. In the future, business enterprises, as well as universities and public research institutes, are expected to make effective use of talented doctorate recipients with creative and specialized knowledge and skills.

References

1. Ministry of Education, Culture, Sports, Science and Technology (MEXT), "Japanese Government Policies in Education, Culture, Sports, Science and Technology" (from FY2001)
2. Ministry of Education, "Japanese Government Policies in Education, Science, Sports and Culture" (until FY2000)

Part III

Knowledge Production

Chapter 6
International Comparison of National R&D systems

In Part III (Chapters 6 to 11), R&D activities in Japan and other major developed countries are examined based primarily on statistics on R&D expenditure and human resources. These data refer only to input into R&D and allow us to understand only one side of R&D activities. However, since statistics on these topics are relatively expensive, they can be used as important indicators to assess the internal structure of National R&D systems and activities.

Chapter 6 examines how well a country's R&D activities work as a single system and reviews some indicators to identify the overall characteristics of such systems, with particular emphasis on the roles of and the relationships between different sectors such as business, government, higher education, and private non-profit organizations.

6.1 R&D trends in major countries

6.1.1 Overall trends

Let us begin with the gross domestic expenditure on R&D to identify the amount and trend of R&D activities in Japan and other major countries. There are some aspects that should be considered when examining these statistics. Despite continuous efforts by the OECD and other organizations to standardize the methodology for surveying R&D expenditure, there is still some variation from country to country in the survey contents and methods. This makes precise comparison of R&D expenditure very difficult. In addition, since country-by-country comparison of R&D expenditure requires currency conversion, the results are inevitably influenced by factors other than R&D itself. The statistics on R&D expenditure shown in this section are, in principle, expressed in Japanese currency, yen, having been converted using the purchasing power parity of GDP calculated by the OECD.

Figure 6-1-1 shows the gross domestic R&D expenditure for selected countries. Plot (A) indicates the nominal figures (R&D expenditure expressed in each year's prices) and Plot (B) shows the real figures (R&D expenditure expressed in 1995 prices, where 1995 is the reference year). Since gross domestic R&D expenditure is dependent on the country's economic size, the U.S. is dominant, followed by Japan and Germany. France and the U.K. rank after them at similar levels. Other than the five major developed countries, China has risen, surpassing the U.K. and France, and even Germany, by 2001.

Over time, the U.S., Japan, China, and Germany have demonstrated an upward trend, while trends in France and the U.K. remain flat. The EU has also been on the rise.

The gross domestic R&D expenditure of Japan for fiscal year[1] 2002 totaled ¥16,675.1 billion, up 0.9% from ¥16,528 billion of the previous year. Japan's R&D expenditure indicated brisk, constant growth until the early 1990s before declining in 1993 and 1994. The country's R&D expenditure resumed growth in 1995 and increased steadily for the four consecutive years through 1998. However, it experienced a 0.8% decline in 1999, since which time the pace of increase has remained slow.

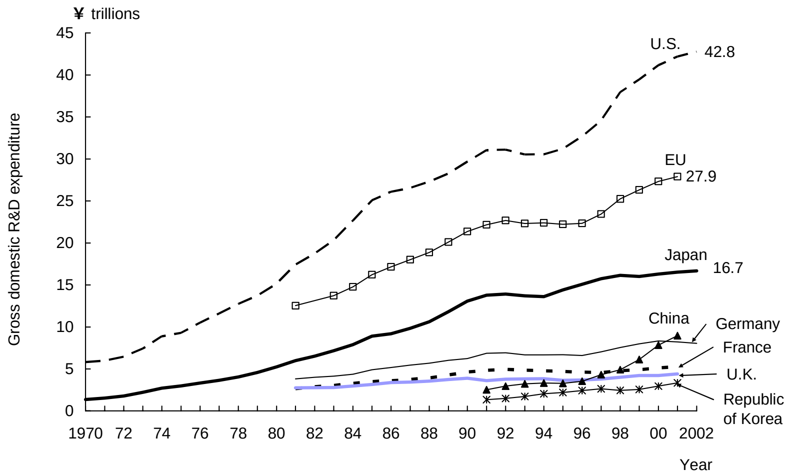
The gross domestic R&D expenditure in real terms illustrated in Plot (B) is more appropriate for identifying changes in R&D expenditure over time. However, note that Plot (B) does not accurately indicate long-term trends either, because of the impact of currency conversion on the results of all selected countries but Japan. Nevertheless, it is obvious that all counties in the plot either experienced a slowdown or a decline in the early 1990s. In the latter half of the 1990s, the trends in

[1] Since the period covered to collect yearly gross domestic R&D expenditure data differs depending on the country, this report in principle uses the calendar year for international comparison. However, the fiscal year may sometimes be used for certain types of data for convenience.

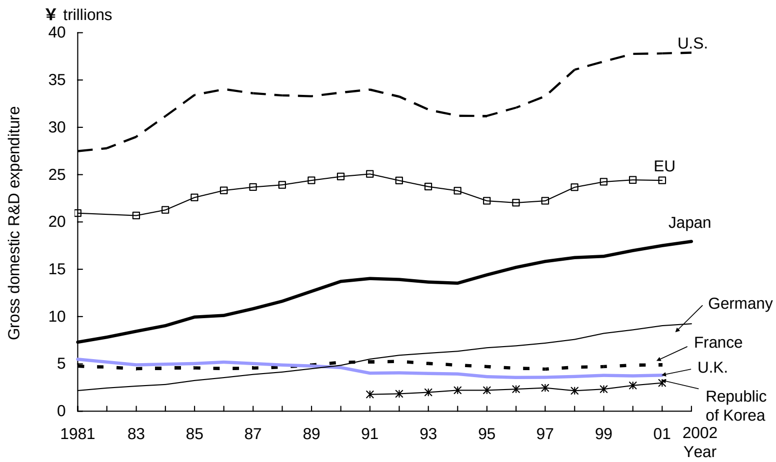
the U.S. and Japan took an upturn, followed some time after by those in Germany, the U.K. and France. For the remainder of the selected period, all countries showed either slight growth or a leveling-off. The EU also posted a rise in the second half of the 1990s but has not recovered its peak level of 1991.

Figure 6-1-1: Trends in gross domestic R&D expenditure for selected countries

(A) Nominal figures (on a PPP basis)



(B) Real figures (in 1995 prices; on a PPP basis)

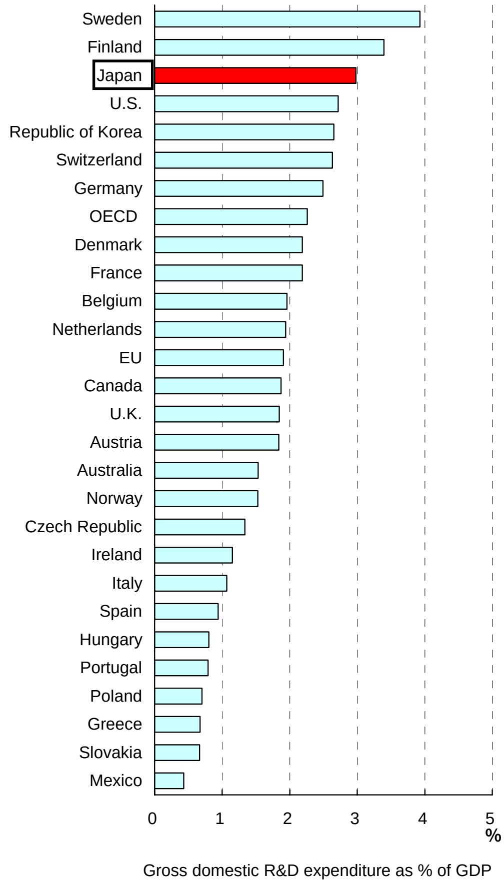


Notes: 1) R&D expenditure includes social sciences and humanities (except for Republic of Korea). The data for Japan include the software industry since fiscal year 1996.
2) The data for Germany refer only to the former federal states until 1990 and to all of Germany since 1991.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
<U.S.> NSF, "National Patterns of R&D Resources 2002 Data Update"
<Germany> Bundesministerium für Bildung und Forschung, "Faktenbericht Forschung 2002"; For German data since 2000, OECD, "Main Science and Technology Indicators 2003/01"
<France, U.K., China, Republic of Korea, and the EU> OECD, "Main Science and Technology Indicators 2003/01"; For British data since 1991, ONS, "Gross domestic expenditure on research and development 2001"
1) The real figures are calculated using the deflator (based on Reference Statistics D).
2) The same purchasing power parities as for Reference Statistics D are used. See: Table 6-1-1

The next graph (Figure 6-1-2) shows gross domestic R&D expenditure as a percentage of GDP (the ratio of gross domestic R&D expenditure to gross domestic product) to compare each country's R&D spending adjusted for the size of the economy. This indicator, which measures the intensity of a country's R&D efforts, is often used for international comparison because it does not involve currency conversion. The indicator is sometimes even discussed as a policy objective.

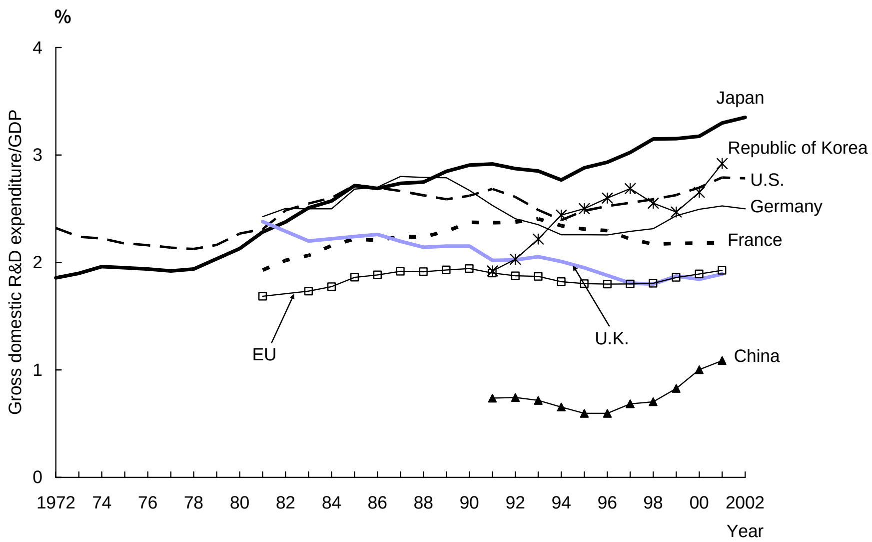
Japan's gross domestic R&D expenditure as a percentage of GDP was the third largest among the OECD countries, standing at a relatively high level.

Figure 6-1-2: Gross domestic R&D expenditure as a percentage of GDP by country (1999-2000)



Notes: The data for the OECD, Denmark, Belgium, Greece, Slovakia, and Mexico refer to 1999. The data for the remainder of the countries refer to 2000.
<OECD> Not including Hungary, Poland, and Slovakia
<EU> Not including Belgium, Denmark, and Greece
Source: OECD, "STI Scoreboard 2003"
See: Table 6-1-2

Figure 6-1-3: Trends in R&D expenditure per GDP for selected countries



Note: This graph is the same as in Figure 1-1-1.
For notes on gross domestic R&D expenditure, see those on Table 6-1-1. For notes on GDP, see those on Reference Statistics C.
Sources: The source of gross domestic R&D expenditure is the same
as in Table 6-1-1. The source of GDP is the same as in Reference Statistics C.
See: Table 6-1-3

Next, let us examine changes in the intensity of R&D activities in individual countries by analyzing long-term trends in gross domestic R&D expenditure as a percentage of GDP (Figure 6-1-3). As the graph illustrates, the gross domestic R&D expenditure of all the five major countries except the U.K. grew at rates higher than their GDP growth rates between the early 1970s and the mid-1980s. Expenditure on R&D accounted for over 2% of GDP in these countries for most of the 1980s. Each country, however, saw this trend slow down or take a downward turn between the latter half of the 1980s and the early half of the 1990s. From the mid-1990s onwards, each country has shown varying trends; Japan and the U.S. were the first to resume growth, followed by Germany, the U.K. and the EU. The trend of France has remained flat since around 1998.

Gross domestic R&D expenditure per GDP in Japan was the highest among the five countries in 1987, thanks to a brisk rise since the second half of the 1970s, and the country maintained top position for the remainder of the period shown. After a decline for four consecutive years from 1991 to 1994, and some growth and leveling-off periods in the subsequent years, gross domestic R&D expenditure per GDP in Japan finally resumed its increase in 2000. The percentage for Japan in 2002 was 3.35%, up 0.05 points from the previous year. The increase in 2001 is in part attributed to the year-on-year decline in GDP that Japan registered for the same year.

Gross domestic R&D expenditure per GDP of the U.S. declined significantly between 1992 and 1994 before increasing by 2002 to 2.78%, a high level relative to levels of the past. The U.S. ranked second after Japan as of 2002 among the five major countries.

In Germany, gross domestic R&D expenditure per GDP was similar to that of the U.S. in 1989 but declined continuously until 1996. Recovery started in 1997, and the percentage figure increased to 2.50% by 2002, which is, as is the case with the U.S., a high level relative to levels of the past. The data for Germany shows a break in the series in 1991; data until 1990 refer to West Germany only and data from 1991 onward refer to unified Germany. France showed a modest but steady increase from the latter half of 1970s to the early half of 1990s, peaking in 1993. After the peak, gross domestic R&D expenditure per GDP in France declined and leveled off, standing at 2.18% as of 2001. Gross domestic R&D expenditure per GDP of the U.K. declined continuously until 1998 since a peak in 1981 and has grown slightly since 1999. The negative trends Germany and the U.K. indicated since the 1990s can partly be attributed to a rise in their GDP.

China, which has seen rapid industrial growth in recent years, has also grown in terms of gross domestic R&D expenditure per GDP since 1996, quickly narrowing the wide gap that still exists between China and Japan or other developed countries. Republic of Korea exceeded the U.S. in 2001, reaching the second highest level after Japan.

Now let us consider the number of researchers in individual countries. Note that there are some problems with the existing statistics such as differences by country in the definition of research personnel[(2)] and the methodology for counting them. Figure 6-1-4 illustrates the trends in the number of researchers in selected countries, demonstrating that the number is growing in all of the selected countries. In addition, the overall trend in the number of researchers is largely dependent on changes in the number of researchers in the business sector, which accounts for 60% to 80% of the total number of researchers in all sectors in each country.

The number of researchers in the U.S. has increased markedly since the latter half of the 1970s. After a slowdown for several years, growth resumed sharply in 1997 to hit the highest ever figure of 1,261,000 researchers in 1999.

Japan has the second largest research population, or 791,000 researchers, after the U.S. as of 2003. The number of researchers in the country grew linearly between 1970 and 2000. As explained later, the growth derives from the increased number of researchers in the business sector. A large increase in 2002 from the previous year is attributable to a change in the method for survey data aggregation. In the Japanese statistics, the Japanese definition of researchers is rather wide, possibly resulting in an overestimate compared with U.S. statistics.

Throughout the selected period in Figure 6-1-4, the number of researchers in the EU increased linearly. The trends in major European countries are as follows. In Germany, the number of researchers suddenly rose in 1991 owing to the reunification of East and West Germany in 1990 and declined slightly in 1995 and 1996. Changes in the number of researchers in the business sector had a large impact on this fall. Since 1997, the number of researchers has increased slightly. In the U.K., after a modest decline between 1989 and 1991, the number of researchers increased slowly for the remainder of the selected period. In France, it increased steadily throughout the selected period.

It is to some extend inappropriate to compare Japan's statistics on researchers directly with those of other countries because Japan's data until 2001 are not expressed in full-time equivalent (FTE), unlike statistics on researchers in many other countries. On a full-time equivalent basis, researchers are counted considering their activities, and the hours spent on non-research activities are excluded[(3)]. Because of the difference in the counting method, Japan's research population in and before 2001 is assumed to be overestimated. In 2002, Japan finally started to count full-time-equivalent researchers, a decision that allowed us to show two types of data, data measured using the traditional method (head count, or 'HC' in the plot) and the data of full-time equivalents ('FTE' in the plot) for 2002 and 2003 in Figure 6-1-4.

Japan's research personnel statistics are based on the definition presented by the Ministry of Public

(2) 'Researcher' is defined as 'experts engaged in the invention and creation of new knowledge, products, processes, methods, and systems, and management of these operations' in the Frascati Manual published by the OECD.

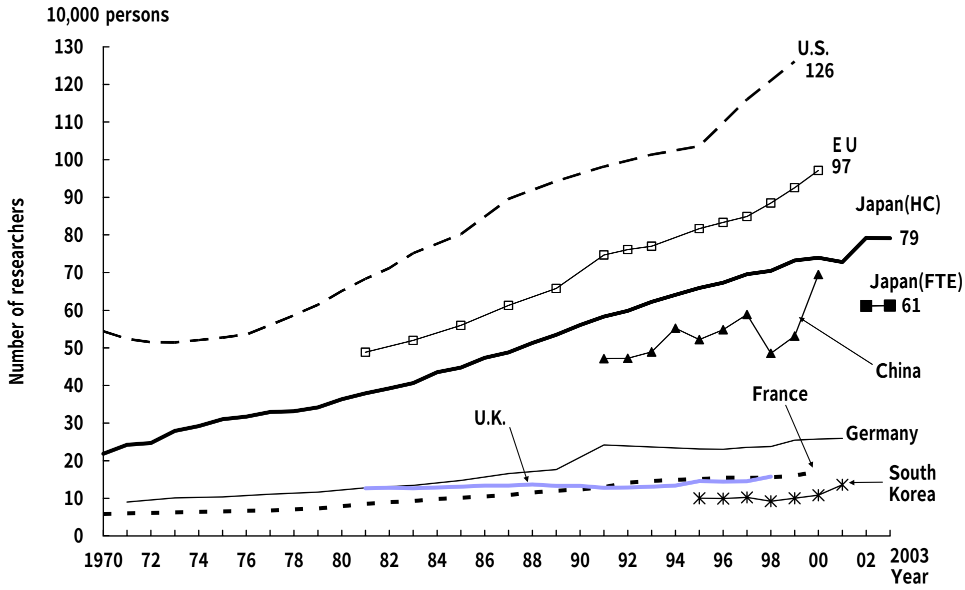
(3) Calculating the number of full-time-equivalent researchers (FTE) intends to count researchers based on the hours actually spent on R&D by distinguishing R&D activities from other activities. Its purpose lies in measuring the staff time actually used for R&D, considering that researchers at universities and other higher education institutions are often engaged in both education and research (part-time researchers), unlike full-time researchers, who are dedicated to R&D. For example, a researcher who spends 60% of his/her hours on R&D is considered as 0.6 FTE.

Since the OECD recommended in 1975 that R&D personnel manpower should be calculated on a full-time equivalent basis, many OECD countries have adopted this calculation method. The need to count full-time-equivalent researchers and the principle of calculation are described in the Frascati Manual, the OECD's proposal for an international standard for surveys on R&D statistics.

In Japan, the Statistics Bureau of the Ministry of Public Management, Home Affairs, Posts and Telecommunications has been measuring the total number of full-time-equivalent researchers, except for those in the 'higher education' sector since 2002, to publish in its 'Report on the Survey of Research and Development.' The number of researchers in the higher education sector was investigated by the Science and Technology Policy Bureau, the Ministry of Education, Culture, Sports, Science and Technology, through the 'Survey on the Data Calculated in Full-Time Equivalent in Universities etc.' on November 30, 2002 (see Figure 10-1-2).

Management, Home Affairs, Posts and Telecommunications in its 'Report on the Survey of Research and Development.' To be more specific, it defines researcher as 'persons who have completed any undergraduate course (not including junior college courses) (or persons who have equivalent or higher technical knowledge) and are working on specific research themes.' The report refers to the research personnel who are primarily engaged in research in institutions as 'regular researchers" (the term is used for all sectors until 2001 and only for universities since 2002). In our report, researchers refer only to 'regular researchers' to avoid double counting non-regular researchers.

Figure 6-1-4: Trends in the number of researchers for selected countries



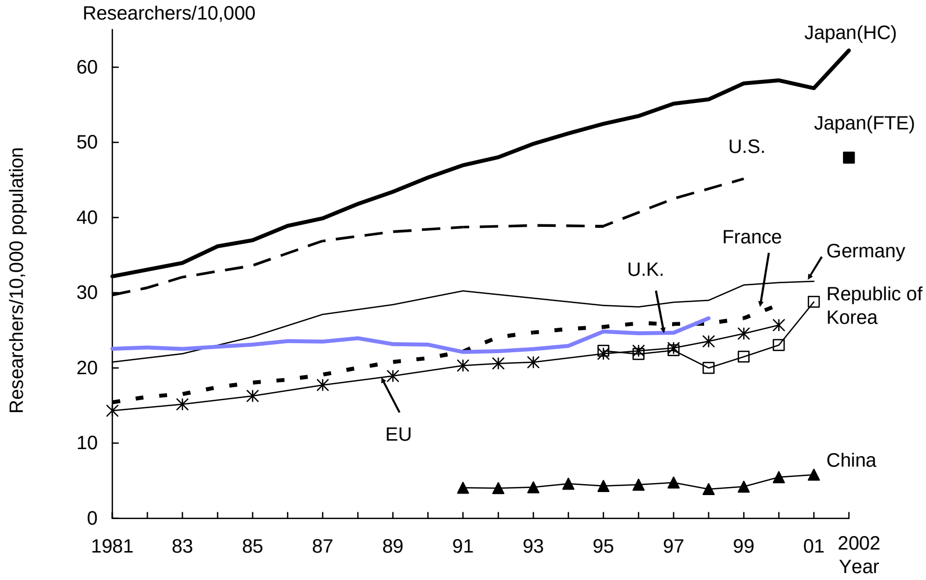
Notes: The data for all countries (except Republic of Korea) refer to the total number of researchers in natural sciences, social sciences, and humanities.
<Japan> (i) Because of a change in the content and date of the survey, data until 2000 refer to the number of regular researchers as of April 1 of that year, and data since 2001 refer to the number of researchers as of March 31.
(ii) The Japanese data on university researchers (FTE) are calculated from the results of the 'Survey on the Data Calculated in Full-Time Equivalent in Universities, etc.' conducted in 2002, and those on researchers in business enterprises, public institutions, or non-profit agencies are the sum of the numbers of researchers (FTE) listed in the 'Report on the Survey of Research and Development' published by the Ministry of Public Management, Home Affairs, Posts and Telecommunications.
(iii) The data for Japan include the software industry since 1997.
<Germany> The data for Germany refer only to the former federal states until 1990 and to all of Germany since 1991.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
Ministry of Education, Culture, Sports, Science and Technology, "Survey on the Data Calculated in Full-Time Equivalent in Universities etc."
<U.S.> NSF, "National Patterns of R&D Resources 1992, 1996, 2002 Data Update"
<Germany> Bundesministerium für Forschung und Technologie, Bundesbericht Forschung 1996, "Faktenbericht Forschung 2002"
<France> OECD, "Basic Science and Technology Statistics 1996/1998/2001"
<U.K., China, Republic of Korea, and the EU> OECD, "Main Science and Technology Indicators 2003/1"; For German data since 1999 and French data since 1981, OECD, "Main Science and Technology Indicators 2003/1"
See: Table 6-1-4

Next, we compare the number of researchers per capita in selected countries. Since the number represents the relative number of researchers, international comparison without the influence of country size is possible. Figure 6-1-5 shows the number of researchers per 10,000 of population. As mentioned earlier, some of the data for Japan are not expressed in full-time equivalents and are thus not directly comparable with other countries' data. However, in 2002, when Japan's data are available on full-time equivalents, the number of researchers per capita in Japan is as high as that in the U.S. The relatively large population of researchers in Japan is attributable to, in addition to the large pool of research personnel in the business sector, an overestimate of university researchers for institutional reasons. Further discussion on the international comparison of university researchers is provided in Chapter 10.

Considering the change over time, particularly during the 1990s, the number of researchers per capita in the U.S. and Germany declined, whereas the number in Japan increased. In the U.S., the downward trend reversed in 1996.

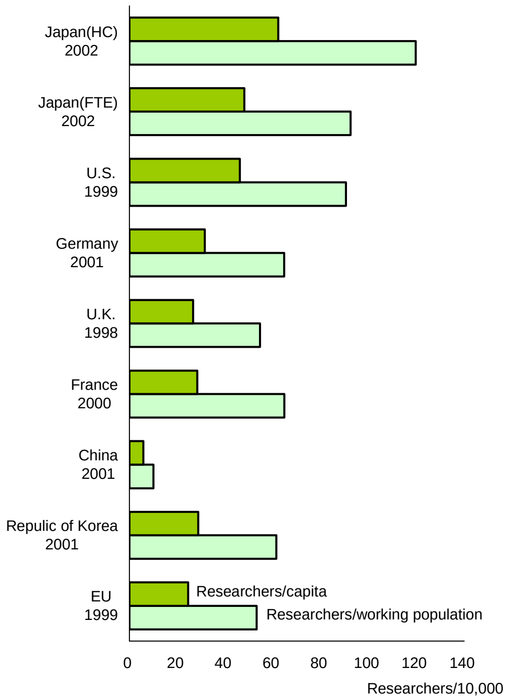
China, while surpassing Germany, France and the U.K. in terms of the total number of researchers, remained low with only about one-fifth of the number of researchers per capita of Germany, France and the U.K.

Figure 6-1-5: Trends in the number of researchers per capita for selected countries



Note: For notes on the number of researchers, the same as in Table 6-1-4; For notes on population, the same as in Reference Statistics A
Sources: For the number of researchers, the same as in Table 6-1-4; For population, the same as Reference Statistics A
See: Table 6-1-5

Figure 6-1-6: Relative number of researchers by country
(Researchers per capita and researchers per working population)



Note: The number of researchers (FTE) in Japan is calculated from the results of the 'Survey on the Data Calculated in Full-Time Equivalent in Universities etc.,' conducted in 2002. However, the data for "medical staff and others" (FTE) are calculated using the ratio of time spent on R&D for teaching staff.
Sources: For population, the same as Reference Statistics A; For working population, the same as Reference Statistics B; For the number of researchers by sector, the same as in Table 6-1-11
See: Table 6-1-6

Since the number of researchers in Japan has become available in full-time equivalents since 2002, as mentioned earlier, we can compare the number with those of other countries as shown in Figure 6-1-6. While the survey year differs by country because of our intention to use the latest available data, this should not be a problem in comparison because the number of researchers has not varied significantly over time.

From the data, we estimate that Japan's numbers of researchers per capita and per working population surpasses those of Germany, France, and the U.K. and, in this respect, Japan shares top position with the U.S., standing at the highest level among the selected countries, including the five major developed countries, China, and the EU. However, the results are subject to certain conditions. In the U.S., for example, only researchers who have earned a doctor's degree within the U.S. are reported as university researchers, resulting in an underestimate, as opposed to a possible overestimate in the Japanese statistics. Therefore, in reality, it is likely that the numbers of researchers per capita and per working population of the U.S. exceed those of Japan. However, we have not found an appropriate method of correctly estimating the data. The full-time equivalent number of Japanese researchers in the higher education sector, which is particularly important as an indicator, is analyzed in detail in Chapter 10 (Figure 1-2-7).

6.1.2 R&D in industry, higher education, and government

The national R&D system consists of a variety of implementing bodies that can typically be divided into two basic sectors, public and private. The former can be further split into the government sector and the higher education sector (or the academic sector that additionally includes related institutions) and the latter into the business sector and the private non-profit sector, to form a total of four categories. In this report, we principally use this classification to perform country-by-country comparison. Focusing on the allocation of R&D resources to these four sectors, this section compares the R&D system of selected countries. The state of R&D activities in each sector and the international comparison of these states are discussed elsewhere in an independent chapter or section.

R&D expenditure in each sector serves as an important indicator of the characteristics of the national R&D system of a country. This indicator should be analyzed considering the source of R&D funding as well as the performer of R&D. Figure 6-1-7 shows a breakdown of R&D expenditure by funding sector and performing sector for selected countries. The percentage of funding from foreign countries is also indicated where possible, since this fifth sector is often reported in the statistics. The U.S. statistics, however, does not categorize foreign sources as an independent funding sector.

The business sector accounts for the largest part of R&D expenditure as both a performer and a funding source in all selected countries. This is the evidence that today's national R&D system is primarily supported by industry. The trend is more evidently seen in the way that R&D funding is used, or in other words, data regarding the performing sectors or R&D; more than 60% of the nationwide R&D expenditure is spent by the business sector in all of the five developed countries.

On the other hand, the significance of the business sector as a source of R&D funding differs from country to country. This sector's contributions to R&D expenditure as a source of funding and a performer are similar in Japan, whereas they differ considerably in other countries. In France and the U.K., the disparity in contribution stems from large amounts of government and foreign R&D funding received by the business sector. This topic is illustrated in Figure 6-1-8. Another common characteristic among the selected countries is that the share of R&D expenditure provided by the business sector is smaller than the share of R&D expenditure it spends.

The share of the government sector as an R&D performer and a funding source varies widely depending on the country. In Japan, the share of R&D expenditure funded by government is the smallest among the five major countries and that of R&D expenditure by the government sector is the second smallest after the U.S. These proportions often become a source of debate on government expenditure on R&D. In Japan, in particular, the proportion of government funding in total R&D expenditure is often discussed as key in policymaking. Japan, the U.S., the U.K. and China share the same trend not seen in the remainder of the countries regarding the breakdown of R&D expenditure. While the shares of R&D expenditure by the government sector of these four countries account for less than 10% of nationwide R&D expenditure, those of Germany, France and the EU represent over 10%.

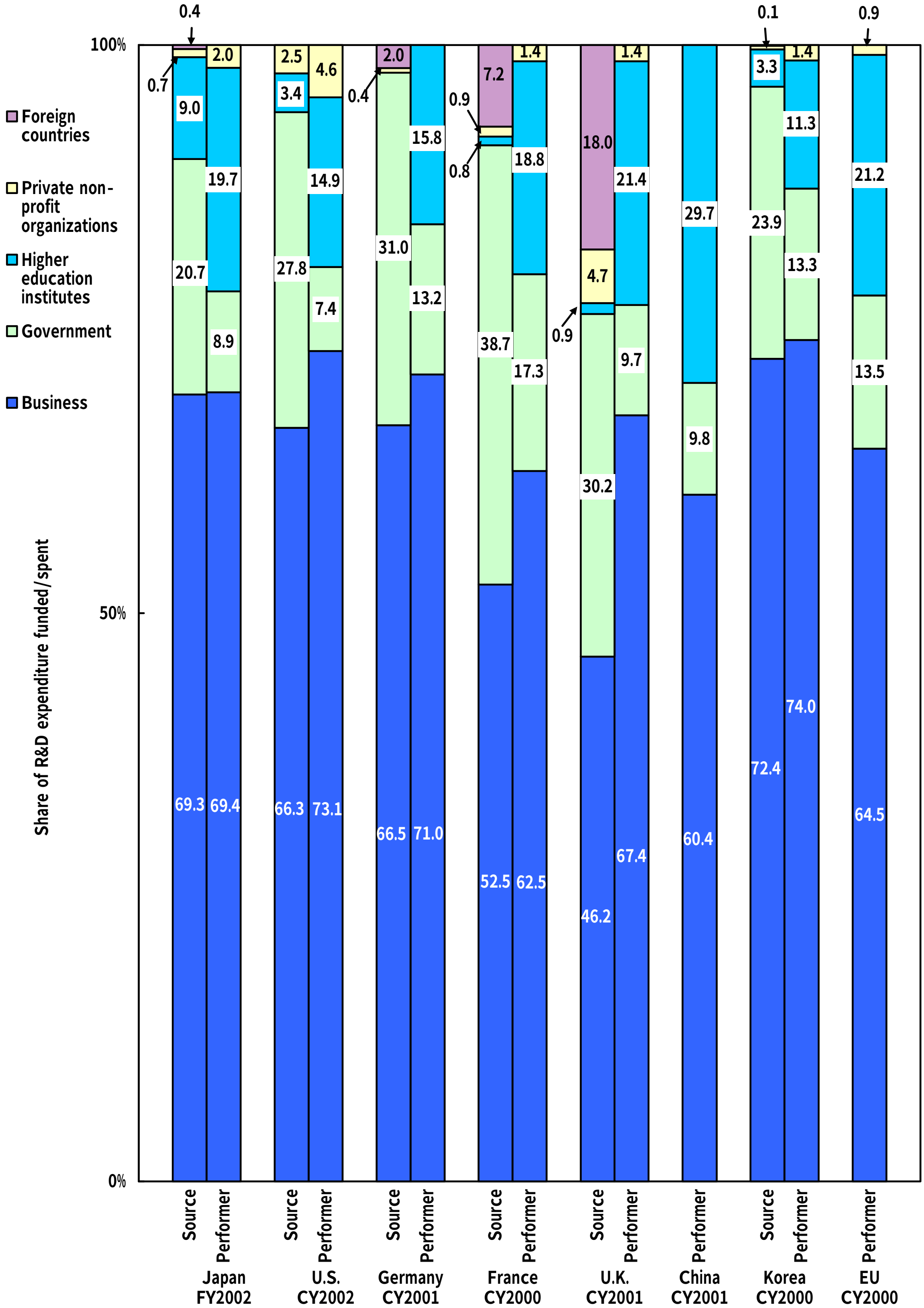
A finding concerning the higher education sector is that the share of R&D expenditure funded by higher education institutes is small in Germany, France, and the U.K. Compared with these three European countries, the share is larger in the U.S., with one-eighth of the share of the R&D funding provided by the government. The share of the higher education sector is the largest in Japan among the five countries, with as much as half of the share of the government sector. From the perspective of the performer of R&D, the higher education sector of Japan plays a major role, spending 19.7% of the total R&D expenditure, which is comparable to the share of the higher education sector in France. France, however, is dissimilar to Japan in that higher education institutes make little contribution to R&D funding. In Japan, private universities are the source of most R&D expenditure funded by the higher education sector.

The share of R&D expenditure by the higher education sector in Japan is relatively high among the selected countries. For the reasons given earlier about full-time equivalents, however, the labor costs included in R&D expenditure in Japan may have been overestimated. Although sufficient data are not available for accurately calculating full-time equivalents regarding R&D expenditure, they were calculated based on the coefficient used for calculating the full-time equivalents for Figure 6-1-6. The resultant share of R&D expenditure by Japan's university sector was 16.3%[(4)]. Assuming this to be a conservative estimate, we infer that, internationally, Japanese higher education institutes spend a relatively large proportion of the nationwide R&D funding. Before this can be accepted as an adequate conclusion, further statistical surveys and the development of more appropriate analysis methods are needed.

An additional noteworthy point is that in the U.K., the share of R&D expenditure funded by foreign countries is large relative to the remainder of the selected countries. As demonstrated in the breakdown in Figure 6-1-8 below, this means a large influx of R&D funding from overseas.

[(4)] Preferably, this should have been calculated by multiplying the labor costs of each type of R&D-related personnel (researchers, research assistants, etc.) by their respective ratio of time spent on R&D to total staff time. However, since a breakdown of labor costs and the working pattern of R&D-related personnel other than researchers are unavailable, we used the ratio of time spent on R&D among researchers (the ratio used for the estimates in Figure 3-1-6) for the multiplication of the labor cost of all types of R&D-related personnel.

Figure 6-1-7: R&D expenditure by performing sector and source of funding for selected countries



Notes: R&D expenditure (except for those of Republic of Korea) is the total of those in natural sciences, social sciences, and humanities.
<Japan> (i) The business sector as a source of funding includes public works and projects conducted by national and local public bodies such as special or independent administrative corporations, government financial corporations, and other public corporations.
(ii) The government sector as a source of funding consists of national and local public bodies, national and public universities (including junior colleges, etc.), national and public research institutes, research institutes run by special or independent administrative corporations, and the like.
(iii) The higher education sector as a source of funding consists of private universities.
(iv) The government sector as a performer consists of national and public research institutes and research institutes run by special or independent administrative corporations (operating on a self-sustaining basis, i.e. affiliated to national or local public bodies).
(v) The higher education sector as a performer consists of national, public, and private universities (including junior colleges, etc.).
<U.S.> (i) The government sector as a source of funding refers to the federal government (part of the R&D expenditure by universities is provided by state governments).
(ii) The higher education sector consists of private and state universities.
(iii) The government sector as a performer consists of federal research agencies.
(iv) The expenditure of the Federally Funded Research and Development Centers (FFRDC's) under the administration of universities is added on the basis of R&D-implementing departments.
(v) The data are preliminary.
<Germany> (i) The government sector as a source of funding consists of the federal and state governments.
(ii) The government sector as a performer consists of federal, state, municipal administrative agencies and private non-profit research institutes.
(iii) The data are estimates by the government or estimates corrected as needed by the OECD secretariat to adhere to the OECD standard.
(iv) There may be breaks in the data series.
<France> (i) The government sector as a performer includes public research institutes.
(ii) The higher education sector as a performer includes technical schools (Grandes Ecoles) and national science research centers.
<U.K.> (i) The government sector as a source of funding consists of central and local government, the Research Councils, and the Higher Education Funding Council.
(ii) The higher education sector consists of private universities.
<Republic of Korea> R&D expenditure does not include that for social sciences and humanities.
<EU> R&D expenditure is preliminary figures estimated by the OECD Secretariat based on the data of individual countries.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
<U.S.> NSF, "National Patterns of R&D Resources: 2002 Data Update"
<Germany, France, and Republic of Korea> OECD, "Basic Science and Technology Statistics 2002/2"
<U.K.> ONS, "Gross domestic expenditure on research and development 2002"
<China and the EU> OECD, "Main Science and Technology Indicators 2003/01"
See: Table 6-1-7

Next, we analyze the flow of R&D expenditure across different sectors as an indicator of relationships between the sectors involved in R&D in the five major countries (Figure 6-1-8). The resultant charts indicate how R&D funding flows from the source sectors to the performing sectors and illustrates the characteristics of each country's R&D system in an easy-to-understand manner.

The most remarkable characteristic of Japan is the meagerness of the flow between sectors. In particular, the outgoing flow from the government sector concentrates on government agencies and higher education institutes, leaving only a small portion to be directed toward the business sector, unlike the other countries that allocate greater funding to this sector. Furthermore, government funding to higher education institutes can hardly be considered as expenditure to a different sector because the majority of the funds goes to national universities. From this fact, it is evident that the Japanese government functions as an R&D performer rather than a source of R&D funding to other sectors. A government with such a position within the national R&D system is dissimilar to those of the other four countries.

The business sector of Japan shows a robust flow to itself. This is a characteristic shared across all the selected countries. In other words, the largest flow of R&D expenditure is within the business sector. Another finding about R&D expenditure flow regarding the Japanese business sector is that the volume of R&D funding received from other sectors is far smaller than the volume received by its counterparts in the other countries. By contrast, a fair amount of R&D expenditure flows from the business sector to the other three sectors.

R&D expenditure flow in the remaining four countries is characterized as follows. In the U.S., there is sizable R&D expenditure flowing from government to business, and this constitutes a large part of the government outgoing flow and the business incoming flow of R&D funding.

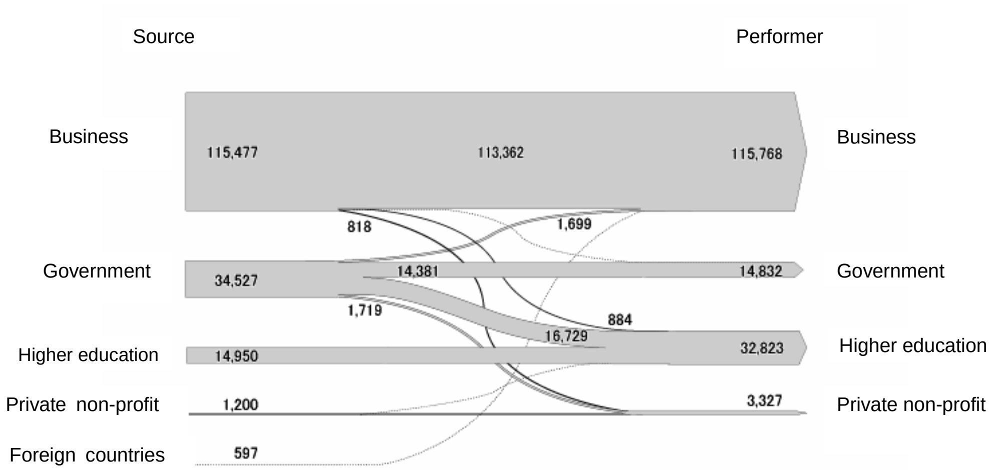
In Germany, a relatively large flow is seen between the government and higher education sectors. Since the government sector and the private non-profit sector fall into the same category in the German R&D statistics, the flow within this aggregate sector represents a relatively large part of all R&D expenditure. In addition, most private non-profit research institutes in Germany are government funded and thus serve as the equivalent of state-run research agencies in other countries.

In France, R&D expenditure from the government sector constitutes a substantial portion of the R&D funding spent by individual sectors.

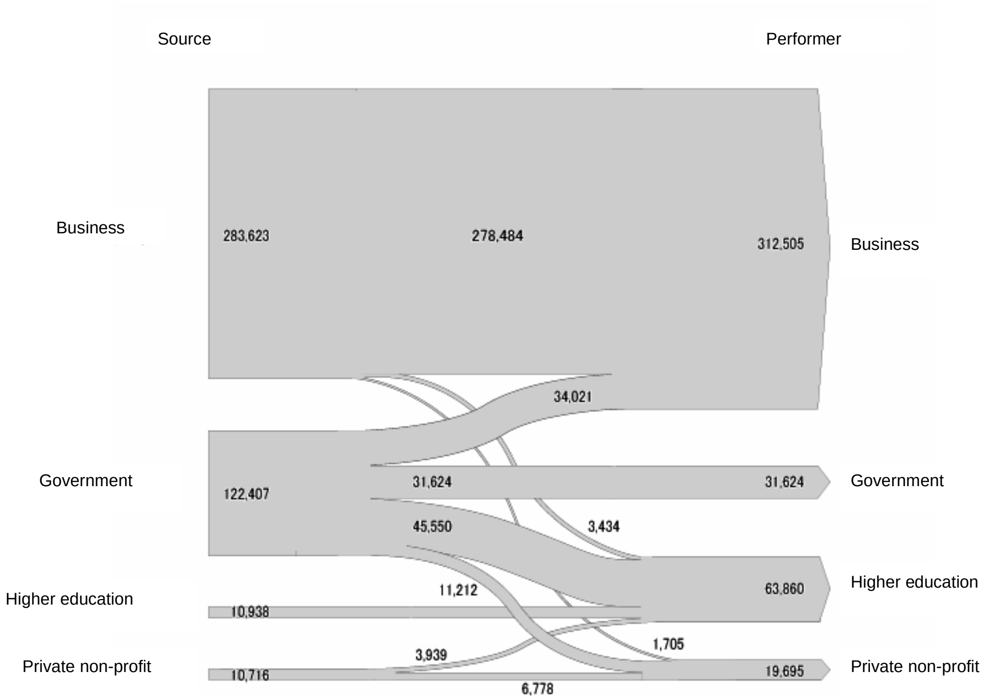
A major part of R&D expenditure in the U.K. is spent by the business sector. It is also notable that the U.K. receives enormous amounts of R&D funding from foreign sources.

Figure 6-1-8: R&D expenditure flow in selected countries

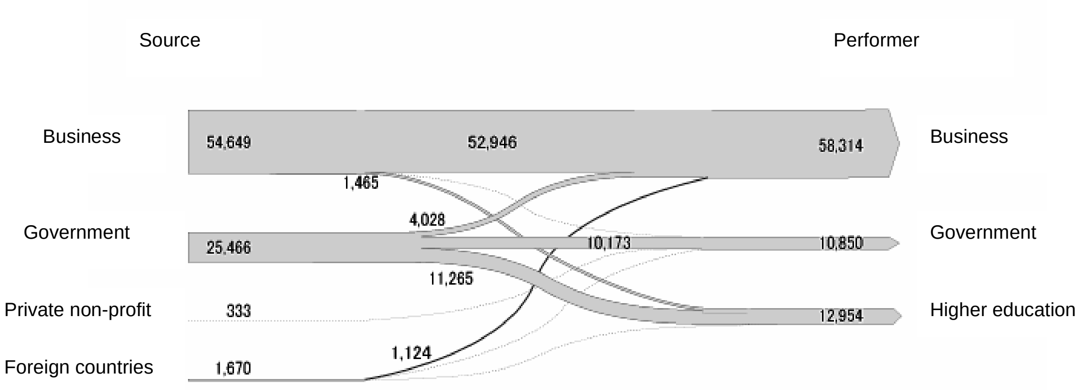
(A) Japan (2002) [in 100 millions of yen]



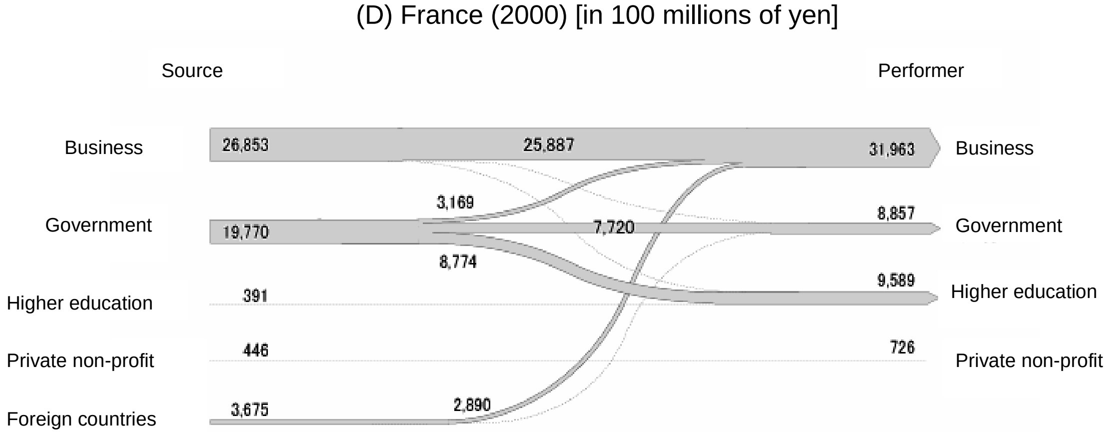
(B) U.S. (2002) [in 100 millions of yen]



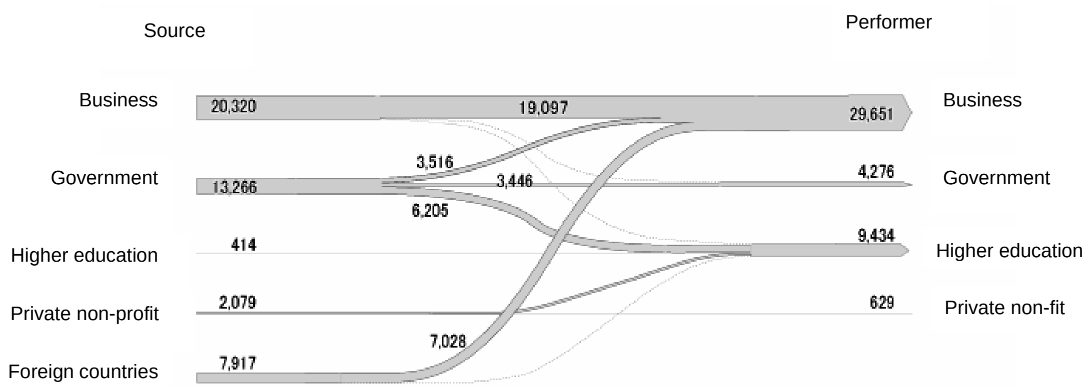
(C) Germany (2001) [in 100 millions of yen]



(D) France (2000) [in 100 millions of yen]



(E) U.K. (2001) [in 100 millions of yen]



Note: Same as Table 6-1-7
Source: Same as Table 6-1-7
Currency conversion is based on the purchasing power parities in Reference Statistics C.
See: Table 6-1-8

We further analyze R&D expenditure by sector considering change over time. Figure 6-1-9 illustrates how the position of each sector in each country has changed over the long term by showing trends in the breakdown of R&D expenditure by performing sector and source of funding.

Each country demonstrates a different trend in the composition of performing sectors, with little in common with the other countries. Attention should be paid to statistics of, among others, the business and government sectors, both of which constitute a major source of R&D funding.

In Japan, the percentage of R&D expenditure funded by the business sector increased in the 1980s, followed by a decline that started in fiscal year 1991 and continued until fiscal year 1995. Since then, the share of the sector has shown a slow recovery. The percentage of the government sector, which, unlike the business sector, was on the decline in the 1980s, has indicated a leveling-off in general since 1993, albeit with slight fluctuations. There was no remarkable change in the proportion of R&D expenditure funded by higher education institutes throughout the selected period.

One characteristic that the U.S. shares with Germany is the relatively high proportion of R&D from the government. However, from the latter half of the 1980s through 2000, the proportion of this sector showed a gradual decrease in the U.S. and the percentage of the business sector as a funding source rose instead. The government sector increased its share again in 2001 and 2002. The higher education and private non-profit sectors, while holding meager shares as sources of R&D funding, have been on the rise over the long term.

In Germany, the government sector serves as a significant source of R&D funding, as described above, although its proportion has shrunk since the latter half of the 1990s. The business sector demonstrates the opposite trend to the government sector as a source of R&D funding. A characteristic of German R&D expenditure is that the contribution of foreign countries remains smaller than that of the U.K. and France.

France has seen the growth of its business sector as a source of R&D funding over time. By contrast, the proportion of the government sector, which was a little bigger than that of the business sector in 1981, continued to decline every year and became a funding source smaller than the business sector in 1992[5]. The higher education and private non-profit sectors, which constitute a minimal source of R&D expenditure, show a modest increase since the early 1990s. R&D expenditure deriving from foreign countries, although having grown in percentage between 1983 and 1991, indicates a gradual fall later on.

In the U.K., the proportion of the R&D expenditure funded by government declined almost constantly throughout the selected period. Compared with the business sector, the government sector held a somewhat larger share in 1981 before the figure declined to a level below that of the business sector in the second half of the 1980s. This downward trend has intensified each year. The private non-profit sector has been a growing source of funding. The major characteristic of the U.K. is that the proportion of R&D expenditure funded by foreign countries has been rising since FY1981, marking highest percentage figures among the selected five countries since the latter half of the 1990s.

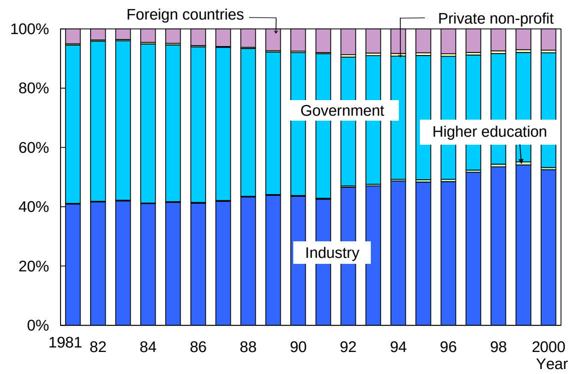
---

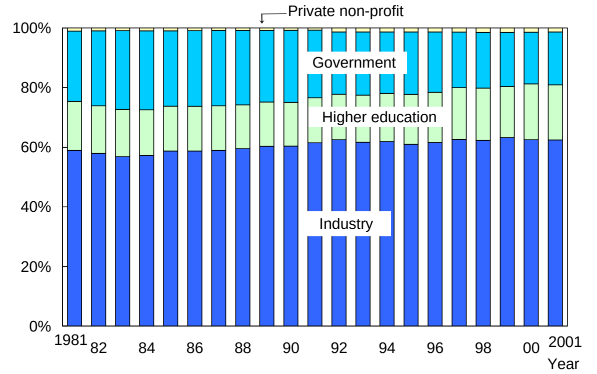
[5] The statistics for France have a break in the data series because of a revision in 1992. However, in the long run, the government is a shrinking source of funding, while the business sector is a growing source.

Figure 6-1-9: Trends in R&D expenditure by performing sector and source of funding for selected countries

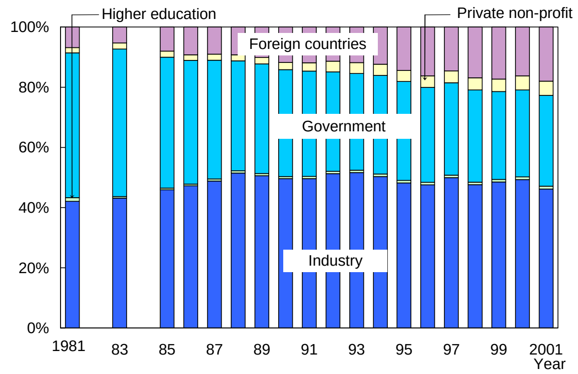
Country | Source | Performer

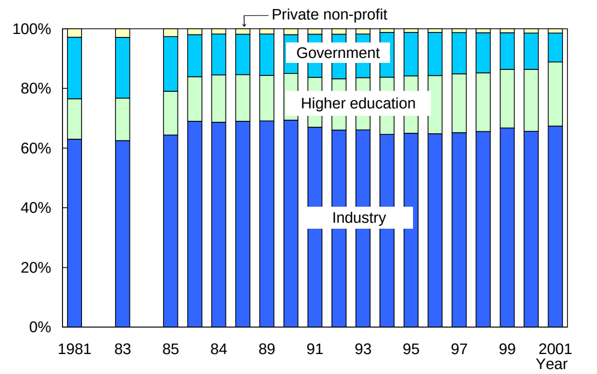
(D) France





(E) U.K.





Note: Same as Figures 6-1-1 and 6-1-8
Source: Same as Figures 6-1-1 and 6-1-8
See: Table 6-1-9

Findings from the trends in R&D expenditure by performing sector for the five countries are as follows. In Japan, as is the case with R&D funding sources, the share of R&D expenditure by the business sector increased in the 1980s before declining between fiscal years 1992 and 1995. Since the end of the decline, this sector has been showing a slow, upward trend as a whole with slight fluctuations. The government sector, on the other hand, maintains a stable contribution to R&D performance. The share of R&D expenditure by the higher education sector declined during the 1980s, when the nation's economy was booming, but recovered in the 1990s to secure a certain proportion for the remainder of the selected period. The share of the private non-profit sector remained stable throughout the selected period. A sudden drop in the share of this sector in FY2001 is attributable mainly to a revision of the classification methodology used for statistics.

The trends in the U.S. performing sectors can be characterized into two aspects: the share of the higher education sector continuing to grow until around 1992 and the share of the government sector steadily shrinking over the selected period. The share of R&D expenditure by the business sector, which has generally remained stable over time, has declined for the last few years. The share of R&D expenditure by the private non-profit sector, while small in percentage, has grown almost constantly.

In Germany, the trend of the business sector as a performer of R&D is similar to the trend as a funding source; growth has continued since the latter half of the 1990s. The share of R&D expenditure by the higher education sector increased in the early half of the 1990s, followed by a leveling-off since the latter half of the 1990s. There is also a similarity between the trends in the shares of R&D performed and funded by government, which is a continued fall since 1990. The share of R&D expenditure by the government sector, however, has been relatively stable.

In France, the contribution of the government sector to total R&D performance was the largest among the five countries, although the percentage share has been on a long-term decline since the mid-1980s. As opposed to this, the share of R&D expenditure by the business sector has grown gradually. The higher education sector's share has also increased slightly since the 1990s.

A basic trend in R&D spending in the U.K. since the 1990s is that, just like in France, the government sector's share has declined, while the higher education sector's share has increased. The business sector's share in total R&D expenditure performed increased in the 1980s and has remained stable since the 1990s.

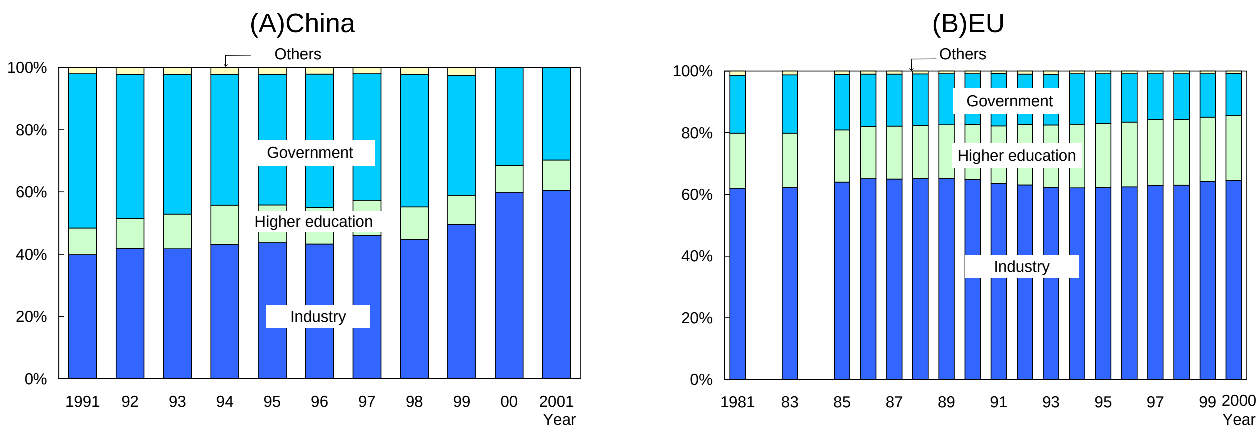
Major developed countries and three members of the EU, Germany, France, and the U.K., have common characteristics. In these three countries, the government sector's share in total R&D expenditure has been declining, while the higher education sector' share has been increasing slowly.

The regions that have been attracting attention recently outside the five major countries are the EU and China. Figure 6-1-10 illustrates R&D expenditure by performing sector in these regions over time. Unfortunately, no data are available on R&D expenditure by source of funding.

In China, the share of R&D expenditure by the government sector is far the largest among the five countries, although it has been diminishing since 1999. By contrast, the share of the business sector has grown over time, and the growth rate was particularly high in the 1999-to-2000 period. This suggests that R&D performance in industry intensified as the economy developed.

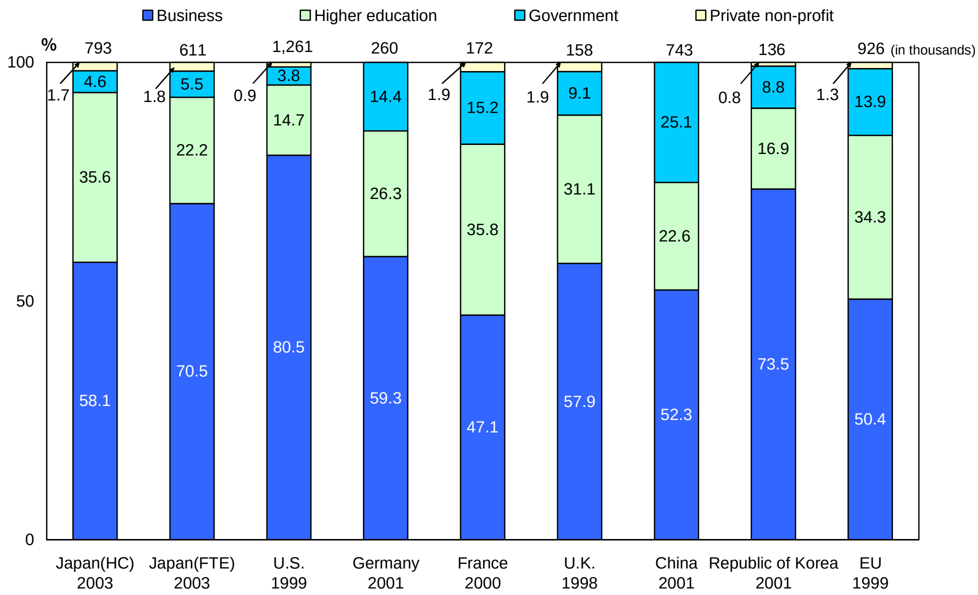
The EU shares the following three characteristic in common with Germany, the U.K., and France: (1) the share of the business sector increased in the 1980s, declined temporarily in the first half of the 1990s, and later recovered slightly, (2) the share of the government sector has shown a downward trend for a long time, and (3) the share of the higher education sector has increased.

Figure 6-1-10: Trends in R&D expenditure by performing sector for the EU and China



Notes: 1) R&D expenditure includes expenditure in social sciences and humanities.
2) The data for the 'Other' category are calculated by subtracting the shares of the business, higher education, and government sectors from the total.
Source: OECD, "Main Science and Technology Indicators 2003/1"
See: Table 6-1-10

Figure 6-1-11: Number of researchers by sector for selected countries



Notes: 1) The Japanese data on university researchers (FTE) are calculated from the results of the 'Survey on the Data Calculated in Full-Time Equivalents in Universities, etc.' conducted in 2002.
2) The data for the private non-profit sector of the EU are calculated by subtracting the shares of the business, higher education, and government sectors from the total.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"; Science and Technology Policy Bureau, Ministry of Education, Culture, Sports, Science and Technology, "Survey on the Data Calculated in Full-Time Equivalents in Universities etc."
<U.S.> NSF, "National Patterns of R&D Resources: 2002 Data Update"
<France, U.K., China, Republic of Korea, and the EU> OECD, "Main Science and Technology Indicators 2003/1"
See: Table 6-1-11

In Figure 6-1-11, the number of researchers by sector in selected countries is compared. As in the case of R&D expenditure, the share of the business sector is the largest in all countries. The higher education sector and the government sector follows in all countries other than China, where the share of the latter sector exceeds that of the former. However, these percentage figures may not be completely accurate and should therefore be considered just as information that can help identify rough trends, because the survey methodology to obtain statistics on the number of researchers in each sector varies by country or sector.

It is notable that Japan has a relatively small government sector share. For Japan, we indicate the data both as full-time equivalents and head counts. The higher education sector share of Japan in full-time equivalents stood at 22.2%, which is lower than the equivalent figures for France and the U.K. but comparable to that of Germany.

In the U.S., the share of the business sector is the highest among the five countries, while the share of the higher education sector is the lowest. However, the actual share of the U.S. higher education sector must be larger than this because, as explained earlier, the number of university researchers in the U.S. is assumed to be underestimated, as opposed to Japan. Likewise, when analyzing the contribution of the private non-profit sector of the U.S., it is necessary to consider similar underestimates.

In France and the U.K., the share of the researchers in the higher education sector is larger than that of the remainder of the selected countries. The EU shows the same trend with a high percentage of higher education researchers.

The share of government researchers in China is higher than that of the remainder of the countries.

The share of the business sector in Republic of Korea is large, whereas the share of the higher education sector is small.

6.2 R&D Characteristics and challenges in Japan

6.2.1 R&D expenditure per researcher

This section continues the discussion on R&D statistics, this time from the viewpoint of R&D characteristics in Japan.

First, consider R&D expenditure per researcher. This is an indicator that reflects the environment for researchers and also measures the balance between the number of research personnel and R&D expenditure. The values of the indicator vary widely depending on the area of R&D and the nature of the research institutes to be surveyed. We first compare R&D expenditure per researcher in the five selected countries based on the latest available data. A major finding is that R&D expenditure per researcher in Japan was ¥21.08 million as of 2003, the lowest of the five countries (Figure 6-2-1 (A)).

From the perspective of balance between the R&D population and R&D expenditure, Japan has a large number of researchers and spends a small amount of R&D funds.

Figure 6-2-1 (A) also shows Japan's R&D expenditure per researcher on a full-time equivalent basis (¥27.24 million for 2003) for reference. The value may not be accurate because the R&D expenditure in full-time equivalents (calculated by subtracting the labor costs of non-R&D activities from the total labor costs of researchers included in R&D expenditure) is unavailable. With this value, Japan exceeds the U.K., although still standing below Germany, the U.S., and France.

Because R&D expenditure per researcher for the latest available year alone is not sufficient to clearly identify trends, we present Figure 6-2-1 (B), which shows how each country's indicators have changed over time.

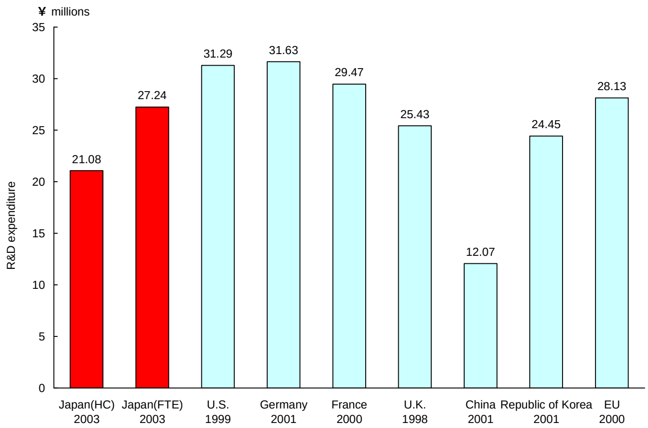
In Japan, R&D expenditure per researcher demonstrates a steady increase until the early 1990s and has recently stabilized in general with some fluctuations.

The U.S. shows a similar trend throughout the selected period.

Since the 1990s, none of the selected countries but China experienced a steady rise in R&D expenditure per researcher. While some countries have recently shown certain growth, their upward trends are limited. For example, Germany has not recovered its peak level recorded in the early years and Republic of Korea has failed to maintain steady growth.

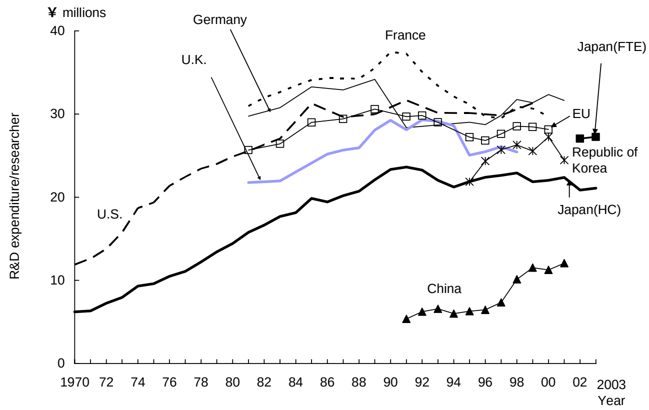
Figure 6-2-1: R&D expenditure per researcher for selected countries

(A) Latest available year



Notes: Same as Figures 6-1-1 and 6-1-4
For Japan, the calculation method for R&D expenditure per researcher differs between the period up to fiscal year 2000 and the subsequent period because the Statistics Bureau, the Ministry of Public Management, Home Affairs, Posts and Telecommunications, changed in 2002 (effective for fiscal 2001 data) the content and date of the survey applicable to its 'Report on the Survey of Research and Development.' R&D expenditure per person until fiscal year 2000 has been calculated by dividing annual R&D expenditure by the number of full-time researchers as of the fiscal year beginning (April 1) and the expenditure since fiscal year 2001 has been calculated by dividing the annual R&D expenditure by the number of researchers as of the end if the fiscal year (March 31).
Sources: Same as Figures 6-1-1 and 6-1-4
See: Table 6-2-1 (A)

(B) 1970 to 2003



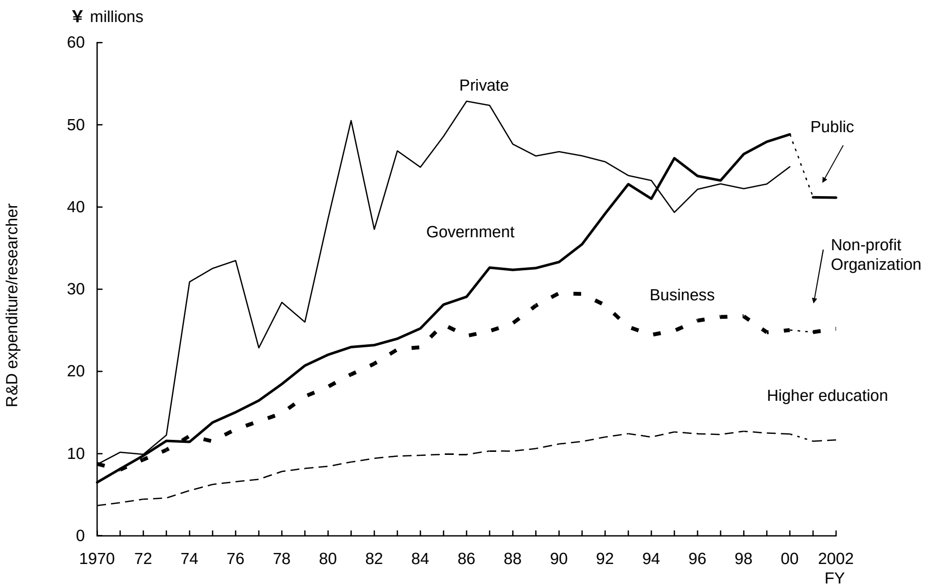
Note: Same as Figure 6-2-1 (A)
Source: Same as Figure 6-2-1 (A) See: Table 6-2-1 (B)

Figure 6-2-2 shows trends in Japan's R&D expenditure per researcher by sector. It illustrates that the value is smallest in the higher education sector, growing at a lower rate than any other sectors. R&D expenditure per researcher in the business sector increased steadily during the 1980s driven by the booming economy, but growth slowed in the 1990s and turned negative with some fluctuations. The government sector, on the other hand, posted major growth in the 1990s and, after a series of peaks and troughs, still continues to increase as opposed to the trend of the business sector.

R&D expenditure per researcher is especially high, among other governmental agencies, in special public corporations, which conduct large-scale R&D activities. Detailed statistics on research institutes constituting the government sector are provided in Chapter 9 (Figure 9-2-3).

R&D expenditure per researcher in private research institutes increased until the latter half of the 1980s with some fluctuations, thanks to the positive economic trend. However, it fell continuously since the late 1980s until 1995, when a slow recovery started.

Figure 6-2-2: Trends in R&D expenditure per researcher in Japan



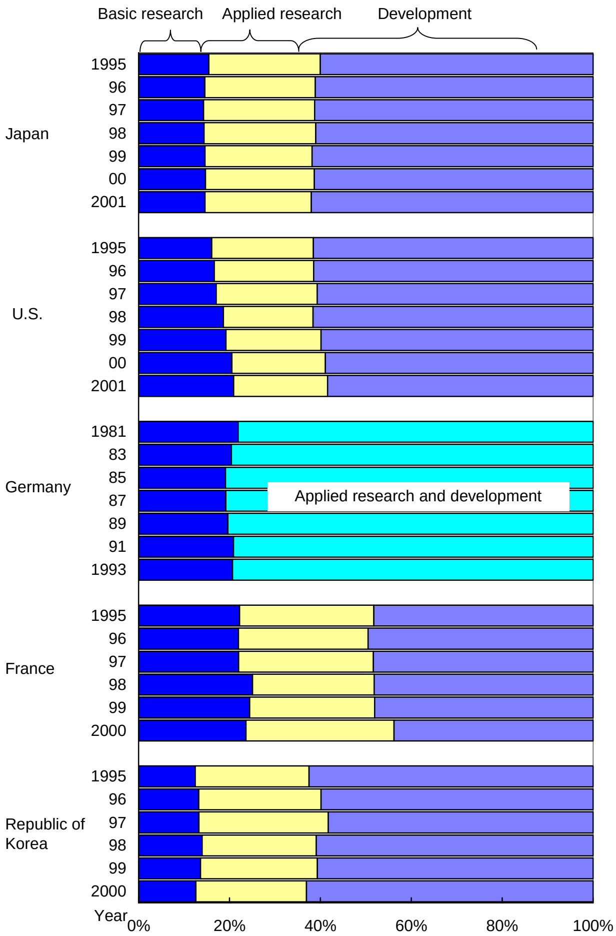
Note: Same as Figure 6-2-1 (A)
Source: Same as Figure 6-2-1 (A)
See: Table 6-2-2

6.2.2 R&D expenditure by character of work

We have already found that a remarkable trend in R&D activities in Japan is that the contribution of the business sector is particularly large, while the share of the government sector is smaller than that of other major developed countries. In this context, a frequently discussed topic is whether R&D funds are appropriately allocated to basic research, applied research, and development. In general, expenditure on basic research is high in higher education institutes and low in the business sector. Figure 6-2-3 compares the allocation of R&D funding in five selected countries, including Republic of Korea, which has been experiencing significant economic growth. The U.K. has been excluded because statistics on R&D expenditure by character of work is unavailable in the country. The shares of basic research expenditure in Japan and the U.S. are smaller than those of Germany and France. In particular, this share in Japan remains the lowest among the four developed countries except for 1995, when it exceeded the U.S. level. The smaller shares of basic research expenditure in Japan and the U.S. are mainly attributable to that the contribution of the business sector to the total domestic R&D expenditure being large in these two countries. Compared with the other four countries, Republic of Korea places less emphasis on basic research (about half the level of France) and focuses more on development.

From the trends over the years, it is noticeable that, in the U.S., the share of basic research expenditure has increased recently, while development expenditure has declined. In Japan, where no significant change has occurred, the overall trend is in contrast to that of the U.S.; the share of basic research expenditure has declined slightly, while that of development expenditure has somewhat increased.

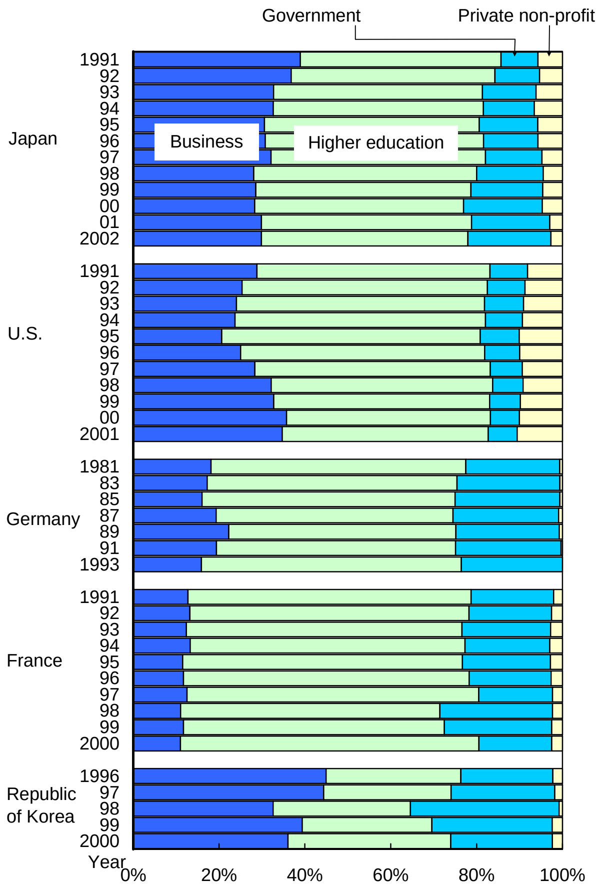
Figure 6-2-3: Trends in R&D expenditure by character of work for selected countries



Notes: 1) The data for Japan include the software industry since FY1996.
2) R&D expenditure for Japan and Republic of Korea refer only to natural sciences. R&D expenditure for the other countries is the combined total of natural sciences and humanities.
3) The data for Germany refer only to basic research.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”
<U.S.> NSF, “National Patterns of R&D Resources 2002 Data Update”; For the data since 1998, OECD, “Basic Science and Technology Statistics 2002/2”
<Germany, France, and Republic of Korea> OECD, “Basic Science and Technology Statistics 2002/2”
See: Table 6-2-3

Next, we investigate which sector assumes the key role in basic research in each country. The trends in expenditure on basic research by performing sector (Figure 6-2-4) illustrate that, in Japan, the share of the business sector remains relatively large, although it was principally declining throughout the 1990s, with a significant reduction in 1993 and 1998. They are the times when many Japanese enterprises curtailed the total R&D spending. The share of the business sector declined or leveled off until 2001, when it marked a year-on-year increase. The share of the government sector has increased over time.

Figure 6-2-4: Trends in basic research expenditure by performing sector for selected countries



Note: Same as Figure 6-2-3
Source: Same as Figure 6-2-3, except for the U.S. data on the government, higher education, and private non-profit sectors, which are based on NSF's "National Patterns of R&D Resources 2002 Data Update"
See: Table 6-2-4

In the U.S., major changes occurred in the business and higher education sectors, while the government and private non-profit sectors have shown a slight decline. The share of basic research expenditure by the business sector declined in the first half of the 1990s, as it did in Japan, but recovered in the latter half of the 1990s, unlike in Japan. However, the share of the business sector declined in 2001 compared with the previous year.

In Germany, the business sector plays a less important role in basic research than in Japan and the U.S. The contribution of this sector is even smaller in France, where the higher education sector assumes the dominant position in conducting basic research.

Republic of Korea is dissimilar to the other four in that the business sector, not the university sector as in the other countries, is the main performer of basic research. This is in sharp contrast to France, where the higher education sector is by far the main performer of basic research.

Differences between Japan and the U.S. on the one hand and Germany and France on the other are as follows. In Germany and France, the higher education sector is the primary performer of basic research, followed by the government sector; the business sector does not play a significant role. As opposed to this, in Japan and the U.S., the business sector plays the most important role after higher education institutes in the area of basic research. Another common trend shared between Japan and the U.S. is that the private non-profit sector is a relatively important performer of basic research.

6.2.3 The number of researchers by field of research

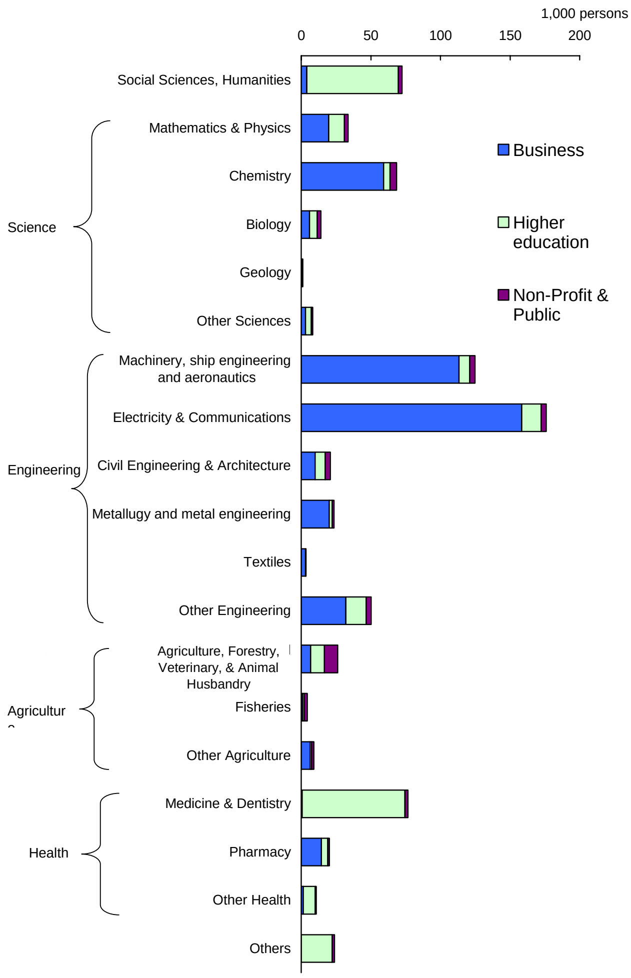
Information on the domestic distribution of R&D funding and personnel is extremely important in formulating science and technology policies. Although statistics on R&D by field of research are very difficult to compile and therefore unavailable in an appropriate format, we provide the number of researchers by field of research in Figure 6-2-5 as an example of such data. In the data, researchers are categorized based on their expertise rather than their current field of research. Therefore, the results primarily reflect the outcome of human resources development efforts in Japan.

Among all research fields, the ‘electricity and communications’ field has the largest number of researchers, followed by ‘machinery, ship engineering and aeronautics’ In these engineering fields as well as in ‘chemistry,’ the largest field in the science category, the majority of researchers belong to business enterprises (the business sector). This suggests that R&D activities in Japan’s business sector are performed primarily by researchers specializing in these fields.

Researchers in the ‘social sciences and humanities’ and ‘health’ categories belong mainly to universities, except the ‘pharmacy’ field in the health category, in which most of the researchers are provided with funds from the business sector. In the ‘agriculture’ category, the non-profit and public sectors account for a relatively large part of the research population.

Figure 6-2-5: Number of researchers by field of research and by sector in Japan

(A) 2003



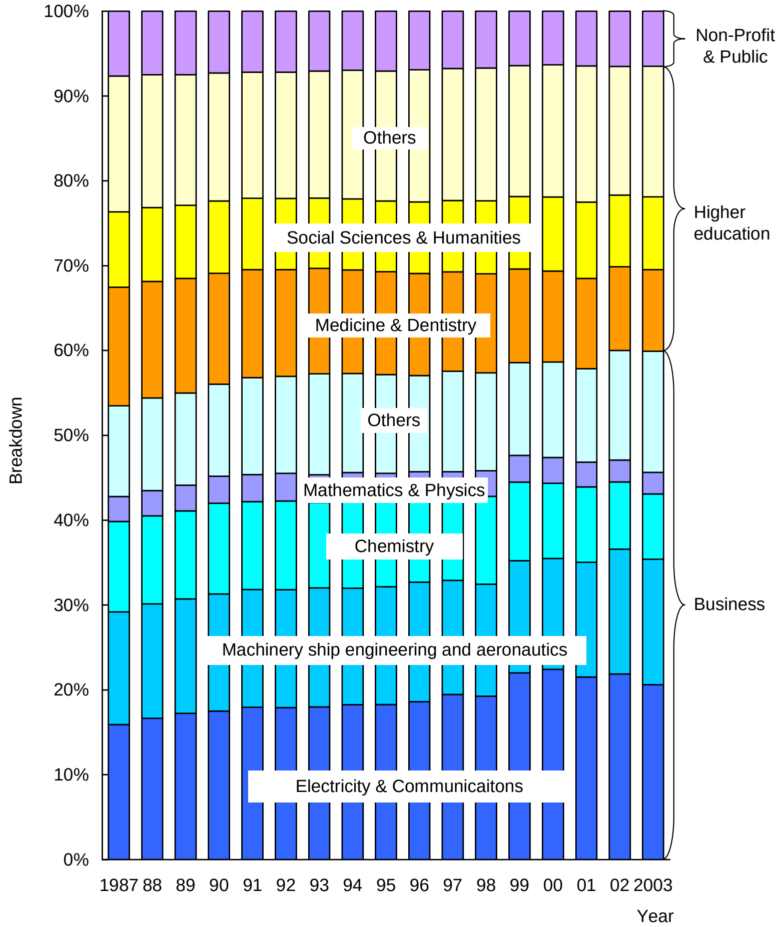
Notes: The data represent head counts.
University researchers do not include part-time researchers, research assistants, technicians, or clerical and other supporting personnel.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”
See: Table 6-2-5

Figure 6-2-5 (B) shows the same type of data as Figure 6-2-5 (A) from a long-term perspective. Only the significant fields and sectors are selected from Figure 6-2-5 (A) to appear in the graph below; the remainder are combined to form the 'others' category.

Since these data primarily reflect the outcome of human resources development efforts, as explained earlier, changes in the number of researchers in each field of research and each sector are not clearly recognizable. However, we have found that in the business sector, the share of the researchers specializing in electricity and communications has increased over time, while the share of chemical researchers has declined.

Figure 6-2-5: Research personnel by field of research and by sector in Japan

(B) 1987 to 2003



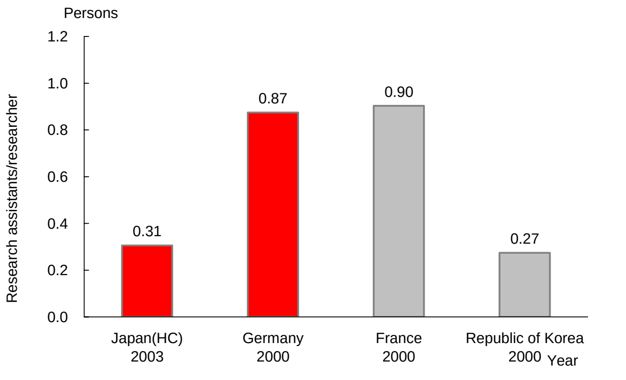
Notes: 1) In 2002, the Ministry of Public Management, Home Affairs, Posts and Telecommunications revised the organizational classification used for its 'Report on the Survey of Research and Development,' and the former categories of 'Companies' and 'Research Institutes' (used until 2001) have changed to the 'Business' and 'Non-Profit & Public' sectors, respectively.
2) Private for-profit research institutes, which fell in the Research Institutes category until 2001, are included in the business sector in the subsequent years.
3) The same notes as Figure 6-2-5 (A) apply other than the above.
Source: Same as Figure 6-2-5 (A)
See: Table 6-2-5

6.2.4 Research assistants

Despite the vital role they assume in R&D, research assistants tend to be treated as auxiliary staff in the research community. In reality, however, they are as essential as researchers for today's R&D projects, which are growing in complexity and scale. It is more appropriate to consider that the distinction between research assistants and researchers is based only on the character of work to be conducted. It is therefore very important, especially in using statistics to measure R&D activities, to consider not only researchers but also research assistants. The definition of a research assistant varies from one country to another as is the case with the definition of a researcher. In Japan, research assistants refer collectively to 'assistant research workers,' 'technicians,' and 'clerical and other supporting personnel.'

While many countries provide statistics on research personnel including research assistants, their definition and survey methodology vary. We use the ratio of research assistants to researchers, that is, the number of research assistants per researcher for comparison. The number of research assistants per researcher in Japan is 0.31 as of 2003, a smaller figure compared with major European countries (Figure 6-2-6).

Figure 6-2-6: Research assistants per researcher for selected countries

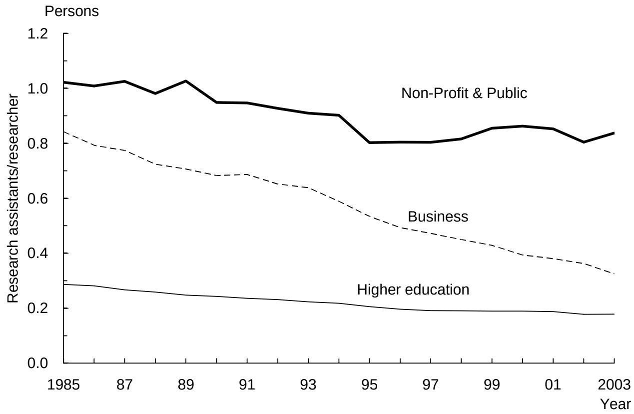


Notes: For notes on researchers, see those on Table 6-1-4.
The data for Japan represent head counts.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
<U.S., France, and Republic of Korea> OECD, "Basic Science and Technology Statistics 2002/2"
See: Table 6-2-6

Figure 6-2-7 shows the trend in the number of research assistants per researcher in Japan. The number of research assistants per researcher has declined over time in Japan, especially in the business sector since 1993.

The number of research assistants in universities is explored further in Chapter 10 (Figures 10-2-15 and 10-2-16).

Figure 6-2-7: Trends in the number of research assistants per researcher in Japan



Notes: 1) See notes (i), (iii), and (iv) on Japan in Figure 6-1-4.
2) Since 2002, the 'Companies' and 'Research Institutes' categories have changed to the 'Business' and 'Non-Profit & Public' sectors, respectively.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 6-2-7

Chapter 7
R&D Performance

7.1 Scientific papers

In recent years, statistics on scientific papers have come into more widespread use as an indicator of output in science and technology. Since it is not easy to directly measure the R&D results, especially those of scientific research, many countries have been compiling a variety of statistics on scientific papers by constructing extensive databases of scientific literature and have developed diverse indicators.

The Science Citation Index (SCI), an enormous database of scientific literature compiled by a U.S. institution, is often used to develop such indicators. This database is very useful as it provides statistics on article citations and covers all fields of science and technology, despite disadvantages such as listing a smaller number of articles in each field compared to databases dedicated to a specific field, and emphasizing English-language articles. In this section, indicators on scientific papers are calculated based on the National Science Indicators (NSI) database, which lists SCI-indexed papers.

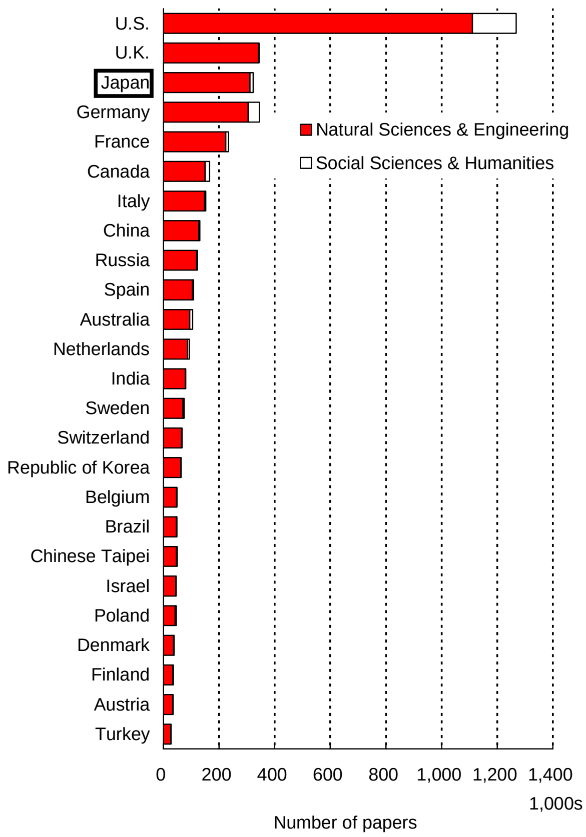
Summarizing the number of papers published by each country allows us to quantitatively compare R&D results in different countries. Since such summarization by country is usually possible only by counting papers based on the location of the institution to which the author belongs, we have used this counting method to obtain the data to report. Papers written by several people who are affiliated to different institutions in different countries (known as international co-authorship) have been double-counted as papers of the respective countries. Several indicators regarding international co-authorship are examined in Chapter 8, considering the globalization of knowledge production.

We have calculated the aggregate number of papers listed in the SCI database by country for the last five years (1998-2002) for which data are available. The U.S. topped the list, followed by the U.K., Japan, Germany, and France (Figure 7-1-1). The U.S. was so dominant that even the second-ranking U.K. was less than one-third the size of the U.S. in terms of the number of papers published. If the comparison excludes social sciences and humanities and refers only to natural sciences and engineering, Japan will rank second in the world, surpassing the U.K. and Germany in the number of papers published.

By region, 13 of the top 25 countries turned out to be European countries. Other than Japan, four Asian countries were among the top 25, namely, China (No. 8), India (No. 13), Republic of Korea (No. 16), and Taiwan (No. 19).

In principle, R&D indicators examined in this report refer to not only natural sciences and engineering but also social sciences and humanities. In line with this, Figure 7-1-1 includes the papers in social sciences and humanities. However, because of a significant difference in the listings of the SCI database between the natural sciences and engineering category and the social sciences and humanities category, the remainder of the figures in this chapter do not refer to articles in social sciences and humanities. Figure 7-1-1 shows that the share of the papers in social sciences and humanities is relatively large in English-speaking countries such as the U.S., the U.K., Canada, and Australia, probably because of SCI's listing in favor of English-language literature. This inclination, also seen in the natural sciences and engineering category, is far more apparent in social sciences and humanities. Another reason that we need to treat these two categories differently is that the majority of articles listed in the SCI database fall into natural sciences and engineering rather than social sciences and humanities.

Figure 7-1-1: Number of scientific papers published, by country: Top 25 countries (total for 1998-2002)



Notes: 1) Papers have been sorted according to the location of the author's institution.
2) Internationally co-authored papers have been double-counted according to each author's national affiliation.
3) China includes Hong Kong.
Source: Compiled by NISTEP based on the statistics listed in "National Science Indicators, 1981-2002" of the Institute for Scientific Information
See: Table 7-1-1

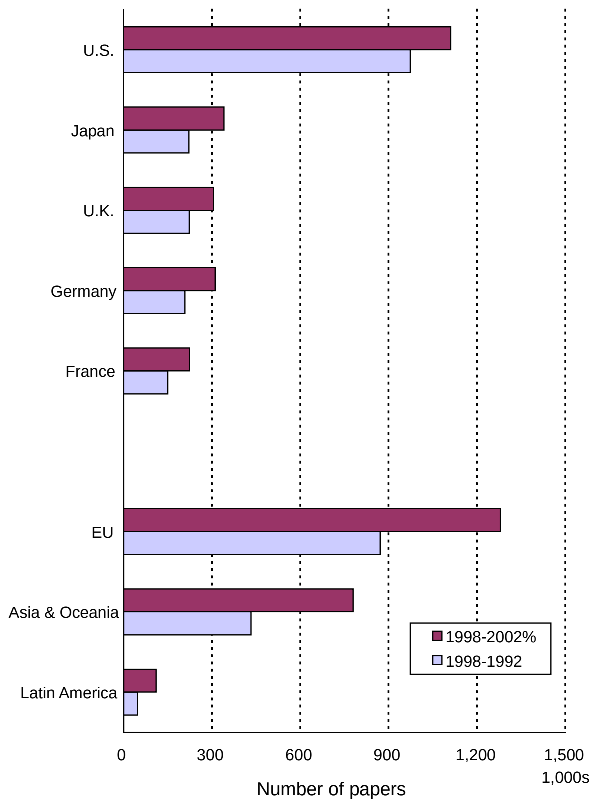
Figure 7-1-2 compares the number of papers published during the five-year period from 1998 to 2002 with that of 10 years ago (1988-1992) to measure growth over time. The growth rate for the entire SCI database (except for social sciences and humanities) during this period was 28.1%.

By country, the growth rate was 12.4% in the U.S., 53.5% in Japan, 39.8% in the U.K., 48.4% in Germany, and 49.2% in France. Japan marked the fastest growth among the five.

By region, high growth rates were demonstrated by regions whose production of scientific papers has traditionally been meager, such as 132.8% in Latin America and 79.6% in Asia and Oceania. The EU grew by 47.7%, a remarkable growth equivalent to an increase by approximately 440,000 papers, contributing to over half of the total growth in SCI itself (about 810,000 papers). The fact that the growth rates posted by all the selected countries and regions other than the U.S. were higher than that of overall SCI can be attributed partly to an increase in international co-authorship.

Most of the papers published in the EU derived from the U.K., France, and Germany. This applies to both the 1988-1992 and 1998-2000 periods.

Figure 7-1-2: Growth in the number of scientific papers published, by country and region
(natural sciences and engineering)



Notes: 1) The data for the EU are the total of the current 15 member countries. The data for Asia and Oceania include Japan.
2) Papers published by authors from different countries or regions have been double-counted according to each author's national or regional affiliation. Therefore, the total of all countries or regions does not equal the value of the aggregate total.
Source: Compiled by NISTEP based on the statistics listed in "National Science Indicators, 1981-2002" of the Institute for Scientific Information
See: Table 7-1-2

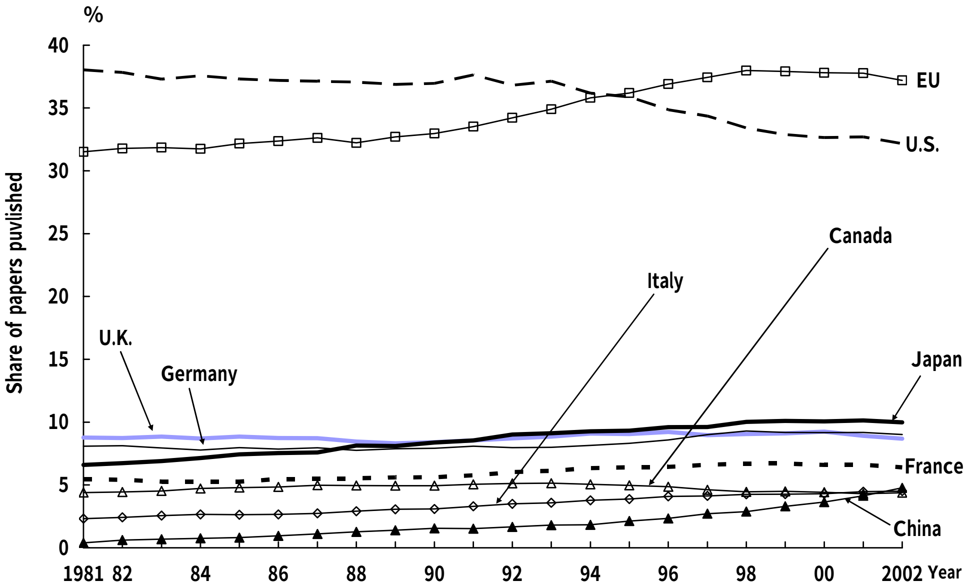
To compare the R&D results of Japan with those of other countries, the number of papers published in each country as the worldwide total percentage serves as a useful indicator. The trend in the share of papers written in each country shows that Japan has ranked second after the U.S. since 1990 in the natural sciences and engineering category (Figure 7-1-3). The number of papers (excluding those in social sciences and humanities) listed in SCI totaled 688,000 in 2002, of which 221,000, or 32.2%, derived from the U.S. and 69,000, or 10%, from Japan.

The U.S. remained dominant throughout the selected period, constantly accounting for over 30% of the worldwide total, but its share has declined since the 1990s. Given that the actual number of papers published in the U.S. has increased steadily, the decline in share must be a result of the growth of papers published in other countries, rather than reduced productivity in the U.S.

As for other countries, the shares of the U.K. and Canada have leveled off or declined since the mid-1990s, while those of Germany, France, and Italy have risen slightly. As illustrated in the graph, upward trends are more obvious in non-English-speaking countries, especially in China and EU countries, rather than in English-speaking ones such as the U.S., the U.K., and Canada.

Since our calculation is based on SCI, which primarily lists English-language papers, the results are assumed to underestimate the number of papers published in non-English-speaking countries. Nevertheless, we consider that the indicator values reflect the degree of the actual impact of papers produced in each country in that English-language papers are growing in importance with the rapid globalization of science and technology activities. An increased share of the papers produced in non-English-speaking countries also implies an increase in the number of papers written in English in these countries.

Figure 7-1-3: Trends in the share of scientific papers published for selected countries (natural sciences and engineering)



Notes: 1) Papers published by authors from different countries have been double-counted according to each author's national affiliation.
2) The number of papers in the 'others' category has been calculated by subtracting the total for the selected countries (not including the total for the EU) from the worldwide total.
Source: Compiled by NISTEP based on the statistics listed in "National Science Indicators, 1981-2002 (Deluxe version)" of the Institute for Scientific Information
See: Table 7-1-3

Next, let us examine the citation count of scientific papers, a typical indicator to measure the quality of papers produced. The citation count is the frequency with which a given paper is cited by other papers and represents the intensity of the impact of the paper.

Figure 7-1-4 illustrates the correlation between the worldwide share of scientific paper production and the citation count, with the former represented by the horizontal axis and the latter by the vertical axis. The straight dotted line with a slope of 1 marks the point where the production share equals the citation share. If a country is plotted along the line, it means that its citation frequency is at the world average level, or in other words, its citation count is commensurate with its production of scientific papers. If a country is plotted above the line, it means that the country's citation share outnumbers its production share, suggesting that the papers produced in the country have an impact greater than the world average.

While the U.S. holds the largest production share of scientific papers, its citation share even exceeds this value. Since about half of the papers cited worldwide originate in the U.S., its papers exert a significant impact on the world's research community.

Papers published in the U.K. receive the second largest citations after the U.S. Its citation share also outnumbers the production share, a sign of a high impact. The citation share of the U.K. declined until 1988 but has increased since 1989.

Japan has ranked fourth in the world since 1994 in terms of citation share. However, its impact on the world research community remains modest because it is plotted under the straight line with a slope of 1, implying the country's citation count is relatively small compared with its production of scientific papers. Since 1998, following a slow-growth period between 1992 and 1997, Japan's citation count share has increased steadily at a rate which is still below the world average but is slightly greater than the growth rate of its production share.

When analyzing the results of Japan, we should take account of possible factors behind Japan's citation count being lower than the average among North American and European countries. Specifically, they are disadvantages such as Japan's geographical location and that English-language papers tend to be cited more frequently. Nevertheless, this indicator correctly reflects the reality that the center of communications in the scientific community is in the West, and English is the mainstream language for scientific literature. In this sense, the resultant indicator values for Japan represent the correct degree of the impact of its scientific papers.

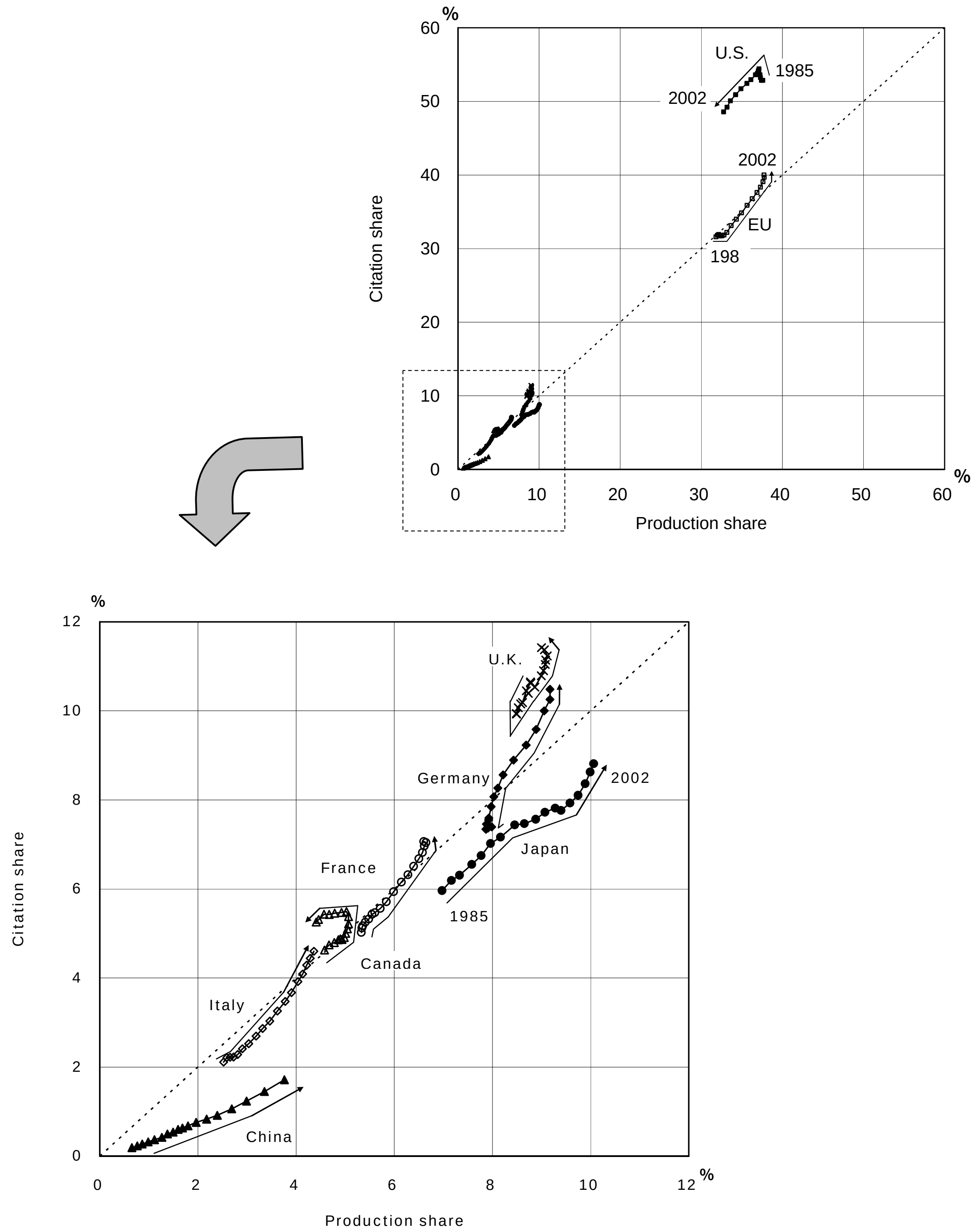
Germany, France, and Italy, while not posting a significant growth in production share, demonstrated a large increase in citation share and subsequently the degree of impact.

The EU showed a change in the trend over time, from where the production share almost equaled the citation share to where the citation share is growing at a pace beyond the growth rate of its production share.

In Canada, the production share has been on the decline since around 1992. Its citation share, after steady growth until 1994, has also declined since 1995, suggesting the diminishing impact of scientific papers originating in Canada.

China has grown in terms of both production share and citation share, although the growth of the citation share is not as large as that of the production share.

Figure 7-1-4: Trends in citation count for selected countries (natural sciences and engineering; 1985-2002)

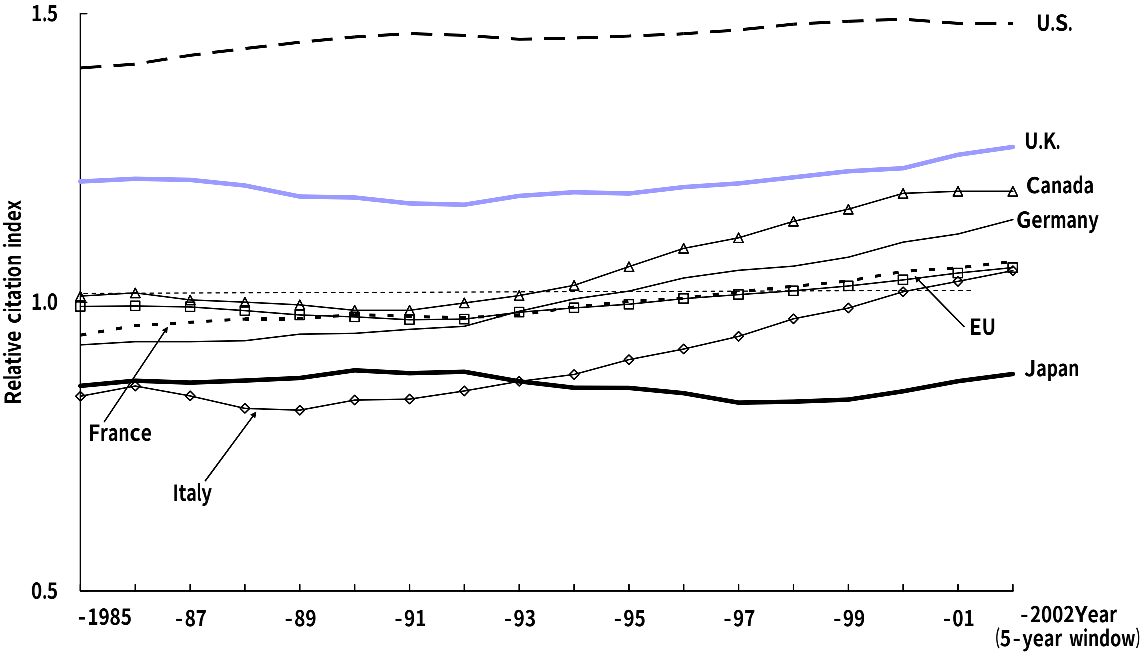


Notes: 1) The data do not include social sciences or humanities.
2) Five-year-window data have been used to ensure a comparison of citation data on the same basis.
3) Papers published by authors from different countries have been double-counted according to each author's national affiliation.
Source: Compiled by NISTEP based on the statistics listed in "National Science Indicators, 1981-2002 (Deluxe version)" of the Institute for Scientific Information
See: Table 7-1-4

The fact that Japan's citation share is below the international average is shown even more clearly by the relative citation index (RCI) in Figure 7-1-5. The relative citation index is calculated by dividing the citation count per paper for a given country by the international average, which is assumed to be 1. The RCI for Japan not only remains below 1, but also stays the lowest among the selected countries, although there has been a slight increase since 2002.

The RCI for the U.S. remains at a high level throughout the selected period, indicating the strong impact of U.S. scientific papers on the world. The RCI has been stable in the U.S and the U.K., the two countries whose RCI values were originally high. The RCI has increased significantly in Germany, France, Italy, and Canada since the beginning of the 1990s. Particularly noteworthy is that both production share and the RCI have grown at the same time in Germany, France, and Italy.

Figure 7-1-5: Trends in relative citation index (RCI) for selected countries



Notes: 1) (relative citation index: RCI) = (citation count per paper for a country) ÷ (citation count per paper worldwide)
2) The data do not include social sciences and humanities.
3) Five-year-window data have been used to ensure a comparison of citation data on the same basis. For example, '-2002' represents the cumulative sum for the five-year period between 1998 and 2002.
Source: Compiled by NISTEP based on the statistics listed in "National Science Indicators, 1981-2002 (Deluxe version)" of the Institute for Scientific Information
See: Table 7-1-5

R&D statistics by field of research are essential for clarifying the nature of R&D activities in individual countries. Among others, the number of papers produced in each field serves as a useful indicator that augments the data on R&D input, which are not readily available in a form categorized by field of research. This indicator is important in that it can quantitatively express the results of the R&D system and the allocation of R&D resources of a country.

Figure 7-1-6 shows the trends in the number of scientific papers in all research fields other than social sciences and humanities as a percentage of the total for Japan, the U.S., the EU, and the entire SCI database.

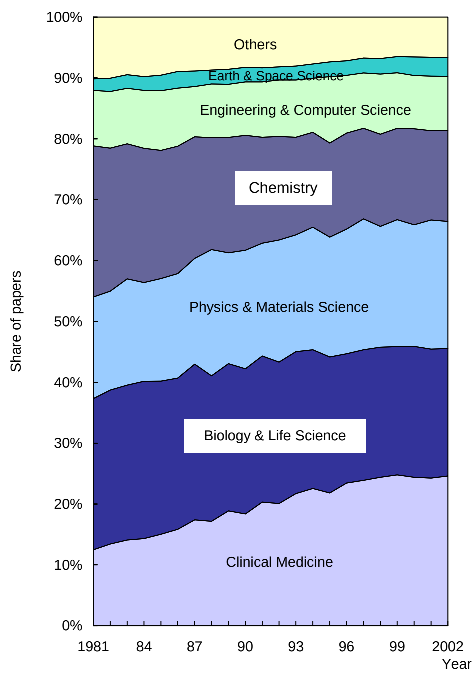
Japan shows considerable changes, especially in the field of 'clinical medicine,' where major growth has been seen. The share of the 'physics and materials science' field has also increased. 'Biology and life science' maintained a certain proportion throughout the selected period. The share of 'chemistry' has declined over time. One noticeable fact concerning Japanese scientific papers is that the share of the 'earth and space science' field is smaller compared with other fields in Japan or the same field in the other countries.

In the U.S., the shares of 'biology and life science' and 'clinical medicine' have been dominant, while the shares of 'physics and materials science' and 'chemistry' have been smaller than those of the other countries. The EU resembles Japan in that the share of 'physics and materials science' has increased, while the share of 'chemistry' has declined. The shares of 'earth and space science' and 'engineering and computer science' have also grown slightly in the EU.

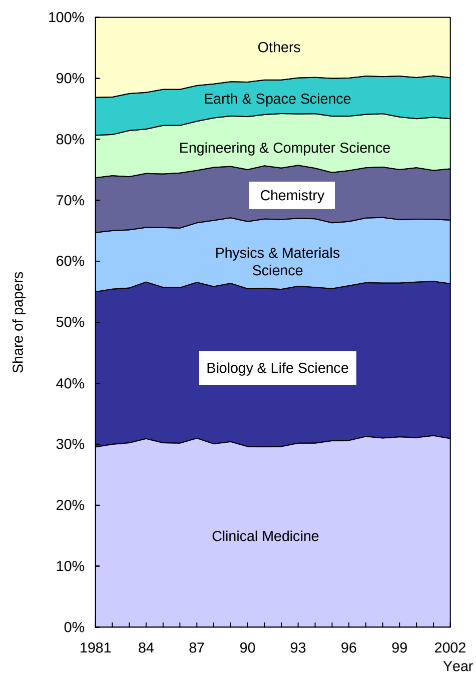
For the entire SCI database, the share of 'physics and materials science' has grown steadily. The shares of 'engineering and computer science' and 'clinical medicine,' which increased until the mid-1990s, have remained stable since the latter half of the 1990s. The 'biology and life science' field has declined slightly in recent years.

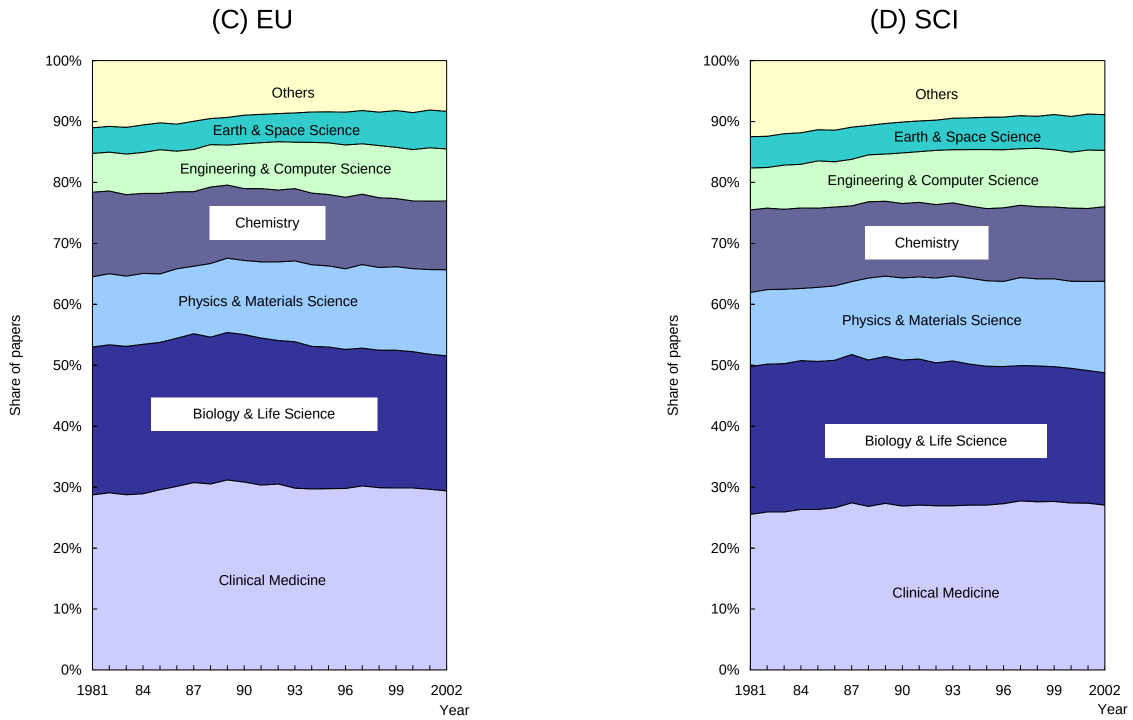
Figure 7-1-6: Breakdown of scientific papers by field in Japan, the U.S., and the EU

(A) Japan



(B) U.S.



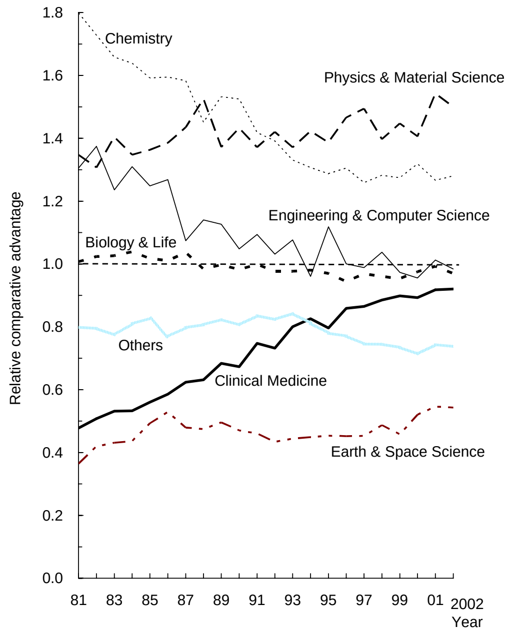


Source: Compiled by NISTEP based on the statistics listed in “National Science Indicators, 1981-2002 (Deluxe version)” of the Institute for Scientific Information
See: Table 7-1-6

An indicator called the relative comparative advantage (RCA) is often used to clearly identify changes in the output of papers by field of research. This indicator can be calculated by dividing the domestic share of the papers in a given field by the worldwide share of the papers in that field. For example, in 2002, the ‘clinical medicine’ field accounted for 30.2% of the total number of papers produced in the natural sciences and engineering category in Japan, while the equivalent figure in the world was 32.9%. Dividing the domestic share of 30.2% by the worldwide share of 32.9% yields an RCA of 0.92. An RCA of less than 1 indicates that the country’s specialization in a given field is at the world average. The RCA has often been discussed in relation with national core competence and is a useful tool for identifying Japan’s area of specialty.

Figure 7-1-7 shows the trend in the RCA of Japanese papers by field of research. There are two fields in which the production of scientific papers has traditionally been well above the world average, namely, ‘chemistry’ and ‘physics and materials science.’ In the former field, the RCA has declined sharply, while it has leveled off or increased over time in the latter field. The ‘clinical medicine’ field has approached the world average through robust growth.

Figure 7-1-7: Trends in the relative comparative advantage (RCA) of Japanese scientific papers by field



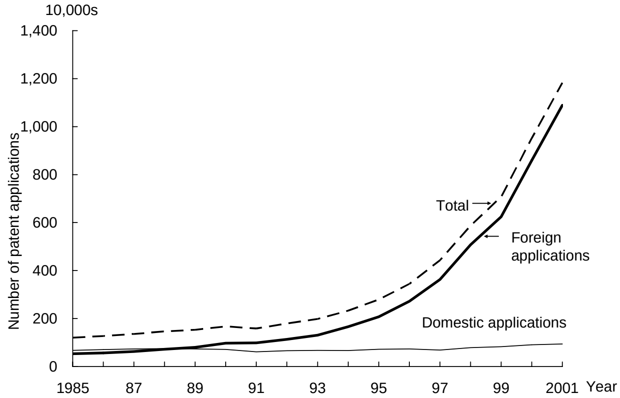
Notes: 1) (relative comparative advantage: RCA) = (domestic share of papers in a field) / (worldwide share of papers in a field) Source: Compiled by NISTEP based on the statistics listed in “National Science Indicators, 1981-2002 (Deluxe version)” of the Institute for Scientific Information See: Table 7-1-7

7.2 Patents

Statistics on patents are an important information source on the production of science and technology knowledge especially in that they provide information on not only technological knowledge but also the practical use of scientific and technological knowledge. While the data on patents give us a variety of information on technological knowledge, it does not cover all inventions and technical knowledge. Therefore, it should be considered as an indicator that represents only one aspect of science and technology. In addition, of the characteristics and limitations in analyzing patent statistics, the main two are: weight assigned to patent data varies because of significant differences in the value of patents by industry or the area of technology; and international comparison are usually difficult because the patent system varies widely from one country to another. In addition, time series data sometimes involve breaks because of revisions in the patent system or the patent fees paid by applicants. Statistics on patents are compiled by each country's authority responsible for patents. The data we report are, in principle, based on the counting method that assigns patents to the country to which the applicant or the patent owner belongs (this can sometimes be determined by nationality) to ensure the appropriateness as an indicator of R&D results.

The number of patents filed abroad has increased considerably since the 1990s. Figure 7-2-1 shows the trends in the number of patent applications in all member nations of the World Intellectual Property Organization (WIPO). The graph shows that an increase in the number of foreign patent applications (patents filed from foreign countries) does not necessarily indicate an increase in the total number of inventions. On the contrary, from the number of domestic patent applications remaining flat, we infer that the total number of inventions has not increased at all. When an inventor files a patent in multiple countries, the patent is assigned to all of the countries, resulting in a sharp rise in the number of foreign patent applications. The growing use of the international patent application system is another factor contributing to this rise. Therefore, the growth in the number of foreign patent applications has no direct relation to the growth in scientific and technological knowledge. Nevertheless, the number of foreign patent applications is still an indicator that reflects the move toward the international protection of technology rights and the rapid globalization of science and technology.

Figure 7-2-1: Trends in the number of patent applications worldwide

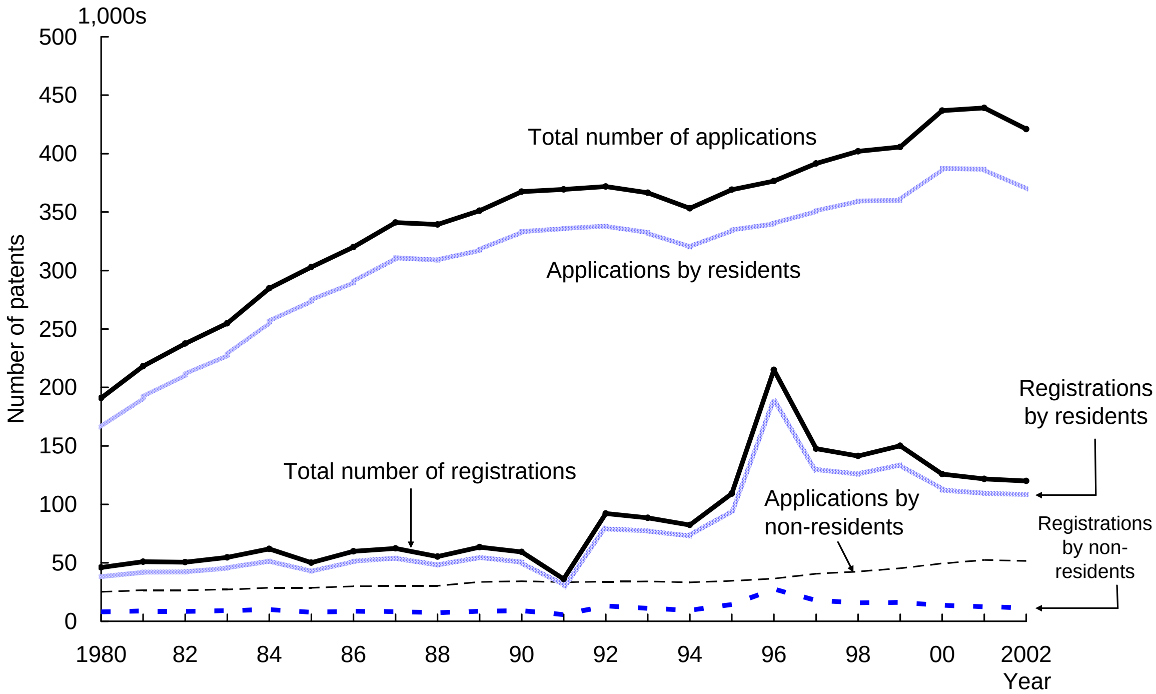


Sources: For data until 1993, Japan Patent Office; For later data, WIPO's "Industrial Property Statistics 1994-2001"
See: Table 7-2-1

As Figure 7-2-2 shows, the number of patents filed to the Japan Patent Office increased sharply until the latter half of the 1980s, followed by a slowdown that lasted until the mid-1990s and an increase for the remainder of the selected period. Of all patent applications filed to the Japan Patent Office, those filed by residents of Japan account for the most part (88% as of 2001) and those filed by non-residents constitute only one-fifth the patents filed by residents. However, the number of patents filed by foreign inventors has recently increased slightly.

There has been a significant gap between the number of patents filed and the number of patents granted. After narrowing between 1995 and 1996, the gap has recently widened again. It should be remembered that the number of patents granted can increase or decline suddenly in response to a revision of the patent system. For example, the sharp rise in 1992 was due to a revision in order to introduce an electronic patent application system. The surge in 1996 was because of a change in the procedure to handle filed patents so as to allow such action to be taken after patent registration. The revision has shortened the time required for the procedure from patent application to registration, and has caused a concentration of patent registrations under the old and new procedures at the same time, resulting in a temporary rise in the number of patents granted.

Figure 7-2-2: Trends in the number of patents filed and granted in Japan



Source: Japan Patent Office, “Japan Patent Office Annual Report” and “Annual Report of Patent Administration”
See: Table 7-2-2

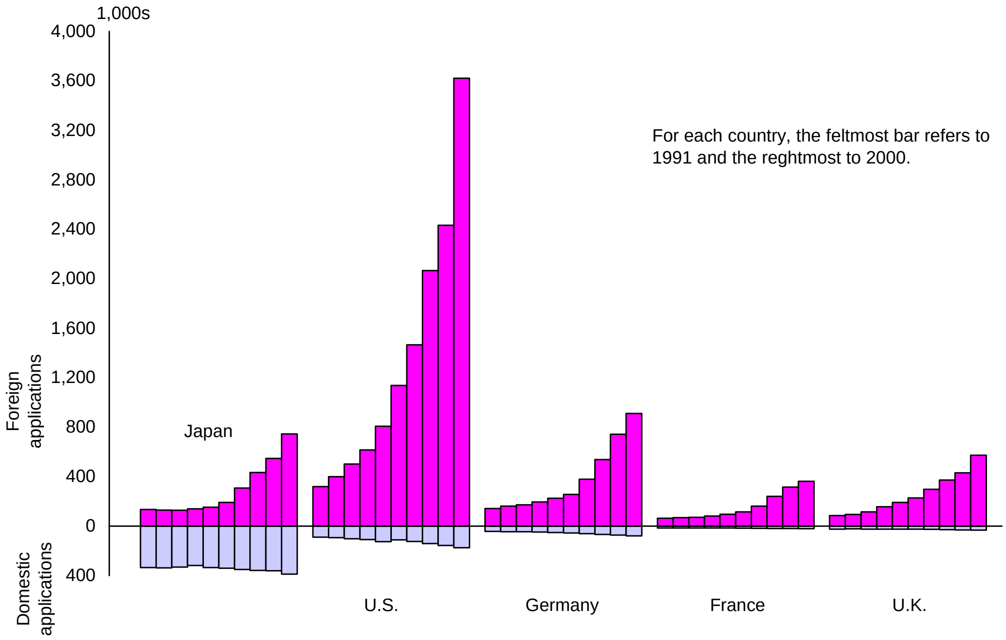
Figure 7-2-3 shows the state of patent applications in selected countries. In the U.S., Germany, France, and the U.K., the number of patents filed abroad exceeded the number of patents filed in the applicant's home country throughout the selected period. By contrast, in Japan, the number of domestic applications remained larger than the number of foreign applications until 1997, suggesting Japanese inventors' emphasis on securing patents in their home country. This trend in Japan has changed since 1998, however, and foreign applications now outnumber domestic applications by a widening margin.

The growth in the number of foreign applications is not limited to Japan but shared among all of the five countries. This trend is particularly remarkable in the U.S. The sharp rise in the number of patents filed abroad by U.S. inventors is mainly attributable to the growing use of the international patent application system based on the Patent Cooperation Treaty (PCT)[(1)], which allows inventors to file a patent application in multiple countries at the same time. In Europe, the European patent system is in effect, contributing to the increase in foreign patent applications.

Another noticeable trend in the U.S. is the widening gap between the number of domestic applications, which has increased at a modest pace, and the number of foreign applications, which has soared. The growth of foreign patents was particularly sharp in the latter half of the 1990s. These trends imply that the U.S. has been stepping up the protection of its inventions worldwide.

In Germany, the number of foreign applications has increased significantly, just as in Japan. However, its number of domestic applications is far smaller than that of Japan. This is also true for France and the U.K.

Figure 7-2-3: Trends in the number of domestic and foreign patent applications originating in selected countries (1991-2000)



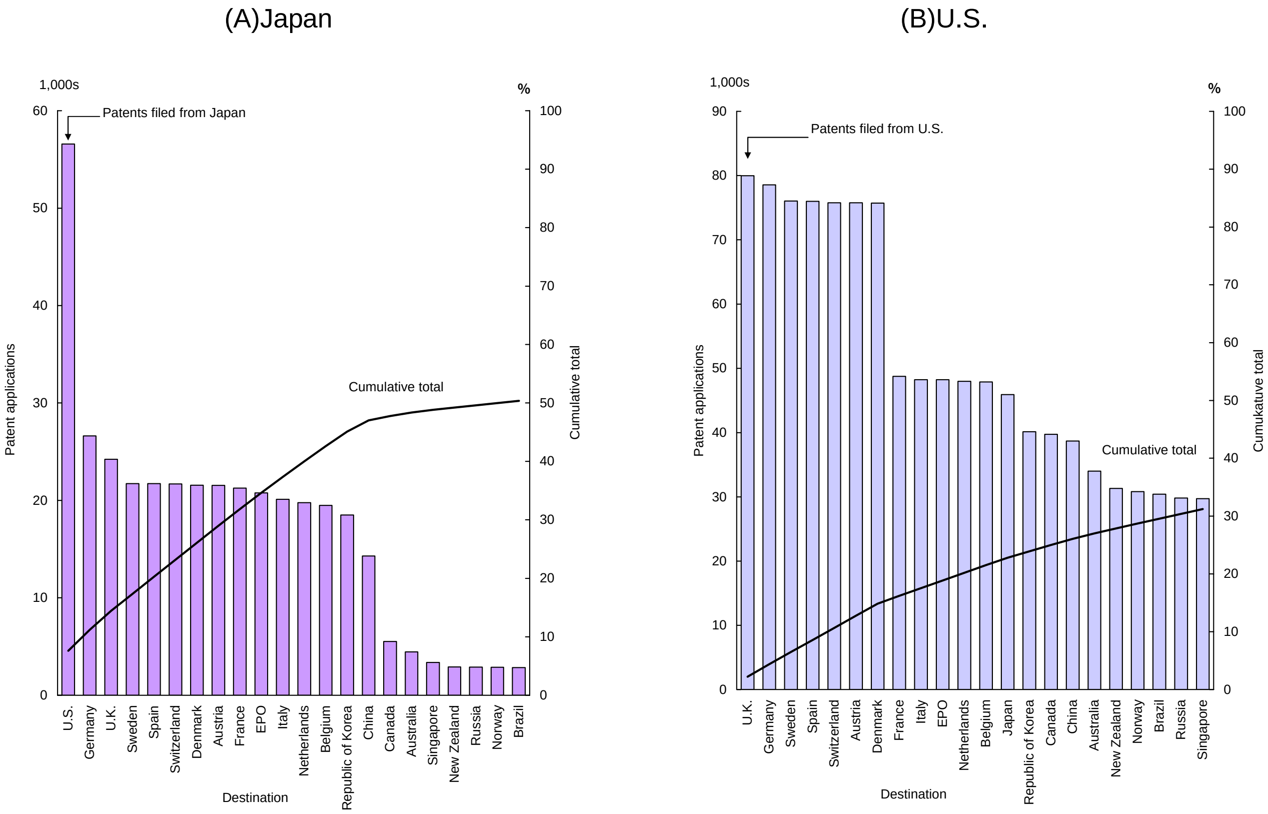
Note: The data for Germany, France, and the U.K. include European patent applications in designated countries.
Source: Japan Patent Office, "Japan Patent Office Annual Report" and "Annual Report of Patent Administration"
See: Table 7-2-3

(1) Based on the Patent Cooperation Treaty, when filing a patent application in a country, an inventor can designate additional countries (designated countries) in which he or she wants to file it concurrently. By doing so, the inventor avoids the need to file with respective national patent offices.

Foreign applications originating in Japan and the U.S. are further examined below. Figure 7-2-4 shows the number of applications filed with the top 22 foreign Patent Offices (including the European Patent Office) by Japanese and U.S. inventors in 2000. The largest number of applications was filed with the U.S. Patent Office by Japanese inventors, accounting for 7.6% of the total number of foreign applications from Japan. Germany was the second largest foreign destination with a contribution of no more than 3.6%. The combined number of applications filed in the top 22 countries accounted for 50.4% of the total number of foreign applications from Japan. The majority of foreign applications were filed in North American and European countries, with only three Asian countries appearing on the list.

In the U.S., foreign applications are dispersed widely among a number of countries around the world, as even the U.K., which was the most popular foreign destination of patent applications among U.S. inventors, accounted for only 2.2% of the total. Japan ranked as low as 13th. The diversity of destinations is a key characteristic of the U.S., where the applications in the top 22 countries accounted for only 31.2% of the total number of foreign applications. This trend suggests that the U.S. intends to protect its inventions globally.

Figure 7-2-4: Foreign patent applications originating in Japan and the U.S. by destination (2000)



Note: The data include PCT applications and European patent applications in designated countries.
Source: Japan Patent Office, “Annual Report of Patent Administration”
See: Table 7-2-4

Next, foreign patent applications are analyzed considering their share in the destination countries. Figure 7-2-5 shows the total number of patents filed with and granted by the patent offices of five major countries and China as well as the European Patent Office, by source country.

Let us start with the number of patents filed. In the U.S., Germany, and Japan as destination countries, the patents filed by residents account for the largest percentage of the total number of patent applications. In particular, as much as 80% of the patents filed with the Japan Patent Office are from residents in Japan, an extraordinary high figure compared with other countries in the world.

The share of applications from Japan of the total number of patent applications in each destination country is 17.1% in the U.S., the second largest figure after the share of the domestic applications by U.S. residents. The share of applications from Japan represents 20.6% of the total number of patents filed with the European Patent Office. Again, Japan is the second largest source of patent applications after the U.S. (47.9%). In Germany, France, the U.K., and China, applications from Japan represent a little over 10%.

Applications from the U.S., on the other hand, account for a major part of the total in all of the selected destination countries except Japan. In France, the U.K., and China, in particular, the share of applications from the U.S. is larger than the share of domestic applications. As much as 50% of the total number of applications to the European Patent Office derive from the U.S., demonstrating the strong presence of U.S. inventions in Europe.

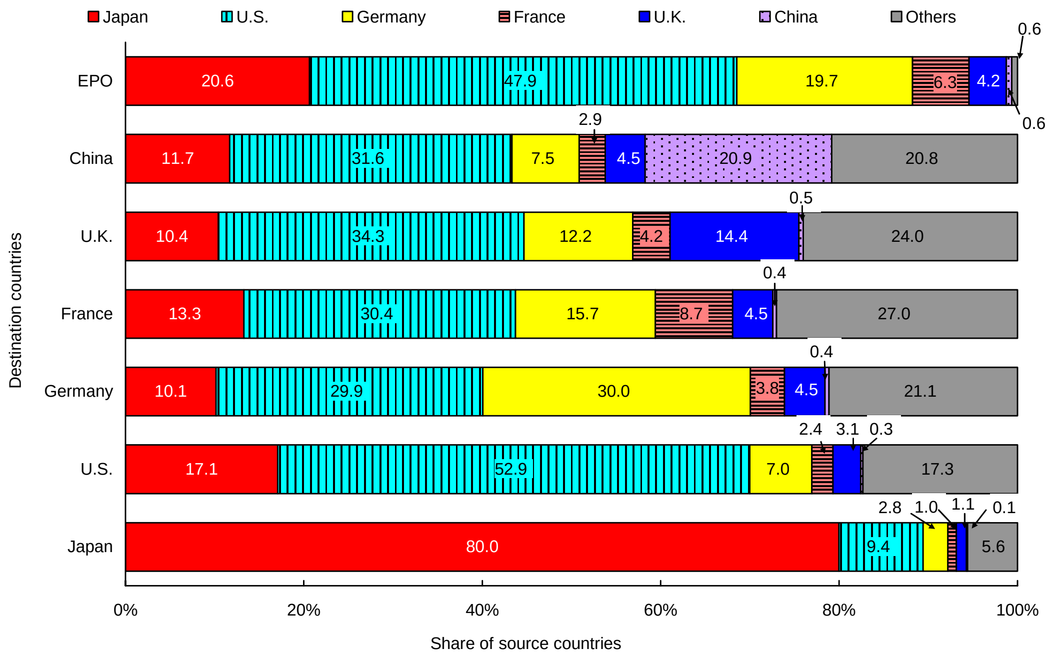
Patent applications from the U.S. can be characterized as follows, although this applies to limited destinations. For the European Patent Office, the U.S. is by far the largest source of patent applications, whereas, in terms of patents actually granted, the share of the U.S is similar to that of Japan. In China, too, the U.S. is the dominant source of patents filed, while being a minor source of patents granted. Although this gap may be attributable to a small proportion of the patents from the U.S. being granted by the destination country, it is more appropriate to interpret it as a result of the jump in the number of applications from the U.S.

Other than the U.S., Germany is a large source of patent applications filed with the European, French, and U.K. Patent Offices. This suggests that German patents play a major role in Europe.

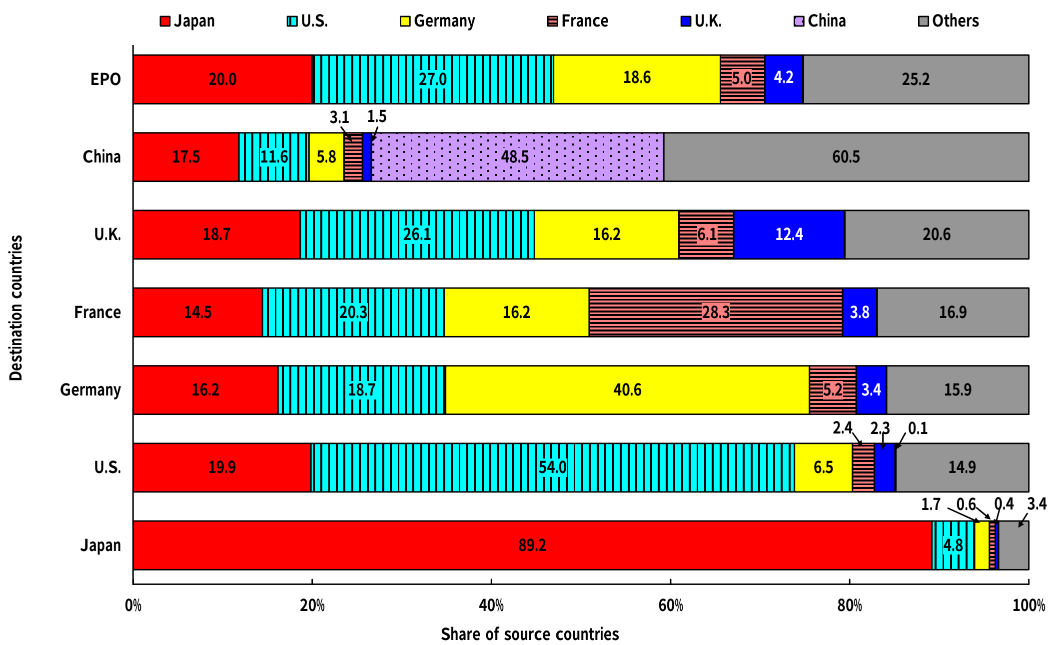
In terms of patents granted, all countries other than China indicate a breakdown similar to that of patents filed.

Figure 7-2-5: Patents filed and granted in selected countries and region by source country (2000)

(A) Patents filed

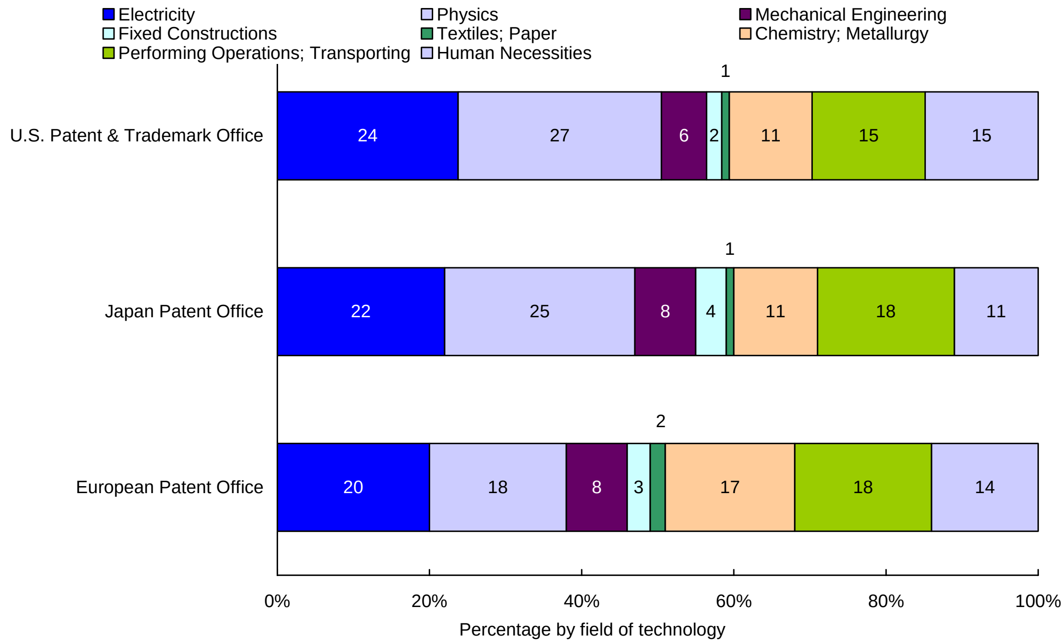


(B) Patents granted



Notes: 1) Germany, France, and the U.K. are European Patent Convention (EPC) member countries.
2) The data include PCT applications and European patent applications in designated countries.
3) The data for the European Patent Office are based on 'European patents filed/granted by country of origin and a breakdown by designated contracting state.'
Source: Japan Patent Office, "Annual Report of Patent Administration"
See: Table 7-2-5

Figure 7-2-6: Patents filed in Japan, the U.S., and Europe by field of technology (2001; 2000 for Japan only)



Source: WIPO, "Trilateral Statistical Reports 2000, 2001"
See: Table 7-2-6

In Figure 7-2-5, the breakdown of patent applications filed with the Japan and U.S., and European Patent Offices (Trilateral Offices, collectively) by field of technology is compared. In general, there is no significant difference in the shares of individual fields of technology among the Trilateral Offices. A closer examination shows that the share of patent applications in 'human necessities' is high in the U.S. On the other hand, this share is low in Japan, while the shares of patent applications in 'mechanical engineering' and 'performing operations; transporting' are relatively high instead. A common finding of Japan and the U.S. is that the shares of 'physics' and 'electricity' are higher compared with the European Patent Office. However, the share of 'chemistry; metallurgy' is higher in the European Patent Office.

The following part of this report provides an in-depth analysis of patent statistics in the U.S. The U.S. has been chosen for two reasons. Firstly, U.S. patent statistics include interesting information on, among others, the citation of patents and scientific articles, which is not available in other countries.

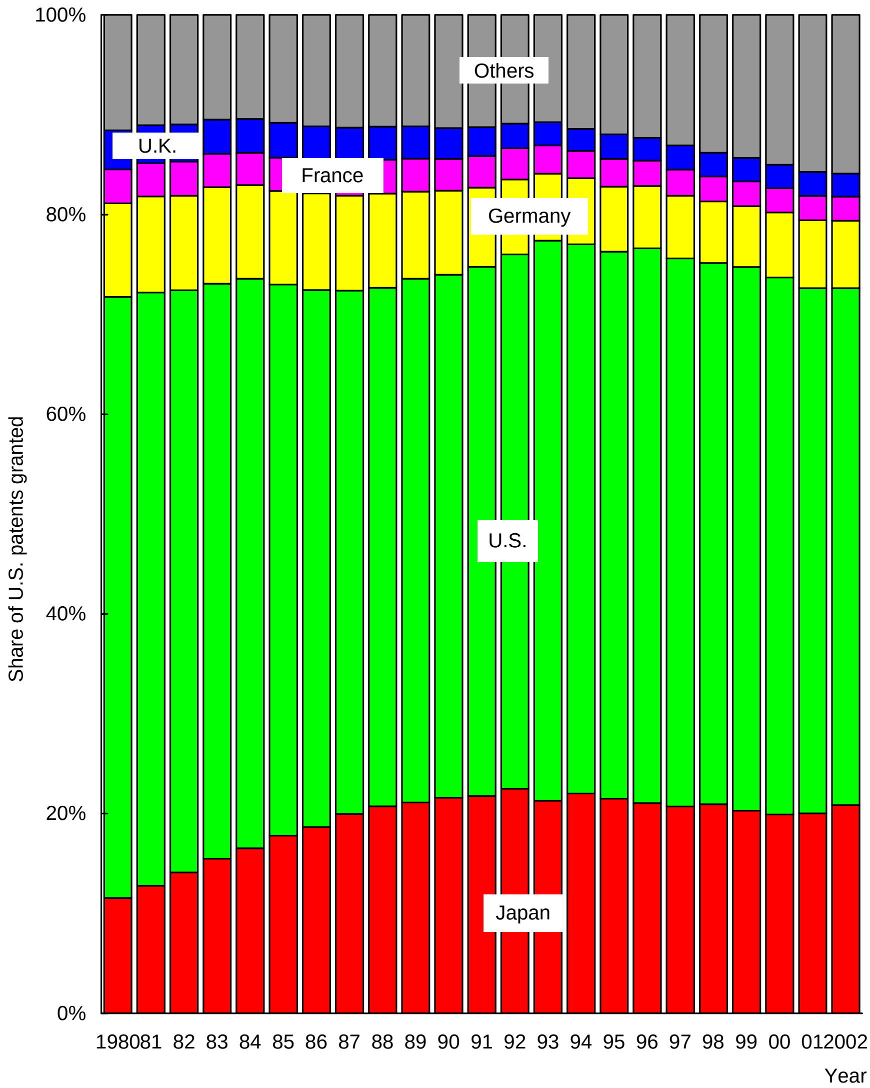
Secondly, since a relatively small proportion of Japanese patents are filed by non-residents, assessing Japan's R&D results in comparison with other countries is not feasible. In this regard, U.S. patent statistics are more suitable for the purpose. In addition, important Japanese inventions are often filed in the U.S. as well.

Figure 7-2-7 shows the breakdown of patents granted in the U.S. by country of origin. The share of patents originating in Japan increased significantly in the 1980s, although the pace of growth slowed down in the latter half of the 1980s. After declining slightly until the latter half of the 1990s, this share recovered slightly in 2001 and 2001. Despite such fluctuations, Japan has remained the second largest source of the U.S. patents after the U.S. itself.

The proportion of the U.S. continued to decline until around 1988, followed by growth until 1993 and another decline, which continued for the remainder of the selected period, except for 1996. By 2002, it declined to a little over 50%.

The share of patents originating in Germany suffered a long-term decline but leveled off in the mid-1990s, followed by a slight increase since 2000.

Figure 7-2-7: Trends in the patents granted in the U.S. by source country



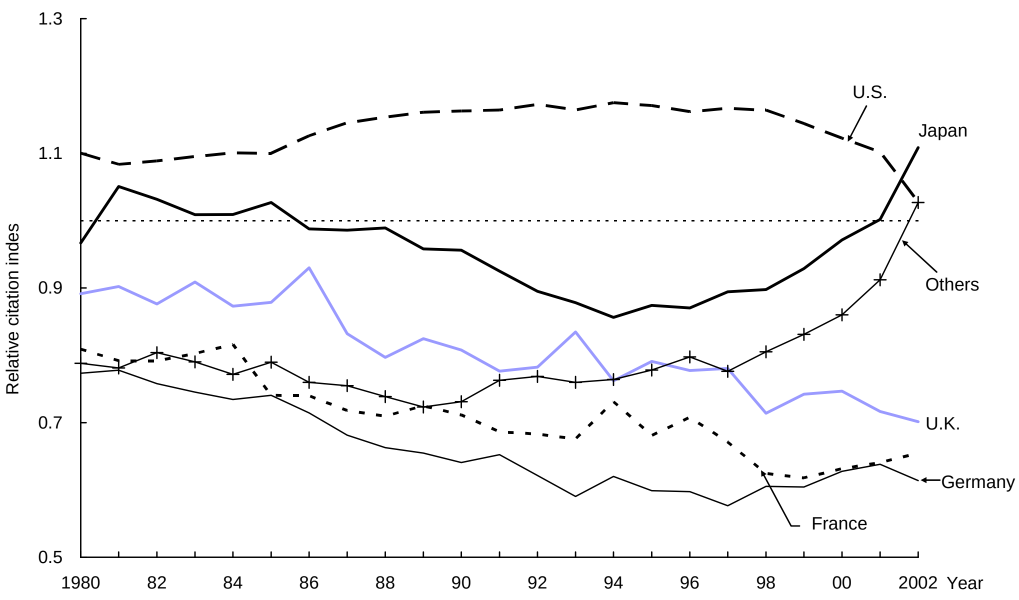
Source: Compiled by NISTEP based on “TP2-Int'l Technology Indicators Database for Data Years 1980-2002,” CHI Research, Inc.
See: Table 7-2-7

Next, we discuss an index regarding the citation of U.S. patents. The U.S. patent system requires patent examiners to cite prior patents and other documents to show the content of the inventions as objectively as possible. The data on these citations can be used to count citations by succeeding patents (citation count), from which the relative citation index can be calculated as with scientific papers. In the case of patents, the purpose of citation is to claim or confirm the novelty, innovativeness, etc. of the invention to be patented, and citations are therefore made from a standpoint neutral to the value of patents to be cited. Nevertheless, the cited patents can still be considered relatively important(2).

Figure 7-2-8 shows the RCI of U.S. patents by country of origin. The definition of the RCI is similar to that given for scientific papers (see the notes on Figure 7-1-5), where the international average is assumed to be 1. The RCI of patents originating in Japan stood above 1, close to the U.S. level, in the first half of the 1980s, but dropped to below 1 in the latter half of the 1980s, continuing to decline until the mid-1990s. It recovered later, reaching 1 by 2000 and even exceeded the U.S. level in 2002 (Figure 7-2-8).

The RCI of the U.S. in the 1990s remained stable and higher than that in the 1980s, but fell significantly in the latter half of the 1990s. The RCI values of the U.K., Germany, and France have stayed far below the levels of Japan and the U.S. and have declined gradually over time.

Figure 7-2-8: Trends in the relative citation index (RCI) of U.S. patents

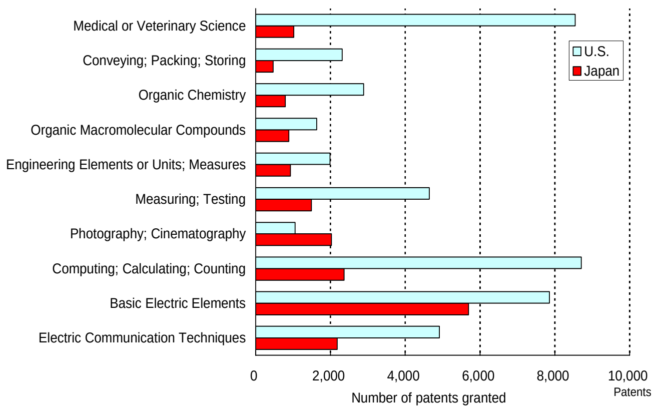


Note: (relative citation index: RCI) = (citation count per patent for a country) ÷ (citation count per patent worldwide)
Source: Compiled by NISTEP based on "TP2-Int'l Technology Indicators Database for Data Years 1980-2002," CHI Research, Inc.
See: Table 7-2-8

(2) There have been a number of empirical studies to verify that the patent citation count adequately reflects the value of technology. Some of them have demonstrated that frequently cited patents are those that are valued highly among experts (see References [2] and [3]).

Let us also examine U.S. patents by field of technology. Figure 7-2-9 compares Japan and the U.S. as source countries of U.S. patents in 2002 in the top 10 fields of technology of the 118 fields (three-digit classification) defined by the International Patent Classification (IPC). Patents from the U.S. outnumber those from Japan in nine fields of technology. The gap between the two is particularly large in 'medical and veterinary science.' On the other hand, the number of Japanese patents exceeds that of U.S. patents in the field of 'photography; cinematography.' In the fields of 'basic electric elements' and 'electric communication techniques,' Japan is outperformed by the U.S. by a relatively narrow margin, although the margin has been widening over time.

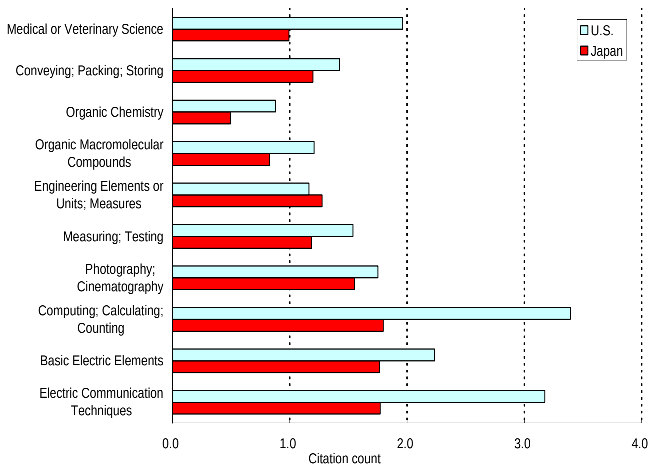
Figure 7-2-9: Japanese and U.S. patents granted in the U.S. by field of technology (2002)



Source: Compiled by NISTEP based on "TP2-Int'l Technology Indicators Database for Data Years 1980-2002," CHI Research, Inc.
See: Table 7-2-9

We compare Japan and the U.S. as sources of U.S. patents by citation count in the 10 major fields of technology listed in Figure 7-2-9. The citation index (the frequency of citation per patent) of the U.S. patents for 2002 is shown by field of technology in Figure 7-2-10. A comparison of the two countries illustrates that Japan exceeds the U.S. only in 'engineering elements or units; measures,' with the U.S. outnumbering Japan in the remainder of the fields. Even in 'photography; cinematography,' the only field where Japan exceeds the U.S. in terms of the number of patents granted in the U.S., as shown in Figure 7-2-9, the U.S. surpasses Japan in the citation index. The gap between the two countries in individual fields is narrower than that in the number of patents granted.

Figure 7-2-10: Citation index of the Japanese and U.S. patents granted in the U.S. by field of technology (2002)

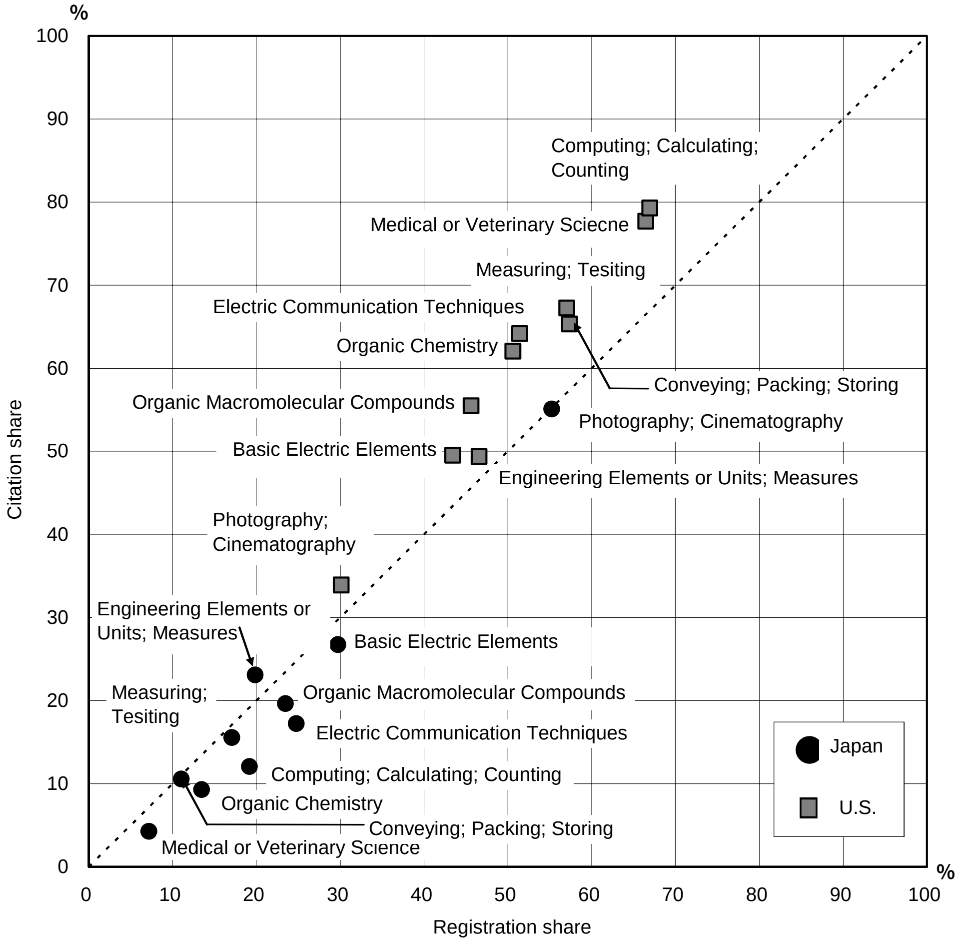


Note: (citation index) = (citation count in a field) / (the number of patents granted in a field)
Source: Compiled by NISTEP based on "TP2-Int'l Technology Indicators Database for Data Years 1980-2002," CHI Research, Inc.
See: Table 7-2-10

Figure 7-2-11 illustrates again Japanese patents and U.S. patents granted in the U.S. in the top 10 fields of technology, this time from the perspectives of the share of patents granted, which is represented by the horizontal axis, and the share of patent citations, which is indicated by the vertical axis, to show the relation between the two values. In this graph, if a field of technology is plotted on the line with a slope of 1, it indicates that the citation share is greater than the registration share,; in other words, the citation count in the given field is above the average of all patents granted in the U.S. While all fields of the U.S. are plotted above the straight line, only one field, 'engineering elements or units; measures,' of Japan is plotted above the line. The 'photography; cinematography' field of Japan is plotted on the line, suggesting that the citation count for the patents in this field, although not particularly high relative to those of the other fields, is commensurate with its large share.

In all of the 10 major fields, the U.S. citation share is above average, although the citation index across all fields is not much higher than that of Japan, as illustrated in Figure 7-2-8. It is noteworthy that the U.S. citation index is far above Japan's in such major fields of technology, as listed in the graph.

Figure 7-2-11: Comparison of citations of Japanese and U.S. patents granted in the U.S. by field of technology (total of 1998-2002)



Note: (citation index) = (citation count in a field) / (the number of patents granted in a field)
Source: Compiled by NISTEP based on "TP2-Int'l Technology Indicators Database for Data Years 1980-2002," CHI Research, Inc.
See: Table 7-2-11

7.3 International distribution of science and technology knowledge: Technology trade

In general, technology export refers to granting business enterprises or individuals abroad the right[3] to use specific technologies in exchange for a consideration, and technology import (technology introduction) involves receiving such rights from business enterprises or individuals in foreign countries by paying a consideration. These two types of trade are collectively known as the technology trade. The data on the technology trade serve as important indicators of the globalization of science and technology because they indicate the international flow of technological knowledge. They are also used to measure the technological standard of a country in an international context. More specifically, the amount of technology exports (receipts) and the ratio of technology exports to technology imports (payments), which is known as the technology exports to imports ratio, are used as indicators of technological capability.

This section discusses data on the technology trade as indicators to compare Japan's R&D achievements with those of other countries. Technology trade statistics as indicators of the globalization of science and technology are addressed in Chapter 11. Japan has two major sources of statistics on the technology trade: the Statistics Bureau of the Ministry of Public Management, Home Affairs, Posts and Telecommunications and the Bank of Japan. This section uses the statistics of the former.

Figure 7-3-1 shows data on the technology trade for five leading industrial nations. The upper half of the plot illustrates technology exports and the lower half represents technology imports. The values of the technology trade have been converted into Japanese currency (yen) using the power purchasing parities calculated by the OECD to allow direct comparison.

As a whole, the value for Japan is rather small in terms of both technology imports and exports among the five countries. However, comparing national data without adjustments is not appropriate because the conditions differ by country. Therefore, we focus on the relation between technology imports and exports and on long-term trends.

While the selected countries show different trends in technology trade value, they share an upward trend. By country, Japan experienced a significant increase in technology exports in the 1990s and has had a favorable technology trade balance, or an excess of exports over imports, since FY1993. Japan's value of technology exports totaled ¥1,386.8 billion and that of technology imports totaled ¥541.7 billion in 2002.

The U.S. is predominates in technology exports, with the total value being 4.6 times as high as Japan's in 2001. From a long-term perspective, the value has indicated a sharp rise since the latter half of the 1980s until it made a downturn in 2000. Technology imports of the U.S. also grew steadily until 2000, when they began to decline. Technology imports have been smaller than technology exports in size, allowing the U.S. to have a very favorable technology trade balance.

Germany's technology imports and exports, both standing above Japan's in value, have increased steadily over time. The technology trade balance of Germany remained favorable throughout the selected period (1981-2001).

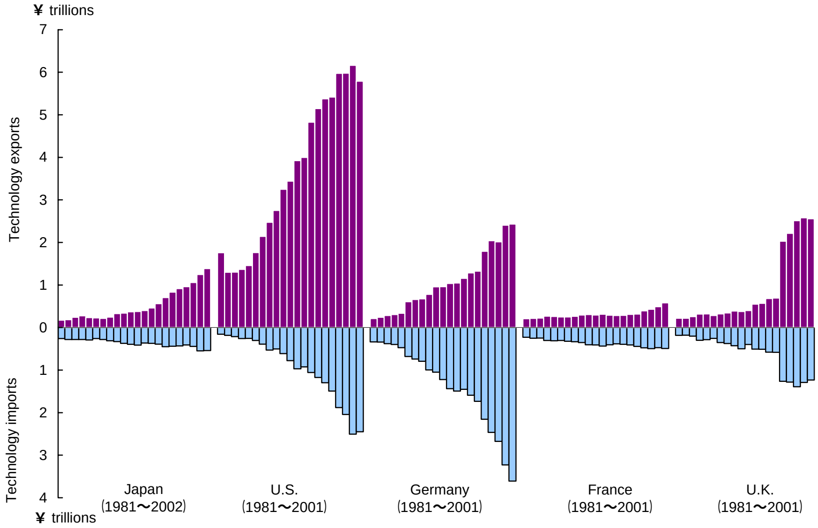
In France, technology imports and exports have been rather small among the selected countries. From a long-term viewpoint, technology exports have grown since 1998, while technology imports have been stable. As in the case of Germany, the technology trade balance remained favorable for most of the selected period (1981-2000).

In analyzing long-term trends in the U.K., it should be remembered that there was a change in the statistical survey methodology in 1996. Aside from this, technology exports of the U.K. have increased in general.

Figure 7-3-2 shows the trends in the exports to imports ratio (the value of exports divided by the value of imports) in technology for the selected five countries. The ratio for Japan hovered at 1 from the mid-1980s to the early 1990s. This can be attributed to the growth of Japanese industry that boosted technology imports as well as the introduction of technology from overseas. After this period, technology exports increased faster than technology imports, resulting in continuous growth in the exports to imports ratio, hitting 1 for the first time in 1993. The ratio stood at 2.56 in FY2002, despite a temporary decline in this year.

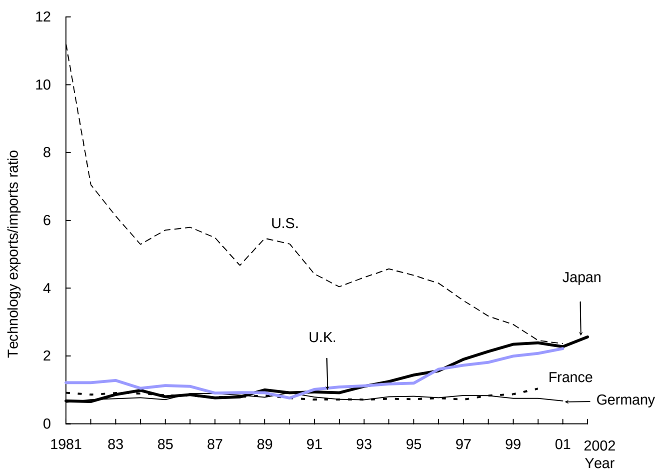
Despite frequent fluctuations, the exports to imports ratio of U.S. technology has declined generally over the long term, becoming equal to that of Japan by 2001. In the U.K., the ratio fell during the 1980s but has grown since 1990, reaching a level on a par with Japan's by 2001. Germany's ratio has never topped 1, suggesting an excess of technology imports over exports. This trend has intensified since the 1990s. In France, too, the exports to imports ratio remained stable below 1 until 2000, when it hit 1 for the first time.

Figure 7-3-1: Trends in the total value of technology trade in selected countries



Notes: The following notes are copied from Table 1-2-4.
<Japan> The data refer to patents, expertise, and technical assistance.
In the data, there are breaks in the series due to the addition of industries to be surveyed in 1996 and 2001.
<U.S.> The data refer to loyalties and licenses only
<Germany> The data refer to West Germany until 1990 and to patents, licenses, trademarks, and designs until 1985. Additionally including technical services, computer services, and private-sector R&D since 1986.
<France> No definition available
<U.K.> Including data for the petroleum industry since 1984. Including patents, inventions, licenses, trademarks, designs, technology-related services and R&D since 1996.
Based on the same purchasing power parity as for Reference Statistics E
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Survey of Research and Development"
<U.S., Germany, France and U.K.> OECD, "Main Science and Technology Indicators 2003/1" See: Table 7-3-1

Figure 7-3-2: Trends in technology trade balance for selected countries



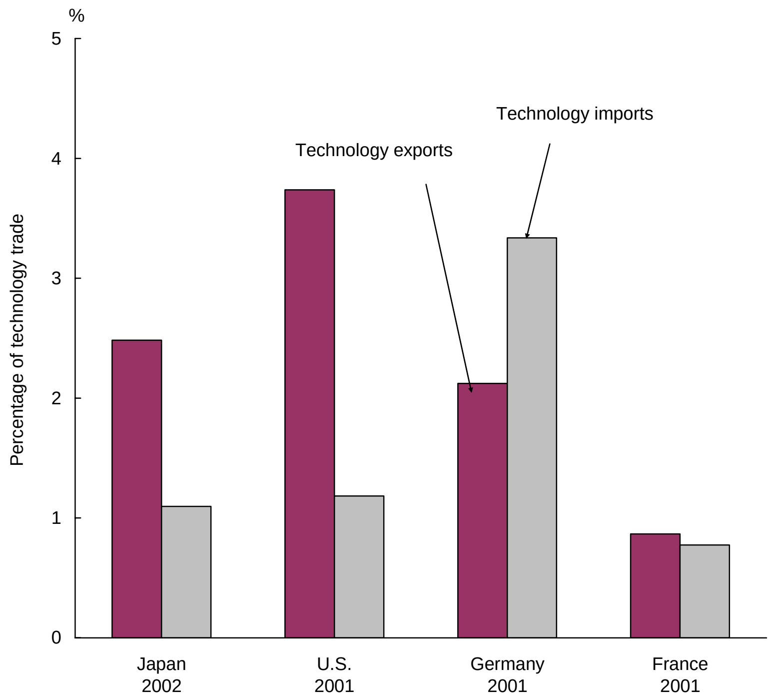
Note: Same as Table 7-3-1 Source: Same as Table 7-3-1 See: Table 7-3-2

Since the value of technology trade is subject to the country's geographical and historical conditions and international relationships, the impact of these elements should be considered. In this context, we measure the level of technology trade in reference to the total external trade in goods and services (Figure 7-3-3). In the section below, technology exports as a percentage of total exports are called the 'technology export ratio,' and technology imports as a percentage of total imports are referred to as the 'technology import ratio.'

The U.S. has the highest technology export ratio at 3.7%, followed by Japan (2.5%) and Germany (2.1%). Germany is the No. 1 at 3.3% in its technology import ratio among the selected countries, with the remainder posting ratios around 1%. Only Germany that registers a technology import ratio higher than its technology export ratio.

Combined with the absolute values of technology exports shown in Figure 7-3-1, the technology export ratio illustrates that Japan's technology trade value, though not remarkable among the selected five countries, accounts for a relatively large proportion of the total value of trade. In fact, Japan's total trade including goods and services is rather small in value, a factor that explains to some extent the small value of Japan's technology trade.

Figure 7-3-3: Technology trade as a percentage of total trade



Source: For technology imports and exports, the same as those on Table 7-3-1
Total imports and exports: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
<U.S., Germany, and France> OECD, "Annual National Accounts 2003/3"
See: Table 7-3-3

There is one aspect that should be considered when statistics on the technology trade are discussed, which is that technology transfer within enterprise groups, for example, between companies that are affiliated to the same enterprise group but located in different countries, are now included in the statistics on the technology trade, as business activities become more global. Such technology trade among affiliated companies can be an indicator of the internationalization of technological knowledge but is not an effective indicator of the international competitiveness of the technological capability of a country. Since this report is to evaluate the R&D achievement of Japan through international comparison, technology transfer within enterprise groups should be excluded from the technology trade statistics it uses.

With regard to the data on technology trade by Japanese business enterprises, the ‘Report on the Survey of Research and Development’ published by the Statistics Bureau of the Ministry of Public Management, Home Affairs, Posts and Telecommunications has distinguished technology trade between parent companies and their subsidiaries from technology trade between unaffiliated companies since the 2002 survey. Similarly, the U.S. splits the technology trade between parent companies and their subsidiaries from the remainder when reporting statistics on trade in technology. Based on these data, Figure 7-3-4 shows technology imports and exports in a manner in which trade between parent companies and their subsidiaries is distinguishable.

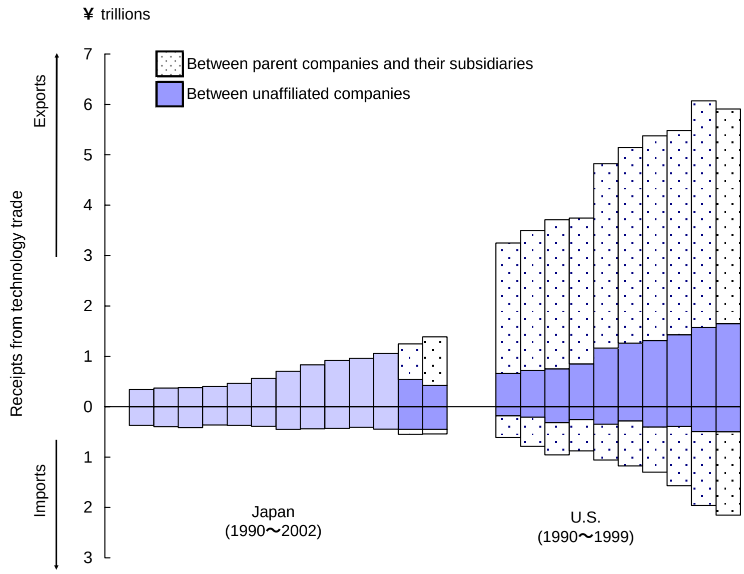
In Japan, of the total technology exports of ¥1,386.8 billion for 2002, 69.6% or ¥965.7 billion derive from the technology trade between parent companies and their subsidiaries. This value represents the payments received by Japanese companies from their foreign subsidiaries for the right to use specific technologies. The remaining part of the technology exports account for 30.4% of the total, or ¥421.1 billion. Technology imports for the same year total ¥541.7 billion, of which 16.9% or ¥91.7 billion derive from the technology trade between parent companies and their subsidiaries. The remainder of the technology imports constitute 83.1%, or ¥450 billion, of the total. The trade balance in technology calculated from the values excluding the technology trade between parent companies and their subsidiaries is an import surplus of ¥28.9 billion, with an exports to imports ratio of 0.9.

In the U.S., in 1999, the latest available year, technology exports excluding those between parent companies and their subsidiaries were worth ¥1,646.3 billion when converted into Japanese yen using the purchasing power parity. The value accounts for 27.9% of the total technology exports of the country. Technology imports excluding those between parent companies and their subsidiaries are ¥497 billion on a purchasing parity basis, representing 23.1% of the total technology imports. The trade balance in technology excluding trade between parent companies and their subsidiaries is an export surplus of ¥1,149.3 billion, with an exports to imports ratio of 3.31.

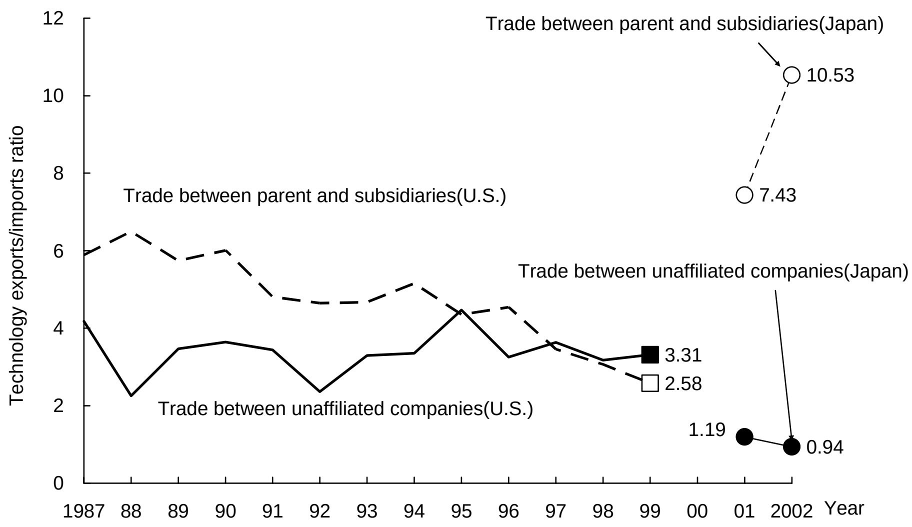
The above calculations of the trade balance in technology for Japan and the U.S., excluding technology trade between parent companies and their subsidiaries, reveal a trend that is dissimilar to that indicated in Figure 7-3-2; the U.S. trade balance in technology is far more favorable than Japan’s. In other words, when measured by a realistic indicator of national technological capability, free from the impact of the technology trade between parent companies and their subsidiaries, U.S. technological capability far exceeds Japan’s.

Figure 7-3-4: Trends in technology trade in the U.S and Japan
(technology trade between parent companies and their subsidiaries and between unaffiliated companies)

(A) Trade in technology



(B) Technology trade balance



Notes: <Japan> A parent and subsidiary relationship is acknowledged when a business enterprise is more than 50% owned by another.
<U.S.> A parent and subsidiary relationship is acknowledged when a business enterprise located in one country is directly or indirectly owned or controlled by an entity of another country to the extent of 10% or more of its voting stock.
Source: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
<U.S.> NSF, "Science & Engineering Indicators 2002"
See: Table 7-3-4

References

[1] Worcester Polytechnic Institute
"Analysis of Highly Cited Patents: Are They Important?"
Report prepared for the U.S. Patent Office, 16 December 1988.
[2] Albert, M.B., Avery, D., Narin, F., and McAllister, P.
"Direct Validation of Citation Counts as Indicators of Industrially Important Patents,"
Research Policy, Vol. 20, No. 3, June 1991, pp. 251-259

Chapter 8
Transformation of Knowledge Production

8.1 Knowledge production through networks of researchers

It has recently become widely accepted that the methods that researchers use to gain science and technology knowledge are changing considerably. Gibbons, Ziman, and others address this issue in their books about the social systems of science and argue that the form of research activities is undergoing a transformation. In their arguments, they performed qualitative analysis of the cause and effect of this transformation. This chapter explains the changes pointed out by the two authors using quantitative data based on bibliometrics. Among other increasingly common characteristics of research activities, we focus on the development of networks of researchers and internationalization.

First, we verify the trend that scientific papers are more often produced by groups than individuals. Figure 8-1-1 shows the number of papers listed in SCI, the data already used in Chapter 7, by the count of authors. The data shown do not cover social sciences or humanities.

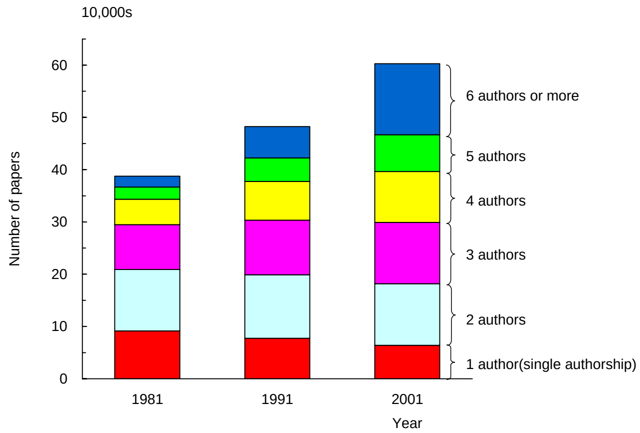
As the figure illustrates, compared with a 1.6-fold increase in the total number of SCI papers between 1981 and 2001, the number of papers written by a single author (single authorship) declined during the same period. In 2001, single authorships accounted for no more than 10.6% of the total number of SCI papers.

Similarly, the number of papers written by two authors did not grow during this period, and papers written by three authors indicated only a meager increase. Moreover, the combined total number of papers produced by three authors or less barely increased during the 20-year period, or remained stable in other words. In 2001, the papers produced by three authors or less accounted for only 49.6% of the total number of SCI papers.

By contrast, the number of papers written by four authors or more surged. In particular, those written by six authors or more increased 6.5-fold in the selected 20 years.

This trend in the authorship patterns of scientific papers implies that more and more research activities are conducted by large groups rather than individuals or groups of a few scientists. The actual state may differ depending on the field of research and there may still be fields where single authorship is dominant. Nevertheless, as far as natural science, the category covered here, is concerned, groups conducting research activities are mainstream.

Figure 8-1-1: Trends in the authorship pattern of SCI papers

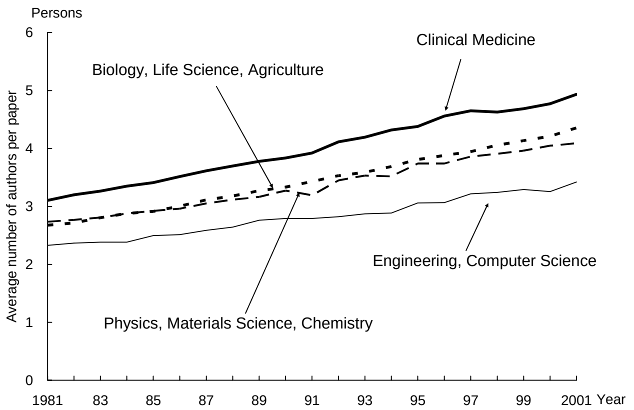


Source: Compiled by NISTEP based on Thomson ISI's "Science Citation Index, Compact Disk Edition"
See: Table 8-1-1

The growth in joint research activities can be measured using the average number of authors per paper as an indicator. In Figure 8-1-2, the SCI papers are divided into four major research fields, for each of which the average number of authors per paper is shown. Not all SCI papers are covered by the four categories, since we have excluded fields consisting of a small number of papers, such as multidisciplinary fields and mathematics.

Except for a temporary decline in some fields, the average number of authors per paper has increased in all four fields over time. By field, the number of authors per paper has been highest in 'clinical medicine' throughout the selected period, while it has been lowest in 'engineering & computer science.' 'Biology, life science & agriculture' and 'physics, materials science & chemistry' have remained at similar levels, whereas the former has been slightly above the latter since 1985.

Figure 8-1-2: Trends in the average number of authors per paper by field of research



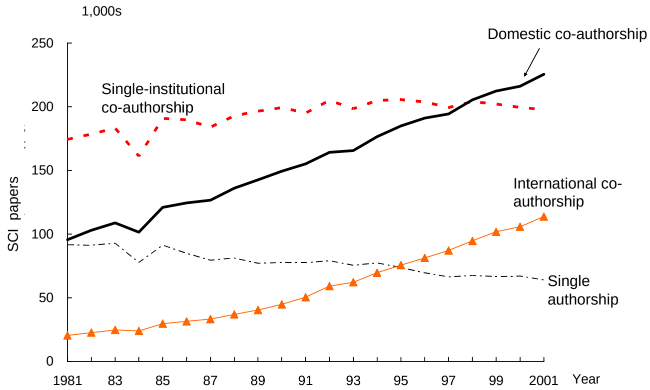
Source: Compiled by NISTEP based on Thomson ISI's "Science Citation Index, Compact Disk Edition"
See: Table 8-1-2

Below, we further analyze the authorship patterns of scientific papers, considering not only the number of authors but also the combination of institutions to which the authors belong. Figure 8-1-3 shows the change in the number of SCI papers by the following authorship patterns. 'Single-institutional co-authorship' refers to papers written by multiple persons belonging to the same institution. 'Domestic co-authorship' refers to papers written by multiple persons belonging to different institutions in the same country. Finally, 'international co-authorship' represents papers written by multiple persons belonging to different institutions in different countries. Figure 8-1-3 shows the number of single authorships in addition to the three above types of co-authorship.

Examining the trends in authorship patterns shows that domestic co-authorship and international co-authorship grew steadily throughout the selected period, while single-institutional co-authorship barely increased. More specifically, in the 20 years between 1980 and 2001, domestic co-authorship and international co-authorship increased 2.4-fold and 5.6-fold, respectively, whereas single-institutional co-authorship increased only slightly by 1.1-fold. On the other hand, single authorship declined almost steadily during this period.

From the growth in domestic co-authorship and international co-authorship and the leveling-off (or the decline in recent years) of single-institutional co-authorship, we can conclude that external networks of researchers have developed.

Figure 8-1-3: Change in authorship of papers (Trends in the number of SCI papers by authorship)



Source: Compiled by NISTEP based on Thomson ISI's "Science Citation Index, Compact Disk Edition"
See: Table 8-1-3

How much does the distribution of papers among different types of co-authorship vary by country? Does this distribution represent the characteristics of the production of scientific papers and knowledge in a country? To answer these questions, we show a breakdown of papers by type of co-authorship for Japan, the U.S., and major European countries in Figure 8-1-4. The papers assigned to Japan in this figure are, as in the case in Chapter 7 (Section 7.1), those written by persons who belong to institutions located in Japan. Figure 8-1-4 also uses the same classification of co-authorship as that for Figure 8-1-3.

The most remarkable characteristic of Japan is the share of single authorships, which is considerably smaller than those of the other four countries. Furthermore, the share even declined between 1981 and 2001 to as low as 5.3%.

A second characteristic of Japan is the large proportion of single-institutional co-authorship. In 1981, this category accounted for over half, or 56.5%, of the total number of Japanese papers. However, the share declined markedly over time and stood at 33% in 2001.

A third characteristic of Japan is a significant increase in the share of domestic co-authorship. This is in sharp contrast to the other four countries, which have experienced either a leveling-off or a slight increase in this category.

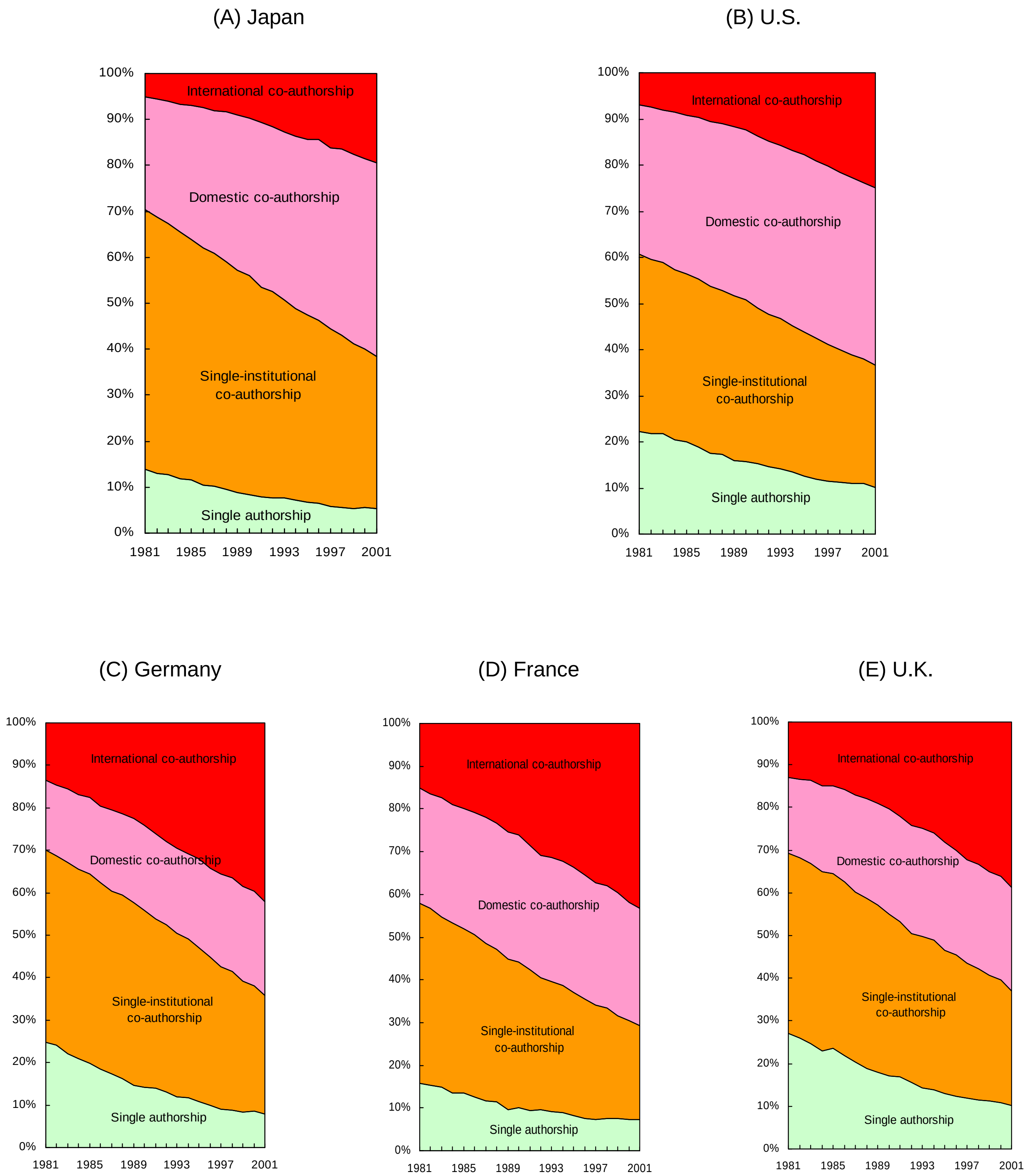
A fourth characteristic is the brisk growth in the share of international co-authorship. This share, however, remained the smallest among the five countries throughout the selected period.

The third characteristic of Japan does not hold true for the U.S., which has not shown remarkable growth in the share of domestic co-authorship. However, the U.S. is similar to Japan in that the share of international co-authorship, while being smaller than those of the three European countries, has increased significantly over time.

Germany, France, and the U.K. share the same characteristic, which is that the share of international co-authorship is larger than those of Japan and the U.S., while the share of domestic co-authorship is rather small.

A common trend among the five countries is the remarkable growth in international co-authorship on the one hand and a decline in single authorship and single-institutional co-authorship on the other. To sum up, the unit of implementing R&D is undergoing a transition from the individual to the group, and from a single institution to multiple institutions, driving the move toward globalization.

Figure 8-1-4: Trends in the percentage of authorship of papers for five selected countries



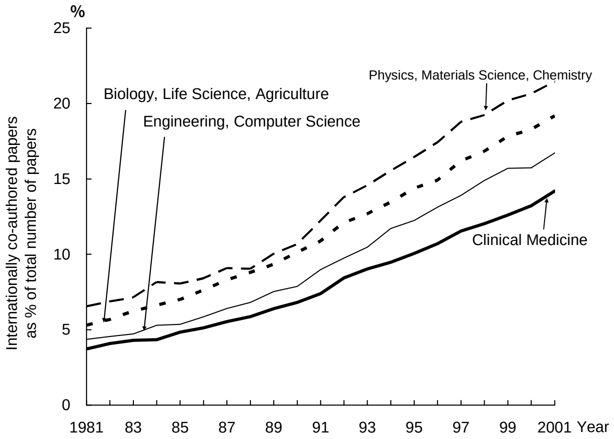
Source: Compiled by NISTEP based on Thomson ISI's "Science Citation Index, Compact Disk Edition"
See: Table 8-1-4

In the preceding part of this section, we discussed the growth in the number of internationally co-authored papers and their growing share of the total number of scientific papers produced in the five major countries. Next, we show the detailed state of the increase in international co-authorship.

Figure 8-1-5 shows what we refer to as the international co-authorship ratio, or the number of internationally co-authored papers as a percentage of the total number of papers produced in all the selected countries, by field of research. We split SCI papers into four fields of research to calculate the international co-authorship ratio by field.

In all four fields of research, the international co-authorship ratio has increased almost steadily. During the selected period, 'physics, materials science & chemistry' indicated the highest international co-authorship ratio, followed by 'biology, life science & agriculture,' 'engineering & computer science,' and 'clinical medicine.' R&D in such fields as physics, materials science, and chemistry that have a high ratio of international co-authorship is more globalized compared with other areas.

Figure 8-1-5: Trends in the percentage of internationally co-authored papers by field of research

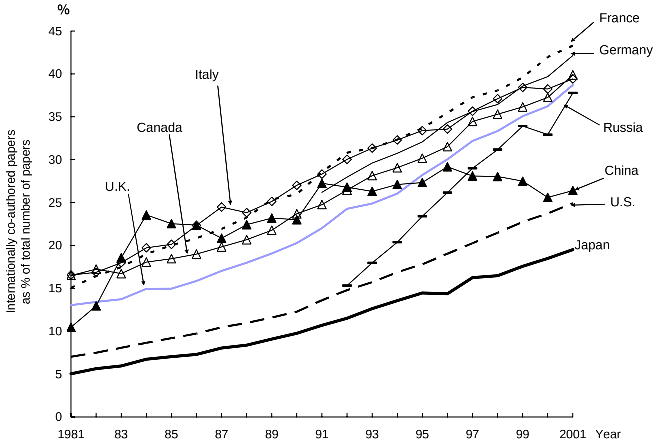


Source: Compiled by NISTEP based on Thomson ISI's "Science Citation Index, Compact Disk Edition"
See: Table 8-1-5

Figure 8-1-6 shows the trends in the international co-authorship ratio for the top nine countries in the number of papers listed in SCI.

Except for China, all countries show an increase in the international co-authorship ratio during the 20 years from 1981 to 2001. Although this trend is also true for Japan, the country's international co-authorship ratio remained the lowest among the nine countries throughout the period.

Figure 8-1-6: Trends in the international co-authorship ratio by country



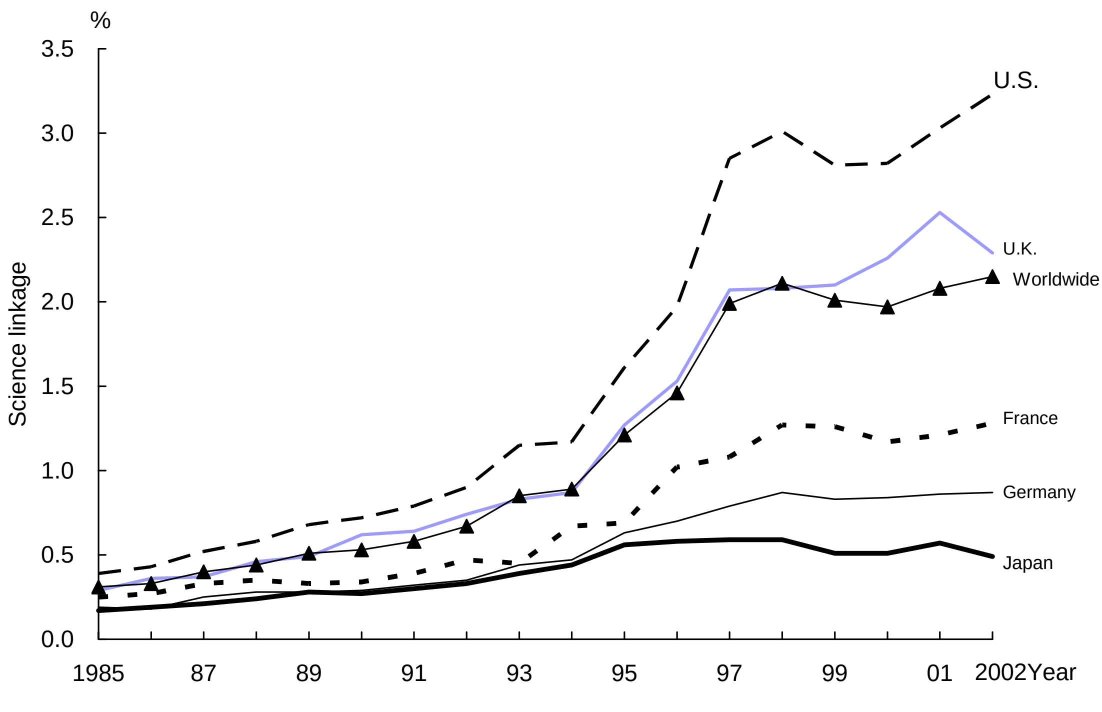
Source: Compiled by NISTEP based on Thomson ISI's "Science Citation Index, Compact Disk Edition" See: Table 8-1-6

8.2 Science linkage: the relationship between science and technology

This section discusses "science linkage," an indicator of the strength of the relationship between patents and scientific papers. Science linkage refers to the average number of scientific papers cited in a U.S. patent as appears in the patent examination report. As mentioned in Chapter 7 (Section 7.2), the U.S. patent examination reports list references to earlier patents or non-patent literature to clarify the content of individual patents. The science linkage is an indicator developed based on the number of scientific papers included in these lists. Since citations made by patents of scientific papers is a means that relates technologies (patents) to the scientific knowledge they depend on, the science linkage, as an index of such relationships, serves as a measure of the strength of the relationship between technology and science. Furthermore, since citations are made by examiners and not by inventors of patents, this indicator is assumed to be more objective.

Figure 8-2-1 shows the trends in the science linkage of U.S. patents by the origin of invention. As a whole, the science linkage increased throughout the selected period, suggesting a closer link between patents and scientific papers. By country, the science linkage of the U.S. has remained the highest among the selected countries as a result of a remarkable increase. By contrast, Japan's science linkage has remained the lowest with a margin that widened even more in the latter half of the 1990s.

Figure 8-2-1: Trends in the science linkage of U.S. patents for selected countries



Note: (science linkage) = (the number of scientific papers cited) / (the number of U.S. patents)
Source: CHI Research, Inc., "TP2-Int'l Technology Indicators Database for Data Years 1980-2002"
See: Table 8-2-1

The science linkage index varies widely depending on the field of technology and is high in specific fields. Many of these fields are related to life science. Figure 8-2-2 (A) shows the science linkage for Japan and the U.S. in seven fields: ‘biology and microbiology,’ ‘organic chemistry,’ ‘medical and veterinary science,’ which are the three fields in which the science linkage is the highest, and four other highly cited fields. Sixty percent of the citations made by U.S. patents of scientific papers derive from these seven fields.

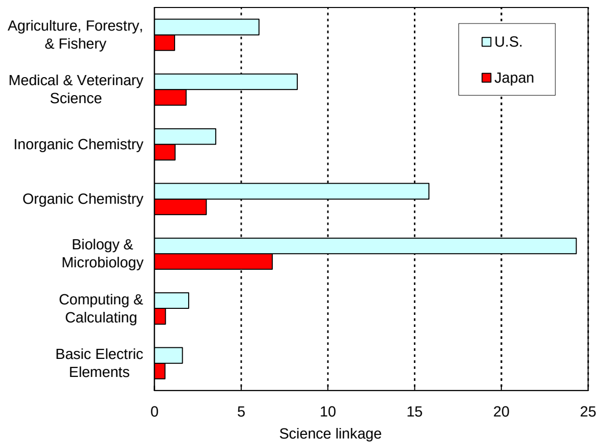
In all the seven fields, U.S. science linkage exceeded Japan’s as of 2002. The U.S. value was particularly high in ‘biology and microbiology’ at 24.3. This suggests a close relationship between scientific literature and patents related to genetic engineering.

Let us examine the trends in the science linkage of four highly cited fields for Japan and the U.S. in Figure 8-2-2 (B). They show that the science linkage of the U.S. has increased significantly for the past 10 or more years in the fields of ‘biology and microbiology,’ ‘organic chemistry,’ and ‘medical and veterinary science,’ among others. While Japan has also posted growth in these fields, its indicator levels are still far lower than those of the U.S.

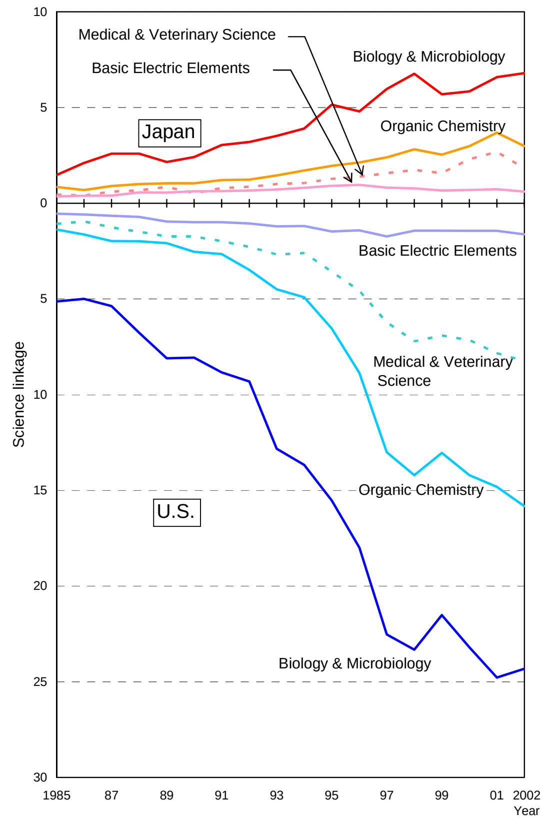
Although more modest in value and growth rate compared with the other three fields, ‘basic electric elements’ is a major area in terms of the strength of science linkage, and its science linkage value increased steadily until the latter half of the 1990s. Subsequently, the value declined in both Japan and the U.S. and leveled off for the remainder of the selected period.

Figure 8-2-2: Science linkage in major fields in Japan and the U.S.

(A) 2002



(B) Trends in science linkage (1985-2002)



Note: (science linkage) = (the number of scientific papers cited) / (the number of U.S. patents)
Source: CHI Research, Inc., “TP2-Int'l Technology Indicators Database for Data Years 1980-2002”
See: Table 8-2-2

References

[1]M.Gibbons, et al.,“THE NEW PRODUCTION OF KNOWLEDGE: The Dynamics of Science and Research in Contemporary Societies”
[2] J.Ziman, “Prometheus Bound”

Chapter 9
The Role of the Government

9.1 Government as the hub of the national innovation system

In the innovation system of a country, the government is key in that it funds other sectors and coordinates between different sectors, even if it is not the primary performer. This chapter analyzes the role the government plays in the national science and technology system, with emphasis on the funding it provides for individual sectors.

There are two ways of measuring how much governments spend on R&D. The first is to survey the units that actually carry out R&D in order to collect data on funding from the government. The second is to examine government budget data in order to identify all the budget items related to R&D.

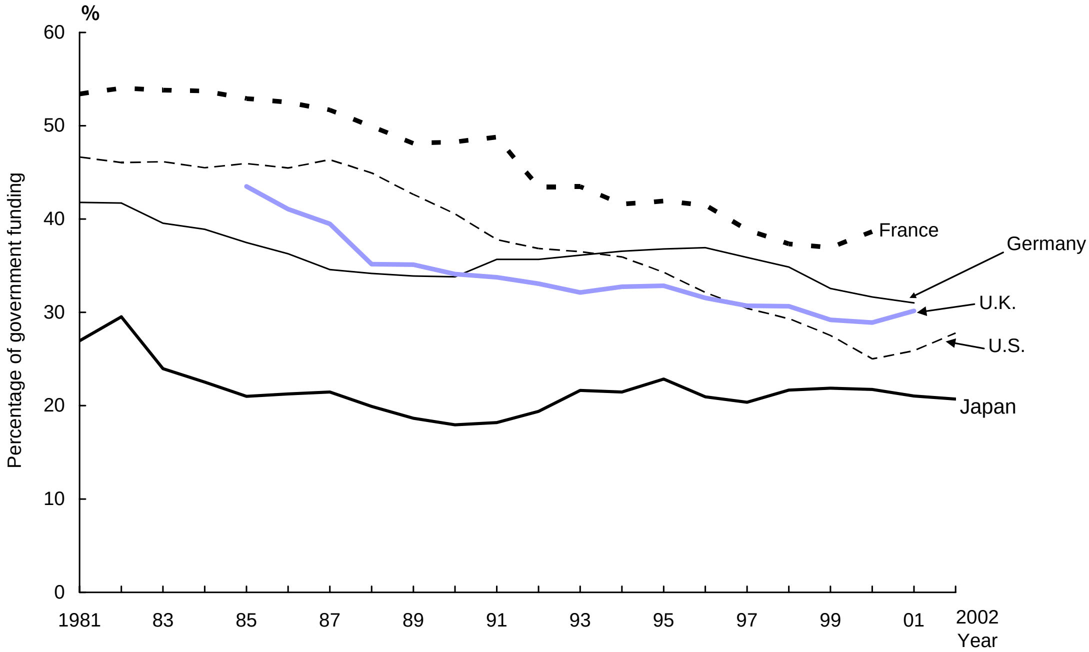
Of the above two methods, the first, or the survey of the performance-based data, is the primary approach to compiling statistics on R&D funded by not only the government but also other sectors. This method allows researchers to accurately calculate the total R&D expenditure of a country, even if it involves complex flow, as long as the survey covers the entire nation. However, since the source of funding is not always clearly identifiable, the other method, or the budget-based survey, also needs to be employed. With this method, an accurate estimation of R&D expenditure is difficult because some R&D funding may be used for non-R&D activities. In the following sections, we first show R&D expenditure funded by the government, based on statistics on the source of funding (Section 9.1.1), and next analyze science- and technology-related outlays included in government expenditure (Section 9.2.1).

9.1.1 R&D expenditure funded by the government

Figure 9-1-1 shows the trends in the government R&D funding as a percentage of the nationwide R&D expenditure for selected countries. As it illustrates, the ratio of government funding was principally on the decline in the 1980s in all the five countries, of which Japan and Germany maintained a downward trend into the 1990s. The decline was particularly remarkable in the U.S., where the proportion of government funding fell from 46.7% in 1981 to as low as 25.0% in 2000. In the latter half of the 1990s, the trend turned upward slightly in France and the U.K., followed by the U.S. in the 2000s. Figure 9-1-3, which is shown later to illustrate trends in the government science and technology budgets in selected countries, clearly demonstrates that the long-term decline in the ratio of government funding is mainly attributable to an increase in business-sector R&D expenditure, rather than curtailment of government R&D spending. However, at the same time, this suggests that the role of the government in the national innovation system has been changing.

The ratio of government funding in Japan remained the lowest among the five countries throughout the selected period, standing at 20.7% as of 2002. The ratio, while not showing any major change in Japan in the long run, was slightly higher in the 1990s than in the latter half of the 1980s.

Figure 9-1-1: Trends in the ratio of R&D expenditure funded by the government for selected countries

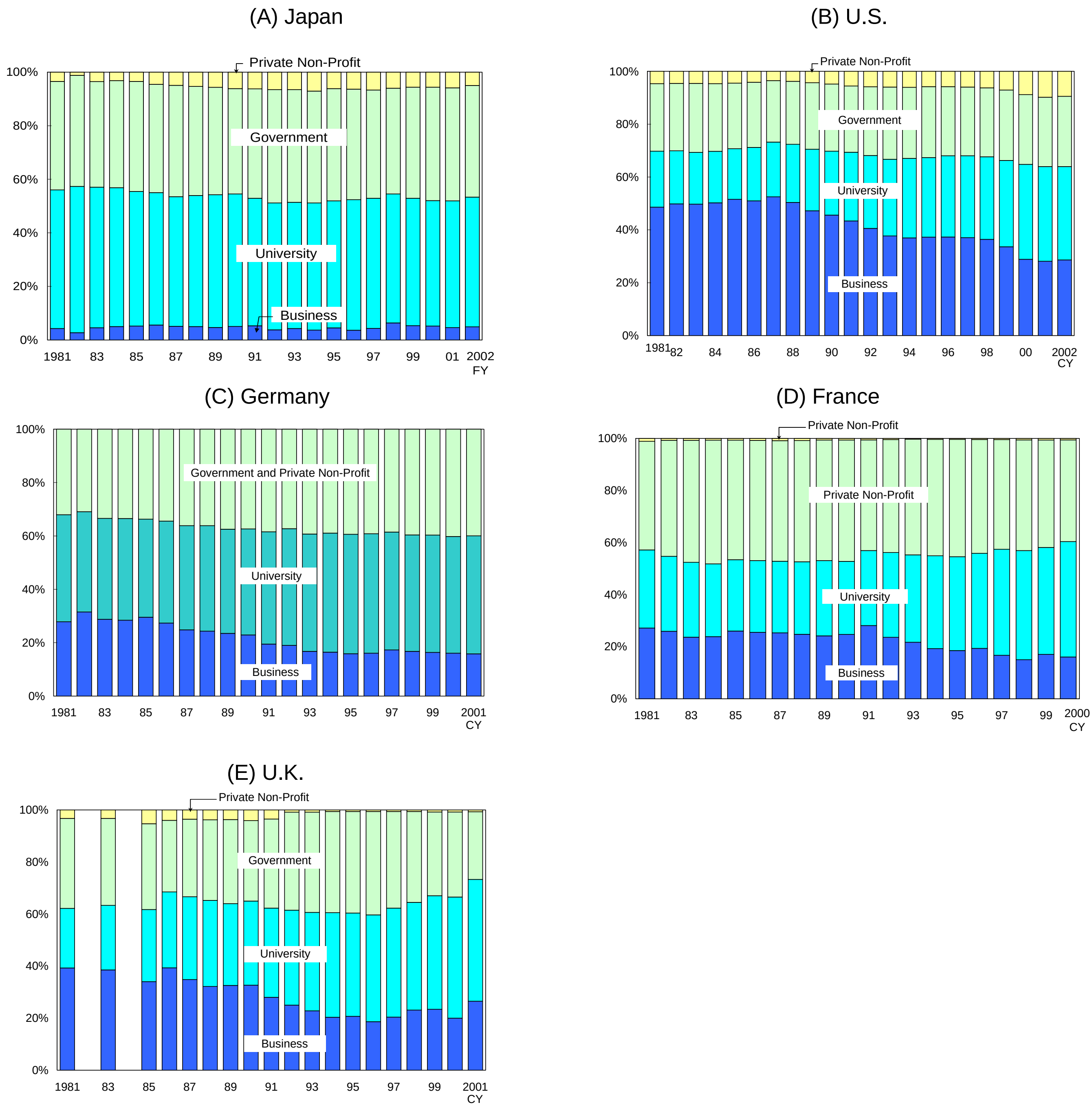


Notes: R&D expenditure is the combined total of the expenditure in natural sciences, social sciences, and humanities (for all countries).
<Japan> 1)The government refers to national and local public bodies, national and public research institutes, research institutes run by special public corporations, and national and public universities (including junior colleges etc.).
2) The data for Japan include the software industry since fiscal year 1996.
<U.S.> R&D expenditure for 2001 and 2002 are preliminary figures. The government refers to the federal government and federal research agencies.
<Germany> The data for Germany refer only to the former federal states until 1990 and to all of Germany since 1991. The government refers to the federal and state governments.
<France> The government refers to public research institutes.
<U.K.> The government refers to the central and local governments.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
<U.S.> NSF, "National Patterns of R&D Resources 2002 Data Update"
<Germany, France, and U.K.> OECD, "Basic Science and Technology Statistics 2002/2"; For British data since 1991, ONS, "Gross domestic expenditure on Research and Development 2001"
See: Table 9-1-1

In Figure 9-1-2, we examine government R&D expenditure by destination to identify the performing sector of government-funded R&D. The shares of Japan's R&D performing sectors did not show any significant change throughout the selected period. During this period, the university and government sectors were the major destinations of government funding. As already mentioned in Chapter 6 in the description of the flow of R&D expenditure (Figure 6-1-8), it is notable that Japan's government provides smaller funding to the business sector than other countries' governments do.

Traditionally, the U.S. government has allocated a large proportion of its R&D funding to the business sector. The proportion was particularly high between 1984 and 1988 at over 50%. It considerably declined between the latter half of the 1980s and the first half of the 1990s as the share of the university sector increased. The share of the private non-profit sector also grew during this period, although it was still small. The above decline in funding to the business sector is partly due to the reduction in defense spending. During another decline in the share of the business sector between the latter half of the 1990s to 2000, the shares of the university and private non-profit sectors rose again. Overall, there has been no major change in the proportion of the government sector.

Figure 9-1-2: Change in the performing sectors of government-funded R&D for selected countries



Notes: R&D expenditure is the combined total of the expenditure in natural sciences, social sciences, and humanities (for all countries).
<Japan> 1)The government refers to national and local public bodies, national and public research institutes, research institutes run by special or independent administrative corporations, and national and public universities (including junior colleges etc.).
2) The data for Japan include the software industry since fiscal 1996.
<U.S.> R&D expenditure for 2001 and 2002 are preliminary figures. The government refers to the federal government and federal research agencies.
<Germany> The data for Germany refer only to the former federal states until 1990 and to all of Germany since 1991. The government refers to the federal and state governments.
<France> The government refers to public research institutes.
<U.K.> The government refers to the central and local governments.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”
<U.S.> NSF, “National Patterns of R&D Resources 2002 Data Update”
<Germany, France, and the U.K.> OECD, “Basic Science and Technology Statistics 2002/2”; For British data since 1991, ONS, “Gross domestic expenditure on Research and Development 2001” See: Table 9-1-2

In Germany, the share of the business sector dropped but those of the university and private non-profit sectors rose between the 1980s and the mid-1990s. Since the latter half of the 1990s, the share of each sector has remained stable without any significant change.

In France, the share of the government sector was traditionally large, while that of the university sector was rather small. However, since the early 1990s, universities have increased their contribution while the government and business sectors have reduced theirs.

In the U.K., government funding to universities has increased almost steadily. Funding to the business sector, since the end of the continuous decline between 1981 and 1996, has continued to grow except for 2000. The share of the government sector has declined since the latter half of the 1990s.

In summary, in all the selected countries other than Japan and the U.K., R&D expenditure provided by the government to the business sector has declined on the one hand, and that for the university sector has increased relatively on the other hand. The latter trend is even true for the U.K., where R&D funding for the business sector has been on the rise recently.

9.1.2 Government budget appropriations for science and technology

In this section, we examine budget-based data, or government budget appropriations, for science and technology (S&T). Since there is no international definition of the S&T budget, unlike R&D expenditure, the basis of the statistics available on the S&T budget varies somewhat from country to country. However, they are common in that they all cover R&D and other related budgets. In Japan, the budget appropriations for R&D are not calculated separately from the total S&T budgets.

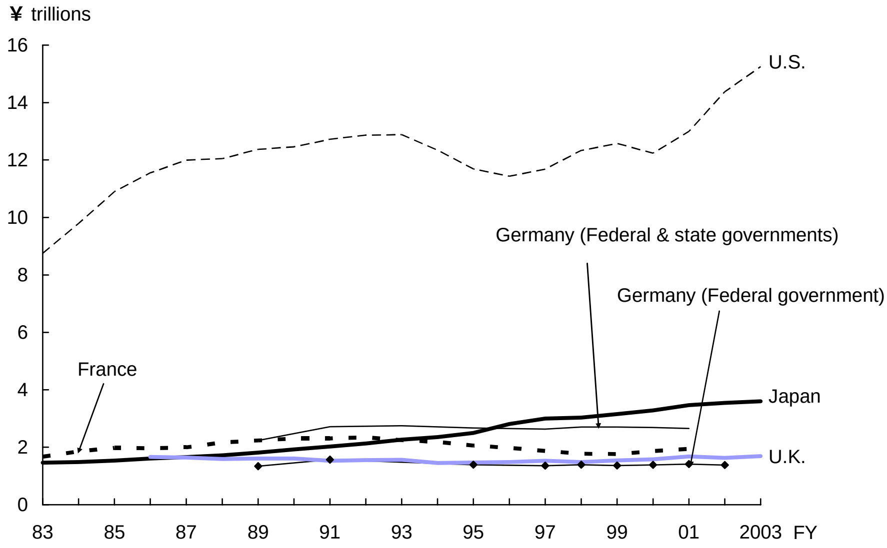
As Figure 9-1-3 (A) on the S&T budget in selected national governments shows, Japan's S&T budget is about a quarter the size of that of the U.S. for 2003. Although comparison with other countries should take account of differences in the size of the government expenditure and the fiscal system, the comparison results still imply that Japan's S&T budget is small relative to its economic size,. With this recognition, the need for the government to increase its S&T budget has often been debated in Japan. From the long-term perspective, Japan's S&T budget has grown, especially in the latter half of the 1990s. On the other hand, S&T budget of the U.S. government has increased markedly since 2001.

In international comparison of government budget appropriations for S&T, the defense budget is often excluded. Since the defense budget is dissimilar to other expenditure in nature, it should be excluded especially when comparing a country like Japan with other countries. Figure 9-1-3 (B) shows the total government S&T budget except the appropriation for defense, which is known as the non-defense or civilian budget.

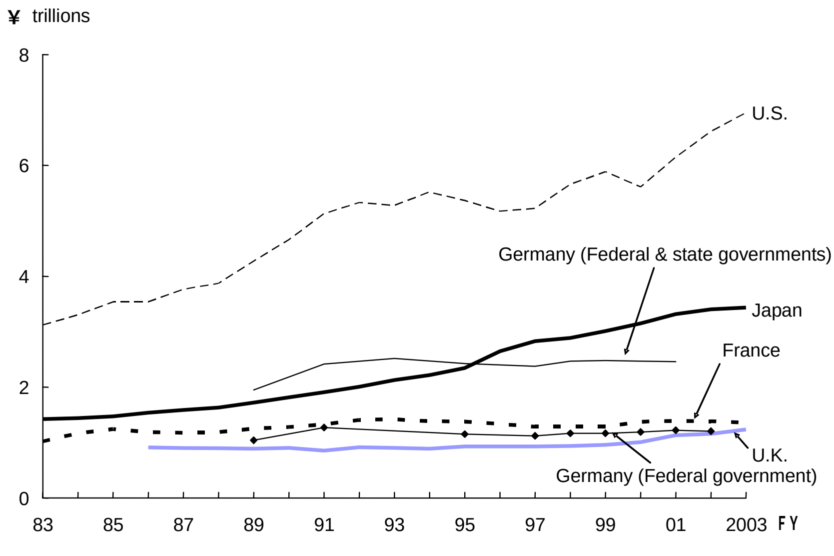
Japan's non-defense S&T budget accounted for as much as 95.5% of the total government S&T budget for 2003, while the figure equivalent to this was no more than 45.6% in the U.S. for the same year. If Japan is compared with the U.S. based on the civilian budget, Japan's S&T budget size is closer to that of the U.S. than in the previous comparison, being a little under half the size of the U.S. for 2003. The long-term trends in the non-defense budget are similar to those in the total S&T budget.

Figure 9-1-3: Trends in government budget appropriations for science and technology for selected countries

(A) Total science and technology budget



(B) Non-defense science and technology budget



Notes: <Japan> The data for all years refer to the original budget.
<U.S.> The data for 2002 refer to the preliminary figures and those for 2003 requested figures.
<Germany> 1) The data for the federal government since 2002 refer to planned figures.
2) While the data for Germany are available either in marks or euros, all reported data are in euros.
<France> The data since 2001 are in euros.
<U.K.> The data for FY2001 are estimates and those for FY2002 are planned figures in the Cross-Cutting Review.
Sources: <Japan> Ministry of Education, Culture, Sports, Science and Technology, "Indicators of Science and Technology" and "Science and Technology Budget for Fiscal Year 2002"
<U.S.> NSF, "Federal R&D Funding by Budget Function Fiscal Years 2001-2003"
<Germany> Bundesministerium für Bildung und Forschung, "Undesbericht Forschung 2000" and "Faktenbericht 2002"
<France> Budget bill appendices 1996-2003; Ministry of Education, Culture, Sports, Science and Technology, "Indicators of Science and Technology"
<U.K.> OST, "SET Statistics"
Currency conversion is based on the purchasing power parities in Reference Statistics E.
See: Table 9-1-3

For international comparison free from the impact of the economic size, we compiled Figure 9-1-4, which shows the S&T budget as a percentage of GDP. Between the latter half of the 1980s and 2000, the percentage figures for all the selected countries except Japan were on the decline. Possible factors behind this are the curtailment of the defense budget and reforms in governments. Japan’s figure alone indicated growth in the 1990s. Even after this growth however, Japan’s level, which had long been far lower than those of the other industrial countries, barely exceeded that of the U.K. in 2002 and is still below the levels of the U.S., France, and the U.K.

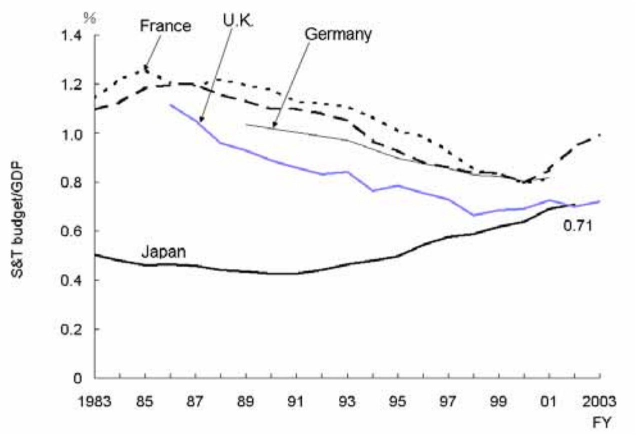
Among the countries experiencing a fall in the ratio of the S&T budget to GDP, the U.K. has shown a slight increase since the end of the 1990s. The ratio also began increasing in the U.S. in 2000, since which time sharp growth has continued.

With respect to government budget appropriations for S&T, the OECD has proposed a standard for the classification of budgetary data by socio-economic objective. In Figure 9-1-5 (A), we performed another international comparison using the data classified by this method. This comparison illustrates overall trends only, because of significant differences in the fiscal system and the classification method among countries.

Japan and Germany have one thing in common; the largest part (49.4% for Japan) of the government S&T budget is allocated to ‘general university funds.’ Japan also differs from the others in that the share of ‘production/supply/rational use of energy’ is considerably large at 18.1% and that the share of ‘defense’ is the lowest among the five at 4.1%.

On the other hand, it is notable that the U.S. has an exceptionally large share of ‘defense’ (54.0%) and significant shares of ‘promotion of health’ (24.9%) and ‘exploration and exploitation of space’ (6.7%). Socio-economic objectives of notable size in the remainder of the countries are: ‘industrial development technology’ (12.5%) in Germany, ‘exploration and exploitation of space’ (9.8%) in France, and ‘defense’ (36.6%), ‘general university funds’ (19.6%), and ‘promotion of health’ (14.6%) in the U.K. What is noteworthy about Republic of Korea is that the share of ‘industrial development technology’ is the largest at 24.3%.

Figure 9-1-4: Trends in the government science and technology budget as a percentage of GDP for selected countries

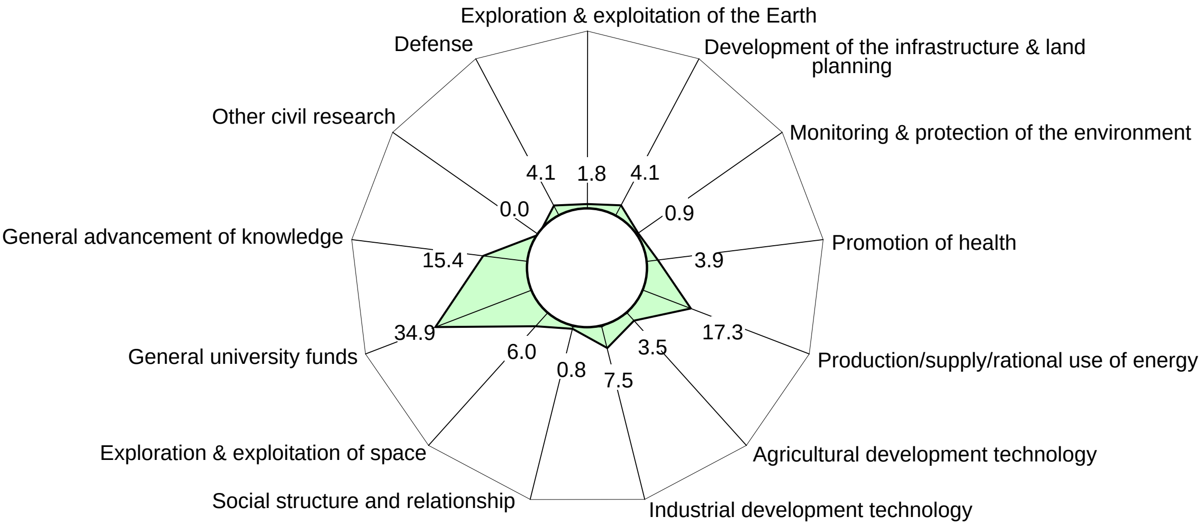


Notes: <Budget> Same as Figure 9-1-3, except that the German data refer to the federal and state governments
<GDP> Same as Reference Statistics C
Sources: <Budget> Same as Figure 9-1-3
<GDP> Same as Reference Statistics C
See: Table 9-1-4

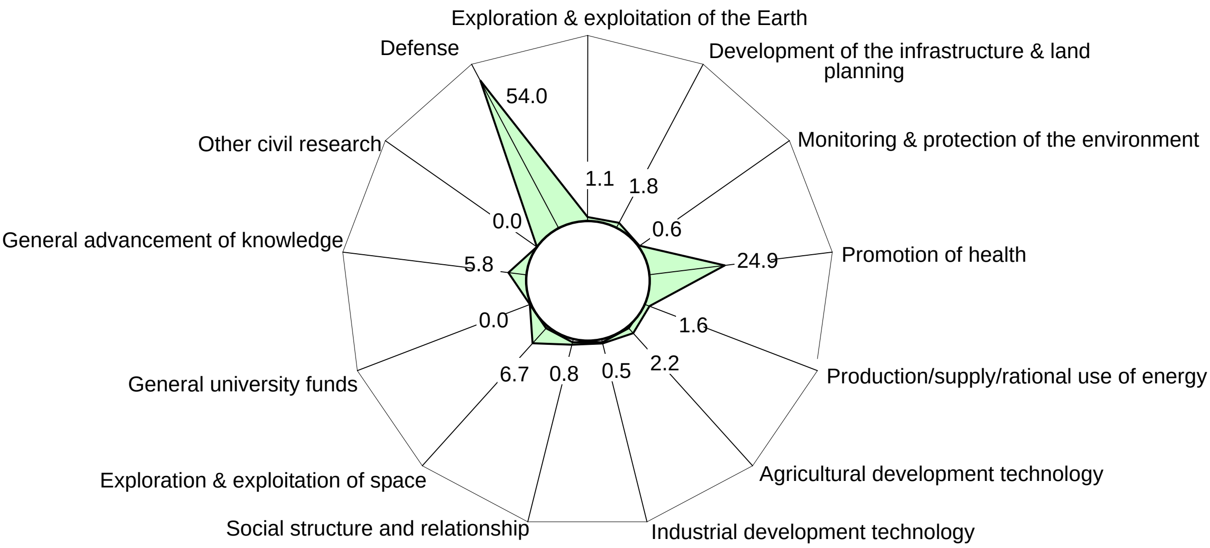
Figure 9-1-5: Science and technology budget by socio-economic objective

(A) Latest available year

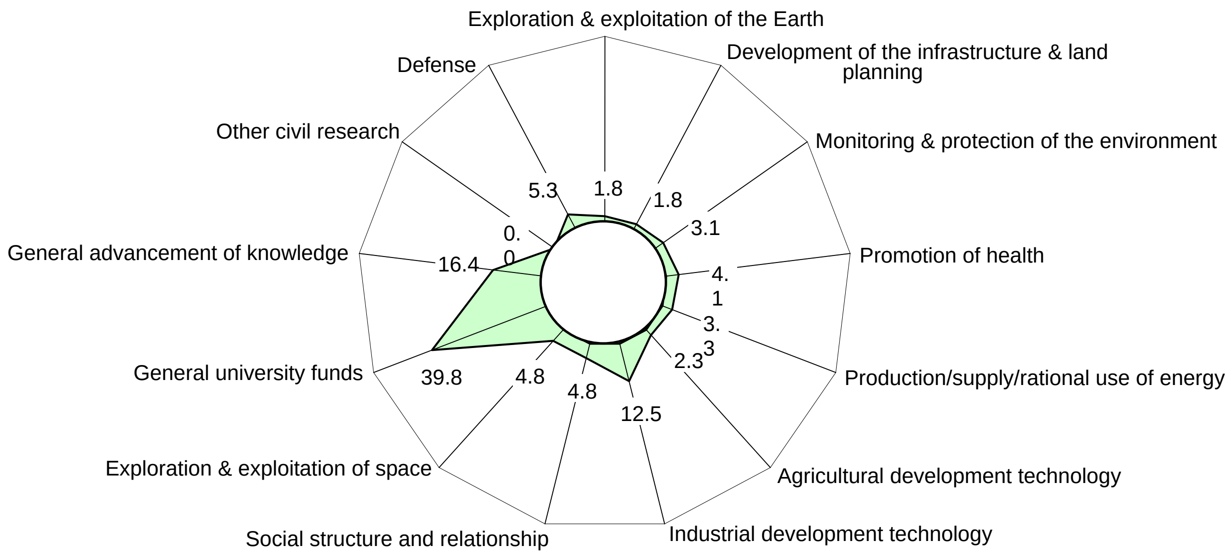
(a) Japan(2002)



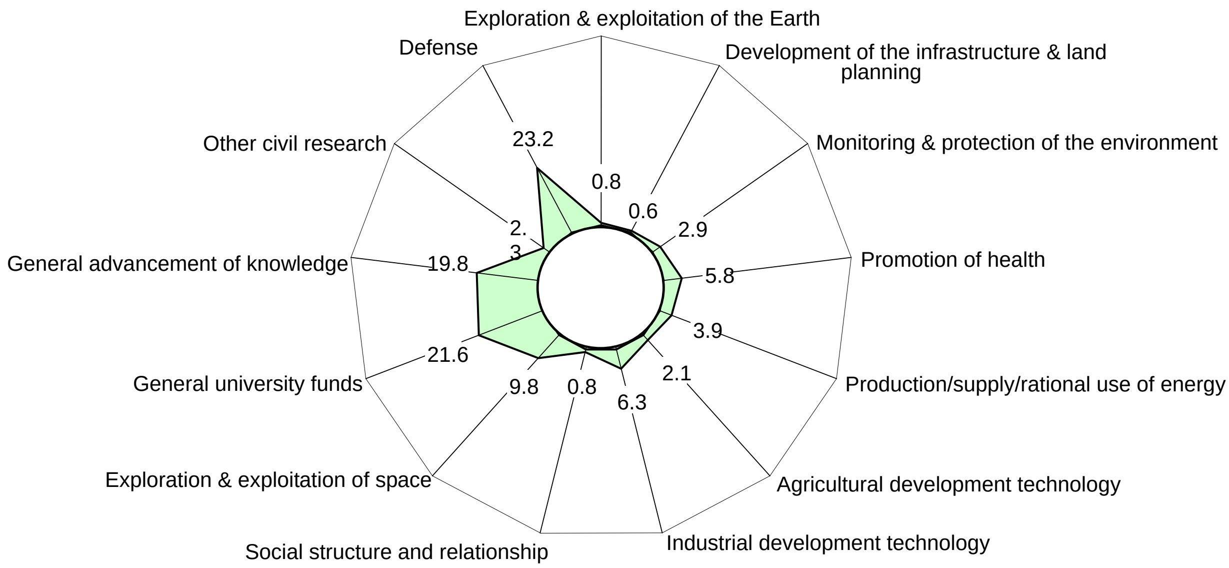
(b)U.S.(2002)



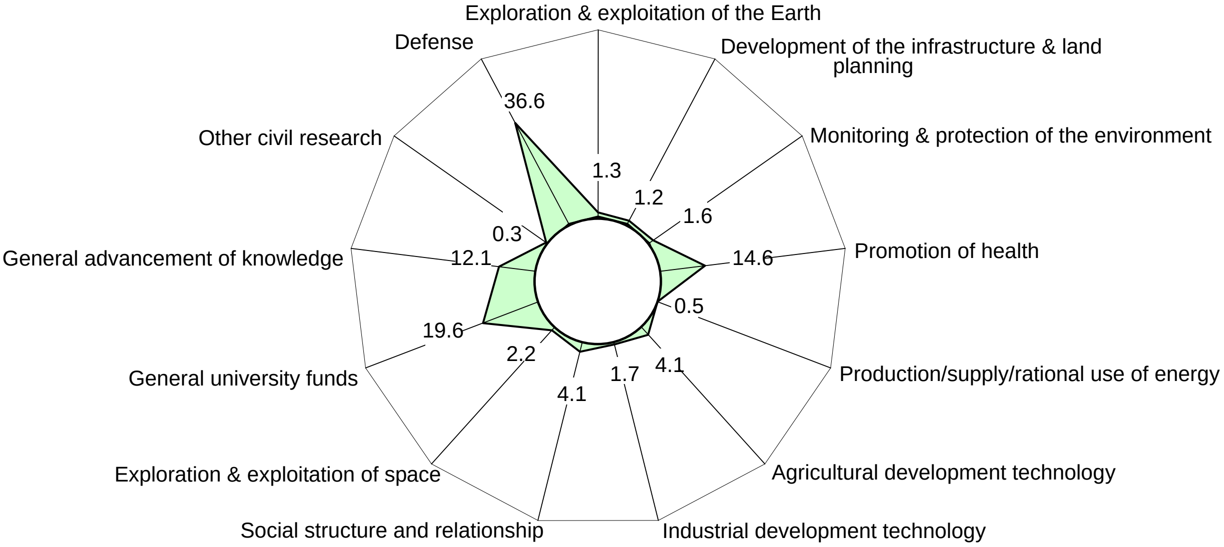
(c) Germany(2002)



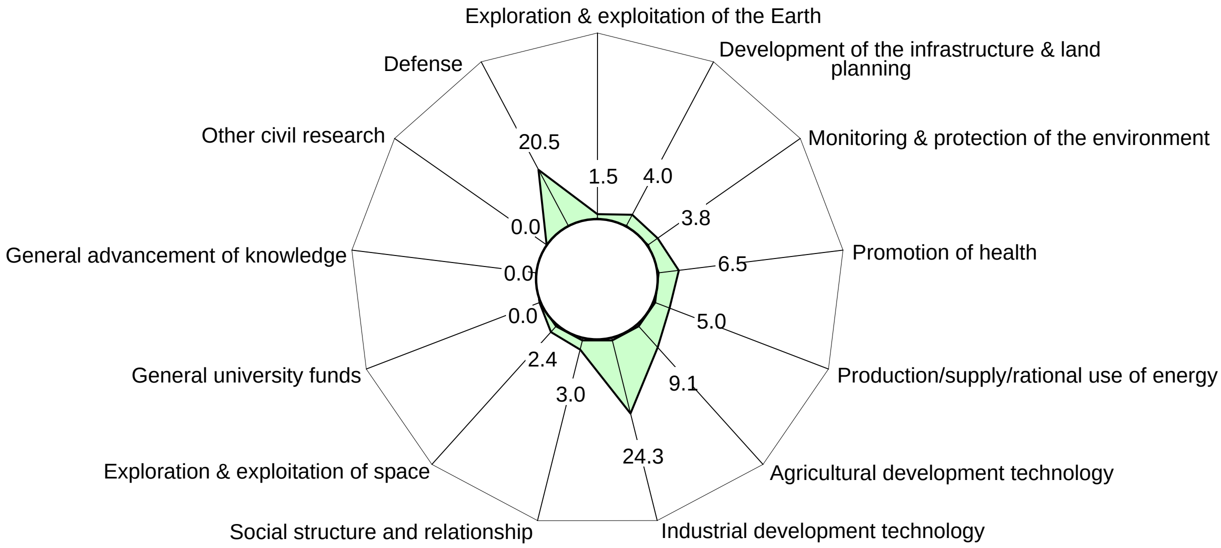
(d) France(2001)



(e) U.K. (2000)



(f) Republic of Korea(2000)



Note: The total for Republic of Korea does not equal 100% because of unavailability of data in some categories.
Source: OECD, “Basic Science and Technology Statistics 2002/2”
See: Table 9-1-5 (A)

The government S&T budgets classified by socio-economic objective are not suited for direct international comparison because of differences in the budgetary system and the classification methods among countries. Therefore we focus on the change in S&T budgets over time as shown in Figure 9-1-5 (B), in an attempt to identify trends in S&T policy of governments.

In Japan, the share of the budget for the dominant socio-economic objective, 'general university funds,' declined almost steadily throughout the selected period, from 43.7% in 1988 to 34.9% in 2002. This does not necessarily mean a reduction in budgets allocated to universities. The key is an increase in the share of the budget for 'general advancement of knowledge,' most of which is allocated to universities. The combined total share of this budget item and 'general university funds' remained almost stable throughout the selected period. This implies that the superficial decline in budget appropriations for universities is a result of a change in the nature of funding rather than reduced funds for universities.

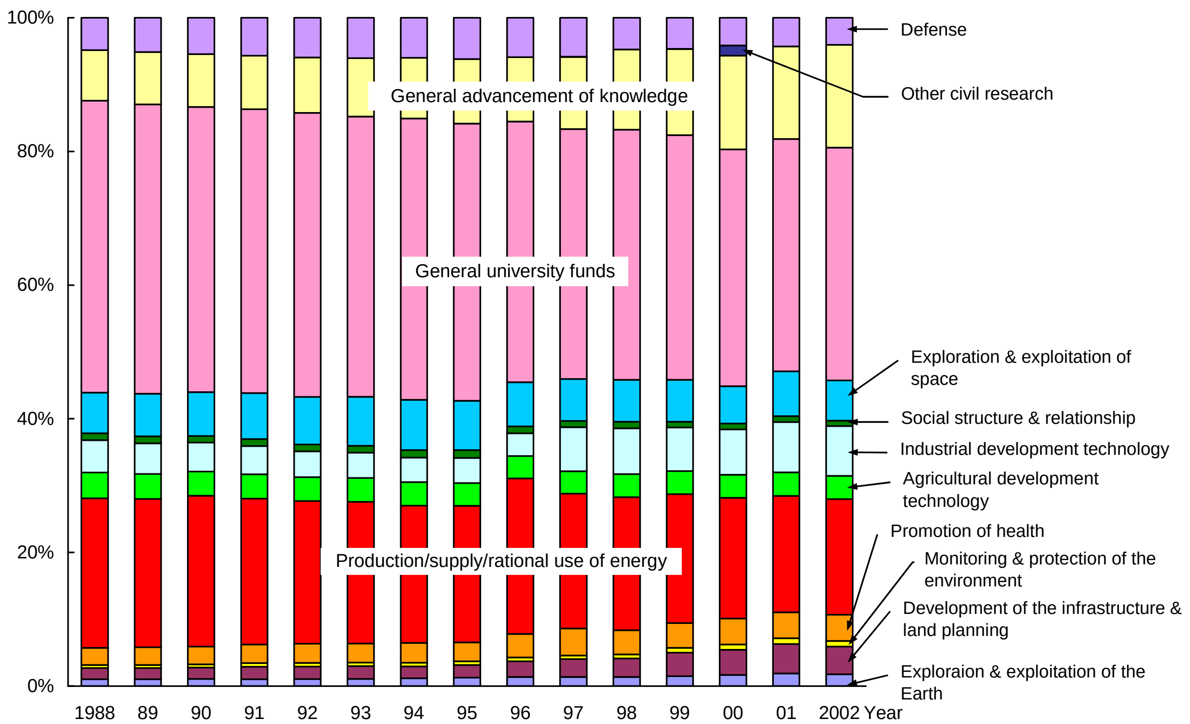
Among other S&T budget items, 'industrial development technology' and 'development of the infrastructure and land planning' have grown over time. Although smaller than these, the shares of 'promotion of health' and 'exploration and exploitation of the Earth' have also risen continuously. On the other hand, the share of 'production/supply/rational use of energy' has been on the decline for a long time.

A common trend across the five countries is an increase in the share of 'general advancement of knowledge.' 'Promotion of health' is another budget item whose share has increased in all the five countries, even though the actual size varies from country to country. In the U.S., in particular, the proportion of this item has grown steadily since the mid-1980s.

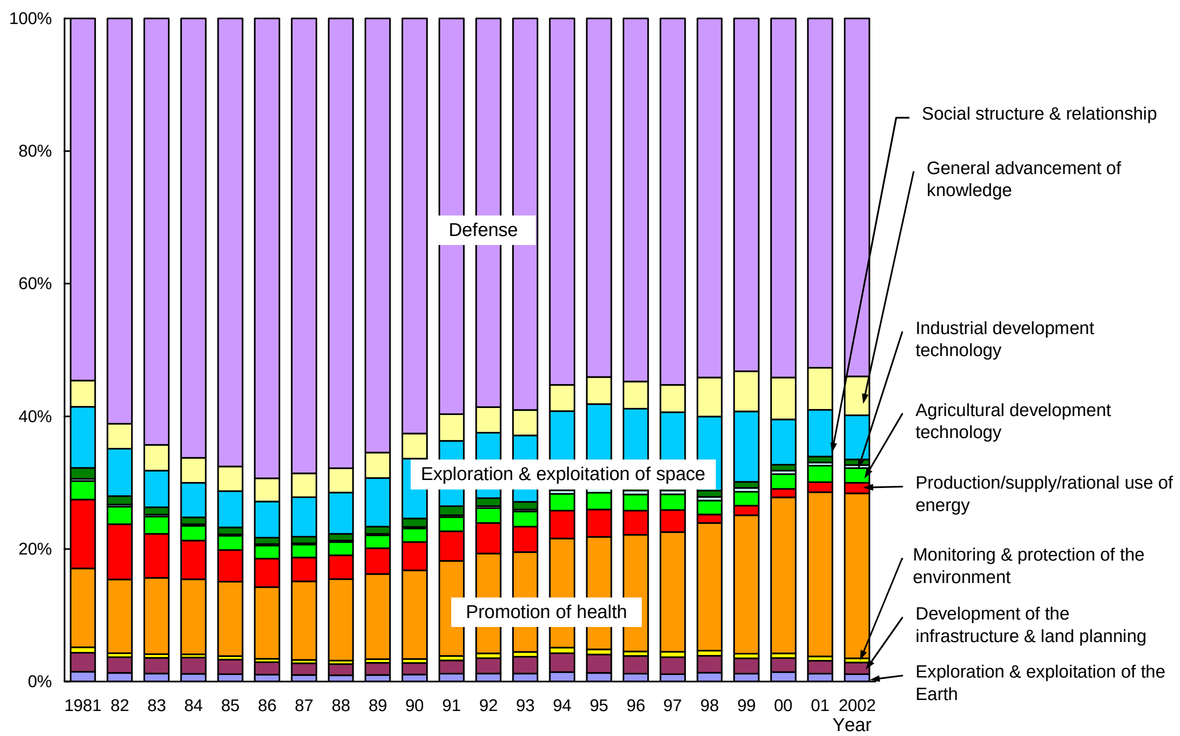
Figure 9-1-5:Science and technology budget by socio-economic objective

(B) Time series

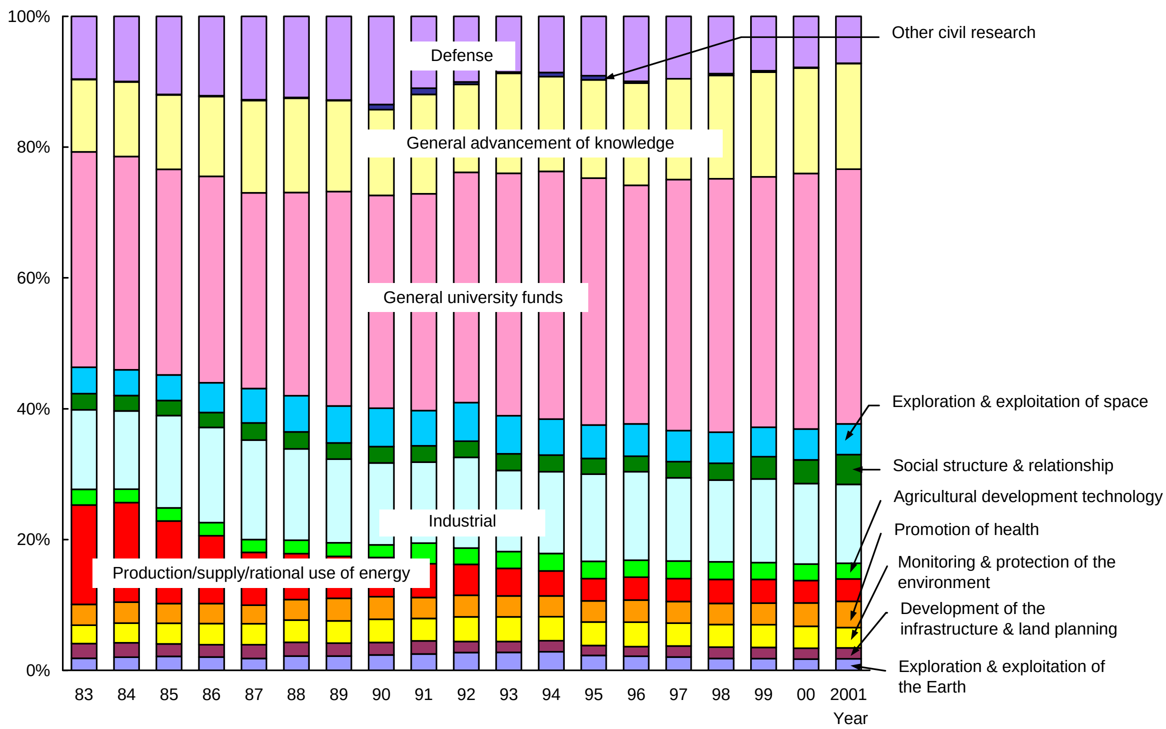
(a)JAPAN(2002)



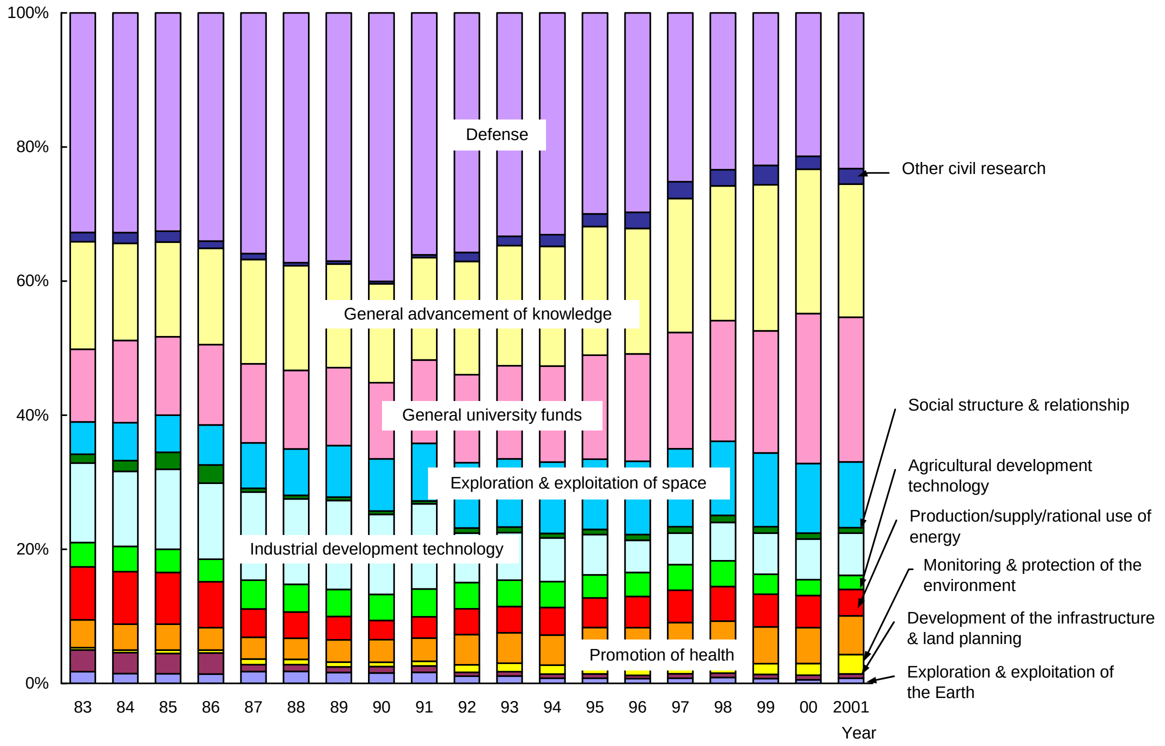
(b) U.S.(2002)



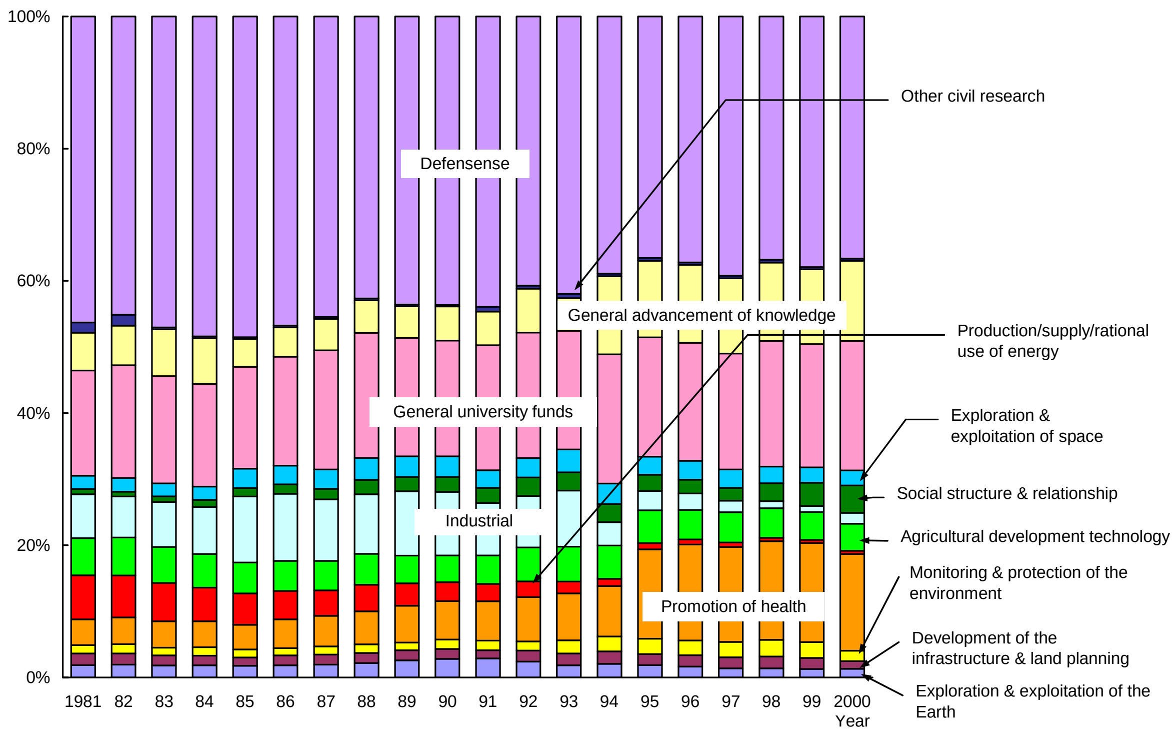
(c) Germany(2001)



(d) France(2001)



(e) U.K. (2000)



Source: OECD, “Basic Science and Technology Statistics 2002/2”
See: Table 9-1-5 (B)

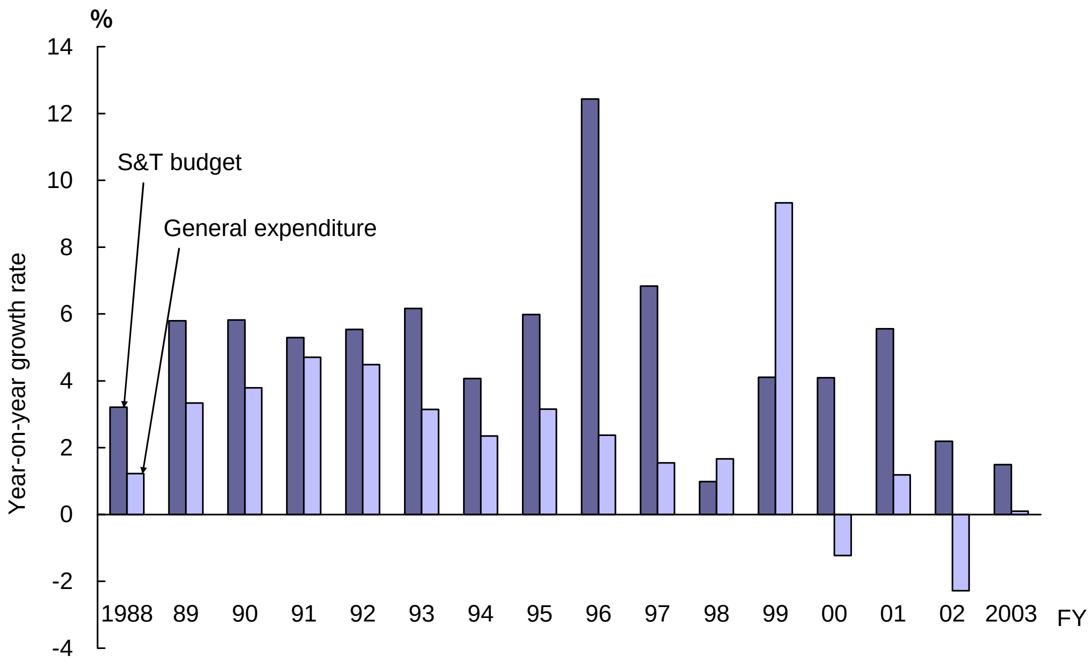
9.1.3 Government budget appropriations for science and technology in Japan

Essential indicators of budget appropriations for science and technology in Japan are described below.

Figure 9-1-6 compares the year-on-year growth rate of the S&T budget with that of the general expenditure of the Japanese government. It shows that during a period between the latter half of the 1980s and fiscal year 2003, the growth of the S&T budget was greater than that of general expenditure, except for fiscal years 1998 and 1999. The growth rate of the S&T budget was remarkably high at 12.4% in 1996, when the scope of the budget was revised. In fiscal years 2000 and 2001, the S&T budget recorded positive growth even when the general expenditure experienced negative growth amid the deteriorating economy.

A note on the reported data is that the growth rates are based on the original budget. A supplementary budget may have been added to this, and some it may have been allocated to S&T.

Figure 9-1-6: Trends in the growth rate of Japan's science and technology budget



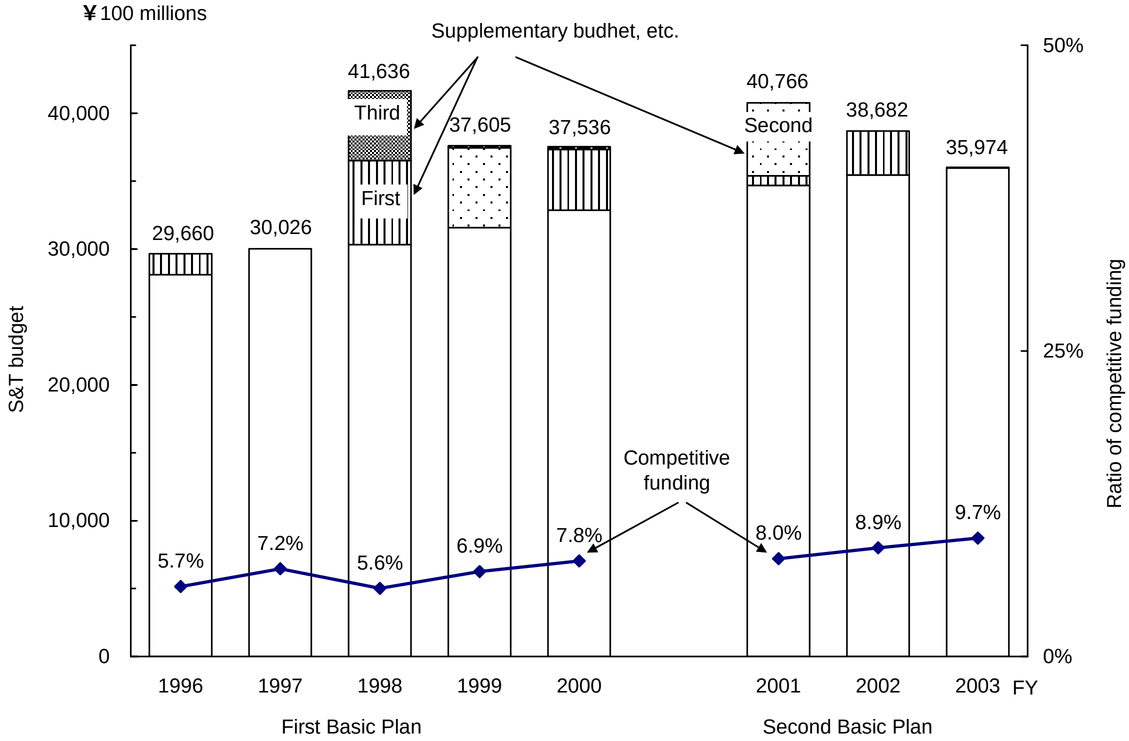
Notes: 1) The data for all years refer to the original budget
2) The scope of the S&T budget was revised in fiscal years 1996 and 2001 in accordance with the First and Second Basic Plans for Science and Technology.
Sources: Ministry of Education, Culture, Sports, Science and Technology, "Indicators of Science and Technology"; Surveys by the Ministry of Education, Culture, Sports, Science and Technology
See: Table 9-1-6

The Japanese Cabinet approved the Basic Plans for Science and Technology (hereinafter called the First Basic Plan) in July 1996. This First Basic Plan states, 'With regard to the short-term doubling of research and development funding, for the underlying purpose of raising the ratio of such funding to GDP by the early 21st century to a level comparable to those of Western nations, there is a strong need to realize the doubling within the planned timeframe. To meet this need, the combined size of the science and technology budget for the period between fiscal years 1996 and 2000 needs to be increased to approximately 17 trillion yen.'

This goal has been achieved. We have confirmed that the combined total of the S&T budget for the five-year period of fiscal 1996-2000, which is covered by the First Basic Plan for Science and Technology, was ¥17,646.3 billion. A closer examination of the changes during the five years shows that the S&T budget was highest in FY1998. A supplementary budget compiled as part of the economy-boosting policy contributed to this, as Figure 9-1-7 shows.

Following the completion of the First Basic Plan, on March 30, 2001, the Japanese Cabinet approved the Second Basic Plan for Science and Technology to cover the next five fiscal years, 2001-2005. The initial S&T budget amounts of the Second Plan term were slightly higher than that of the First Plan term.

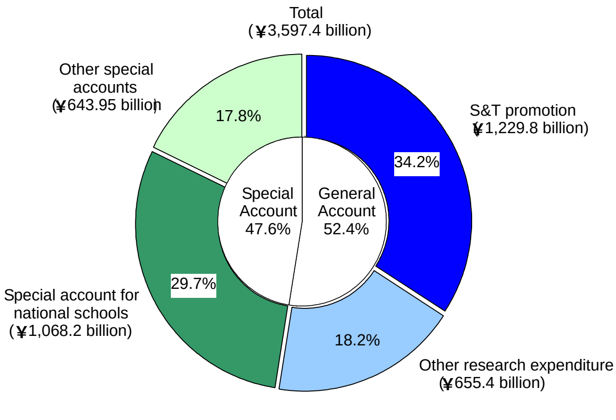
Figure 9-1-7: Trends in the S&T budget under the Basic Plan for Science and Technology



Note: Supplementary budgets refer to additional allocations only.
Source: Surveys by the Ministry of Education, Culture, Sports, Science and Technology
See: Table 9-1-7

As Figure 9-1-8 shows, the Japanese government's S&T budget is split roughly in half between the General Account and the Special Account. The S&T budget from the general account consists of expenditure on national testing and research institutes, 'Funds for Promoting Science and Technology,' which include various subsidies and other research expenditure. On the other hand, large part of the S&T budget from the special account comprises expenditure on national schools.

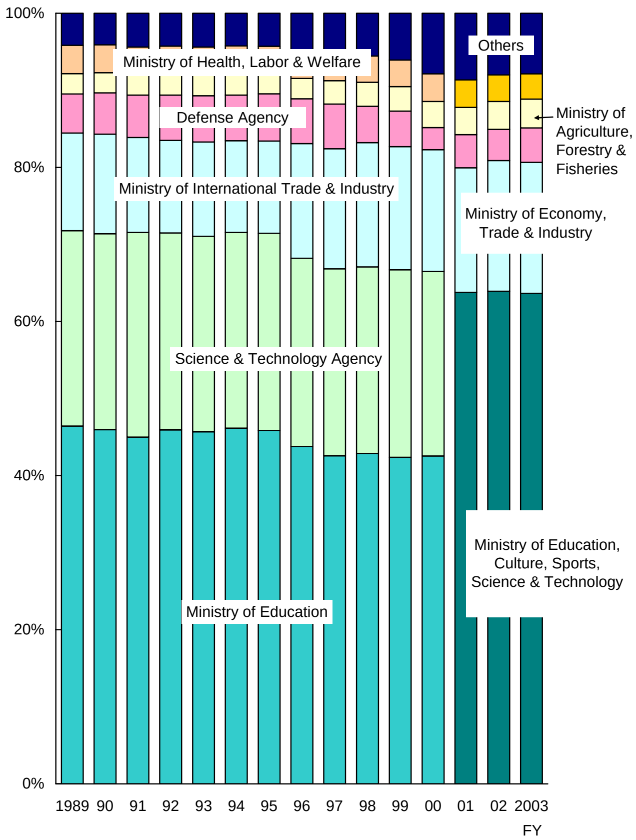
Figure 9-1-8: Breakdown of the S&T budget (FY2003)



Source: Surveys by the Ministry of Education, Culture, Sports, Science and Technology
See: Table 9-1-8

The breakdown among government ministries and agencies in Figure 9-1-9 does not show any significant change except for fiscal year 1996, when the coverage of the S&T budget was revised, and 2003, when the government was reorganized. Among all ministries and agencies, the Ministry of Education, Culture, Sports, Science and Technology (the Science and Technology Agency and the Ministry of Education until FY2000) has been allocated the largest proportion of the S&T budget throughout the selected period. In FY2003, its share was 63.7%, while the Ministry of Economy, Trade and Industry followed with 17%, the Defense Agency with 4.5%, and the Ministry of Health, Labor and Welfare with 3.7%.

Figure 9-1-9: Trends in the S&T budget by government ministry/agency

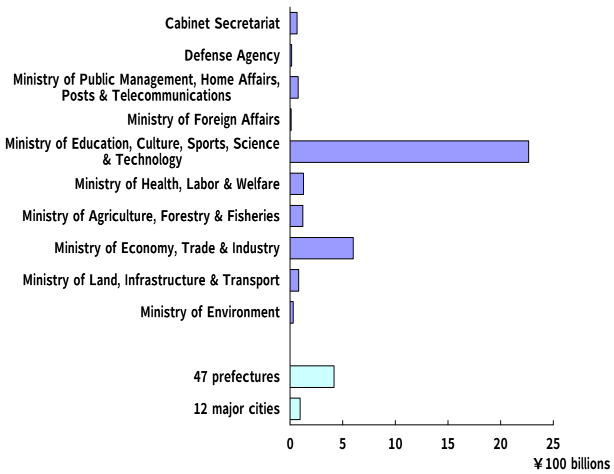


Notes: 1) The data for all years refer to the original budget.
2) Expenditure on the Japan Key Technology Center is double-counted in both the Ministry of International Trade and Industry and the Ministry of Posts and Telecommunications (but the total does not include double-counting).
3) The data on the S&T budget have been compiled by the Ministry of Education, Culture, Sports, Science and Technology based on references submitted by individual ministries and agencies.
4) The funding for special or other public corporations included in the S&T budget of the Industrial Investment Special Account, which is administered by the Ministry of Finance, has been split among the respective competent ministries of such public corporations. The exception is expenditure on the National Agriculture and Bio-oriented Research Organization, which is under the joint jurisdiction of the Ministry of Finance and the Ministry of Agriculture, Forestry and Fisheries, and has been reported as a budget of the latter ministry only.
5) The sum of all budget figures may not equal the reported total because the figures have been rounded off.
Source: Ministry of Education, Culture, Sports, Science and Technology, "Indicators of Science and Technology"; Surveys by the Ministry of Education, Culture, Sports, Science and Technology
See: Table 9-1-9

For international comparison of the government S&T budget, data are sometimes collected from local governments as well as the central government. The Japanese S&T budget data presented so far in this report do not include local government expenditure on S&T, which is not available on the same basis as central government expenditure. However, Figure 9-1-10 has been compiled based on the certain references that are available.

In fiscal year 2002, the total S&T budget of 47 prefectural governments and 12 major city governments in Japan was ¥512.7 billion. This is equivalent to 14.5% of the S&T budget of the Japanese government in the same year (¥3,544.4 billion). If compared with ministry-level S&T budgets, the combined total S&T budget of the 47 prefectural governments and the 12 major city governments (¥512.7 billion) stands just above that of the Ministry of Economy, Trade and Industry.

Figure 9-1-10: S&T budgets of ministries and local governments (FY2002)



Notes: 1) The data refer to the original budget.
2) Local government budgets do not include national treasury disbursements.
Sources: Surveys by the Ministry of Education, Culture, Sports, Science and Technology; Japan Association for the Advancement of Research Cooperation, "Report on the Survey of the Local-Level Promotion of Science and Technology"
See: Table 9-1-10 (B)

9.2 Government research institutes

This section analyzes the government sector as a performer of R&D. We principally use the term 'government sector' in this section to refer to, in addition to the government research institutes in a narrow sense, institutions that perform R&D with public funds (except for higher education institutions such as universities). This also covers private non-profit research institutes in some countries. These establishments are collectively called the government sector or government research institutes in this section.

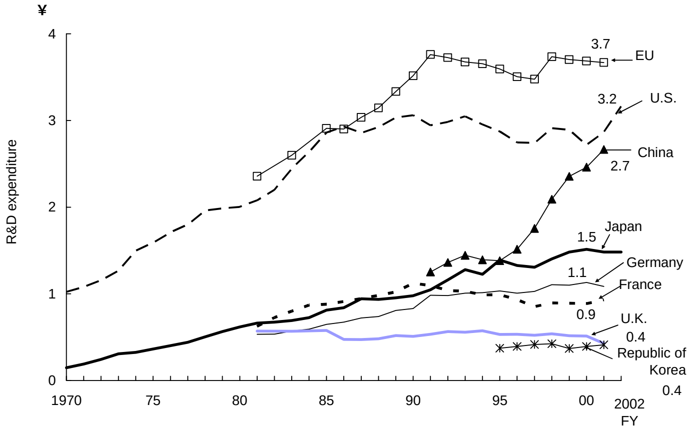
In Japan, government research institutes do not form an independent category in R&D statistics (the Survey of Research and Development conducted by the Statistics Bureau of the Ministry of Public Management, Home Affairs, Posts and Telecommunications). Instead, public research institutes are listed under the 'non-profit institutions and public organizations' category with such subcategory names as 'national institutes' (national testing and research institutes, etc.), 'public institutes' (public testing and research institutes, etc.), and 'special or independent administrative corporations.' This report refers to these public institutes as government research institutes.

Figure 9-2-1 shows the trends in R&D expenditure (funds spent) of government research institutes in five selected countries. The expenditure of the countries other than Japan has been converted into Japanese yen using the GDP purchasing power parities calculated by the OECD.

R&D expenditure by the government sector in Japan was similar to that of Germany and France until around 1990. In recent years, Japan has exceeded these countries. However, the size of Japan's R&D expenditure by the government sector is still small relative to its economic size.

R&D expenditure by China's government sector was close to that of Japan's until the first half of the 1990s. It has increased markedly since the latter half of the 1990s, approaching the U.S. level by 2001.

Figure 9-2-1: Trends in R&D expenditure by government research institutes in selected countries

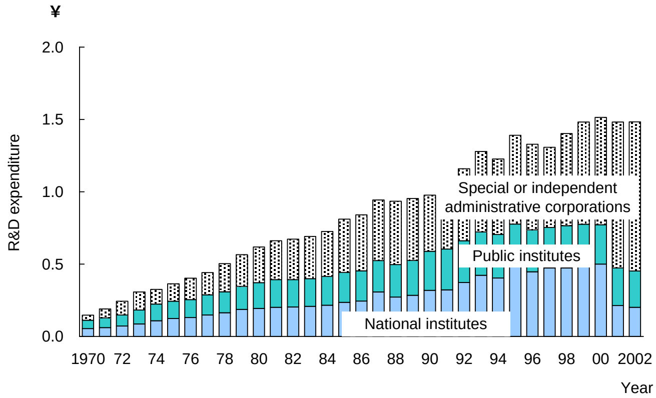


Notes: 1) R&D expenditure includes expenditure in social sciences and humanities (except for Republic of Korea).
2) The data for Japan include the software industry since FY1996.
3) The data for Germany refer only to the former federal states until 1990 and to all of Germany since 1991.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
<U.S.> NSF, "National Patterns of R&D Resources 2002 Data Update"
<Germany, France, U.K., and Republic of Korea> OECD, "Basic Science and Technology Statistics 2002/2"; For British data since 2001, ONS, "Gross domestic expenditure on Research and Development 2001"
<China and the EU> OECD, "Main Science and Technology Indicators 2003/1"
See: Table 9-2-1

Figure 9-2-2 illustrates the trends in R&D expenditure by the government research institutes of Japan. As shown, all categories have experienced steady growth except for a few separated years. The largest R&D performer among the government research institutes is special corporations (in the graph, 'special or independent administrative corporations' until FY2000). This category has also recorded the fastest growth. A note regarding the data in the graph is that there is a break in the data series in FY2001, since which time some 'national institutes' and 'special or independent administrative corporations' have become known as independent administrative corporations.

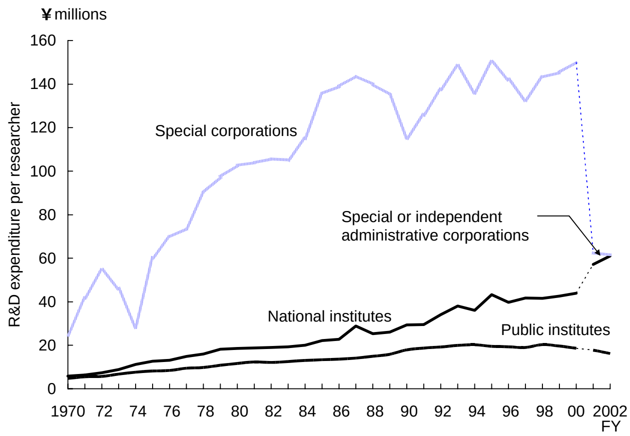
As Figure 9-2-3 shows, R&D expenditure per researcher in Japanese government research institutes increased sharply among the then-special corporations (in the graph, 'special or independent administrative corporations' until FY2000) between the latter half of the 1970s and the mid-1980s. In subsequent years, the growth of this sector slowed down. The high level of R&D expenditure per researcher in this sector is mainly attributable to large-scale R&D projects on nuclear energy, space exploitation and so forth conducted by special corporations. it should again be noted that there is a break in the data series in FY2001 for the above reason.

Figure 9-2-2: Trends in R&D expenditure by Japan's government research institutes



Note: The 'special or independent administrative corporations' category refers only to special corporations until FY2000. As a result of the government reorganization in FY2001, some of the national research institutes have become independent administrative corporations.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 9-2-2

Figure 9-2-3: Trends in R&D expenditure per researcher in Japan's government research institutes

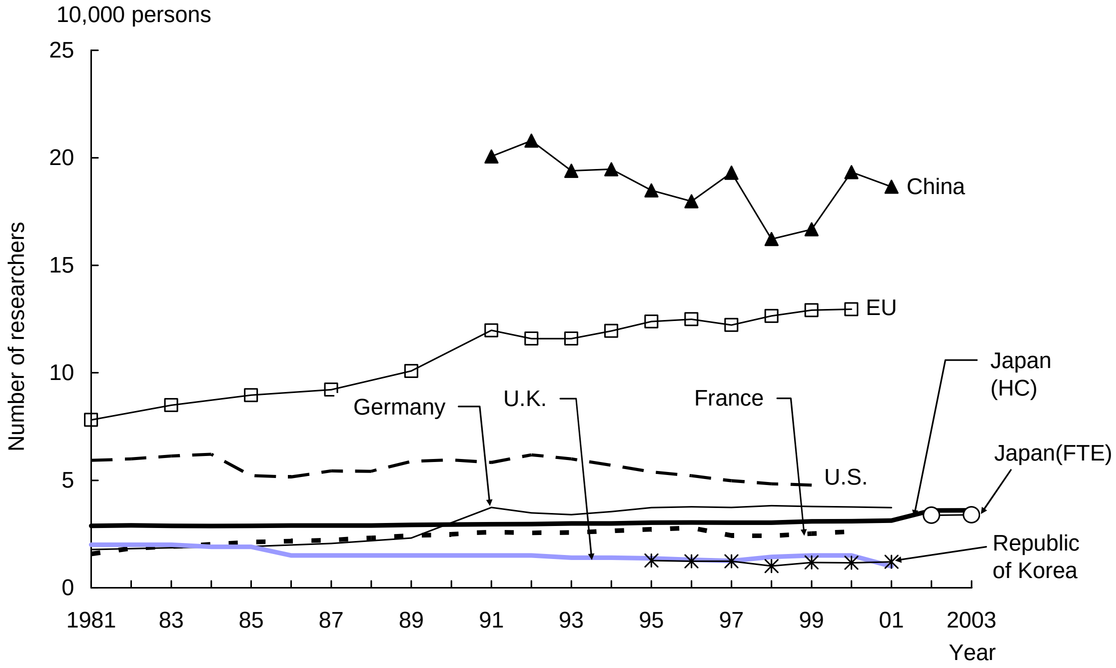


Notes: 1) As a result of the government reorganization in 2001, some of the national research institutes has become independent administrative corporations.
2) The calculation method for R&D expenditure per researcher differs between the period up to FY2000 and the subsequent period because the Statistics Bureau, and the Ministry of Public Management, Home Affairs, Posts and Telecommunications, changed in 2002 (effective for fiscal 2001 data) the content and date of the survey applicable to its 'Report on the Survey of Research and Development.' R&D expenditure per person until FY2000 has been calculated by dividing the annual R&D expenditure by the number of full-time researchers as of the fiscal year beginning April 1. R&D expenditure per person since fiscal 2001 has been calculated by dividing the annual R&D expenditure by the number of researchers as of the end of the fiscal year (March 31).
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 9-2-3

Next, we analyze the number of researchers in the government sector of five selected countries in the same manner as the R&D expenditure (Figure 9-2-4). It is notable that the number of researchers in Japan's government research institutes has long-term stability. The sudden rise in 2002 is primarily due to the revision of the statistical survey content and methodology. There is no significant gap between the five countries, and Japan stands in the middle of the spectrum of the five countries.

China's government research institutes have a far greater number of researchers than those of the other countries. Large fluctuations in China's statistics contrast sharply with those of the other countries, which remain rather stable. Republic of Korea is at about the same level as the U.K.

Figure 9-2-4: Trends in the number of researchers in government research institutes for selected countries

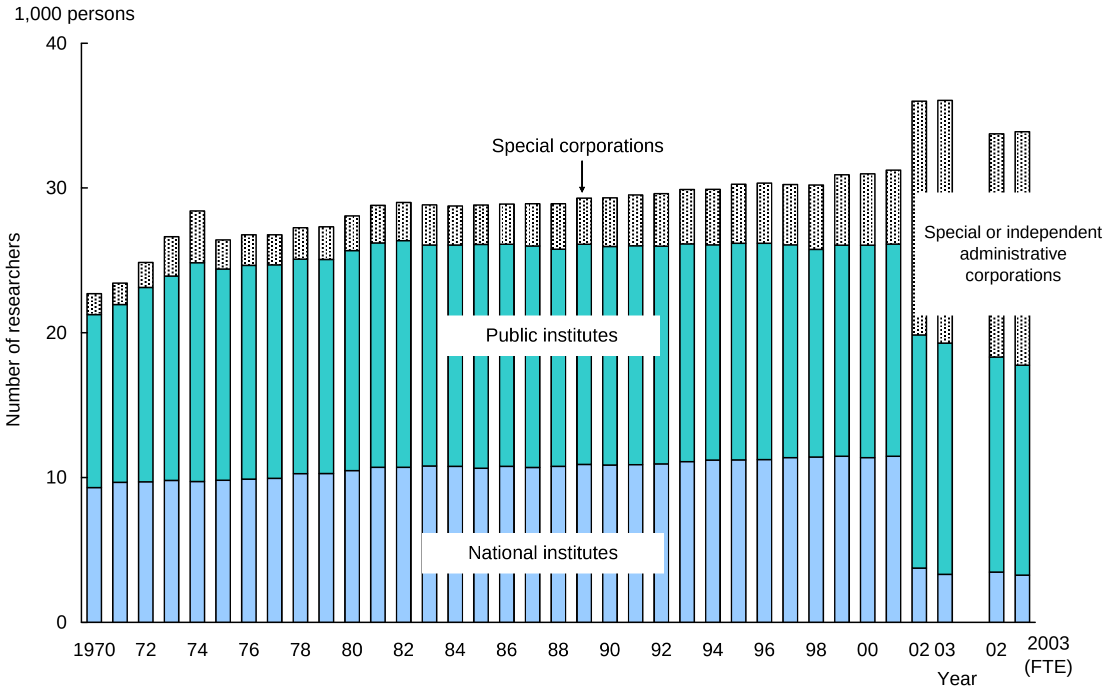


Notes: <Japan> The data include the software industry since 1997. The value for 2002 is as of March 31, 2002.
<U.S.> The data refer only to the federal government.
<Germany> The data refer only to the former federal states until 1990 and to all of Germany since 1991.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
<U.S.> NSF, "National Patterns of R&D Resources 2002 Data Update"; For the 1981-1984 data, OECD, "Main Science and Technology Indicators 2003/1"; For the 1985-1986 data, NSF, "National Patterns of R&D Resources 1996"
<Germany, France, U.K., China, Republic of Korea, and the EU> OECD, "Main Science and Technology Indicators 2003/1"
See: Table 9-2-4

Let us examine the number of researchers in Japan's government research institutes by type of organization. In 2003, the 'special or independent administrative corporations' had the largest number of researchers (some 'national institutes' and 'special corporations' turned to independent administrative corporations in fiscal years 2001 and 2003, respectively). The time series data show that the number of researchers in public research institutes declined slightly during the 1980s and remained stable for the remainder of the selected period. On the other hand, the number of researchers increased slowly in national research institutes until 2001. As is the case with Figures 9-2-1 to 9-1-3, there is a break in the data series in 2002 due to some government research institutes having turned to independent administrative corporations.

Since 2002, the number of researchers has become available for both full-time equivalents and through head counts (actual number). While the number of full-time-equivalent researchers is smaller than that through head counts, they both show similar breakdowns.

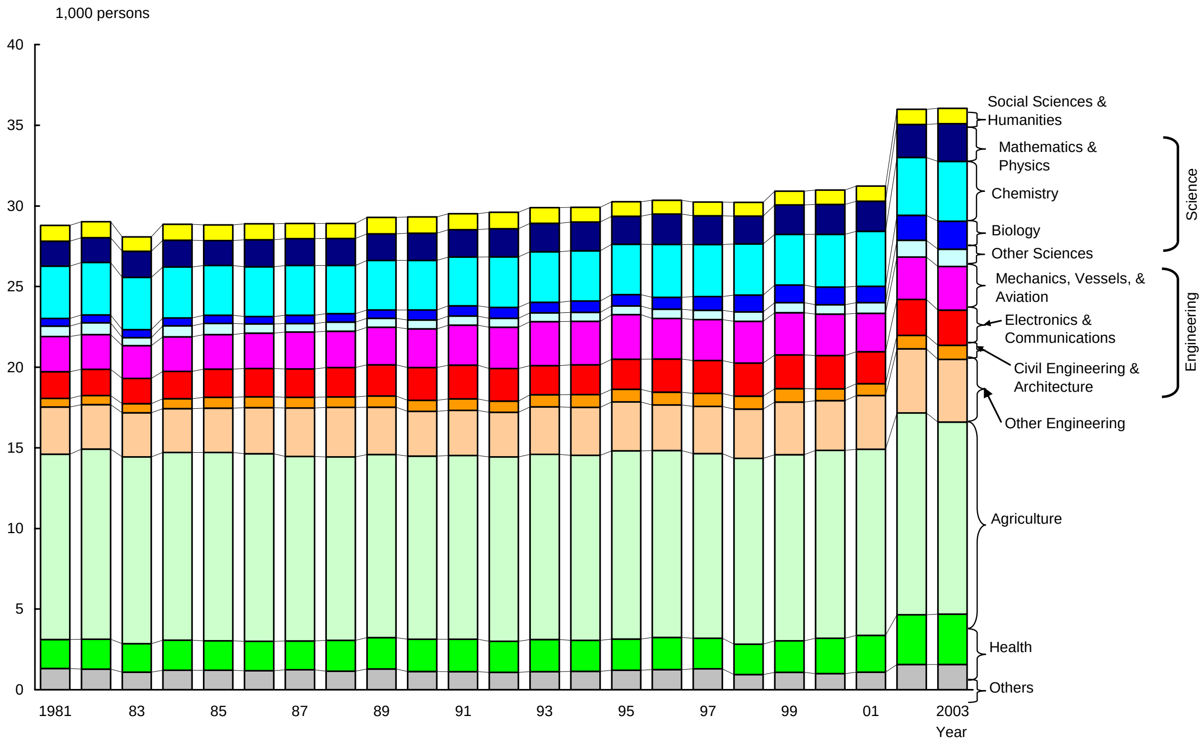
Figure 9-2-5: Trends in the number of researchers in Japan's government research institutes



Notes: 1) The data represent head counts.
2) The data for 'Special or independent administrative corporations' refer only to special corporations
3) Some national research institutes has become independent administrative corporations since FY2001.
4) Due to a change in the survey content and date, data until 2000 refer to the number of full-time researchers as of April 1 of that year and those since 2001 the number of researchers as of March 31 of that year.
Source: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 9-2-5

Statistics on the number of researchers in Japan's government research institutes by field of research show that 'agriculture' has been the largest research area for a long time. The period between 1981 and 2001 is notable for its overall stability in data, with no specific research field indicating a substantial increase or decline. The total number of researchers in government research institutes suddenly increased in 2002 as a result of the government reorganization in 2001, which transformed some national research institutes into independent agencies, and of the revision of the data classification method. The growth has been particularly remarkable in research fields such as 'agriculture,' 'health,' and 'biology.'

Figure 9-2-6: Trends in the number of researchers in Japan's government research institutes by field of research



Note: The data represent head counts.
Source: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 9-2-6

Chapter 10
Universities: Their Production of Science Knowledge and Collaboration with Other Sectors

Higher education institutions such as universities, as performers of R&D, play an essential role in the R&D system of a country. As discussed in Section 6.1, in the five major developed countries, this sector spends 15% to slightly over 20% of the nationwide R&D expenditure. Higher education institutions are also experiencing qualitative changes in R&D activities, such as growing collaboration with the business sector.

The scope of the higher education sector differs from one country to another, although its primary element is universities in any country. In this chapter, unless otherwise needed, we use the term 'universities' or 'university sector' in place of the 'higher education sector.' 'University sector' is the term often used in governmental or statistical literature in Japan and refers to, in addition to universities, junior colleges, technical colleges, university research institutes, and other related institutions[(1),(2)].

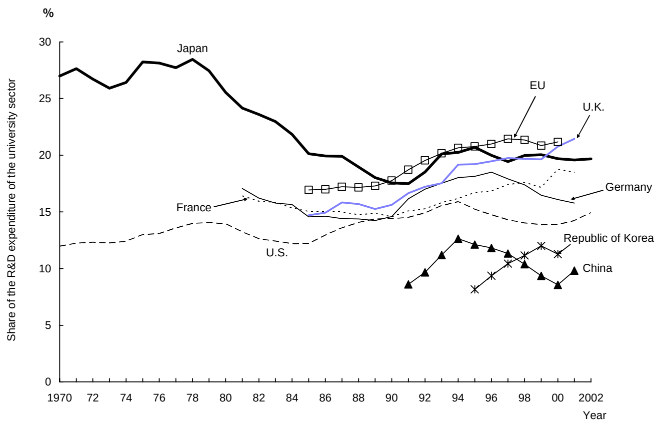
10.1 The role of universities: the source of knowledge

This section discusses the role assumed by the university sector in the national R&D system. First, let us examine the trends in the ratio of R&D expenditure by the university sector to the nationwide total in selected countries in Figure 10-1-1.

The share of the university sector in Japan is rather high among the selected countries, despite a long-term decline from the latter half of the 1970s to around 1990. This fall is attributable mainly to an increase in the ratio of the R&D expenditure of the business sector to the nationwide R&D expenditure of Japan. In other words, during this period, the relative significance of the role of the university sector declined as the role of the business sector grew. The share of the university sector in Japan increased temporarily in the first half of the 1990s and remained flat for the remainder of the selected period. This increase is also due to the concurrent decline in the R&D expenditure of the business sector.

In the U.K. and France, the share of the university sector has increased since the latter half of the 1990s, while it has declined in Germany. In the EU, the steady growth of the share of the university sector since the latter half of the 1980s leveled off in the latter half of the 1990s. In the U.S., the share of the university sector peaked in 1994, followed by a decline until 2000 and growth again for the remainder of the selected period.

Figure 10-1-1: Trends in R&D expenditure by the university sector as a percentage of the total for selected countries



Note: Same as Figures 6-1-1 and 6-1-7
Source: Same as Figures 6-1-1 and 6-1-7
See: Table 10-1-1

(1) According to the "Report on Basic Survey of Schools" for FY2003 published by the Ministry of Education, Culture, Sports, Science and Technology, Japan has 702 universities (100 national, 76 public, and 526 private schools), 525 junior colleges (13 national, 49 public, and 463 private schools), and 63 technical colleges.

(2) The 'Report on the Survey of Research and Development' published by the Statistics Bureau, the Ministry of Public Management, Home Affairs, Posts and Telecommunications, which is the source of the data reported in this chapter, reports universities by faculty (or by field of study for graduate schools). The total number of university faculties in Japan is 1,796 as of March 31, 2003. 'Other institutions' refer to inter-university research institutes, the National Center for University Entrance Examinations, the National Institution for Academic Degrees, the Center for National University Finance, research institutes under the jurisdiction of the Ministry of Education, Culture, Sports, Science and Technology, and so forth.

In general, universities have been expected to serve as educational and research institutions. However, their actual role varies to some extent by country, and some clearly distinguish ‘universities for education’ from ‘universities for research.’ On the other hand, there are countries like Japan where the principle is that all universities promote education and research in an integrated manner. Recently, in many countries including Japan, the concept that social services and contributions, in addition to education and research, are another essential function of universities has become more and more prevalent. While the university function that is most relevant to the subject of this report is research, education and social services are no less important as foundations to support a knowledge-based society.

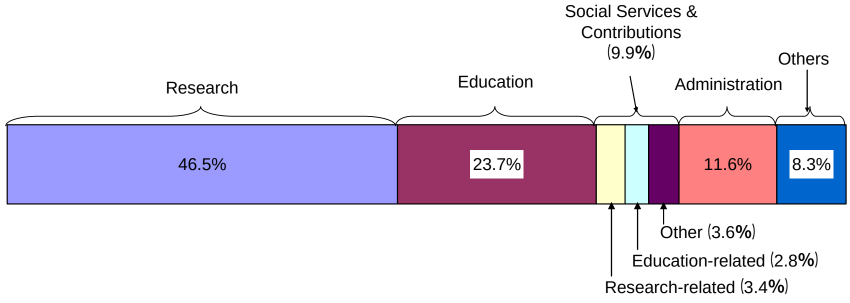
How important are these functions of universities in reality? Useful data are found in the results of a survey conducted by the Ministry of Education, Culture, Sports, Science and Technology regarding the activities of university teaching staff. The survey is based on sampling teaching staff members (professors, assistant professors, lecturers, and assistants) of universities nationwide and uses questionnaires asking about their annual work hours by type of activity.

The results show that university teaching staff in Japan on average allocate 46.5% of their work hours to research and 23.7% to education.

The hours spent on social services and contributions account for 9.9% of the total hours worked. The survey divides this category into three subcategories: research-related, education-related, and other. Research-related social services and contributions refer to activities that apply research outcomes for the benefit of society, including industry-academia collaborations, which have recently been emphasized. Education-related social services and contributions involve educational and awareness-building activities to support life-long learning in communities. Activities that fall in the ‘other’ category are, for example, medical diagnosis and treatment at university hospitals. The shares of these three types of activity are very close: 3.4%, 2.8%, and 3.6%, respectively.

This survey was conducted to compile statistics on universities on a full-time equivalent basis. Accordingly, the data we report are full time equivalents calculated from the survey results.

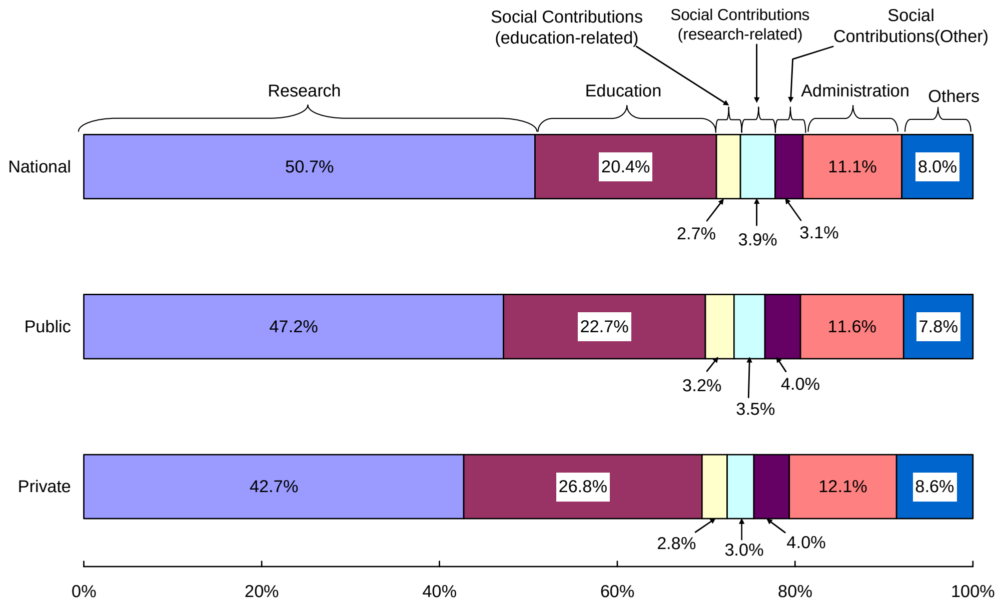
Figure 10-1-2: Breakdown of hours worked by university teaching staff by type of activity (yearly average for FY2002)



Note: This indicator is based on the results of a survey (sampling survey) in which questionnaires were sent to university teaching staff to ask them to report their self-assessed data.
Source: Science and Technology Policy Bureau, Ministry of Education, Culture, Sports, Science and Technology, “Report on Survey for FTE data of Researchers in Universities and Colleges. (FY2002)”
See: Table 10-1-2

To what extent does the content of activities vary by university ownership (national, public, and private universities)? Figure 10-1-3 shows the breakdown of hours worked by university teaching staff by type of activity and by school ownership. Variation by ownership is largest in the activities for research and education. In terms of the share of staff time spent on research, national universities come first, followed by public universities, second and private universities, third. The order is reversed when it comes to the share of time spent on education. The share is largest in private universities, followed by public and national universities. For activities other than research and education, differences between the three ownership types are limited.

Figure 10-1-3: Breakdown of hours worked by university teaching staff by type of activity (by university ownership)
Note: Same as Figure 10-1-2



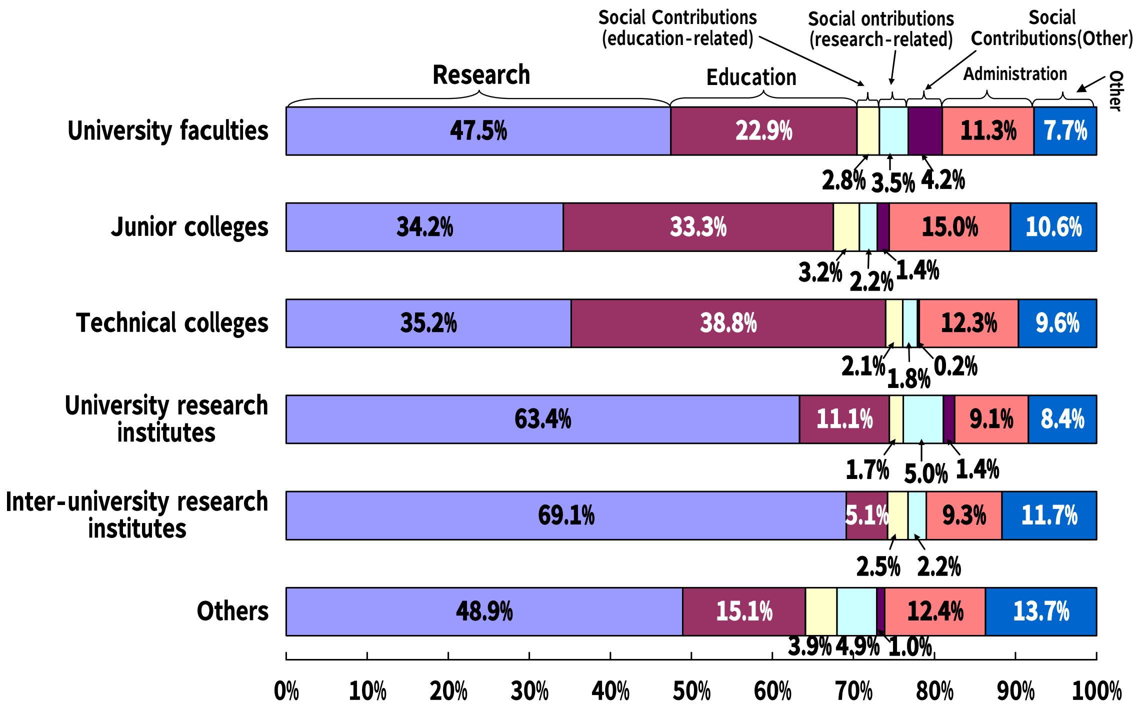
Source: Same as Figure 10-1-2
See: Table 10-1-3

Figure 10-1-4 compares activities of university teaching staff by type of institution. The breakdown varies more widely between different types of institution compared with the case of the comparison by school ownership. The variation is particularly remarkable with the shares of education and research. On the other hand, the share of administration stands around 10% in all types of institution, without notable variation.

A closer examination of the data considering the type of institution shows that the activities of faculty teaching staff are similar to the average of the entire university sector illustrated in Figure 10-1-2. This is reasonable given that faculty teaching staff constitute more than 80% of the total teaching staff in the university sector[3]. In junior and technical colleges, the shares of staff time spent on research are small, at 34.2% and 35.2%, respectively, and the shares of time for education are high instead. Since university research institutes and inter-university research institutes are establishments whose primary function is research, the shares of time spent on research are high at both types of institute, at 63.4% and 69.1%, respectively. Of these two types of institute, the share of staff time spent on research is even higher in inter-university research institutes, which engage primarily in large-scale research projects.

(3) Teaching staff in university faculties account for 83.7% of the total full-time teaching staff in the university sector as of March 2002.

Figure 10-1-4: Breakdown of hours worked by university teaching staff by type of activity (by type of institution)



Note: Same as Figure 10-1-2
Source: Same as Figure 10-1-2
See: Table 10-1-4

10.2 R&D in the higher education sector

10.2.1 International comparison

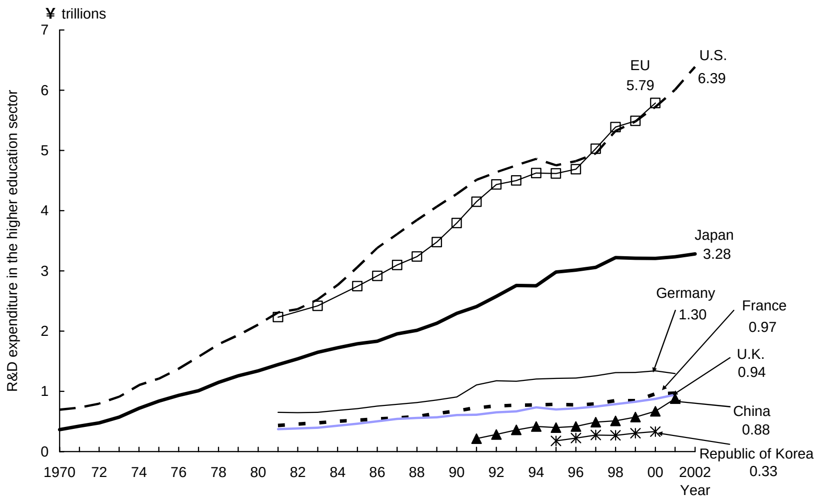
Figure 10-2-1 shows the trends in R&D expenditure by the higher education sector in selected countries. Calculation of the total R&D in the higher education sector requires collecting university expenditure in a manner that makes expenditure on educational activities distinguishable from that on R&D activities. However, this is infeasible in most cases. Therefore, those who deal with statistics regarding R&D expenditure in the higher education sector should be aware that the accuracy of these data is low.

Overall, the positions of the five countries and their long-term trends resemble those seen in total R&D expenditure (see Figure 6-1-1, Chapter 6). For example, the level of the U.S. is 1.5 to two times higher than Japan's.

R&D expenditure by Japanese universities totaled ¥3,282.3 billion in 2002. This accounts for 18.3% of the nationwide R&D expenditure of that year. From a long-term perspective, R&D expenditure in Japan's university sector increased linearly throughout the selected period, except for 1994, 1999, and 2000, which all saw a decline from the previous year. Japan's figure has barely grown since 1999, leveling-off for the first time during the selected period.

As for the remainder of the selected countries, it is not appropriate to identify changes over time solely based on the plot below, partly because of the impact of currency conversion. Nevertheless, significant growth since the mid-1990s in the U.S. and the EU is evident. During the same period, France and the U.K., major members of the EU in terms of the size of R&D expenditure, also experienced a steady increase in R&D expenditure by the higher education sector. In Germany, the growth slowed down at the end of the 1990s and eventually turned negative in 2001. China and Republic of Korea have seen steady growth in this indicator.

Figure 10-2-1: Trends in R&D expenditure in the higher education sector for selected countries

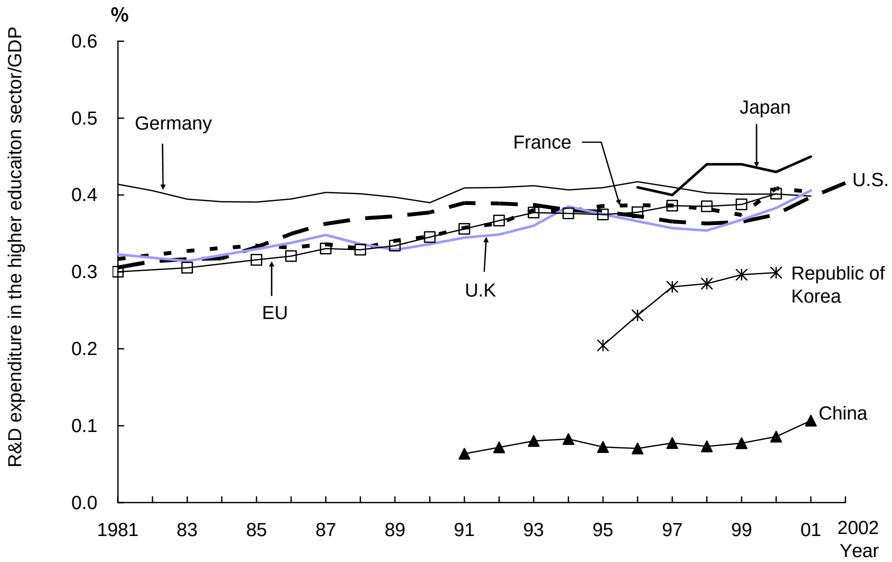


Note: Same as Figures 6-1-1 and 6-1-7
Source: Same as Figures 6-1-1 and 6-1-7
See: Table 10-2-1

Figure 10-2-2 shows an international comparison of R&D expenditure by the higher education sector as a percentage of GDP. While the percentage figures for the U.S., Germany, France, the U.K., and the EU hover around 0.3% to 0.4%, the figure for Japan stays well above at 0.5% or 0.6%. R&D expenditure in the higher education sector of a country is not easily comparable with that of another because of differences in the fiscal system or methods for compiling statistics, such as the handling of full-time equivalents. Nevertheless, it can be seen that one of the reasons that R&D

expenditure by Japan's university sector is large in the international context is, as already illustrated in Figure 10-1-4, that all types of higher education institution including junior and technical colleges perform research. In some other countries, some higher education institutions rarely conduct research, possibly resulting in a relatively small amount of R&D expenditure by the higher education sector. We also note that Japan's R&D expenditure may have been overestimated because it is not on a full-time equivalent basis. However, it is assumed that the influence of this overestimate is too small to completely account for Japan's university sector spending on R&D being exceptionally high among the major developed countries.

Figure 10-2-2: R&D expenditure in the higher education sector as a percentage of GDP for selected countries



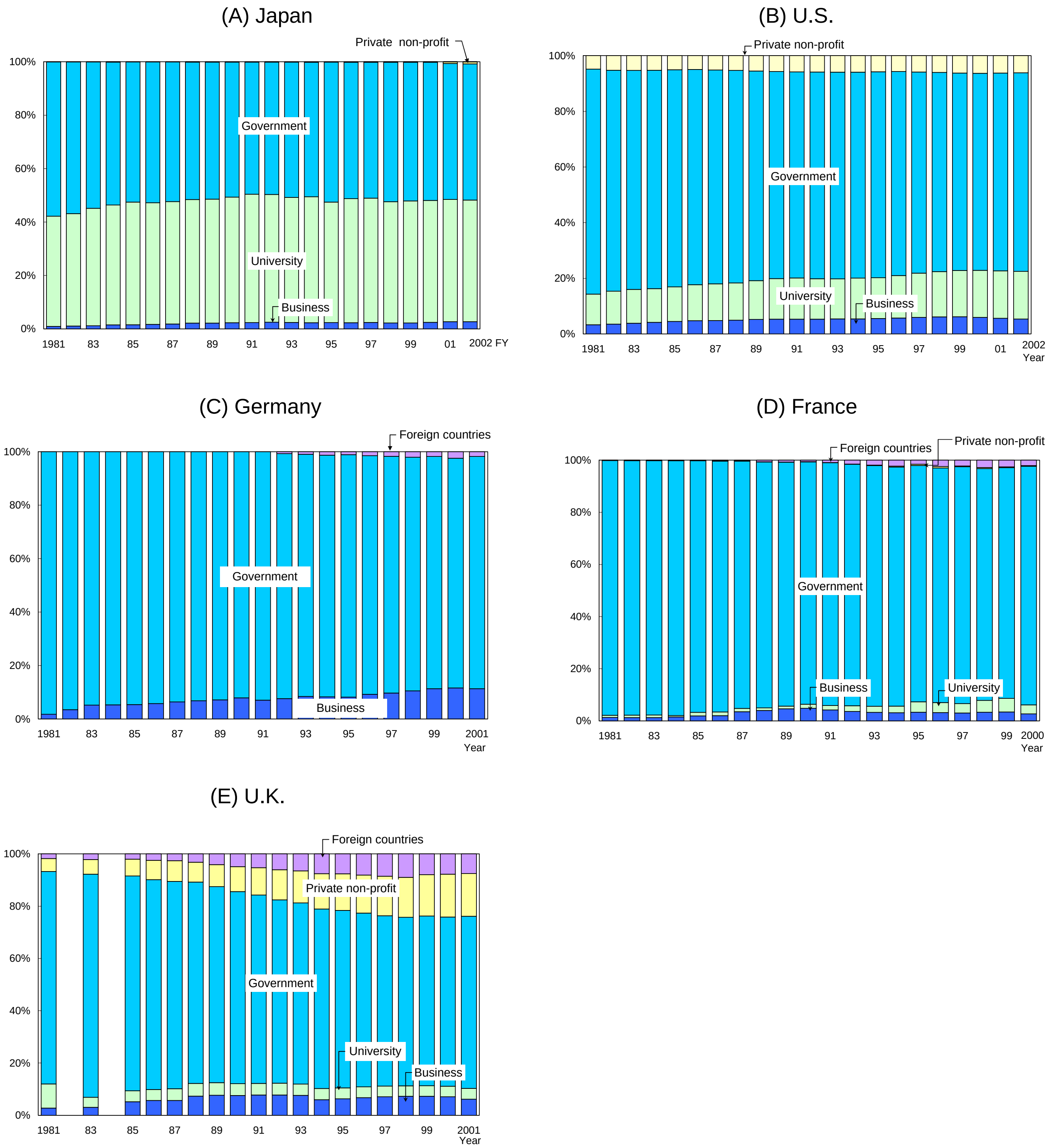
Note: Same as Figures 6-1-1 and 6-1-7 and Reference Statistics C
Source: Same as Figures 6-1-1 and 6-1-7 and Reference Statistics C
The data for Japan (OECD data) are based on the OECD's "Main Science and Technology Indicators 2003/01"
See: Table 10-2-2

Next, we examine the funding sectors of R&D performed by the higher education sector. Figure 10-2-3 shows the trends in the percentage of R&D expenditure in the higher education sector by source of funding in selected countries.

In Japan, the share of the funding of the university sector is the highest among the five countries. This is in contrast to the other four countries, where the government is the major funding source of the R&D performed by universities. There are two factors behind the strong presence of the university sector as the source of funding in Japan. The first is that the government budget appropriated for the national schools as the National School Special Account has been classified as the expenditure funded by universities in the statistics used for this report. The second is that a large part of the R&D expenditure of private universities is self-financed.

Figure 10-2-3 also suggests that the share of university R&D expenditure funded by the business sector in Japan is smaller than those of the other countries. In Japan, this share increased continuously until 1992, followed by a decline that continued until 1999, when a recovery started. In the U.S., the share of the business sector as the funding source grew steadily for a long time but declined slightly later in the selected period. A remarkable trend in the U.S. is the long-term growth in the share of R&D expenditure funded by universities. It is notable that Germany has long-term growth in the share of its business sector. In the U.K., the share of private non-profit research institutes has increased since the latter half of the 1980s. As a result, this sector has recently become a major funding source of R&D performed by universities.

Figure 10-2-3: Trends in the percentage of R&D expenditure in the higher education sector by source of funding in selected countries



Note: Same as the note on the source of funding in Figure 6-1-7
Source: Same as Figure 6-1-7
See: Table 10-2-3

Below, we analyze the higher education sector considering the number of researchers. When performing international comparison, note that the classification, coverage, and method for the survey to compile statistics on the number of researchers in the higher education sector vary widely from one country to another. The following analysis is based on the data that are commonly used as R&D statistics (Figure 10-2-4).

In Japan, statistics on the number of university researchers were not available in full-time equivalents until 2001. Since 2002, however, these statistics have been expressed in both full-time equivalents and traditional head counts. Similarly, the U.S. statistics on the number of university researchers are primarily in head counts, with a limited part available in full-time equivalents.

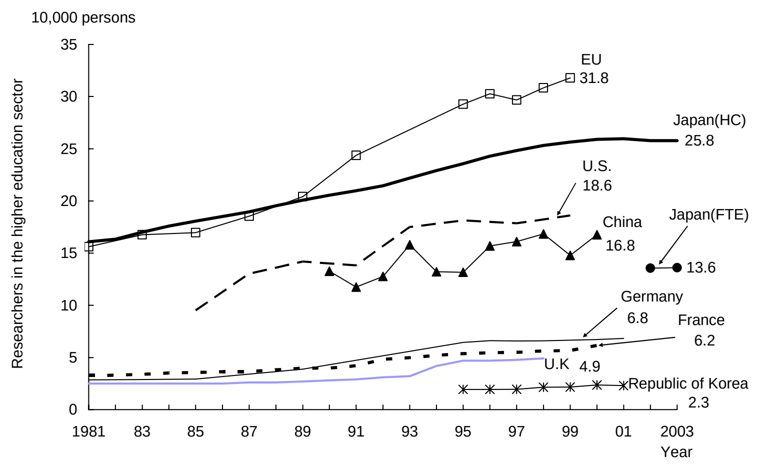
When compared by head count, the number of university researchers in Japan surpasses that of the U.S. This is due to the strong influence of the narrower definition of the target set by the U.S. statistics. Therefore, the statistics of the two countries cannot be compared on equal grounds.

From 2002 onward, Japan's full-time equivalent data are additionally plotted in the graph below. The latest available number of full-time equivalent university researchers is 136,000, which is smaller than the number in the U.S. (186,000 in 1999). This comparison is not valid either for the above reason. More realistic comparison of the number of researchers between Japan and the U.S. is discussed in Section 10.2.2 (see Figure 10-2-7).

The numbers of university researchers in the three selected European countries are reported in full-time equivalents. In Germany, data since 1991 reflect the impact of the reunification of East and West Germany. The U.K. data shows a clear difference between the pre- and post-1993 periods. This gap is due to a change in the survey coverage as a result of the reform of the higher education institutions. In France, the number of researchers in the higher education sector increased steadily throughout the selected period.

From Asia, we have selected China and Republic of Korea for comparison. In China, the number of university researchers has increased over time despite repeated fluctuations and stands above Japan's figure in full-time equivalents as of 2000. By contrast, the number of university researchers in Republic of Korea has remained stable at a level far lower than those of the other countries.

Figure 10-2-4: Trends in the number of researchers in the higher education sector for selected countries



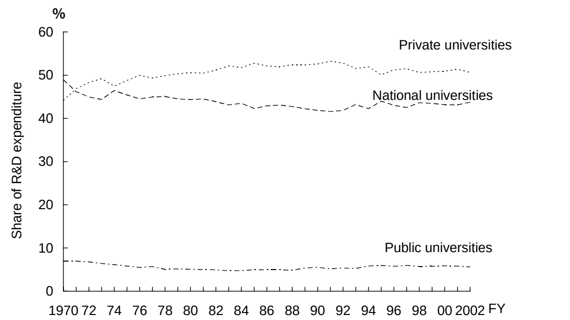
Notes: The data for all countries (except Republic of Korea) refer to the total number of researchers in natural sciences, social sciences, and humanities.
<Japan> (i)Because of a change in the content and date of surveys, data until 2000 refer to the number of full-time researchers as of April 1 of that year, and data since 2001 refer to the number of researchers as of March 31 of that year.
(ii) The number of university researchers (FTE) in Japan is calculated from the results of the 'Survey on the Data Calculated in Full-Time Equivalents in Universities, etc.,' conducted in 2002. However, the data for "medical offices, etc." (FTE) are calculated using the conversion factor for teaching staff.
<Germany> The data for Germany refer to the former federal states until 1990 and to all of Germany since 1991.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"; Science and Technology Policy Bureau, Ministry of Education, Culture, Sports, Science and Technology, and NISTEP, "Survey on the Data Calculated in Full-Time Equivalent in Universities etc."
<U.S.> For the 1985-1955 data, NSF, "National Patterns of R&D Resources: 2002 Data Update"; For the rest, OECD, "Main Science and Technology Indicators 2003/1"
<Germany, France, and U.K.> OECD, "Main Science and Technology Indicators 2003/1" See: Table 10-2-4

10.2.2 R&D structure at universities

Figure 10-2-5 shows the trends in the percentage of R&D expenditure (funds for intramural R&D) by Japanese universities by school ownership. It demonstrates that the share of R&D expenditure by national universities declined slowly until the early 1990s, while that of private universities grew steadily. The decline in the share of national universities stopped in around 1991, stabilizing at slightly over 40% after fluctuations. The share of R&D expenditure by private universities has declined slightly since 1992. The share of public universities increased slightly in the first half of the 1990s, followed by a leveling-off since the latter half of the 1990s. In fiscal year 2002, national, public, and private universities accounted for 43.7%, 5.6%, and 50.6%, respectively, of the total R&D expenditure by universities. In terms of the actual value of expenditure, all types of university, regardless of ownership, indicated a linear increase until the latter half of the 1990s, although their growth has leveled off since around 1998.

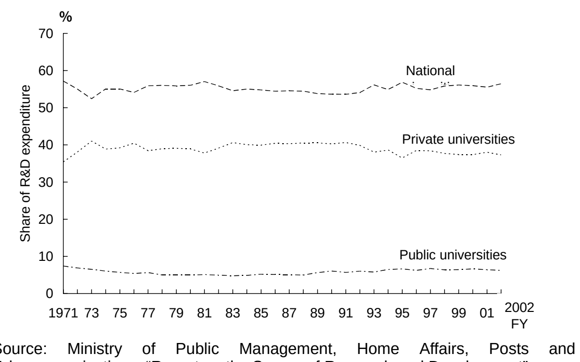
Figure 10-2-5: Trends in the percentage of R&D expenditure by universities by university ownership

(A) Overall



Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 10-2-5 (A)

(B) Natural Sciences



Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 10-2-5 (B)

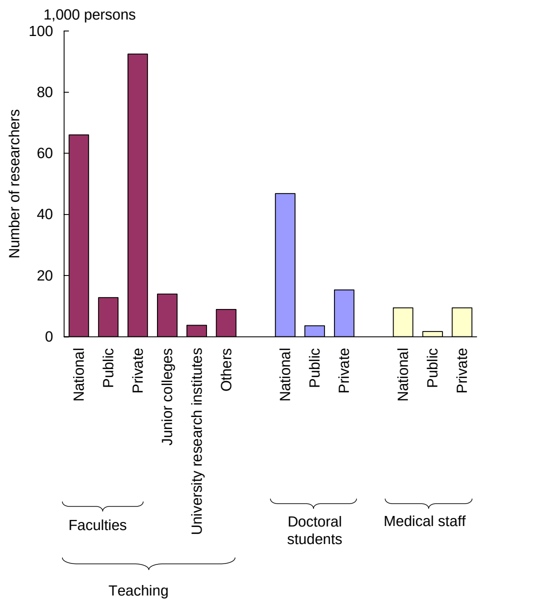
Figure 10-2-6 shows a breakdown of university researchers in Japan by institutional affiliation and type of position.

The total number of university researchers reported in the latest Japanese statistics ('full-time researchers' in the 'Report on the Survey of Research and Development') is 257,792 as of March 31, 2003. Of these researchers, 66.4%, or 171,288 persons, are teaching staff. Other types of university researcher include doctoral students in graduate schools (65,817 persons) and medical staff (20,687 persons).

Of the teaching staff, 144,610 persons are university faculty members, and the remainder are affiliated to junior colleges (13,987 persons) and university research institutes (3,745 persons). In the above statistical report, the majority of university teaching staff are counted as researchers[(4)].

In private universities, the majority of researchers belong to faculties, while in national universities, many researchers are doctoral students. In public universities, the number of researchers is small in all positions including faculty staff, doctoral students, and medical staff.

Figure 10-2-6: Breakdown of university researchers in Japan (2003)



Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 10-2-6

(4) These data can be compared with university statistics listed in the 'Report on Basic Survey of Schools 2003' compiled by the Ministry of Education, Culture, Sports, Science and Technology. According to the report, the number of full-time teaching staff is 156,155 in university faculties and graduate schools and 13,534 in junior colleges as of May 1, 2003.

Next, we analyze the number of researchers in Japan's university sector in an international context. Japan is compared with the U.S. in Figure 10-2-7.

Because of considerable differences in the survey method, the statistics of these two countries are not easily comparable as Figure 10-2-4 shows. For an accurate comparison, the number of graduate students has been subtracted from the number of researchers in the statistics of both countries before the data can be adjusted and estimated to eliminate the differences between the survey criteria of the two countries[4]. In accordance with the U.S. statistics on researchers, which refer only to four-year universities, only teaching and medical staff in university faculties (including graduate schools) and university research institutes have been extracted from the Japanese statistics.

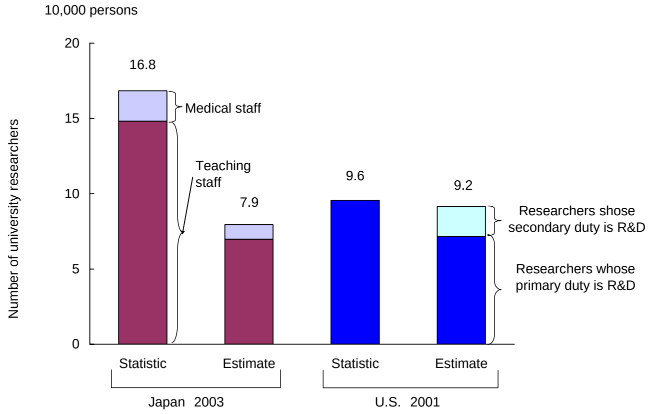
More specifically, differences between the statistics of the two countries are as follows. In Japan, as mentioned earlier, most university teaching staff are counted as researchers, and the data have been expressed in full-time equivalents since 2002. On the other hand, in the U.S., statistics are not in full-time equivalents and cover only researchers who have received a doctor's degree from a U.S. university and whose primary duty is R&D.

Considering the above differences, we have estimated the number of researchers in Japan and the U.S. as follows. The number of university teaching staff in Japan has been adjusted to cover only the full-time-equivalent teaching staff in four-year universities and university research institutes to make it comparable with the U.S. data. As for medical staff, whose number is not available in full-time equivalents, estimates have been calculated using the same conversion factor used for the estimation of teaching staff.

While the U.S. statistics say that 96,000 personnel are primarily engaged in R&D, this number also needs to be adjusted to account for other R&D personnel who are primarily engaged in teaching (106,000 people). Assuming that personnel whose primary duty is R&D spend 50% to 100% of their time on R&D, their total number has been converted using a presumed conversion factor of 0.75, which is the mean value. Similarly, assuming that personnel whose secondary duty is R&D spend 0% to 50% of their time on R&D, their total number has been converted using the mean value, 0.25, as a presumed conversion factor.

The resulting numbers of university researchers in Japan and the U.S. are 79,000 and 92,000, respectively, reversing the position of two countries in the comparison based on the reported statistics. This estimate for the U.S. still does not include researchers who earned a doctor's degree outside the U.S. or who have no doctor's degree. If these people were added, the total number of university researchers in the U.S. would be even larger.

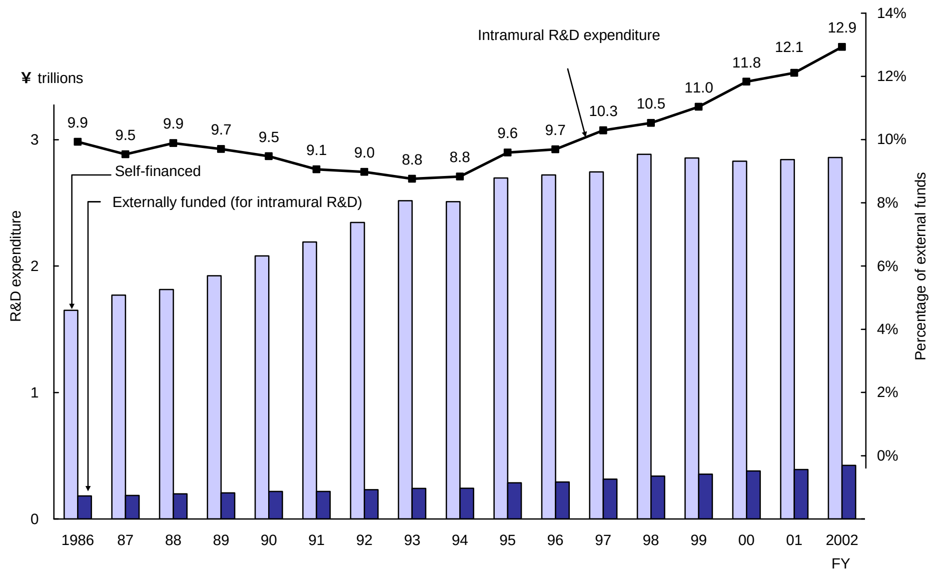
Figure 10-2-7: Comparison of the number of university researchers in Japan and the U.S.



Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"; Science and Technology Policy Bureau, Ministry of Education, Culture, Sports, Science and Technology, "Survey on the Data Calculated in Full-Time Equivalent in Universities, etc."
Estimates have been compiled by NISTEP based on the above references.
<U.S.> NSF, "Characteristics of Doctoral Scientists and Engineers in the United States: 2001"
Estimates have been compiled by NISTEP based on the above references.
See: Table 10-2-7

(4) Graduate students have been excluded because of a major diference between the two countries' survey criteria applied in obtaining data on them. In addition, there are no sufficient data to correct the difference.

Figure 10-2-8: Trends in intramural R&D expenditure in universities by source of funding



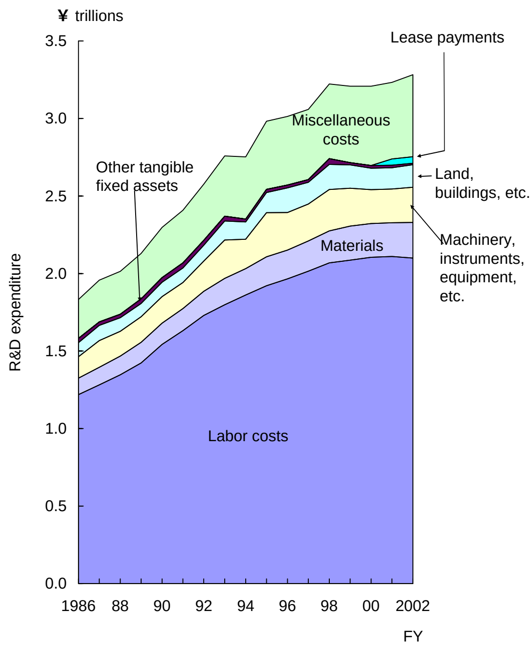
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”
See: Table 10-2-8

In Japan, the proportion of R&D expenditure by the university sector of the nationwide R&D expenditure is, as mentioned in Chapter 6, notably high compared with other countries. Another remarkable point about Japan’s university R&D expenditure is the small amount of external funding received. Figure 10-2-8 shows intramural R&D expenditure in universities by source of funding: self-financed expenditure and externally funded expenditure.

Of the total expenditure on R&D performed by Japanese universities (¥3,282.3 billion for FY2002), self-financed expenditure was ¥2,859 billion, while externally funded expenditure was ¥424.5 billion, accounting for only 21.9%. However, the proportion of externally funded expenditure has increased since 1995. A note on the above statistics is that self-financed R&D expenditure in Japanese universities includes funds provided by national universities for their internal R&D.

By type of cost, labor costs account for the major part of the expenditure on R&D performed by Japanese universities and their value increased steadily throughout the selected period in Figure 10-2-9. The labor costs for FY2002 were ¥2,100 billion, constituting 64.0% of the total. The combined total of the remainder of the cost items amounted to ¥1,182.3 billion. Throughout the selected period, there was no significant change in the share of each type of cost.

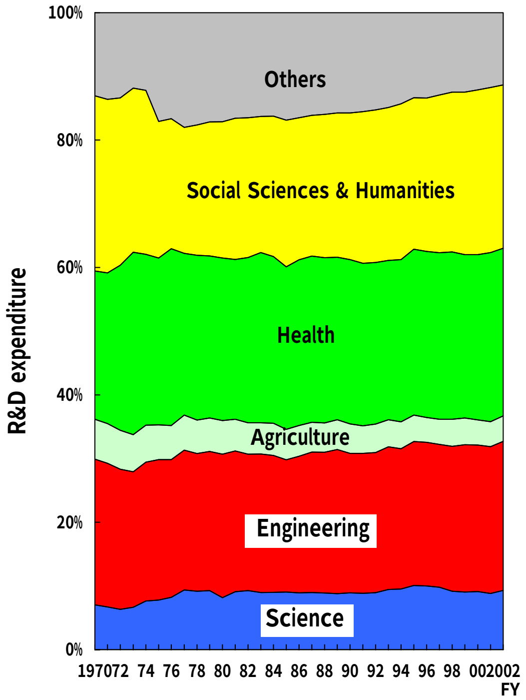
Figure 10-2-9: Trends in R&D expenditure in universities by type of cost



Note: ‘Lease payments’ was added to the survey items in FY2001.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”
See: Table 10-2-9

Considering the field of study, university R&D expenditure has shown small changes over the period selected in Figure 10-2-10. Since the fields of study shown here are not categorized by the field of R&D but by university organization, such as faculties, it is not easy to identify changes in the content of R&D from the chart. However, it does at least reflect trends in the structure of university organizations. The data shown below are noteworthy in that they suggest there has been no remarkable change in the organizational structure of Japanese universities.

Figure 10-2-10: Trends in R&D expenditure in universities by field of study



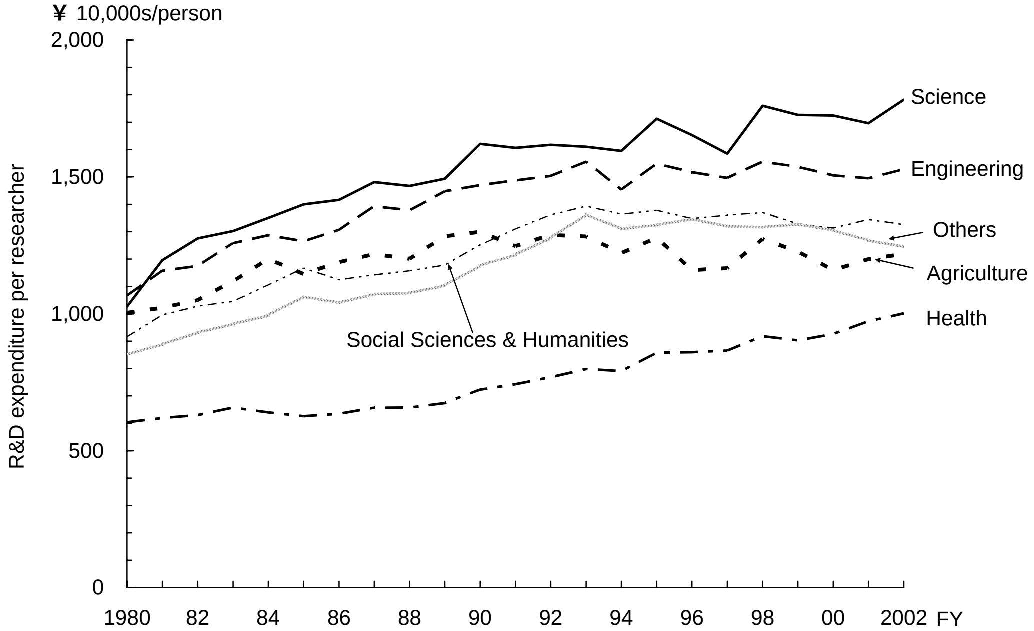
Note: The field of study is classified by the type of university organization, such as faculties.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”
See: Table 10-2-10

Figure 10-2-11 (A) shows trends in intramural R&D expenditure per researcher in universities by field of study. As shown, expenditure has been largest in the field of science, followed by engineering. Expenditure in both fields grew for a long time, at a steady pace in the 1980s and a somewhat slower pace in the 1990s, until a decline started in the latter half of the 1990s. R&D expenditure per researcher in the health field, although smallest in value, has increased since 1990s but still remains well below the values of other fields. The agriculture field has declined for the most part since the beginning of the 1990s, despite some fluctuations. R&D expenditure per researcher in social sciences and humanities rose markedly between 1990 and 1992, followed by a downward trend with some fluctuations.

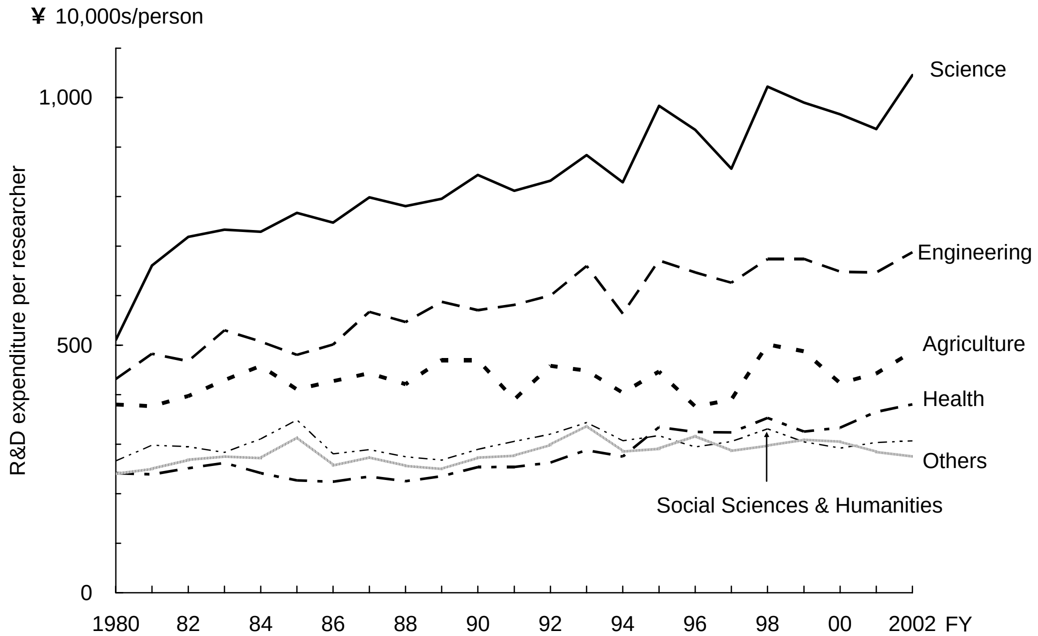
For the analysis of R&D expenditure per researcher, R&D expenditure excluding the labor costs of R&D personnel is sometimes used as shown in Figure 10-2-11 (B). The graph illustrates that overall expenditure has hardly changed over the past 10 years. By field of study, the amount has been largest in science, followed by engineering.

Figure 10-2-11: Trends in R&D expenditure per researcher in universities

(A) Total R&D expenditure



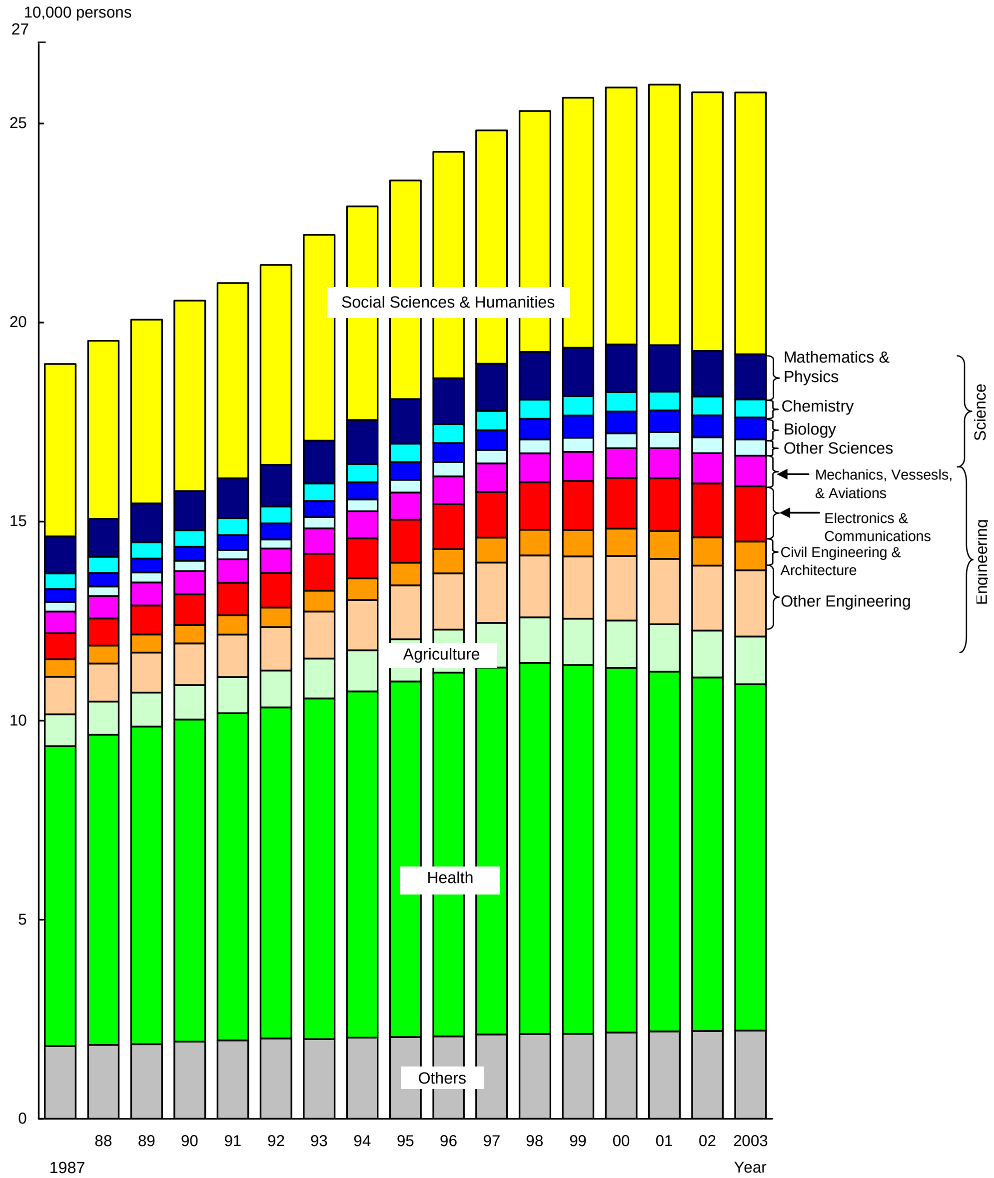
(B) R&D expenditure excluding labor costs



Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 10-2-11

Next, we examine R&D activities in Japanese universities from the perspective of personnel. We demonstrated earlier that the structure of the fields of study in Japanese universities has hardly changed, with data on R&D expenditure in Figure 10-2-10. Similar trends are observed in the data on the number of researchers. As the trends in the number of researchers by specialty in Figure 10-2-12 show, there has been no significant change in the breakdown of researchers by field of research over the long term, despite an increase in the total number of researchers. It is assumed that these data reflect the state of R&D personnel development in universities rather than the current population of university researchers in each field of research because researchers probably tend to give their specialty by the type of the faculty from which they graduated.

Figure 10-2-12: Trends in the number of university researchers by specialty



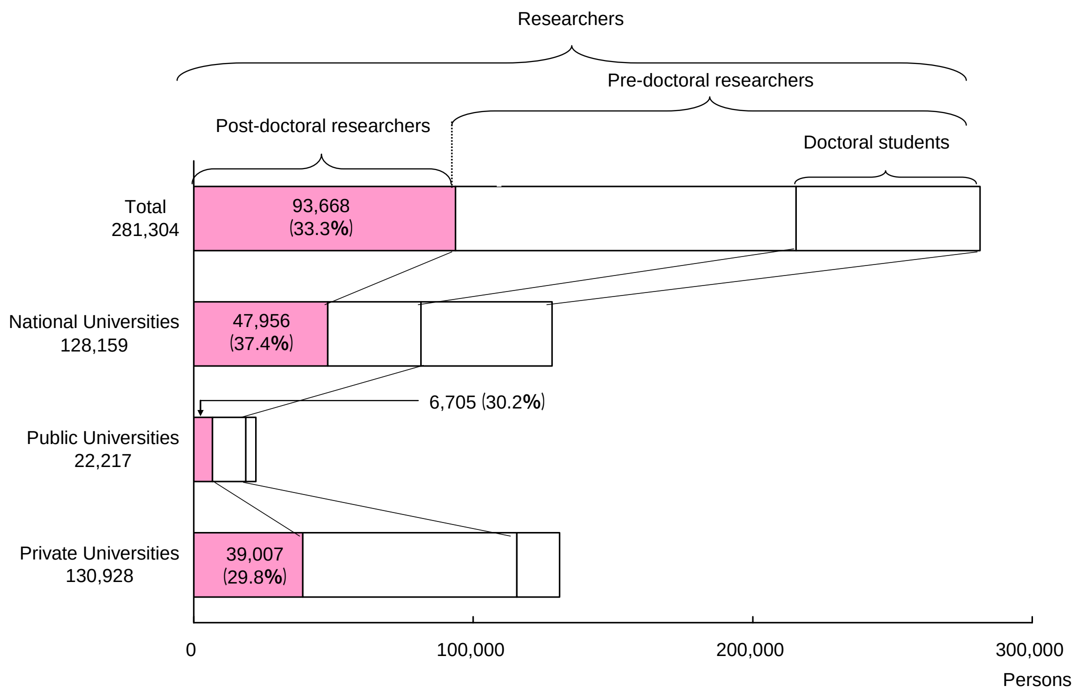
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”
See: Table 10-2-12

In some cases, international comparison of university researchers requires the number of post-doctoral researchers and the breakdown of researchers by educational attainment. For example, in the U.S. statistics, the number of university researchers refers only to post-doctoral researchers. Equivalent data have been compiled for Japan to compare the two countries in this respect.

Figure 10-2-13 shows the ratio of post-doctoral researchers to the total number of university researchers in Japan. The number of researchers in Japan's university sector amounts to 281,304 (the sum of the numbers of teaching staff, medical staff, and students on doctoral courses) as of the end of March 2003. Those who hold a doctorate account for 33.3%, or 93,668, of them. If a total of 65,827 doctoral students are subtracted from the aggregate number of university researchers, the percentage of post-doctoral researchers in the remaining total (215,481 researchers) is 43.5%.

By university ownership, the ratio of post-doctoral researchers to the total researchers is highest in national universities with 27.4%, followed by public universities with 30.2% and private universities with 29.8%.

Figure 10-2-13: Number of post-doctoral researchers in universities (2003)

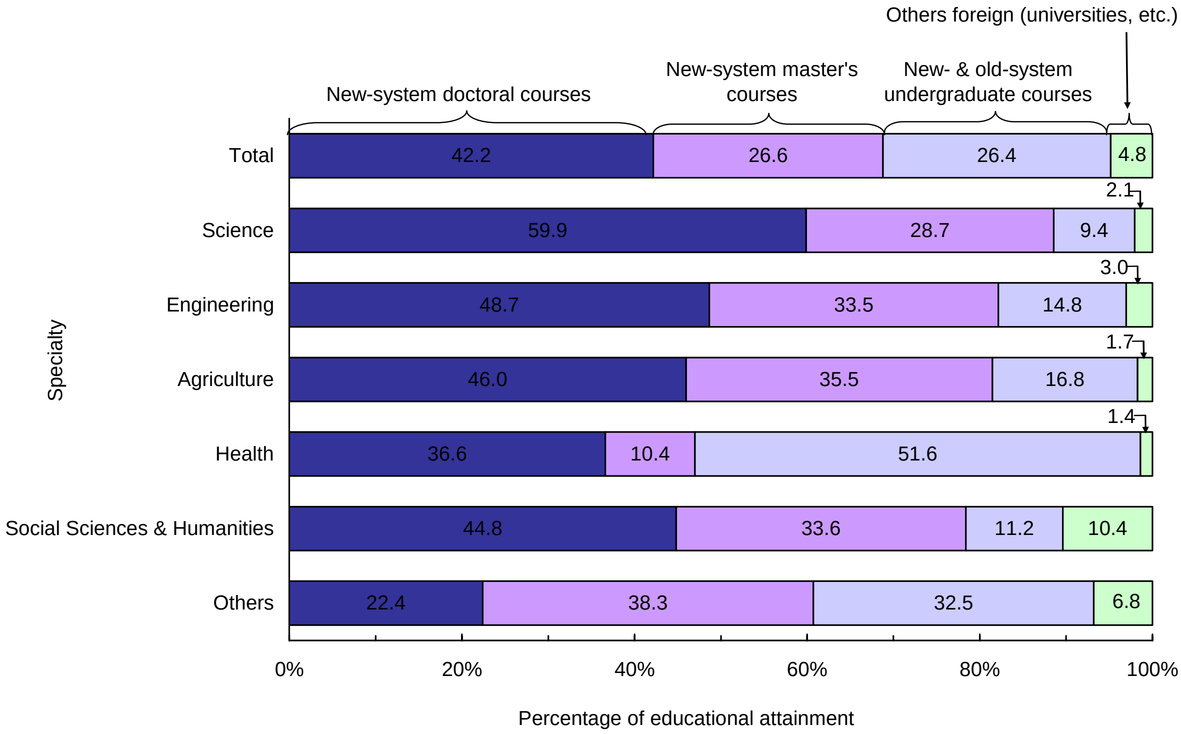


Note: The data represent head counts as of March 31, 2003.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 10-2-13

The number of researchers by educational attainment is discussed below using the statistics on university teaching staff. Figure 10-2-14 shows a breakdown of the number of university teaching staff by educational attainment. The largest percentage, or 42.2%, of the university teaching staff have completed a doctoral course at a graduate school under the new system of education, followed by 26.6% who have completed a master's course at a new-system graduate school. The percentage of teaching staff who have completed an undergraduate course at university under either the new or old system is relatively high.

By specialty, the percentage of the university teaching staff who have obtained a doctorate from graduate schools under the new system is highest in the field of science at 59.9%, followed by engineering at 48.7% and agriculture at 46.0%.

Figure 10-2-14: Breakdown of university teaching staff by educational attainment (FY2001)



Note: The data refer to total teaching staff in university faculties, graduate schools, university hospitals, and university research institutes.
Source: Ministry of Education, Culture, Sports, Science and Technology, "Report on the School Teachers Survey" (FY2003 edition)
See: Table 10-2-14

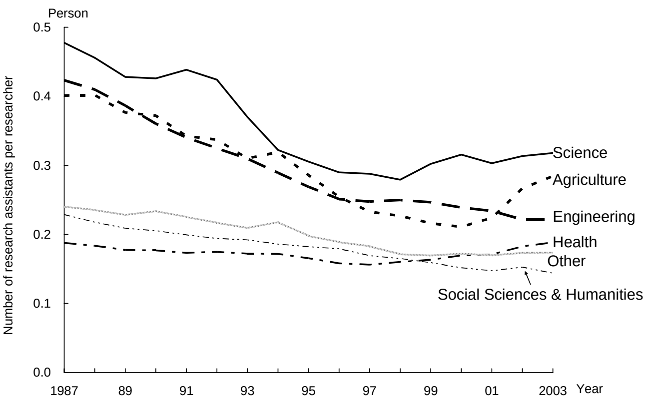
Figure 10-2-15 (A) shows the trends in the number of research assistants per university researcher. As already described in Chapter 6, the number of research assistants per researcher in Japan, especially in Japanese universities, is smaller than those in other major countries. The graphs below illustrate that the number has declined still further over time, particularly in research areas that once had a relatively large number of research assistants per researcher. However, the trends have turned positive recently in the fields of science and agriculture. The growth was especially remarkable in agriculture between 2001 and 2002.

Figure 10-2-15 shows the trends in the number of research assistants per researcher by three types of research assistant: (B) technicians, (C) assistant research workers, and (D) clerical and other supporting personnel.

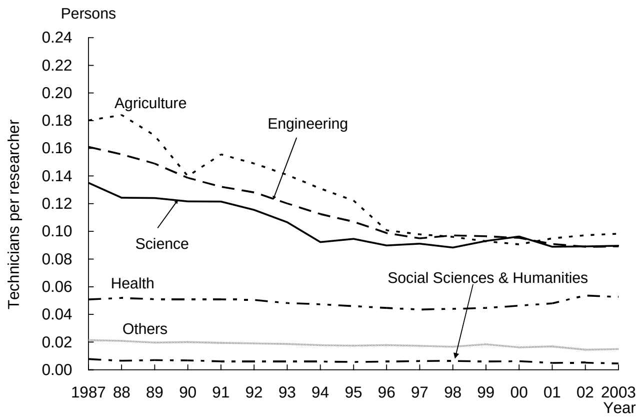
Overall, the greater the number of research assistants per researcher in the field or faculty, the greater the decline in that field of faculty. Of the three categories, the fall in number is significant among ‘assistant research workers’ and ‘technicians’ even with some variations by field or faculty. Compared with these two categories, the decline among ‘clerical and other supporting personnel’ has been limited.

Figure 10-2-15: Trends in the number of research assistants per university researcher

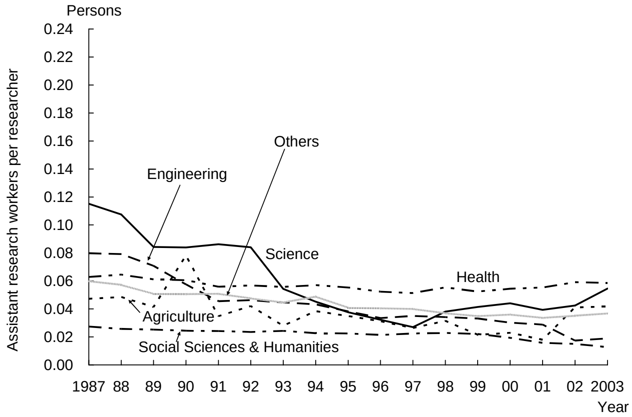
(A) Total



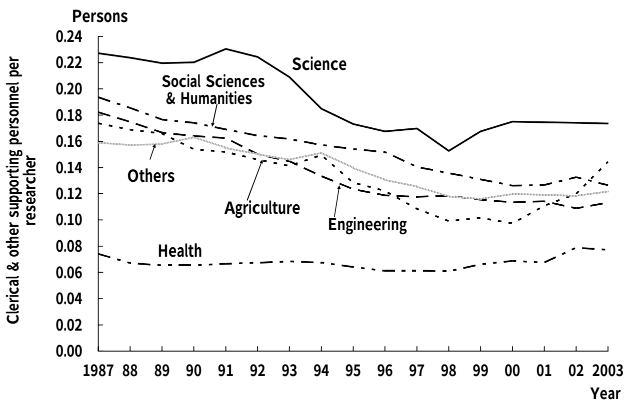
(B) Technicians



(C) Assistant research workers



(D) Clerical and other supporting personnel



Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”

See: Table 10-2-15

10.3 Industry-academia collaboration

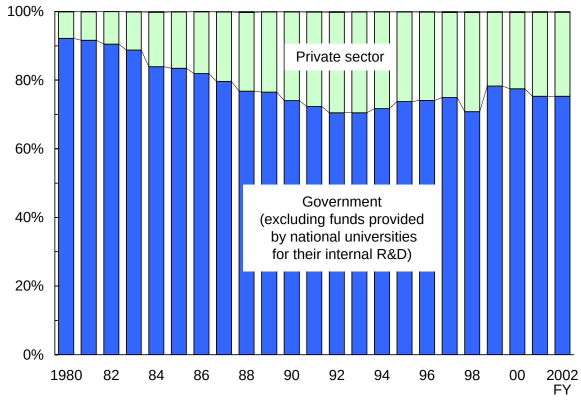
As the national-level creation of innovation becomes an increasingly important issue for a country, many countries have been strengthening efforts to make full use of the potential of universities. Universities are irreplaceable organizations in that they provide places to produce knowledge, which is the source of innovations. Transferring the knowledge produced at universities to other entities, however, is not easy. Recognizing this, there have been growing moves toward the promotion of industry-academia collaboration. This section provides an overview of the current state of industry-academia collaboration from the perspective of universities.

External R&D funding to universities reflects the external need for R&D at universities. Figure 10-3-1 shows the trends in intramural R&D expenditure of universities funded by external sources. The sources are divided into two types, the government sector and the private sector, and expressed as a percentage of the total. Until fiscal year 1992, the share of government-funded R&D expenditure declined, while that of private funding increased steadily. Between fiscal years 1993 and 1997, however, the share of government-funded R&D expenditure grew. Since fiscal year 2000, the share of private funding increased again, recovering from 21.5% in FY1999 to 24.4% in FY2002.

Next, let us examine the university R&D expenditure funded by business enterprises as an indicator of the state of industry-academia collaboration (Figure 10-3-2). From a long-term perspective, university R&D expenditure funded by the business sector increased significantly until FY1992, leveled off during the latter half of the 1990s, and has grown again markedly since FY1999. Business sector funding, however, accounts for a minimal part of the intramural expenditure of universities on R&D. For example, in FY2002, no more than 2.4% (¥77.8 billion) of the intramural expenditure of universities on R&D (¥3,282.3 billion) was funded by the business sector.

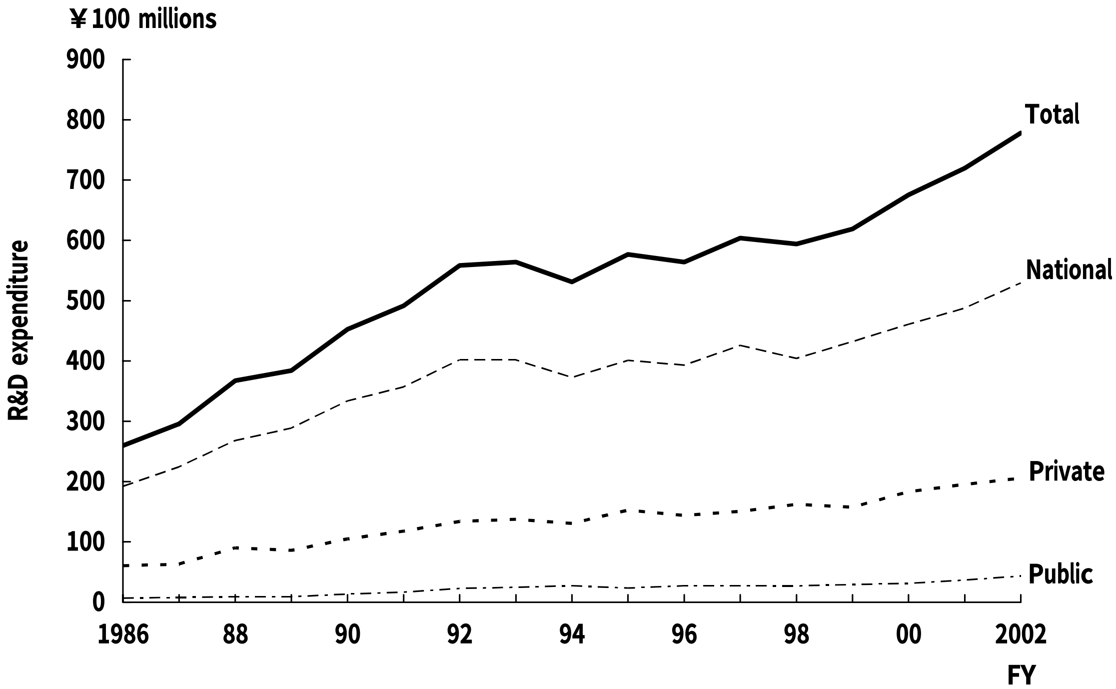
By school ownership, national universities receive a larger amount of R&D funding from the business sector than public and private universities do.

Figure 10-3-1: Trends in the percentage of externally-funded R&D expenditure in universities by source of funding



Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 10-3-1

Figure 10-3-2: Trends in universities' intramural R&D expenditure funded by the business sector



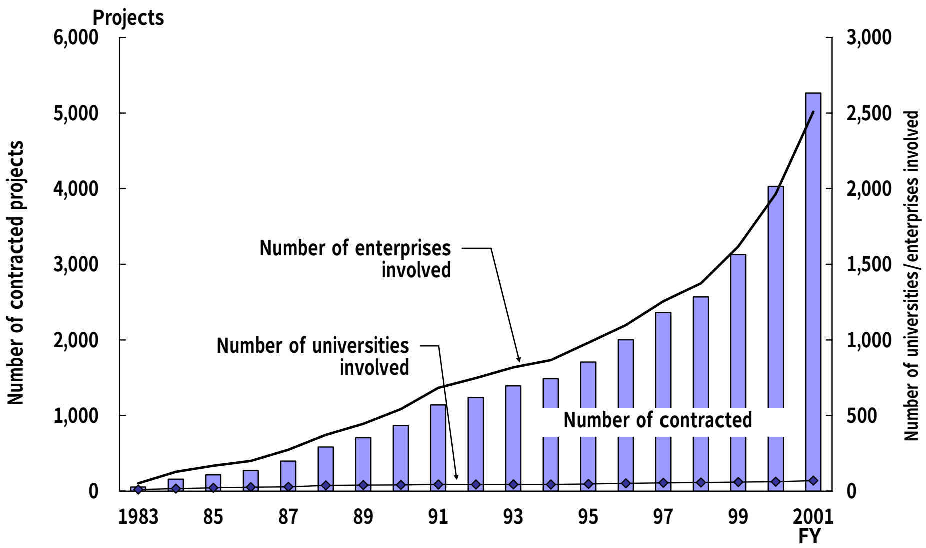
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 10-3-2

With growing awareness of the significance of industry-academia collaboration, Japan has recently been building systems to promote such activities. To examine the usage of these systems, consider the 'Joint Research with the Private Sector,' for example, a system established in 1983 and revised in March 1997 by a notification of the Ministry of Education. The number of joint research projects contracted with national universities under this system increased steadily during the 19-year period between fiscal years 1983 and 2001 (Figure 10-3-3).

On closer examination of the graph, rapid growth is seen between fiscal years 1983 and 1988, the time one may call a growth period at an early stage of the system. A period of steady growth followed between fiscal years 1989 and 1995, when the number of institutions that implemented the system increased. Since 1995, the field of research and the type of private-sector organization involved have diversified considerably, as described later. The last three years in the graph, between fiscal years 1999 and 2001, rapid growth was recorded again in all aspects, namely, the total number of joint research projects, the number of institutions involved, and the average number of projects.

These data are meaningful in that they additionally cover industry-academia joint research projects that do not involve the direct financing of R&D expenditure, unlike Figure 10-3-2. However, they have two disadvantages as an indicator; the data refer only to national universities and are not measurable in value terms.

Figure 10-3-3: Trends in the number of joint research projects between national universities and business enterprises

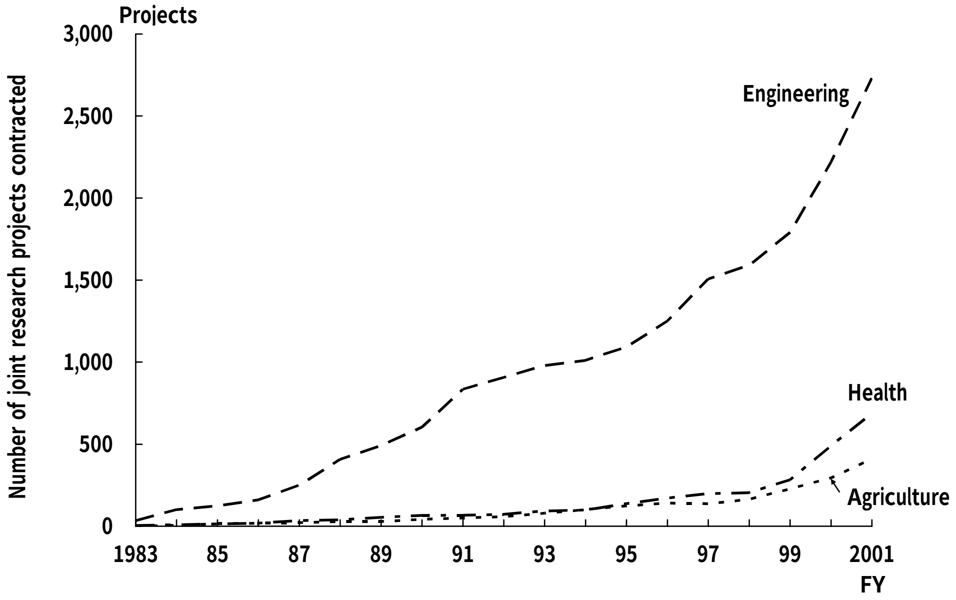


Source: NISTEP, "University-Industry Research Cooperation: A Status Report, 1983-2001" (Research Material No. 96)
See: Table 10-3-3

By field of research, engineering has been dominant in the number of joint research projects conducted in national universities since the establishment of the system. Since the latter half of the 1990s, however, the number of joint research projects in the health and agriculture fields has grown, as Figure 10-3-4 shows. This suggests diversification of research fields in line with the increase in joint research activities.

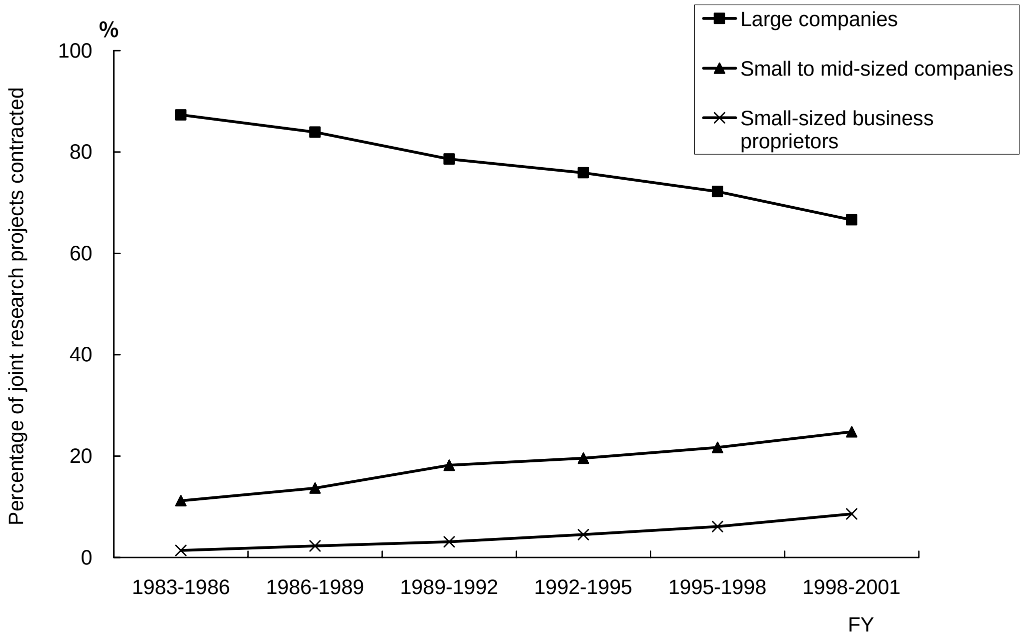
While the majority of joint research partners of national universities are business enterprises in Japan, the presence of incorporated foundations and special corporations increased toward the end of the 1990s. From the perspective of the size of the business enterprise, large companies were the dominant research partner of national universities right after the introduction of the system, whereas the shares of partnerships with small to mid-sized businesses and small-sized business proprietors have increased recently. This trend suggests that joint research partners of national universities have been diversifying (Figure 10-3-5).

Figure 10-3-4: Trends in the number of joint research projects between national universities and business enterprises by field of research



Source: NISTEP, "University-Industry Research Cooperation: A Status Report, 1983-2001" (Research Material No. 96)
See: Table 10-3-4

Figure 10-3-5: Trensd in the percentage of Japanese business enterprises as research partners of national universities by size of business



Source: NISTEP, "University-Industry Research Cooperation: A Status Report, 1983-2001" (Research Material No. 96)
See: Table 10-3-5

References

[1] Science and Technology Policy Bureau, Ministry of Education, Culture, Sports, Science and Technology, "Survey on the Data Calculated in Full-Time Equivalent in Universities etc." FY2002 edition, November 2003

[2] National Institute of Science and Technology Policy, "University-Industry Research Cooperation: A Status Report, 1983-2001" (Research Material No. 96)

Chapter 11
R&D in the Business Sector

11.1 Comparison of the business sectors in major countries

The business sector is the largest sector in terms of both R&D expenditure and the number of researchers in many major countries, as already shown in Figures 6-1-7 and 6-1-11, Chapter 6. By analyzing these indicators, this section clarifies the state of R&D activities in the business sector.

11.1.1 International comparison of R&D expenditure

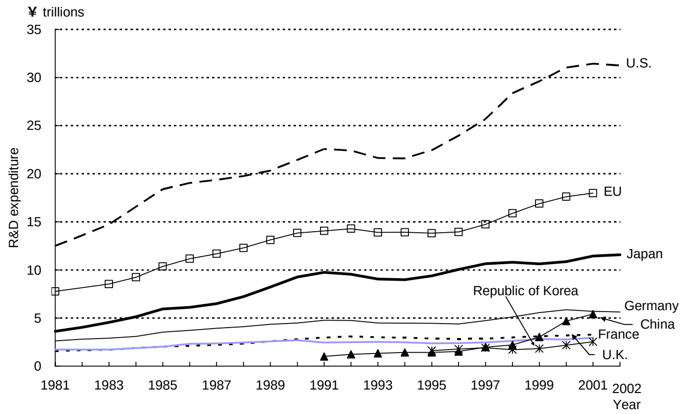
(1) Comparison of R&D expenditure in the business sector

It is showed the trends in R&D expenditure in the business sectors of the five major countries (Japan, the U.S., Germany, France, and the U.K.), China, Republic of Korea, and the EU in Figure 11-1-1 (A). National currency-based R&D expenditure in these countries except Japan has been converted to Japanese yen using purchasing power parities. R&D expenditure in the five major countries increased in the 1980s, slowed down for a few years since 1992 or 1993, and picked up again later. The U.S. showed the most remarkable growth among the selected countries in the latter half of the 1990s, followed by a leveling-off since 2000. In China, where R&D has become very active recently, R&D expenditure in the business sector has also increased sharply. Its approximate year-on-year increase in yuan was 36% in 1999, 60% in 2000, and 17% in 2001.

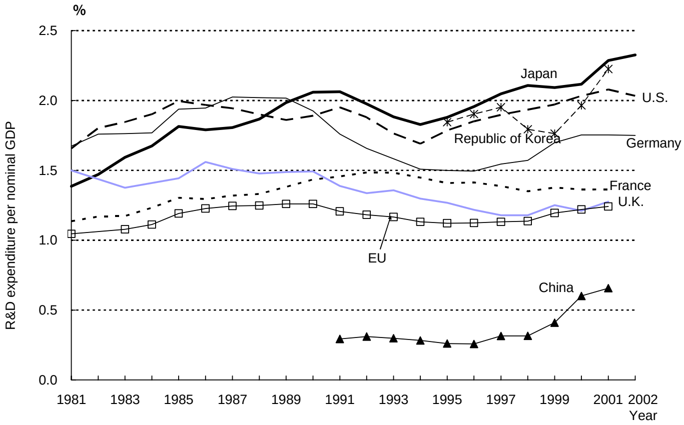
To measure the level of R&D investment in the business sector, we compare R&D expenditure, an input element of R&D activities, and the nominal GDP, an indicator of the economy. Trends in R&D expenditure as a percentage of the nominal GDP in the business sector show that gaps among the five major countries are smaller than those in R&D expenditure. At country level, R&D expenditure per nominal GDP has been largest in Japan since fiscal year 1990 (Figure 11-1-1 (B)). In 2001, the U.S. came after Japan, followed by Germany, France, and the U.K. In Japan, the U.S., and Germany, R&D expenditure per nominal GDP declined in the early to mid-1990s and increased afterwards. In France, the percentage figure peaked in 1992, followed by a gradual decline and, for the last few years, a leveling-off.

Figure 11-1-1: R&D expenditure in the business sector for major countries

(A) Trends in R&D expenditure (All industries)



(B) Trends in R&D expenditure per nominal GDP (All industries)



Notes: GDP data are the same as those in Reference Statistics C.
The purchasing power parities used for Plot (A) are the same as those for Reference Statistics E.
R&D expenditure:
<Japan> The data are collected on a fiscal year basis.
The data for fiscal years 1996-2000 include the software industry.
In FY2001, the industry classification for the Survey of Research and Development was revised, adding some industries and changing the coverage categories. In FY2002, the Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised.
<U.S.> Capital expenditure is excluded.
<Germany> The data until 1990 refer to West Germany.
<France> There was a change in the coverage categories between 1991 and 1992. The estimation method was changed in 1997.
<U.K.> There was a change in the coverage categories between 1985 and 1986 and in 2000. The research institute categories were reorganized between 1991 and 1992.
<China> The data do not include social sciences and humanities.
The data until 1999 refer to large companies and small to mid-sized companies. The data since 2000 refer to all industries and companies beyond a specific size.
<Republic of Korea>The data do not include social sciences and humanities.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
<U.S., Germany, France, U.K., EU, China, and Republic of Korea> OECD, "Main Science and Technology Indicators Vol. 2003 release 01"
See: Table 11-1-1

In the U.K., R&D expenditure per nominal GDP declined after a peak in 1986 and has recovered since 1999.

A side-by-side comparison of the R&D expenditure data and the nominal GDP data (Reference Statistics C) indicates that the size of the R&D expenditure in the EU business sector is smaller than that of the U.S. business sector, despite the similarity in the size of the nominal GDP between the two. Fluctuations in R&D expenditure are considered to be related to the state of business activity, or the economy in other words. Assuming that the nominal GDP is an indicator of the economy, the U.S. saw a slowdown in the economy in 1995 preceded by a decline in R&D expenditure in 1992-1995. There was a time lag between the two phenomena in the U.S. In Japan, increases and decreases in the nominal GDP and R&D expenditure have been almost concurrent, although the degree of fluctuation has been greater in R&D expenditure probably because of the larger impact of the economy on the nation's R&D.

(2) The breakdown of R&D expenditure in the business sector

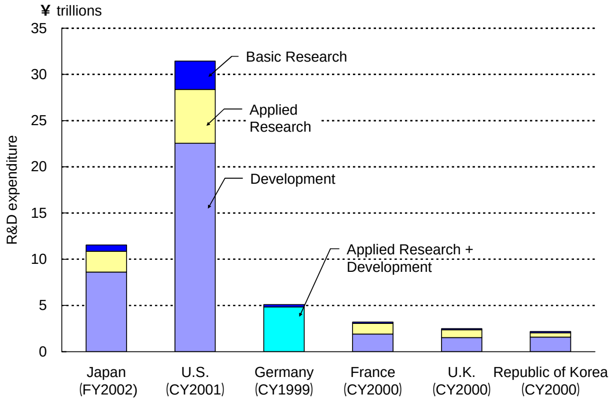
(i) Comparison of R&D expenditure by character of the work

Below, we examine R&D expenditure in the business sector by character of the work performed (basic research, applied research, and development) in major countries. The latest available data are used for comparison (Figure 11-1-2 (A)). In Japan, in FY2002, expenditure on basic research totaled ¥0.7 trillion, that on applied research ¥2.3 trillion, and that on development ¥8.6 trillion. In the U.S., in 2001, expenditure on basic research amounted to ¥3.1 trillion, that on applied research ¥5.8 trillion, and that on development ¥22.6 trillion. Germany does not distinguish applied research expenditure from development expenditure.

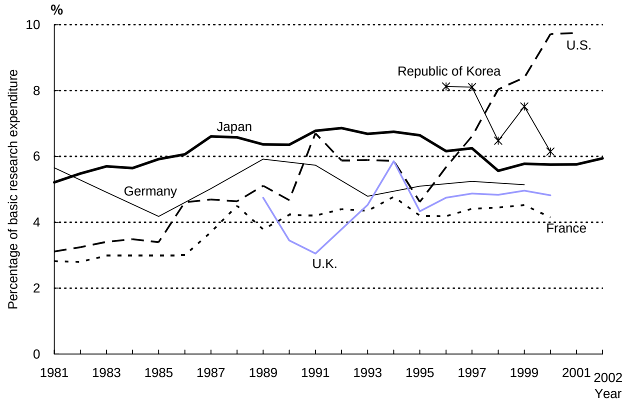
Figure 11-1-2 (B) shows the trends in basic research expenditure as a percentage of total R&D expenditure since 1981. In Japan, the percentage of basic research expenditure increased modestly from 5.2% in FY1981 to 6.9% in FY1992. It declined since FY1993 to reach 5.9% by FY2002. In the U.S., the percentage of basic research expenditure rose from 3.1% in 1981 to 6.7% in 1991, followed by a decline between 1992 and 1995 and a surge since 1996. It accounted for 9.8% of total R&D expenditure in the business sector in 2001. In Germany, France, and the U.K., the percentage of basic research expenditure has remained stable since 1995.

Figure 11-1-2: R&D expenditure in the business sector by character of the work for major countries (all industries)

(A) Comparison of R&D expenditure by character of work in the latest available year



(B) Comparison of basic research expenditure as a percentage of total R&D expenditure



Notes: The purchasing power parities used for plot A are the same as those for Reference Statistics E.
<Japan, France, and Republic of Korea> The data refer to total expenditure on R&D (ordinary expenditure on R&D + capital expenditure on R&D).
<U.S., Germany, and U.K.> The data refer to ordinary expenditure on R&D.
<Japan> The data are collected on a fiscal year basis.
The data for fiscal years 1996-2000 include the software industry. In FY2001, the industry classification for the Survey of Research and Development was revised, adding some industries and changing the coverage categories. In FY2002, the Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised. Until FY2000, all kinds of R&D expenditure in the business sector was categorized as ‘expenditure on R&D in natural sciences.’ Since FY2001, ‘expenditure on R&D in natural sciences’ has become part of R&D expenditure in the business sector.
<Germany> The data until 1990 refer to West Germany.
<France> There was a change in the coverage categories in 1991. The survey method was changed in 1998.
<U.K.> There was a change in the coverage categories between 1985 and 1986.
<Republic of Korea> The data do not include social sciences and humanities.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”
<U.S., Germany, France, U.K., and Republic of Korea> OECD, “Main Science and Technology Statistics Vol. 2002 release 01”
See: Table 11-1-2

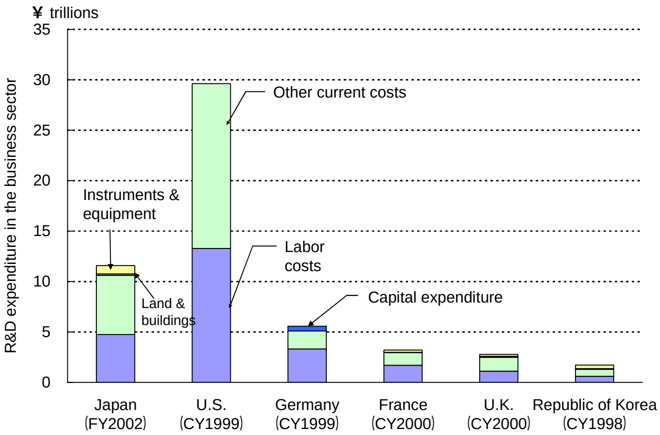
(ii) Trends in R&D expenditure by type of cost

Below, we examine the R&D expenditure in the business sectors in selected countries by type of cost (costs of personnel, land and buildings, etc.). The classification of costs corresponds to the one defined by the OECD. For the comparison in Figure 11-1-3 (A), the latest available data are used. In Japan, in FY2002, labor costs totaled ¥4.7 trillion, other current costs, which consist of non-personnel costs such as materials costs, were worth ¥5.9 trillion, the cost of land and buildings ¥0.2 trillion, and the cost of instruments and equipment ¥0.8 trillion. In the U.S., in 1999, labor costs totaled ¥13.3 trillion and other current costs ¥16.4 trillion. The U.S. R&D expenditure refers only to current expenditure, and Germany does not provide details of its capital expenditure on R&D, which is the sum of the cost of land and buildings and the cost of instruments and equipment.

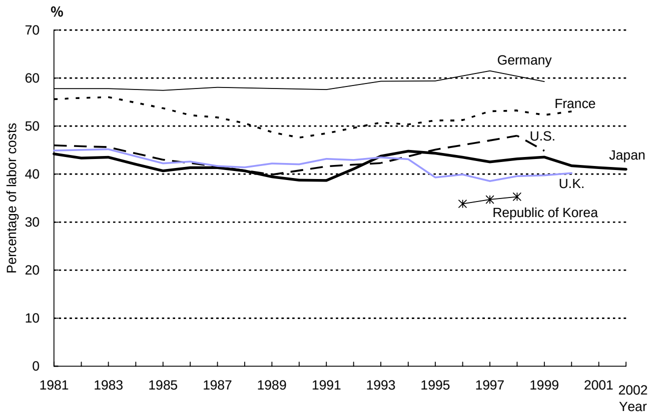
Next, we analyze the trends in labor costs as a percentage of total R&D expenditure since 1981 (Figure 11-1-3 (B)). The percentage of labor costs is highest in Germany, where it increased steadily from 57.8% in 1981 to 61.5% in 1997, followed by a fall to 59.3% in 1999. In the U.S., the percentage of labor costs declined from 46.0% in 1981 to 39.9% in 1989 but recovered to 48.0% by 1998. In 1999, the latest available year, it stood at 44.8%. In Japan, the share of labor costs declined from 44.2% in FY1981 to 38.7% in FY1991. After a temporary increase to 44.8% in FY1994, it continued to fall to 43.5% in fiscal 1999 and 41.0% in fiscal 2002.

Figure 11-1-3: R&D expenditure in the business sector by type of cost for selected countries (all industries)

(A) Comparison of R&D expenditure by type of cost in the latest available year



(B) Trends in labor costs as a percentage of total R&D expenditure

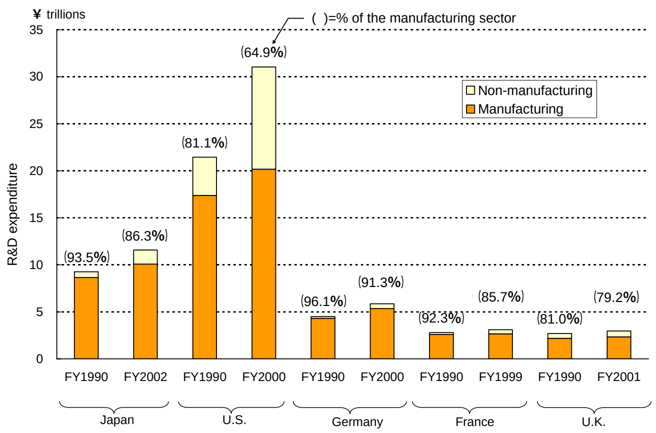


Notes: The purchasing power parities used for Plot A are the same as those for Reference Statistics E. The total amounts for the countries other than Japan are the sum of all types of cost.
<Japan> The data are collected on a fiscal year basis.
The data for fiscal years 1996-2000 include the software industry. In FY2001, the industry classification for the Survey of Research and Development was revised, adding some industries and changing the coverage categories. In FY2002, the Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised.
<U.S.> Total R&D expenditure excludes all or almost all capital expenditure
Since 1990, the industry classification system has changed from the SIC to the NAICS. R&D expenditure in the field of agriculture is not included.
<Germany> The data until 1990 refer to West Germany.
<France> There was a change in the coverage categories in 1992 and 1997.
<U.K.> There was a change in the coverage categories between 1985 and 1986.
<Republic of Korea> The data do not include social sciences and humanities.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
<U.S., Germany, France, U.K., and Republic of Korea> OECD, "Main Science and Technology Statistics Vol. 2002 release 01"
See: Table 11-1-3

(3) Comparison of R&D expenditure in the manufacturing sector in major countries

This section discusses R&D expenditure in the manufacturing sector in major countries. Figure 11-1-4 compares the manufacturing sector's share of total R&D expenditure across all industries in the latest available year and that of 1990. Between these years, the share of the manufacturing sector declined in all the selected countries. Growth in the non-manufacturing sector in Japan is primarily attributable to the addition of the service industry to the survey coverage due to a revision of the statistical survey method in FY2002. In the U.S., the service industry grew markedly between 1990 and 2000. In terms of the rate of growth between these years, the U.S. service industry posted a 229.7% growth, compared with 81.8% in all industries and 45.7% in the manufacturing industry.

Figure 11-1-4: Comparison of R&D expenditure in all industries and the manufacturing sector for major countries



Notes: The purchasing power parities used are the same as those for Reference Statistics E.
The industry classification for Japan is the one that the Ministry of Public Management, Home Affairs, Posts and Telecommunications defined in its 'Report on the Survey of Research and Development' by revising the Japan Standard Industry Classification.
The industry classification for the U.S., Germany, France, and the U.K. (1990) is based on the ISIC Rev. 3.
The industry classification for the U.K. (2001) is based on the SIC of the country.
The Japan Standard Industry Classification does not correspond with the ISIC Rev. 3.
<Japan> In FY2002, the Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised.
<Germany> The data for 1990 refer to West Germany and data for 2000 the Federal Republic of Germany.
<France> There was a change in the coverage categories in 1992.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
<U.S., Germany, France, U.K. (2000), and Republic of Korea> OECD, "STAN database for industrial analysis"; ANBERD, "Research and Development Expenditure in Industry (ISIC Rev. 3) Vol. 2002 release 01"
<U.K. (2001)> Office for National Statistics, "Expenditure on R&D performed in UK businesses: 1980-2001"
See: Table 11-1-4

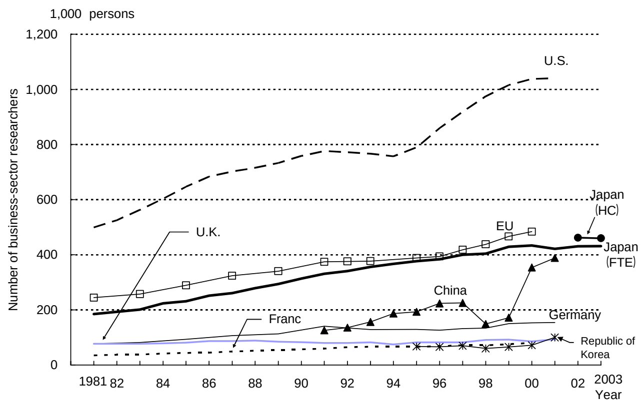
Next, we examine R&D expenditure in major manufacturing industries (Table 11-1-4 at the end of the report). The classification of industry is the one defined by the OECD. R&D expenditure is largest in the U.S. in the majority of industries. In the machinery and equipment, n.e.c. industry, Japan rivals the U.S. Japan posts the largest R&D expenditure in the electrical machinery and apparatus, n.e.c. industry. In the motor vehicles, trailers and semi-trailers industry, R&D expenditure of Germany surpassed that of Japan in 1999.

11.1.2 International comparison of the number of researchers

In this section, we first analyze the number of researchers in the business sector in the five major countries, China, Republic of Korea, and the EU. As Figure 11-1-5 shows, the number of researchers in all industries in Japan increased steadily until 2000, followed by a slight decline in 2001, a recovery in 2002, and a leveling-off in 2003. The population of researchers in Japan roughly equals to that of the total EU researchers. In the U.S., the number of researchers increased considerably by 248,100 persons between 1995 and 2000. According to our detailed examination of the U.S. data listed in 'Research and Development in Industry' published by the NSF, the rates of increase are similar between the manufacturing and non-manufacturing sectors. This implies that there has been no one-sided concentration of researchers on either the manufacturing or non-manufacturing sector in the U.S. The major contributors to the growth in the U.S. manufacturing sector are the electrical equipment and transportation equipment industries. The primary contributor to the growth in the non-manufacturing sector is the service industry. Meanwhile, China changed its statistical survey methodology in 2000.

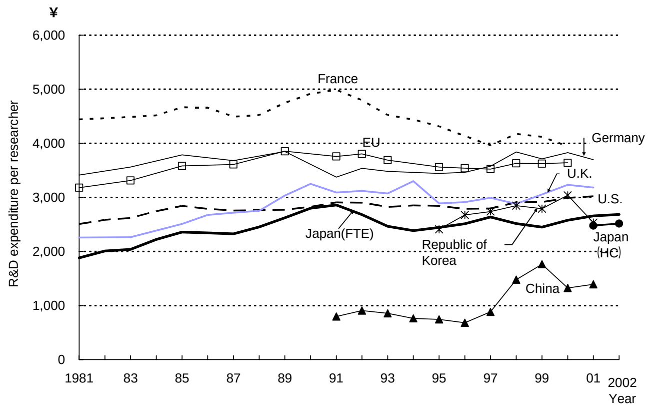
Next, we examine R&D expenditure per researcher in the business sector (Figure 11-1-6). Among the selected countries (five major countries, China, Republic of Korea, and the EU), France indicates the largest business R&D expenditure per researcher, although the amount has declined since the 1991 peak. Japan ranks last among the five. In both Japan and the U.S., while R&D expenditure and the number of researchers in the business sector have increased steadily, R&D expenditure per researcher remained flat until recent years, when a slight increase has been seen. In France and Germany, where R&D expenditure in the business sector is not as large as Japan and the U.S., R&D expenditure per researcher is relatively high among the selected countries.

Figure 11-1-5: Trends in the number of researchers in the business sector for selected countries (All industries)



Notes: <Japan> The data for 1997-2001 include the software industry. In 2002, the industry classification for the Survey of Research and Development was revised, adding the definition of 'researcher' and of some industries, and changing the coverage categories. In 2003, the Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised. The data until 2001 are as of April 1 of that year and data since 2002 are as of March 31.
<U.S., Germany, France, U.K., EU, Republic of Korea, and China> The data are expressed in full-time equivalents.
<U.S.> The data until 2000 are annual averages and data since 2001 are as of January of that year. Until 2000, the numbers of researchers are estimates based on the number of scientists and engineers. In 1985, the estimation method of the number of researchers was changed.
<Germany> The data until 1990 refer to West Germany.
<France> There was a change in the coverage categories between 1991 and 1992. The survey method regarding research personnel in the administrative departments was changed in 1997.
<U.K.> There was a change in the coverage categories between 1985 and 1986 and in 2000. The research institute categories were reorganized between 1991 and 1992.
<China> The data do not include social sciences and humanities.
The data until 1999 refer to large companies and small to mid-sized companies. The data since 2000 refer to all industries and companies beyond a specific size.
<Republic of Korea> The data do not include social sciences and humanities.
Sources: <Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
<U.S.> Until 2000: OECD, "Main Science and Technology Indicators Vol. 2003 release 01"
2001: NSF, "Research & Development in Industry: 2000"
<Germany, France, U.K., EU, China, and Republic of Korea> OECD, "Main Science and Technology Indicators Vol. 2003 release 01"
See: Table 11-1-5

Figure 11-1-6: Trends in R&D expenditure per researcher (All industries)



Notes: R&D expenditure: Same as Table 11-1-1
Number of researchers: Same as Table 11-1-5
Formula: (R&D expenditure) / (number of researchers)
For Japan, data in 2001 are based on R&D expenditure in FY2001 and the number of researchers in 2002, and data in 2002 on R&D expenditure in FY2002 and the number of researchers in 2003.
Sources: R&D expenditure:
<Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
<U.S., Germany, France, U.K., EU, China, and Republic of Korea> OECD, "Main Science and Technology Indicators Vol. 2003 release 01"
Number of researchers:
<Japan> Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
<U.S.> Until 2000: OECD, "Main Science and Technology Indicators Vol. 2003 release 01"
2001: NSF, "Research & Development in Industry: 2000"
<Germany, France, U.K., EU, China, and Republic of Korea> OECD, "Main Science and Technology Indicators Vol. 2003 release 01"
See: Table 11-1-6

11.2 Business R&D activities in Japan

11.2.1 Comparison of R&D expenditure

(1) Trends in R&D expenditure in major industries

Based on the ‘Report on the Survey of Research and Development’ published by the Ministry of Public Management, Home Affairs, Posts and Telecommunications, the number of business enterprises performing R&D in Japan and R&D expenditure of major industries are examined (Figure 11-2-1). It should be noted that, in the above ministerial survey, the software industry was additionally covered regarding R&D expenditure between FY1996 and FY2000, as well as the numbers of researchers and business enterprises between 1997 and 2001. In addition, a major revision was made to the survey method in 2002. Furthermore, the Japan Standard Industry Classification was revised in January 1984, October 1993, and March 2002, which resulted in the revision of the industry classification used for the Survey of Research and Development by the Ministry of Public Management, Home Affairs, Posts and Telecommunications (see the appendix at the end of the report).

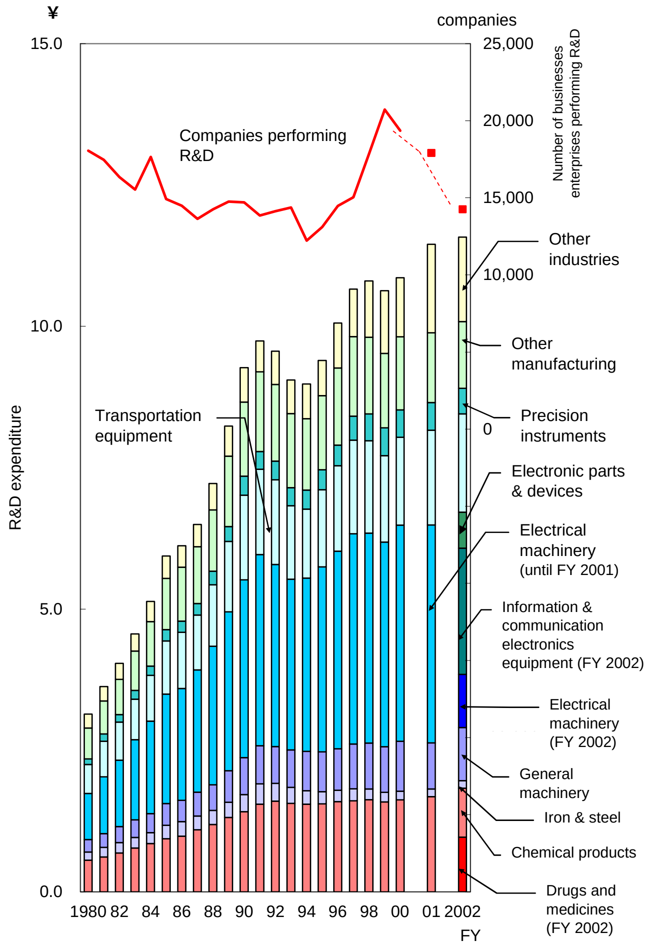
The number of business enterprises performing R&D in Japan declined slowly until FY1991, while R&D expenditure in the business sector increased steadily. Both indicators declined between FY1992 and FY1994 and increased for the succeeding few years, between FY1995 and FY1997. Between FY1998 and FY1999, the number of business enterprises increased, while R&D expenditure in the business sector remained stable. Between FY2000 and FY2002, the number of business enterprises declined, although R&D expenditure increased. R&D expenditure in Japan’s business sector totaled ¥11,576.8 billion in FY2002. By industry, the transportation equipment industry and the electrical instruments industry contributed to the 1992-1994 decline and the 1995-1997 increase in total R&D expenditure, respectively.

The growth rate of R&D expenditure serves as an indicator of the intensity of R&D activities in each industry. Based on real R&D expenditure listed in Table 11-2-1 (B), we compare R&D expenditure in FY2000 and FY2001 with that of 20 years ago, FY1980. The growth rate of R&D expenditure in the manufacturing industry was 178.0% between FY1980 and FY2000 and 183.4% between FY1980 and FY2001. The highest growth rate was recorded by the communication and electronic equipment industry with 321.2% in FY2000 and 333.4% in FY2001, followed by the precision instruments industry with 301.9% in FY2000 and 309.9% in FY2001 and the rugs and medicines industry with 222.3% in FY2000 and 254.6% in FY2001. Although data in FY2002 are not easily comparable with those in the previous years because of the revision of the Japan Standard Industry Classification, industries with the highest growth rates of R&D expenditure between FY1980 and FY2002 are drugs and medicines (318.8%), precision instruments (275.4%), and general machinery (253.3%).

To assess the growth of business R&D expenditure over a shorter period, we compare the above data with those of 10 years ago, FY1990. In the manufacturing industry, the growth rate of R&D expenditure was 11.7% in FY2000 and 13.8% in FY2001. The industries demonstrating the highest growth rates are, in descending order: drugs and medicines (42.5% in FY2000; 56.7% in FY2001), precision instruments (42.8% in FY2000; 45.7% in FY2001), and communication and electronic equipment (26.2% in FY2000; 29.8% in FY2001). As for FY2002, the drugs and medicines (85.1%) and general machinery (42.9%) industries topped the list.

The above analysis indicates that business R&D activities in Japan have strengthened for the past 20 years particularly in the drugs and medicines, communication and electronic equipment, precision instruments, and general machinery industries.

Figure 11-2-1: Trends in R&D expenditure by industry and the number of business enterprises performing R&D in all industries in Japan



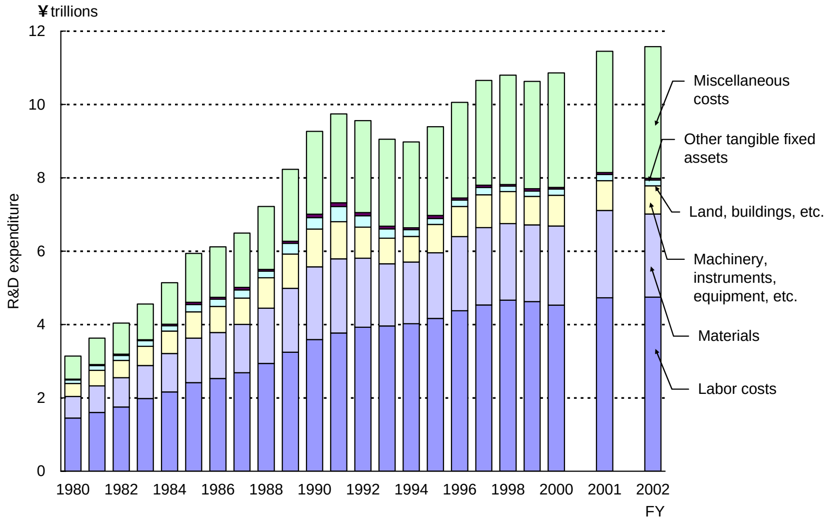
Notes: R&D expenditure:
'Other industries' between FY1996 and FY2000 include the software industry. In FY2001, the industry classification for the Survey of Research and Development was revised, adding some industries and changing the coverage categories. In FY2002, the Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised.
The number of business enterprises performing R&D:
The survey covers the industries selected from the Japan Standard Industry Classification specifically for the 'Report on the Survey of Research and Development.'
The Japan Standard Industry Classification was revised in January 1984, October 1993, and March 2002. The business enterprises covered have been extracted from the results of the 'Establishment and Enterprise Census' conducted by the Ministry of Public Management, Home Affairs, Posts and Telecommunications.
The data until FY2000 are as of April 1 of that year. Business enterprises and special corporations capitalized at ¥10 million or more are covered.
The data between FY1996 and FY2000 include the software industry. The data since FY2001 are as independent administrative corporations capitalized at ¥10 million or higher are covered.
In FY2001, the industry classification for the Survey of Research and Development was revised, adding some industries and changing the coverage categories. In FY2002, the industry classification for the Survey of Research and Development was revised.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development" See: Table 11-2-1

(2) The breakdown of R&D expenditure in the business sector

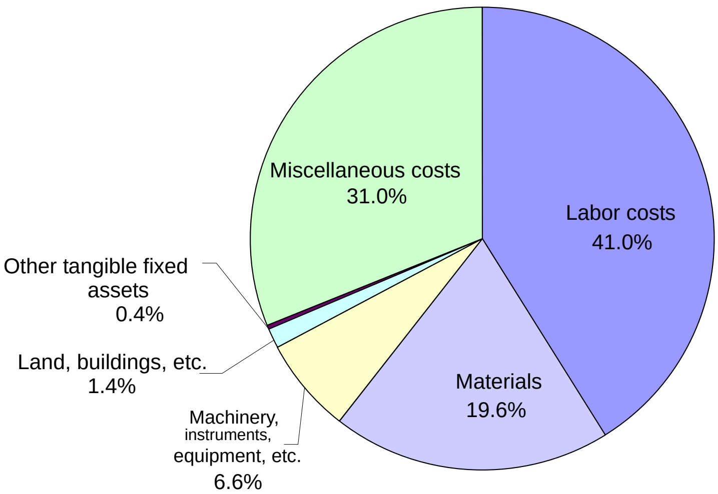
Below, we examine R&D expenditure in the business sector by type of cost (Figure 11-2-2 (A)). Labor costs, which constitute the largest proportion of R&D expenditure, increased until FY1998, declined slightly since FY1999, resuming growth in FY2001 and FY2002. While the overall R&D expenditure fluctuates in response to changes in the economy, labor costs remain stable. Over time, the percentage of labor costs in total R&D expenditure has stayed in the low forties except for the period between FY1989 and 1991, when it remained below 40% due to an increase in other types of cost. A category that has increased steadily is miscellaneous costs, whose content is unknown but probably includes the cost of acquiring and processing various information or data. Of total R&D expenditure in Japan's business sector in FY2002, 41.0% was spent on labor costs, 19.6% on materials, 6.6% on machinery, instruments, equipment, etc., 1.4% on land, buildings, etc., 0.4% on other tangible fixed assets, and 31.0% on miscellaneous costs (Figure 11-2-2 (B)).

Figure 11-2-2: R&D expenditure in Japan's business sector by type of cost (all industries)

(A) Trends in R&D expenditure by type of cost



(B) Breakdown of R&D expenditure by type of cost for FY2002

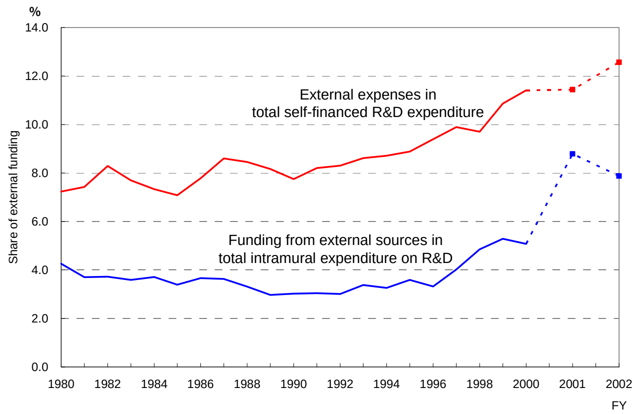


Notes: <About Plot A> The data between FY1996 and FY2000 include the software industry. In FY2001, the industry classification for the Survey of Research and Development was revised, adding some industries and changing the coverage categories. In FY2002, the Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised. 'Miscellaneous costs' since 2001 are the sum of the 'lease payments' and 'miscellaneous costs' listed in the Report on the Survey of Research and Development.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 11-2-2

(3) Collaboration in science and technology as illustrated by business expenditure on R&D

This section assesses collaboration among industry, government and academia considering industry, based on the external flow of R&D expenditure in the business sector. First, let us examine trends in R&D funds received by the business sector from external sources and R&D expenditure provided by the business sector for external entities (Figure 11-2-3). The share of external funding of total intramural expenditure on R&D in the business sector declined from 4.3% in FY1980 to 3.0% in FY1992, but gradually increased to 5.1% by FY2000 and 7.9% by FY2002 (note that the survey method was revised in FY2002). The share of expenses on external R&D in total self-financed R&D expenditure in the business sector fluctuated during the 1980s before increasing generally in the 1990s to reach 12.6% by FY2002.

Figure 11-2-3: Trends in the share of external funding in the business sector (All industries)



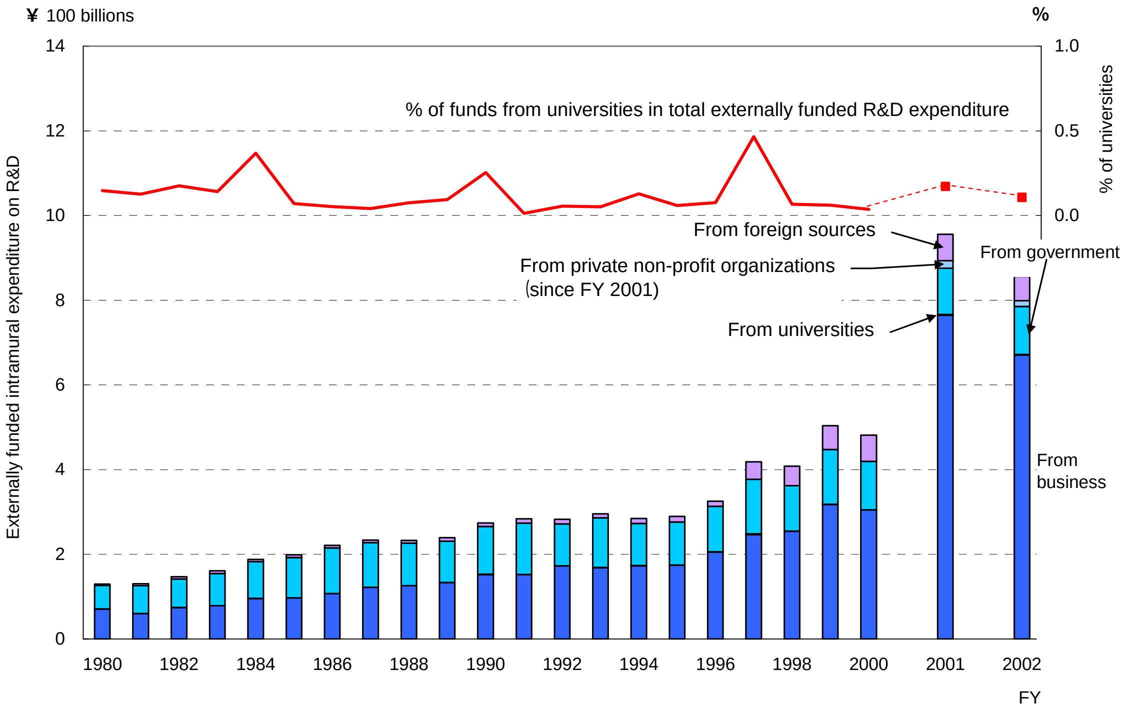
Notes: The data between FY1996 and FY2000 include the software industry.
In FY2001, the industry classification for the Survey of Research and Development was revised, adding some industries and changing the coverage categories. In FY2002, the Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 11-2-3

In line with the classification for the Survey of Research and Development, external funds (funds provided by external organizations in the business, university, government, or private non-profit (applicable since FY2001) sectors) in total intramural R&D expenditure in business enterprises are defined as externally funded R&D expenditure. The business sector mentioned here refers to: (i) business enterprises, (ii) government financial corporations, public corporations, and special companies, (iii) private research institutes, (iv) other private institutions (those operating on a self-sustaining basis among corporations established by municipal governments for welfare services, housing projects, etc. and intermediate corporations such as research associations and consumers' unions, (applicable until FY2000)), and (v) Other national and local public corporations (those for public services such as water and sewage, transportation, electricity, gas, and hospitals (except for hospital research institutes) (applicable since FY2001)). Universities refer to university faculties, junior colleges, technical colleges, university research institutes, inter-university research institutes, and the National Institution for Academic Degrees and University Evaluation, the Center for National University Finance.

On the other hand, external funding from business enterprises is defined as the sum of: (i) some intramural R&D expenditure in the private sector (or business sector since FY2001) that has been received from business enterprises, (ii) some intramural R&D expenditure in universities that has been received from business enterprises, (iii) some intramural R&D expenditure in national and public research institutes and special corporations that do not operate on a self-sustaining basis received from business enterprises, (v) some intramural R&D expenditure in private non-profit organizations received from business enterprises (applicable since FY2001). The private sector mentioned above refers to business enterprises and private research institutes.

Figure 11-2-4 shows intramural expenditure on R&D received by business enterprises from external sources. The share of R&D funds received from the business sector has increased from the lowest figure, 48.5%, in FY1986, to 78.4% in FY2002 after fluctuations. A sudden increase in the value of R&D funds provided by the business sector in FY2001 is attributable to the addition of the new survey category, 'academic research institutes' (¥405.8 billion), to the sector in FY2001. From the perspective of the international flow of funding, the share of foreign funds in externally funded R&D expenditure in the business sector was 3% to 4% in the first half of the FY1990s and increased since FY1997, from 9.8% in FY1997 to 12.9% in FY2000. Since FY2001, the share of foreign funds, although having increased in value terms, declined because total externally funded expenditure on R&D grew at a faster pace than that of foreign funds. As a result, the share dropped to 6.7% by FY2002. R&D expenditure funded by universities is meager, accounting for less than 0.5% of the total externally funded R&D expenditure in business enterprises.

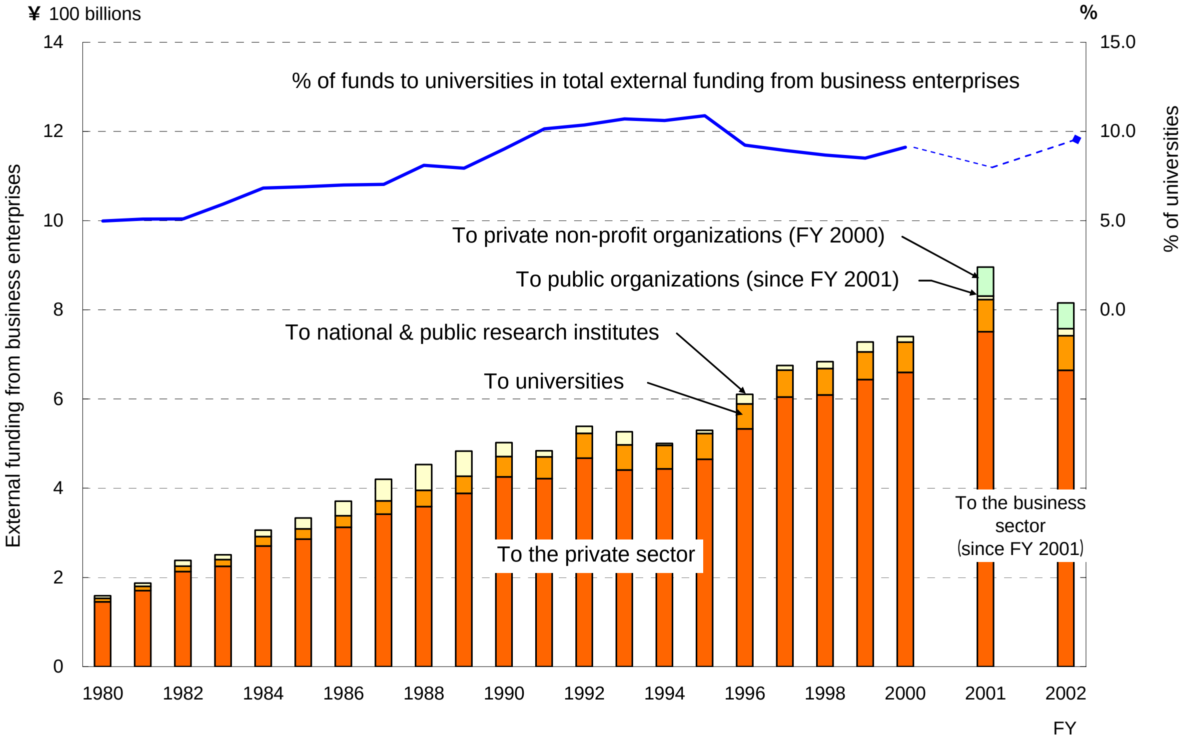
Figure 11-2-4: Trends in externally funded intramural expenditure on R&D in business enterprises



Notes: The data until FY2000:
<Business> Public corporations, special companies, business enterprises, private research institutes, etc.
<Government> National and local public corporations, national and public research institutes, special corporations which are categorized as research institutes or agencies, etc.
The data between FY1996 and FY2000 include the software industry.
The data since FY2001:
<Business> Government financial corporations, public corporations, business enterprises, etc.
<Government> National and local public corporations, national and public research institutes, special and independent administrative corporations which are categorized as research institutes, etc.
In FY2001, the industry classification for the Survey of Research and Development was revised, adding some industries and changing the coverage categories. In FY2002, the Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”
See: Table 11-2-4

Figure 11-2-5 illustrates the external flow of funds from business enterprises. The majority of external funding from business enterprises is directed toward the private sector (business sector since FY2001). The flow of funds from business enterprises to universities has increased steadily in value terms. The share of funds to universities in total external funding from business enterprises increased gradually from 5.0% in FY1980 to 10.9% in FY1995. It declined from FY1996, dropping to 9.6% by FY2002. External funding from business enterprises to national and public research institutes increased since FY1980, reaching ¥58.3 billion by FY1988, accounting for 12.9% of the total external funding. However, it declined for the remainder of the selected period with minor fluctuations, falling to ¥12.7 billion by FY2000, constituting 1.7% of the total. In FY2002, external funding from business enterprises to public organization totaled ¥15.9 billion (2.0%) and that to private non-profit organizations totaled ¥57.2 billion (7.0%).

Figure 11-2-5: Trends in external funding from business enterprises



Notes: The data until FY2000:
<Private sector> The data refer to business enterprises, and special corporations (private affiliated) and private research institutes which are operating on a self-sustaining basis
<National & public research institutes> The data refer to national and public research institutes, and special corporations (national and local public corporations) which are not operating on a self-sustaining basis. The data between FY1996 and FY2000 include the software industry.
The data since FY2001:
<Business sector> The data refer to business enterprises, and special corporations (private affiliated) and independent administrative corporations which are operating on a self-sustaining basis
In FY2001, the industry classification for the Survey of Research and Development was revised, adding some industries and changing the coverage categories. In FY2002, the Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”
See: Table 11-2-5

Figures 11-2-3 to 11-2-5 suggest that business enterprise collaboration with external organizations is growing at least considering R&D expenditure flow. The generally upward trend over time in the value of the external flows of funds and their share of total R&D expenditure implies that outsourcing R&D activities in the business sector has been growing, albeit slowly. One exception is FY2002, when the flow of funding between business enterprises lessened. Most of the external flows of funding take place between different organizations within the business sector. In terms of industry-academia collaboration, the flow of funds from business enterprises to universities has remained flat as a percentage (Figure 11-2-5), whereas it has increased slightly in value (Table 11-2-5 at the end of the report). It should be noted that the data on external funding reported in this sector do not include certain forms of industry-academia collaboration, such as scholarship funds offered by businesses to universities, because the data refer only to the expenditure provided or received for outsourced research or research performed under commission (both including joint research).

Section 3 of Chapter 10 describes industry-academia collaboration from the perspective of universities, presenting an analysis from a perspective different from the one for this chapter. For example, trends in the number of joint research projects between national universities and business enterprises (Figure 10-3-3) demonstrate the increase in such projects and the number of enterprises involved, suggesting intensifying industry-academia collaboration. As Chapter 10 points out, the development of new indicators is key in the more accurate assessment of industry-academia collaboration.

11.2.2 Comparison of the number of researchers in the business sector

This section discusses the number of researchers in the business sector. The reference used in this section, ‘Report on the Survey of Research and Development’ published by the Ministry of Public Management, Home Affairs, Posts and Telecommunications, defines researchers as persons who meet the following criteria.

Criteria until 2001

(i) Those who hold a university degree or it’s equivalent.

(ii) Those who have two or more years of research experience.

(iii) Those who perform research activities of their own specific area of study.

Criteria since 2002

From the above criteria, (ii) is excluded.

In addition, researchers are divided into two categories in the statistics until 2001: regular researchers, whose are mainly engaged on R&D activities within the organization, and external non-regular researchers, whose have regular work outside of the organization. Since 2002, only the total number of researchers has been surveyed without distinguishing regular from external non-regular researchers.

In this section, researchers refer to regular researchers in the data until 2001 and general researchers in data since 2002, unless otherwise noted.

Figure 11-2-6 shows the trends in the number of researchers in Japan’s business sector. The total of researchers across all industries continued to increase until 2000, and it suddenly declined in 2001, down 12,395 persons from the previous year. Declines in the precision instruments industry (down by 3,075 persons) and the software industry (down by 7,972 persons) contributed to this. The data in 2001 and data in the subsequent years are not directly comparable because of a break in the data series between 2001 and 2002. The break is due to the revision of the definition of researchers as described above and the addition and revision of industries to be covered, resulting in the transfer of certain organizations and institutions to different categories in 2002. Even so, data show that the total number of researchers has increased for the last three years (from 421,363 researchers in 2001 to 430,688 in 2002 and 431,190 in 2003).

The number of researchers in the manufacturing industry increased until 2000 and declined in 2001. It also declined in 2002 despite the broader definition of researchers and the wider survey coverage. While the number of researchers increased in 2003 from the previous year, overall trends in recent years have remained flat. This reflects the recent doldrums in the manufacturing sector in Japan. Between 1997 and 1998, the number of researchers declined in almost all industries before increasing in the following year. These fluctuations suggest that, during this period, personnel reduction in response to the negative business climate affected even researchers, although new research personnel were soon added.

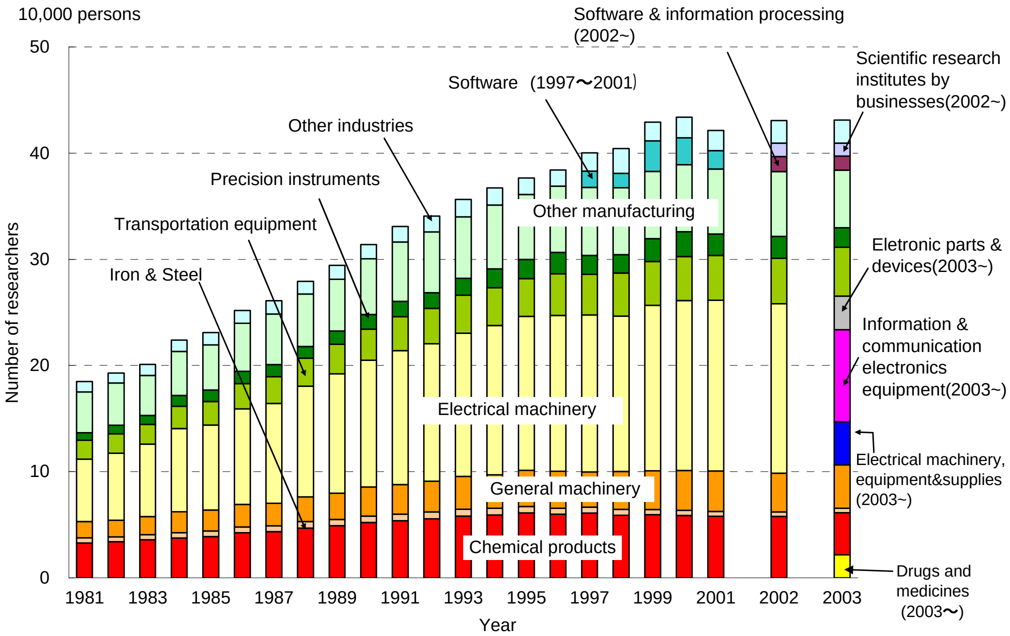
The number of researchers by industry in 2003 shows that the largest number of researchers are held by the information & communication electronics equipment industry (86,862 researchers, 20.1% of the total across all industries), followed by transportation equipment (45,747 researchers, 10.6%), general machinery (40,792 researchers, 9.5%), and electrical machinery, equipment & supplies (40,629 researchers, 9.4%).

As an indicator of the trend in the scale of research activity by industry, the growth rates of the number of researchers are examined below. More specifically, the numbers of researchers in 2001, 2002, and 2003 are compared respectively with those of 20 years ago, 1981. The manufacturing industry posted a growth rate of 119.9% in 2001, 118.5% in 2002, and 119.3% in 2003. Among the industries listed in Table 11-2-6 at the end of the report, those indicated particularly high growth rates since 1981 are communication and electronic equipment (206.5% in 2001, 207.7% in 2002), precision instruments (186.5% in 2001, 192.6% in 2002, 161.4% in 2003) and transportation equipment (180.5% in 2001, 184.4% in 2002, 215.0% in 2003).

To assess the trends over a shorter period, the data of these three years are compared with those of 10 years ago, 1991. The manufacturing industry posted a growth rate of 21.7% in 2001, 20.9% in 2002, and 21.4% in 2003. The industries that demonstrated high growth rates are transportation equipment (42.3% in 2001, 44.3% in 2002, 59.8% in 2003), precision instruments (40.1% in 2001, 43.1% in 2002, 27.8% in 2003), and communication and electronic equipment (32.2% in 2001, 32.7% in 2002).

The communication and electronic equipment industry and the transportation equipment industry play a key role in R&D in Japan's business sector because the number of researchers and the rate of increase are higher in these industries. With respect to the precision instruments industry, while not a particularly large industrial sector from the viewpoint of either R&D expenditure or the number of researchers, and even in the light of analysis in Section 1.1., it can be considered as one of the fastest growing industries in Japan in the past 20 years.

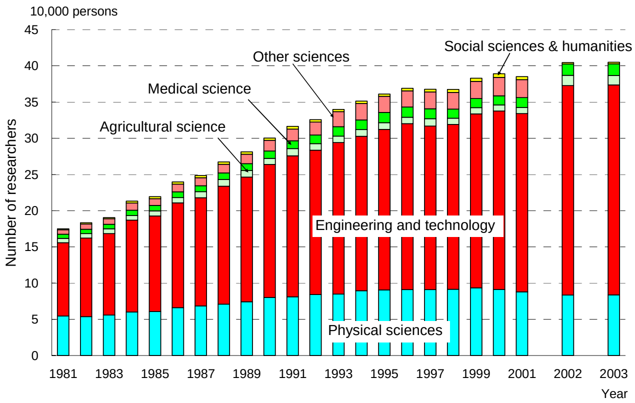
Figure 11-2-6: Trends in the number of researchers in Japan's business sector (All industries)



Notes: The data refer to the total of natural sciences, social sciences, and humanities.
<Until 2001> The data refer to regular researchers among all researchers as of April 1 each year.
<Since 2002> The definition of researchers has been revised.
In 2002, the industry classification for the Survey of Research and Development was revised, adding some industries and changing the coverage categories. In 2003, the Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised.
The data refer to all researchers as of March 31 each year.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 11-2-6

Let us examine the number of researchers in the manufacturing sector in Japanese industry by field of research (Figure 11-2-7). Unlike Figure 11-2-6, which expresses the number of full-time-equivalent researchers, this chart shows it in head counts. The largest number of researchers specialize in engineering and technology, followed by physical sciences. The combined total of researchers in engineering and technology (289,879 persons, accounting for 71.6% of the total in the manufacturing sector) and in physical sciences (83,759 persons, 20.7%) constitutes 92.3% of the total in the manufacturing sector. The number of researchers in engineering and technology declined slightly in 1997 but increased in 1999 and again, this time even more, in 2002. The number of researchers specializing in physical sciences has declined since its peak in 1999. The data in 2002 onwards do not cover the 'other natural sciences' category because of a revision of the survey method.

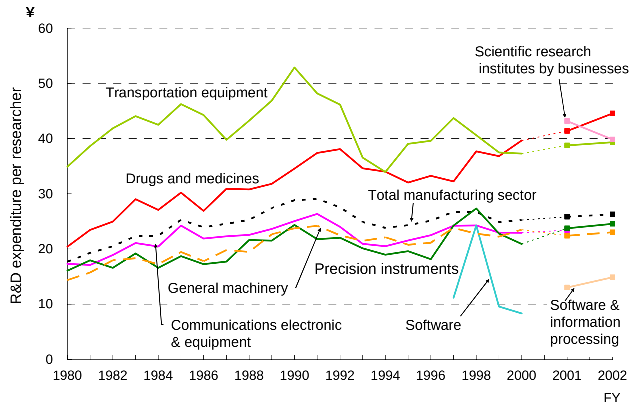
Figure 11-2-7: Trends in the number of researchers in Japan's manufacturing sector



Notes: <Until 2001> The data between 1996 and 2000 include the software industry. The data are as of April 1 each year and refer to regular researchers among all research-related personnel.
<Since 2002> The data are as of March 31 each year and refer to the head count of researchers.
In 2002, the definition of researchers and the industry classification for the Survey of Research and Development were revised, adding some industries and changing the coverage categories. In 2003, the Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development" See: Table 11-2-7

Figure 11-2-8 shows the trends in R&D expenditure per researcher. In the overall manufacturing sector, R&D expenditure per researcher peaked in FY1991, declined until FY1994, and resumed growth in FY1995. It has remained stable since FY1998, standing at ¥26.26 million per full-time-equivalent researcher in FY2002. R&D expenditure per researcher is highest in the transport equipment industry, although fluctuation is large in this industry primarily because of the fluctuation of R&D expenditure rather than the number of researchers. In the drugs and medicines industry, R&D expenditure per researcher peaked in FY1992, declined until the mid-1990s, and has rebounded sharply since FY1998. In the precision instruments industry, a surge in R&D expenditure per researcher is observed in FY1997 and FY1998. This is attributable to a sharp increase in R&D expenditure in parallel with a rapid decline in the number of researchers.

Figure 11-2-8: Trends in R&D expenditure per researcher



Notes: For the number of researchers, the same as in Table 11-2-6; For R&D expenditure, the same as in Table 11-2-1; R&D expenditure per researchers until FY2000 is calculated from the number of researchers in each calendar year and R&D expenditure in each fiscal year, that of FY2001 from the number of researchers in 2002 and R&D expenditure in FY2001, and that of FY2002 from the number of researchers in 2003 and R&D expenditure in FY2002
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 11-2-8

See Section 1, Chapter 4, for an additional analysis of the trends of researchers in the business sector.

11.2.3 Characteristics of R&D activities in Japan's business sector

(1) R&D intensity

R&D intensity is an indicator of the degree of emphasis that business enterprises place on R&D activities. The R&D intensity indicators discussed in this section are R&D expenditure as a percentage of sales (R&D expenditure intensity) and the number of researchers as a percentage of the total workforce (R&D personnel intensity).

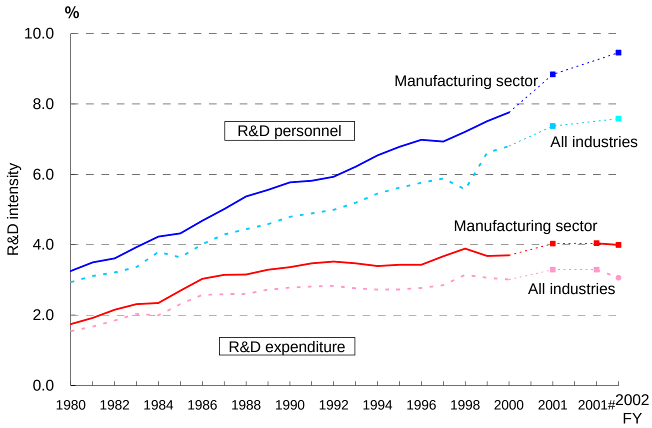
(i) Trends in R&D intensity

Figure 11-2-9 (A) shows the trends in R&D intensity in business enterprises performing R&D as they appear in the 'Report on the Survey of Research and Development' published by the Ministry of Public Management, Home Affairs, Posts and Telecommunications. R&D expenditure intensity in FY2002 is 3.1% on average across all industries and 4.0% in the manufacturing sector. This means that the manufacturing sector has 1.3 times (4.0% divided by 3.1%) as much R&D expenditure intensity as the overall business sector on average. The R&D personnel intensity is 7.6% across all industries and 9.5% in the manufacturing sector. Thus the R&D personnel intensity in the manufacturing sector is 1.2 times higher than that in the entire business sector, producing comparison results similar to those on R&D expenditure intensity.

Now, consider trends in R&D intensity in the manufacturing sector over time. R&D expenditure intensity has increased since FY1980, gradually leveling off between FY1992 and FY1996 but eventually hitting 4.0% in FY2001 and FY2002. On the other hand, R&D personnel intensity demonstrated an almost linear increase throughout the selected period. It grew even in the mid-1990s, when R&D expenditure intensity declined, thereby widening the gap between R&D expenditure intensity and personnel intensity.

Figure 11-2-9: R&D intensity

(A) Trends in R&D intensity in the manufacturing sector and all industries



Notes: R&D expenditure intensity in the manufacturing sector:
<Until FY2000> The data do not include special corporations.
<Since FY2001> The data do not include special and independent administrative corporations. The data for FY2001 with a '#' sign reflect the revision of the Japan Standard Industry Classification in March 2002.
R&D personnel intensity in the manufacturing sector:
<Until FY2000> The data refer to regular researchers (FTE) as of April 1 each year and do not include special corporations.
<Since FY2001> The data refer to researchers (FTE) as of March 31, 2002 and do not include special and independent administrative corporations.
R&D expenditure intensity in all industries:
<Until FY2000> The data do not include special corporations.
<Since FY2001> The data do not include the finance and insurance industry and special and independent administrative corporations.
R&D personnel intensity in all industries:
<Until FY2000> The data refer to regular researchers (FTE) as of April 1 each year and do not include special corporations.
<Since FY2001> The data refer to researchers (FTE) as of March 31, 2002 and do not include the finance and insurance industry and special and independent administrative corporations.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 11-2-9

(ii) R&D intensity by industry

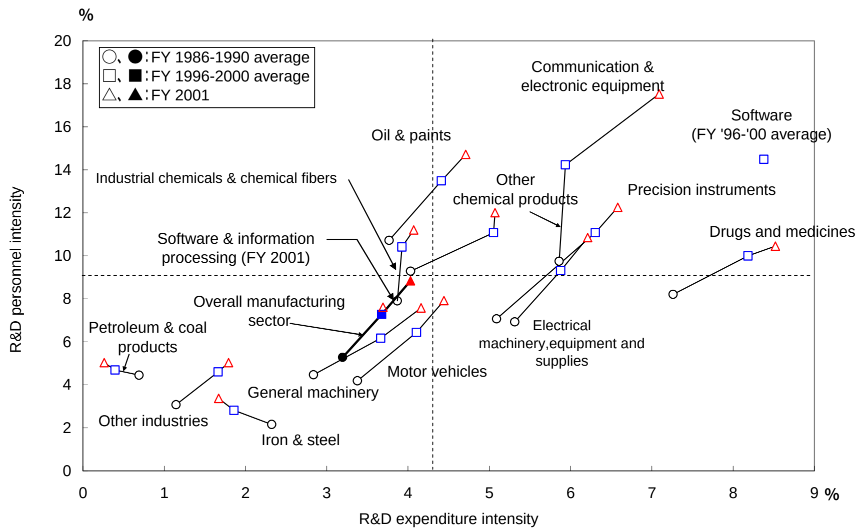
R&D intensity by selected industry is examined below. In Figure 11-2-9 (B), the horizontal axis represents R&D expenditure intensity, and the vertical axis refers to R&D personnel intensity. The average values between FY1986 and FY1990 and between FY1996 and FY2000 as well as the value for FY2001 are plotted.

As for the overall manufacturing sector, the index value climbs linearly toward the upper-right-hand side of the graph. A similar increase is seen in many of the selected industries, even if the slope varies. By contrast, the index values in the petroleum and coal products industry and the iron and steel industry climb toward the upper-left. In the iron and steel industry, R&D personnel intensity increases toward the end of the selected period because the rate of decrease in the total number of employees exceeds that in the number of researchers. In the industrial chemical and chemical fibers industry and the communication and electronic equipment industry, the R&D personnel intensity has significantly increased from the FY1986-1990 average to the FY1996-2000 average. The reason for this growth is that the rate of decrease in the total number of employees has surpassed that in the number of researchers in the industrial chemical and chemical fibers industry, and the rate of increase in the number of researchers has exceeded that in the total number of employees in the communication and electronic equipment industry.

On closer examination of FY2001, the drugs and medicines industry indicates the highest R&D expenditure intensity at 8.5%, followed by communication and electronic equipment industry at 7.1%, precision instruments at 6.6%, and electrical machinery, equipment and supplies at 6.2%. These results reveal that R&D expenditure intensity is higher in high-technology industries. On the other hand, R&D personnel intensity is highest in the communication and electronic equipment industry at 17.5%, followed by oil and paints at 14.7%, precision instruments at 12.3%, and other chemical products at 12.0%. The software industry, which recorded high values in both R&D expenditure intensity and R&D personnel intensity until FY2000, was transformed into the software and information processing industry as a result of the revision of the coverage industries in FY2001. In this industry, R&D expenditure intensity stands at 3.7% and R&D personnel intensity at 7.6% as of FY2001.

Figure 11-2-9: R&D intensity

(B) R&D intensity by industry (FY1986-1990 average, FY1996-2000 average, and FY2001)



Notes: R&D expenditure intensity:
<FY1986-1990 average and FY1996-2000 average> The data do not include special corporations.
< FY2001> The data do not include special and independent administrative corporations.
R&D personnel intensity:
<FY1986-1990 average and FY1996-2000 average> The data refer to regular researchers (FTE) as of April 1 each year and do not include special corporations.
<FY2001> The data refer to researchers (FTE) as of March 31, 2002 and do not include special and independent administrative corporations.
Software industry: The FY1996-2000 average refers to the average of the four years between FY1997 and FY2000.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”
See: Table 11-2-9

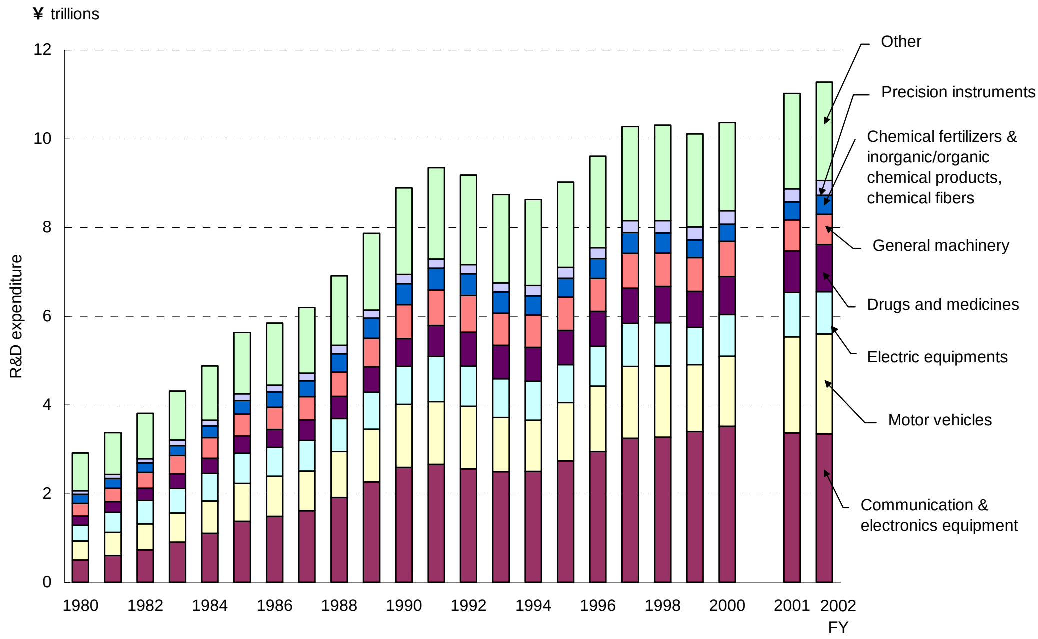
(2) Trends in R&D expenditure by product group

In this section, R&D expenditure is divided by product group to analyze the degree of R&D activity in individual fields of Japanese industry. To do this, when an automobile company performs R&D on electronic equipment, for example, expenditure on this activity is categorized as R&D expenditure in the field of electronic equipment but not in the field of motor vehicles. This classification method is based on the subject of R&D rather than the performer.

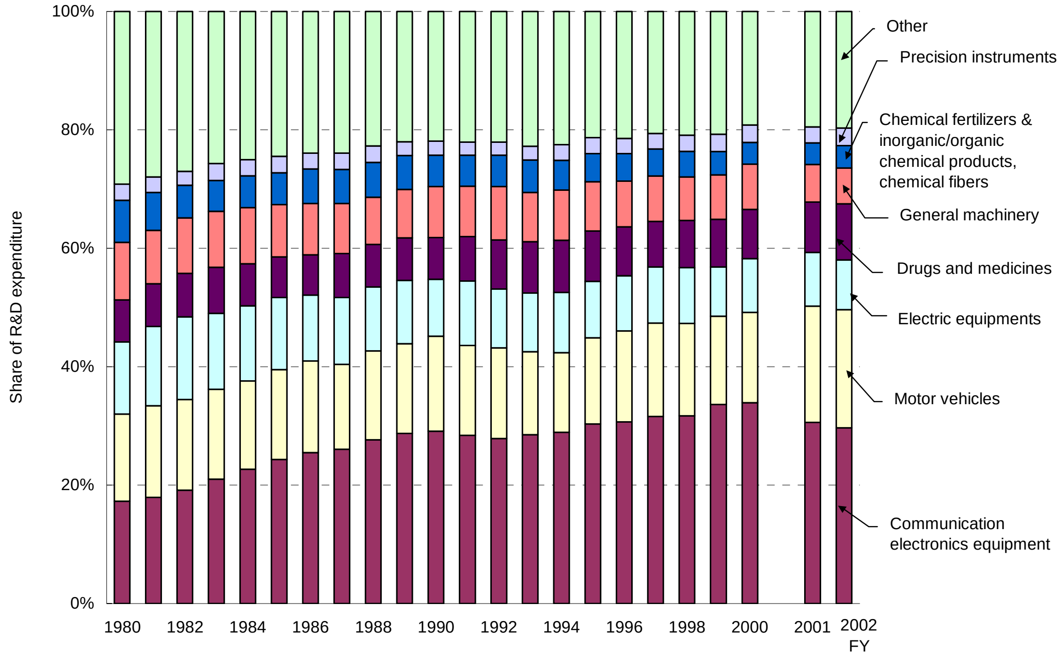
Figures 11-2-10 (A) and 11-2-10 (B) show the trends in R&D expenditure by product group in Japan's business sector in value and share, respectively. Since FY1980, communication and electronics equipment has been the product group that is dominant in the value and share of R&D expenditure. The second largest is the motor vehicle category, whose value and share of R&D expenditure increased significantly in FY2001. The electric equipments category maintains third position. A product group worth attention is drugs and medicines, on which R&D expenditure has increased steadily in value and share since FY1980.

Figure 11-2-10: R&D expenditure by product group (All industries)

(A) Trends in R&D expenditure in value



(B) Trends in the share of R&D expenditure by product group



Notes: The data refer to companies (business enterprises since FY2001) capitalized at ¥100 million or higher.
<FY2001> The industry classification for the Survey of Research and Development was revised, changing the coverage categories.
<FY2002> The Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised. Electric equipments and instruments refer to the combination of 'household electric appliances' and 'Other electric equipment.'
<Since FY2001> Communication & electronics equipment refer to 'information and communications equipment and electronic parts.'
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 11-2-10

An analysis of R&D expenditure by product group in the six major industries reveals that the way expenditure is split between core products and non-core products varies from one industry to another, and each industry emphasizes a different R&D area. There are roughly two patterns of R&D activity; in Pattern 1, the majority of R&D expenditure is spent on core products, and in Pattern 2, R&D expenditure on core products roughly equals that on non-core products or where the latter even surpasses the former.

Industries following Pattern 1 are, among others, communication and electronic equipment (divided among ‘electronic equipment and electric measuring instruments,’ ‘information and communication electronics equipment,’ and ‘electronic parts and devices’ in FY2002), shown in Figure 11-2-11 (A), motor vehicles (Figure 11-2-11 (B)), and drugs and medicines (Figure 11-2-11 (C)). In the communication and electronic equipment industry, while R&D expenditure on core products equaled that on non-core products in FY1980, R&D expenditure on communication and electronics equipment, core products, has increased markedly over time. In addition, a large proportion of R&D expenditure on non-core products comprises electric equipments, a product group that is closely related to core products. The motor vehicles and drugs and medicines industries direct most of their R&D expenditure toward R&D on core products. This can be interpreted as these two industries concentrating on their core products as far as the internal R&D is concerned.

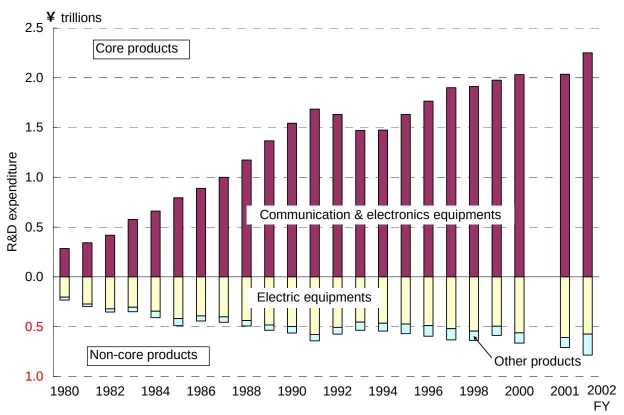
Major industries that follow Pattern 2 are the electrical machinery, equipment and supplies industry (‘miscellaneous electrical machinery equipment and supplies in FY2002), shown in Figure 11-2-11 (D), the general machinery industry (Figure 11-2-11 (E)), and the precision instruments industry (Figure 11-2-11 (F)). In the electrical machinery, equipment and supplies industry, R&D expenditure on non-core products, which was comparable to that on core products in FY1980, has increased markedly, especially in the product group of communication and electronics equipment, over time. However, R&D expenditure on non-core products has declined since FY1997. In the general machinery industry, while R&D expenditure on core products is higher than that on non-core products, the share of the latter in total R&D expenditure has been rising. The general machinery, industry is also notable for R&D on a wide range of non-core products. In the precision instruments industry, R&D on core products assumed a higher priority in the 1980s, whereas the priority order reversed in FY1989. With regard to non-core products, R&D expenditure on general machinery which accounted for the largest proportion until FY1992, has declined since FY1993 as R&D expenditure on communication and electronics equipment grew.

A common characteristic shared between (D) electrical machinery, equipment and supplies and (F) precision instruments is that the combined total R&D expenditure on all non-core products has exerted a greater impact on the total R&D expenditure in the industry than that on core products.

(D)electrical machinery, equipment and supplies, (E) general machinery, and (F) precision instruments show the same trend in R&D expenditure on non-core products; the degree of impact of R&D expenditure on communication and electronics equipment has increased.

Figure 11-2-11: Trends in R&D expenditure by product group in selected industries

(A) Communication and electronic equipment



(B) Motor Vehicles

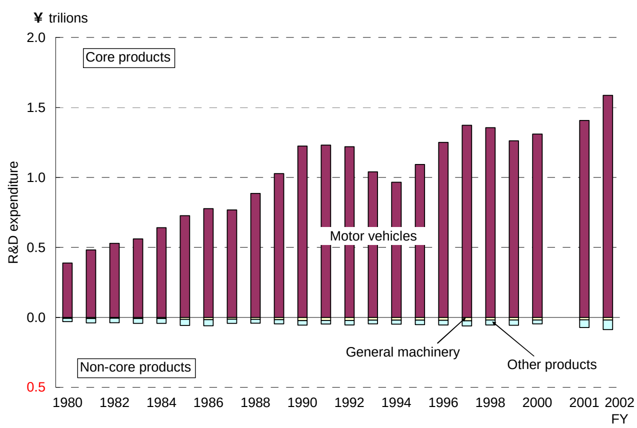
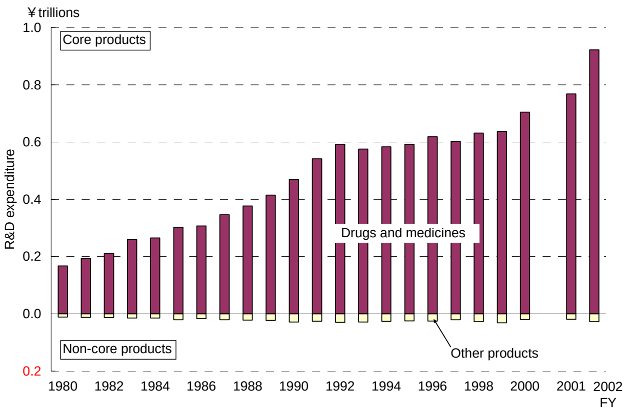
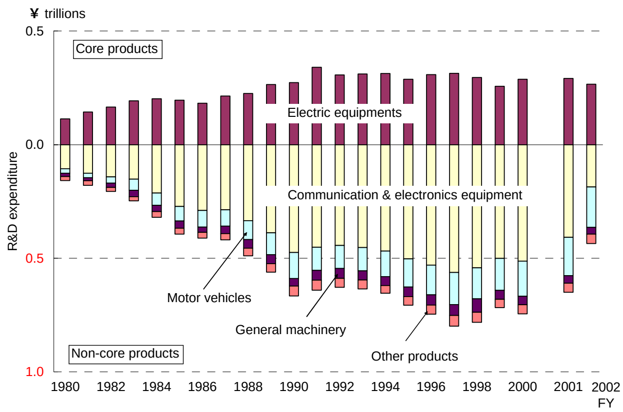


Figure 11-2-11: Trends in R&D expenditure by product group in selected industries

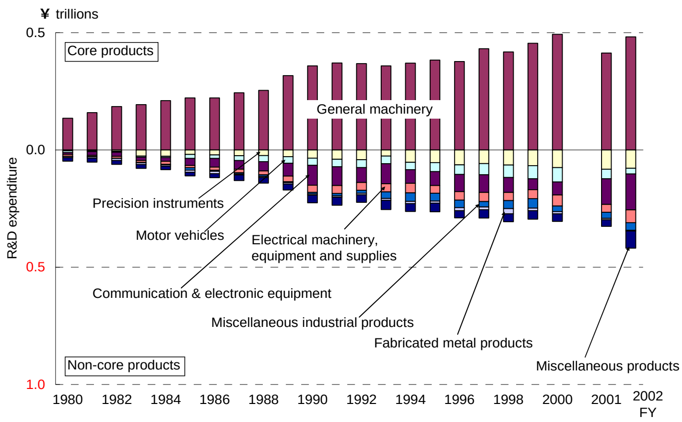
(C) Drugs and medicines



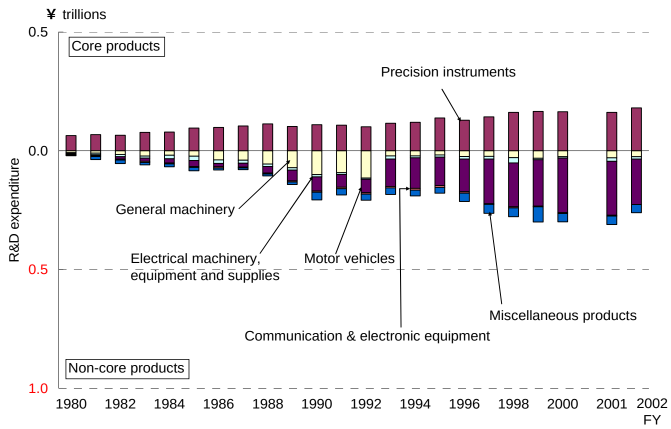
(D) Electrical machinery, equipment and supplies



(E) General machinery



(F) Precision instruments



Notes: Figure 11-2-11 (A)-(F)
The data refer to companies (business enterprises since FY2001) capitalized at ¥100 million or higher.
<FY2001> The industry classification for the Survey of Research and Development was revised, changing the coverage categories.
<FY2002> The Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised. In response to this, the industry classification for FY2002 is expressed according to that for FY2001 as follows.
D. Eectrical machinery, equipment and supplies: ‘miscellaneous electrical machinery equipment and supplies’ in the FY2002 classification
E. Communication and electronics equipment: ‘electronic equipment and electric measuring instruments’ + ‘information and communication electronics equipment’ + ‘electronic parts and devices’ in the FY2002 classification.
Electric equipments refer to the combination of ‘household electric appliances’ and ‘other electric equipments.’
<Since FY2001> Communication & electronics equipment refer to ‘information and communication electronics equipment and electronic parts.’
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”
See: Table 11-2-11

11.3 Technology trade in Japan

In general, technology export refers to granting the right[(1)] to use specific technologies to business enterprises or individuals located abroad in exchange for a consideration, and technology import (technology introduction) involves receiving such rights from business enterprises or individuals located in foreign countries by paying a consideration. These two types of trade are collectively known as the technology trade. Data regarding the technology trade are used to measure the technological standard of a country in an international context. More specifically, the amount of technology exports (receipts) and the ratio of technology exports to technology imports (payments), or the technology exports to imports ratio, are used as indicators of technological capability. Data on the technology trade are also important in that they represent the international flow of technological knowledge.

In discussing statistics on technology trade, it should be noted that, as business activities globalize, technology transfer within enterprise groups, such as transfer between companies affiliated to the same enterprise group but located in different countries has increased. Such technology transfer constitutes a certain part of the international trade in technology.

Japan has two major sources of statistics on technology trade: the Ministry of Public Management, Home Affairs, Posts and Telecommunications and the Bank of Japan. We use the statistics provided by the former in Section 11.3.1 and those provided by the latter in Section 11.3.2 the data on technology trade as a measure to compare Japan's R&D performance with other countries' are examined in Section 3, Chapter 7.

11.3.1 Technology trade in Japan by industry

(1) Value of technology trade

Figure 11-3-1 (A) shows the trends in the total value of technology exports (total consideration received) and the total value of technology imports (total consideration paid) of all Japanese industries.

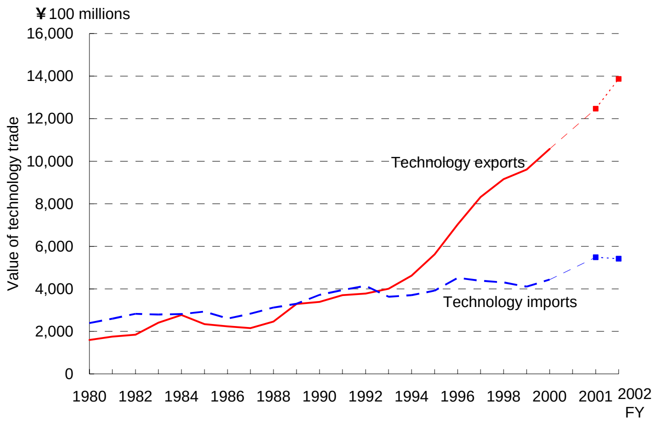
(1) These include intellectual property rights granted under law concerning patents, utility models, trademarks, copyrights, and so forth, as well as technological rights concerning design drawings, blueprints, so-called know-how, etc.

The value of technology exports in Japan's business sector has increased markedly since the mid-1990s. On the other hand, the value of technology imports has fluctuated more or less while indicating a general increase. In FY2002, the value of technology exports totaled ¥1,386.8 billion and the value of technology imports totaled ¥541.7 billion, resulting in an export surplus of ¥845.1 billion.

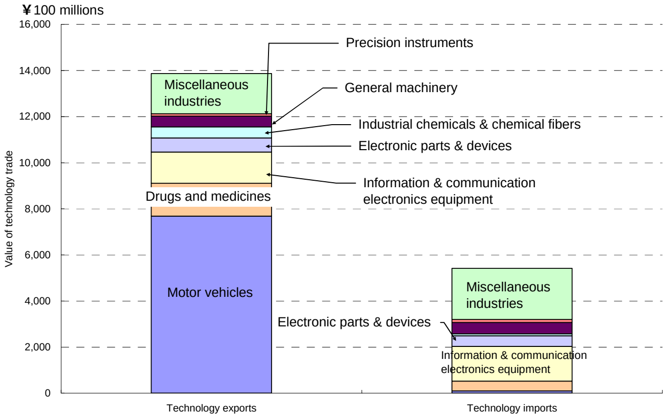
The technology trade in FY2002 in major industries is analyzed below (Figure 11-3-1 (B)). Industries that made major contributions to technology exports are the motor vehicles industry (¥768.2 billion, accounting for 55.4% of total technology exports) and the drugs and medicines industry (¥142.2 billion, 10.3%). Combined, these two industries represent 65.7% of the total value of technology imports in Japan's business sector. The third largest contributor was the information and communication electronics equipment industry (¥136 billion, 9.8%). With respect to technology imports, the information and communication electronics equipment industry made the largest contribution (¥151.6 billion, accounting for 28.0% of total technology imports), followed by the general machinery industry (¥49.5 billion, 9.1%) and drugs and medicines industry (¥41.7 billion, 7.7%). The motor vehicles industry, while being the largest technology exporter among all industries in Japan, makes very little contribution to technology imports (¥10.2 billion, accounting for 1.9% of total technology imports).

Figure 11-3-1: Technology trade in Japan

(A) Trends in the value of technology trade (All industries)



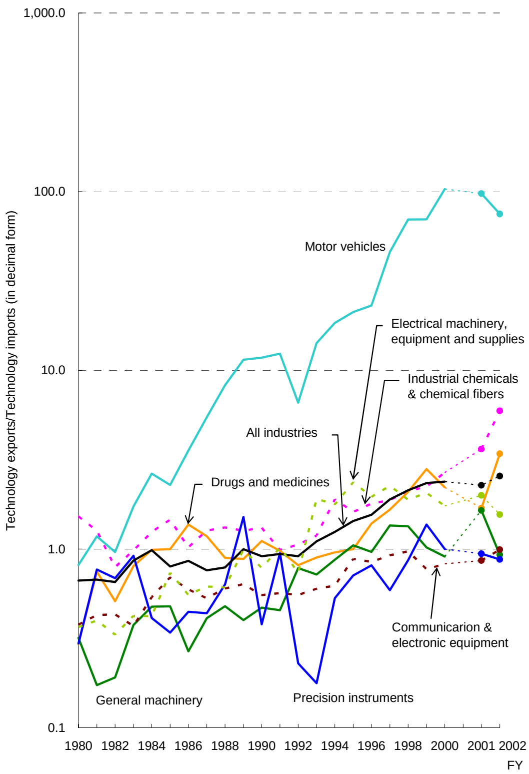
(B) Value of technology trade by industry in FY2002



Notes: The data between FY1996 and FY2000 include the software industry.
<FY2001> The industry classification for the Survey of Research and Development was revised.
<FY2002> The Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised.
The data on technology trade refer to patents, expertise, technical assistance, etc.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 11-3-1

Figure 11-3-2 shows the trends in the technology exports to imports ratio (technology exports divided by technology imports, in decimal form) in the entire business sector and the seven major industries. The technology exports to imports ratio for Japan has increased steadily in recent years due to a higher growth rate of technology exports than that of technology imports. The ratio exceeds 1 for the first time in FY1993 and continued to climb to mark 2.6 in FY2002. From a long-term perspective, between the mid-1980s and the early 1990s, technology exports to imports ratio hovered just below the 1 mark. The major factor behind this is that Japan's business sector increased technology exports as well as introducing technology from overseas during this period. The graph shows that the ratio finally started growing in the latter half of the 1990s.

Figure 11-3-2: Trends in the technology exports to imports ratio for Japan

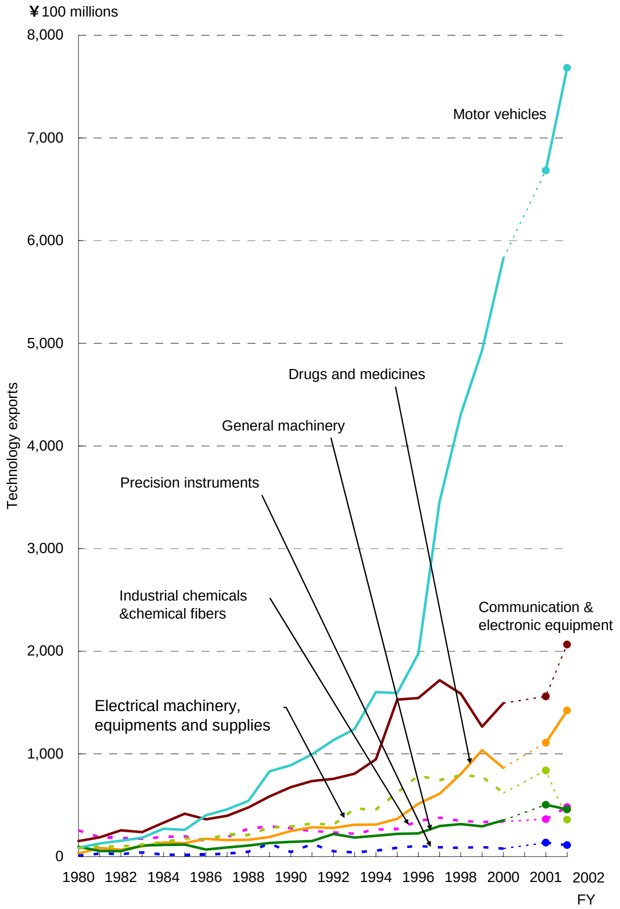


Notes: <FY1996-2000> 'All industries' include the software industry.
<FY2001> The industry classification for the Survey of Research and Development was revised, changing the coverage categories.
<FY2002> The Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised. 'Electrical machinery, equipment and supplies' refers to 'miscellaneous electrical machinery, equipment and supplies.' 'Communication and electronic equipment' refers to a combination of 'electronic equipment and electric measuring instruments,' 'information and communication electronics equipment,' and 'electronic parts and devices.'
The data on the technology trade refer to patents, expertise, technical assistance, etc.
Technology exports to imports ratio: (technology exports) / (technology imports)
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 11-3-2

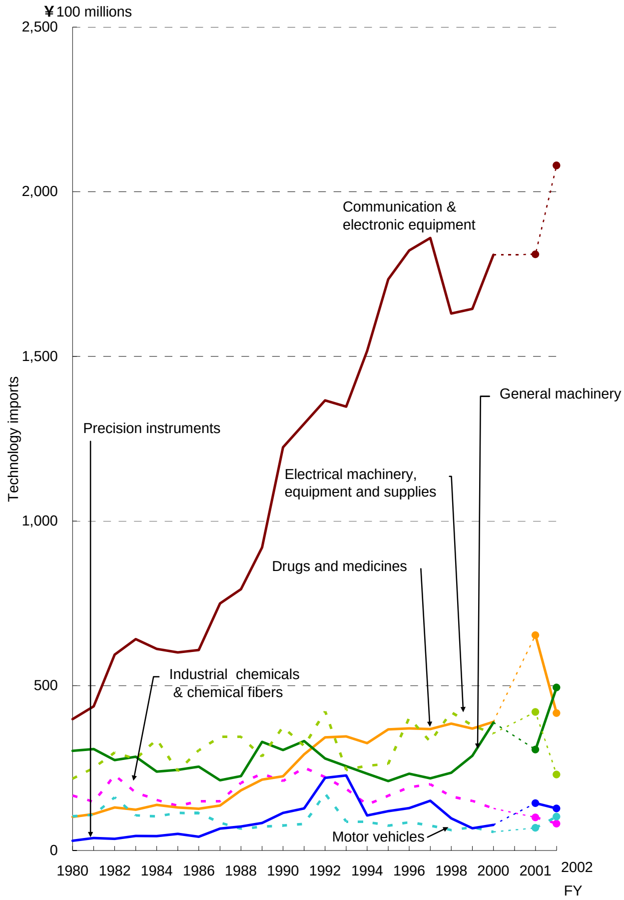
Figures 11-3-1 (C) and 11-3-1 (D) show respectively the trends in technology exports and imports in the seven major industries. The trends in technology trade illustrated in these graphs as well as Figure 11-3-2, which has been presented earlier, suggest characteristics of each industry.

Figure 11-3-1: Value of technology trade in Japan

(C) Trends in technology exports in selected industries



(D) Trends in technology imports in selected industries



Notes: <FY2001> The industry classification for the Survey of Research and Development was revised, changing the coverage categories.
<FY2002> The Japan Standard Industry Classification and the industry classification for the Survey of Research and Development were revised. ‘Electrical machinery, equipment and supplies’ refers to ‘miscellaneous electrical machinery, equipment and supplies.’ ‘Communication and electronic equipment’ refers to a combination of ‘electronic equipment and electric measuring instruments,’ ‘information and communication electronics equipment,’ and ‘electronic parts and devices.’
The data on the technology trade refer to patents, expertise, technical assistance, etc.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”
See: Table 11-3-1

In the industrial chemicals and chemical fibers industry, the value of technology exports hovered at ¥20 billion until the mid-1990s but increased to over ¥30 billion by FY1996. On the other hand, the value of technology imports stayed between ¥15 billion and ¥20 billion for most of the selected period, although it varied somewhat by year. Since a peak in FY1997, this value has declined. The exports to imports ratio stood above 1 (5.9 in FY2002) throughout the selected period except for fiscal years 1982, 1983, and 1991, indicating a favorable trade balance.

In the drugs and medicines industry, the exports to imports ratio, which stayed around 1 until FY1995, has increased far above 1 since FY1996. This growth derives from the rate of increase in technology exports being considerably higher than that in technology imports. In FY2002, the value of technology imports dropped suddenly, resulting in the increase in the exports to imports ratio from 1.7 in FY2001 to 3.4.

In the general machinery industry, the technology exports to imports ratio remained below 1 for a long time since FY1980, but it increased gradually and surpassed 1 for the first time in FY1995. After peaking in FY1998 at 1.3, the ratio hovered at 1, standing at 0.9 as of FY2002. The fluctuation of the technology exports to imports ration in this industry derives primarily from technology imports, which have shown considerable fluctuations, rather than technology exports, which have increased steadily.

In the electrical machinery, equipment and supplies industry (categorized as miscellaneous electrical machinery, equipment and supplies in FY2002), the technology exports to imports ratio continued to increase from a level below 1 in FY1980 to exceed 1 by FY1991. It soared in FY1993 and has remained around 2 since then, standing at 1.6 as of FY2002. The value of technology exports grew steadily until FY1996 and remained stable after this until FY1999. After a temporary decline in FY2000, it resumed growth in FY2001 but largely declined again in FY2002. The value of technology imports increased in general until a decline between FY1993 and FY1995. The growth resumed in FY1996 and continued until FY2002, which suffered a sudden fall.

The value of technology exports in the communication and electronic equipment industry (split among ‘electronic equipment and electric measuring instruments,’ ‘information and communication electronics equipment,’ and ‘electronic parts and devices’ in FY2002) is the second greatest after the motor vehicles industry. As for the value of technology imports, this industry’s presence overwhelms the others. While both technology exports and imports suffered a significant decline in FY1998 and FY1999, they regained their previous levels in later years. The exports to imports ratio has remained below 1 since FY1980, demonstrating an import surplus. However, the long-term trend is upward, approaching 1 in the past few years with the ratios of 0.9 in FY2001 and 1.0 (the combined total of the three industries) in FY2002.

In the motor vehicles industry, the exports to imports ratio has risen exceptionally since the trade balance became favorable in FY1981. The pace of increase in technology exports has been particularly remarkable since FY1997, and the value of technology exports is 75 times the value of technology imports as of FY2002, indicating a huge positive trade balance. From a long-term perspective, the motor vehicles industry is the only industry that successfully kept the technology exports to imports ratio well above 1 even in the latter half of the 1980s, when the ratio was below or around 1 in many other industries. The industry suffered a temporary decline in the ratio in FY1992, but this recovered as quickly as by the next year. There was another sudden drop in FY2002 to 75.0 from 97.6 in the previous year.

The values of technology exports and imports are modest in the precision instruments industry relative to the other industries, although they have fluctuated significantly over time. The technology trade balance in this industry has been generally negative, even though the technology exports to imports ratio exceeded 1 in FY1989, FY1999 and FY2000.

(2) Financial relationships in the technology trade

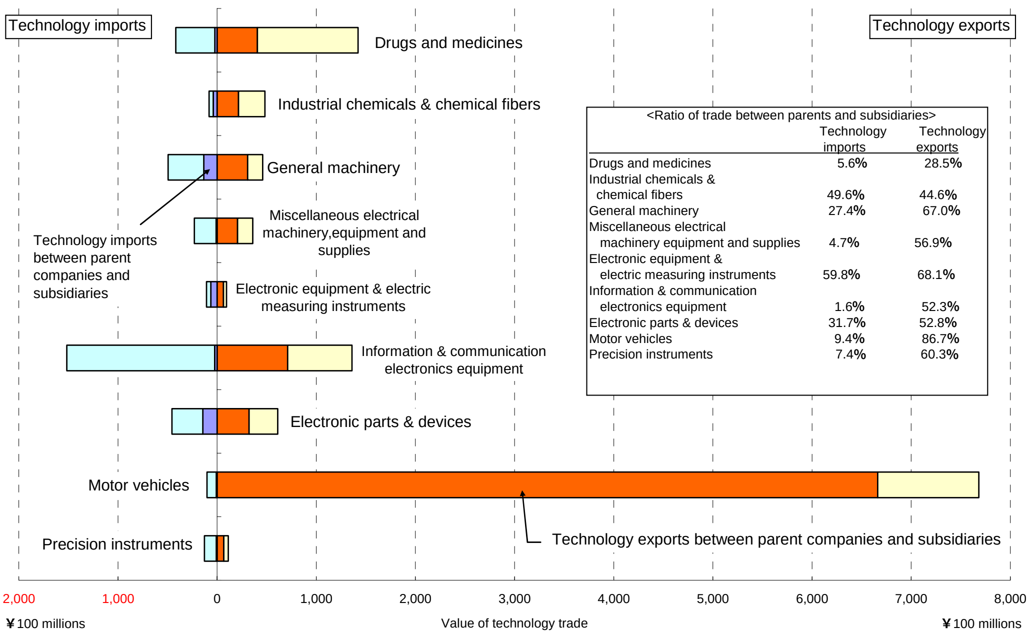
The technology trade in the nine major industries in FY2002 is analyzed below considering the financial relationships between the companies involved (Figure 11-3-3 (A)). In the ‘Report on the Survey of Research and Development,’ a parent and subsidiary relationship is acknowledged when a business enterprise is more than 50% owned by another. In the entire business sector, trade between parent companies and their subsidiaries accounts for 69.6% of technology exports and 16.9% of technology imports in value terms. The ratio is higher in technology exports in the majority of industries. The ratio of the technology trade between parent companies and subsidiaries to total technology exports is the highest in the motor vehicles industry at 86.7%, followed by electronic equipment and electric measuring instruments at 68.1%, general machinery at 67.0%, and precision instruments at 60.3%. With regard to technology imports, the ratio of the trade between parent companies and subsidiaries is the highest in the electronic equipment and electric measuring instruments industry at 59.8%, followed by industrial chemicals and chemical fibers at 49.6% and electronic parts and devices at 31.7%. Japan's trade in technology has recently grown markedly in the value of exports, of which the motor vehicles industry makes up a large share. This suggests nearly half the value of technology exports derives from trade between parent companies and their subsidiaries.

Figure 11-3-3 (B) shows the technology trade between business enterprises without parent and subsidiary relationships (unaffiliated companies) in the same industries as listed in Figure 11-3-3 (A). The graph has been compiled from a perspective opposite to the previous one. The trade between unaffiliated companies accounts for 30.4% of technology exports and 83.1% of technology imports. In value terms, technology exports of unaffiliated companies total ¥421.1 billion and technology imports of them total ¥450.0 billion, producing an exports to imports ratio of 0.9.

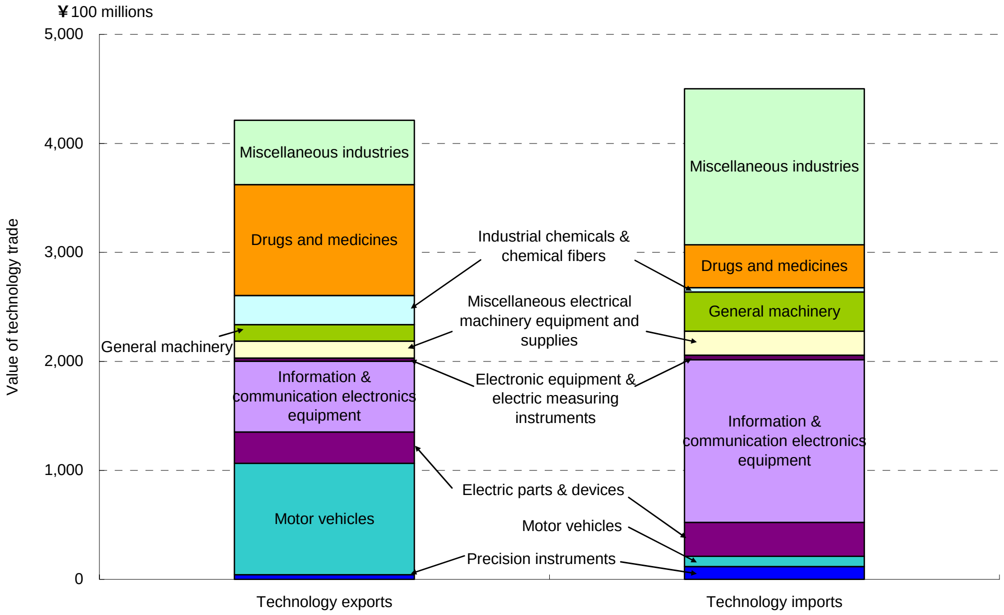
By industry, the value of overall technology exports is highest in the motor vehicles industry at ¥102.0 billion, followed by the drugs and medicines (¥101.7 billion) and information and communication electronics equipment (¥64.8 billion) industries. In terms of the ratio of the trade between unaffiliated companies to the total value of technology exports, the drugs and medicines industry ranks first at 71.5% (see Figure 11-3-3 (A)). In the value of technology imports, the industries that top the list are, in descending order, information and communication electronics equipment (¥149.2 billion), drugs and medicines (¥39.3 billion), and general machinery (¥35.9 billion). The ratio of the trade between unaffiliated companies to the total value of technology imports is extremely high in both the information and communication electronics equipment and drugs and medicines industries at 98.4% and 94.4%, respectively (see Figure 11-3-3 (A)). A significant part of technology imports derives from the category called miscellaneous industries. It includes the non-ferrous metals and products industry (¥41.4 billion) and the software and information processing industry (¥33.9 billion), which, combined, contribute to half the total of the miscellaneous industries.

Figure 11-3-3: Comparison of financial relationships in technology exports and imports by industry

(A) Comparison of financial relationships (FY2002)



(B) Technology trade outside the parent and subsidiary relationship (FY2002)



Notes: The data on the technology trade refer to patents, expertise, technical assistance, etc.
A parent and subsidiary relationship is acknowledged when a business enterprise is more than 50% owned by another.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”
See: Table 11-3-3

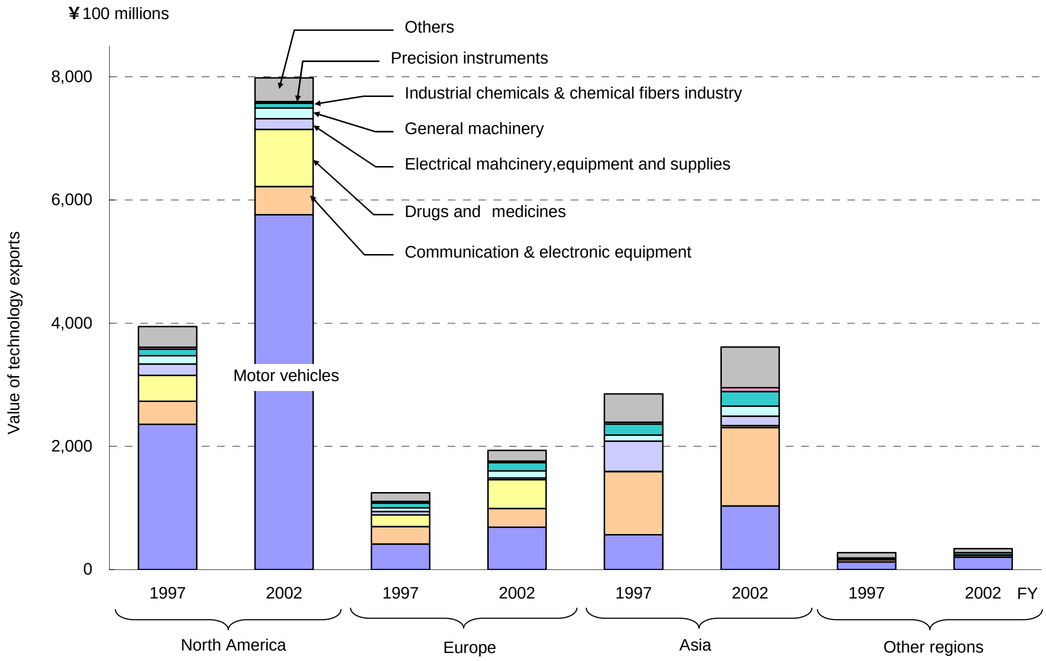
(3) Technology trade in Japan’s business sector by destination
(i) Technology exports

Figure 11-3-4 (A) compares technology exports in FY1997 and FY2002 by region and by industry. The value of technology exports in FY2002 totaled ¥1,386.8 billion across the business sector in Japan. Of the total, technology exports to North America were worth ¥798.2 billion, accounting for 57.6%. The second largest export destination was Asia (hereafter excluding West Asia in this section) with a value of ¥361.3 billion (26.1%). Technology exports to Europe were worth ¥193.4 billion (13.9%).

At industry level, the motor vehicles industry accounted for a dominant share of technology exports to North America in FY2002 at 72.2%, followed by the drugs and medicines industry at 11.6% and the communication and electronic equipment industry (a combination of the ‘electronic equipment and electric measuring instruments,’ ‘information and communication electronics equipment,’ and ‘electronic parts and devices’ industries) at 5.8%. The value of technology exports to North America roughly doubled between FY1997 and FY2002 owing to an almost two-fold increase in the motor vehicles industry. With respect to technology exports to Asia, the communication and electronic equipment industry made up the largest share of 35.2%, followed by the motor vehicles industry (28.6%) and the industrial chemicals and chemical fibers industry (6.6%). When the value of technology exports to Asia in FY1997 is compared with that of FY2002, a significant increase is observed in the motor vehicles industry. Among the three regions, Asia is the largest destination of technology exports from Japan in the industrial chemicals and chemical fibers industry and the communication and electronic equipment industry.

Figure 11-3-4: Value of technology trade by region and by industry

(A) Comparison of the breakdown of technology exports between FY1997 and FY2002



Notes: <FY1997 and FY2002> The data are based on different versions of the Japan Standard Industry Classification and the industry classification for the Survey of Research and Development.
<FY2002> 'Electrical machinery, equipment and supplies' refers to 'miscellaneous electrical machinery, equipment and supplies.' 'Communication and electronic equipment' refers to a combination of 'electronic equipment and electric measuring instruments,' 'information and communication electronics equipment,' and 'electronic parts and devices.'
The data on the technology trade refer to patents, expertise, technical assistance, etc.
Countries included in each region
<North America> The U.S., Canada, Mexico, Panama, etc.
<Europe> The U.K., Italy, Netherlands, Switzerland, Sweden, Spain, Russia, Denmark, Germany, Norway, France, Rumania, etc.
<Asia (excluding West Asia)> India, Indonesia, Republic of Korea, Thailand, China (including Taiwan), Philippines, Malaysia, etc.
<Other regions> West Asia (Iraq, Iran, Saudi Arabia, Turkey, etc.), South America (Columbia, Argentina, Brazil, etc.) Africa (Egypt, Nigeria, South Africa, etc.), Oceania (Australia, New Zealand, etc.)
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 11-3-4

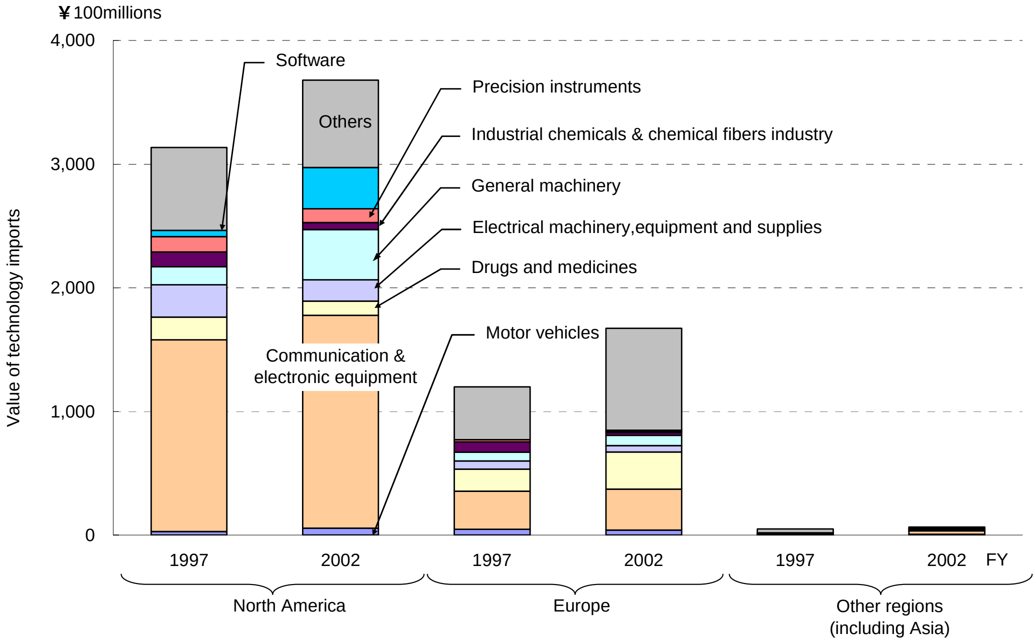
(ii) Technology imports

Figure 11-3-4 (B) compares technology imports in FY1997 and FY2002 by region and by industry. The value of technology imports in FY2002 totaled ¥541.7 billion across the business sector in Japan. Of the total, technology imports from North America were worth ¥367.9 billion. Technology imports from Europe were worth ¥167.3 billion. Combined, these two regions accounted for 98.8% of the total value of technology imports in Japan's business sector.

By industry, the communication and electronic equipment industry made up the largest share of technology imports from North America at 46.8%, followed by the general machinery industry at 11.0%. The growth in the value of technology import from North America between FY1997 and FY2002 is primarily dependent on the software and information processing industry. As for technology imports from Europe in FY2002, the communication and electronic equipment industry accounted for the largest share of 19.8%, followed by the drugs and medicines industry with 18.0%. The increase in technology imports from Europe between FY1997 and FY2002 is attributable mainly to the growth of the drugs and medicines industry as well as the non-ferrous metals and products industry, which is included in the 'others' category and which increased from ¥5.5 billion in FY1997 to ¥37.6 billion in FY2002.

Figure 11-3-4: Value of technology trade by region and by industry

(B) Comparison of the breakdown of technology imports between FY1997 and FY2002

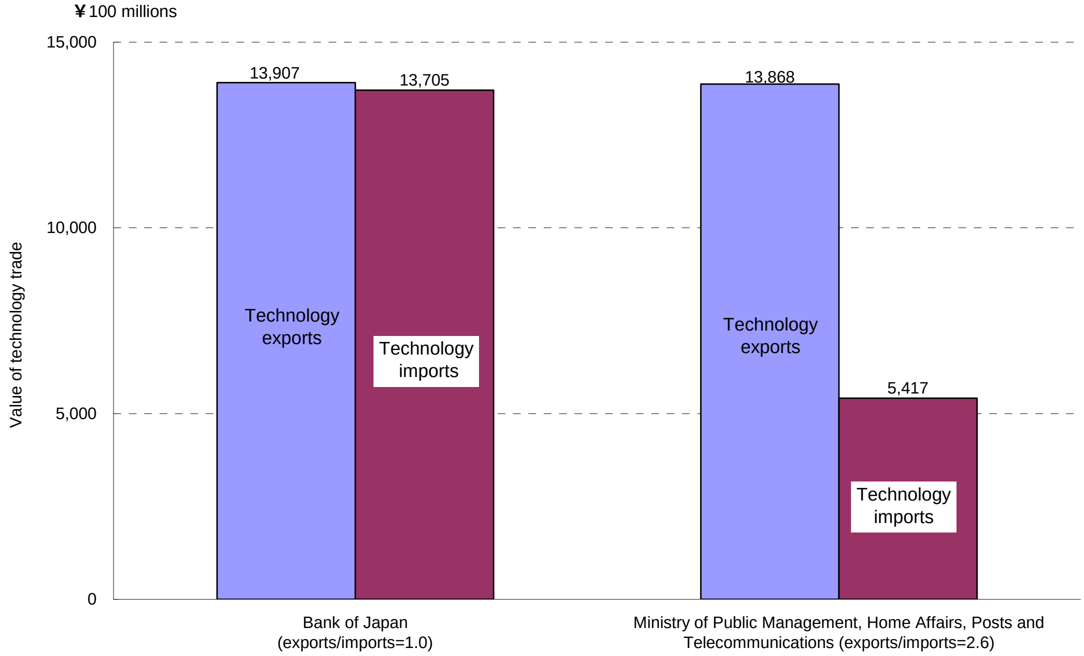


Notes: <FY1997 and FY2002> The data are based on different versions of the Japan Standard Industry Classification and the industry classification for the Survey of Research and Development.
<FY2002> 'Electrical machinery, equipment and supplies' refers to 'miscellaneous electrical machinery, equipment and supplies.' 'Communication and electronic equipment' refers to a combination of 'electronic equipment and electric measuring instruments,' 'information and communication electronics equipment,' and 'electronic parts and devices.'
The data on the technology trade refer to patents, expertise, technical assistance, etc.
Countries included in each region
<North America> The U.S., Canada, Mexico, Panama, etc.
<Europe> The U.K., Italy, Netherlands, Switzerland, Sweden, Spain, Russia, Denmark, Germany, Norway, France, Rumania, etc.
<Other regions> Asia (India, Indonesia, Republic of Korea, Thailand, China (including Taiwan), Philippines, Malaysia, Iraq, Iran, Saudi Arabia, Turkey, etc.), South America (Columbia, Argentina, Brazil, etc.) Africa (Egypt, Nigeria, South Africa, etc.), Oceania (Australia, New Zealand, etc.)
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development"
See: Table 11-3-4

11.3.2 Japanese statistics on the technology trade

Japan has two major sources of statistics on the technology trade: the Bank of Japan and the Ministry of Public Management, Home Affairs, Posts and Telecommunications. While the statistics compiled by both of them cover the technology trade, there is a wide difference between the two in the value of technology trade, especially the value of technology imports (Figure 11-3-5). Therefore, the ratios of technology exports to imports (the value of technology exports divided by the value of technology imports) produced based on these statistics are also significantly different. Consider the statistics for FY2002. The ministerial statistics yield 2.6 as the technology exports to imports ratio, suggesting an excess of imports over exports, whereas the ratio is 1.0 according to the statistics prepared by the Bank of Japan, indicating a balance between exports and imports. Such variations derive from differences in the objective of the statistical survey; the statistics of the Bank of Japan are intended for foreign exchange control and the ministerial statistics focus on assessing the state of R&D activities in Japan. The survey methodology and coverage also differ between the two sources.

Figure 11-3-5: Comparison of the statistics on the technology trade in Japan (FY2002)



Notes: The technology trade refers to the following items.
<Bank of Japan> Licensing fees for patents etc. (loyalties for patents, rights of industrial property such as trademarks, mining rights, and copyrights, and loyalties under licensing agreements)
< Ministry of Public Management, Home Affairs, Posts and Telecommunications > Patents, expertise, and technical assistance
Sources: International Department, Bank of Japan, “Balance of Payments Monthly”
Ministry of Public Management, Home Affairs, Posts and Telecommunications, “Report on the Survey of Research and Development”
See: Table 11-3-5

The following three factors contribute to the differences between the statistics prepared by the Bank of Japan and the Ministry of Public Management, Home Affairs, Posts and Telecommunications.

(i) The industries covered by the ministerial statistics are not complete. The industries included in the Japan Standard Industry Classification but excluded from the statistical survey are part of General Category J ‘Wholesale and Retail Trade’, part of General Category K ‘Finance and Insurance’, General Category L ‘Real Estate’, General Category M ‘Eating and drinking places, accommodations’, General Category N ‘Medical, health core and welfare’, General Category O ‘Education, learning support’, General Category P ‘Compound services’, and part of General Category Q ‘Services, n.e.c’.

(ii) The statistics of the Bank of Japan exclude considerations paid for expertise and industry-specific technical assistance offered along with the export of industrial plants. These technical services in parallel with plant exports and the like should be considered as technology trade.

(iii) The statistics of the Bank of Japan include considerations for the transfer and licensing of trademarks. They need to be subtracted because non-technical industrial property rights such as trademarks should not be considered as technology trade.

Part IV

Science & Technology and Society

Chapter 12
Innovation and the Japanese Economy and Society

Part IV examines science and technology (S&T) activities in Japan considering their impact on Japan's economy and society as well as public interest in and understanding of S&T. Chapter 12 examines the impact of S&T on the economy and society. Study from the macroeconomic standpoint begins in section 12.1 and examines the relationship between technological progress and improvement in productivity, employing a total factor productivity indicator. In section 12.2, the microeconomic sphere is examined, looking at innovations in the light of new product development. Sections 12.3 and 12.4 present indicators of economic activities by small and medium enterprises (SMEs) that are recently attracting attention as a vitalizing force in Japan's industry.

12.1 Technological Progress and Improvement in Productivity

Advances in S&T affect our economy and society in a variety of ways. For instance, the launch of a new product may enrich the quality of consumer living and the introduction of a new manufacturing process may cut down working hours, allowing people to enjoy more leisure time. In view of the complexity and range of the impact of S&T on socioeconomic activities, various attempts have been made to give a generalized assessment of the effects of S&T in the form of indicators.

This section examines into the influence of S&T on the economy and society from the perspective of 'improvement in productivity.' Productivity is defined as quantity of output per unit of input factor. Technological knowledge, as a product of S&T activity, has the potential to improve 'productivity' by integration into new products and new processes. For this reason, the economic contribution made by technological progress can be evaluated with the growth rate in productivity as an indicator of assessment.

Among the many types of productivity indicator[1], this section focuses on 'total factor productivity.'

Although this indicator has its limitations, it is effective as a primary approximation in assessing the impact of technology on the economy and society.

12.1.1 Technological progress and changes in total factor productivity

Total factor productivity is defined as the ratio of total added value to all production factors (total amount of labor and capital). Total factor productivity is an indicator effective in evaluating the efficiency of the production activities of a national economy.

By definition, total factor productivity represents the added value per unit of total input factors, and can be interpreted to show the efficiency of production technologies in a national economy. Therefore, growth in total factor productivity can be regarded as improvement in production technology efficiency for technological advance. This can be understood from the following.

If the input of the total production factors during a fiscal term is doubled, and the total added value obtained in the following fiscal term is double that of the added value for the current term, the increase in the total added value can be fully explained by the increase in production factors, showing that there is no change in the efficiency of production technology.

If, however, the total added value in the following fiscal term more than doubles, it signifies that there has been an increase in efficiency that cannot be explained by the growth rate in production factors; that is, there has been progress

(1) Indicators commonly used to measure productivity are classified into the following types. indicators that measure output with physical quantity are called physical output. Indicators measuring value level (monetary value) are called value output. In addition, indicators measuring input factors with stock are called capital output, and indicators based on labor (number of workers or total working hours) are called labor productivity. Because measurement of physical productivity is restricted to where output quantity is numerical, it does not apply in the evaluation of productivity related to any economic activities, including those of the service industry. For this reason, gross national product (GNP) calculated as the total added value of the nation or value-added productivity, employing gross domestic product (GDP) as a numerator, is employed as a macroeconomic indicator of productivity.

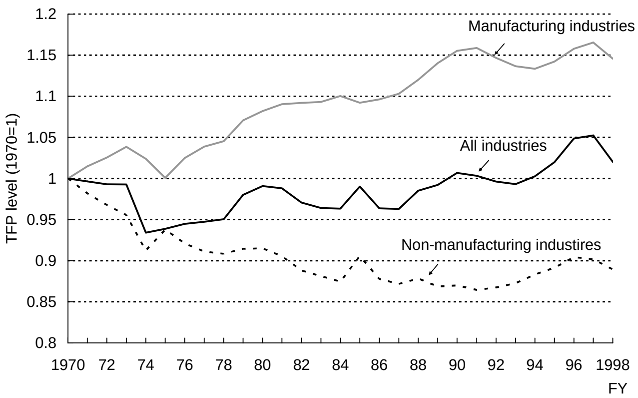
in technology. If the growth rate in output exceeds the growth rate in inputs over the two time periods, this means that there has been improvement in production technology efficiency over that time, or an advance in technology itself.

Figure 12-1-1 shows changes in total factor productivity in Japan from 1970 to 1998. The total factor productivity (hereinafter abbreviated to TFP) for each fiscal year represents the TFP level for each year normalized by the TFP level in 1970.

The bold line in Figure 12-1-1 shows the TFP indicator for all industries. A close look reveals the following distinctive features. First, the TFP indicator falls dramatically during the recessionary periods of the first oil crisis in 1974 and the second oil crisis in 1979. In addition, TFP growth remains virtually zero between 1970 and 1985.

Later, the indicator begins to rise from 1986 but stagnates again with economic recession following the collapse of the 1990 economic bubble. Additionally, the TFP indicator shows signs of recovery from 1993 to 1997 but plummets again with the economic setback of 1998.

Figure 12-1-1: Time-series change in the TFP indicator



Source: Data recomputed by the National Institute of Science and Technology Policy based on 'Economic Analysis No. 170,' Economic and Social Research Institute, Cabinet Office
See: Table 12-1-1

Obviously, the TFP indicator for all industries is an aggregate of the TFP indicators of various industries. In the following passage, these industries are classified into 'manufacturing industries' and 'non-manufacturing industries' for convenience, and the change in TFP indicator for each group over time is examined(2).

The other straight line in Figure 12-1-1 shows the change in TFP indicator over time in the manufacturing industries. The broken line indicates change in the non-manufacturing industries.

The figure clearly shows the marked difference between the manufacturing and the non-manufacturing industries. TFP in manufacturing has been on a steady rise since the first oil crisis, while TFP for non-manufacturing declined steadily from 1970 to 1990. However, the latter has begun to rise, although at a very slow rate, since 1990.

These trends suggest that growth in TFP, that is, long-term advance in technology, was driven chiefly by the manufacturing industries. It must be noted, however, that the TFP growth rate in this category slowed down in the 1990s. This is attributed to factors such as stagnation in the ratio of newcomers into such industries and the withdrawal of highly productive business enterprises. These developments suggest the need to vitalize 'a new metabolic function' in the market(3).

12.1.2 TFP indicator focusing on labor quality and utilization rate

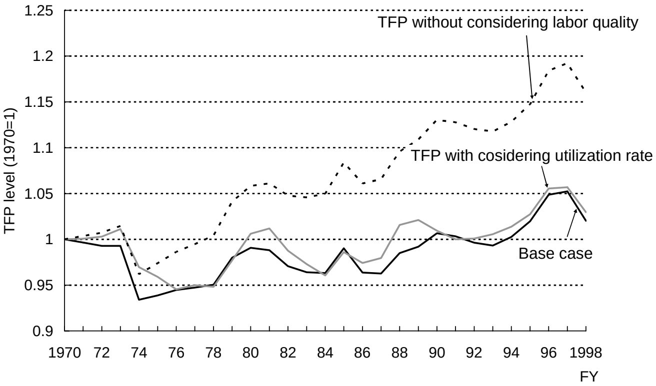
According to "Economic Analysis No. 170" (published by the Economic and Social Research Institute, Cabinet Office), it is widely known that the TFP indicator can vary widely with production factors such as labor and capital and how output quantity is estimated. This section examines time-series changes in the TFP indicator considering labor quality and the capital utilization rate, based on this publication.

(2) In the tabulation of the TFP growth rate for each industry into that for the entire economy (or for the entire manufacturing industry), the TFP growth rate by industry is multiplied by the 'Domar weight' of the industry. Domar weight by industry is defined as the output of each industry divided by the added value of the economy as a whole: OECD (2001), "Measuring Productivity: OECD Manual Measurement of Aggregate and Industry-level Productivity Growth," pp. 94-99.

(3) Quoted from 'Keizai Kyoshitsu,' Nihon Keizai Shimbun, September 30, 2003.

Figure 12-1-2 shows the three types of TFP indicator covering all industries. In the figure, the bold line shows TFP covering labor quality (base case), the broken line shows TFP without considering labor quality, and the remaining line, TFP based on the capital utilization rate.

Figure 12-1-2: Time-series change in the TFP indicator (All industries)



Source: Data recomputed by the National Institute of Science and Technology Policy based on “Economic Analysis No. 170,” Economic and Social Research Institute, Cabinet Office
See: Table 12-1-2

First, the TFP indicator considering difference in labor quality is compared with that without considering the difference made by labor quality.

The TFP indicator is commonly used as index that does not consider differences in labor quality. This can be interpreted as an indicator that assumes that the total hours worked by workers of various types produce 'uniform quality.'

The TFP indicator of this type shows a steady rise, despite slight fluctuations since the first oil crisis.

On the other hand, the TFP indicator covering labor quality remains stagnant until around 1985 but shows an upward turn from 1986.

This difference emerges from whether or not labor quality is taken into account.

An example of change in labor quality is improvement in labor productivity per hour, caused by higher education levels and the accumulation of human capital through training and refinement of expertise.

As mentioned earlier, TFP is calculated assuming uniform labor quality. However, this means that true labor force is underevaluated. This results in an exaggerated evaluation in TFP.

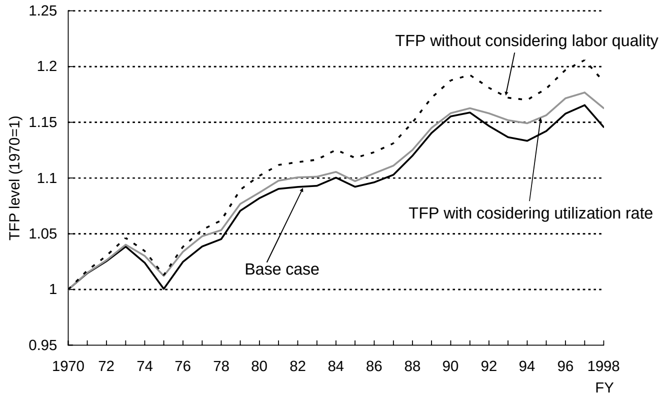
'Labor force' calculated considering labor quality produces a higher value than when calculated by man-hours or based simply on the number of workers. This causes the level of TFP considering labor quality to be lower in comparison to that without considering quality.

Next, capital utilization is compared. Capital utilization rate refers to the level of how existing capital is utilized in actual production activities. Commonly, the economic stagnation rate is expected to decline (after a slight delay). If decline in utilization is not taken into account, the TFP assessment is lower. This is the result of the economic recession causing decline in 'output quantity,' which is a factor in the numerator of TFP and 'capital' in the denominator not decreasing at the same time. This causes TFP, which is the ratio of these two factors, to be lower than necessary.

The fine line in Figure 12-1-2 shows the indicator considering utilization rate; the bold line represents the index excluding the utilization rate (base case). A comparison of these two shows that TFP that excludes the utilization rate is lower than the TFP that includes the utilization rate during the recessionary periods of 1974-1975, 1980-1983 and 1992-1994. The data show that TFP is being underevaluated.

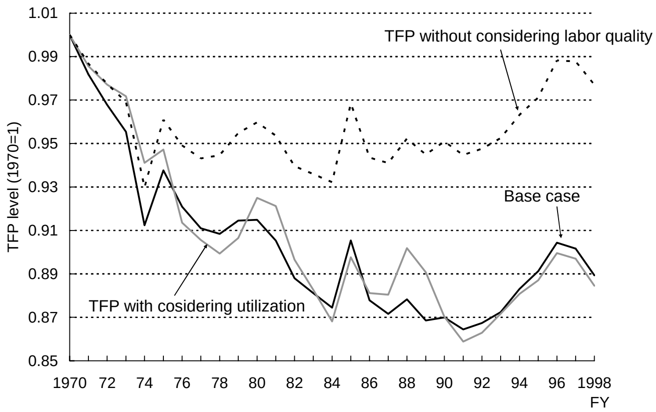
The indicators for the manufacturing and non-manufacturing industries are shown in Figure 12-1-3 and 12-1-4.

Figure 12-1-3: Time-series change in the TFP indicator (Manufacturing industries)



Source: Data recomputed by the National Institute of Science and Technology Policy based on "Economic Analysis No. 170," Economic and Social Research Institute, Cabinet Office
See: Table 12-1-3

Figure 12-1-4: Time-series change in the TFP indicator (Non-manufacturing industries)



Source: Data recomputed by the National Institute of Science and Technology Policy based on "Economic Analysis No. 170," Economic and Social Research Institute, Cabinet Office
See: Table 12-1-4

The difference in indicator considering labor quality and that without considering this factor, shown in Figure 12-1-4, can be seen more clearly in the non-manufacturing industries. During the period from 1970 to 1998, the non-manufacturing industry underwent growth in the number of workers and dramatic improvement in labor quality. This signifies an increase in labor input. It appears that TFP was headed on a downward course with growth in labor input.

On the other hand, labor quality in the manufacturing industries improved during the same period. However, the number of workers also failed to grow, resulting in the absence of marked change in labor input. As a result, TFP maintained an upward rise.

Figure 12-1-3 shows that TFP including the capital utilization rate for manufacturing industries has consistently started higher than base-case TFP. In addition, the same TFP considering utilization rate in the same figure has remained higher than the base-case indicator, even during recessions.

In the non-manufacturing industries, this regularity is observed as a rule. This suggests that adjustment of the capital utilization rate is important for manufacturing industries, in which capital is relatively concentrated, for accurate TFP.

The findings show that the conclusion given in 12.1.1 remains valid, even when labor quality and capital utilization rate are taken into account. In other words, TFP in manufacturing industries has been on a steady rise, that is, there is technological progress in the long run, while the indicator for non-manufacturing industries has recently shown a general decline in productivity. Furthermore, it demonstrates that technological progress in Japan has been driven chiefly by the manufacturing industries.

However, it must be noted that there are some problems in the total factor productivity calculated in this manner. As mentioned earlier, the TFP indicator declines with improvement in labor quality because of the increase of investment in human capital. However, better labor quality means improvement in labor productivity. For this reason, careful interpretation is necessary as to whether decline in TFP through improvement in labor quality can be simply translated into stagnation in technological progress.

Moreover, TFP includes segments for which differences in rise in the total added value cannot be explained simply by an increase in production input quantity of capital or labor. Greater production efficiency can at times be achieved without technological progress, but rather with improvement in management, introduction of new industrial organization or economy of scale. Therefore, the TFP growth rate as an index for technological progress should be treated with caution because of its limitations in assessing factors other than technology.

12.2 Innovation in New Product Development

12.2.1 Objective and significance of the indicators

This section examines 'innovation from the perspective of new product development,' as an aspect in which S&T contributes to the economy and society. Knowledge gained through science and research is reflected in products, processes, etc., in the form of technology or expertise. Moreover, 'technology' in the broad sense including economic and social mechanisms, as well as expertise, may be reflected in products, processes and services. The economy and society perceived from this standpoint is called either a 'knowledge-based economy' or 'knowledge-based society.' The process in which new products, processes, services and mechanisms are created is called 'innovation.'

Of the goods created as products, we will focus on 'products' provided to consumers as 'final consumer goods' to examine one aspect of innovation through the behavior of products launched in the marketplace. Product behavior not only reflects technological innovations for the product or process developed, but also innovation in distribution, etc., outside the realm of technology.

S&T are not the only factors that make apparent and direct contributions to new product development. But there is no denying that S&T achievements affect a wide range of processes in innovation. In the area of products, the application of S&T achievements can be clearly seen in household appliances. They have also been actively utilized in processed foods, such as functional foods. In terms of process, S&T achievements have contributed to improvement in manufacturing methods, packaging, etc., leading to the development of new products. In this respect, analysis of the state of innovation in final consumer goods, one aspect of the contribution of S&T to the economy and society, is extremely significant.

In the analysis of the state of new product development, the recent advances in the digitization of distribution have played a major part in the development of consumer goods. Virtually all products marketed in major countries bear symbols known as 'barcodes,' a product code based on the globally accepted EAN (European Article Number) code. In Japan, this is known as the 'JAN (Japan Article Number) code,' and a product database named JICFS (JAN Item Code File Service) shared by retailers and wholesalers has been developed. The following is an analysis based on JICFS statistical data on products carrying this JAN code. For an outline of the JAN code and JICFS, refer to the article entitled "JAN Code and JICFS" in NISTEP Report No. 66, April 2000 issue.

Despite limitations in statistical data on patents, stemming from differences in the nature and area of each patent, quantitative assessment and comparison of patents as a whole is meaningful in the observation of R&D activities. The same applies for products, with quantitative and holistic measurement of the state of new product development being extremely important despite the limitations created by differences in the quality of each product, in approaches to a product as a unit, and in differences due to business category. In the past, analysis of innovation chiefly focused on the process. However, studies spotlighting the product as an achievement of innovation have been rare, and comprehensive data on products viewed from the perspective of innovation are not available. Moreover, linking between the area of technology and product is likely to lead to more direct observation of the contribution of technology to product development in the future. In addition, information on products with the JAN code (such as the EAN code and the Universal Product Code, or UPC) not found in JICFS can be utilized to enable, for instance, assessment of the distribution of product life and to identify trends in new product development for broad range of consumer goods from the standpoint of distribution. With the EAN code (known as the JAN code in Japan, as mentioned earlier) expected to be accepted worldwide (scheduled to be adopted in the United States and Canada as well), indicators utilizing this code will make possible in the future international comparison of product innovation activities. The indicators shown in this section have great potential, and have been adopted in this version of the Science and technology Indicators once again on trial basis to show current conditions in Japan.

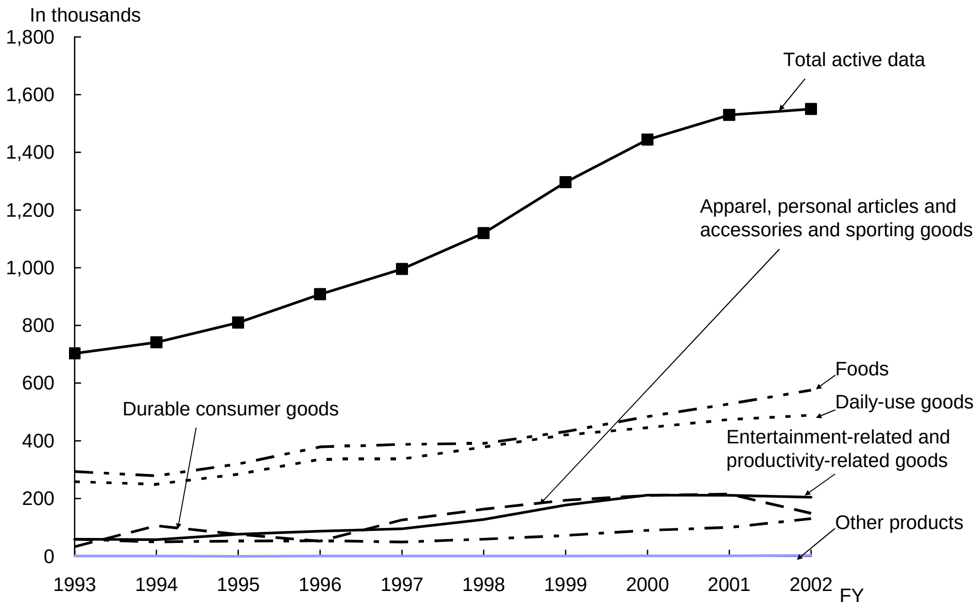
The JAN code is used not only for final consumer goods but also for many consumer goods in general. Of all the items handled in supermarkets and convenience stores today, approximately 99% have the JAN code. In addition, the ratio of JICFS in the JAN code found on such products was 85-90% in supermarkets and more than 95% in convenience stores. Existing surveys suggest that products with the JAN code not registered in JICFS are either products that have been coded independently by the retailer or products that are distributed independently in a certain region. In addition, examples of consumer goods that do not carry the JAN code are automobile components and parts (excluding car accessories), motor vehicles, home-related products (excluding those sold at home improvement retailers, and fresh produce (processed foods carry the JAN code). Therefore, JICFS can be deployed for an analysis of final consumer goods that are distributed in Japan today. It must be noted that books and magazines also carry the JAN code, but are excluded in this analytic study because they are managed separately using a different system and database.

12.2.2 Changes in the number of products and average product life

The following are the findings from observations on JICFS and the key points that have been uncovered. Note that attention must be paid in analysis on whether the data reflect real market conditions or the distinctive characteristics of the database. Even if it reflects real market conditions, values may be constant or variable. If the data are variable, it should be considered whether the interpretation reflects the achievement of technical innovation as a result of new product development or whether it reflects the achievement of non-technical innovation such as the deregulation or restructuring of the distribution system. In relation to database characteristics, it must be noted that the database service has been in operation only for short time and that there are processes in which data have been newly included in the database in large volumes due to efforts to win the participation of certain business segments and categories.

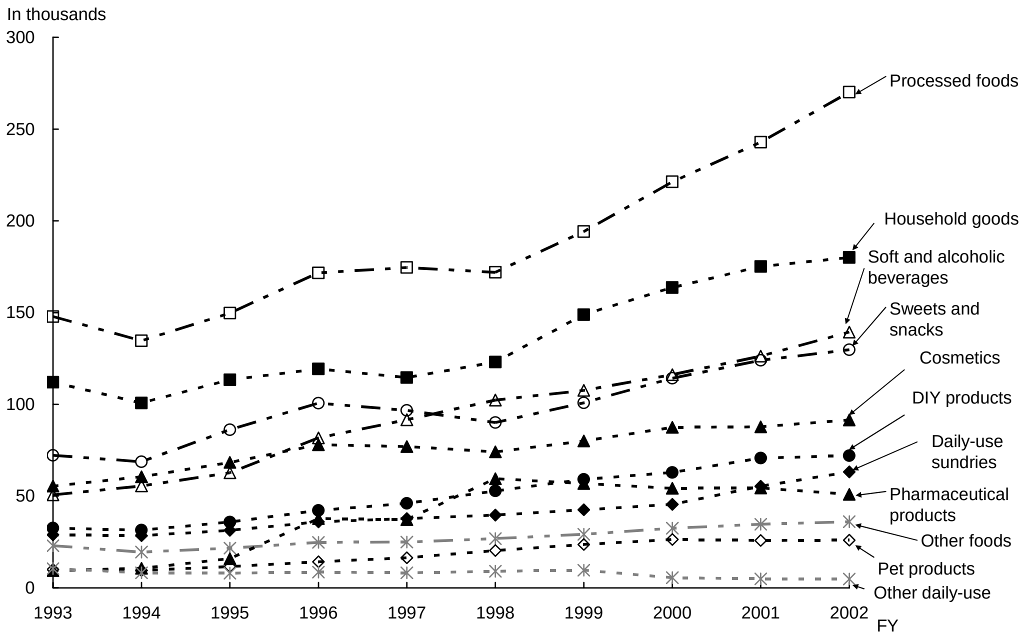
Figure 12-2-1 shows changes in the 'active data' registered in JICFS, broken down by large product categories. A general slowdown is seen, despite the increase in data volume. In the breakdown by category, both 'foods' and 'daily-use goods' show a nominal rise. On the other hand, the data have been roughly constant for 'entertainment-related and productivity-related goods' and 'durable consumer goods.' There are fluctuations by year, caused by changes in database administration. Figure 12-2-2 shows changes in the subcategories under 'foods' and 'daily-use goods.' Growth is seen in all subcategories (excluding 'others') except in 'pharmaceutical products' in recent years. The increase for 'processed foods' and 'daily-use sundries' is significant especially in the last 3 to 4 years.

Figure 12-2-1: Trends in the amount of JICFS registration data (by category)



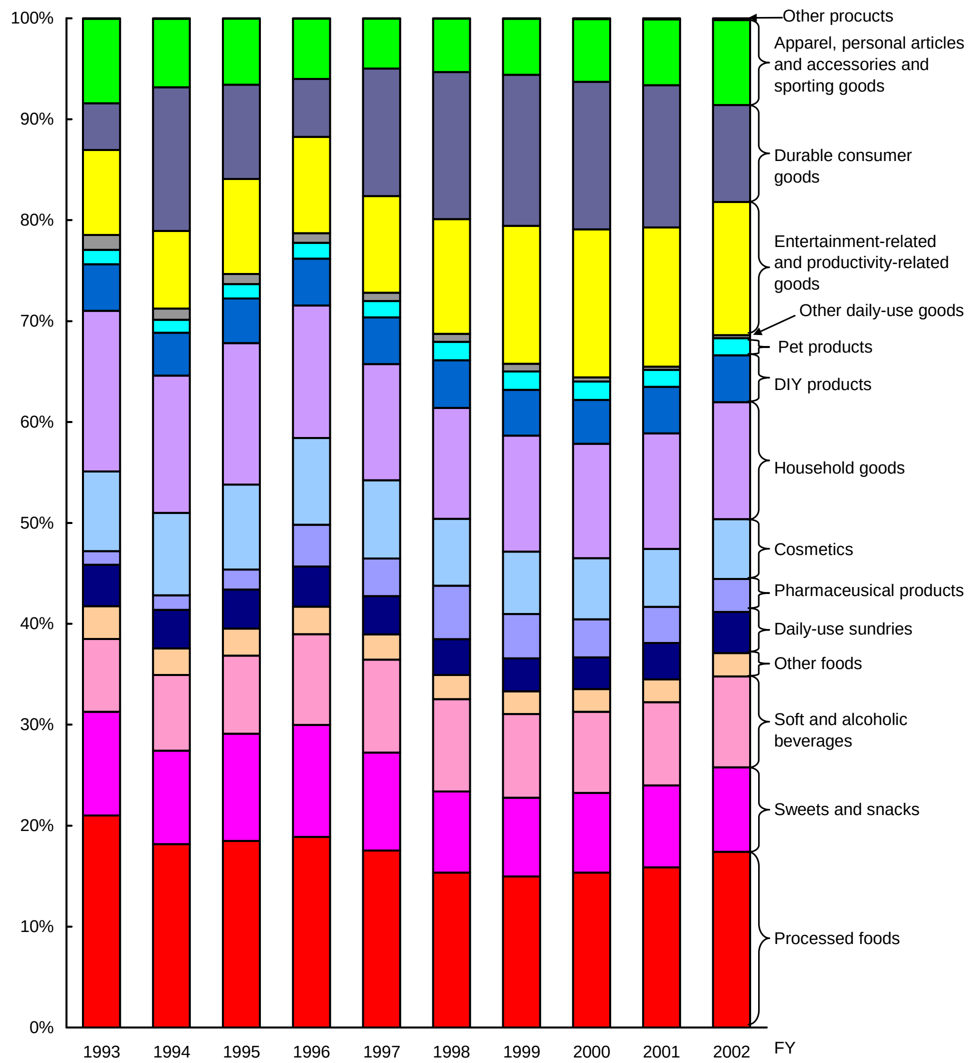
Source: Data recomputed by the National Institute of Science and Technology Policy based on JICFS (JAN Item Code File Service) data of Distribution Code Center, The Distribution Systems Research Institute
See: Table 12-2-1

Figure 12-2-2: Trends in the amount of JICFS registration data
(by subcategory under 'foods' and 'daily-use goods')



Source: Data recomputed by the National Institute of Science and Technology Policy based on JICFS (JAN Item Code File Service) data of Distribution Code Center, The Distribution Systems Research Institute
See: Table 12-2-1

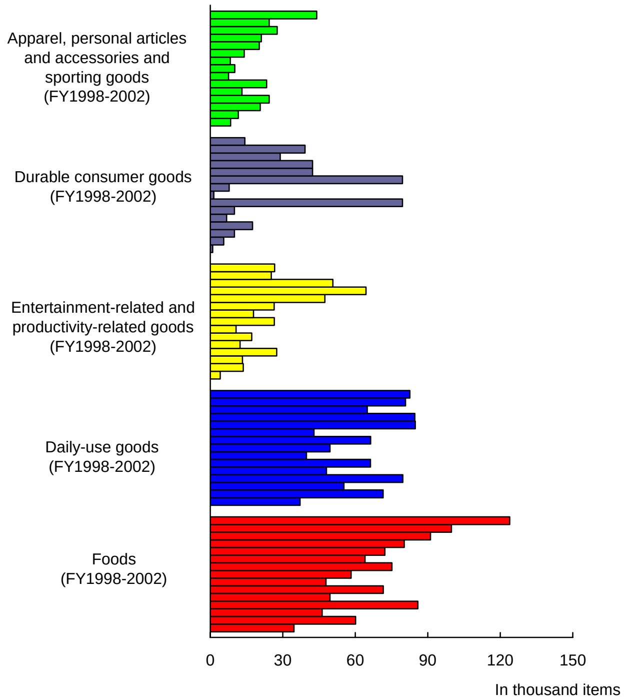
Figure 12-2-3: Trends in the amount of JICFS registration data



Source: Data recomputed by the National Institute of Science and Technology Policy based on JICFS (JAN Item Code File Service) data of Distribution Code Center, The Distribution Systems Research Institute
See: Table 12-2-3

Figure 12-2-3 shows changes in the ratio of JICFS registration data classified by category. Because of the wild fluctuations by year seen for 'durable consumer goods' included in the figure, these fluctuations are excluded in the analysis, and only distinctive and continuous trends are examined. The trend during the past three to four years is that the ratios of 'processed foods' and 'apparel, personal articles and accessories and sporting goods' have increased under the 'foods' category. On the other hand, the ratios of 'pharmaceutical products' and 'cosmetics' have declined.

Figure 12-2-4: Trends in the number of new JICFS registration data (by category)



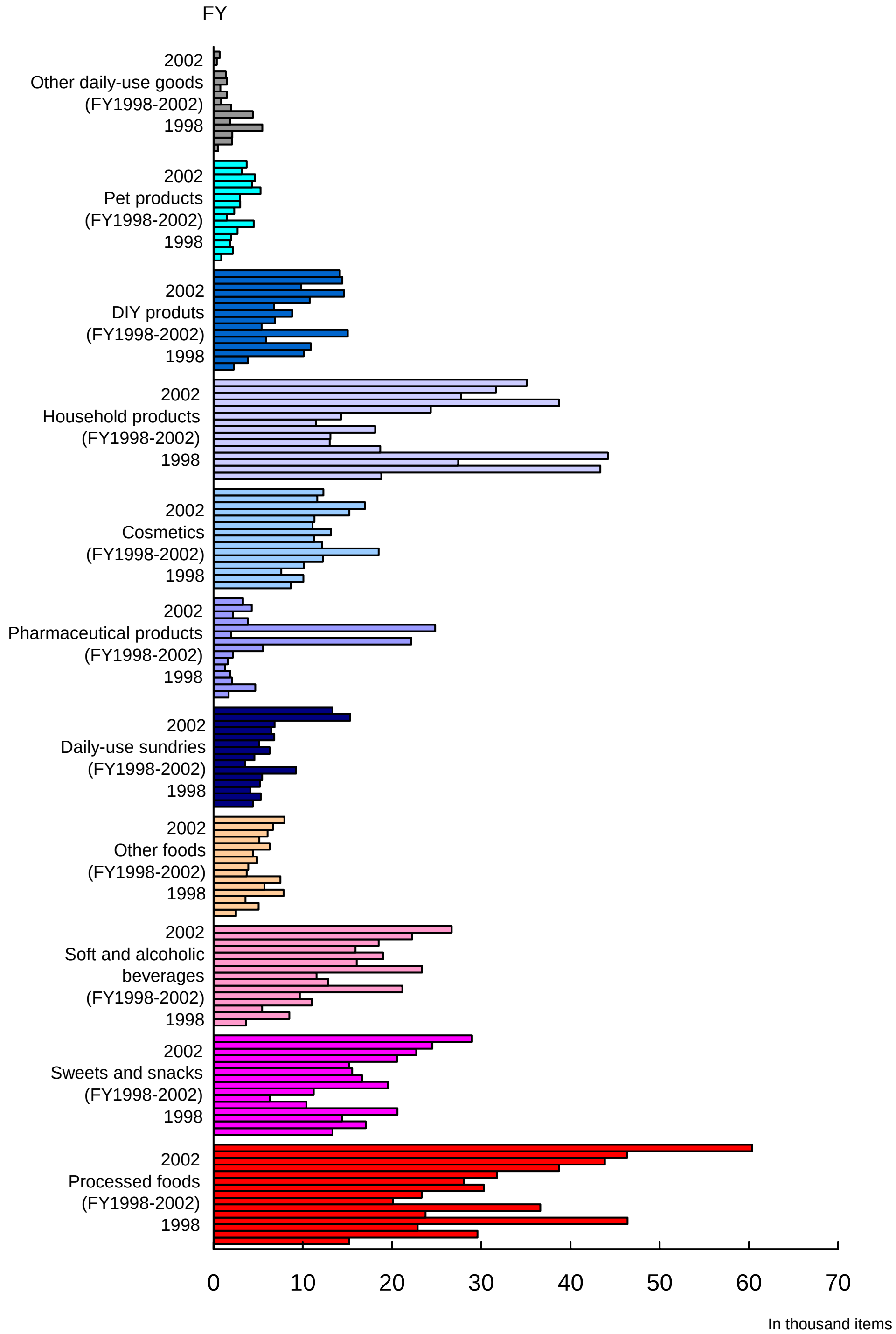
Source: Data recomputed by the National Institute of Science and Technology Policy based on JICFS (JAN Item Code File Service) data of Distribution Code Center, The Distribution Systems Research Institute
See: Table 12-2-4

Figure 12-2-4 shows changes in the amount of new data registered in JICFS, broken down by fiscal year and by category. This shows that the number of data items has increased from 80 thousand (in FY1998) to 120 thousand (in FY2002) for 'foods' during the past several years. In addition, the number for 'daily-use goods' has stayed around 80 thousand, despite fluctuations, during the past five years. Attention must be paid to 'entertainment-related and productivity-related goods' and 'durable consumer goods' due to marked variations by year. Figure 12-2-5 shows the subcategories under 'foods' and 'daily-use goods.' For 'processed foods,' 'sweets and snacks,' and 'soft and alcoholic beverages,' the number has been increasing rapidly in recent years. A point of note here, again, is the significant fluctuations by year even in the subcategories.

In 'soft and alcoholic beverages' and 'pharmaceutical products,' there is a dramatic increase in new registration in FY1996 and FY1998. Because this study looks into only the number of products registered in JICFS, it is difficult to discern whether this is the result of genuine new product development or the addition to JICFS of data related to existing products newly carrying the JAN code. According to the Distribution Systems Research Institute, data input had been conducted in several times for 'pharmaceutical products' in response to needs from the industry and its users. However, in view of the need for data sharing through JICFS for products that are distributed on a national scale, it is likely that these fluctuations are the result of some form of innovation for these products. In fact, products that are classified under alcoholic beverages and pharmaceutical products have undergone non-technical innovation such as change in marketing method and change in retail marketing, spurred by deregulation. It may be that the quantitative increase in the number of new products is the result of these changes.

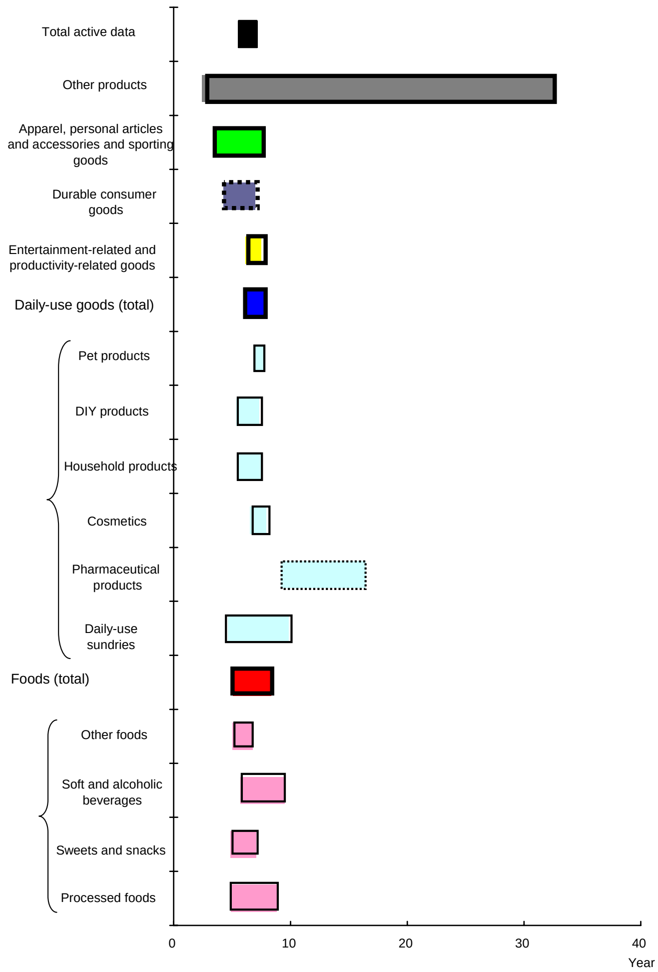
The reason for the increase in the number of new registration data items cannot be identified simply from the indicators shown in this section. However, detailed assessment of product sales data with point-of-sale information in convenience stores in recent years has reportedly prompted products that are performing poorly in this sales channel to be driven to discount stores and for commercial consumption. In addition, manufacturers are reportedly working to develop new products one after another to cater for consumer tastes. These non-technical factors in the business environment appear to be generating the trend in new product development for final consumer goods.

Figure 12-2-5: Trends in the amount of new JICFS registration data (under 'foods' and 'daily-use goods' categories)



Source: Data recomputed by the National Institute of Science and Technology Policy based on JICFS (JAN Item Code File Service) data of the Distribution Code Center, The Distribution Systems Research Institute
See: Table 12-2-5

Figure 12-2-6: Average product life by category, based on new registration into and withdrawals from JICFS



Source: Data recomputed by the National Institute of Science and Technology Policy based on JICFS (JAN Item Code File Service) data of Distribution Code Center, The Distribution Systems Research Institute
See: Table 12-2-6

The number of newly registered data items, the number of data items withdrawn and the number of registered data items in JICFS, classified by category, have been employed to calculate the average span of time for which data on each product remain active in JICFS. This span of time is tentatively called 'average product life.' Figure 12-2-6 shows the average product life by category. Data of greater accuracy can be obtained from an analysis based on new registrations and withdrawals for each product, and at the same time, the distribution of the span of data retention can be obtained. Due to limitations in data use, however, analysis was conducted for the whole by category, conducting calculation employing the number of newly registered data items and calculation employing the number of data items withdrawn. If the number of newly registered data items and the number of data items that are withdrawn remain roughly equivalent and constant, the estimation is roughly identical, and the actual conditions can be identified very closely, if the time lag caused by withdrawal taking place roughly one year later is taken into account.

The analytic findings show that the average product life based on the number of newly registered data items, despite differences by subcategory, is approximately 5.0 years for 'foods (total).' The average product life for 'daily-use goods (total)' is roughly 6.2 years. The product life is roughly five years for 'processed foods,' 'sweets and snacks,' 'soft and alcoholic beverages,' and 'daily-use sundries.' In contrast, the average product life for 'durable consumer goods' is roughly seven years, which is longer than any other of the newly registered data items. When examined considering the number of data items withdrawn, product life becomes shorter compared to the other categories. A particular point of note is the significant increase in the number of data items withdrawn during FY2002. In the calculation of product life for data for FY2000 and FY2001, the average product life ranges from 6.26 to 7.32, roughly comparable to that for 'daily-use goods (total)' and 'entertainment-related and productivity-related goods.' The fact that the average life for 'durable consumer goods' is roughly identical to that of 'daily-use goods' can be imagined easily from the Japanese lifestyle. However, this is a very interesting finding in view of the nature of 'durability' expected from durable consumer goods. In other words, products are being launched in the market with product characteristics similar to 'daily-use goods,' with new products released in the marketplace in succession to replace existing products.

More refined and ongoing data analysis is expected to uncover the actual state of innovation from the perspective of new product development.

12.3 The economic environment surrounding new start-up firms

Since the start of the 1990s, the Japanese economy has experienced an economic slowdown of unprecedented scale. As mentioned in section 12.1, the TFP growth rate in the manufacturing industries that have driven the technological progress of Japan slowed down in the 1990s. This is chiefly attributed to the decline in new metabolic function of the market.

To escape this recession and to succeed in the transition to a new economic structure, Japan places high hopes in its small and medium enterprises (hereinafter SMEs), especially in startup firms.

SMEs have the versatility to respond quickly to economic changes and at the same time create new industries based on new technologies. For this reason, expectations are high for their potential to increase the national income level. Furthermore, the increase in the number of such enterprises is expected to stimulate 'new metabolism' in markets.

In view of this development, this section examines the economic environment surrounding Japan's new enterprises, based on comparison with other countries.

The section below examines Japan's ratios of business closings and startups compared with those of other countries. Based on these data, the relationship between the economic growth rate and business startup rate is examined. This is followed by an examination of Japan's securities market as the infrastructure surrounding SMEs, as well as the current state of venture capital. Finally, indicators will be presented on innovation activities at SMEs.

12.3.1 The birth and death rates of Japanese firms

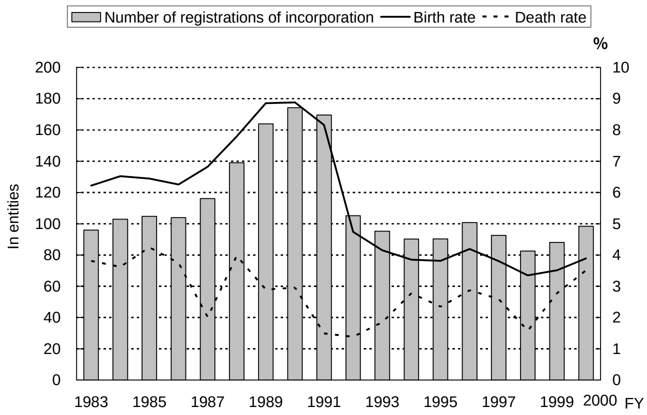
As already mentioned, new startup firms are expected to have the potential to create new industries and employment, and raise the national income level.

Figure 12-3-1-1 shows the birth rate (the entry rate) and the death rate (the exit rate) of Japanese firms over time. The figure shows that the number of registered incorporated entities shown in the form of a bar graph peaked around 1990 and has remained at around 10,000 thereafter.

The birth and death rates of Japanese enterprises are shown by the dotted line in the figure. The exit rate is similar to the registration of incorporated entities in that the number peaked around 1990 and has been on a moderate declining curve since then.

In contrast, both birth and death rates have been on the rise since 1991, especially over the recent years. In fact, the gap between the birth and death rates is gradually narrowing each year, with both levels settling at around 4%.

Figure 12-3-1-1: Birth and death rates of Japanese firms



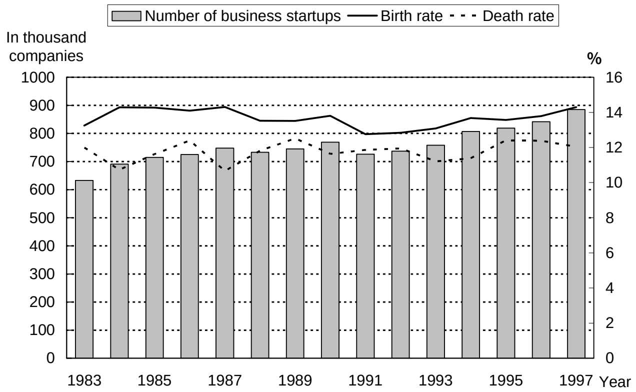
Sources: "White Paper on Small and Medium Enterprises "(Small and Medium Enterprise Agency),"Report on the Results of the Corporation Sample Survey (National Tax Agency)' and "Minji, Shomu, Jinken Tokei Nenpou (Ministry of Justice)"
See: Table 12-3-1-1

The number of new startups, the birth rate and the death rate in the United States over time are shown in Figure 12-3-1-2. The number of startups in the US is shown in the bar graph in Figure 12-3-1-2. In 1997, the number of startups in the us exceeded 880, 000, which is roughly 10 times the number of business enterprises registered in Japan during the same year.

The birth rate and death rate in the US are shown by the dotted lines in Figure 12-3-1-2. The birth rate, despite some fluctuations, remained around 13-14%. At the same time, the death rate is also constant around 11-12%. The net growth rate shown by the difference between the birth rate and the death rate is roughly 1-2%. This trend has continued.

As the data show, birth and death rates in the US show the large-scale births and deaths of business enterprises, while the rates in Japan remain on a smaller scale.

Figure 12-3-1-2: Birth and death rates in the United States



Source: "The State of Small Business: A Report of the President (The U.S. Small Business Administration) "
See: Table 12-3-1-2

A large difference can be seen in the level of birth rate and death rate between Japan and the United States. This section examines whether a similar difference is seen in European countries.

The birth and death rates for European countries are reported in Appendix Table 12-3-1-4. The values shown in the table are the average levels of annual birth rates (death rates) from 1995 to 2000(4).

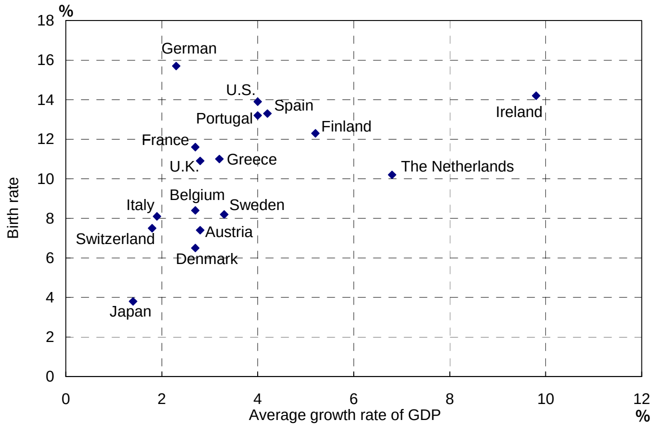
The table shows that the birth rate is 11.6% in France, 15.7% in Germany, 8.1% in Italy and 10.9% in the United Kingdom. On the other hand, Japan's counterpart is 3.8%, while the average birth rate for the United States from 1995 to 1997 was 13.9%. Even for Denmark, which has the lowest birth rate among European countries, had entry rate of 6.5%, showing that the level of Japan is lower than those of European countries.

There is also a large gap between Japan and Europe in death rates. In Europe, the exit rate is 12.6% for Germany, 6.5% for Italy and 10.3% for UK, showing that many countries have a far higher exit rate than Japan.

These findings show that Japan's birth and death rates are on a low level compared to most western countries.

Figure 12-3-2: Birth rate and economic growth

Source: Data recomputed by the National Institute of Science and



Technology Policy based on "STAN Database," OECD
See: Table 12-3-1-4

Considering the potential of new startup firms in creating new industries and in contributing to improvement in national income level, the relationship between birth rate and economic growth rate is shown in Figure 12-3-2.

This figure shows the birth rates in the OECD countries and their relationship with the average growth rate of GDP. The vertical axis on the graph shows the average birth rate for the six years from 1995 to 2000. The horizontal axis shows the average growth rate of GDP for the same period of time.

This growth shows that countries with a high birth rate generally show a high level of GDP growth. Of course, there is also the reverse causality in which high economic growth rate raises the birth rate. For this reason, it is necessary to consider the fact that an increase in business startup rate does not immediately translate into the acceleration of economic growth(5).

(4) Average birth rates for 1995-1998 for Denmark and Portugal, 1997-2000 for Germany, 1995-1999 for Greece, Ireland and UK and 1996-2000 for Spain.

(5) The relationship between birth rate and economic growth (or greater productivity) is shown to be in direct correlation in both Holtz-Eakin and Kao (2003) and in Holtz-Eakin and Rose (2004).

12.3.2 Changes in the number of business enterprises listed on stock exchanges

One of the goals of startup firms is to achieve business growth. Initial Public Offering (IPO) can be regarded as one of the indicators related to the growth of startups. This is because the value of the firm rises so that its stocks can be offered to the public. In this section, the number of business enterprises newly listed on stock exchanges over time in Japan and the United States are shown.

Appendix Table 12-3-2 shows the changes in the number of business enterprises newly listed on stock exchanges in Japan and the United States. The number of listed enterprises and the number of newly listed enterprises in Japan are based on the " Monthly Statistics Report May 2002 No, 547 (Tokyo Stock Exchange)," and the numbers for the United States are based on the "2002 National Venture Capital Association Yearbook".

The number of business enterprises listed in the Tokyo Stock Exchange has been on the rise since 1990. The numbers stood at 1651 in 1990 and rose by 27.4% to 2103 in 2001. The number of newly listed enterprises is similarly growing, from 15 in 1990 to 92 in 2001.

In the United States, the numbers of newly listed business enterprises from 1997 to 2001 were 519 in 1997, 337 in 1998, 508 in 1999, 351 in 2000, and 110 in 2001.

Comparison shows that the number of business enterprises going public in Japan was less than a tenth of that in the United States in 1997 but rose to roughly the same level in 2001.

The increase in the number of newly listed enterprises was most likely caused by the opening of new securities markets and other developments that encouraged initial public offerings.

12.3.3 Scale and scope of venture capital investment

Startup firms are expected to face various constraints in the process of business growth. The most serious hurdle may be to procure funds.

In the United States, venture capital is regarded as an important force for new startup firms, not only for supplying funds but also for providing managerial assistance. In particular, venture capital is regarded as the supplier of investment to business enterprises with outstanding business potential.

According to Appendix Table 12-3-2, the number of firms listed on stock exchanges in the United States and supported by venture capital was 136 in 1997, 77 in 1998, 257 in 1999, 226 in 2000, and 7 in 2001.

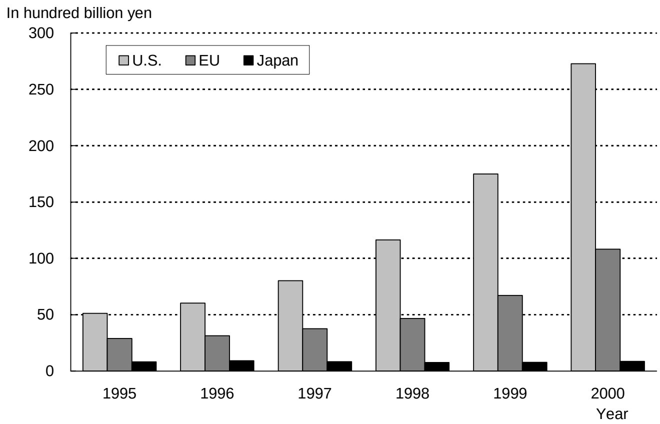
The following is a comparison of Japan, United States and Europe in terms of venture capital investment scale and beneficiaries of their investment.

The investment (flow) in the United States in 1995 was 741 billion yen, roughly five times that of Japan. Venture capital investment in Europe was also 4.2 times greater than that of Japan. The gap between these two regions of the world has continued to grow, with 52 times greater investment in the United States and 17 times greater investment in Europe that in Japan (see Appendix Table 12-3-3-1).

A similar trend can also be seen in venture capital investment (stock).

Figure 12-3-3 shows the venture capital investment (stock) for Japan, the United States and Europe.

Figure 12-3-3: The scale of venture capital investments (stock)



Source: Data based on "Venture Capital Investments Survey" (2002), Venture Enterprise Center
See: Table 12-3-3-1

In the comparison of Japan's venture capital investment to that of the United States and Europe, the US and Europe had 6.2 times and 3.2 times, respectively, greater venture capital investment than in Japan. In the year 2000, the gap widened further to 31 times and 12.6 times, respectively.

The gap may be due to the fact that banks remain the leading supplier of funds even for startup firms. At the same time, it may be due in part to the fact that Japanese venture capital does not provide investment but chiefly loans.

Next, this section examines industries to which venture capital supplies funds. Appendix Table 12-3-3-2 shows the scale and scope of venture capital investment in Japan.

In the 1980s, the principal beneficiaries of venture capital were in the semiconductor and business services industries in Japan. Starting in the latter half of the 1990s, investment increased in computers, biotechnology, consumer services and internet-related businesses. Simultaneously, the scale of investment is growing.

On the other hand, Appendix Table 12-3-3-3 shows the beneficiaries of venture capital investment in four European countries. In the breakdown of venture capital investment in 2001 in France, Germany, Italy and the UK, the principal areas of investment in France were consumer-related businesses (18.3%), manufacturing (18.0%) and communications (13.8%).

In Germany, the largest share of investment went to chemicals (15.3%), computer-related businesses (15.0%) and consumer-related businesses[6] (14.5%). In Italy, telecommunications holds the largest share, with 38% of the total investment. This is followed by other manufacturing industries, with 11.4%. In the UK, consumer-related businesses (23.1%) and communications (14.0%) are the major areas of investment.

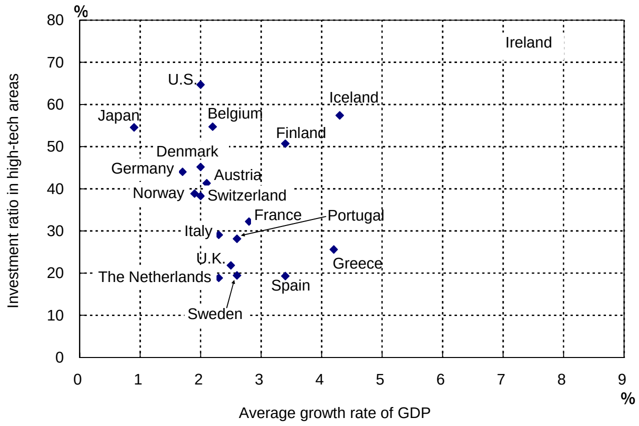
Appendix Table 12-3-3-5 shows the fields of venture capital investment in the United States. In 2001, investment was largest for computer software and biotechnology. These show that Japan, the United States and European countries place greater emphasis on high-tech industries as beneficiaries of venture capital spending.

Venture capital seems inclined to support new firms with growth potential. Such enterprises are expected to ultimately contribute to the growth of the national economy. The relationship between venture capital investment ratio to high-tech areas and the economic growth rate is shown in Figure 12-3-4.

The vertical axis of the figure shows the ratio of total investment by venture capital into high-tech areas. The vertical axis shows the average GDP growth rate. In addition to data on venture capital investment, the average GDP growth rate has been defined as the three-year average for the period from 1999 to 2001.

High-tech areas are defined, in compliance with definition in the "EVCA Yearbook" of European Private Equity & Venture Capital Association, as information and communication equipment, internet technology, computer hardware and software, electronics, semiconductors, biotechnology and medical equipment.

Figure 12-3-4: Venture capital investment and economic growth



Source: Data recomputed by the National Institute of Science and Technology Policy based on" EVCA Yearbook," European Private Equity & Venture Capital Association, and "2002 Yearbook," National Venture Capital Association
See: Table 12-3-3-6

In the relationship between the average growth rate of GDP and venture capital investment into high-tech areas, a clearly direct correlation could not be found (Figure 12-3-4). For this reason, attention should be paid to the fact that high-tech investment is not immediately linked to economic growth.

(6) Consumer-related businesses are in the areas of consumer goods, services, recreation and entertainment, and retail sales.

12.4 Innovation activities by SMEs

This section introduces the indicators related to innovation activities by SMEs. Since innovation activities are broad in range, it is not easy to elicit appropriate indicators.

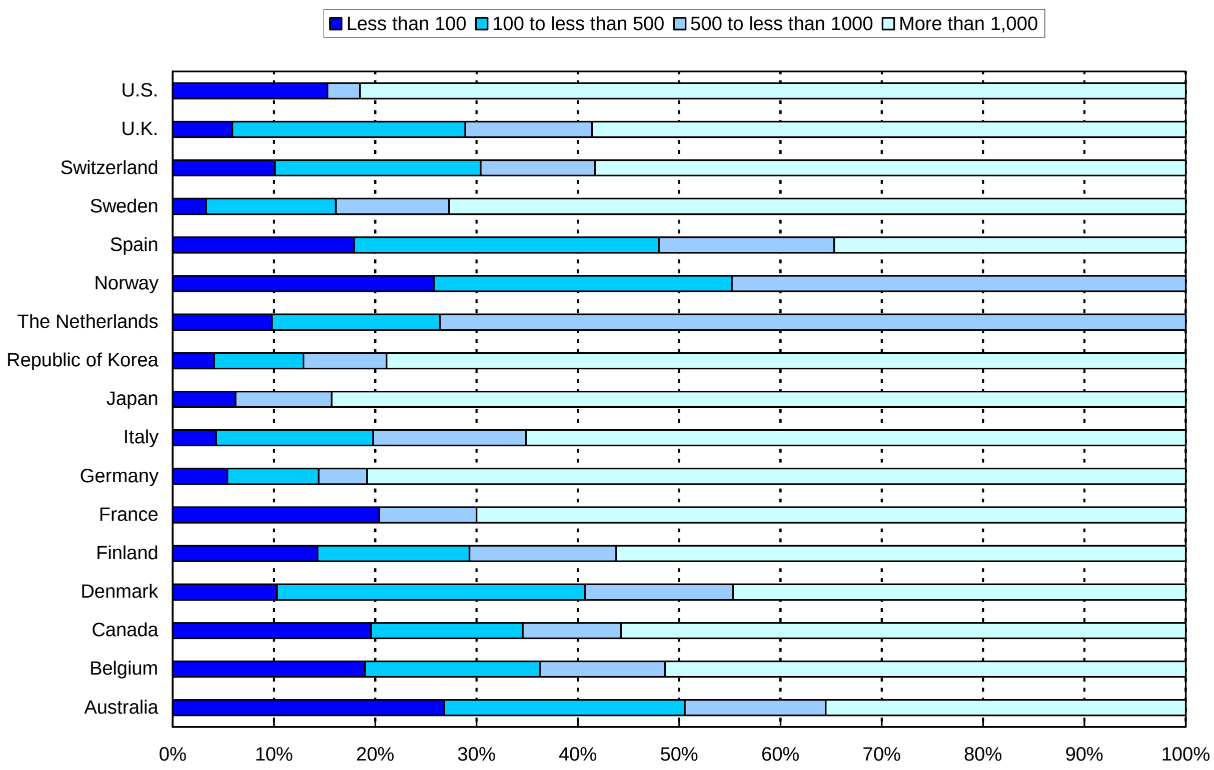
In fact, there may be a variety of indicators, such as patents, number of new products, etc., to represent innovation activities. On the other hand, however, the number of indicators available for international comparison of SME innovation activity is small.

This section begins with an international comparison of R&D expenditure of SMEs, based on OECD's "Small and Medium Enterprise Outlook 2000 Edition." Innovation activities in SMEs are very often discussed in comparison with those in large firms. For this reason, an international comparison was conducted on the ratio of SMEs vis-à-vis large firms in R&D expenditure.

This is followed by a presentation on the findings of the second Community Innovation Survey (CIS 2) conducted in European countries. Here again, the data are organized to find whether SMEs are more innovative than large firms.

Figure 12-4-1 shows the relationship between R&D expenditure and firm size in OECD countries, including Japan[7].

Figure 12-4-1: Firm size and R&D expenditure



Source: "Small and Medium Enterprise Outlook 2000 Edition", OECD
See: Table 12-4-1

(7) Data for Australia, The Netherlands and Switzerland as of 1996; data for Finland, Japan, South Korea, UK and US as of 1997; all others as of 1995.

The horizontal axis on the graph in Figure 12-4-1 shows the percentage of R&D expensed by each size class in total industrial R&D. In Japan, for instance, R&D expensed by firms with less than 100 employees makes up 6.2% of total industrial R&D. In other words, the vast majority (84.6%) of industrial R&D in Japan are conducted by firms with more than 1000 employees.

Countries in which large firms share the most parts of industrial R&D are the United States (81.6%), Germany (80.8%) and South Korea (78.9%) (see Appendix Table 12-4-1).

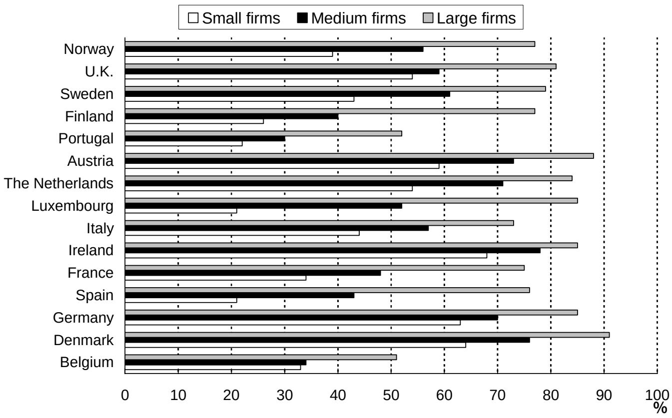
On the other hand, the share of SMEs is relatively large in countries such as Austria, Denmark and Spain. In these countries, the shares of firms with more than 1000 employees are 34.7% for Spain, 35.5% for Austria and 44.7% for Denmark.

Looking into R&D expenditure by firm size, it is not easy to conclude that large firms carry greater weight in all countries. Although this depends in some way on how firm size is measured, there are countries in which relatively small firms contribute a significant portion of industrial R&D. The findings show that R&D activities by SMEs cannot be ignored in such countries.

This section also examines the relationship between firm size and innovation, as shown in Figures 12-4-2 and 12-4-3.

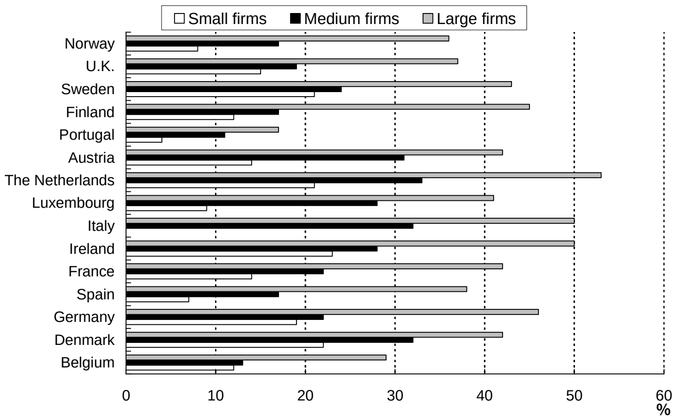
Figure 12-4-2 shows innovators, that is, “firms that have introduced technologically new or significantly improved products or services to the market, or have introduced technologically new or significantly improved processes to the firm” in the definition of the CIS 2. ‘New’ as used in this context does not necessarily mean new to the world, to the country or to the enterprises’ market. The requirement is that the product, process or service must be new to the firm. As for ‘significantly improved’, it is defined as an objective improvement in the performance of a product / service or in the way in which it is produced or delivered (Statistics on Innovation in Europe Data 1996-1997). This must be differentiated from ‘novel’ innovator described later.

Figure 12-4-2: The ratio of innovators classified by firm size



Source: "Statistics on Innovation in Europe Data 1996-1997," European Commission
See: Table 12-4-2

Figure 12-4-3: The ratio of 'novel' innovators classified by firm size



Source: "Statistics on Innovation in Europe Data 1996-1997," European Commission
See: Table 12-4-3

Figures 12-4-2 and 12-4-3 show the relationship between firm size and innovation activities in manufacturing in countries. Firm sizes are classified into small, medium and large firms, based on the number of employees. Firms with 20 or more than 20 and less than 50 employees are classified as small firms, firms with 50 or more and less than 250 employees classified as medium firms, and firms with 250 or more employees classified as large firms.

The bar graphs in the figures show the percentage of firms in each class that are engaged in innovation. For instance, in Belgium, small firms engaged in innovation account for 33% of all small firms in the country.

A large percentage of firms engaged in innovation among large firms can be seen in Denmark (91%), Austria (88%), Germany (85%), Ireland (85%) and Luxembourg (85%). However, there are many small and medium enterprises engaged in innovation as well. For instance, the ratios of firms engaged in innovation in the small firm group in these countries are 64% for Denmark, 63% for Germany, 68% for Ireland and 59% for Austria (see Appendix Table 12-4-2).

Figure 12-4-3 examines the percentage of 'novel' innovators in each size class. Here, 'novel innovator’ is defined as the enterprise which has introduced products or services which were new not only to the enterprise itself but also to its market.

In the comparison of Figure 12-4-2 and Figure 12-4-3, the ratio of novel innovators is smaller than innovators in general. This trend is seen in all size classes. However, there are significant differences by country, with novel innovators accounting for more than 50% of large firms in The Netherlands and Ireland.

For small firms, the ratio of novel innovators is highest at 23% (in Ireland and Italy), which is relatively low compared to the percentage for large firms. Notwithstanding, this can be interpreted as the ratio being as high as 23% for small firms engaged in novel innovation in such countries.

To sum up, there are countries where R&D concentrates among large firms and countries where smaller firms account for the large part.

In the comparison of smaller and large firms in innovation indicators, firms engaged in innovation and 'novel' innovation account for a relatively large portion of the group for large firms. However, the contribution by small firms is not negligible[(8)].

References

1. Kyoji Fukao, et al, "Economic Analysis No. 170: Productivity by Industry and Economic Growth: 1970-1998", 2003, Economic and Social Research Institute, Cabinet Office

2. OECD, 2001, Measuring Productivity OECD Manual: Measurement of Aggregate and Industry-Level Productivity Growth

3. Douglas Holtz-Eakin and Chihwa Kao, 2003, Entrepreneurship and Economic Growth: The Proof Is in the Productivity, Center for Policy Researcher Working Paper No. 50, Syracuse University

4. Douglas Holtz-Eakin and Harvey S. Rosen, 2004, Public Policy and Economics of Entrepreneurship, the MIT Press

(8) In European countries, the third Community Innovation Survey (CIS 3) was conducted following the CIS 2. The CIS 3 data by country were not available when this section was produced. For this reason, data from the CIS 2 were used. In Japan, the National Institute of Science and Technology Policy is currently conducting a survey comparable to the CIS 3.

Chapter 13
Public Interest in Science and Technology

For general improvement in Japan's S&T capabilities as a nation, it is necessary to upgrade the interest and understanding of the Japanese people as a whole toward S&T. This is because the S&T capability of a nation cannot improve without basic understanding and knowledge of S&T by its society. For this purpose, action must start with an assessment of public interest and understanding in this area, followed by development of a plan to address the situation. This chapter presents the findings of various polls conducted for this purpose. This is followed by an investigation into public interest in bioscience and biotechnology, as well as sources to gain S&T information, etc., in order to understand the current state of cutting-edge science and technology.

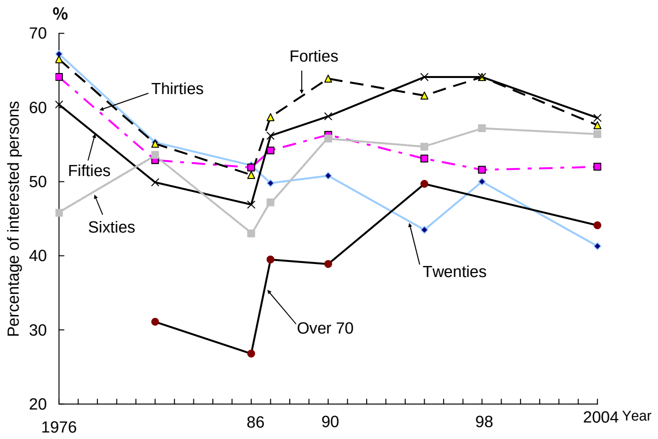
13.1 Public Awareness of S&T in General

13.1.1 Changes in interest toward S&T

Figure 13-1-1 shows the changes in public interest in S&T based on age group. As of 1976, people in their twenties, who ranked top in terms of interest, steadily declined in interest, falling to the bottom in ranking in the 1995 survey. In the 1998 survey, people in their thirties became the second lowest ranking in terms of S&T interest. Instead, people in their forties and fifties show great interest in this area.

The interest level as of 1998 was 50.0% for people in their twenties, 51.6% for those in their thirties, 64.1% for people in their forties, 64.1% for people in their fifties, and 57.2% for those over 60.

Figure 13-1-1: Trends in interest toward S&T (breakdown by age group)



Notes: 1. Interest level in this survey is the total number of respondents who showed 'great interest' or 'some interest' in the 1976 survey. In the surveys conducted in 1981, 1987, 1990 and 1995, the level is the total number of respondents who said they were 'very interested' or 'somewhat interested.' In the 1986 survey, the level is the total number of respondents who said they were 'very interested' or 'slightly interested.' The level in the 1998 survey is the total number of those who expressed either 'interest' or 'some measure of interest.'
2. Persons in their sixties in the 1976 and 1998 surveys included those aged 70 above.
Source: Cabinet Office Polls (1976, 1981, 1986, 1987, 19 90, 1995 and 1998)
See: Table 13-1-1

13.1.2 International comparison of interest and understanding

In the level of interest of the public, interest in S&T is declining, and at a sharper rate among young people, as shown in Figure 13-1-1.

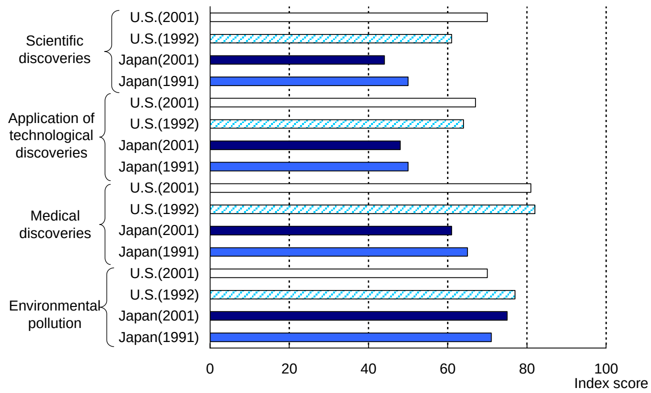
Figure 13-1-2 is a comparison of interest toward S&T-related issues (expressed in index score) between Japan and the United States. In contrast to the growing interest in the US toward scientific discoveries, interest in Japan was roughly 50 index score in 1991, falling to 44 index score 10 years later. Interest in the application of newly discovered technology also fell, but at a lower rate, from 50 to 48 index score. Apart from the issue of the decline in interest, these findings show that less than half of the Japanese population has interest in scientific discoveries or the application of new technologies.

Although Japanese interest toward medical discoveries exceeds 60 index score, interest in this area has also declined over the past decade from 65 to 61 index score.

The only trend that differs is interest in environmental issues. While interest in the US has declined from 77 to 70 index score, interest in Japan has risen from 71 to 75 index score.

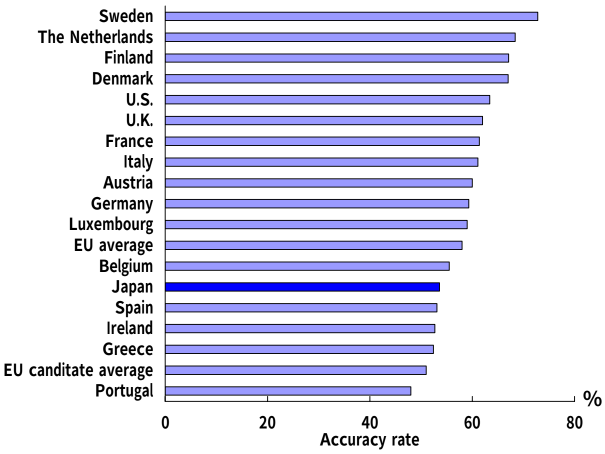
Figure 13-1-3 shows an international comparison of average accuracy in response to 11 questions on basic concepts in science and technology (such as 'the core of the Earth is extremely hot,' 'antibiotics kill both bacteria and viruses,' and 'the size of an electron is smaller than an atom'). (Accuracy rates for US, EU, average for EU candidate nations and Japan.) The rate for Japan falls short of the EU average and belongs in the lower half of the nations.

Figure 13-1-2: US-Japan comparison of interest in issues related to S&T



Note: Index scores were calculated by assigning a value of 100 for a 'very interested' (level of interest) of 'well informed' (sense of being well informed) response × 100 points, a value of 50 for a 'somewhat interested' or ' somewhat informed' response, and a value of 0 for a 'uninterested' / 'uninformed' or 'I don't know' response.
Source: 'Science and Technology White Paper (FY2003)," Ministry of Education, Culture, Sports, Science and Technology
See: Table 13-1-2

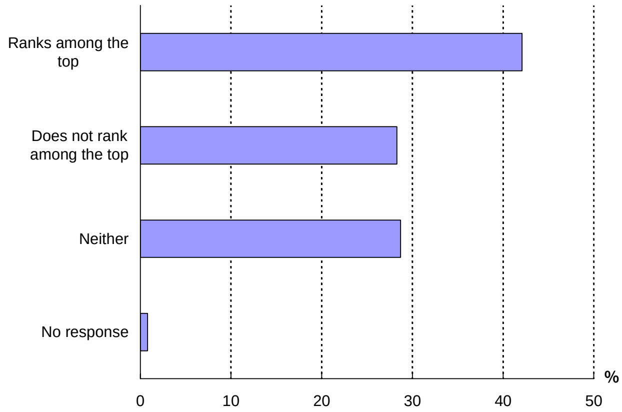
Figure 13-1-3: International Comparison of Understanding of Basic S&T Concepts (average accuracy of response to 11 questions)



Note: Survey conducted in 2001 for the US Japan and EU and in 2002 for EU candidate (13 countries).
Source: 'Science and Technology White Paper (FY2003),' Ministry of Education, Culture, Sports, Science and Technology (MEXT) and 'Candidate Countries Eurobarometer 2002.3 Research November 2002'
See: Table 13-1-3

As the figure shows, Japanese interest in and understanding of science and technology is not high from an international perspective. On the other hand, a survey on whether Japan's S&T level compares with the top nations in the world shows that 42.1% believe that Japan belongs among the top class (Figure 13-1-4).

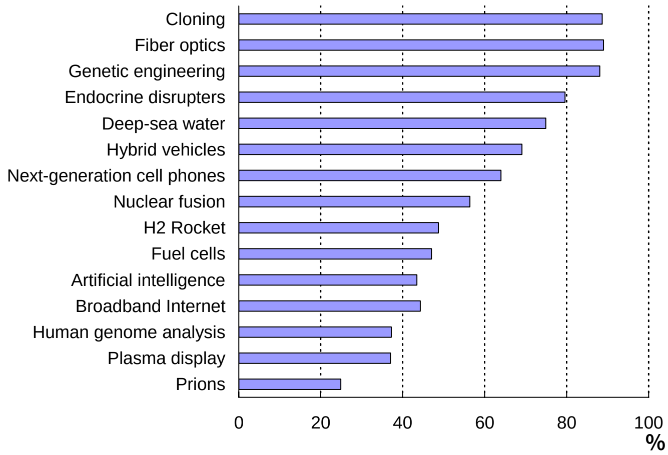
Figure 13-1-4: Japan's S&T level



Note: A nationwide survey of 1,800 Japanese citizens aged over 16 (response rate of 73.1%)
Source: 'Public Opinion Survey on Science and Technology and Bioethics," Broadcasting Culture Research Institute, NHK
See: Table 13-1-4

Figure 13-1-5 shows the ratio of S&T terms that have been introduced in recent years that have been seen or heard by respondents.

Figure 13-1-5: Recognition of S&T terminology



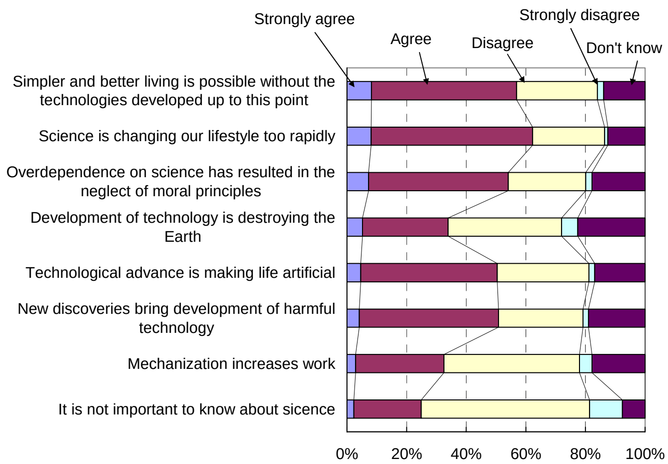
Note: Multiple-choice answers.
See: Same as Figure 13-1-4

The recognition level of terms that have attracted attention in relation to current events and those related to health issues, such as cloning (88.7%), genetic engineering (88.1%) and endocrine disrupters (78.6%), drew a recognition of nearly 80% or higher. In addition, terms that are closely related to everyday living drew a high recognition level, with 89.0% for fiber optics, 74.9% for deep-sea water, 69.1% for hybrid vehicles and 64.0% for next-generation cell phones.

On the other hand, recognition was not high for terms related to advanced technologies such as the H2 Rocket (48.7%), fuel cells (47.0%) and human genome analysis (37.2%).

In view of this, what opinions do people have regarding advances in science and technology? Figure 13-1-6 shows the results of reactions toward eight opinions related to S&T.

Figure 13-1-6: Reaction to opinions on S&T

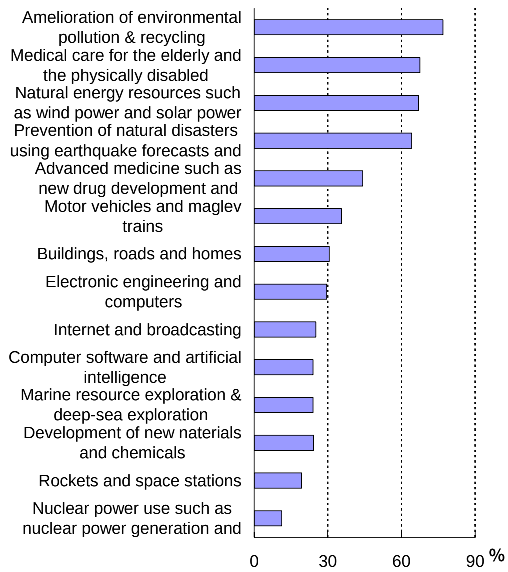


Note: Nationwide survey of 3,000 Japanese citizens aged over 18 (response rate of 71.5%)
Source: 'Awareness Survey on Science and Technology' (2001), National Institute of Science and Technology Policy
See: Table 13-1-6

The results show the following. Opinion is roughly split between people who believe that 'science is changing our lifestyle too rapidly,' 'overdependence on science has resulted in the neglect of moral principles,' 'new discoveries bring development of harmful technology,' and 'simpler and better living is possible without the technologies developed up to this point' and people who do not believe 'mechanization increases work' and think that 'it is important to know science.'

So, what expectations do people have of S&T? The findings of a poll on research areas where people hope to have greater future emphasis placed are shown in Figure 13-1-7.

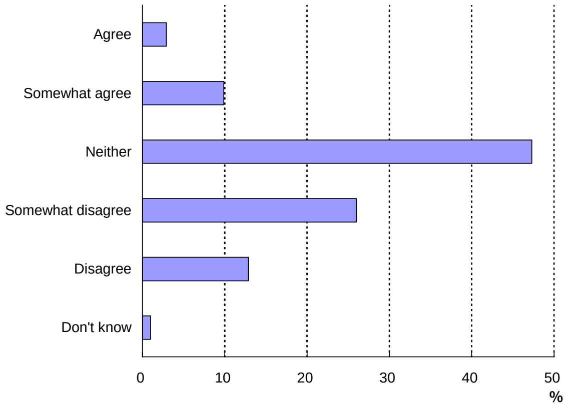
Figure 13-1-7: Research areas where greater future emphasis should be placed



Source: Same as Figure 13-1-4
See: Table 13-1-7

The findings show that the areas that people want greater emphasis to be placed are: 'Amelioration of environmental pollution and recycling' (76.9%), 'medical care for the elderly and physically disabled' (67.5%), 'natural energy resources such as wind power and solar power generation' (67.0%) and 'prevention of natural disasters using earthquake forecasts and weather forecast technologies' (64.2%). These show that the public is interested in environmental, medical and disaster-prevention issues that are closer to their everyday lives.

Figure 13-1-8: Opinions toward science education



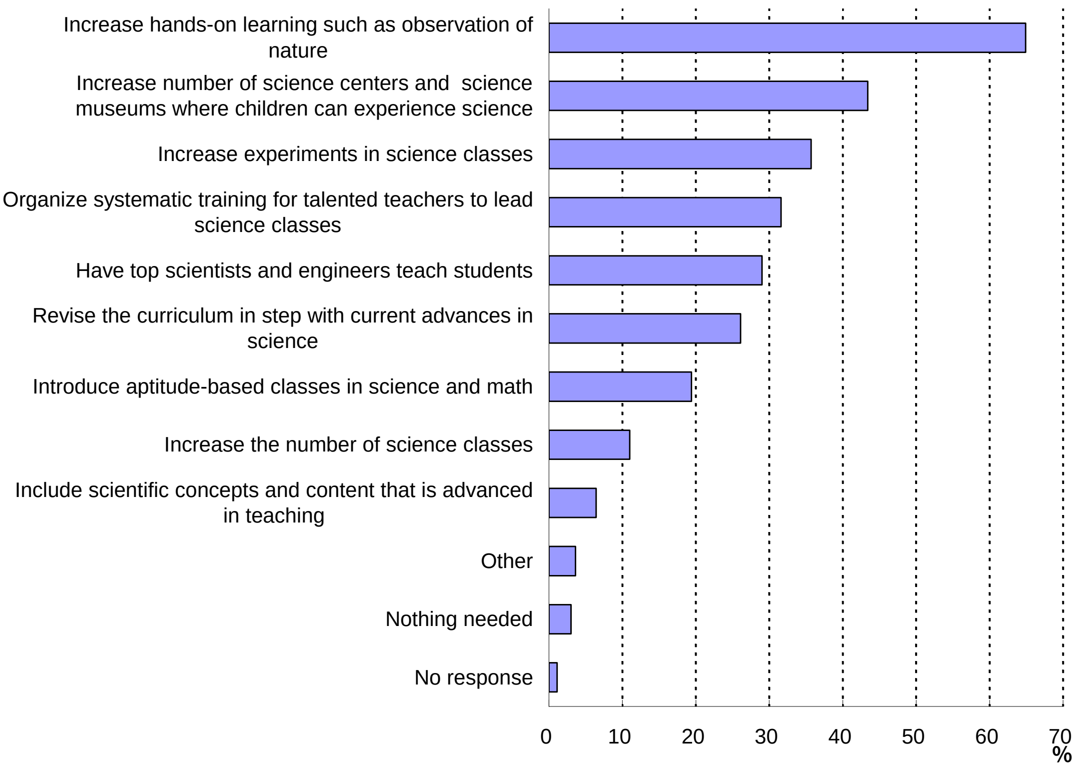
Note: Responses to the question, 'Do you believe that the current science education in Japan's elementary, junior high and high schools is adequate?'
Source: Same as Figure 13-1-4
See: Table 13-1-8

In realizing these expectations, how do people discern the current state of science education provided to the younger generation to lead society in the future? Figure 13-1-8 shows the findings of public opinion toward science education implemented in Japanese elementary, junior high and high schools.

The responses showed that only 12.8% of the respondents think that science education in Japan is adequate and that 38.9% think otherwise (with 47.3% undecided). The responses to the question on their expectations toward science education in the future are presented in Figure 13-1-9.

The figure shows that there are few respondents who want to 'increase the number of science classes' (11.0%), while many place hope on experience-based learning such as 'increase hands-on learning such as observation of nature' (64.9%), 'increase number of science centers and science museums where children can experience science' (43.4%) and 'increase experiments in science classes' (35.7%).

Figure 13-1-9: Expectations toward science education in the future



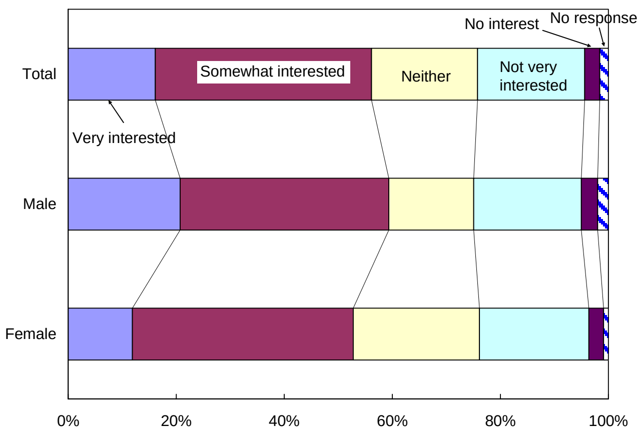
Note: Responses to the question, 'What do you believe is necessary to upgrade the quality of science education in Japan?'
Source: Same as Figure 13-1-4
See: Table 13-1-9

13.2 Public awareness of life science and technology

13.2.1 Interest in life science and technology

The recent advances in life science and technology are dramatic. What is the opinion of the general public on these developments? The findings on their interest are shown in Figure 13-2-1.

Figure 13-2-1: Interest toward life science and technology developments



Note: Nationwide survey of 4,000 Japanese citizens aged over 20 (response rate of 27.1%)
Source: 'National Awareness Survey on Human Embryo Research' (2002), Cabinet Office
See: Table 13-2-1

Overall, 56.1% of the respondents showed a measure of interest in developments in life science and technology. In the breakdown by gender, 20.7% of men said that they are 'very interested,' while 11.9% of women responded likewise. The total number of those who said they are 'not very interested' and 'not interested' was 22.9% for men and 23% for women, showing very little gender difference.

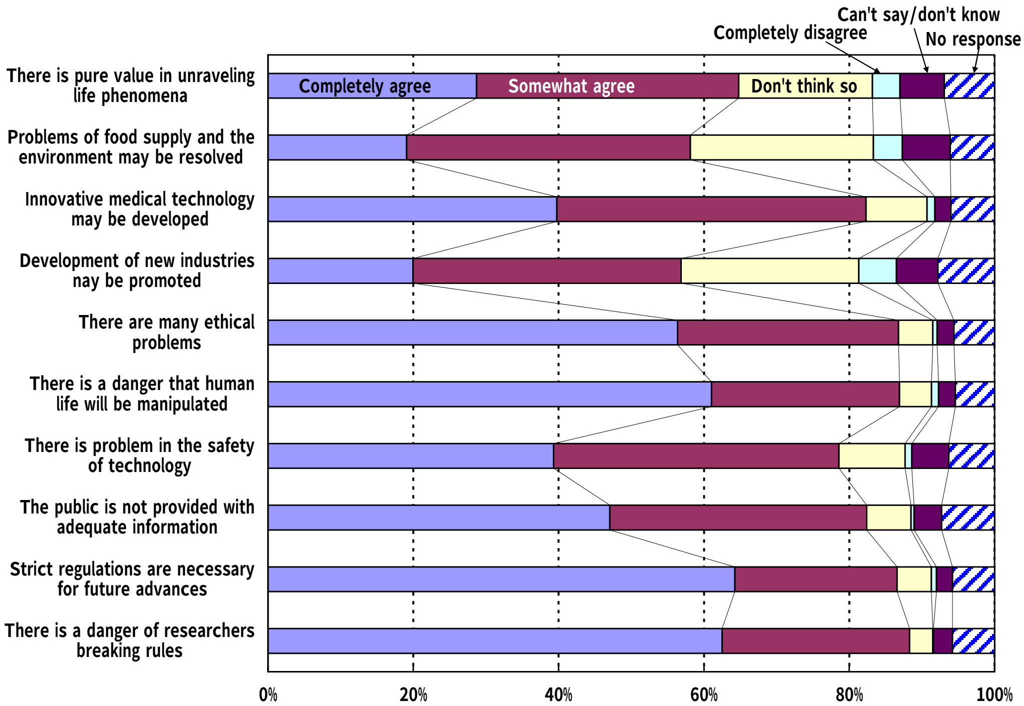
Respondents who said they are 'very interested' or 'somewhat interested' and those who chose neither in the survey shown in Figure 13-2-1 were asked whether they are currently interested in life science and technology (expectations and awareness of issues). The findings are shown in Figure 13-2-2.

The large number of respondents who believe that 'strict regulation is necessary for future advances' (64.2%), 'there is a danger of researchers breaking rules' (62.5%), 'there is a danger that human life will be manipulated' (61.1%) and 'there are many ethical problems' (56.3%) suggests that there are many who feel threatened by the rapid advances made in this area.

On the other hand, 82.4% of the respondents responded positively regarding expectations toward life science and technology, saying either they 'agree' or 'somewhat agree' to "development of innovative medical technology." In addition, the number of respondents who said they believe 'there is pure value in unraveling life phenomena' reached as high as 64.8%.

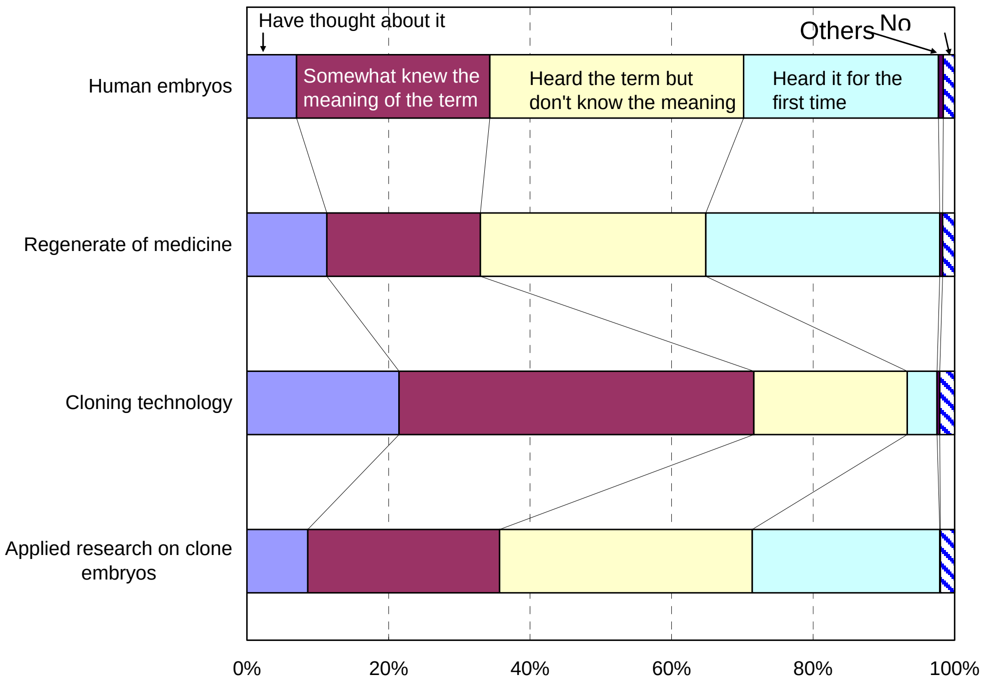
Figure 13-2-3 shows the level of awareness of technical terms. This shows that understanding (recognition level) is high (total number of respondents who 'have thought of the term' or 'somewhat knew the meaning of the term' exceeding 40%) only for 'clone technology' (71.7%).

Figure 13-2-2: Interest in present-day life science and technology (expectations and awareness of issues)



Note: Question asked of respondents who selected 'very interested,' 'interested' or 'neither' in Figure 13-2-1.
Source: Same as Figure 13-2-1
See: Table 13-2-2

Figure 13-2-3: Awareness of life science and technology terms

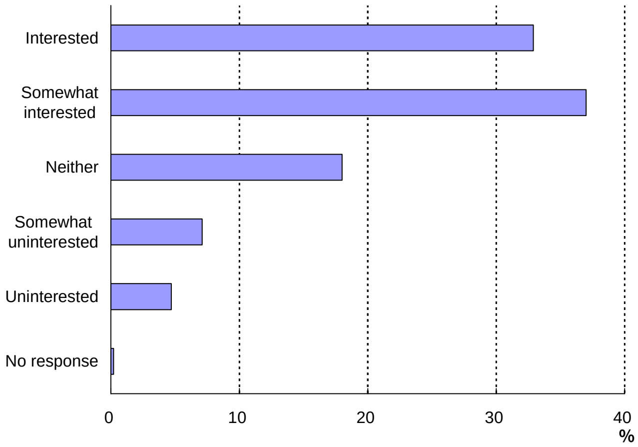


Source: Same as Figure 13-2-1
See: Table 13-2-3

13.2.2 Awareness of bioethics

The rapidly advancing area of life science and technology is posing problems in society. An area that requires great attention is bioethics. The findings on the question asked of people aged over 16 on whether they 'have interest in recent advances in medical technology, such as brain death, organ transplants, surrogate childbirth and gene therapy, and bioethical issues surrounding these technologies' are shown in Figure 13-2-4.

Figure 13-2-4: Interest in issues related to bioethics

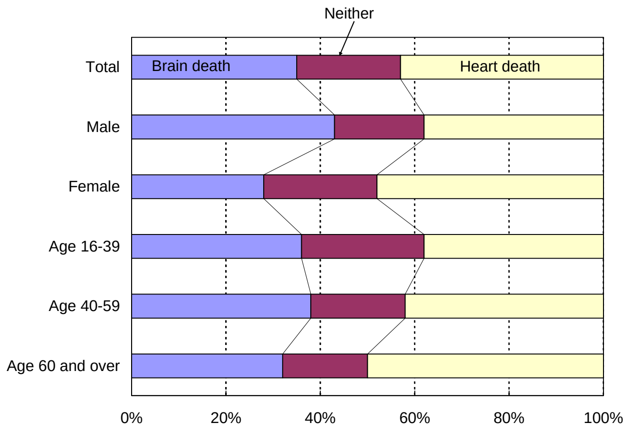


Note: Question given in the text
Source: Same as Figure 13-1-4
See: Table 13-2-4

The ratio of people with some measure of interest was nearly 70%, while those without interest made up less than 12%. A closer look at the data shows that this trend is roughly identical for both genders and all age groups. Japanese interest in bioethics is generally high.

A bioethical issue that spurred the most heated debate was the issue of brain death and organ transplants. Because organ transplants, such as heart transplants, are not possible unless brain death is regarded death, the Organ Transplant Law took effect in October 1997. As a result, the first brain-death organ transplant took place under the law in February 1999, and since then, 26 transplants have been made as of October 7, 2003 (according to Japan Organ Transplant Network).

Figure 13-2-5: Does brain death or heart death constitute human death?

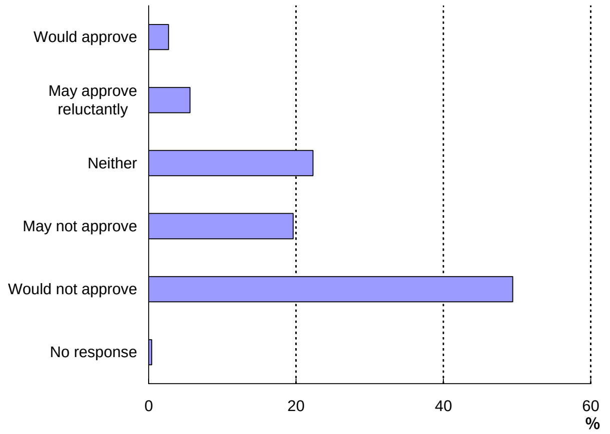


Note: 'Brain death' responses are the total number of those who believe that 'brain death constitutes human death' and 'brain death may constitute human death.' Likewise, 'heart death' responses are the total number of those who believe that 'heart death constitutes human death' and 'heart death may constitute human death.'
Source: Same as Figure 13-1-4
See: Table 13-2-5

The findings on the question regarding what constitutes human death, asked in January 2002, are shown in Figure 13-2-5. There were distinctive differences by gender and by age group regarding this question. In other words, 43% of men said they believe that brain death constitutes human death, while the percentage of women was 28%. Of those who said that heart death constitutes human death, 38% were men, and 48% were women. The number of respondents who said heart death constitutes human death rises with age as well, with percentage of 38% in the 16-39 age group and rising to 50% in the 60-and-over age group.

A topic that has attracted huge controversy over bioscience in recent years is the birth of the cloned sheep, Dolly, announced in February 1997. The success made the idea of cloning a human being much closer to reality. The announcements by a number of private individuals and organizations claiming the birth of cloned human beings, stirring worldwide uproar, are still fresh in our minds. Figure 13-2-6 shows the findings on the question, "What is your opinion on a person who has lost a child due to illness or accident trying to create a clone inheriting the dead child's genes obtained from the child's somatic cell nucleus?"

Figure 13-2-6: Would you approve cloning a dead child?



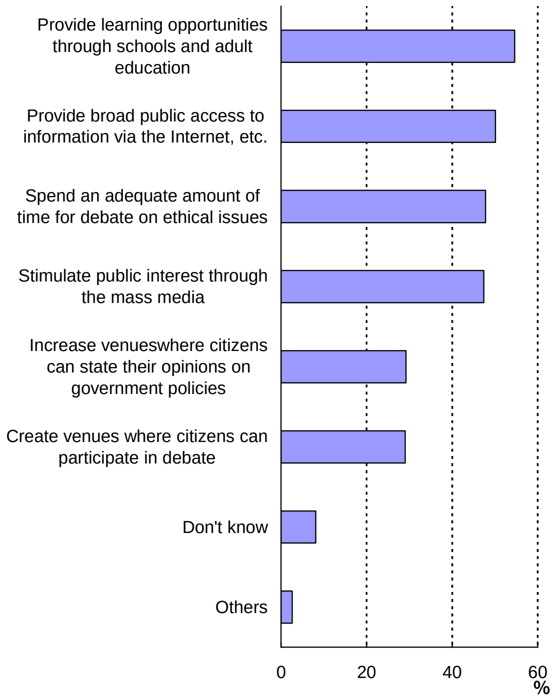
Note: Question described in text
Source: Same as Figure 13-1-4
See: Table 13-2-6

The percentage of people who said they would not approve accounted for roughly half of the respondents, at 49.4%. Combined with those who said they 'may not approve,' the group adds up to 66.0%. Proponents of the idea reached only 8.3%.

In pursuing bioscience research in the future, broad national consensus is supposed necessary. For this reason, adults aged 20 or over were asked to give multiple-choice answers to the question on what areas should be considered in pursuing bioscience research in order to reflect broad public opinion (Figure 13-2-7).

In the survey, many sought improvement in the promotion of public awareness and in access to information, namely, 'provide learning opportunities through schools and adult education' (54.6%), 'broad public access to information via the Internet, pamphlets, videos, lectures, etc.' (50.1%), and 'stimulation of public interest in life science and technology through the mass media' (47.4%). There was also a large percentage of respondents who believe in 'spending an adequate amount of time for debate on ethical issues' (47.8%).

Figure 13-2-7: Areas that should be considered to reflect public opinion in research promotion



Note: Responses to the question, 'Life science and technology in the future must be conducted in a way that reflects the opinion of the Japanese public at large. What areas do you think should be improved in this effort?' (Multiple-choice responses)
Source: Same as Figure 13-2-1
See: Table 13-2-7

13.3 Methods of Obtaining Information about S&T

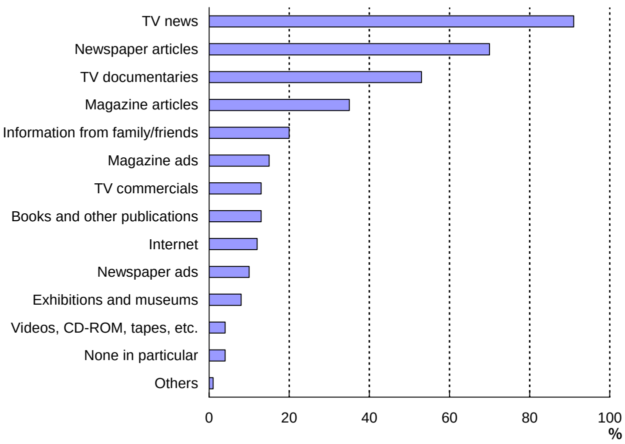
13.3.1 Sources of information about S&T

As shown in Figure 13-2-7, there is large demand for improvement in access to S&T information. So, how is such information obtained in reality? Figure 13-3-1 shows the findings on the question on what are leading sources of information about S&T, asked of citizens aged 18 and over.

An overwhelming majority of 91% chose 'TV news.' This is followed by 'newspaper articles' (70%) and 'TV documentaries' (53%). In addition to newspapers, printed media and information from museums, exhibitions, etc., rated relatively low as information sources.

Next, Figure 13-3-2 shows how newspaper articles related to S&T are being read. Newspaper articles have been classified into 45 genres and have been ranked by general viewing rate. Ranked by viewing rate, health and medicine ranked ninth (32.0%), environment ranked 27th (14.1%), science and technology ranked 33rd (10.9%), recycling, 35th (9.2%) and IT & Internet, 39th (6.7%). (TV programs ranked highest with 80.5%, followed by social issues, incidents and accidents with 70.0%.) In the breakdown by gender, there were significant differences, with 20.0% of men and 42.6% of women reading articles related to medicine and health, 16.7% of men and 5.2% of women reading articles related to S&T and 9.3% of men and 4.2% of women reading those related to IT and the Internet.

Figure 13-3-1: Leading sources of information about S&T

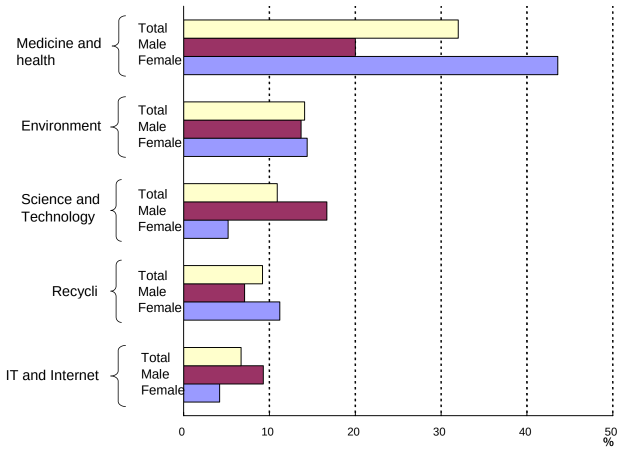


Note: Multiple-choice responses
Source: Shinji Okamoto, et al., 'Survey on S&T Awareness,' National Institute on Science and Technology Policy, 2001
See: Table 13-3-1

Figure 13-3-1 shows that the use of 'magazine articles' ranks high (35%), following television and newspapers. However, there is a wide gap between Japan and the United States regarding scientific journals.

According to 'Science and Engineering Indicators 2002' conducted in the United States in 2001, people who read scientific journals regularly accounted for 16% in the United States, and people who had been to science-related museums at least once during the past year was as high as 66% of the respondents. On the other hand, the ratio of people who 'subscribe' to science journals or 'do not subscribe but read frequently' is only 5%, with only 19% having experience of visiting a nature museum at least once during the past year, 12% having been to a science museum and only 25% having visited either type of museum at least once (according to 'Survey on S&T Awareness,' National Institute on Science and Technology Policy).

Figure 13-3-2: Frequency of reading newspaper articles related to S&T

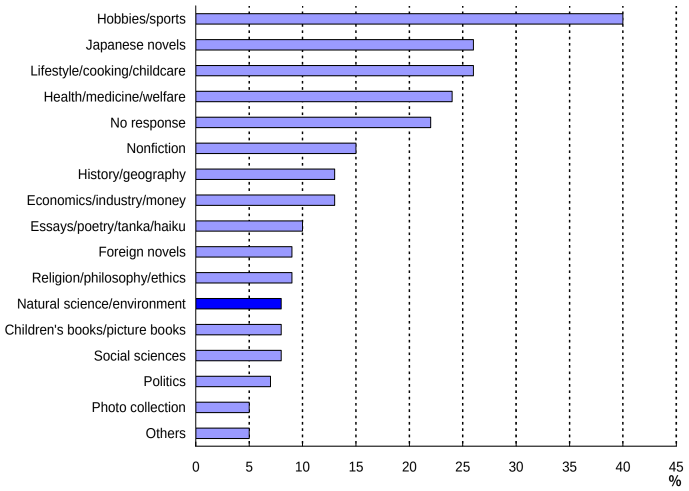


Note: Survey was conducted nationwide with people aged over 15 and under 69 (3,618 respondents giving multiple-choice answers).
Source: Based on the '2001 National Survey on Media Contact and Evaluation' (October 2001), Japan Newspaper Publishers & Editors Association
See: Table 13-3-2

Next, findings on Figure 13-3-3 show the level of reading in natural sciences among people who read books.

Although books on natural sciences and environment rated only 8%, it ranked alongside foreign novels (9%), books on religion, philosophy and ethics (9%), children's books and picture books (8%) and books on social sciences (8%), suggesting that it is not particularly unpopular.

Figure 13-3-3: Readers’ interests by genre

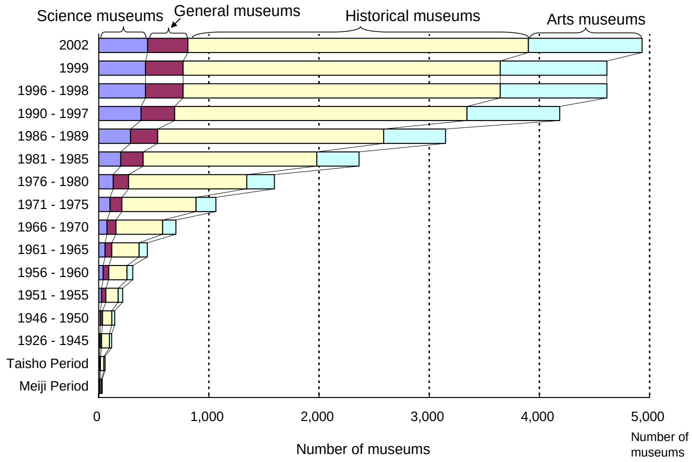


Note: 1. Breakdown of responses on 'principal genre of books read' (multiple-choice answers)
2. Survey covering respondents aged over 16
Source: '2003 Public Opinion Poll on Reading,' Mainichi Shimbun
See: Table 13-3-3

13.3.2 Establishment offering access to S&T information

In addition to mass media, science museums are establishment that should be utilized more extensively to gain S&T information. Figure 13-3-4 shows the changes in the number of science and other general museums (offering information and resources in both human and natural sciences).

Figure 13-3-4: Trends in the number of science museums and other comprehensive museums



Note: 1. Cumulative total number of registered museums, facilities and equivalents to museums.
2. General museums are defined as museums offering reference and resources in both human and natural sciences.
Source: 'FY1999 Survey on Social Education' and 'Interim Report on FY2002 Survey on Social Education,' Ministry of Education, Culture, Sports, Science and Technology (MEXT)
See: Table 13-3-4

For science museums alone, there were 76 registerd in 1970, with the number decreasing every five years to 27, 29, 69, 88 and 95. From 1996 to 1998, 42 new museums opened. With the opening of nine new museums in 1999, the number reached 435.

Changes in the number of visitors from 1989 to 1998 are shown in Figure 13-3-5. While the number of science museums increased by 130 (roughly 50% increase) in the 10 years from 1989, the incremental growth of the number of visitors was 40%, or 9,882,616.

Science and general museums are chiefly located in major cities. In other parts of Japan, there are activities rooted in communities. One example is the presence of Invention Clubs for Schoolchildren (for elementary and junior high school students) in various parts of the country. Activities focus chiefly on science workshops but range widely by club. The number of such clubs is growing steadily, as shown in Figure 13-3-6.

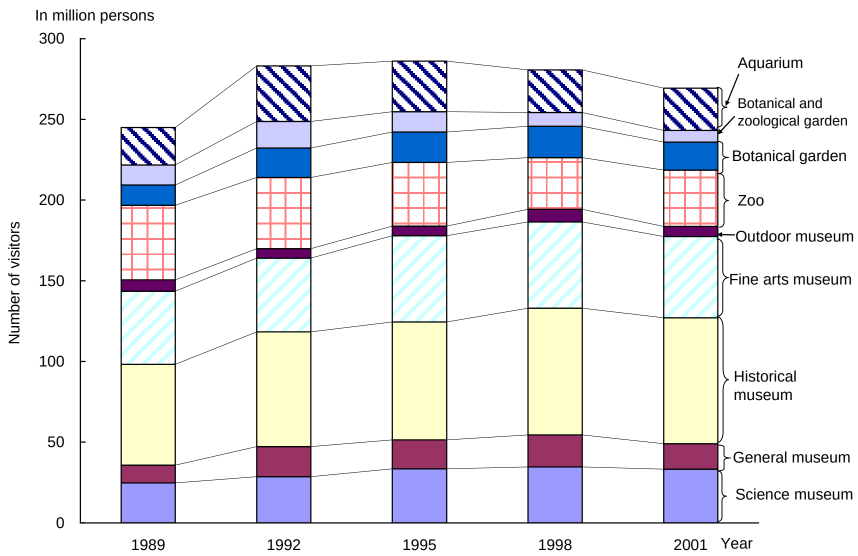
As of September 1, 2002, Invention Clubs for Schoolchildren number 148 nationwide and have 8076 regular members.

To sum up, interest in and understanding of S&T is not necessarily high among Japanese adults, vis-à-vis other countries (see Figures 13-1-1 through 13-1-3). However, the people believe that the S&T level of the country is among the top in the world

(Figure 13-1-4), with interest, expectations and awareness not at a low level for S&T areas closely linked to everyday living, such as medicine, environment and bioethics, and related issues. The top sources of S&T information are television and newspapers, with interest high in issues featured in news articles (see Figure 13-3-2). However, media and facilities other than television and newspapers are not used at this point, despite the high level of expectation toward educational institutions, mass media and the Internet as suppliers of information (see Figure 13-2-7).

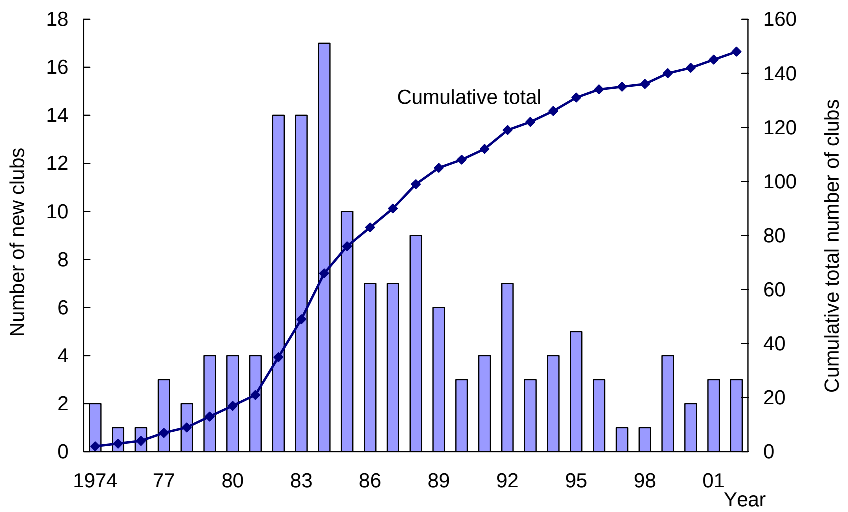
The issue to be addressed in the future is the vitalization of a wide variety of media to stimulate the flow of accurate, easy-to-understand S&T information (S&T communication), as well as to build talented human resources.

Figure 13-3-5: Trends in the number of visitors to science museums, etc.



Note: Zoos, botanical gardens, aquariums, etc., are defined as museum equivalent establish.
Source: Same as Figure 13-3-4
See: Table 13-3-5

Figure 13-3-6: Trends in the number of Invention Club for Schoolchildren in Japan



Source: 'Summary of Invention Clubs for Schoolchildren,' Japan Institute of Invention and Innovation (JIII)
See: Table 13-3-6

Appendix Tables

STATISTICAL TABLES

Chapter 10 Universities: Their Production of Science Knowledge and Collaboration with Other Sectors 487

Chapter 11 R&D in the Business Sector....507

Chapter 12 Innovation and the Japanese Economy and Society 549

Chapter 13 Public Interest in Science and Technology 565

Reference Statistics

A: Population of Selected Countries

(unit: 1,000 persons)

Year	Japan	U.S.	Germany	France	U.K.	China	Republic of Korea	EU
1981	117,902	229,966	61,682	55,419	56,357	—	38,723	341,173
1982	118,728	232,188	61,638	55,746	56,325	—	39,326	341,907
1983	119,536	234,307	61,423	56,048	56,384	—	39,910	342,430
1984	120,305	236,348	61,175	56,326	56,513	—	40,406	342,923
1985	121,049	238,466	61,024	56,610	56,693	—	40,806	343,541
1986	121,660	240,651	61,066	56,898	56,859	—	41,214	344,293
1987	122,239	242,804	61,077	57,208	57,015	—	41,622	345,054
1988	122,745	245,021	61,449	57,526	57,166	—	42,031	346,179
1989	123,205	247,342	62,063	57,862	57,365	—	42,449	347,657
1990	123,611	250,132	63,253	58,171	57,567	1,143,330	42,869	349,744
1991	124,101	253,493	79,984	58,464	57,814	1,158,230	43,296	367,481 a
1992	124,567	256,894	80,594	58,754	58,013	1,171,710	43,748	369,250
1993	124,938	260,255	81,179	59,006	58,198	1,185,170	44,195	370,875 a
1994	125,265	263,436	81,422	59,221	58,401	1,198,500	44,642	372,026
1995	125,570	266,557	81,661	59,430	58,612	1,211,210	45,093	373,054
1996	125,864	269,667	81,896	59,634	58,807	1,223,890	45,525	374,057
1997	126,166	272,912	82,052	59,839	59,014	1,236,260	45,954	375,033
1998	126,486	276,115	82,029	60,049	59,237	1,248,100	46,287	375,864
1999	126,686	279,295	82,087	60,294	59,501	1,259,090	46,617	376,900
2000	126,926	282,434	82,188	60,589	59,756	1,265,830	47,008	378,170
2001	127,291	285,545	82,340	60,912	58,837	1,276,270	47,343	379,662
2002	127,435	288,600	82,482	61,230	59,207	—	47,640	—

Note: a: The data lack continuity with the data until the previous year.
<Germany> West Germany until 1990.
Source: <Japan>Statistics Bureau, Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Population Estimates' Annual Report (website)
<U.S.>The Executive Office of the President, "Economic Report of the President 2003" (website)
<Germany>Until 1990, OECD, "Main Science and Technology Indicators 2003/1," and after 1991, OECD, "National Accounts 2003/3"
<France, U.K., Korea>OECD, "National Accounts 2003/3"
<China, EU>OECD, "Main Science and Technology Indicators 2003/1"

B: Labor Population of Selected Countries

(unit: 1,000 persons)

Year	Japan	U.S.	Germany	France	U.K.	China	Republic of Korea	EU
1981	56,610	108,670	28,305	23,673	26,740	—	14,683	147,127
1982	57,770	110,204	28,558	23,905	26,678	—	15,032	148,221
1983	58,070	111,550	28,605	23,972	26,610	—	15,118	149,120
1984	58,650	113,544	28,298	24,123	27,235	—	14,997	150,054
1985	58,710	115,461	28,434	24,180	27,486	—	15,592	150,845
1986	59,550	117,834	28,768	24,322	27,491	—	16,116	151,930
1987	60,610	119,865	29,036	24,448	27,943	—	16,873	154,250
1988	61,360	121,669	29,220	24,550	28,345	—	17,305	155,910
1989	62,630	123,869	29,624	24,724	28,764	—	18,023	157,336
1990	63,680	125,840	30,771	24,838	28,909	642,922	18,539	159,856
1991	65,040	126,346	39,577 a	24,983	28,813	651,512	19,115	168,975 a
1992	65,660	128,105	39,490	25,087	28,581	659,179	19,499	168,689
1993	66,070	129,200	39,557	25,126	28,447	667,931	19,879	167,485 a
1994	65,870	131,056	39,492	25,316	28,455	676,754	20,396	167,964
1995	66,100	132,304	39,376	25,347	28,486	684,666	20,853	168,468
1996	66,630	133,943	39,550	25,625	28,664	694,028	21,243	169,754
1997	67,260	136,297	39,804	25,784	28,852	701,700	21,662	170,971
1998	67,170	137,673	40,131	26,015	28,892	712,110	21,456	172,603
1999	67,150	139,368	40,174	26,341	29,194	719,650	21,634	174,150
2000	67,380	140,863	40,104	26,574	29,412	726,900	21,950	175,542
2001	66,990	141,815	40,121	26,786	29,470	737,050	22,181	176,226
2002	66,220	−	40,124 b	26,867 b	29,665 b	−	22,569 b	177,475 b

Note: a: The data lack continuity with the data until the previous year.

b: OECD estimates/calculates based on the data for each country.

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, Labor Force Survey, Labor Force Population as of December each year (website)

<U.S.>Bureau of Labor Statistics, U.S. Department Labor, Current Population Survey (website)

<Germany, France, U.K., China, EU, Korea>OECD, "Main Science and Technology Indicators 2003/1"

C: Gross Domestic Product (GDP) in Selected Countries

(A) National currencies

Year	Japan (billion yen)	U.S. (billion dollars)	Germany (A) (billion euros)	Germany (B) (billion euros)	France (billion euros)	U.K. (billion pounds)	China (billion yuan)	Republic of Korea (billion won)	EU (billion dollars)
1981	261,914.3	3,104.5	866.6 E	800.2 *	493.8	253.0	486.2	47,382.6	3,080.4
1982	274,572.2	3,228.6	900.8 E	831.8 *	565.1	277.1	529.5	54,431.3	3,301.6
1983	286,278.2	3,502.0	944.6 E	872.2 *	625.2	302.8	593.5	63,857.5	3,510.0
1984	306,809.3	3,896.6	990.9 E	915.0 *	680.0	324.4	717.1	73,003.6	3,757.0
1985	327,433.2	4,174.9	1,034.6 E	955.3 *	727.4	355.0	896.4	81,312.3	3,985.7
1986	341,920.5	4,411.8	1,094.0 E	1,010.2 *	782.9	381.3	1,020.2	94,861.7	4,198.2
1987	359,508.9	4,698.9	1,129.9 E	1,043.3 *	825.7	419.6	1,196.3	111,197.7	4,465.1
1988	386,736.1	5,061.9	1,189.7 E	1,098.5 *	889.9	468.4	1,492.8	132,111.8	4,836.3
1989	414,742.9	5,439.7	1,265.2 E	1,168.3 *	955.9	514.2	1,690.9	148,197.0	5,231.7
1990	449,997.1	5,750.8	1,380.7 E	1,274.9 *	1,009.3	557.3	1,854.8	178,796.8	5,630.6
1991	472,261.4	5,930.7	1,502.2	−	1,049.5	586.1	2,161.8	216,510.9	6,038.1 a
1992	483,837.5	6,261.8	1,613.2	−	1,086.4	610.9	2,663.8	245,699.6	6,427.5
1993	480,662.5	6,582.9	1,654.2	−	1,101.7	642.3	3,463.4	277,496.5	6,474.6
1994	491,274.6	6,993.3	1,735.5	−	1,143.3	681.3	4,675.9	323,407.1	6,809.5
1995	500,005.5	7,338.4	1,801.3	−	1,181.8	719.2	5,847.8	377,349.8	7,254.6
1996	514,168.7	7,751.1	1,833.7	−	1,212.2	763.3	6,788.5	418,479.0	7,499.5
1997	520,612.8	8,256.5	1,871.6	−	1,251.2	810.9	7,446.3	453,276.4	7,989.6
1998	512,441.7	8,720.2	1,929.4	−	1,305.9	859.4	7,834.5	444,366.5	8,336.8
1999	508,000.4	9,212.8	1,978.6	−	1,355.1	903.9	8,205.4	482,744.2	8,735.6
2000	513,209.4	9,762.1	2,030.0	−	1,420.1	951.3	8,940.4	521,959.2	9,283.9
2001	500,920.0	10,019.7	2,073.7	−	1,475.6	994.0	9,593.3	551,557.5	9,674.1
2002	497,646.6	10,383.1	2,110.4	−	1,520.8	1,043.9	−	596,381.2	9,876.5 b
2003	−	10,773.2 b	2,166.4 b	−	1,559.0 b	1,086.5 b	−	639,387.5 b	10,202.2 b

(B) OECD Purchasing Power Parity Equivalent

Year	Japan (billion yen)	U.S. (billion yen)	Germany (A) (billion yen)	Germany (B) (billion yen)	France (billion yen)	U.K. (billion yen)	China (billion yen)	Republic of Korea (billion yen)	EU (billion yen)
1981	261,914.3	749,598.0	170,160 E	157,121.7 *	137,218.0	116,049.0	−	25,693.3	743,775.6
1982	274,572.2	747,980.1	172,905 E	159,656.8 *	142,596.5	120,056.7	−	28,076.3	764,900.2
1983	286,278.2	790,222.1	179,246 E	165,512.5 *	146,445.4	126,730.8	−	31,471.2	792,016.8
1984	306,809.3	862,677.2	189,303 E	174,798.5 *	152,138.3	133,471.9	−	34,667.4	831,761.2
1985	327,433.2	911,785.2	197,939 E	182,772.3 *	157,018.0	140,818.2	−	37,578.7	870,463.7
1986	341,920.5	956,944.6	207,267 E	191,386.3 *	163,234.3	149,188.0	−	42,336.2	910,623.6
1987	359,508.9	987,538.7	210,755 E	194,607.2 *	167,377.4	156,534.0	−	46,912.4	938,409.9
1988	386,736.1	1,031,591.4	220,225 E	203,351.0 *	176,168.5	165,864.2	−	51,968.9	985,610.4
1989	414,742.9	1,083,435.9	233,963 E	216,036.3 *	186,783.8	173,425.7	−	55,941.3	1,042,009.9
1990	449,997.1	1,123,131.2	252,575 E	233,222.2 *	195,502.4	180,708.4	309,131.7	62,114.4	1,099,648.1
1991	472,261.4	1,144,982.7	270,840	−	204,061.8	178,123.9	342,317.8	69,511.3	1,165,713.6 a
1992	483,837.5	1,178,226.5	287,390	−	208,922.6	186,649.7	395,975.0	73,176.8	1,209,402.9
1993	480,662.5	1,213,271.9	283,557	−	202,641.1	185,760.4	449,341.7	77,422.4	1,193,311.2
1994	491,274.6	1,262,913.1	296,315	−	204,568.9	190,671.3	505,612.4	83,821.6	1,229,714.8
1995	500,005.5	1,247,101.6	297,027	−	203,945.6	186,906.5	551,155.2	87,785.3	1,232,859.9
1996	514,168.7	1,283,699.2	292,966	−	200,374.3	196,292.5	593,721.7	93,103.8	1,242,028.0
1997	520,612.8	1,345,905.3	307,181	−	205,681.8	209,997.3	632,069.8	98,119.2	1,302,404.6
1998	512,441.7	1,462,034.8	325,995	−	221,689.0	222,951.6	698,914.2	95,340.2	1,397,749.8
1999	508,000.4	1,492,802.5	327,950	−	225,667.9	225,147.4	739,799.5	103,619.7	1,415,480.1
2000	513,209.4	1,518,482.0	334,177	−	234,601.3	229,265.6	780,747.6	111,230.3	1,444,101.9
2001	500,920.0	1,500,691.5	324,983	−	240,745.4	232,408.7	824,625.7	114,100.0	1,448,928.3
2002	497,646.6	1,522,536.3	322,153	−	241,138.2	234,138.8	−	119,443.5	1,448,256.6 b
2003	−	1,534,290.5 b	−	−	239,487.4 b	234,281.6 b	−	124,203.0 b	1,452,961.7 b

Note: a: The data lack continuity with the data until the previous year.
b: OECD estimates/calculates
E: Estimates
* Pre-EMU Euro is not used for cross-cutting comparison in calculating regional grand total.
<Japan>Annual data of each year. All final figures up to 2002.
<Germany>Germany (A) is East and West Germany, and Germany (B) is West Germany.
Source: <Japan>Cabinet Office, Economic and Social Research Institute, "SNA (National Accounts) Time Series Table by Demand Component (93SNA)" (website)
<U.S.>Bureau of Economic Analysis, "National Income and Product Accounts Tables" (website). For 2003, OECD, "Main Science and Technology Indicators 2003/1"
<Germany, France, U.K., Korea>OECD, "National Accounts 2003/3." For 2003, "Main Science and Technology Indicators 2003/1"
<China>Until 1989, "National Bureau of Statistics of China," and after 1990, OECD, "Main Science and Technology Indicators 2003/1"
<EU (dollar)>OECD, "Main Science and Technology Indicators 2003/1"

D: Gross Domestic Product (GDP) Deflator

Year	Japan	U.S.	Germany (A)	Germany (B)	France	U.K.	Republic of Korea
1981	82.0	63.5	66.8 E	67.8	55.6	50.3	38.7
1982	83.5	67.4	69.9 E	71.1	61.9	54.0	41.5
1983	85.1	70.1	72.2 E	73.4	67.5	57.0	43.9
1984	87.5	72.7	73.7 E	74.9	72.3	59.6	46.4
1985	89.4	75.0	75.3 E	76.5	76.2	62.9	48.5
1986	90.9	76.7	77.7 E	79.0	80.1	65.1	51.0
1987	90.8	79.0	79.1 E	80.4	82.4	68.5	53.9
1988	91.4	81.8	80.3 E	81.6	84.8	72.8	58.0
1989	93.2	84.9	82.2 E	83.5	87.5	78.2	61.3
1990	95.4	88.2	84.8 E	86.2	90.0	84.2	67.9
1991	98.2	91.4	87.8	−	92.7	89.7	75.2
1992	99.9	93.6	92.2	−	94.5	93.3	81.0
1993	100.4	95.9	95.6	−	96.7	95.9	86.7
1994	100.5	97.9	98.0	−	98.4	97.4	93.3
1995	100.0	100.0	100.0	−	100.0	100.0	100.0
1996	99.2	101.9	101.0	−	101.4	103.4	103.9
1997	99.5	103.9	101.7	−	102.8	106.3	107.2
1998	99.4	105.2	102.8	−	103.7	109.3	112.6
1999	97.9	106.8	103.3	−	104.3	111.8	110.3
2000	96.0	109.0	103.1	−	105.3	113.4	109.1
2001	94.5	111.6	104.4	−	107.2	116.0	111.8
2002	93.0	112.9	106.1	−	109.1	119.7	113.7
2003	92.3 b	114.4 b	−	−	110.3 b	123.8 b	115.6 b

Note: b: OECD estimates/calculates based on the data for each country.
E: Estimates
<Germany>Germany (A) is East and West Germany, and Germany (B) is West Germany.
Source: OECD, "National Accounts 2003/3." For 2003, "Main Science and Technology Indicators 2003/1"

E: Purchasing Power Parity of Selected Countries

Year	Japan [yen/yen]	U.S. [yen/dollars]	Germany [yen/euros]	France [yen/euros]	U.K. [yen/pounds]	China [yen/yuan]	Republic of Korea [yen/won]
1970	1.0000	221.6850	165.5601	348.5613	859.2442	—	1.8523
1971	1.0000	221.8310	162.1572	344.4581	824.6506	—	1.7045
1972	1.0000	224.9230	162.6341	339.7628	806.1756	—	1.5292
1973	1.0000	240.1050	171.8719	353.0956	845.4401	—	1.5017
1974	1.0000	266.0830	193.6557	381.7547	892.8960	—	1.3793
1975	1.0000	260.7780	196.8136	362.1917	751.5216	—	1.1698
1976	1.0000	266.6330	204.7873	351.7586	705.3783	—	1.0266
1977	1.0000	267.4330	210.9093	343.7442	663.6055	—	0.9403
1978	1.0000	261.1680	211.8151	326.4600	621.8286	—	0.7940
1979	1.0000	247.6280	210.0322	304.9606	557.7207	—	0.6820
1980	1.0000	239.1240	211.2403	289.4964	493.0392	—	0.5783
1981	1.0000	241.4553	196.3530	277.8862	458.6917	—	0.5423
1982	1.0000	231.6732	191.9413	252.3398	433.2770	—	0.5158
1983	1.0000	225.6488	189.7644	234.2456	418.5658	—	0.4928
1984	1.0000	221.3923	191.0366	223.7190	411.4334	—	0.4749
1985	1.0000	218.3969	191.3245	215.8712	396.7246	—	0.4622
1986	1.0000	216.9057	189.4538	208.5030	391.2440	—	0.4463
1987	1.0000	210.1638	186.5304	202.7043	373.0277	—	0.4219
1988	1.0000	203.7953	185.1170	197.9748	354.1187	—	0.3934
1989	1.0000	199.1720	184.9150	195.4008	337.2938	—	0.3775
1990	1.0000	195.3000	182.9337	193.6924	324.2570	166.6667	0.3474
1991	1.0000	193.0603	180.2954	194.4408	303.8884	158.3500	0.3211
1992	1.0000	188.1610	178.1490	192.3150	305.5554	148.6499	0.2978
1993	1.0000	184.3066	171.4161	183.9387	289.1991	129.7386	0.2790
1994	1.0000	180.5890	170.7374	178.9250	279.8528	108.1307	0.2592
1995	1.0000	169.9419	164.8961	172.5649	259.8897	94.2498	0.2326
1996	1.0000	165.6151	159.7676	165.3010	257.1663	87.4604	0.2225
1997	1.0000	163.0116	164.1277	164.3925	258.9541	84.8842	0.2165
1998	1.0000	167.6607	168.9617	169.7658	259.4162	89.2097	0.2146
1999	1.0000	162.0357	165.7485	166.5321	249.0941	90.1601	0.2146
2000	1.0000	155.5487	164.6192	165.1962	241.0113	87.3280	0.2131
2001	1.0000	149.7741	156.7166	163.1526	233.8028	85.9585	0.2069
2002	1.0000	146.6360	152.6504	158.5597	224.2827	—	0.2003
2003	1.0000	142.4172	—	153.6158	215.6203	—	0.1943

Note: The figures in 2003 are OECD estimates/calculates based on the data for each country.

Source: OECD, “National Accounts 2003/3.” After 1981, “Main Science and Technology Indicators 2003/1”

Table 1-1-1: Trends in R&D expenditure per GDP for selected countries

(unit : %)

Year	Japan	U.S.	Germany	France	U.K.	China	Republic of Korea	EU
1972	1.86	2.32	—	—	—	—	—	—
1973	1.90	2.24	—	—	—	—	—	—
1974	1.96	2.22	—	—	—	—	—	—
1975	1.95	2.18	—	—	—	—	—	—
1976	1.94	2.16	—	—	—	—	—	—
1977	1.92	2.14	—	—	—	—	—	—
1978	1.94	2.13	—	—	—	—	—	—
1979	2.04	2.16	—	—	—	—	—	—
1980	2.13	2.27	—	—	—	—	—	—
1981	2.28	2.31	2.43	1.93	2.38	—	—	1.69
1982	2.38	2.48	2.50	2.02	-	—	—	—
1983	2.51	2.55	2.50	2.06	2.20	—	—	1.73
1984	2.57	2.60	2.50	2.16	-	—	—	1.78
1985	2.72	2.72	2.68	2.22	2.24	—	—	1.86
1986	2.69	2.70	2.70	2.21	2.26	—	—	1.88
1987	2.74	2.66	2.80	2.24	2.20	—	—	1.92
1988	2.75	2.62	2.79	2.24	2.14	—	—	1.91
1989	2.85	2.59	2.79	2.29	2.15	—	—	1.93
1990	2.91	2.62	2.67	2.37	2.15	—	—	1.94
1991	2.92	2.68	2.53	2.37	2.02	0.74	1.92	1.90
1992	2.87	2.61	2.41	2.38	2.02	0.74	2.03	1.88
1993	2.85	2.49	2.35	2.40	2.05	0.72	2.22	1.87
1994	2.77	2.39	2.26	2.34	2.01	0.65	2.44	1.82
1995	2.88	2.48	2.26	2.31	1.95	0.60	2.50	1.80
1996	2.93	2.52	2.26	2.30	1.88	0.60	2.60	1.80
1997	3.02	2.55	2.29	2.22	1.81	0.68	2.69	1.80
1998	3.15	2.59	2.31	2.17	1.80	0.70	2.55	1.81
1999	3.15	2.63	2.44	2.18	1.87	0.83	2.47	1.86
2000	3.17	2.70	2.49	2.18	1.84	1.00	2.65	1.89
2001	3.30	2.79	2.53	2.18	1.89	1.09	2.92	1.93
2002	3.35	2.78	2.50	—	—	—	—	—

Note: See the note for Table 6-1-1 for R&D expenditure. As for GDP, see the note for Reference Statistics C.
Source: R&D expenditure is the same as in Table 6-1-1. GDP is the same as in Reference Statistics C.

Table 1-1-2: Investment in knowledge

(A) Research and Development

(unit: %)

Ranking	Country	Ratio to GDP
1	Sweden	3.9
2	Finland	3.4
3	Japan	3.0
4	U.S,	2.7
5	Republic of Korea	2.7
6	Swetzerland	2.6
7	Germany	2.5
8	OECD	2.3
9	Denmark	2.2
10	France	2.2
11	Belgium	2.0
12	Netherlands	1.9
13	EU	1.9
14	Canada	1.9
15	U.K.	1.8
16	Austria	1.8
17	Australia	1.5
18	Norway	1.5
19	Czech Republic	1.3
20	Ireland	1.1
21	Italy	1.1
22	Spain	0.9
23	Hungary	0.8
24	Portugal	0.8
25	Poland	0.7
26	Greence	0.7
27	Slovak Republic	0.7
28	Mexico	0.4

(B) Software

(unit: %)

Ranking	Country	Ratio to GDP
1	Sweden	2.4
2	Netherlands	2.2
3	Switzerland	1.9
4	U.K.	1.8
5	U.S.	1.8
6	France	1.7
7	Denmark	1.7
8	Canada	1.7
9	Finland	1.7
10	Germay	1.6
11	Czech Republic	1.6
12	Belgium	1.6
13	Norway	1.4
14	EU	1.4
15	Australia	1.4
16	Hungary	1.4
17	OECD	1.3
18	Austria	1.3
19	Japan	1.1
20	Slovak Republic	1.0
21	Ireland	0.7
22	Italy	0.7
23	Poland	0.7
24	Spain	0.6
25	Portugal	0.6
26	Republic of Korea	0.5
27	Mexico	0.4
28	Greece	0.3

(C) Higher Education

(unit: %)

Ranking	Country	Ratio to GDP
1	U.S.	2.3
2	Republic of Korea	2.3
3	Canada	1.8
4	OECD	1.3
5	Ireland	1.2
6	Denmark	1.1
7	Finland	1.1
8	Australia	1.1
9	Mexico	1.0
10	Hungary	0.9
11	Spain	0.9
12	Norway	0.8
13	Sweden	0.8
14	Belgium	0.8
15	Portugal	0.8
16	Austria	0.8
17	Slovak Republic	0.7
18	Czech Republic	0.7
19	Greece	0.7
20	France	0.7
21	EU	0.7
22	Netherlands	0.7
23	Japan	0.6
24	Germany	0.6
25	U.K.	0.6
26	Switzerland	0.6
27	Poland	0.5
28	Italy	0.5

Note: Data of 1999 for OECD countries, Denmark, Belgium, Greece, the Slovak Republic, and Mexico. Data of 2000 for other countries.
<Japan, U.S., Canada>Post-secondary non-tertiary education is included in the data for higher education.
<Greece, Denmark>Annual average growth rate for 1992-1999.
<OECD>Excludes Hungary, Poland, and the Slovak Republic. Annual average growth rates for 1992-1999 except in Belgium, the Czech Republic, Hungary, Korea, Mexico, Poland, and the Slovak Republic.
<Belgium>See the text body for the data for higher education.
<EU>Excludes Belgium, Denmark, and Greece. Annual average growth rates for 1992-1999 excluding Belgium.

Source: OECD, “STI Scoreboard 2003

Table 1-2-1: Increasing international co-authorship of scientific papers: Trends in the percentage of internationally co-authored papers in SCI

(unit: %)

Year	International collaboration	Collaboration within domestic institutes	Collaboration within a single institute	Single authorship
1981	5.3	24.6	44.8	23.5
1982	5.6	25.6	44.4	22.7
1983	5.9	26.1	44.0	22.3
1984	6.5	27.5	43.7	21.1
1985	6.7	27.5	43.4	20.8
1986	7.2	28.5	43.4	19.4
1987	7.8	29.5	42.9	18.5
1988	8.2	30.0	42.5	17.9
1989	8.8	30.9	42.5	16.7
1990	9.4	31.3	41.8	16.3
1991	10.4	32.1	40.3	16.0
1992	11.6	32.1	40.0	15.4
1993	12.3	32.7	39.2	14.9
1994	13.1	33.1	38.5	14.5
1995	13.9	34.0	37.8	13.6
1996	14.8	34.8	37.1	12.7
1997	15.8	35.3	36.2	12.1
1998	16.5	35.7	35.5	11.7
1999	17.4	36.2	34.5	11.4
2000	17.9	36.5	33.7	11.3
2001	18.8	37.3	32.7	10.6

Note: (Collaboration) = (Collaboration within domestic institutes) + (Collaboration within a single institute) + (International collaboration)
Source: Compiled by NISTEP based on Thomson ISI, "Science Citation Index, Compact Disk Edition"

Table 1-2-2: Increasing foreign patent applications: Trends in the number of global patent applications

(unit: 10,000)

Year	Number of patent applications in the world	Applications from overseas countries	Applications filed within the country
1985	120.3	53.2	67.0
1986	126.8	56.2	70.6
1987	136.0	62.4	73.6
1988	146.1	71.8	74.3
1989	153.2	80.0	73.2
1990	166.8	97.3	71.3
1991	158.9	98.5	61.3
1992	179.0	113.1	65.5
1993	198.4	130.9	67.3
1994	232.7	165.9	66.6
1995	279.3	206.9	71.9
1996	344.5	271.5	73.0
1997	442.7	362.9	68.7
1998	586.6	507.0	78.5
1999	707.2	624.5	82.7
2000	951.4	858.9	90.8
2001	1,182.9	1,089.0	93.9

Source: Until 1993, Patent Office, WIPO data, and after that, WIPO, "Industrial Property Statistics 1994-2001"

Table 1-2-3: Trends in the total value of technology trade for selected 11 OECD countries

(A) Export value of technological trade

(unit: million dollars)

Year	U.S.	Germany	U.K.	Japan	Belgium	Switzerland
1985	6,678.0	1,171.2	1,038.2	981.9	694.3	870.1
1986	8,113.0	2,874.5	1,053.9	1,329.7	1,015.0	1,154.6
1987	10,183.0	3,853.4	1,407.0 a	1,490.4	1,105.5	1,366.0
1988	12,146.0	4,046.2	1,718.3	1,921.6	1,262.2	1,595.7
1989	13,818.0	4,389.8	1,884.9	2,387.3	1,615.2	1,599.7
1990	16,634.0	6,335.8	2,063.3	2,343.7	1,885.4	1,867.3
1991	17,819.0	6,282.5	2,333.3	2,750.8	1,945.3	1,941.4
1992	20,841.0	7,295.5	3,157.4	2,982.1	2,386.2	2,166.8
1993	21,695.0	7,233.3	2,957.6	3,600.4	2,499.5	2,322.7
1994	26,712.0	8,185.9	3,729.6	4,521.4	2,783.7	2,553.9
1995	30,289.0	10,632.6	4,218.3	5,975.8	3,757.6 a	2,778.1
1996	32,470.0	10,798.4	12,322.2 a	6,462.9	4,311.3	2,703.1
1997	33,228.0	12,343.6	13,998.8	6,872.9	4,502.6	2,805.7
1998	35,626.0	13,424.4	16,032.8	6,998.2	4,967.7	2,985.2
1999	36,902.0	12,937.0	16,742.8	8,435.0	5,479.3	2,769.4
2000	39,607.0	13,477.1	16,033.4	9,816.3	5,642.2	2,869.4
2001	38,668.0 p	13,896.1	17,104.9 p	-	-	3,263.8

Year	Italy	France	Canada	Austria	Norway	Total
1985	144.2	893.8	399.1	29.8 m	28.3 m	12,928.9
1986	219.0	1,138.9	422.5	43.5 m	42.9 m	17,407.5
1987	300.8	1,348.3	578.4	55.1 m	67.4 m	21,755.3
1988	638.3	1,478.8	725.6	70.3 m	324.4 a	25,927.4
1989	515.1	1,549.7	747.5	76.3 m	378.6	28,962.1
1990	705.5	1,896.0	845.9	89.9 m	450.7	35,117.5
1991	1,410.4	1,741.9	928.7	78.7 m	474.0	37,706.0
1992	3,272.8 a	2,012.3	917.5	1,021.7 a	513.2	46,566.5
1993	2,667.4	1,816.0	989.1	1,055.2	528.7	47,364.9
1994	2,545.0	1,862.7	1,191.4	1,357.8	532.5	55,975.9
1995	3,050.7	2,170.3	1,283.1	1,906.8	542.7	66,605.0
1996	3,182.0	2,393.9	1,395.7	2,153.8	657.4	78,850.7
1997	3,410.6	2,168.9	1,396.8	1,956.5	579.9	83,264.3
1998	3,032.3	2,590.5	1,884.1	2,357.0	868.1	90,766.3
1999	3,369.5	2,755.1	2,005.1	2,281.6	925.5	94,602.3
2000	2,806.6	2,741.8	2,583.0	2,429.7	1,057.1	99,063.6
2001	2,683.6	3,196.4	-	-	-	78,812.8

(B) Import value of technological trade

(unit: million dollars)

Year	U.S.	Germany	U.K.	Japan	Belgium	Switzerland
1985	1,170.0	1,650.2	922.7	1,229.0	800.3	232.8
1986	1,401.0	3,227.8	957.2	1,546.3	1,173.5	334.6
1987	1,857.0	4,321.8	1,554.1 a	1,958.3	1,553.6	393.0
1988	2,601.0	4,785.3	1,874.9	2,436.2	1,812.2	429.2
1989	2,528.0	5,599.3	2,068.2	2,391.5	2,100.6	532.4
1990	3,135.0	6,942.4	2,727.4	2,568.6	2,522.5	733.5
1991	4,035.0	7,979.3	2,301.5	2,929.8	2,380.0	745.5
1992	5,161.0	10,116.2	2,918.7	3,268.1	2,661.5	896.0
1993	5,032.0	10,287.2	2,650.1	3,264.2	2,706.4	861.5
1994	5,852.0	10,250.2	3,175.6	3,626.8	2,960.8	1,103.3
1995	6,919.0	13,169.6	3,530.2	4,164.5	3,080.2 a	1,261.8
1996	7,837.0	14,117.9	7,654.2 a	4,063.6	3,237.7	1,430.4
1997	9,161.0	14,811.5	8,120.0	3,623.4	3,475.4	1,145.2
1998	11,235.0	16,220.9	8,870.1	3,285.2	4,047.5	1,338.1
1999	12,609.0	17,209.2	8,386.0	3,602.0	4,298.8	2,135.6
2000	16,115.0	18,064.3	7,730.0	4,113.5	4,235.3	1,924.4
2001	16,359.0 p	20,606.5	7,713.2 p	-	-	1,956.6

Year	Italy	France	Canada	Austria	Norway	Total
1985	545.9	1,063.5	550.0	113.5 m	76.5 m	8,354.4
1986	708.6	1,369.6	567.1	164.9 m	110.6 m	11,561.2
1987	787.8	1,732.2	592.0	216.7 m	196.8 m	15,163.3
1988	1,178.2	1,859.5	699.6	265.2 m	417.4 a	18,358.7
1989	1,038.0	1,868.2	786.3	231.7 m	415.4	19,559.6
1990	1,226.1	2,507.3	846.8	284.8 m	545.1	24,039.5
1991	2,366.0	2,451.4	927.8	301.0 m	650.8	27,068.1
1992	4,198.8 a	2,791.6	853.8	1,471.2 a	872.0	35,208.9
1993	3,506.6	2,550.1	872.0	1,432.6	925.3	34,088.0
1994	3,448.7	2,543.2	916.1	1,548.1	914.3	36,339.1
1995	3,436.8	2,987.8	1,007.7	2,140.2	1,058.5	42,756.3
1996	3,865.5	3,171.1	1,023.9	2,589.2	788.9	49,779.4
1997	3,647.3	3,033.7	1,162.8	2,519.3	875.7	51,575.3
1998	3,616.2	3,124.2	1,189.8	3,000.0	1,276.2	57,203.2
1999	4,238.6	3,169.4	1,401.3	2,631.0	1,256.9	60,937.8
2000	3,505.4	2,644.2	1,299.6	2,425.8	1,283.8	63,341.3
2001	3,439.8	2,695.3	-	-	-	52,770.4

Note: a: The data lack continuity with the data until the previous year.
m: Undervalued or based on undervalued data.
p: Provisional value.
Added up export/import values of technological trade of 11 OECD member countries, whose continuous data were available. These 11 countries are U.S., Japan, Germany, U.K., France, Italy, Canada, Austria, Belgium, Switzerland, and Norway.
Source: OECD, "Main Science and Technology Indicators 2003/01"

Table 1-2-4: Trends in the value of technology trade for selected countries

(A) National currencies

Export value of technological trade									
Year	Japan (million yen)	U.S. (,million dollars)	Germany (,million euros)		France (million euros)		U.K. (million pounds)	
1981	175,106	7,284	1,079	*	750	*	480	
1982	184,921	5,603	1,262	*	855	*	502	
1983	240,887	5,778	1,487	*	952	*	615	
1984	277,512	6,177	1,603	*	1,207	*	766	a
1985	234,220	6,678	1,763	*	1,224	*	809	
1986	224,078	8,113	3,192	a,*	1,203	*	719	
1987	215,575	10,183	3,541	*	1,235	*	861	a
1988	246,255	12,146	3,633	*	1,343	*	966	
1989	329,348	13,818	4,220	*	1,507	*	1,152	
1990	339,352	16,634	5,234	a,*	1,574	*	1,162	
1991	370,552	17,819	5,331	*	1,498	*	1,323	
1992	377,691	20,841	5,825	*	1,624	*	1,799	
1993	400,362	21,695	6,115	*	1,568	*	1,972	
1994	462,128	26,712	6,792	*	1,577	*	2,437	
1995	562,077	30,289	7,791	*	1,652	*	2,673	
1996	703,033	32,470	8,308	*	1,867	*	7,898	a
1997	831,563	33,228	10,944	*	1,930	*	8,551	
1998	916,098	35,626	12,078	*	2,330	*	9,681	
1999	960,800	36,902	12,143		2,586		10,348	
2000	1,057,853	39,607	14,628		2,976		10,597	
2001	1,246,814	38,668	15,529	p	3,572		11,882	p
2002	1,386,769							

Import value of technological trade									
Year	Japan (,million yen)	U.S. (million dollars)	Germany (million euros)		France (million euros)		U.K. (million pounds)	
1981	259,632	650	1,709	*	821	*	397	
1982	282,613	795	1,778	*	997	*	415	
1983	279,280	943	2,010	*	1,055	*	482	
1984	281,447	1,168	2,082	*	1,347	*	731	a
1985	293,173	1,170	2,484	*	1,457	*	719	
1986	260,577	1,401	3,584	a,*	1,446	*	653	
1987	283,245	1,857	3,972	*	1,587	*	951	a
1988	312,195	2,601	4,297	*	1,689	*	1,054	
1989	329,925	2,528	5,382	*	1,817	*	1,264	
1990	371,907	3,135	5,735	a,*	2,081	*	1,536	
1991	394,661	4,035	6,771	*	2,109	*	1,305	
1992	413,908	5,161	8,077	*	2,253	*	1,663	
1993	362,974	5,032	8,696	*	2,202	*	1,767	
1994	370,693	5,852	8,505	*	2,153	*	2,075	
1995	391,715	6,919	9,650	*	2,274	*	2,237	
1996	451,169	7,837	10,862	*	2,473	*	4,906	a
1997	438,400	9,161	13,132	*	2,699	*	4,960	
1998	430,054	11,235	14,594	*	2,810	*	5,356	
1999	410,296	12,609	16,153		2,975		5,183	
2000	443,287	16,115	19,607		2,870		5,109	
2001	548,379	16,359	23,028	p	3,012		5,358	p
2002	541,713	-	-		-		-	

(B) OECD Purchasing Power Parity Equivalent

(unit: million yen)

Esport value of technological trade					
Year	Japan	U.S.	Germany	France	U.K.
1981	175,106	1,758,760	211,924 *	208,526 *	220,172
1982	184,921	1,298,065	242,211 *	215,776 *	217,505
1983	240,887	1,303,799	282,256 *	223,072 *	257,418
1984	277,512	1,367,540	306,308 *	270,051 *	315,158 a
1985	234,220	1,458,454	337,286 *	264,291 *	320,950
1986	224,078	1,759,756	604,642 a,*	250,725 *	281,304
1987	215,575	2,140,098	660,541 *	250,421 *	321,177 a
1988	246,255	2,475,298	672,567 *	265,860 *	342,079
1989	329,348	2,752,159	780,286 *	294,528 *	388,562
1990	339,352	3,248,620	957,493 a,*	304,852 *	376,787
1991	370,552	3,440,141	961,101 *	291,331 *	402,044
1992	377,691	3,921,463	1,037,736 *	312,320 *	549,694
1993	400,362	3,998,532	1,048,124 *	288,398 *	570,301
1994	462,128	4,823,893	1,159,649 *	282,093 *	682,001
1995	562,077	5,147,370	1,284,705 *	284,991 *	694,685
1996	703,033	5,377,522	1,327,349 *	308,600 *	2,031,099 a
1997	831,563	5,416,549	1,796,213 *	317,261 *	2,214,316
1998	916,098	5,973,080	2,040,719 *	395,537 *	2,511,408
1999	960,800	5,979,441	2,012,684	430,652	2,577,626
2000	1,057,853	6,160,817	2,408,050	491,624	2,553,997
2001	1,246,814	5,791,465	2,433,653 p	582,781 0	2,778,045 p
2002	1,386,769	-	-	-	-

(unit: million yen)

Import value of technological trade					
Year	Japan	U.S.	Germany	France	U.K.
1981	259,632	156,946	335,626 *	228,089 *	182,101
1982	282,613	184,180	341,233 *	251,659 *	179,810
1983	279,280	212,787	381,502 *	247,106 *	201,749
1984	281,447	258,586	397,643 *	301,417 *	300,758 a
1985	293,173	255,524	475,231 *	314,481 *	285,245
1986	260,577	303,885	678,927 a,*	301,516 *	255,482
1987	283,245	390,274	740,843 *	321,753 *	354,749 a
1988	312,195	530,072	795,429 *	334,320 *	373,241
1989	329,925	503,507	995,287 *	355,043 *	426,339
1990	371,907	612,266	1,049,161 a,*	403,151 *	498,059
1991	394,661	778,998	1,220,690 *	409,978 *	396,574
1992	413,908	971,099	1,438,981 *	433,266 *	508,139
1993	362,974	927,431	1,490,652 *	404,978 *	511,015
1994	370,693	1,056,807	1,452,088 *	385,154 *	580,695
1995	391,715	1,175,828	1,591,247 *	392,344 *	581,373
1996	451,169	1,297,926	1,735,396 *	408,789 *	1,261,658 a
1997	438,400	1,493,349	2,155,325 *	443,761 *	1,284,412
1998	430,054	1,883,668	2,465,827 *	477,008 *	1,389,433
1999	410,296	2,043,108	2,677,335	495,416	1,291,055
2000	443,287	2,506,667	3,227,689	474,113	1,231,327
2001	548,379	2,450,155	3,608,871 p	491,416	1,252,716 p
2002	541,713	-	-	-	-

Note: Same as Table 7-3-1.

Source: Same as Table 7-3-1.

Table 1-2-5: Trends in the total foreign trade in the high technology industries of all OECD countries

(unit: billion dollars)

Year	Export value of	Import value of technological
1981	151.2	123.2
1982	152.2	122.5
1983	160.2	133.5
1984	180.6	157.9
1985	194.9	171.7
1986	235.4	213.1
1987	278.3	255.7
1988	332.5	311.9
1989	360.6	342.6
1990	422.5	403.1
1991	453.9 a	430.9
1992	489.7	466.0
1993	499.5	471.8
1994	584.7	564.1
1995	701.9 a	686.7
1996	725.0	727.3
1997	804.6	782.0
1998	880.0	850.7
1999	954.6	947.3
2000	1,094.5	1,104.0
2001	1,035.8	1,029.6

Note: a: The data lack continuity with the data until the previous year.
Source: OECD, "Main Science and Technology Indicators 2003/1"

Table 1-2-6: Trends in the total foreign trade in the high technology industries of all OECD countries: A breakdown by industry

(A) Export

(unit: illion dollars)

Industrial sector	Aerospace	Electronics	Office equipment/computers	Pharmaceuticals	medical/precision/optical equipment
1981	31,878.1	46,618.3	24,554.4	12,376.3	35,725.6
1982	31,407.5	46,891.4	26,154.1	13,563.4	34,148.5
1983	29,647.5	51,127.7	31,680.3	12,782.6	34,939.4
1984	29,430.4	60,730.0	40,065.7	13,014.0	37,382.9
1985	32,331.3	62,537.1	44,565.7	14,032.6	41,429.3
1986	35,422.1	76,700.4	53,872.3	18,159.9	51,277.2
1987	40,353.2	89,072.7	67,347.2	21,621.5	59,910.8
1988	52,417.2	107,248.7	79,597.0	24,371.3	68,913.6
1989	66,188.7	113,440.2	83,337.7	25,245.4	72,375.6
1990	80,104.7	132,860.1	94,103.2	31,213.7	84,178.0
1991	91,925.0 a	141,652.0 a	96,710.4 a	34,821.4 a	88,810.1 a
1992	93,920.5	154,373.1	102,435.6	42,387.6	96,582.1
1993	81,371.2	169,192.8	108,081.0	44,420.4	96,412.7
1994	78,464.3	223,237.4	125,534.3	50,347.3	107,151.6
1995	84,640.0 a	257,025.8 a	165,548.0 a	74,651.0 a	119,990.8 a
1996	91,717.0	251,989.5	172,755.1	81,390.6	127,112.0
1997	112,081.8	280,001.0	190,686.3	87,006.1	134,833.4
1998	138,765.3	301,582.5	198,592.6	101,633.7	139,423.4
1999	139,904.9	343,979.8	211,424.2	109,482.7	149,763.3
2000	140,128.9	433,474.8	239,951.6	113,616.7	167,329.7
2001	159,107.1	355,675.5	218,075.7	136,779.5	166,187.1

(B) Import

(unit: million dollars)

Industrial sector	Aerospace	Electronics	Office equipment/computers	Pharmaceuticals	Medical/precision/optical equipment
1981	22,914.3	40,801.4	22,695.9	8,852.1	27,939.1
1982	20,822.1	41,143.7	24,729.9	8,904.7	26,861.6
1983	20,572.7	45,538.8	30,448.3	9,457.6	27,493.4
1984	20,130.0	57,373.7	40,006.4	9,937.6	30,454.9
1985	23,061.3	60,167.3	44,410.7	10,793.9	33,260.7
1986	27,162.0	73,823.1	54,835.0	14,398.1	42,893.0
1987	28,581.2	88,325.6	70,492.4	17,595.1	50,681.6
1988	39,720.6	107,782.0	84,909.7	20,893.7	58,641.3
1989	47,647.7	116,309.8	93,115.2	21,128.1	64,403.7
1990	59,695.9	133,637.3	107,977.8	26,549.7	75,238.6
1991	66,285.4 a	142,008.1 a	112,502.5 a	30,334.6 a	79,795.9 a
1992	62,933.8	153,983.8	124,734.4	37,142.9	87,251.2
1993	53,690.3	163,639.7	130,995.1	38,831.2	84,628.3
1994	57,859.3	208,659.8	154,571.9	44,750.8	98,296.4
1995	59,509.7 a	244,450.2 a	206,824.2 a	68,706.8 a	107,220.7 a
1996	66,781.8	251,759.1	218,832.8	74,228.9	115,683.1
1997	80,757.6	265,247.4	236,970.9	79,587.4	119,413.5
1998	98,393.1	282,109.8	253,834.7	91,337.9	125,005.7
1999	106,575.3	326,216.5	277,227.9	101,756.4	135,476.5
2000	116,270.5	425,647.2	303,230.9	107,537.1	151,347.3
2001	123,594.2	357,376.9	268,645.5	128,932.7	151,072.1

Note: a: The data lack continuity with the data until the previous year.

Source: OECD, "Main Science and Technology Indicators 2003/1"

Table 1-3-1: Change in authorship of papers (Trends in the number of SCI papers by authorship)

(A) Number of scientific papers

(unit: number)

Year	Total	Single authorship	Collaboration			
			Collaboration	Collaboration within a single institue	Collaboration among domestic institutes	International collaboration
1981	389,301	91,619	296,148	174,321	95,598	20,465
1982	402,030	91,289	309,486	178,499	102,958	22,575
1983	416,541	92,750	322,055	183,095	108,828	24,753
1984	368,813	77,674	289,687	161,050	101,479	24,040
1985	439,355	91,265	346,755	190,819	121,018	29,634
1986	437,217	84,880	350,801	189,731	124,454	31,492
1987	428,868	79,468	348,261	183,831	126,553	33,244
1988	453,376	81,238	371,202	192,858	136,001	36,961
1989	462,223	77,106	384,181	196,481	142,633	40,467
1990	476,512	77,686	397,933	199,377	149,335	44,817
1991	483,592	77,534	404,974	195,000	155,186	50,438
1992	511,876	79,024	431,878	204,922	164,239	59,188
1993	505,838	75,469	428,952	198,377	165,574	62,246
1994	532,621	77,361	453,596	204,885	176,532	69,610
1995	543,620	73,795	468,243	205,643	184,921	75,657
1996	549,282	69,543	478,090	203,765	191,000	81,334
1997	551,041	66,427	482,666	199,269	194,365	87,145
1998	575,126	67,519	505,697	203,972	205,350	94,613
1999	586,324	66,595	517,831	201,999	212,220	101,815
2000	592,095	67,087	523,205	199,426	216,036	105,747
2001	604,485	63,981	538,800	197,701	225,536	113,759

(B) Raio

(unit: %)

Year	Single authorship	Collaboration		
		Collaboration within a single institute	Collaboration among domestic institutes	International collaboration
1981	23.5%	44.8%	24.6%	5.3%
1982	22.7%	44.4%	25.6%	5.6%
1983	22.3%	44.0%	26.1%	5.9%
1984	21.1%	43.7%	27.5%	6.5%
1985	20.8%	43.4%	27.5%	6.7%
1986	19.4%	43.4%	28.5%	7.2%
1987	18.5%	42.9%	29.5%	7.8%
1988	17.9%	42.5%	30.0%	8.2%
1989	16.7%	42.5%	30.9%	8.8%
1990	16.3%	41.8%	31.3%	9.4%
1991	16.0%	40.3%	32.1%	10.4%
1992	15.4%	40.0%	32.1%	11.6%
1993	14.9%	39.2%	32.7%	12.3%
1994	14.5%	38.5%	33.1%	13.1%
1995	13.6%	37.8%	34.0%	13.9%
1996	12.7%	37.1%	34.8%	14.8%
1997	12.1%	36.2%	35.3%	15.8%
1998	11.7%	35.5%	35.7%	16.5%
1999	11.4%	34.5%	36.2%	17.4%
2000	11.3%	33.7%	36.5%	17.9%
2001	10.6%	32.7%	37.3%	18.8%

Note: Collaboration = Collaboration among domestic institutes + Collaboration within a single institute + International collaboration

Source: Compiled by NISTEP based on Thomson ISI, “Science Citation Index, Compact Disk Edition.”

Table 2-1-1: Trends in per capita GDP

(A) Nominal value

(unit: dollar)

Year	U.S.	Canada	Sweden	Luxembourg	New Zealand
1984	15,923	13,259	11,562	10,116	6,904
1985	16,844	13,395	12,062	10,405	6,916
1986	17,581	13,776	15,886	15,298	8,777
1987	18,519	15,531	19,225	18,770	11,166
1988	19,810	18,148	21,562	20,993	13,281
1989	21,042	19,902	22,511	22,028	12,825
1990	21,966	20,437	26,821	27,226	12,945
1991	22,389	20,763	27,776	28,402	12,196
1992	23,246	19,795	28,559	31,927	11,733
1993	24,252	18,910	21,255	32,221	12,419
1994	25,512	18,593	22,389	35,281	14,509
1995	28,164	19,736	27,201	44,548	16,403
1996	29,453	20,094	29,628	43,334	17,596
1997	30,985	20,512	26,834	41,569	17,285
1998	32,377	19,607	26,866	42,652	14,007

Year	Australia	Switzerland	Iceland	Norway	U.K.
1984	12,226	13,949	11,719	14,683	7,645
1985	10,661	14,201	12,086	15,362	8,066
1986	11,060	20,580	16,127	18,272	9,894
1987	12,901	25,807	21,973	21,827	12,092
1988	16,064	27,498	23,866	23,317	14,624
1989	17,445	26,701	21,358	23,381	14,673
1990	17,295	33,679	24,479	27,198	16,982
1991	17,396	33,952	26,058	27,606	17,499
1992	16,915	35,046	26,390	29,441	18,006
1993	16,419	33,435	22,934	26,851	16,190
1994	18,585	36,782	23,199	28,432	17,479
1995	20,850	43,644	25,852	33,624	19,191
1996	22,817	41,864	27,093	35,985	20,042
1997	22,736	36,113	27,682	34,912	22,621
1998	19,916	36,917	30,617	33,122	23,711

Year	France	Denmark	Germany	Belgium	Finland
1984	9,071	10,677	10,057	7,791	10,381
1985	9,462	11,351	10,148	8,108	10,915
1986	13,177	16,086	14,522	11,335	14,237
1987	15,904	19,958	18,136	14,144	17,843
1988	17,156	21,201	19,424	15,251	20,994
1989	17,111	20,448	19,065	15,390	22,863
1990	21,072	25,115	23,734	19,264	27,033
1991	21,050	25,114	21,492	19,709	24,136
1992	23,081	27,273	24,431	21,980	21,112
1993	21,689	25,954	23,508	20,835	16,671
1994	22,944	28,180	25,129	22,515	19,104
1995	26,714	34,464	30,104	27,205	25,301
1996	26,630	34,807	29,097	26,484	24,910
1997	24,043	31,958	25,767	23,939	23,817
1998	24,669	32,896	26,219	24,481	24,952

(unit: dollar)

Year	Netherlands	Austria	Japan	Republic of Korea
1984	8,765	8,448	10,528	−
1985	8,842	8,623	11,282	−
1986	12,265	12,315	16,535	−
1987	14,837	15,469	19,921	−
1988	15,684	16,703	23,843	−
1989	15,398	16,584	23,550	−
1990	18,973	20,527	24,273	−
1991	19,253	21,092	27,557	−
1992	21,207	23,630	29,979	−
1993	20,393	22,846	34,449	−
1994	21,733	24,669	37,632	−
1995	26,830	29,268	41,075	10,851
1996	26,518	28,750	36,555	11,423
1997	24,141	25,610	33,405	10,361
1998	24,937	26,103	30,323	6,908

(B) Ranking of Japan

(unit: rank)

Year	Ranking	Year	Ranking
1960	22	1983	12
1961	20	1984	9
1962	20	1985	8
1963	20	1986	4
1964	20	1987	5
1965	20	1988	3
1966	19	1989	2
1967	19	1990	8
1968	19	1991	5
1969	19	1992	3
1970	18	1993	1
1971	18	1994	1
1972	17	1995	3
1973	16	1996	3
1974	17	1997	4
1975	16	1998	7
1976	16		
1977	16		
1978	14		
1979	16		
1980	17		
1981	14		
1982	14		

Note: GDP figures are 68SNA-based nominal values.　GDP figures are currency exchange equivalents excluding U.S.

Source: Economic and Social Research Institute (ESRI), Cabinet Office, '(Preliminary Estimate) National Accounts (1955-1998)'

Table 2-1-2: Trends in per capita GDP in selected countries (real figures)

(A) Real value (1995 base)

(unit: dollar/person)

Year	Real Value and purchasing power parity equivalent (1995 base)						
	Japan	U.S.	Germany	France	U.K.	Republic of Korea	OECD
1981	15,943.80	21,255.30	16,064.00	16,285.30	13,543.60	4,327.50	15,310.70
1982	16,339.50	20,618.10	15,954.30	16,616.00	13,826.00	4,570.00	15,185.10
1983	16,608.50	21,317.60	16,246.50	16,773.30	14,318.30	4,984.90	15,479.20
1984	17,138.00	22,669.80	16,764.90	16,965.30	14,656.10	5,329.80	16,081.60
1985	17,811.90	23,326.50	17,171.70	17,125.10	15,146.10	5,619.20	16,513.60
1986	18,220.90	23,895.40	17,581.80	17,448.30	15,707.30	6,173.60	16,866.30
1987	18,926.20	24,478.90	17,833.70	17,793.40	16,371.40	6,784.60	17,320.90
1988	20,080.20	25,266.40	18,405.90	18,511.80	17,185.50	7,421.30	17,955.10
1989	21,046.30	25,905.60	18,989.50	19,172.50	17,506.00	7,795.30	18,474.00
1990	22,063.80	26,083.80	19,902.60	19,568.00	17,596.80	8,412.00	18,869.80
1991	22,713.10	25,619.00	20,754.70	19,663.80	17,298.00	9,097.60	18,895.70
1992	22,865.80	26,056.20	21,058.70	19,858.60	17,300.90	9,493.20	19,108.90
1993	22,869.80	26,405.00	20,679.80	19,598.50	17,699.20	9,913.20	19,189.80
1994	23,048.20	27,149.20	21,102.00	19,930.80	18,483.60	10,623.60	19,622.30
1995	23,377.80	27,554.10	21,403.80	20,192.50	18,975.80	11,455.40	19,951.20
1996	24,122.40	28,216.90	21,505.90	20,345.10	19,434.30	12,112.70	20,378.60
1997	24,505.90	29,128.60	21,764.20	20,661.80	20,059.10	12,600.90	20,930.10
1998	24,168.40	30,033.20	22,196.10	21,289.70	20,594.40	11,673.40	21,340.10
1999	24,154.00	30,921.80	22,634.40	21,884.60	21,023.70	12,853.40	21,836.20
2000	24,784.30	31,741.30	23,252.40	22,604.10	21,627.40	13,935.30	22,521.20
2001	24,830.80	31,520.70	23,342.90	22,955.30	22,033.20	14,266.00	22,530.30
2002	-	-	23,343.30	23,111.70	-	15,076.70	-

(B) Index (All OECD countries = 100)

Year	Index based on real value and purchasing power parity equivalent (1995 base; OECD = 100)						
	Japan	U.S.	Germany	France	U.K.	Republic of Korea	OECD
1981	104.1	138.8	104.9	106.4	88.5	28.3	100
1982	107.6	135.8	105.1	109.4	91.0	30.1	100
1983	107.3	137.7	105.0	108.4	92.5	32.2	100
1984	106.6	141.0	104.2	105.5	91.1	33.1	100
1985	107.9	141.3	104.0	103.7	91.7	34.0	100
1986	108.0	141.7	104.2	103.5	93.1	36.6	100
1987	109.3	141.3	103.0	102.7	94.5	39.2	100
1988	111.8	140.7	102.5	103.1	95.7	41.3	100
1989	113.9	140.2	102.8	103.8	94.8	42.2	100
1990	116.9	138.2	105.5	103.7	93.3	44.6	100
1991	120.2	135.6	109.8	104.1	91.5	48.1	100
1992	119.7	136.4	110.2	103.9	90.5	49.7	100
1993	119.2	137.6	107.8	102.1	92.2	51.7	100
1994	117.5	138.4	107.5	101.6	94.2	54.1	100
1995	117.2	138.1	107.3	101.2	95.1	57.4	100
1996	118.4	138.5	105.5	99.8	95.4	59.4	100
1997	117.1	139.2	104.0	98.7	95.8	60.2	100
1998	113.3	140.7	104.0	99.8	96.5	54.7	100
1999	110.6	141.6	103.7	100.2	96.3	58.9	100
2000	110.0	140.9	103.2	100.4	96.0	61.9	100
2001	110.2	139.9	103.6	101.9	97.8	63.3	100
2002	-	-	-	-	-	-	-

Note: 1) The data of OECD are for a total of 15 member countries excluding the Czech Republic, Hungary, Poland, and the Slovak Republic.
2) GDP figures are 1995-based real value compliant with 93SNA.　GDP figures except U.S. are purchasing power parity equivalents.
Source: OECD, "Annual National Accounts - Comparative tables based on exchange rates and PPPs"

Table 2-1-3: Trade balance in the manufacturing sector for selected countries

(unit: national currency)

Year	Japan (billion yen)			U.S. (million dollars)			Germany (million euros)		
	Export	Import	Balance Ratio	Export	Import	Balance Ratio	Export	Import	Balance Ratio
1980	28,891 w	12,692 w	2.3	167,523 w	161,428 w	1.0	167,750 w	123,291 w	1.4
1981	33,023 w	12,190 w	2.7	178,113 w	182,002 w	1.0	189,500 w	131,720 w	1.4
1982	33,939 w	13,252 w	2.6	164,633 w	181,313 w	0.9	204,540 w	136,078 w	1.5
1983	34,493 w	13,162 w	2.6	156,244 w	205,200 w	0.8	207,018 w	147,818 w	1.4
1984	39,799 w	14,668 w	2.7	167,790 w	273,274 w	0.6	236,024 w	166,611 w	1.4
1985	41,411 w	14,547 w	2.8	169,239 w	297,151 w	0.6	259,005 w	178,559 w	1.5
1986	34,843 w	11,728 w	3.0	171,967 w	328,595 w	0.5	254,640 w	169,834 w	1.5
1987	32,882 w	13,454 w	2.4	199,854 w	363,038 w	0.6	255,844 w	172,544 w	1.5
1988	33,397	16,064	2.1	247,681 w	401,436 w	0.6	277,709	188,561	1.5
1989	37,177	19,548	1.9	278,362	419,905 w	0.7	315,243	219,375	1.4
1990	40,698	22,287	1.8	319,503	431,772	0.7	314,617	241,164	1.3
1991	41,586	21,489	1.9	349,470	430,651	0.8	324,327	285,305	1.1
1992	42,215	19,940	2.1	371,993	471,926	0.8	327,498	282,484	1.2
1993	39,424	18,576	2.1	388,390	518,893	0.7	300,682	242,215	1.2
1994	39,635	20,343	1.9	427,768	599,033	0.7	332,971	268,941	1.2
1995	40,563	23,746	1.7	480,830	671,721	0.7	357,540	284,611	1.3
1996	43,505	28,435	1.5	513,803	705,534	0.7	368,377	282,800	1.3
1997	49,398	30,284	1.6	578,916	752,858	0.8	426,480	323,729	1.3
1998	48,924	27,806	1.8	617,406	831,759	0.7	465,102	361,025	1.3
1999	45,865	27,049	1.7	634,644	894,770	0.7	481,922	376,463	1.3
2000	49,656	30,478	1.6	713,805	1,035,153	0.7	571,189	451,098	1.3
2001	46,772	31,536	1.5	661,787	986,550	0.7	610,185	462,871	1.3

Year	France (million euros)			U.K. (million pound)		
	Export	Import	Balance Ratio	Export	Import	Balance Ratio
1980	65,553 w	60,918 w	1.1	40,363 w	40,913 w	1.0
1981	76,216 w	68,401 w	1.1	39,752 w	41,392 w	1.0
1982	84,454 w	82,877 w	1.0	42,779 w	47,573 w	0.9
1983	95,496 w	89,825 w	1.1	46,047 w	56,741 w	0.8
1984	112,325 w	101,545 w	1.1	53,206 w	68,074 w	0.8
1985	119,735 w	111,570 w	1.1	59,768 w	72,771 w	0.8
1986	113,529 w	113,309 w	1.0	60,229 w	75,523 w	0.8
1987	118,071 w	124,242 w	1.0	67,411 w	84,561 w	0.8
1988	133,203	141,529	0.9	68,409	95,422	0.7
1989	152,241	163,028	0.9	77,860	103,828	0.7
1990	158,886	169,354	0.9	88,943	108,873	0.8
1991	168,633	173,735	1.0	91,227	103,151	0.9
1992	172,637	171,437	1.0	94,696	110,904	0.9
1993	164,009	153,720	1.1	104,141	119,372	0.9
1994	183,571	172,276	1.1	118,320	135,635	0.9
1995	201,628	187,265	1.1	141,447	153,603	0.9
1996	207,214	193,440	1.1	148,291	164,094	0.9
1997	236,942	211,384	1.1	155,722	168,747	0.9
1998	254,840	234,467	1.1	151,753	175,333	0.9
1999	262,543	245,296	1.1	151,044	179,696	0.8
2000	303,702	293,399	1.0	167,382	204,181	0.8
2001	307,620	292,527	1.1	175,201	213,082	0.8

Note: w: Estimates based on ISIC Rev.2.

Source: OECD, “STAN database for Industrial Analysis 2003/4”

Table 2-1-4: Trade balance in the high technology industry for selected countries

(A) Japan

Year	Total (billion yen)			Pharmaceuticals (billion yen)			Office equipment (billion yen)			Communication equipment (billion yen)			Aircraft (billion yen)		
	Export	Import	Balance ratio	Export	Import	Balance ratio	Export	Import	Balance ratio	Export	Import	Balance ratio	Export	Import	Balance raio
1980	4,393 w	1,108 w	4.0	136 w	300 w	0.5	669 w	235 w	2.8	3,568 w	277 w	12.9	20 w	296 w	0.1
1981	5,388 w	1,192 w	4.5	148 w	309 w	0.5	754 w	226 w	3.3	4,458 w	290 w	15.4	28 w	367 w	0.1
1982	5,698 w	1,234 w	4.6	154 w	378 w	0.4	999 w	248 w	4.0	4,501 w	319 w	14.1	44 w	289 w	0.2
1983	6,831 w	1,402 w	4.9	168 w	357 w	0.5	1,546 w	246 w	6.3	5,080 w	348 w	14.6	37 w	451 w	0.1
1984	8,976 w	1,478 w	6.1	170 w	371 w	0.5	2,238 w	326 w	6.9	6,534 w	443 w	14.7	34 w	338 w	0.1
1985	9,196 w	1,669 w	5.5	188 w	384 w	0.5	2,324 w	375 w	6.2	6,650 w	395 w	16.8	34 w	515 w	0.1
1986	8,138 w	1,433 w	5.7	175 w	354 w	0.5	2,357 w	294 w	8.0	5,572 w	364 w	15.3	34 w	421 w	0.1
1987	7,908 w	1,492 w	5.3	174 w	361 w	0.5	2,571 w	327 w	7.9	5,124 w	429 w	11.9	39 w	375 w	0.1
1988	8,579	1,756	4.9	186	397	0.5	2,889	426	6.8	5,450	563	9.7	54	370	0.1
1989	9,484	2,194	4.3	205	444	0.5	3,228	616	5.2	5,978	777	7.7	73	357	0.2
1990	10,309	2,743	3.8	235	483	0.5	3,588	769	4.7	6,400	894	7.2	86	597	0.1
1991	10,597	2,808	3.8	250	498	0.5	3,635	770	4.7	6,619	996	6.6	93	544	0.2
1992	10,688	2,790	3.8	271	548	0.5	3,872	777	5.0	6,445	955	6.7	100	510	0.2
1993	10,125	2,821	3.6	249	522	0.5	3,689	779	4.7	6,101	1,082	5.6	86	438	0.2
1994	10,458	3,354	3.1	242	526	0.5	3,601	957	3.8	6,528	1,399	4.7	87	472	0.2
1995	10,871	4,481	2.4	262	578	0.5	3,512	1,528	2.3	7,017	2,032	3.5	80	343	0.2
1996	11,216	5,746	2.0	313	612	0.5	3,816	2,119	1.8	6,948	2,626	2.6	139	389	0.4
1997	12,749	6,367	2.0	351	652	0.5	4,588	2,341	2.0	7,573	2,766	2.7	237	608	0.4
1998	12,499	6,312	2.0	368	615	0.6	4,375	2,206	2.0	7,423	2,618	2.8	333	873	0.4
1999	11,794	6,548	1.8	378	663	0.6	3,781	2,320	1.6	7,354	2,751	2.7	281	814	0.3
2000	13,261	7,833	1.7	396	652	0.6	3,795	2,971	1.3	8,832	3,706	2.4	238	504	0.5
2001	11,520	7,755	1.5	446	751	0.6	3,466	2,851	1.2	7,285	3,662	2.0	323	491	0.7

(B) U.S.

Year	Total (million dollars)			Pharmaceuticals (million dollars)			Office equipment (million dollars)			Communication equipment (million dollars)			Aircraft (million dollars)		
	Export	Import	Balance ratio	Export	Import	Balance ratio	Export	Import	Balance ratio	Export	Import	Balance ratio	Export	Import	Balance ratio
1980	31,857 w	18,243 w	1.7	2,428 w	1,250 w	1.9	8,400 w	2,780 w	3.0	5,785 w	10,706 w	0.5	15,244 w	3,507 w	4.3
1981	35,871 w	22,457 w	1.6	2,662 w	1,412 w	1.9	9,407 w	3,229 w	2.9	6,331 w	13,384 w	0.5	17,471 w	4,432 w	3.9
1982	35,452 w	24,052 w	1.5	2,741 w	1,425 w	1.9	9,815 w	4,120 w	2.4	8,110 w	14,218 w	0.6	14,786 w	4,289 w	3.4
1983	38,305 w	29,598 w	1.3	3,002 w	1,748 w	1.7	11,271 w	6,890 w	1.6	8,761 w	17,543 w	0.5	15,271 w	3,417 w	4.5
1984	41,366 w	43,459 w	1.0	3,171 w	2,243 w	1.4	14,243 w	11,198 w	1.3	9,923 w	25,200 w	0.4	14,029 w	4,818 w	2.9
1985	43,925 w	46,245 w	0.9	3,153 w	2,547 w	1.2	14,951 w	11,675 w	1.3	9,341 w	26,053 w	0.4	16,480 w	5,970 w	2.8
1986	47,328 w	53,981 w	0.9	3,615 w	3,101 w	1.2	15,467 w	14,756 w	1.0	10,638 w	28,768 w	0.4	17,608 w	7,356 w	2.4
1987	56,254 w	60,849 w	0.9	3,706 w	3,681 w	1.0	18,916 w	19,007 w	1.0	12,742 w	30,689 w	0.4	20,890 w	7,472 w	2.8
1988	68,659 w	72,557 w	0.9	4,503 w	4,777 w	0.9	23,632 w	23,460 w	1.0	16,704 w	35,629 w	0.5	23,820 w	8,691 w	2.7
1989	75,375	77,248 w	1.0	4,133	3,235 w	1.3	23,204	25,984 w	0.9	18,747	38,349 w	0.5	29,291	9,680 w	3.0
1990	87,554	80,883	1.1	4,692	3,811	1.2	24,736	27,533	0.9	22,489	38,529	0.6	35,637	11,010	3.2
1991	96,020	88,229	1.1	5,372	4,614	1.2	25,988	30,681	0.8	23,239	40,658	0.6	41,421	12,276	3.4
1992	100,584	100,726	1.0	6,241	5,482	1.1	26,998	37,088	0.7	24,971	45,073	0.6	42,374	13,083	3.2
1993	100,207	112,323	0.9	6,701	5,890	1.1	27,172	43,971	0.6	29,225	50,976	0.6	37,109	11,486	3.2
1994	110,482	135,050	0.8	7,272	6,448	1.1	30,883	53,016	0.6	37,108	63,581	0.6	35,219	12,005	2.9
1995	120,829	162,220	0.7	7,616	7,782	1.0	36,411	63,970	0.6	46,439	79,542	0.6	30,363	10,926	2.8
1996	134,452	166,904	0.8	8,652	9,821	0.9	39,676	67,559	0.6	48,497	76,397	0.6	37,627	13,127	2.9
1997	159,373	182,272	0.9	9,889	11,731	0.8	43,650	75,017	0.6	58,605	78,351	0.7	47,229	17,173	2.8
1998	191,654	196,507	1.0	11,326	14,397	0.8	47,775	78,086	0.6	69,696	81,723	0.9	62,857	22,301	2.8
1999	204,389	219,261	0.9	13,115	16,857	0.8	48,792	84,445	0.6	81,487	93,670	0.9	60,995	24,289	2.5
2000	227,849	263,573	0.9	14,920	18,502	0.8	57,529	92,162	0.6	102,466	126,046	0.8	52,934	26,863	2.0
2001	205,714	226,985	0.9	17,642	22,163	0.8	49,408	75,913	0.7	81,082	97,321	0.8	57,582	31,588	1.8

(C)Germany

Year	Total (million euros)			Pharmaceuticals (million euros)			Office equipment (million euros)			Communication equipment (million euros)			Aircraft (million euros)		
	Export	Import	Balance ratio	Export	Import	Balance raio	Export	Import	Balance ratio	Export	Import	Balance ratio	Export	Import	Balance ratio
1980	13,400 w	12,518 w	1.1	2,794 w	1,572 w	1.8	3,157 w	3,217 w	1.0	4,647 w	4,509 w	1.0	2,802 w	3,220 w	0.9
1981	16,471 w	16,238 w	1.0	3,251 w	1,793 w	1.8	3,718 w	3,878 w	1.0	5,086 w	5,156 w	1.0	4,416 w	5,411 w	0.8
1982	19,470 w	17,853 w	1.1	3,434 w	1,901 w	1.8	4,137 w	4,163 w	1.0	5,591 w	5,279 w	1.1	6,308 w	6,510 w	1.0
1983	19,715 w	19,541 w	1.0	3,683 w	2,054 w	1.8	4,890 w	5,281 w	0.9	5,943 w	5,944 w	1.0	5,199 w	6,262 w	0.8
1984	23,776 w	22,699 w	1.0	4,200 w	2,367 w	1.8	5,924 w	6,855 w	0.9	7,114 w	7,337 w	1.0	6,538 w	6,140 w	1.1
1985	25,762 w	25,144 w	1.0	4,603 w	2,676 w	1.7	7,484 w	8,343 w	0.9	7,814 w	7,813 w	1.0	5,861 w	6,312 w	0.9
1986	24,133 w	23,579 w	1.0	4,587 w	2,744 w	1.7	7,567 w	8,106 w	0.9	8,078 w	7,855 w	1.0	3,901 w	4,874 w	0.8
1987	24,631 w	24,480 w	1.0	4,660 w	2,762 w	1.7	7,222 w	8,395 w	0.9	8,355 w	8,364 w	1.0	4,394 w	4,959 w	0.9
1988	27,285	28,090	1.0	5,128	3,016	1.7	7,108	9,336	0.8	9,466	9,847	1.0	5,583	5,891	0.9
1989	32,257 z	34,653	0.9	5,475	3,399	1.6	8,156 z	11,573	0.7	10,470 z	11,057	0.9	8,156	8,624	0.9
1990	31,900	36,970	0.9	5,808	3,606	1.6	8,067	12,225	0.7	10,348	12,430	0.8	7,677	8,709	0.9
1991	36,537	45,870	0.8	6,611	4,482	1.5	8,283	14,335	0.6	11,617	14,601	0.8	10,026	12,452	0.8
1992	35,444	44,010	0.8	7,112	4,712	1.5	7,702	14,616	0.5	10,809	13,565	0.8	9,821	11,117	0.9
1993	33,615	41,079	0.8	7,468	4,408	1.7	7,398	13,641	0.5	10,649	13,469	0.8	8,100	9,561	0.8
1994	38,344	45,699	0.8	8,376	5,351	1.6	8,197	14,960	0.5	13,358	16,093	0.8	8,413	9,295	0.9
1995	40,738	46,255	0.9	8,600	5,737	1.5	9,485	16,186	0.6	14,868	17,213	0.9	7,785	7,119	1.1
1996	41,754	47,028	0.9	9,296	6,235	1.5	9,285	15,564	0.6	15,202	16,943	0.9	7,971	8,286	1.0
1997	53,845	56,814	0.9	11,732	7,246	1.6	11,087	19,142	0.6	19,323	19,203	1.0	11,703	11,223	1.0
1998	62,126	69,244	0.9	14,136	8,616	1.6	12,828	23,518	0.5	20,176	21,953	0.9	14,986	15,157	1.0
1999	70,303	77,040	0.9	15,566	9,148	1.7	13,579	26,639	0.5	23,729	24,704	1.0	17,429	16,549	1.1
2000	91,846	102,155	0.9	16,584	11,331	1.5	18,652	32,085	0.6	34,648	36,556	0.9	21,962	22,183	1.0
2001	99,948	103,308	1.0	21,825	13,124	1.7	17,650	31,507	0.6	34,491	37,310	0.9	25,982	21,367	1.2

(D) France

Year	Total (million euros)			Pharmaceuticals (million euros)			Office equipment (million euros)			Communication equipment (million euros)			Aircraft (million euros)		
	Export	Import	Balance ratio	Export	Import	Balance raito	Export	Import	Balance raito	Export	Improt	Balance ratio	Export	Import	Balance ratio
1980	4,863 w	5,002 w	1.0	1,093 w	560 w	2.0	1,242 w	1,750 w	0.7	1,416 w	1,831 w	0.8	1,112 w	861 w	1.3
1981	6,264 w	6,705 w	0.9	1,304 w	727 w	1.8	1,553 w	2,224 w	0.7	1,645 w	2,248 w	0.7	1,762 w	1,506 w	1.2
1982	9,315 w	8,326 w	1.1	2,820 w	857 w	3.3	1,730 w	3,085 w	0.6	1,920 w	2,693 w	0.7	2,845 w	1,691 w	1.7
1983	9,664 w	9,661 w	1.0	1,857 w	1,034 w	1.8	2,404 w	3,811 w	0.6	2,391 w	2,811 w	0.9	3,012 w	2,005 w	1.5
1984	12,595 w	11,423 w	1.1	2,136 w	1,176 w	1.8	3,140 w	4,687 w	0.7	2,955 w	3,578 w	0.8	4,364 w	1,982 w	2.2
1985	13,533 w	12,744 w	1.1	2,408 w	1,323 w	1.8	3,536 w	5,567 w	0.6	3,435 w	3,812 w	0.9	4,154 w	2,042 w	2.0
1986	13,085 w	13,591 w	1.0	2,450 w	1,405 w	1.7	3,885 w	5,768 w	0.7	3,409 w	4,275 w	0.8	3,341 w	2,143 w	1.6
1987	14,629 w	15,290 w	1.0	2,528 w	1,514 w	1.7	4,403 w	6,397 w	0.7	3,914 w	5,052 w	0.8	3,784 w	2,327 w	1.6
1988	16,861	19,523	0.9	2,924	1,891	1.5	4,440	7,447	0.6	4,375	6,279	0.7	5,122	3,906	1.3
1989	19,993	21,385	0.9	3,470	2,377	1.5	5,040	8,314	0.6	4,736	6,678	0.7	6,747	4,016	1.7
1990	21,362	23,499	0.9	3,596	2,640	1.4	4,816	8,302	0.6	5,413	7,307	0.7	7,537	5,250	1.4
1991	26,233	26,627	1.0	4,018	3,140	1.3	5,369	8,431	0.6	5,857	7,927	0.7	10,989	7,129	1.5
1992	26,965	25,612	1.1	4,548	3,423	1.3	5,466	8,522	0.6	5,728	7,266	0.8	11,223	6,401	1.8
1993	26,105	24,707	1.1	4,363	3,678	1.2	5,056	7,980	0.6	6,076	7,425	0.8	10,610	5,624	1.9
1994	29,375	27,894	1.1	5,017	4,283	1.2	5,707	9,111	0.6	7,150	8,179	0.9	11,501	6,321	1.8
1995	33,665	29,306	1.1	5,772	4,980	1.2	6,814	10,052	0.7	9,234	9,336	1.0	11,845	4,938	2.4
1996	36,065	31,638	1.1	6,277	5,288	1.2	7,657	10,616	0.7	10,179	9,947	1.0	11,952	5,787	2.1
1997	44,341	38,581	1.1	7,712	6,018	1.3	9,139	12,161	0.8	12,873	12,225	1.1	14,617	8,177	1.8
1998	51,786	46,115	1.1	9,062	7,644	1.2	9,722	14,004	0.7	15,777	14,414	1.1	17,225	10,053	1.7
1999	55,579	48,425	1.1	10,621	8,469	1.3	9,438	14,123	0.7	17,169	15,340	1.1	18,351	10,493	1.7
2000	69,290	62,700	1.1	12,870	10,829	1.2	10,692	16,957	0.6	24,012	22,571	1.1	21,716	12,343	1.8
2001	68,816	59,135	1.2	15,309	12,051	1.3	9,307	15,991	0.6	20,215	18,767	1.1	23,985	12,326	1.9

(E) U.K.

Year	Total (million pounds)			Pharmaceuticals (million pounds)			Office equipment (million pounds)			Communication equipment (million pounds)			Aircraft (million pounds)		
	Export	Import	Balance ratio	Export	Import	Balance raito	Export	Import	Balance raito	Export	Import	Balance ratio	Export	Import	Balance ratio
1980	5,682 w	5,027 w	1.1	884 w	293 w	3.0	1,163 w	1,337 w	0.9	931 w	1,190 w	0.8	2,704 w	2,207 w	1.2
1981	5,467 w	5,183 w	1.1	995 w	393 w	2.5	1,115 w	1,620 w	0.7	1,032 w	1,712 w	0.6	2,325 w	1,458 w	1.6
1982	6,562 w	6,357 w	1.0	1,150 w	488 w	2.4	1,404 w	2,086 w	0.7	1,233 w	2,151 w	0.6	2,775 w	1,632 w	1.7
1983	7,492 w	8,093 w	0.9	1,273 w	611 w	2.1	1,932 w	2,985 w	0.6	1,450 w	2,700 w	0.5	2,837 w	1,797 w	1.6
1984	9,395 w	10,094 w	0.9	1,475 w	699 w	2.1	2,952 w	4,131 w	0.7	1,820 w	3,141 w	0.6	3,148 w	2,123 w	1.5
1985	11,364 w	11,431 w	1.0	1,712 w	756 w	2.3	3,735 w	4,525 w	0.8	2,189 w	3,558 w	0.6	3,728 w	2,592 w	1.4
1986	11,964 w	11,425 w	1.0	1,886 w	888 w	2.1	3,543 w	4,556 w	0.8	2,322 w	3,775 w	0.6	4,213 w	2,206 w	1.9
1987	12,287 w	12,793 w	1.0	2,009 w	1,032 w	1.9	4,432 w	5,484 w	0.8	2,604 w	4,488 w	0.6	3,242 w	1,789 w	1.8
1988	15,438	16,177	1.0	2,060	1,103	1.9	5,218	6,228	0.8	2,878	5,125	0.6	5,282	3,721	1.4
1989	18,105	18,193	1.0	2,395	1,393	1.7	5,564	7,424	0.7	3,326	5,697	0.6	6,820	3,679	1.9
1990	19,647	20,035	1.0	2,635	1,501	1.8	5,943	7,592	0.8	3,903	5,550	0.7	7,166	5,392	1.3
1991	20,301	19,025	1.1	2,915	1,715	1.7	6,108	7,453	0.8	4,153	5,389	0.8	7,125	4,468	1.6
1992	20,293	20,078	1.0	3,337	2,027	1.6	6,082	8,140	0.7	4,215	5,661	0.7	6,659	4,250	1.6
1993	24,535	23,944	1.0	4,159	2,438	1.7	7,898	9,800	0.8	6,156	7,446	0.8	6,322	4,260	1.5
1994	28,031	27,892	1.0	4,524	2,797	1.6	9,359	10,734	0.9	8,058	9,540	0.8	6,090	4,821	1.3
1995	35,026	32,321	1.1	5,498	3,355	1.6	11,512	12,202	0.9	10,537	12,200	0.9	7,479	4,564	1.6
1996	37,927	36,143	1.0	5,949	3,857	1.5	11,976	12,491	1.0	12,448	14,377	0.9	7,554	5,418	1.4
1997	39,788	37,966	1.0	5,872	4,049	1.5	13,000	13,718	0.9	10,883	12,386	0.9	10,033	7,813	1.3
1998	42,775	42,010	1.0	6,270	4,370	1.4	12,621	15,518	0.8	13,732	13,525	1.0	10,152	8,597	1.2
1999	44,703	46,026	1.0	6,749	5,234	1.3	13,437	16,801	0.8	14,276	15,538	0.9	10,241	8,453	1.2
2000	55,544	60,439	0.9	7,738	6,060	1.3	14,517	19,657	0.7	19,605	22,365	0.9	13,684	12,357	1.1
2001	62,807	62,228	1.0	9,571	7,857	1.2	13,407	16,446	0.8	20,183	18,576	1.1	19,646	19,349	1.0

Note: w: Estimates based on ISIC Rev.2.

z: Estimates of each item of the sector based on corresponding variances.

Source: Same as Table 2-1-3.

Table 2-1-5: Trends in the trade value in the high technology industry for selected countries

(unit: million dollars)

Japan

Year	Aerospace		Electronics		Office equipment/computers		Pharmaceuticals		Medical/precision/optical equipment		Total	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
1981	129	1,623	19,098	1,499	2,708	1,031	317	1,156	8,094	1,531	30,346	6,840
1982	178	1,162	17,245	1,469	3,206	1,008	293	1,254	6,893	1,523	27,816	6,416
1983	159	1,861	20,493	1,644	5,227	1,030	334	1,217	7,752	1,656	33,965	7,408
1984	144	1,386	26,701	2,097	7,666	1,366	340	1,260	8,840	1,920	43,691	8,029
1985	143	2,113	27,007	1,850	7,909	1,550	372	1,286	9,672	1,972	45,103	8,771
1986	208	2,443	32,250	2,401	11,432	1,711	492	1,669	11,903	2,277	56,285	10,500
1987	279	2,555	34,598	3,304	14,548	2,228	569	2,000	13,050	2,875	63,044	12,961
1988	421	2,888	42,541	4,394	22,553	3,327	1,449	3,099	12,813	4,164	79,776	17,872
1989	529	2,595	43,492	5,654	23,488	4,481	1,493	3,230	13,633	4,974	82,634	20,934
1990	593	4,142	44,299	6,199	24,834	5,335	1,623	3,352	14,259	5,656	85,608	24,684
1991	688	4,039	49,147	7,393	26,994	5,716	1,853	3,697	15,881	6,152	94,562	26,997
1992	788	4,033	51,021	7,556	30,647	6,145	2,148	4,331	16,095	6,198	100,699	28,263
1993	771	3,944	54,979	9,750	33,248	7,014	2,242	4,703	17,031	6,898	108,271	32,309
1994	859	4,633	64,108	13,741	35,363	9,406	2,378	5,169	18,739	8,368	121,447	41,317
1995	853	3,656	74,893	21,647	37,483	16,276	2,800	6,154	21,916	10,463	137,944	58,196
1996	1,275	3,578	63,830	24,139	35,060	19,479	2,876	5,623	21,283	12,240	124,324	65,059
1997	1,955	5,033	62,589	22,880	37,921	19,368	2,905	5,390	21,817	12,567	127,188	65,238
1998	2,554	6,685	56,887	20,041	33,530	16,890	2,821	4,709	19,432	11,746	115,224	60,070
1999	2,466	7,157	64,517	24,176	33,174	20,387	3,318	5,823	22,321	13,032	125,795	70,574
2000	2,210	4,679	81,943	34,374	35,210	27,551	3,674	6,044	28,838	15,095	151,874	87,742
2001	2,657	4,032	59,882	30,095	28,486	23,433	3,663	6,169	23,685	14,799	118,372	78,529

(unit: million dollars)

U.S.

Year	Aerospace		Electronics		Office equipment/computers		Pharmaceuticals		Medical/precision/optical equipment		Total	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
1981	17,193	4,290	7,567	14,025	9,485	2,940	2,130	953	7,920	5,336	44,295	27,544
1982	14,405	4,161	9,629	14,859	9,830	3,742	2,240	960	7,987	5,039	44,091	28,761
1983	15,019	3,232	10,323	18,289	11,203	6,242	2,453	1,184	7,746	5,629	46,744	34,576
1984	13,874	4,648	11,635	26,415	14,087	10,200	2,563	1,512	8,137	7,319	50,296	50,094
1985	16,325	5,768	10,807	27,485	14,593	10,704	2,588	1,703	9,169	8,357	53,481	54,017
1986	17,480	7,145	12,257	30,514	15,034	13,601	2,962	2,063	9,759	10,096	57,493	63,418
1987	20,716	7,239	14,614	32,652	18,301	17,573	3,033	2,462	10,717	10,861	67,380	70,788
1988	23,469	8,405	19,029	37,881	22,710	21,675	3,674	3,208	12,869	11,839	81,750	83,008
1989	29,291	9,430	18,747	40,673	23,204	23,948	4,133	2,084	15,056	12,746	90,431	88,880
1990	35,637	11,010	22,489	38,529	24,736	27,533	4,692	3,811	16,840	13,297	104,394	94,179
1991	41,421	12,276	23,239	40,658	25,988	30,681	5,372	4,615	18,810	14,840	114,829	103,070
1992	42,374	13,083	24,971	45,073	26,998	37,088	6,241	5,482	20,114	15,954	120,698	116,681
1993	37,109	11,486	29,225	50,976	27,172	43,971	6,701	5,890	21,232	17,495	121,439	129,817
1994	35,219	12,005	37,109	63,581	30,883	53,016	7,272	6,448	23,236	19,473	133,719	154,523
1995	30,364	10,926	46,439	79,542	36,411	63,970	7,616	7,782	25,996	22,197	146,826	184,417
1996	37,627	13,127	48,489	76,396	39,669	67,559	8,652	9,821	29,070	23,625	163,507	190,528
1997	47,229	17,174	58,585	78,350	43,635	75,015	9,889	11,731	33,320	25,643	192,657	207,913
1998	62,857	22,301	69,681	81,721	47,765	78,084	11,326	14,397	36,029	28,992	227,658	225,495
1999	60,995	24,290	81,473	93,669	48,784	84,444	13,115	16,857	38,703	31,876	243,069	251,135
2000	52,934	26,863	102,456	126,045	57,523	92,162	14,920	18,502	45,938	38,834	273,769	302,406
2001	57,582	31,588	81,076	97,320	49,404	75,912	17,642	22,163	45,248	37,226	250,952	264,209

(unit: million dollars)

Germany

Year	Aerospace		Electronics		Office equipment/computers		Pharmaceuticals		Medical/precision/optical equipment		Total	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
1981	3,579	4,611	5,432	4,826	3,013	3,118	2,006	1,139	5,280	3,540	19,309	17,234
1982	4,819	5,107	5,539	4,574	3,110	3,098	1,977	1,121	5,272	3,312	20,716	17,211
1983	3,715	4,674	5,580	4,890	3,484	3,732	2,003	1,144	5,172	3,318	19,955	17,758
1984	4,263	4,052	5,957	5,373	3,764	4,312	2,031	1,168	5,334	3,384	21,350	18,289
1985	3,793	4,062	6,495	5,644	4,720	5,177	2,212	1,298	6,177	3,783	23,396	19,964
1986	3,360	4,319	9,069	7,686	6,446	6,813	3,016	1,778	8,570	5,240	30,460	25,835
1987	4,507	5,287	11,281	9,873	7,400	8,512	3,708	2,156	10,367	6,431	37,262	32,258
1988	5,957	6,474	10,540	10,963	7,915	10,395	5,710	3,358	12,207	6,963	42,330	38,153
1989	8,304	8,974	10,842	11,574	8,445	12,115	5,730	3,558	12,359	7,238	45,679	43,459
1990	9,196	10,783	12,799	15,427	9,978	15,172	7,183	4,476	14,626	9,074	53,781	54,932
1991	11,538	14,608	13,747	17,260	9,802	16,947	7,823	5,299	14,448	10,174	57,358	64,289
1992	11,959	13,761	13,554	16,993	9,657	18,310	8,918	5,903	16,237	11,187	60,324	66,154
1993	9,345	11,225	12,597	15,941	8,751	16,145	8,834	5,217	14,760	9,285	54,287	57,813
1994	9,803	11,124	16,167	19,480	9,920	18,108	10,137	6,477	15,959	10,366	61,986	65,554
1995	10,200	9,572	20,327	23,536	12,967	22,132	11,757	7,844	19,006	12,019	74,257	75,104
1996	9,822	10,635	19,751	22,017	12,063	20,226	12,077	8,103	19,124	12,290	72,837	73,272
1997	12,551	12,598	21,795	21,673	12,506	21,604	13,234	8,178	18,894	12,264	78,980	76,318
1998	15,839	16,883	22,468	24,452	14,286	26,196	15,743	9,597	20,540	13,545	88,876	90,673
1999	17,729	17,619	25,258	26,301	14,454	28,361	16,569	9,739	21,127	13,756	95,138	95,777
2000	19,501	20,417	31,909	33,645	17,178	29,530	15,274	10,429	21,491	14,622	105,352	108,643
2001	22,513	19,145	30,910	33,430	15,817	28,230	19,559	11,759	23,115	15,267	111,914	107,831

(unit: million dollars)

France

Year	Aerospace		Electronics		Office equipment/computers		Pharmaceuticals		Medical/precision/optical equipment		Total	
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
1981	2,195	1,849	2,332	3,040	1,797	2,439	1,372	708	2,120	2,703	9,815	10,738
1982	2,921	1,690	2,237	3,034	1,645	2,818	2,524	691	2,006	2,653	11,333	10,886
1983	2,633	1,751	2,387	2,743	1,958	3,015	1,372	719	2,043	2,563	10,393	10,791
1984	3,313	1,499	2,577	3,042	2,234	3,231	1,367	708	2,196	2,500	11,688	10,980
1985	3,119	1,506	2,936	3,174	2,466	3,758	1,509	778	2,571	2,709	12,600	11,925
1986	3,203	2,052	3,739	4,556	3,478	4,983	1,970	1,064	3,024	3,678	15,413	16,333
1987	4,185	2,578	4,958	6,228	4,551	6,394	2,337	1,329	3,823	4,727	19,854	21,257
1988	5,653	4,310	4,829	6,927	4,901	8,216	3,229	2,087	4,312	5,087	22,923	26,626
1989	6,946	4,133	4,875	6,872	5,188	8,556	3,573	2,447	4,277	5,391	24,859	27,399
1990	9,098	6,340	6,533	8,825	5,813	10,026	4,342	3,189	5,392	6,402	31,177	34,781
1991	12,812	8,320	6,828	9,251	6,260	9,839	4,685	3,664	5,405	6,496	35,990	37,571
1992	13,910	7,936	7,100	9,009	6,775	10,566	5,637	4,244	5,849	7,038	39,271	38,794
1993	12,901	6,827	7,388	9,014	6,148	9,687	5,305	4,464	5,579	6,516	37,320	36,508
1994	13,635	7,491	8,476	9,692	6,766	10,797	5,948	5,075	5,997	6,728	40,822	39,783
1995	15,586	6,495	12,151	12,278	8,966	13,220	7,596	6,550	7,018	7,944	51,317	46,488
1996	15,323	7,420	13,050	12,749	9,817	13,606	8,048	6,784	7,170	8,276	53,407	48,835
1997	16,443	9,201	14,482	13,755	10,281	13,683	8,676	6,772	7,662	7,878	57,543	51,288
1998	19,187	11,188	17,574	16,040	10,829	15,583	10,095	8,506	7,886	8,465	65,571	59,782
1999	19,954	11,415	18,668	16,686	10,262	15,362	11,549	9,213	7,706	8,800	68,138	61,477
2000	20,022	11,378	22,139	20,806	9,858	15,631	11,866	9,982	7,667	9,060	71,552	66,858
2001	22,236	11,429	18,742	17,401	8,629	14,827	14,193	11,173	8,654	9,770	72,454	64,600

(unit: million dollars)

Year	Aerospace		Electronics		Office equipment/computers		Pharamaceuticals		Medical/precision/optical equipment		Total	
U.K.												
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
1981	4,467	2,860	2,572	3,806	2,101	3,058	1,521	598	3,154	2,961	13,815	13,283
1982	4,787	2,834	2,740	4,159	2,359	3,425	1,572	646	3,178	2,966	14,636	14,030
1983	4,200	2,677	2,764	4,510	2,786	4,233	1,497	697	3,027	3,115	14,273	15,232
1984	4,067	2,842	3,076	4,643	3,773	5,184	1,518	710	3,195	3,309	15,630	16,689
1985	4,761	3,344	3,584	5,065	4,625	5,469	1,715	734	3,540	3,491	18,225	18,103
1986	6,107	3,188	4,285	6,099	4,944	6,247	2,093	967	4,257	4,167	21,687	20,667
1987	4,775	2,737	5,424	8,129	6,980	8,432	2,479	1,258	5,037	4,947	24,695	25,503
1988	9,409	6,626	5,128	9,124	9,296	11,090	3,670	1,964	5,688	5,582	33,190	34,386
1989	11,150	6,022	5,438	9,325	9,096	12,152	3,915	2,281	5,740	5,889	35,338	35,669
1990	12,826	9,613	6,986	9,896	10,636	13,536	4,715	2,676	6,669	6,530	41,833	42,250
1991	12,589	7,893	7,339	9,521	10,793	13,169	5,151	3,030	6,709	6,536	42,581	40,149
1992	11,689	7,484	7,400	9,970	10,678	14,336	5,859	3,570	7,056	6,838	42,682	42,198
1993	9,492	6,397	9,242	11,180	11,857	14,716	6,243	3,661	6,259	6,293	43,092	42,246
1994	9,340	7,389	12,357	14,622	14,353	16,453	6,937	4,288	7,289	6,893	50,276	49,645
1995	11,805	7,206	16,630	19,261	18,169	19,264	8,678	5,297	8,341	7,959	63,623	58,985
1996	11,802	8,460	19,447	22,451	18,711	19,505	9,294	6,023	9,438	9,138	68,692	65,576
1997	16,434	12,799	17,826	20,290	21,295	22,474	9,619	6,632	10,480	9,502	75,654	71,696
1998	16,821	14,244	22,753	22,409	20,913	25,711	10,390	7,241	10,532	9,932	81,409	79,537
1999	16,575	13,678	23,106	25,142	21,749	27,184	10,923	8,469	10,263	9,819	82,616	84,293
2000	20,695	18,693	29,649	33,834	21,955	29,737	11,702	9,167	10,613	11,082	94,613	102,513
2001	28,287	27,853	29,060	26,741	19,304	23,675	13,781	11,310	11,238	11,598	101,670	101,177

(unit: million dollars)

Year	Aerospace		Electronics		Office equipment/computers		Pharamaceuticals		Medical/precision/optical equipment		Total	
Republic of Korea												
	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export	Import
1981	0	0	0	0	0	0	0	0	—	—	—	—
1982	0	0	0	0	0	0	0	0	—	—	—	—
1983	0	0	0	0	0	0	0	0	—	—	—	—
1984	0	0	0	0	0	0	0	0	—	—	—	—
1985	0	0	0	0	0	0	0	0	—	—	—	—
1986	0	0	0	0	0	0	0	0	—	—	—	—
1987	0	0	0	0	0	0	0	0	—	—	—	—
1988	—	—	—	—	—	—	—	—	—	—	—	—
1989	—	—	—	—	—	—	—	—	—	—	—	—
1990	—	—	—	—	—	—	—	—	—	—	—	—
1991	—	—	—	—	—	—	—	—	—	—	—	—
1992	—	—	—	—	—	—	—	—	—	—	—	—
1993	—	—	—	—	—	—	—	—	—	—	—	—
1994	763	2,921	20,569	10,005	3,607	2,616	423	743	1,374	4,679	26,736	20,963
1995	882	3,248	28,818	13,469	4,968	3,571	497	887	1,722	6,256	36,887	27,431
1996	373	3,085	21,711	13,030	5,675	3,990	576	1,020	1,676	6,586	30,011	27,710
1997	864	2,024	28,276	17,754	6,406	3,721	665	975	2,238	6,126	38,448	30,599
1998	1,141	1,163	27,181	15,243	5,420	1,973	623	758	2,742	3,614	37,107	22,751
1999	533	1,040	33,211	21,378	10,572	4,331	559	983	3,792	4,923	48,667	32,655
2000	774	1,152	40,405	27,732	19,634	7,712	638	1,101	2,004	6,933	63,455	44,629
2001	626	973	31,719	21,793	13,499	5,642	613	1,290	1,899	5,789	48,356	35,487

Source: OECD, “Main Science and Technology Indicators 2003/1”

Table 2-2-1: Japan's R&D levels in comparison with the U.S.

(A) Imput

Field	Private enterprises		Universities		National research institutes		Government R&D budget	Evaluation
	Research expenditure	Researchers	Research expenditure	Researchers	Research expenditure	Researchers		
Life Science	○	○	●	○	-	●	●	●
Information and telecommunicatio	○	○	○	●	-	●	-	○
Evnironment	-	-	●	●	-	●	●	●
Energy	◎	◎	-	-	-	-	◎	◎
Materials	◎	◎	-	○	-	●	-	◎
Manufacturing technology	○	◎	-	◎	-	●	-	○
Social infrastructure	●	●	-	◎	-	○	●	●

(B) Output

Field	Scientific papers in English journals		U.S. Patents		Science linkage	Evaluation
	Number of papers	RCI	Number of patents granted	RCI		
Life Science	↑ ●	●	↓ ●	●	● ↓	●
Information and telecommunicatio	●	● ↓	↓ ○	● ↓	● ↓	↓ ○
Evnironment	↑ ●	●	●	○	● ↓	●
Energy	↑ ●	● ↓	○	↑ ◎	● ↓	○
Materials	○	●	●	↑ ○	● ↓	○
Manufacturing technology	●	●	●	○	● ↓	○
Social infrastructure	↑ ●	●	●	○	●	↑ ●

Note: 1) By evaluating input and output level of Japan and U.S. based on quality and quantity indicators 'per capita,'
◎: Japan is higher (Level of Japan is more than 125% of U.S.)
○: Equivalent (Level of Japan is more than 80% and less than 125% of U.S.)
●: Japan is lower (Level of Japan is less than 80% of U.S.)
Blank: No data available.
2) ↑↓shows roughly estimated direction of output level of Japan in the past 5 years, and no mark shows equivalence to U.S.
Source: Japan Research Institute, Ltd., National Institute of Science and Technology Policy, Science and Technology Agency, 'Study on R&D Level of Japan (March, 2000)'

Table 2-2-2: Japan's R&D level in comparison with Europe

(A) Imput

Field	Private enterprises		Universities		National research institutes		Government R&D budget	Evaluation
	Research expenditure	Researchers	Research expenditre	Researchers	Research expenditure	Researchers		
Life Science	○	◎	-	-	-	-	●	○
Information and telecommunicatio	◎	◎	-	-	-	-	-	○
Environment	-	-	-	-	-	-	●	●
Energy	◎	◎	-	-	-	-	◎	◎
Materials	◎	◎	-	-	-	-	-	◎
Manufacturing technology	◎	◎	-	-	-	-	-	◎
Social infrastructure	●	○	-	-	-	-	○	○

(B) Output

Field	Scientific papers in English journals		U.S. Patents		Science linkage	Evaluation
	Number of papers	RCI	Number of patents granted	RCI		
Life Science	●	● ↓	↓ ○	○	● ↓	○ ↓
Information and telecommunicatio	○	● ↓	◎	○ ↓	●	○
Environment	●	●	◎	◎	○ ↑	●
Energy	↑ ○	○ ↓	◎	↑ ◎	● ↓	○
Materials	○	○ ↓	◎	↑ ◎	○ ↓	◎
Manufacturing technology	○	●	◎	↑ ◎	● ↓	○
Social infrastructure	●	●	◎	◎	● ↓	○

Note: 1) By evaluating input and output level of Japan and Europe based on quality and quantity indicators 'per capita,'
◎: Japan is higher (Level of Japan is more than 125% of Europe)
○: Equivalent (Level of Japan is more than 80% and less than 125% of Europe)
●: Japan is lower (Level of Japan is less than 80% of Europe)
Blank: No data available.
2) ↑ ↓ show roughly estimated direction of output level of Japan in the past 5 years, and no mark shows equivalence to U.S.
Europe means Germany, France, and U.K.
Source: Same as Table 2-2-1

Table 2-3-1: Trends in the General Indicator of Science and Technology for selected countries

Year	Japan	U.S.	Germany	France	U.K.
1981	0.913	2.102	0.490	0.309	0.392
1982	0.944	2.132	0.500	0.318	0.397
1983	0.973	2.219	0.511	0.324	0.410
1984	1.042	2.355	0.527	0.339	0.429
1985	1.082	2.451	0.562	0.352	0.441
1986	1.105	2.525	0.620	0.358	0.442
1987	1.149	2.611	0.646	0.367	0.457
1988	1.207	2.689	0.671	0.383	0.473
1989	1.264	2.739	0.721	0.404	0.491
1990	1.336	2.813	0.799	0.424	0.505
1991	1.390	2.864	0.852	0.434	0.500
1992	1.392	2.988	0.869	0.462	0.558
1993	1.379	3.038	0.870	0.469	0.576
1994	1.398	3.217	0.898	0.490	0.645
1995	1.472	3.405	0.928	0.514	0.683
1996	1.535	3.553	0.956	0.530	0.844
1997	1.606	3.734	1.050	0.568	0.877
1998	1.635	3.962	1.108	0.609	0.926
1999	1.689	4.137	1.169	0.650	0.954
2000	1.781	4.482	1.272	0.686	0.993

Note: 1) The above is the 1st-principal component score (eigenvalue of the 1st principal component: 8.38 contribution rate: 69.8%)

2) Added constant term to ordinary 1st-principal component so that the principal component score becomes zero when all the variables are zero (constant value: 1.233).

Source: Calculated by NISTEP based on various data (See Table 2-3-5).

Table 2-3-2: Trends in GIST and GDP for selected countries

Year	Japan	U.S.	Germany	France	U.K.
1981	0.69	0.43	0.51	0.30	0.41
1982	0.67	0.44	0.52	0.32	0.41
1983	0.65	0.44	0.51	0.34	0.42
1984	0.66	0.44	0.50	0.36	0.42
1985	0.65	0.44	0.51	0.37	0.43
1986	0.64	0.43	0.56	0.38	0.42
1987	0.61	0.44	0.56	0.38	0.42
1988	0.58	0.43	0.55	0.38	0.42
1989	0.57	0.42	0.55	0.38	0.44
1990	0.55	0.43	0.58	0.38	0.46
1991	0.56	0.44	0.53	0.38	0.49
1992	0.54	0.44	0.52	0.39	0.52
1993	0.53	0.44	0.54	0.41	0.55
1994	0.52	0.45	0.54	0.43	0.60
1995	0.50	0.46	0.53	0.43	0.62
1996	0.49	0.46	0.55	0.44	0.74
1997	0.50	0.47	0.57	0.46	0.72
1998	0.53	0.48	0.59	0.48	0.76
1999	0.53	0.48	0.60	0.49	0.77
2000	0.52	0.50	0.61	0.48	0.76

Note: GDP figures of major countries are in trillion dollars (real price of 1995 base; purchasing power parity equivalent). Science and technology general indicators are the same as in Table 2-3-1, and real GDP is the same as in Reference Statistics C, D, and E.

Source: Science and technology general indicators are the same as in Table 2-3-1, and real GDP is the same as in Reference Statistics C, D, and E.

Table 2-3-3: Trends in per capita GIST for selected countries

Year	Japan	U.S.	Germany	France	U.K.
1981	7.741	9.141	7.937	5.580	6.955
1982	7.952	9.183	8.118	5.711	7.045
1983	8.136	9.471	8.323	5.775	7.277
1984	8.658	9.966	8.607	6.022	7.592
1985	8.938	10.280	9.211	6.212	7.783
1986	9.080	10.494	10.159	6.283	7.771
1987	9.396	10.752	10.574	6.410	8.016
1988	9.834	10.976	10.920	6.665	8.279
1989	10.260	11.073	11.616	6.980	8.561
1990	10.808	11.246	12.640	7.293	8.776
1991	11.197	11.298	10.648	7.425	8.640
1992	11.175	11.633	10.781	7.864	9.615
1993	11.035	11.672	10.717	7.942	9.898
1994	11.162	12.211	11.030	8.276	11.051
1995	11.724	12.774	11.368	8.656	11.655
1996	12.193	13.177	11.676	8.892	14.352
1997	12.725	13.682	12.797	9.492	14.855
1998	12.925	14.349	13.506	10.144	15.630
1999	13.333	14.811	14.238	10.777	16.039
2000	14.029	15.869	15.480	11.321	16.620

Note: The science and technology general indicators are the same as in Table 2-3-1, and the population is the same as in Reference Statistics A.
Source: Science and technology general indicators are the same as in Table 2-3-1, and the population is the same as in Reference Statistics A.

Table 2-3-4: Individual variables' contributions to GIST (2000)

(unit: %)

Number	Variables	Average value	Japan	U.S.	Germany	France	U.K.
[1]	Number of bachelor of science	10.1	4.9	9.1	5.6	17.1	13.9
[2]	Number of bachelors of engineering	7.8	15.2	3.4	5.9	8.6	5.7
[3]	Number of researchers	9.0	14.0	9.9	6.8	8.5	5.7
[4]	R&D expenditure	8.4	10.5	10.8	7.5	8.7	4.7
[5]	Import value of technology	7.2	1.8	3.9	17.2	4.8	8.2
[6]	Number of scientific papers	9.5	6.9	8.9	8.8	11.7	11.3
[7]	Frequency of citation of scientific papers	8.8	4.9	9.9	8.2	9.9	11.0
[8]	Number of domestic patent applications	2.4	7.6	1.4	1.5	0.7	0.9
[9]	Number of cross-border patent applications	10.2	7.0	13.5	11.9	8.8	9.6
[10]	Export value of technology	10.2	4.5	10.0	13.4	5.2	17.8
[11]	Added value of industrial products	9.5	11.8	9.5	9.6	10.2	6.4
[12]	Added value of high-tech products	7.0	10.9	9.7	3.7	5.9	4.7

Note: The figures are the ratio of each component (each variable multiplied by corresponding principal component score coefficient) of the 1st principal component score (2000) shown in Table 2-3-1.
Source: Same as Table 2-3-1.

Table 2-3-5: Trends in GIST with a breakdown by variable

(A) Japan

Year	Input					Output						
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
1981	0.063	0.198	0.128	0.086	0.022	0.048	0.021	0.066	0.008	0.016	0.160	0.096
1982	0.061	0.194	0.133	0.092	0.024	0.051	0.023	0.073	0.009	0.016	0.164	0.104
1983	0.060	0.184	0.137	0.099	0.023	0.053	0.025	0.079	0.009	0.021	0.168	0.116
1984	0.063	0.186	0.147	0.106	0.022	0.055	0.027	0.089	0.011	0.023	0.178	0.135
1985	0.064	0.188	0.151	0.117	0.023	0.061	0.029	0.095	0.012	0.019	0.185	0.138
1986	0.064	0.193	0.160	0.119	0.020	0.064	0.031	0.101	0.012	0.018	0.184	0.139
1987	0.066	0.200	0.165	0.127	0.022	0.064	0.034	0.108	0.015	0.017	0.189	0.142
1988	0.065	0.201	0.173	0.137	0.024	0.072	0.037	0.107	0.017	0.020	0.201	0.154
1989	0.063	0.200	0.181	0.149	0.025	0.075	0.039	0.110	0.019	0.026	0.211	0.167
1990	0.068	0.211	0.189	0.161	0.027	0.079	0.043	0.115	0.022	0.026	0.222	0.174
1991	0.071	0.227	0.197	0.165	0.028	0.083	0.046	0.116	0.022	0.027	0.229	0.178
1992	0.071	0.229	0.202	0.164	0.029	0.093	0.051	0.117	0.022	0.027	0.222	0.164
1993	0.075	0.229	0.210	0.160	0.025	0.093	0.053	0.115	0.021	0.029	0.210	0.157
1994	0.079	0.236	0.217	0.159	0.026	0.100	0.057	0.111	0.023	0.033	0.202	0.155
1995	0.082	0.253	0.223	0.169	0.027	0.106	0.061	0.116	0.026	0.041	0.207	0.163
1996	0.085	0.260	0.228	0.167	0.032	0.110	0.065	0.117	0.032	0.051	0.213	0.173
1997	0.087	0.267	0.235	0.174	0.031	0.111	0.071	0.121	0.053	0.061	0.216	0.178
1998	0.089	0.266	0.238	0.179	0.030	0.120	0.075	0.124	0.073	0.067	0.206	0.169
1999	0.088	0.268	0.248	0.180	0.029	0.124	0.081	0.125	0.091	0.071	0.204	0.180
2000	0.088	0.270	0.250	0.187	0.032	0.122	0.088	0.135	0.124	0.080	0.211	0.195

(B) U.S.

Year	Input					Output						
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
1981	0.298	0.165	0.231	0.228	0.012	0.279	0.190	0.022	0.021	0.142	0.315	0.200
1982	0.307	0.175	0.240	0.240	0.014	0.284	0.199	0.022	0.021	0.103	0.296	0.232
1983	0.313	0.188	0.254	0.257	0.016	0.286	0.207	0.021	0.023	0.102	0.303	0.249
1984	0.329	0.197	0.262	0.282	0.019	0.288	0.218	0.021	0.025	0.105	0.330	0.279
1985	0.350	0.201	0.271	0.306	0.018	0.306	0.230	0.022	0.025	0.110	0.329	0.283
1986	0.353	0.199	0.287	0.313	0.022	0.317	0.242	0.023	0.027	0.131	0.331	0.281
1987	0.337	0.193	0.303	0.319	0.028	0.315	0.255	0.024	0.029	0.159	0.345	0.304
1988	0.312	0.182	0.311	0.327	0.038	0.328	0.270	0.026	0.033	0.183	0.367	0.312
1989	0.294	0.174	0.319	0.334	0.035	0.340	0.284	0.029	0.040	0.201	0.367	0.323
1990	0.283	0.168	0.325	0.344	0.042	0.349	0.302	0.031	0.049	0.233	0.361	0.324
1991	0.284	0.161	0.332	0.352	0.052	0.364	0.323	0.031	0.054	0.241	0.350	0.321
1992	0.300	0.161	0.337	0.353	0.065	0.381	0.344	0.032	0.069	0.275	0.354	0.318
1993	0.315	0.163	0.342	0.345	0.062	0.379	0.358	0.035	0.083	0.279	0.361	0.315
1994	0.331	0.163	0.346	0.345	0.071	0.391	0.369	0.037	0.107	0.337	0.383	0.335
1995	0.349	0.164	0.350	0.367	0.082	0.406	0.382	0.043	0.142	0.374	0.395	0.351
1996	0.366	0.164	0.371	0.386	0.091	0.401	0.388	0.037	0.196	0.393	0.396	0.364
1997	0.378	0.162	0.392	0.408	0.104	0.397	0.403	0.041	0.257	0.395	0.407	0.390
1998	0.389	0.158	0.409	0.429	0.127	0.401	0.416	0.046	0.351	0.418	0.417	0.401
1999	0.398	0.156	0.426	0.455	0.140	0.403	0.430	0.054	0.406	0.427	0.425	0.417
2000	0.407	0.154	0.443	0.484	0.175	0.398	0.445	0.061	0.604	0.449	0.427	0.435

(C) Germany

Year	Input					Output						
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
1981	0.045	0.052	0.043	0.055	0.029	0.059	0.027	0.010	0.014	0.019	0.101	0.034
1982	0.050	0.052	0.044	0.057	0.029	0.061	0.028	0.011	0.013	0.022	0.100	0.035
1983	0.050	0.052	0.045	0.057	0.032	0.061	0.029	0.011	0.013	0.025	0.100	0.036
1984	0.050	0.055	0.048	0.059	0.032	0.060	0.030	0.011	0.015	0.026	0.103	0.038
1985	0.051	0.058	0.050	0.065	0.038	0.065	0.032	0.011	0.016	0.028	0.108	0.040
1986	0.053	0.063	0.053	0.067	0.053	0.067	0.033	0.011	0.017	0.049	0.112	0.042
1987	0.054	0.069	0.056	0.070	0.058	0.068	0.035	0.011	0.019	0.054	0.110	0.042
1988	0.057	0.071	0.058	0.073	0.062	0.069	0.038	0.011	0.021	0.054	0.115	0.044
1989	0.061	0.078	0.060	0.075	0.075	0.073	0.041	0.011	0.023	0.061	0.118	0.044
1990	0.075	0.100	0.071	0.076	0.078	0.075	0.045	0.011	0.026	0.074	0.123	0.046
1991	0.076	0.102	0.082	0.084	0.089	0.078	0.050	0.011	0.024	0.073	0.131	0.052
1992	0.081	0.101	0.081	0.081	0.101	0.082	0.056	0.012	0.027	0.076	0.126	0.045
1993	0.091	0.103	0.080	0.079	0.105	0.082	0.061	0.012	0.029	0.077	0.114	0.038
1994	0.102	0.105	0.079	0.077	0.100	0.088	0.066	0.013	0.033	0.083	0.114	0.037
1995	0.096	0.105	0.078	0.079	0.111	0.094	0.072	0.013	0.039	0.093	0.114	0.035
1996	0.090	0.104	0.078	0.079	0.124	0.099	0.078	0.015	0.044	0.099	0.113	0.035
1997	0.085	0.103	0.080	0.081	0.148	0.104	0.084	0.016	0.067	0.129	0.115	0.039
1998	0.080	0.094	0.080	0.084	0.163	0.112	0.090	0.016	0.091	0.141	0.118	0.039
1999	0.075	0.085	0.086	0.090	0.180	0.112	0.096	0.018	0.124	0.141	0.118	0.044
2000	0.071	0.075	0.087	0.095	0.219	0.112	0.104	0.019	0.152	0.170	0.122	0.047

(D) France

Year	Input [1]	Input [2]	Input [3]	Input [4]	Input [5]	Output [6]	Output [7]	Output [8]	Output [9]	Output [10]	Output [11]	Output [12]
1981	0.022	0.030	0.029	0.035	0.018	0.040	0.018	0.004	0.005	0.017	0.065	0.027
1982	0.023	0.032	0.030	0.037	0.019	0.041	0.019	0.004	0.006	0.017	0.063	0.027
1983	0.023	0.033	0.031	0.039	0.019	0.040	0.020	0.004	0.006	0.018	0.063	0.027
1984	0.025	0.033	0.033	0.041	0.022	0.040	0.021	0.004	0.006	0.021	0.064	0.028
1985	0.027	0.035	0.035	0.043	0.023	0.043	0.023	0.004	0.006	0.020	0.064	0.028
1986	0.031	0.034	0.035	0.044	0.022	0.047	0.024	0.004	0.007	0.019	0.063	0.029
1987	0.033	0.036	0.037	0.045	0.023	0.047	0.026	0.004	0.008	0.019	0.062	0.028
1988	0.033	0.037	0.039	0.047	0.024	0.049	0.028	0.004	0.009	0.020	0.064	0.029
1989	0.036	0.039	0.041	0.051	0.025	0.052	0.030	0.004	0.009	0.022	0.066	0.030
1990	0.039	0.042	0.042	0.054	0.028	0.053	0.033	0.004	0.011	0.022	0.066	0.030
1991	0.043	0.043	0.044	0.054	0.027	0.056	0.037	0.004	0.011	0.020	0.065	0.029
1992	0.048	0.046	0.048	0.055	0.029	0.062	0.041	0.004	0.012	0.022	0.065	0.030
1993	0.054	0.050	0.049	0.055	0.027	0.063	0.044	0.004	0.012	0.020	0.061	0.028
1994	0.059	0.053	0.050	0.055	0.026	0.069	0.048	0.004	0.014	0.020	0.062	0.029
1995	0.062	0.056	0.051	0.055	0.027	0.073	0.051	0.004	0.017	0.021	0.064	0.034
1996	0.065	0.059	0.052	0.055	0.029	0.074	0.054	0.005	0.020	0.023	0.063	0.031
1997	0.078	0.059	0.052	0.055	0.032	0.076	0.058	0.005	0.029	0.024	0.065	0.037
1998	0.091	0.059	0.053	0.055	0.033	0.080	0.060	0.005	0.041	0.028	0.067	0.037
1999	0.104	0.059	0.054	0.057	0.034	0.082	0.064	0.005	0.052	0.031	0.067	0.039
2000	0.117	0.059	0.058	0.060	0.033	0.080	0.068	0.005	0.060	0.035	0.070	0.040

(E) U.K.

Year	Input [1]	Input [2]	Input [3]	Input [4]	Input [5]	Output [6]	Output [7]	Output [8]	Output [9]	Output [10]	Output [11]	Output [12]
1981	0.047	0.038	0.043	0.036	0.014	0.064	0.038	0.007	0.005	0.018	0.055	0.026
1982	0.049	0.037	0.043	0.036	0.014	0.066	0.040	0.007	0.006	0.018	0.054	0.028
1983	0.051	0.039	0.043	0.035	0.015	0.068	0.041	0.007	0.006	0.020	0.055	0.029
1984	0.051	0.041	0.044	0.037	0.022	0.067	0.043	0.007	0.006	0.024	0.057	0.031
1985	0.050	0.043	0.044	0.038	0.021	0.073	0.044	0.007	0.007	0.024	0.058	0.033
1986	0.046	0.043	0.045	0.040	0.018	0.074	0.045	0.007	0.007	0.021	0.060	0.035
1987	0.049	0.038	0.045	0.041	0.025	0.074	0.047	0.007	0.008	0.024	0.063	0.037
1988	0.048	0.039	0.046	0.042	0.026	0.075	0.049	0.007	0.009	0.025	0.066	0.040
1989	0.047	0.044	0.045	0.043	0.029	0.077	0.054	0.007	0.011	0.028	0.067	0.041
1990	0.049	0.044	0.045	0.043	0.033	0.079	0.058	0.007	0.013	0.026	0.065	0.042
1991	0.051	0.045	0.043	0.041	0.026	0.083	0.063	0.007	0.014	0.028	0.059	0.039
1992	0.080	0.049	0.044	0.040	0.032	0.090	0.070	0.007	0.016	0.036	0.058	0.035
1993	0.081	0.050	0.044	0.042	0.033	0.090	0.075	0.007	0.020	0.039	0.059	0.036
1994	0.104	0.054	0.045	0.043	0.039	0.098	0.079	0.006	0.027	0.047	0.063	0.040
1995	0.111	0.057	0.049	0.043	0.041	0.103	0.084	0.006	0.034	0.050	0.065	0.041
1996	0.117	0.060	0.049	0.042	0.086	0.106	0.087	0.006	0.039	0.144	0.066	0.040
1997	0.125	0.059	0.049	0.042	0.085	0.104	0.093	0.006	0.052	0.152	0.067	0.043
1998	0.129	0.058	0.053	0.043	0.089	0.109	0.098	0.007	0.064	0.167	0.066	0.044
1999	0.134	0.057	0.055	0.046	0.084	0.111	0.103	0.009	0.072	0.175	0.064	0.045
2000	0.138	0.056	0.057	0.047	0.082	0.113	0.110	0.009	0.095	0.176	0.063	0.047

Definition of variables used in calculation

Number	Variables	Unit	Remarks
[1]	Number of bachelors of science	persons	Number of graduates with a bachelor's degree from a science university
[2]	Number of bachelors of engineering	persons	Number of graduates with a bachelor's degree from an engineering university
[3]	Number of researchers	persons	See Note 2) of Section 6.1.1 (Chapter 1) for the definition of researcher
[4]	R&D expenditure	million dollars	Total expenditure domestically used for R&D. 1995-based real value, purchasing power parity equivalent
[5]	Import value of technology	million dollars	See Section 7.3.1 (Chapter 7) for the definition of import value of technology. 1995-based real value, purchasing power parity equivalent
[6]	Number of scientific papers	number	Number of scientific papers recorded in the SCI database. See Section 7.1 (Chapter 7)
[7]	Frequency of citation of scientific papers	number	Number of citation of scientific papers recorded in the SCI database. See Section 7.1 (Chapter 7)
[8]	Number of domestic patent applications	number	Number of patent applications filed by applicants to their own country. See Figure 7-2-3 (Chapter 7) for a description
[9]	Number of cross-border patent applications	number	Number of patent applications filed by applicants to foreign countries. See Figure 7-2-3 (Chapter 7) for a description
[10]	Export value of technology	million dollars	See Section 7-3-1 (Chapter 7) for the definition of export value of technology. 1995-based real value, purchasing power parity equivalent
[11]	Added value of industrial products	million dollars	1995-based real value, purchasing power parity equivalent
[12]	Added value of high-tech products	million dollars	1995-based real value, purchasing power parity equivalent

Note: The above is each component of the 1st principal component score (each variable multiplied by the corresponding principal component score coefficient) shown in Table 2-3-1.

Source: Calculated by NISTEP using the variables shown below.

Table 3-1-1: Trends in the breakdown of Japan's GDP by industry

(unit: %)

Year	Primary industry	Secondary industry	Tertiary industry
1955	19.2	33.7	47.0
1956	16.4	36.7	46.9
1957	15.7	37.6	46.8
1958	15.1	36.5	48.5
1959	14.3	38.0	47.7
1960	12.8	40.8	46.4
1961	12.0	41.5	46.5
1962	11.4	40.7	47.9
1963	10.6	41.0	48.4
1964	9.6	41.5	48.9
1965	9.5	40.1	50.3
1966	9.2	39.4	51.4
1967	9.0	40.1	50.9
1968	7.9	40.9	51.2
1969	7.0	41.9	51.2
1970	5.9	43.1	50.9
1971	5.1	42.7	52.2
1972	5.3	42.0	52.8
1973	5.7	42.5	51.8
1974	5.4	41.3	53.4
1975	5.3	38.8	55.9
1976	5.1	38.7	56.2
1977	4.9	37.7	57.5
1978	4.5	37.9	57.6
1979	4.2	37.8	58.0
1980	3.6	37.8	58.7
1981	3.4	37.8	58.8
1982	3.3	37.2	59.5
1983	3.2	36.1	60.6
1984	3.2	36.5	60.3
1985	3.1	36.3	60.7
1986	2.9	35.6	61.5
1987	2.7	35.6	61.7
1988	2.6	36.1	61.3
1989	2.5	36.3	61.2
1990	2.4	35.6	62.0
1991	2.2	35.2	62.6
1992	2.1	33.9	64.0
1993	1.9	32.4	65.6
1994	2.0	31.0	67.0
1995	1.8	30.2	68.0
1996	1.8	30.0	68.2
1997	1.5	29.7	68.7
1998	1.5	28.6	69.8
1999	1.4	28.3	70.2
2000	1.3	28.3	70.3
2001	1.3	26.7	72.0

Note: 68SNA data for 1955-1989, and 93SNA data for 1990-1991.
Source: Cabinet Office, '(Preliminary Estimate) National Accounts -Revised in 1990-'
Cabinet Office, 'National Accounts Annual Report 2003'

Table 3-1-2: Investment in knowledge

(A)R&D

(unit: %)

Ranking	Country	Ratio to GDP
1	Sweden	3.9
2	Finland	3.4
3	Japan	3.0
4	U.S.	2.7
5	Republic of Korea	2.7
6	Swetzerland	2.6
7	Germany	2.5
8	OECD	2.3
9	Denmark	2.2
10	France	2.2
11	Belgium	2.0
12	Netherlands	1.9
13	EU	1.9
14	Canada	1.9
15	U.K.	1.8
16	Austria	1.8
17	Australia	1.5
18	Norway	1.5
19	Czech Republic	1.3
20	Ireland	1.1
21	Italy	1.1
22	Spain	0.9
23	Hungary	0.8
24	Portugal	0.8
25	Poland	0.7
26	Greece	0.7
27	Slovak Republic	0.7
28	Mexico	0.4

(B) Software

(unit: %)

Ranking	Country	Ratio to GDP
1	Sweden	2.4
2	Netherlands	2.2
3	Sweitzerland	1.9
4	U.K.	1.8
5	U.S.	1.8
6	France	1.7
7	Denmark	1.7
8	Canada	1.7
9	Finland	1.7
10	Germany	1.6
11	Czech Republic	1.6
12	Belgium	1.6
13	Norway	1.4
14	EU	1.4
15	Australia	1.4
16	Hungary	1.4
17	OECD	1.3
18	Austria	1.3
19	Japan	1.1
20	Slovak Republic	1.0
21	Ireland	0.7
22	Italy	0.7
23	Poland	0.7
24	Spain	0.6
25	Portugal	0.6
26	Republic of Korea	0.5
27	Mexico	0.4
28	Greece	0.3

(C) Higher education

(unit: %)

Ranking	Country	Ratio to GDP
1	U.S.	2.3
2	Republic of Korea	2.3
3	Canada	1.8
4	OECD	1.3
5	Ireland	1.2
6	Denmark	1.1
7	Finland	1.1
8	Australia	1.1
9	Mexico	1.0
10	Hungary	0.9
11	Spain	0.9
12	Norway	0.8
13	Sweden	0.8
14	Belgium	0.8
15	Portugal	0.8
16	Austria	0.8
17	Slovak Republic	0.7
18	Czech Republic	0.7
19	Greece	0.7
20	France	0.7
21	EU	0.7
22	Netherlands	0.7
23	Japan	0.6
24	Germany	0.6
25	U.K.	0.6
26	Switzerland	0.6
27	Poland	0.5
28	Italy	0.5

Note: Reinserted Table 1-1-2.

1999 data for OECD, Denmark, Belgium, Greece, the Slovak Republic, and Mexico, and 2000 data for other countries.

<Japan, U.S., Canada>Post-secondary non-tertiary education is included in the data for higher education.

<Greece, Denmark>Annual average growth rate during 1992-1999.

<OECD>Excludes Hungary, Poland, and the Slovak Republic. Annual average growth rate during 1992-1999 excluding Belgium, the Czech Republic, Hungary, Korea, Mexico, Poland, and the Slovak Republic.

<Belgium>See the text body for data for higher education.

<EU>Excludes Belgium, Denmark, and Greece. Annual average growth rate during 1992-1999 excluding Belgium.

Source: OECD, “STI Scoreboard 2003”

Table 3-1-3: Trends in and projections of Japan's population structure by age group

Year	Total population (1,000 persons)				Constituent ratio (%)		
	Total	Age 0-14	Age 15-64	Age 65 and over	Age 0-14	Age 15-64	Age 65 and over
1970	104,665	25,153	72,119	7,393	24	68.9	7.1
1975	111,940	27,221	75,807	8,865	24.3	67.7	7.9
1980	117,060	27,507	78,835	10,647	23.5	67.3	9.1
1985	121,049	26,033	82,506	12,468	21.5	68.2	10.3
1990	123,611	22,486	85,904	14,895	18.2	69.5	12
1995	125,570	20,014	87,165	18,261	15.9	69.4	14.5
2000	126,926	18,472	86,220	22,005	14.6	67.9	17.3
2010	127,473	17,074	81,665	28,735	13.4	64.1	22.5
2020	124,107	15,085	74,453	34,559	12.2	60	27.8
2030	117,580	13,233	69,576	34,770	11.3	59.2	29.6
2050	100,593	10,842	53,889	35,863	10.8	53.6	35.7

Note: 1) Bureau of Statistics, Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'National Census' for the data during 1970-2000, and National Institute on Population and Social Security Research of Health, Labor and Welfare Ministry, 'Estimation of Population in Japan' (Estimation as of January, 2002) for the data after 2010.

2) Total figures include uncertain age groups.

3) The data excludes Okinawa for the year 1970.

Source: Health, Labor and Welfare Ministry, Labor Statistics Directory Database (http://wwwdbtk.mhlw.go.jp/toukei/youran/index-roudou.html)

Table 3-1-4: Trends in labor participation rates of 5 nations

(A) Labor force population

(unit: 1,000 persons)

Year	Japan	U.S.	Germany	France	U.K.
1981	57,070	110,812	28,305	23,673	26,740
1982	57,740	112,384	28,558	23,905	26,678
1983	58,890	113,749	28,605	23,972	26,610
1984	59,270	115,763	28,298	24,123	27,235
1985	59,630	117,695	28,434	24,180	27,486
1986	60,200	120,078	28,768	24,322	27,491
1987	60,840	122,122	29,036	24,448	27,943
1988	61,660	123,893	29,220	24,550	28,345
1989	62,700	126,077	29,624	24,724	28,764
1990	63,840	128,007	30,771	24,838	28,909
1991	65,050	128,464	39,577	24,983	28,813
1992	65,780	130,071	39,490	25,087	28,581
1993	66,150	130,960	39,557	25,126	28,447
1994	66,450	132,773	39,492	25,316	28,455
1995	66,660	133,924	39,376	25,347	28,486
1996	67,110	135,503	39,550	25,625	28,664
1997	67,870	137,810	39,804	25,784	28,852
1998	67,930	139,163	40,131	26,015	28,892
1999	67,790	140,825	40,174	26,341	29,194
2000	67,660	142,296	40,104	26,574	29,412
2001	67,520	-	40,121	26,786	29,470

(B) Labor participaiton rate

(unit: %)

Year	Japan	U.S.	Germany	France	U.K.
1981	72.0	72.7	68.3	68.0	73.7
1982	72.1	72.9	68.0	67.7	73.1
1983	72.8	73.2	67.5	67.1	72.4
1984	72.5	73.7	66.4	66.8	73.4
1985	72.2	74.2	66.6	66.4	73.9
1986	72.2	75.0	67.3	66.5	73.7
1987	72.3	75.7	67.8	66.4	74.7
1988	72.5	76.3	68.0	66.3	75.6
1989	73.1	77.1	68.9	66.4	76.6
1990	74.1	77.8	69.5	66.6	76.9
1991	75.2	77.5	71.6	66.7	76.5
1992	75.7	77.8	71.5	66.8	75.9
1993	76.0	77.6	71.3	66.8	75.4
1994	76.3	78.0	71.1	67.2	75.2
1995	76.5	77.9	71.0	67.1	74.9
1996	77.0	78.0	71.2	67.6	75.1
1997	78.0	78.3	71.5	67.9	75.2
1998	78.2	78.2	72.1	68.3	74.9
1999	78.1	78.3	72.2	69.0	75.2
2000	78.5	78.2	72.3	69.3	75.2
2001	78.5	-	72.4	69.6	-

Note: 1) Labor participation rate = (labor population ÷ population of age 15-64)×100.
2) The data for Germany until 1990 are for the former West Germany area, and after 1991, unified Germany.
Source: Health, Labor and Welfare Ministry, Labor Statistics Directory Database
(http://wwwdbtk.mhlw.go.jp/toukei/youran/index-roudou.html)

Table 3-1-5: Growth in the percentage of population in Japan and the United States aged over 25 and with educational attainment of bachelor's degree or higher

Year	Number of persons (persons)				Ratio (%)	
	Japan		U.S.			
	Total	University graduates ro those in higher education	Total	University graduates or those in higher education	Japan	U.S.
1970	59,172,687	3,254,155	—	—	5.5	11.0
1980	73,368,684	6,472,825	—	—	8.8	17.0
1990	81,991,363	10,104,914	—	—	12.3	21.3
2000	92,315,158	13,818,396	—	—	15.0	25.6

Note: The data for Japan exclude graduate students currently in school.

Source: <Japan> Bureau of Statistics, Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'National Census' of 1970, 1980, 1990, and 2000.

<U.S.>U.S. Dept. Education, National Center for Education Statistics, "Education Statistics"

Table 3-1-6: Trends in the breakdown of work forces in five major countries by industry

(unit: %)

Year	Japan			U.S.		
	Primary industry	Secondary industry	Tertiary industry	Primary industry	Secondary industry	Tertiary industry
1978	11.7	35.0	53.3	3.7	31.1	65.2
1979	11.2	34.9	53.9	3.6	31.3	65.2
1980	10.4	35.3	54.2	3.6	30.5	65.9
1981	10.0	35.3	54.7	3.5	30.1	66.4
1982	9.7	34.9	55.4	3.6	28.4	68.0
1983	9.3	34.8	56.0	3.5	28.0	68.5
1984	8.9	34.8	56.3	3.3	28.5	68.2
1985	8.8	34.9	56.4	3.1	28.0	68.8
1986	8.5	34.5	57.1	3.1	27.7	69.3
1987	8.3	33.8	57.9	3.0	27.1	69.9
1988	7.9	34.1	58.0	2.9	26.9	70.2
1989	7.6	34.3	58.2	2.9	26.7	70.5
1990	7.2	34.1	58.7	2.9	26.2	70.9
1991	6.7	34.4	58.9	2.9	25.3	71.8
1992	6.4	34.6	59.0	2.9	24.6	72.5
1993	5.9	34.3	59.8	2.7	24.0	73.2
1994	5.8	34.0	60.2	2.9	24.0	73.1
1995	5.7	33.6	60.8	2.9	24.0	73.1
1996	5.5	33.3	61.2	2.8	23.8	73.3
1997	5.3	33.1	61.6	2.7	23.9	73.4
1998	5.3	32.0	62.7	2.7	23.6	73.7
1999	5.2	31.7	63.2	2.6	23.1	74.4
2000	5.1	31.2	63.7	2.6	22.9	74.5
2001	4.9	30.5	64.6	2.4	22.4	75.2

Year	Germay			France		
	Primary industry	Secondary industry	Tertiary industry	Primary indust	Secondary industry	Tertiary industry
1978	5.8	44.3	49.9	9.2	36.7	54.1
1979	5.4	44.2	50.4	8.9	36.1	55.0
1980	5.3	43.7	51.0	8.6	35.7	55.6
1981	5.2	43.0	51.9	8.4	35.0	56.6
1982	5.0	42.1	52.8	8.1	34.6	57.3
1983	5.0	41.4	53.6	7.8	33.8	58.4
1984	4.8	41.3	53.9	7.7	32.9	59.4
1985	4.6	41.3	54.1	7.5	32.0	60.5
1986	4.5	40.8	54.7	7.2	31.4	61.4
1987	4.2	40.2	55.6	6.9	30.8	62.3
1988	4.0	39.9	56.1	6.6	30.3	63.0
1989	3.7	39.5	56.8	6.3	30.1	63.6
1990	3.4	38.6	57.9	5.7	29.7	64.6
1991	4.1	40.9	55.0	5.4	29.2	65.6
1992	3.8	40.0	56.2	5.2	28.4	66.4
1993	3.5	38.9	57.6	5.0	27.3	67.6
1994	3.3	37.7	59.0	4.8	26.6	68.6
1995	3.1	36.3	60.5	4.6	26.3	69.1
1996	3.0	35.4	61.6	4.5	25.9	69.7
1997	2.9	34.8	62.3	4.4	25.3	70.3
1998	2.8	34.5	62.6	4.3	24.9	70.9
1999	2.8	33.7	63.4	4.1	24.4	71.5
2000	2.7	33.4	63.9	3.9	24.2	72.0
2001	2.6	32.5	64.8	3.7	24.1	72.2

Year	U.K.		
	Primary industry	Secondary industry	Tertiary industry
1978	2.8	39.1	58.2
1979	2.7	38.6	58.7
1980	2.6	37.6	59.7
1981	2.7	35.8	61.6
1982	2.7	34.6	62.8
1983	2.7	33.3	64.0
1984	2.6	35.3	62.2
1985	2.3	34.8	62.9
1986	2.2	34.1	63.7
1987	2.3	32.9	64.8
1988	2.3	32.9	64.8
1989	2.2	32.7	65.1
1990	2.1	32.3	65.5
1991	2.3	31.1	66.6
1992	2.2	30.0	67.8
1993	2.0	29.4	68.5
1994	2.1	27.7	70.2
1995	2.1	27.4	70.5
1996	1.9	27.4	70.7
1997	1.9	26.8	71.3
1998	1.7	26.7	71.6
1999	1.6	26.0	72.4
2000	1.5	25.4	73.0
2001	1.4	24.9	73.7

Source: OECD, “Labor Force Statistics 1981-2001”

Table 3-1-7: Trends in the breakdown of workers in Japan by profession

(unit: 10,000 persons)

Year	Specialized/ technical professionals	Managerial employees	Office workers	Sales employees	Security/service employees	Agriculture, forestry and fishery workers	Transportation and tele-communications employees	Mining workers	Manufacturing/ machine operators and construction workers	Laborers
1965	238	131	636	615	354	1,094	177	19	1,236	229
1970	295	134	755	662	387	880	232	11	1,511	218
1975	364	206	820	738	457	654	237	9	1,580	148
1980	438	220	924	797	501	570	248	5	1,653	168
1985	538	211	1021	861	501	502	227	4	1,689	230
1990	690	239	1157	940	535	448	233	3	1,702	274
1995	790	236	1252	945	610	363	237	3	1,687	310
1996	804	240	1263	933	618	352	240	2	1,686	318
1997	824	226	1273	940	637	346	241	3	1,706	328
1998	844	222	1290	928	654	340	232	3	1,634	333
1999	846	215	1273	921	668	332	228	3	1,604	334
2000	856	206	1285	911	677	321	221	3	1,580	347
2001	873	202	1249	968	693	309	214	3	1,506	353
2002	890	187	1228	934	717	291	211	4	1,468	349

Note: Following the revision of classification of occupation at national census in 1980, Labor Force Survey changed its classification since January, 1981 as follows.
1) 'Mining/quarrying worker' was changed to 'Mining worker.'
2) 'Menial laborer' was changed to 'Laborer.'
3) 'Cleaning worker' in the 'Security/service employee' category was moved to the 'Laborer' category.
Source: Health, Labor and Welfare Ministry, Labor Statistics Directory Database.
(http://wwwdbtk.mhlw.go.jp/toukei/youran/index-roudou.html)

Table 3-2-1: Trends in the breakdown of workers in Japan by form of employment

(A) Number of employees

(unit: persons)

Year	Total	Board members in the private sector	Regular staff/employees	Part-time workers	Fringe workers	Temporary staff	Employees on short-term contracts, etc.	Others
1992	54,732,500	3,895,000	34,557,000	7,824,300	4,237,400	720,900	2,477,300	946,300
1997	—	—	—	—	—	—	—	—
2002	—	—	—	—	—	—	—	—

(B)Raio

(unit：%)

Year	Total	Board members in the private sector	Regular staff/employees	Part-time workers	Fringe workers	Temporary staff	Employees on short-term contracts, etc.	Others
1992	100	7.6	72.4	11.3	4.8	0.3	1.7	1.9
1997	100	7.0	70.1	12.7	6.1	0.5	1.8	1.9
2002	100	7.1	63.1	14.3	7.7	1.3	4.5	1.7

Source: Health, Labor and Welfare Ministry, Labor Statistics Directory Database
(http://wwwdbtk.mhlw.go.jp/toukei/youran/index-roudou.html)

Table 3-2-2: Trends in the ratio of temporary workers in the total working populations in five selected countries

(unit: %)

Year	Japan	U.S.	Germany	France	U.K.
1980	9.6	-	-	-	-
1981	9.5	-	-	-	-
1982	9.7	-	-	-	-
1983	10.2	-	-	3.3	5.5
1984	10.2	-	10.0	3.3	6.2
1985	10.2	-	10.0	4.7	7.0
1986	10.0	-	11.2	6.4	7.0
1987	10.3	-	11.6	7.1	6.3
1988	10.5	-	11.4	7.8	6.0
1989	10.6	-	11.0	8.5	5.4
1990	10.6	-	10.5	10.5	5.2
1991	10.4	-	10.1	10.2	5.3
1992	10.3	-	10.5	10.5	5.5
1993	10.3	-	10.3	10.9	5.9
1994	10.3	-	10.3	11.0	6.5
1995	10.5	5.1	10.4	12.3	7.0
1996	10.5	-	11.1	12.6	7.1
1997	11.0	4.6	11.7	13.1	7.4
1998	11.4	-	12.2	13.9	7.1
1999	11.9	4.5	13.1	14.0	6.8
2000	12.9	-	12.7	15.5	6.7
2001	12.8	4.0	-	14.9	6.7

Source: OECD, “Labor Market Statistics 1981-2001”

Table 3-2-3: Trends in the number of years in service with a company in Japan (Total figures for all industries and service industries)

(unit: years, persons)

Age	1981				1991			
	Whole industry		Service industry		Whole industry		Service industry	
	Service years	Number of workers	Service years	Number of workers	Service years	Number of workers	Service years	Number of workers
under 17	1.1	8,968	1.1	1,144	1.1	5,401	1.0	606
18～19	1.1	81,402	1.0	10,709	1.0	77,560	0.9	12,324
20～24	2.8	295,765	2.4	55,155	2.5	363,132	2.2	80,772
25～29	5.7	280,231	4.8	48,216	5.2	324,043	4.5	76,259
30～34	8.9	319,321	7.7	46,683	8.4	256,135	7.5	56,867
35～39	11.7	247,899	9.8	30,456	11.8	272,196	10.2	51,647
40～44	13.2	241,855	11.4	28,818	14.6	350,430	12.4	58,753
45～49	14.4	216,031	12.1	28,117	17.4	272,712	14.0	41,319
50～54	15.9	162,486	12.6	25,362	18.8	241,062	15.0	39,429
55～59	13.3	94,683	10.2	19,381	18.1	169,883	14.1	33,431
60～64	10.4	39,028	8.4	10,551	12.3	61,790	9.7	20,774
65 and over	12.0	24,714	9.8	7,025	13.5	27,258	10.7	10,250
Total	9.5	2,012,382	7.6	311,616	11.0	2,421,602	8.6	482,428

Age	2001			
	Whole industry		Service industry	
	Service years	Number of workers	Service years	Number of workers
under 17	—	—	—	—
18～19	—	—	—	—
20～24	—	—	—	—
25～29	—	—	—	—
30～34	—	—	—	—
35～39	—	—	—	—
40～44	—	—	—	—
45～49	—	—	—	—
50～54	—	—	—	—
55～59	—	—	—	—
60～64	—	—	—	—
65 and over	—	—	—	—
Total	12.2	—	9.5	—

Source: Health, Labor and Welfare Ministry, ‘Key Statistics Report on Wage Structure ’

Table 3-2-4: Trends in the ratio of mid-career recruitment in Japan by profession type

(unit: %)

Year	Managerial position	Clerical work	Technical/research work	Non-clerical work
1971	—	50.8	32.4	—
1989	12.6	35.0	19.8	68.7
1992	15.9	40.0	21.1	68.2
1998	12.7	31.8	18.2	58.9
2001	10.4	28.1	16.1	52.9

Source: Source: Health, Labor and Welfare Ministry, ‘Survey on Employment Management’

Table 3-2-5: Possibility of wage schemes revision in the next three years and breakdown of business enterprises by type of revision (1999)

(unit: %)

	Total in industry investigated
Enterprise with no plan or uncertain of revising the 12 items below in the next 3 years	60.3
Enterprise planning to revise the wage system for only the 12 items below in the next 3 years	39.7
Total	100.0

(unit: %)

Items planned for revision	Total in investigated industry
Increase wages to respond to business performance and outcome	22.3
Increase wages on evaluation of ability of job performance	20.8
Reduce range of wage increase	15.1
Increase wages on evaluation of work assignment, type of job, etc.	13.5
Revise/introduce ability-based grade system	12.5
Revise/introduce annual salary system	8.4
Introduce wage scale	7.1
Abolish annual wage hike	7.0
Expand range of wage increase	6.8
Control basic salary and put relatively more weight on bonuses	6.0
Reduce allowances to combine into basic salary	5.2
Revise/introduce double-track wage system	5.0

Note: As multiple answers were allowed for the items to be revised, the total ratio is not 100%.

Source: Minister's Secretariat, Policy Planning and Research Department, Labor Ministry, 'General Study of Wage and Working Hours System 2000'

Table 3-2-6: Ratio of the Japanese business enterprises adopting merit-based work schemes and flextime work schemes

(unit: %)

FY	Free time system for professional work	Defacto working hours system for manual workers	Flextime system
1984	-	-	-
1985	-	-	-
1986	-	-	-
1987	-	-	-
1988	0.3	2.9	0.8
1989	-	-	1.2
1990	0.6	4.4	2.2
1991	0.7	4.4	2.7
1992	-	-	3.5
1993	-	-	3.9
1994	0.5	4.5	3.6
1995	0.9	4.3	4.3
1996	0.5	5.8	4.8
1997	1.4	8.3	4.4
1998	2.1	7.2	5.1
1999	1.9	8.5	5.7
2000	1.7	7.4	5.6
2001	1.2	7.0	5.0

Note: 1) Surveys were conducted as of end of December until 1999. In 2000, no survey was conducted. In 2001 and 2002, surveys were conducted as of January 1st. Accordingly, the years in the tables and figures refer to the survey year.
2) The free time system for professional work is a system in which workers and management determine a certain job, whose means and hours to perform duties are left to the discretion of the worker, and when a worker has performed the job, it is deemed that the worker has spent a predetermined number of work hours regardless of the actual time spent on the job.
3) The de facto working hours system for manual workers is a system in which manual workers are deemed to have worked a predetermined number of work hours when it is hard to assess actual working hours.
4) The flextime system is a system in which workers independently decide their opening and closing time within a time frame of the total monthly working hours that are predetermined by labor and management. In this case, the average working hours of certain period of time have to be within the working hours of the week.
Source: <Before 1999>Health, Labor and Welfare Ministry, 'General Study for Wage and Working Hours System'
<After 2000> Health, Labor and Welfare Ministry, 'General Study of Working Conditions'

Table 3-2-7: Employment of highly qualified foreign employees (HQFE) in high-tech enterprises in leading countries

(unit: %)

	Ratio of enterprises who employ HQFE	Average ratio of HQFE in enterprises that employ HQFE
U.K.	49.7	10.9
Germany	38.9	9.1
France	34.4	10.9
Netherlands	33.3	16.7
Total of 4 countries	38.8	11.1

Note: HQFE = Highly qualified foreign employees
Source: OECD, "International Mobility of the Highly Skilled" (2002)
IZA, "International Employer Survey 2000"

Table 3-2-8: Influx and outflow of IT-related workers in Australia

(unit: persons)

Year	Desembarkation	Embarkation	Increase
1997-98	4,708	3,743	965
1998-99	5,507	3,934	1,573
1999-2000	7,007	4,227	2,780

Note: IT-related human resources include IT managers, computer specialists, and computer supply technicians.
Source: OECD "International Mobility of the Highly Skilled" (2002)

Table 3-2-9: Implementation rates of planned OJT and Off-JT programs at Japanese business enterprises by scale of full-time workforce (FY2000)

(unit: %)

Seze of full-time workforce	Executing rate of systematic OJT	Executing rate of OFF-JT
Less than 30 workers	30.7	56.1
30-49 workers	31.4	54.4
50-99 workers	41.2	66.8
100-299 workers	49.9	72.3
300 workers and more	71.9	90.8
Total	41.6	64.9

Note: 1) 'Systematic OJT' is training provided while performing daily duties. It is conducted in phased, continuous manner by preparing schedule, specifically assigning a responsible person, targeting employees, employing a time frame, and deciding contents of training.
2) 'OFF-JT' is a training (learning) provided away from daily duties.
Source: Health, Labor and Welfare Ministry, 'Basic Study for Occupational Skills Development' (June, 2002)

Table 3-2-10: Ratio of adult/continuing education programs at Japanese educational institutions (2000)

Educational institutes	Total number of institutes	Executing rate of adult education (%)
Graduate schools	829	57.4
Universities	1,038	35.9
Junior colleges	729	52.4
Special training schools	1,910	27.0
Private-sector educational institutes	about 800	84.8
Public vocational training facilities	89	71.9

Note: The exact total of 'Private-sector educational institutes' is unknown because of the inconsistent numeration system.
Source: CIN, 'Investigation on demand and supply of adult education' (2000)

Table 3-2-11: Ratio of educational programs supporting acquisition of qualifications organized by Japanese adult education institutions (2000)

(unit: %)

Educational institutes	Executing rate of education assistance for obtaining qualifications
Public vacational training facilities	57.8
Private-sector educational institutes	54.8
Special training schools	47.5

Source: CIN, 'Investigation on demand and supply of adult education' (2000)

Table 3-2-12: Growth in the number of working adults in graduate programs in Japan

(unit: persons)

Year	Total number of graduate students	Number of adult graduate students	Ratio to the total number of graduate students (%)
2000	205,311	24,897	12.1
2001	216,322	29,237	13.5
2002	223,512	33,171	14.8
2003	231,489	35,377	15.3

Note: 1) 'Adult' refers to a person who has a job as of May 1st of each year, i.e., a person who has a job for the purpose of earning an income such as salary, wage, compensation, etc., including people retired from business organizations and housewives.
2) Here, a graduate student refers to a student who has enrolled in either a master's course or the first semester of a doctor's course, a doctor's course or the second semester of a doctor's course, or a professional graduate school.
Source: Ministry of Education, Culture, Sports, Science and Technology, 'Basic Survey of Schools'

Table 4-1-1: The number of researchers in selected countries

(unit: persons)

Country		Number of researchers
U.S.	(1999)	1,261,227
Japan (HC)*	(2002)	792,699
Japan (FTE value)**	(2002)	612,049
Germany	(2001)	259,597
France	(2000)	172,070
U.K.	(1998)	157,662

Note: 1) Japan (2003)* means head count (HC) and Japan (2003)** means the number of full-time equivalents (FTE).
2) See Table 6-1-4 of Chapter 6 for more detailed data for each country.
Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'
Ministry of Education, Culture, Sports, Science and Technology, Science and Technology Policy Bureau, 'Survey on the Data for Full-time Equivalents at Universities' (November, 2003)
<U.S.>NSF, "National Patterns of R&D Resources 2002 Data Update"
<Germany, France, U.K.>OECD, "Main Science and Technology Indicators 2003/1"

Table 4-1-2: Trends in the number of researchers per 10,000 persons in the working population

Year	Number of researchers (persons)	Labor force populaton (10,000 persons)	Number of researchers per 10,000 labor force population
1980	363,534	5,650	64
1981	379,405	5,707	66
1982	392,625	5,774	68
1983	406,042	5,889	69
1984	435,340	5,927	73
1985	447,719	5,963	75
1986	473,296	6,020	79
1987	487,779	6,084	80
1988	513,267	6,166	83
1989	535,008	6,270	85
1990	560,276	6,384	88
1991	582,815	6,505	90
1992	598,333	6,578	91
1993	622,410	6,615	94
1994	641,083	6,645	96
1995	658,866	6,666	99
1996	673,421	6,711	100
1997	695,623	6,787	102
1998	704,514	6,793	104
1999	732,658	6,779	108
2000	739,504	6,766	109
2001	728,215	6,752	108
2002	792,699	6,689	119
2003	791,224	6,666	119

Note: 1) 'Labor population' is the sum of employed and unemployed persons. Annual average.
2) Number of researchers is all heads counted.
3) 'Researchers' stated in the 'Report on the Survey of Research and Development' by Ministry of Public Management, Home Affairs, Posts and Telecommunications mean persons who satisfy the following conditions.
Until 2001: (i) A person who has finished a university course (excluding junior college), or has equivalent or higher specialized knowledge.
(ii) A person with two years or more experience in research work.
(iii) A researcher who is conducting research with a specific research theme.
After 2002: Same as above except (ii).
In addition, until 2001, researchers were classified as full-time researchers (who had their research base within the facility) and part-time researchers (who had their research base outside the facility). After 2002, statistics were taken only on the number of researchers regardless of the classification of full-time or part-time. Here, researchers mean full-time researchers until 2001, and all researchers after 2002.
(iv) Includes natural science and social science.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'
Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Labor Force Survey'

Table 4-1-3: Trends in the number of researchers (1980-2003)

(A) Trends in the number of researchers by sector

Actual number (unit: persons)

Year	Industries	Universities and colleges	Government research institutes	Non-profit organizaions	Total number of researchers
1980	173,244	158,446	28,073	3,771	363,534
1981	184,889	160,863	28,792	4,861	379,405
1982	192,942	163,264	29,011	7,408	392,625
1983	201,137	170,103	28,831	5,971	406,042
1984	223,882	175,841	28,761	6,856	435,340
1985	231,097	180,606	28,818	7,198	447,719
1986	251,771	185,070	28,890	7,565	473,296
1987	260,846	189,597	28,909	8,427	487,779
1988	279,298	195,428	28,909	9,632	513,267
1989	294,202	200,730	29,288	10,788	535,008
1990	313,948	205,509	29,322	11,497	560,276
1991	330,996	209,898	29,516	12,405	582,815
1992	340,809	214,462	29,603	13,459	598,333
1993	356,406	222,006	29,894	14,104	622,410
1994	367,278	229,164	29,907	14,734	641,083
1995	376,639	235,702	30,263	16,262	658,866
1996	384,100	242,862	30,346	16,113	673,421
1997	400,361	248,275	30,241	16,746	695,623
1998	404,232	253,165	30,212	16,905	704,514
1999	429,195	256,440	30,910	16,113	732,658
2000	433,758	259,012	30,987	15,747	739,504
2001	421,363	259,759	31,228	15,865	728,215
2002	461,962	280,710	35,992	14,035	792,699
2003	460,053	281,304	36,052	13,815	791,224

Ratio (unit: %)

Year	Industries	Universities and colleges	Government research institutes	Non-profit organizations	Total number of researchers
1980	47.7	43.6	7.7	1.0	100.0
1981	48.7	42.4	7.6	1.3	100.0
1982	49.1	41.6	7.4	1.9	100.0
1983	49.5	41.9	7.1	1.5	100.0
1984	51.4	40.4	6.6	1.6	100.0
1985	51.6	40.3	6.4	1.6	100.0
1986	53.2	39.1	6.1	1.6	100.0
1987	53.5	38.9	5.9	1.7	100.0
1988	54.4	38.1	5.6	1.9	100.0
1989	55.0	37.5	5.5	2.0	100.0
1990	56.0	36.7	5.2	2.1	100.0
1991	56.8	36.0	5.1	2.1	100.0
1992	57.0	35.8	4.9	2.2	100.0
1993	57.3	35.7	4.8	2.3	100.0
1994	57.3	35.7	4.7	2.3	100.0
1995	57.2	35.8	4.6	2.5	100.0
1996	57.0	36.1	4.5	2.4	100.0
1997	57.6	35.7	4.3	2.4	100.0
1998	57.4	35.9	4.3	2.4	100.0
1999	58.6	35.0	4.2	2.2	100.0
2000	58.7	35.0	4.2	2.1	100.0
2001	57.9	35.7	4.3	2.2	100.0
2002	58.3	35.4	4.5	1.8	100.0
2003	58.1	35.6	4.6	1.7	100.0

Note: 1) The number of researchers is all heads counted.

2) For ‘industries’ data, ‘companies and others’ are used until 2001, and ‘business enterprises and others’ after 2002 from the Report on the Survey of Research and Development.

3) ‘Nonprofit organizations’ were ‘private research institutes’ until 2001.

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development’

(B) Change in the number of researchers by industrial sector

(unit: persons)

Year	Agriculture, foresty and fisheries	Mining	Construction	Manufacturing	Transportaion/communicaion/public services and others	Total industrial sector
1980	428	485	4,303	163,867	4,161	173,244
2003	177	451	7,352	404,961	47,112	460,053
Increase/decrease	-251	-34	3,049	241,094	42,951	286,809

Note: Transportation/communication/public services, etc. include the software industry. However, no statistics are available for the software industry for 1980.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

(C) Change in the number of researchers among mamufacturing industries

(unit: persons)

Industry	1980	20036
Food	6,092	12,888
Textiles	3,846	3,256
Pulp/paper	1,355	2,692
Publishing/printing	485	1,444
Chemical engineering/synthetic fiber	12,284	19,230
Fat and oil/coating material	5,325	10,070
Pharmaceuticals	9,309	21,889
Petroleum/Coal product	1,316	1,273
Plastic products	-	5,324
Rubber products	3,180	6,235
Ceramics	5,355	6,696
Iron and steel	4,434	4,917
Nonferrous metal	2,385	6,102
Metal products	4,117	6,486
Machinery	15,273	45,945
Electric machinery and apparatus	24,470	30,769
Communication/electronics/electric measuring instruments	30,997	133,762
Automobiles	12,026	43,836
Precision instruments	6,188	19,228

Note: 1) Statistics were not taken for the plastic products for the year 1980.
2)The figure for the 'Communication/electronics/electric measuring instruments' of 2003 is the total of 'Electronics/electric measuring instruments industry,' 'Information and telecommunications machinery and appliances industry,' and 'Electronic parts and devices industry' stated in the 'Report on the Survey of Research and Development'
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 4-1-4: Trends in the number of researchers for every 10,000 employees in principal industrial sectors (1980-2003)

(unit: persons)

Year	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Transportation/Communicaion/ Public services	Software
1980	181	143	119	323	36	-
1981	78	117	111	348	36	-
1982	63	107	115	359	35	-
1983	100	150	112	390	39	-
1984	75	19	141	421	39	-
1985	71	173	121	432	44	-
1986	124	235	122	468	56	-
1987	119	249	151	508	71	-
1988	138	280	152	537	51	-
1989	183	279	149	556	54	-
1990	171	252	135	577	64	-
1991	171	327	156	582	71	-
1992	140	385	138	593	80	-
1993	79	359	162	622	78	-
1994	205	342	147	654	83	-
1995	233	285	135	678	83	-
1996	244	303	125	698	84	-
1997	237	352	147	693	85	1,517
1998	252	369	112	721	102	1,153
1999	300	404	151	751	123	1,614
2000	291	516	183	776	127	1,514
2001	252	587	151	830	135	1,089
2002	150	702	155	884	143	761
2003	216	450	145	946	-	430

Note: 1) The data for software industry have been collected for statistical purpose since 1997.
2) The transportation/communication/public services category was deleted in 2003 following the change of industrial classification in 2003.
3) Software industry was changed to software/data processing industry in 2002.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 4-1-5: Changes in the number of researchers for every 10,000 employees in leading manufacturing industries (1980-2003)

(unit: person/10,000 persons)

Industrial sector	1980	2003
Food	154	327
Textiles	177	430
Pulp/paper	147	378
Publishing/printing	74	400
Chemical engineering/synthenic fiber	499	1,208
Fat and oil/coating materials	717	1,511
Pharmaceuticals	628	1,070
Petroleum/Coal products	242	462
Plastic products	-	567
Rubber products	327	719
Ceramics	228	512
Iron and steel	128	344
Nonferrous metal	231	668
Metal products	189	352
Machinery	309	816
Electric machinery and apparatus	462	1,070
Communication/electronics/electric measuring instruments	656	1,737
Automobiles	273	895
Precision instruments	406	1,531

Note: 1) Statistics were not taken for the plastic products industry for the year 1980.
2) The figure for the 'Communication/electronics/electric measuring instruments' of 2003 is the total of the 'Electronics/electric measuring instruments industry,' 'Information and telecommunications machinery and appliances industry,' and 'Electronic parts and devices industry.'
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 4-2-1: Trends in the number and ratio of female researchers

(unit: 100 persons, %)

Year	Number of researchers			Ratio of female researchers
	Males	Females	Total	
1992	5,708	492	6,200	7.9
1993	5,913	536	6,449	8.3
1994	6,076	572	6,648	8.6
1995	6,215	611	6,826	9.0
1996	6,329	649	6,978	9.3
1997	6,500	705	7,205	9.8
1998	6,568	742	7,310	10.2
1999	6,811	761	7,572	10.1
2000	6,812	807	7,619	10.6
2001	6,687	820	7,507	10.9
2002	7,075	852	7,927	10.7
2003	7,025	887	7,912	11.2

Note: The ratio of female researchers was extracted from the 'Report on the Survey of Research and Development' published by Ministry of Public Management, Home Affairs, Posts and Telecommunications. The number of researchers until 2001 was calculated including only full-time researchers for business enterprises and nonprofit organizations/public service organizations, but universities and colleges also included external researchers. After 2002, researchers of each sex were surveyed on a head-count basis.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 4-2-2: International comparison in the ratio of female researchers

(unit:%)

Country	Ratio of female researhcers to the total
Latvia	53
Lithuania	47
Portugal	47
Bulgaria	46
Estonia	43
Ronamia	43
Greece	41
Poland	38
Slovenia	37
Spain	35
Iceland	35
Hungary	33
Ireland	29
Cyprus	29
Finland	29
Norway	28
Denmark	28
Italy	28
France	28
Czech Republic	27
U.K.	26
Slovak Republic	24
Switzerland	21
Austria	19
Germany	16
Japan	11

Note: 1) The data of 2003 were used for Japan, data of 2002 for Iceland, of 2000 for Denmark, France, Ireland, Italy, Poland, Switzerland, and U.K., of 1999 for Greece and Portugal, of 1998 for Austria, and data of 2001 for other countries.

2) Ratio figures were rounded to the unit digit.

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development 2003'

<U.K.>European Commission, "Key Figures 2002"

<Other European countries>European Commission, "Key Figures 2003-4"

Table 4-2-3: The reason for the small number of female researchers

Questionnaire items	Total		Males		Females		No response	
	Number of respondents (persons)	Constituent ratio (%)	Number of respondents (persons)	Constituent ratio (%)	Number of respondents (persons)	Constituent ratio (%)	Number of respondents (persons)	Constituent ratio (%)
Poor working conditions(wages/opportunities for advancement, etc.) for female researchers	148	10.9	144	11.1	3	6.8	1	12.5
Unprepared for receiving female researchers	526	38.8	505	38.8	19	43.2	2	25.0
Researcher's posts themselves are rare	206	15.2	197	15.1	8	18.2	1	12.5
Few female students major in science, and the majors for female students are biased	580	42.8	568	43.6	10	22.7	2	25.0
Difficult to continue researhch because of bearing and raising of children, nursing, etc.	611	45.1	579	44.4	27	61.4	5	62.5
Females have little aptitude for scientific research	44	3.2	42	3.2	1	2.3	1	12.5
Role models are rare	172	12.7	164	12.6	6	13.6	2	25.0
Don't know	54	4.0	53	4.1	1	2.3	0	0.0
Other	60	4.4	56	4.3	4	9.1	0	0.0
No response	12	0.9	11	0.8	1	2.3	0	0.0
Total	1,355	178.1	1,303	178.0	44	181.8	8	175.0

Note: 1) Answers by gender (multiple answers of not more than two).

2) Of those surveyed, 50% were from private businesses, 30% from universities, 15% from public research organizations, and 5% from other institutions randomly selected among 2,000 researchers in the industrial sector, academia, and government, who are currently engaged in research activities as the first or second author of scientific papers registered in the JSTPlus File (*) in 2001. JSTPlus File (*) is found in JOIS (JST Online Information systems) provided by Japan Science and Technology Agency (JST), and it is a documentary information database file relating to the science and technology field (including medical science). The survey was conducted from December, 2002 to February, 2003.

Source: Ministry of Education, Culture, Sports, Science and Technology, 'Report on current status of scientific activities in Japan 2003'

Table 4-2-4: Rise in the number of foreign researchers and ratio to total number of researchers

(unit: persons)

Year	Number of researhcers				Ratio of researchers and professors to the total number of researchers
	Number of researchers	Nomber of professor	Total number of researhcers and professor	Total number of resarchers in Japan	
1992	1,328	2,575	3,903	598,333	0.65%
1993	1,477	3,182	4,659	622,410	0.75%
1994	1,697	3,757	5,454	641,083	0.85%
1995	1,711	4,149	5,860	658,866	0.89%
1996	2,019	4,573	6,592	673,421	0.98%
1997	2,462	5,086	7,548	695,623	1.09%
1998	2,762	5,374	8,136	704,514	1.15%
1999	2,896	5,879	8,775	732,658	1.20%
2000	2,934	6,744	9,678	739,504	1.31%
2001	3,141	7,196	10,337	728,215	1.42%
2002	3,369	7,751	11,120	792,699	1.40%

Note: Foreign researchers means the total number of persons whose resident status is 'professor' (engaged in research, instruction of research, or educational activities at universities and equivalent institutions or specialized vocational high schools) and 'researcher' (engaged in research activities based on a contract with public or private institutions).

Source: Ministry of Justice, 'Statistics on Foreign Residents'

Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 4-2-5: The breakdown of foreign researchers in Japan by nationality (as of end of 2002)

Nationality	Number of researchers (persons)			Ratio to the total number of foreign researchers (%)
	Professors	Researchers	Total	
China	2,437	1,483	3,920	35.3
U.S.	1,252	121	1,373	12.3
Republic of Korea/North Korea	838	381	1,219	11.0
India	281	253	534	4.8
France	156	68	224	2.0
Germany	221	71	292	2.6
Russia	248	151	399	3.6
U.K.	433	69	502	4.5
Canada	293	42	335	3.0
Australia	253	51	304	2.7
Others	1,339	679	2,018	18.1
Total	7,751	3,369	11,120	100.0

Note: Foreign researchers means the total number of persons whose resident status is 'professor' (engaged in research, instruction of research, or educational activities at universities and equivalent institutions or specialized vocational high schools) and 'researcher' (engaged in research activities based on a contract with public or private institutions).

Source: Ministry of Justice, 'Statistics on Foreign Resident 2003'

Table 4-2-6: Foreign-born doctorate degree holders in the US in the area of science and engineering (1999)

(A) Ratio of foreign nationals by academic discipline

(unit: %)

Specialized field	Ratio of Ph.D.
Social science	12.9
Physics	29.3
Computer science	35.4
Life science	26.1
Engineering	44.6
Whole scientific and industrial field	27.0

Note: 1) 'Scientific and industrial' means science and engineering.
2) 'Physics' includes Chemistry, Geoscience, Physics and astronomy, and Other.
Source: NSF, "Science and Engineering Indicators 2002"

(B) Distribution by place of birth

(unit: persons, %)

Birthplace	Researchers with doctorates	
	Number of Ph.D. (persons)	Ratio (%)
China	37,900	20
India	30,100	16
U.K.	13,100	7
Taiwan	10,900	6
Canada	8,400	4
Gernamy	7,200	4
Iran	4,800	3
Former Soviet Union	4,600	2
Republic of Korea	4,500	2
Philippines	3,400	2
Poland	3,200	2
Japan	2,800	1
Argentina	2,700	1
Others	58,400	30
Total	192,000	100

Source: NSF, "Science and Engineering Indicators 2002"

Table 4-2-7: Problems pertaining to foreign researchers (FY2002)

Issue	Actual number	Ratio (%)
Difficulty in evaluating their capability at time of recruitment	292	29.9
Inability to effectively utilize the capabilities of a foreign researcher inside the organization	273	28.0
Problems relating to communication, such as language, with Japanese researchers	230	23.6
None in particular	150	15.4
Probelems relating to working conditions and compensation, such as promotion, after recruitment	88	9.0
Problems relating to foreign researchers in adapting to research operations inside the organizaion, such as excessive self-assertion and inadequate willingness to cooperate	70	7.2
Problems relating to administrative procedure for recruitment, such as acquiring work visa	59	6.1
Company interested in hiring but can find no prospects or channels for recruitment	59	6.1
Lack of loyalty to the company	48	4.9
Heavy inclination towards research in a specific area combined with lack of interest and ability in other are	42	4.3
Lack of knowledge and technology in specialized area	16	1.6
Others	15	1.5
Don't know	137	14.1
Respondent enterprises	1,061	-
No response	86	-
Valid response	975	100.0

Note: Multiple answers of not more than two.
Source: Ministry of Education, Culture, Sports, Science and Technology, 'Report on current status of scientific activities by private companies 2002'

Table 4-2-8: Highest academic attainment for researchers in advanced sciences and technology (FY2002)

	Number of responses	Constituent ratio (%)
Doctor degree through university program	374	27.6
Doctor degree through dissertation	441	32.5
Master's degree	233	17.2
Bachelor's degree	244	18.0
Have no academic degree	52	3.8
No answer	11	0.8
Total	1,355	100.0

(1,355 respondents' field of research)

Field of research	Number of responses	Constituent ratio (%)
Life science	287	21.2
Information/communication	179	13.2
Environment	116	8.6
Material/nano-technology	233	17.2
Energy	99	7.3
Manufacturing engineering	83	6.1
Social Infrastructure	171	12.6
Frontier field (Space development, marine development)	16	1.2
Other natural science	106	7.8
Human	13	1.0
Others	37	2.7
No response	15	1.1
Total	1,355	100.0

(1,355 respondents' affiliation)

	Number of resoponses	Constituent ratio (%)
National universities (*) (including common-use facilities o	301	22.2
Public universities (*) (prefectural and municipal universiti	47	3.5
Private universities (*)	147	10.8
Public research institutes (national and public experiments	211	15.6
Private business enterprises	584	43.1
Others (experiment and research institutions of public inte	58	4.3
No response	7	0.5
Total	1,355	100.0

(1,355 respondents' major in school)

	Number of responses	Constituent ratio (%)
Science	137	10.6
Engineering	714	55.3
Agriculture	119	9.2
Health science	78	6.0
Others	50	3.9
No response	194	15.0
Total	1,292	100.0

Source: Ministry of Education, Culture, Sports, Science and Technology, 'Report on current status of scientific activities in Japan 2002'

Table 4-2-9: Trends in in the number of graduates from S&T graduate programs

(unit: persons)

Year	Master of science	Master of engineering	Doctor of science	Doctor of engineering
1968	1,288	3,918	321	407
1969	1,281	3,965	355	461
1970	1,302	3,891	391	590
1971	1,389	4,660	461	533
1972	1,350	4,915	518	544
1973	1,455	5,436	506	513
1974	1,482	6,090	509	598
1975	1,382	6,060	494	570
1976	1,472	5,799	485	551
1977	1,594	6,923	567	659
1978	1,625	7,640	500	573
1979	1,666	7,613	555	656
1980	1,649	7,135	589	657
1981	1,665	6,976	607	685
1982	1,716	7,363	569	621
1983	1,813	7,703	582	579
1984	1,910	8,311	529	563
1985	1,992	8,628	610	552

Year	Master of science	Master of engineering	Doctor of science	Doctro fo engineering
1986	2,019	9,620	564	588
1987	2,213	10,413	605	638
1988	2,377	11,129	589	721
1989	2,598	11,915	675	915
1990	2,805	12,774	634	937
1991	2,913	13,141	674	1,048
1992	3,067	14,351	730	1,141
1993	3,327	16,234	770	1,354
1994	3,632	17,978	863	1,550
1995	4,264	20,197	956	1,783
1996	4,887	22,622	1,016	2,127
1997	5,267	23,337	1,145	2,434
1998	5,503	24,421	1,301	2,767
1999	5,251	24,242	1,406	2,990
2000	5,351	24,762	1,456	2,903
2001	5,633	26,957	1,510	3,048
2002	5,741	28,538	1,607	3,073
2003	5,722	28,498	1,500	3,212

Source: Ministry of Education, Culture, Sports, Science and Technology, 'Basic Survey of Schools'

Table 4-2-10: Number of working-adult students in S&T graduate programs and trends in the ratio of such students

(A) Actual number

(unit: persons)

Year	Total					Adult students				
	Science		Engineering		Total	Science		Engineering		Total
	Masters	Doctors	Masters	Doctors		Masters	Doctors	Masters	Doctors	
2000	12,785	6,410	59,076	11,818	90,089	136	469	749	2,612	3,966
2001	12,897	6,302	60,913	12,165	92,277	150	482	1,329	2,720	4,681
2002	13,281	6,189	61,475	12,499	93,444	135	538	1,487	3,053	5,213
2003	13,833	6,190	63,211	13,170	96,404	133	586	1,645	3,249	5,613

(B) Ratio of adult students in graduate schools

(unit: %)

Year	Science		Engineering		Total
	Masters	Doctors	Masters	Doctors	
2000	1.1	7.3	1.3	22.1	4.4
2001	1.2	7.6	2.2	22.4	5.1
2002	1.0	8.7	2.4	24.4	5.6
2003	1.0	9.5	2.6	24.7	5.8

Source: Ministry of Education, Culture, Sports, Science and Technology, 'Basic Survey of Schools'

Table 4-2-11: Trends in ratio of nonworking persons by type of S&T degree

(A) Actual number

(unit: persons)

FY	Science Department				Engineering Department			
	Masters		Doctors		Masters		Doctors	
	Graduates	Unemployed	Graduates	Unemployed	Graduates	Unemployed	Graduates	Unemployed
1968	1,288	47	321	81	3,918	54	407	35
1969	1,281	46	355	106	3,965	65	461	38
1970	1,302	60	391	153	3,891	86	590	68
1971	1,389	92	461	193	4,660	84	533	68
1972	1,350	129	518	238	4,915	95	544	92
1973	1,455	110	506	242	5,436	159	513	109
1974	1,482	106	509	191	6,090	116	598	117
1975	1,382	97	494	201	6,060	191	570	126
1976	1,472	149	485	262	5,799	434	551	160
1977	1,594	136	567	277	6,923	331	659	167
1978	1,625	174	500	299	7,640	344	573	161
1979	1,666	150	555	302	7,613	224	656	135
1980	1,649	166	589	309	7,135	177	657	175
1981	1,665	144	607	313	6,976	133	685	159
1982	1,716	154	569	302	7,363	127	621	92
1983	1,813	159	582	297	7,703	158	579	94
1984	1,910	122	529	241	8,311	134	563	139
1985	1,992	150	610	278	8,628	170	552	114
1986	2,019	121	564	241	9,620	149	588	126
1987	2,213	124	605	258	10,413	196	638	131
1988	2,377	116	589	248	11,129	178	721	141
1989	2,598	107	675	256	11,915	138	915	194
1990	2,805	81	634	240	12,774	149	937	150
1991	2,913	108	674	273	13,141	161	1,048	96
1992	3,067	108	730	243	14,351	181	1,141	134
1993	3,327	141	770	276	16,234	213	1,354	146
1994	3,632	200	863	280	17,978	348	1,550	194
1995	4,264	380	956	409	20,197	525	1,783	214
1996	4,887	412	1,016	405	22,622	658	2,127	305
1997	5,267	396	1,145	499	23,337	662	2,434	381
1998	5,503	462	1,301	494	24,421	674	2,767	438
1999	5,251	534	1,406	542	24,242	1,141	2,990	801
2000	5,351	596	1,456	633	24,762	1,491	2,903	981
2001	5,633	597	1,510	637	26,957	1,428	3,048	996
2002	5,741	584	1,607	662	28,538	1,617	3,073	1,041
2003	5,722	662	1,500	645	28,498	2,069	3,212	1,168

(B) Ratio

(unit: %)

FY	Science Department			Engineering Department		
	Total	Masters	Doctors	Total	Masters	Doctors
1968	5.1	3.6	25.2	0.8	1.4	8.6
1969	6.4	3.6	29.9	1.0	1.6	8.2
1970	7.4	4.6	39.1	1.3	2.2	11.5
1971	8.8	6.6	41.9	1.6	1.8	12.8
1972	11.5	9.6	45.9	1.9	1.9	16.9
1973	12.9	7.6	47.8	2.3	2.9	21.2
1974	7.5	7.2	37.5	1.7	1.9	19.6
1975	11.2	7.0	40.7	3.5	3.2	22.1
1976	13.9	10.1	54.0	5.2	7.5	29.0
1977	13.1	8.5	48.9	4.8	4.8	25.3
1978	14.8	10.7	59.8	4.5	4.5	28.1
1979	15.4	9.0	54.4	3.3	2.9	20.6
1980	12.4	10.1	52.5	2.8	2.5	26.6
1981	12.0	8.6	51.6	2.7	1.9	23.2
1982	11.6	9.0	53.1	2.2	1.7	14.8
1983	11.5	8.8	51.0	2.5	2.1	16.2
1984	10.7	6.4	45.6	2.3	1.6	24.7
1985	8.7	7.5	45.6	1.9	2.0	20.7

FY	Science Department			Engineering Department		
	Total	Masters	Doctors	Total	Masters	Doctors
1986	7.4	6.0	42.7	1.9	1.5	21.4
1987	7.2	5.6	42.6	2.0	1.9	20.5
1988	6.4	4.9	42.1	1.8	1.6	19.6
1989	4.1	4.1	37.9	1.4	1.2	21.2
1990	3.8	2.9	37.9	1.3	1.2	16.0
1991	3.8	3.7	40.5	1.1	1.2	9.2
1992	4.0	3.5	33.3	1.3	1.3	11.7
1993	5.2	4.2	35.8	1.8	1.3	10.8
1994	6.8	5.5	32.4	3.4	1.9	12.5
1995	9.3	8.9	42.8	4.6	2.6	12.0
1996	10.1	8.4	39.9	5.8	2.9	14.3
1997	9.9	7.5	43.6	5.7	2.8	15.7
1998	9.6	8.4	38.0	6.0	2.8	15.8
1999	11.8	10.2	38.5	9.7	4.7	26.8
2000	14.4	11.1	43.5	12.9	6.0	33.8
2001	13.5	10.6	42.2	11.7	5.3	32.7
2002	16.3	10.2	41.2	14.1	5.7	33.9
2003	16.7	11.6	43.0	15.8	7.3	36.4

Note: 'Unemployed' is a person who has finished a doctor's or a master's course, but is not 'in higher education,' 'employed,' or 'deceased/unknown.'
Source: Ministry of Education, Culture, Sports, Science and Technology, 'Basic Survey of Schools'

Table 4-2-12: Problems about researchers with doctorate degrees (including post-doctorate degrees)

(A) Actual figure

Problems	Capital					
	Over 1 billion and less than 5 billion yen	Over 5 billion and less than 10 billion yen	Over 10 billion and less than 50 billion yen	Over 50 billion yen	Others	Total
Ready to employ, but no applicants No channel recruiting	39	14	14	5	0	72
Difficult to internally utilize researchers who have finished a doctor's course or who have postdoctoral researcher's capacity	185	75	81	15	1	357
Insufficient knowledge and skill in a specialized field	10	1	8	2	0	21
Insufficient capacity to adapt to broader fields than their own line	57	24	37	11	0	129
Slanted to a particular field of research and lack of will to deal with other fields	74	25	50	15	1	165
Problems in adapting to internal research work, such as being too assertive or uncooperative	38	11	22	3	0	74
Problems in sense of business management, such as being haphazard, cost-blind, or lacking a sense of time	69	26	39	11	1	146
Insufficient capacity to advance their own research as independent researchers	10	5	10	2	0	27
Others	5	2	5	0	0	12
None particularly	105	40	75	43	1	264
Don't know	60	31	18	9	1	119
Total	652	254	359	116	5	1386
Respondent enterprises	486	201	274	96	4	1061
No response	36	17	14	4	0	71
Valid response	450	184	260	92	4	990

(B) Ratio

(unit: %)

Problems	Capital				
	Over 1 billion and less than 5 billion yen	Over 5 billion and less than 10 billion yen	Over 10 billion and less than 50 billion yen	Over 50 billion yen	Others
Ready to employ, but no applicant No channel for recruiting	8.7	7.6	5.4	5.4	0.0
Difficult to internally utilize researchers who have finished a doctor's course or who have postdoctoral researcher's capacity	41.1	40.8	31.2	16.3	25.0
Insufficient knowledge and skill in a specialized field	2.2	0.5	3.1	2.2	0.0
Insufficient capacity to adapt to broader fields than their own line	12.7	13.0	14.2	12.0	0.0
Slanted to particular field of research and lack of will to deal with other fields	16.4	13.6	19.2	16.3	25.0
Problems in adaptint to internal research work, such as being too assertive or uncooperative	8.4	6.0	8.5	3.3	0.0
Problems in sense of business management, such as being haphazard, cost-blind, or lacking a sense of time	15.3	14.1	15.0	12.0	25.0
Insufficient capacity to advance their own research as independent researchers	2.2	2.7	3.8	2.2	0.0
Others	1.1	1.1	1.9	0.0	0.0
None particularly	23.3	21.7	28.8	46.7	25.0
Don't know	13.3	16.8	6.9	9.8	25.0

Note: 1) Multiple answers of not more than two.

2) Respondents to this survey are 2,007 private business enterprises presumably conducting R&D activities with capital of more than 1 billion yen, picked up from the list made by the Ministry of Education, Culture, Sports, Science and Technology by referring to the Report on the Survey of Research and Development by the Ministry of Public Management, Home Affairs, Posts and Telecommunications. Valid response: 1,061 companies. The period of the survey was from January to March, 2003.

Source: Ministry of Education, Culture, Sports, Science and Technology, 'Report on current status of scientific activities by private enterprises 2002'

Table 4-2-13: Ratio of faculty members who are alumni of the university where they work

(A) Changes by area specialization

(unit: %)

FY	Total	Specialized fields				
		Social science	Science	Engineering	Agriculture	Health science
1980	36.7	21.7	29.1	42.0	45.8	54.0
1983	37.4	21.4	29.9	42.3	46.7	53.9
1986	38.3	21.6	30.3	43.3	49.2	55.5
1989	38.1	20.7	29.3	41.7	48.2	57.4
1992	37.7	19.4	27.9	40.2	46.2	59.4
1995	37.5	19.4	26.8	39.8	45.1	59.5
1998	36.1	17.2	25.7	37.5	44.5	58.6
2001	34.0	15.8	24.5	35.9	43.1	55.9

Note: Health science includes medical science.

Source: Ministry of Education, Culture, Sports, Science and Technology, 'Statistical Survey on School Teachers'

(B) Breakdown by type of university (2001)

(unit: %)

Type of university	Total	Specialized fields				
		Social science	Science	Engineering	Agriculture	Health science
National	42.4	24.2	32.4	44.4	47.4	62.1
Public	25.7	12.1	13	21.0	22.4	43.3
Private	28.7	13.3	13.7	25.8	35.7	53.7

Source: Ministry of Education, Culture, Sports, Science and Technology, 'Statistical Survey on School Teachers 2001'

Table 4-2-14: Number of new and mid-career researchers recruited in FY2002

(unit: persons)

Type of organization	New hiring (new graduates)	Mid-career recruiting	Total
Private companies	19,427	12,129	31,556
NPO & public institutes	1,310	4,774	6,084
Tertiary education institutions	8,172	14,559	22,731
Total	28,909	31,462	60,371

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development 2003'

Table 4-2-15: Distribution of researcher affiliation before employment by type of organization of current employment (FY2002)

(A) Actual number

(unit: persons)

New working place	Original working place				Total
	Private companies, etc.	NPOs & public institutes	Tertiary education institutions	Others	
Private companies, etc.	11,286	180	397	266	12,129
NPOs & public institutes	1,261	2,512	692	309	4,888
Tertiary education institutions	1,248	5,236	6,119	1,956	14,559

(B) Ratio

(unit: %)

New working place	Original working place			
	Private companies, etc.	NPOs & public institutes	Tertiary education institutions	Others
Private companies, etc.	93.0	1.5	3.3	2.2
NPOs & public institutes	26.4	52.6	14.5	6.5
Tertiary education institutions	8.6	36.0	42.0	13.4

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development 2003'

Table 4-2-16: The ratio of mid-career recruits to number of researchers by type of organization (FY2002)

Type of organizaion	Ratio of transfer researchers to the total number of researchers (%)	Number of transfer researchers (person)	Number of researchers (person)
Private companies, etc.	2.6	12,129	460,053
NPOs & public institutes	9.6	4,774	49,867
Tertiary education institutions	5.2	14,559	281,304
Total	4.0	31,462	791,224

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, "Report on the Survey of Research and Development 2003'

Table 4-3-1: Past performance and future of R&D strategy

(unit: %)

R&D strategies	Past performance	Plan for the future
Focus on R&D in new areas	50.7	49.8
Joint research with Japanese universities and public institutes	58.4	41.8
Organizational reform, such as restructuring of R&D division	68.1	41.4
Reduction and consolidation of R&D themes	56.9	39.3
Outsourcing	29.8	37.6
Strategic partnership with Japanese businesses in other industries	22.7	33.9
Strategic partnership with Japanese businesses in the same industry	25.5	31.5
Consolidation of options in certain segments of existing business area	30.1	27.3
Effective utilization of foreign universities, public institutes and business enterprises	23.6	26.6
Drastic organizaional reform	18.8	20.3
Relocation of manufacturing plants to overseas sites	21.6	18.2
R&D plants to overseas sites	8.6	13.8
Buyouts and mergers with other businesses in Japan	6.7	13.2
Establishment of a joint business enterprise	8.6	12.8
Introduction of knowledge managers	4.3	12.5
Segmentation of R&D themes	17.0	10.8
Focus on existing business area in general	18.6	9.7

Note: 1) Selection of all that apply

2) Respondents to this survey are 1,993 private business enterprises presumably conducting R&D activities with capital of more than 1 billion yen, picked up from the list made by the Ministry of Education, Culture, Sports, Science and Technology by referring to the Report on the Survey of Research and Development by the Ministry of Public Management, Home Affairs, Posts and Telecommunications. Valid response: 1,026 companies. The period of the survey was from January to March, 2002.

Source: Ministry of Education, Culture, Sports, Science and Technology, 'Report on current status of scientific activities by private enterprises 2002'

Table 4-3-2: Ideas to encourage creativity

Scheme	Response	
	Actual number	Ratio (%)
Greater ease in attending academic conference and research meetings	567	56.9
Freedom in working hours, such as flextime, merit-based compensation, etc., granted to researchers	548	55.0
Evalutation of researchers from a variety of perspectives, rather than a uniform yardstick	430	43.2
Promotion of horizontal structuring of the organization	355	35.6
Creating opportunities of exchange among researchers in the organization	312	31.3
Evalutation of researchers from a variety of perspectives, rather than a uniform yardstick	218	21.9
Researcher discretion in research spending within a limited quota	161	16.2
Research goal set a little higher than the capability of the researhcer	160	16.1
Creating relaxing environment for research, in terms of laboratory location, facilities, etc.	138	13.9
Researchers recruited within the organizaion through open recruitment	62	6.2
Researchers capable of devoting more into research activities by increasing number of research assistants	30	3.0
Research themes similar to those conducted in other organizations not approved	15	1.5
Others	19	1.9
Respondent enterprises	1,061	-
no response	65	-
Valid response	996	100.0

Note: Selection of all that apply.

Source: Ministry of Education, Culture, Sports, Science and Technology, 'Report on current status of scientific activities by private enterprises 2002'

Table 4-3-3: Education targeted to researchers

(unit: %)

Contents of training	Deepening of a specialized field	Training of new recruits
Lectures outside the company	58.5	28.9
Group training inside the company	58.5	60.4
Support in self-development	38.3	54.4
Encouragement and assistance to obtain external accreditation	25.1	19.5
OJT	18.9	77.8
Study at domestic academic institutions	17.0	2.6
Assignment or dispatch to other countries	15.8	3.8
Encouragement to obtain academic degree	14.7	2.6
Study at overseas foreign institutions	11.8	2.1
Nothing done	6.5	3.5
Establishment and encouragement to obtain internal accreditation	3.1	3.9
Others	1.0	0.6

Note: Multiple answers of 3 or less.

Source: Ministry of Education, Culture, Sports, Science and Technology, 'Report on current status of scientific activities by private enterprises 2002'

Table 4-3-4: Private companies' demands towad of universities and graduate schools

Multiple-choice item	Response	
	Actual number	Ratio (%)
Change the entrance exam system from simple evaluation of amount of knowledge to one that evaluates various aspects such as ability to think, interests, aptitude, etc.	559	53.8
Introduce lecture evaluation system by students and third persons	76	7.3
Enhance the merit system when entering graduate school or at graduation	387	37.2
Actively employ and assess highly qualified professors as educators regardless of naionality, and give incentives	228	21.9
Expand internal training and credit earning system, such as an internship system	250	24.1
Invite private citizens as lecturers	167	16.1
Emphasize basic area and cross-disciplinary area of studey to prevent students becoming big fish in small pounds (ignorant of the real world)	379	36.5
Foster the ability to think rather than to give knowledte	774	74.5
Flexibly change maximum enrollment of each field to meet the social demand	66	6.4
Give lectures and instruction in English	157	15.1
Emphasize practical approace in human/social science areas, such as MOT (managemento of technology) education	179	17.2
Reinforce recrurrent education for researchers in the company	145	14.0
Others	30	2.9
None particularly	24	2.3
Respondent enterprises	1,061	-
No response	22	-
Valid response	1,039	100.0

Note: Multiple answers of 4 and less.

Source: Ministry of Education, Culture, Sports, Science and Technology, 'Report on current status of scientific activities by private enterprises 2002'

Table 4-4-1: Importance of each quality required in the ideal researcher and evaluation of young researchers

(unit: %)

Ablility	Evaluation of young researchers	Ideal researcher's sophistication/ability
Knowledge in a specialized area	32.0	56.1
Fundamental knowledge	9.2	37.7
Ability to define problems	-26.6	53.7
Ability to solve problems	1.9	45.1
Planning ability	-2.3	10.8
Creativity	-19.8	64.4
Sense of curiosity	1.8	53.1
Ability to work with others	18.8	7.2
Logicality	4.6	21.1
International perspective	-8.6	21.1
Perseverance	-9.3	32.5
Aggressiveness	-10.6	9.6
Sense of balance	-10.8	21.6
Commonsense and social norms	-13.7	11.6
Common knowledge	-11.1	5.8

Note: 1,355 respondents were asked to select from 'very high,' 'high,' 'medium,' 'low,' 'very low,' and 'don't know' to evaluate young researchers. The difference in the total ratio of 'very high' and 'high' minus the total ratio of 'low' and 'very low' for each item was then compiled to evaluate young researchers. Multiple answers for the ideal researcher's sophistication/ability were allowed. The level of importance is a quotient of the number of responses divided by 1,355, the total number of respondents for each item.

Source: Ministry of Education, Culture, Sports, Science and Technology, 'Report on current status of scientific activities in Japan 2003'

Table 5-1-1: TIMSS-R average scores in mathematics

(unit: points)

Country	Score
Singapore (1st)	604
Republic of Korea (2nd)	587
Taiwan (3rd)	585
Hong Kong (4th)	582
Japan (5th)	579
U.S. (19th)	502
U.K. (20th)	496
(among 38 countries)	

Source: Compiled by NISTEP based on National Institute for Educational Policy Research, 'International comparison of math education/science education—The second phase of 3rd International survey of math/science education' (Gyosei 2001).

Table 5-1-2: TIMSS-R average scores for science

(unit: points)

Country	Score
Taiwan (1st)	569
Singapore (2nd)	568
Hungary (3rd)	552
Japan (4th)	550
Republic of Korea (5th)	549
U.K. (9th)	538
U.S. (18th)	515
(among 38 countries)	

Source: Same as Table 5-1-1.

Table 5-1-3: Awareness toward mathematics

(unit: %)

country	Ratio of students who responded 'like very much' and 'like'	In order to get the desired job	To please parents	To gain admission to a desired college
Singapore	79	86	72	95
U.K.	77	77	62	85
U.S.	69	81	81	94
Republic of Korea	54	44	62	85
Japan	48	51	31	88

Source: Same as Table 5-1-1.

Table 5-1-4: Awareness toward science

(unit: %)

Country	Ratio of students who responded 'like very much' and 'like'	In order to get the desired job	To please parents	To gain admission to a desired college
Singapore	86	75	74	92
U.K.	83	59	62	75
U.S.	73	59	79	86
Republic of Korea	52	44	62	83
Japan	55	42	30	83

Source: Same as Table 5-1-1.

Table 5-1-5: Mathematical literacy

(unit: points)

Country	Average score	Male students	Female students
Japan (1st)	557	561	553
Republic of Korea (2nd)	547	559	532
New Zealand (3rd)	537	536	539
Finland (4th)	536	537	536
Australia (5th)	533	539	527
U.K. (8th)	529	534	526
France (10th)	517	525	511
U.S. (18th) (among 27 countries)	493	497	490

Note: Starting from the top, average score for both males and females, for males, and for females of each country.
Source: Compiled by NISTEP based on National Institute for Educational Policy Research, 'Knowledge and skill for living—OECD Academic Achievement Test (PISA) 2000 Annual International Survey Report' (Gyosei 2000).

Table 5-1-6: Scientific literacy

(unit: points)

Country	Average score	Male students	Female students
Republic of Korea (1st)	552	561	541
Japan (2nd)	550	547	554
Finland (3rd)	538	534	541
U.K. (4th)	532	535	531
Canada (5th)	529	529	531
France (12th)	500	504	498
U.S. (14th) (among 27 countries)	499	497	502

Note: Same as Table 5-1-5.
Source: Same as Table 5-1-5.

Table 5-1-7: Average scores in student assessment and relationship with GDP

Country	Average score of academic achievement (points)	GDP per capita (dollar)
Japan	543	24,500
Greece	460	14,800
U.K.	528	22,300
France	507	21,900
U.S.	499	33,900
Czech Republic	500	13,100
Republic of Korea	541	15,900
Finland	540	22,800
Poland	477	8,100
Austria	514	24,600
Ireland	514	25,200
Belgium	507	24,300
Portugal	461	16,500
Australia	530	24,400
Italy	474	21,800
Norway	502	27,600
Spain	487	18,100
Mexico	410	8,100
Hungary	488	10,900
Switzerland	506	27,500
Sweden	513	23,000
Denmark	497	26,300
Germany	487	23,600

Note: GDP figures are 1999 data. The average score of academic achievement, 500 points, is average score of all countries. The diagonal line is a regression line (significant level 1%) by the least-square method for 23 OECD member countries' data.
Source: Same as Table 5-1-5.

Table 5-1-8: Comparison of designated accuracy rate per problem

Classfication		Appears to be higher than the preset pass rate	Appears to be the same as the preset pass rate	Appears to be lower than the preset pass rate
Arithmetic/Math	5th grade	8 questions	35 questions	42 questions
	6th grade	11 questions	38 questions	23 questions
	7th grade	16 questions	20 questions	33 questions
	8th grade	21 questions	29 questions	22 questions
	9th grade	13 quesitions	31 questions	18 quesitions
Science	5th grade	36 questions	39 questions	18 questions
	6th grade	68 questions	21 questions	5questions
	7th grade	23 questions	26 questions	71 questions
	8th grade	26 questions	43 questions	70 questions
	9th grade	44 questions	46 questions	33 questions

Note: According to National Institute for Educational Policy Research, the preset pass rate is a figure that shows how the pass rate (the total ratio of correct answers and near-correct answers of each question) would be, on the assumption that learning activities are performed in standard time frame as assumed at the time when the ministry's curriculum guideline was prepared.
Source: Compiled by NISTEP based on Curriculum Research Center, National Institute for Educational Policy Research, 'State of implementation of elementary school and junior high school curriculum 2001.'

Table 5-1-9: Comparison of accuracy rates for the same problem in a previous survey

Classification		Higher than before	Same as before	Lower than before
Arithmetic/Math	5th grade	1 question	7 questions	16 questions
	6th grade	1 question	5 questions	9 questions
	7th grade	0 questions	1 quesition	15 questions
	8th grade	0 questions	4 questions	15 questions
	9th grade	2 questions	9 questions	9 questions
Science	5th grade	8 questions	8 questions	13 questions
	6th grade	17 questions	10 questions	5 questions
	7th grade	6 questions	10 questions	17 questions
	8th grade	15 questions	10 questions	35 questions
	9th grade	16 questions	10 questions	14 questions

Source: Same as Table 5-1-8.

Table 5-1-10: Reason for studying science

(unit: %)

Grade	Studying science is important	I like studying science	It is important regardless of examination	It develops ability to solve problems and to verify hypothesis	It helps us in our daily life and social life
5th grade	72.2	71.9	63.6	65.2	53.7
6th grade	66.7	65.0	58.9	59.6	48.5
7th grade	58.4	56.4	51.4	49.9	39.9
8th grade	57.6	53.3	49.6	46.3	39.1
9th grade	57.3	55.0	49.0	45.4	36.3

Note: The figures include response of both 'Agree' and 'Somewhat agree.'
Source: Same as Table 5-1-8.

Table 5-1-11: Purpose of studying science

(unit+ %)

Grade	It is necessary for the protection of nature and the environment	Science is very important for the fevelopment of a country	It develops the ability to solve problems and to verify hypotheses	It helps us in our daily life and social life	I want to have a job making use of studying science
5th grade	80.3	69.4	61.0	50.8	26.4
6th grade	85.8	72.1	55.8	45.6	21.6
7th grade	75.8	63.7	48.7	40.0	20.3
8th grade	72.8	62.6	44.8	38.3	20.7
9th grade	76.6	66.2	43.4	36.4	21.9

Note: The figures include responses of both 'Agree' and 'Somewhat agree.'
Source: Same as Table 5-1-8.

Table 5-1-12: Things you like to do related to science

(unit: %)

Grade	I like to go to the zoo or aquarium	I like experiments and observations	I like to go to science and natural history museum	I often read books, picture bookds, or watch TV about nature and science
5th grade	87.6	78.8	74.0	58.3
6th grade	82.7	74.5	68.9	50.1
7th grade	75.4	73.2	59.6	42.3
8th grade	72.4	68.2	53.9	39.1
9th grade	71.9	71.2	51.5	40.1

Note: The figures include response of both 'Agree' and 'Somewhat agree.'
Source: Same as Table 5-1-8.

Table 5-1-13: Student attitude toward science

(unit: %)

Grade	I do experiments and observations using my own judgment	I try to think back to whether or not the way to proceed with the experiments and observations was correct	I try to check by myself what I don't understand or what I am intersted in
5th grade	62.5	52.3	46.6
6th grade	56.5	48.8	41.5
7th grade	43.0	39.5	35.7
8th grade	40.3	39.1	35.2
9th grade	42.1	42.4	40.7

Note: The figures include response of both ‘Agree’ and ‘Somewhat agree.’

Source: Same as Table 5-1-8

Table 5-2-1: Trends in the total number of applicants and ratio of successful admission for academic departments at universities

(A)Total number of applicants

(unit: persons)

FY	Applicants in science and engineering					Applicants in economics and commerce					Applicants in law		Total	
	Science	Engineering	Science and engineering	Total	Index	Economics	Management	Commerce	Total	Index		Index		Index
1965	22,413	157,492	47,777	227,682	100.0	175,232	30,001	102,523	307,756	100.0	125,553	100.0	1,203,337	100.0
1966	27,102	199,106	59,368	285,576	125.4	211,445	52,742	132,813	397,000	129.0	151,960	121.0	1,516,506	126.0
1967	31,688	234,112	78,568	344,368	151.2	246,992	65,020	146,897	458,909	149.1	188,812	150.4	1,769,995	147.1
1968	34,374	261,313	86,877	382,564	168.0	267,815	74,565	144,199	486,579	158.1	198,445	158.1	1,896,060	157.6
1969	40,420	306,548	92,543	439,511	193.0	265,659	86,235	141,042	492,936	160.2	206,568	164.5	1,979,647	164.5
1970	46,479	322,576	104,226	473,281	207.9	250,796	80,225	124,084	455,105	147.9	191,825	152.8	1,943,207	161.5
1971	46,829	325,135	109,799	481,763	211.6	248,190	84,235	115,688	448,113	145.6	188,749	150.3	1,952,684	162.3
1972	47,191	313,287	106,013	466,491	204.9	250,772	78,478	115,946	445,196	144.7	196,400	156.4	1,975,590	164.2
1973	45,286	310,176	107,975	463,437	203.5	254,655	96,149	125,356	476,160	154.7	204,032	162.5	2,071,785	172.2
1974	52,490	337,122	108,822	498,434	218.9	300,445	111,452	152,160	564,057	183.3	242,681	193.3	2,320,113	192.8
1975	60,014	349,144	124,647	533,805	234.5	389,523	134,707	190,389	714,619	232.2	299,032	238.2	2,756,699	229.1
1976	62,424	332,459	117,215	512,098	224.9	395,539	150,427	195,884	741,850	241.1	286,219	228.0	2,794,518	232.2
1977	64,195	349,181	120,161	533,537	234.3	430,677	159,840	208,173	798,690	259.5	308,325	245.6	2,957,894	245.8
1978	66,952	373,095	132,629	572,676	251.5	472,516	165,347	221,260	859,123	279.2	311,668	248.2	3,127,128	259.9
1979	53,958	308,982	115,038	477,978	209.9	429,936	157,658	207,933	795,527	258.5	311,198	247.9	2,796,686	232.4
1980	52,952	281,322	112,326	446,600	196.2	420,018	147,727	194,758	762,503	247.8	289,953	230.9	2,658,633	220.9
1981	50,019	272,593	124,336	446,948	196.3	408,180	144,787	196,098	749,065	243.4	287,251	228.8	2,608,930	216.8
1982	52,585	294,623	125,042	472,250	207.4	394,581	146,792	202,601	743,974	241.7	270,759	215.7	2,590,165	215.2
1983	56,904	349,973	137,948	544,825	239.3	410,354	145,831	199,848	756,033	245.7	268,009	213.5	2,697,177	224.1
1984	62,747	403,791	150,600	617,138	271.1	410,166	138,783	209,009	757,958	246.3	282,483	225.0	2,794,692	232.2
1985	64,377	433,731	158,064	656,172	288.2	391,138	127,862	199,739	718,739	233.5	254,015	202.3	2,729,799	226.9
1986	64,473	498,932	161,813	725,218	318.5	398,389	140,357	222,089	760,835	247.2	257,729	205.3	2,918,628	242.5
1987	81,487	603,939	162,554	847,980	372.4	504,440	155,445	250,967	910,852	296.0	312,032	248.5	3,541,188	294.3
1988	74,493	572,371	173,802	820,666	360.4	589,439	183,683	286,080	1,059,202	344.2	324,984	258.8	3,766,338	313.0
1989	73,060	574,500	197,038	844,598	371.0	668,600	221,336	330,393	1,220,329	396.5	378,694	301.6	4,119,609	342.3
1990	80,306	600,699	213,576	894,581	392.9	776,144	247,173	359,687	1,383,004	449.4	433,788	345.5	4,639,980	385.6
1991	80,958	615,782	223,413	920,153	404.1	825,578	276,989	367,200	1,469,767	477.6	442,903	352.8	4,937,867	410.3
1992	85,615	623,367	221,760	930,742	408.8	810,159	269,174	348,304	1,427,637	463.9	457,215	364.2	5,062,862	420.7
1993	84,774	622,938	201,843	909,555	399.5	773,644	253,985	315,670	1,343,299	436.5	440,795	351.1	4,962,863	412.4
1994	86,470	581,923	188,687	857,080	376.4	730,483	254,108	274,523	1,259,114	409.1	427,882	340.8	4,785,380	397.7
1995	91,741	573,536	185,686	850,963	373.8	666,893	245,788	247,817	1,160,498	377.1	402,271	320.4	4,627,854	384.6
1996	88,927	560,066	197,302	846,295	371.7	601,799	230,226	220,174	1,052,199	341.9	372,678	296.8	4,489,430	373.1
1997	87,238	542,075	182,923	812,236	356.7	523,770	199,166	190,844	913,780	296.9	326,742	260.2	4,181,262	347.5
1998	83,881	515,123	192,593	791,597	347.7	464,109	175,374	172,604	812,087	263.9	300,506	239.3	3,919,634	325.7
1999	78,991	464,803	182,184	725,978	318.9	401,087	147,025	154,230	702,342	228.2	283,753	226.0	3,592,270	298.5
2000	78,102	418,585	172,219	668,906	293.8	372,934	147,900	133,526	654,360	212.6	268,447	213.8	3,451,272	286.8
2001	76,022	406,439	197,675	680,136	298.7	371,123	148,866	130,038	650,027	211.2	275,957	219.8	3,512,301	291.9
2002	76,830	400,296	206,882	684,008	300.4	405,710	151,810	129,346	686,866	223.2	320,436	255.2	3,690,314	306.7
2003	78,146	393,196	204,731	676,073	296.9	396,750	182,605	137,791	717,146	233.0	316,746	252.3	3,796,798	315.5

(B)Number of enrollments

(unit: persons)

FY	Enrollments in science and engineering					Enrollments in economics and commerce					Enrollments in law		Total	
	Science	Engineering	Science and engineering	Total	Index	Economics	Management	Commerce	Total	Index		Index		Index
1965	5,688	37,831	10,925	54,444	100.0	35,057	5,323	21,022	61,402	100.0	23,036	100.0	249,917	100.0
1966	6,309	44,529	12,168	63,006	115.7	41,376	8,287	23,083	72,746	118.5	25,969	112.7	292,958	117.2
1967	6,615	47,603	13,527	67,745	124.4	44,913	10,003	23,174	78,090	127.2	29,241	126.9	312,747	125.1
1968	6,721	50,214	13,694	70,629	129.7	45,769	10,810	24,635	81,214	132.3	30,795	133.7	325,632	130.3
1969	6,761	53,842	14,029	74,632	137.1	46,599	11,732	24,183	82,514	134.4	29,896	129.8	329,374	131.8
1970	7,306	55,029	13,175	75,510	138.7	46,528	12,251	24,487	83,266	135.6	30,921	134.2	333,037	133.3
1971	7,245	59,046	14,683	80,974	148.7	49,110	12,695	25,523	87,328	142.2	33,616	145.9	357,821	143.2
1972	7,696	59,777	14,624	82,097	150.8	52,083	13,876	26,692	92,651	150.9	35,731	155.1	376,147	150.5
1973	7,924	60,976	15,234	84,134	154.5	52,334	14,866	27,512	94,712	154.2	36,698	159.3	389,560	155.9
1974	7,778	62,565	15,362	85,705	157.4	56,313	16,520	29,335	102,168	166.4	38,405	166.7	407,528	163.1
1975	7,888	65,899	14,902	88,689	162.9	58,894	16,445	30,798	106,137	172.9	39,334	170.8	423,942	169.6
1976	7,980	65,271	14,819	88,070	161.8	58,011	16,628	29,925	104,564	170.3	36,980	160.5	420,616	168.3
1977	8,460	67,101	14,369	89,930	165.2	60,125	15,622	29,731	105,478	171.8	37,824	164.2	428,412	171.4
1978	8,797	66,708	13,581	89,086	163.6	58,973	15,385	30,296	104,654	170.4	37,871	164.4	425,718	170.3
1979	8,993	62,241	13,099	84,333	154.9	55,642	14,219	28,831	98,692	160.7	35,154	152.6	407,635	163.1
1980	9,322	64,432	12,852	86,606	159.1	56,533	14,573	28,750	99,856	162.6	35,605	154.6	412,437	165.0
1981	9,559	64,412	14,424	88,395	162.4	55,826	13,593	28,131	97,550	158.9	36,011	156.3	413,236	165.3
1982	9,654	66,202	13,990	89,846	165.0	54,805	13,656	27,042	95,503	155.5	35,164	152.6	414,536	165.9
1983	9,869	66,831	14,786	91,486	168.0	55,965	13,214	26,838	96,017	156.4	35,872	155.7	420,458	168.2
1984	9,921	65,928	13,627	89,476	164.3	54,562	12,930	26,966	94,458	153.8	35,131	152.5	416,002	166.5
1985	9,759	65,937	13,326	89,022	163.5	53,505	13,009	26,587	93,101	151.6	34,982	151.9	411,993	164.9
1986	9,848	70,051	13,817	93,716	172.1	58,040	13,567	27,310	98,917	161.1	37,971	164.8	436,896	174.8
1987	10,368	74,597	14,962	99,927	183.5	62,377	15,546	28,727	106,650	173.7	40,958	177.8	465,503	186.3
1988	10,492	75,223	14,103	99,818	183.3	63,472	15,938	29,058	108,468	176.7	41,687	181.0	472,965	189.2
1989	10,680	73,511	16,323	100,514	184.6	62,828	16,266	28,376	107,470	175.0	42,431	184.2	476,786	190.8
1990	11,087	76,117	17,349	104,553	192.0	65,688	16,881	28,161	110,730	180.3	42,908	186.3	492,340	197.0
1991	11,607	80,608	18,188	110,403	202.8	72,047	19,820	28,578	120,445	196.2	45,750	198.6	521,899	208.8
1992	12,139	82,213	19,319	113,671	208.8	70,048	20,477	30,047	120,572	196.4	47,542	206.4	541,604	216.7
1993	12,822	84,677	18,813	116,312	213.6	73,547	21,348	29,340	124,235	202.3	47,527	206.3	554,973	222.1
1994	12,833	84,033	19,342	116,208	213.4	73,226	22,477	27,897	123,600	201.3	48,292	209.6	560,815	224.4
1995	13,140	86,823	19,248	119,211	219.0	72,416	24,121	26,992	123,529	201.2	48,241	209.4	568,576	227.5
1996	12,748	86,840	19,108	118,696	218.0	72,571	24,117	27,152	123,840	201.7	48,400	210.1	579,148	231.7
1997	13,033	86,496	19,113	118,642	217.9	73,212	23,634	26,489	123,335	200.9	48,096	208.8	586,688	234.8
1998	12,646	86,488	19,135	118,269	217.2	70,940	23,308	26,017	120,265	195.9	47,743	207.3	590,743	236.4
1999	12,876	82,865	19,202	114,943	211.1	68,387	23,400	25,799	117,586	191.5	47,181	204.8	589,559	235.9
2000	12,546	81,072	19,465	113,083	207.7	67,917	23,735	24,326	115,978	188.9	45,460	197.3	599,655	239.9
2001	11,932	77,993	20,120	110,045	202.1	65,969	23,656	23,156	112,781	183.7	44,974	195.2	603,953	241.7
2002	11,857	75,369	19,915	107,141	196.8	64,385	23,987	21,967	110,339	179.7	45,927	199.4	609,337	243.8
2003	11,712	72,893	19,302	103,907	190.9	62,015	24,055	20,585	106,655	173.7	43,215	187.6	604,785	242.0

Note: The figures include students of only these departments shown as the table title, i.e., students of other departments, such as department of politics and economics, department of basic engineering, etc., are not included.

Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), Report on 'School Basic Survey'

Table 5-2-2: Trends in the ratio of the total number of applicants

(A) Compatition rate for enrollment

(unit: times)

FY	Science and engineering					Economics and commerce					Law		Total	
	Science	Engineering	science and engineering	Average	Index	Economics	Management	Commerce	Average	Index		Index		Index
1965	3.9	4.2	4.4	4.2	100.0	5.0	5.6	4.9	5.0	100.0	5.5	100.0	4.8	100.0
1966	4.3	4.5	4.9	4.5	108.4	5.1	6.4	5.8	5.5	108.9	5.9	107.4	5.2	107.5
1967	4.8	4.9	5.8	5.1	121.6	5.5	6.5	6.3	5.9	117.2	6.5	118.5	5.7	117.5
1968	5.1	5.2	6.3	5.4	129.5	5.9	6.9	5.9	6.0	119.5	6.4	118.2	5.8	120.9
1969	6.0	5.7	6.6	5.9	140.8	5.7	7.4	5.8	6.0	119.2	6.9	126.8	6.0	124.8
1970	6.4	5.9	7.9	6.3	149.9	5.4	6.5	5.1	5.5	109.0	6.2	113.8	5.8	121.2
1971	6.5	5.5	7.5	5.9	142.3	5.1	6.6	4.5	5.1	102.4	5.6	103.0	5.5	113.3
1972	6.1	5.2	7.2	5.7	135.9	4.8	5.7	4.3	4.8	95.9	5.5	100.9	5.3	109.1
1973	5.7	5.1	7.1	5.5	131.7	4.9	6.5	4.6	5.0	100.3	5.6	102.0	5.3	110.5
1974	6.7	5.4	7.1	5.8	139.1	5.3	6.7	5.2	5.5	110.1	6.3	115.9	5.7	118.2
1975	7.6	5.3	8.4	6.0	143.9	6.6	8.2	6.2	6.7	134.3	7.6	139.5	6.5	135.0
1976	7.8	5.1	7.9	5.8	139.0	6.8	9.0	6.5	7.1	141.6	7.7	142.0	6.6	138.0
1977	7.6	5.2	8.4	5.9	141.9	7.2	10.2	7.0	7.6	151.1	8.2	149.6	6.9	143.4
1978	7.6	5.6	9.8	6.4	153.7	8.0	10.7	7.3	8.2	163.8	8.2	151.0	7.3	152.6
1979	6.0	5.0	8.8	5.7	135.5	7.7	11.1	7.2	8.1	160.8	8.9	162.4	6.9	142.5
1980	5.7	4.4	8.7	5.2	123.3	7.4	10.1	6.8	7.6	152.4	8.1	149.4	6.4	133.9
1981	5.2	4.2	8.6	5.1	120.9	7.3	10.7	7.0	7.7	153.2	8.0	146.4	6.3	131.1
1982	5.4	4.5	8.9	5.3	125.7	7.2	10.7	7.5	7.8	155.4	7.7	141.3	6.2	129.8
1983	5.8	5.2	9.3	6.0	142.4	7.3	11.0	7.4	7.9	157.1	7.5	137.1	6.4	133.2
1984	6.3	6.1	11.1	6.9	164.9	7.5	10.7	7.8	8.0	160.1	8.0	147.5	6.7	139.5
1985	6.6	6.6	11.9	7.4	176.3	7.3	9.8	7.5	7.7	154.0	7.3	133.2	6.6	137.6
1986	6.5	7.1	11.7	7.7	185.0	6.9	10.3	8.1	7.7	153.5	6.8	124.5	6.7	138.7
1987	7.9	8.1	10.9	8.5	202.9	8.1	10.0	8.7	8.5	170.4	7.6	139.8	7.6	158.0
1988	7.1	7.6	12.3	8.2	196.6	9.3	11.5	9.8	9.8	194.8	7.8	143.0	8.0	165.4
1989	6.8	7.8	12.1	8.4	200.9	10.6	13.6	11.6	11.4	226.6	8.9	163.8	8.6	179.4
1990	7.2	7.9	12.3	8.6	204.6	11.8	14.6	12.8	12.5	249.2	10.1	185.5	9.4	195.7
1991	7.0	7.6	12.3	8.3	199.3	11.5	14.0	12.8	12.2	243.5	9.7	177.6	9.5	196.5
1992	7.1	7.6	11.5	8.2	195.8	11.6	13.1	11.6	11.8	236.2	9.6	176.5	9.3	194.1
1993	6.6	7.4	10.7	7.8	187.0	10.5	11.9	10.8	10.8	215.7	9.3	170.2	8.9	185.7
1994	6.7	6.9	9.8	7.4	176.4	10.0	11.3	9.8	10.2	203.2	8.9	162.6	8.5	177.2
1995	7.0	6.6	9.6	7.1	170.7	9.2	10.2	9.2	9.4	187.4	8.3	153.0	8.1	169.0
1996	7.0	6.4	10.3	7.1	170.5	8.3	9.5	8.1	8.5	169.5	7.7	141.3	7.8	161.0
1997	6.7	6.3	9.6	6.8	163.7	7.2	8.4	7.2	7.4	147.8	6.8	124.6	7.1	148.0
1998	6.6	6.0	10.1	6.7	160.0	6.5	7.5	6.6	6.8	134.7	6.3	115.5	6.6	137.8
1999	6.1	5.6	9.5	6.3	151.0	5.9	6.3	6.0	6.0	119.2	6.0	110.3	6.1	126.5
2000	6.2	5.2	8.8	5.9	141.4	5.5	6.2	5.5	5.6	112.6	5.9	108.3	5.8	119.5
2001	6.4	5.2	9.8	6.2	147.8	5.6	6.3	5.6	5.8	115.0	6.1	112.6	5.8	120.8
2002	6.5	5.3	10.4	6.4	152.7	6.3	6.3	5.9	6.2	124.2	7.0	128.0	6.1	125.8
2003	6.7	5.4	10.6	6.5	155.6	6.4	7.6	6.7	6.7	134.2	7.3	134.5	6.3	130.4

(B) Trends in the ratio of the total number of applicants

(unit: %)

FY	Applicants in science and engineering					Applicants in economics and commerce					Applicants in law		Total	
	d engineering	Engineering	Scinece and engineering	Total	Index	Economics	Management	Commerce	Total	Index		Index		Index
1965	1.9	13.1	4.0	18.9	100.0	14.6	2.5	8.5	25.6	100.0	10.4	100.0	100.0	100.0
1966	1.8	13.1	3.9	18.8	99.5	13.9	3.5	8.8	26.2	102.4	10.0	96.0	100.0	100.0
1967	1.8	13.2	4.4	19.5	102.8	14.0	3.7	8.3	25.9	101.4	10.7	102.2	100.0	100.0
1968	1.8	13.8	4.6	20.2	106.6	14.1	3.9	7.6	25.7	100.3	10.5	100.3	100.0	100.0
1969	2.0	15.5	4.7	22.2	117.3	13.4	4.4	7.1	24.9	97.4	10.4	100.0	100.0	100.0
1970	2.4	16.6	5.4	24.4	128.7	12.9	4.1	6.4	23.4	91.6	9.9	94.6	100.0	100.0
1971	2.4	16.7	5.6	24.7	130.4	12.7	4.3	5.9	22.9	89.7	9.7	92.6	100.0	100.0
1972	2.4	15.9	5.4	23.6	124.8	12.7	4.0	5.9	22.5	88.1	9.9	95.3	100.0	100.0
1973	2.2	15.0	5.2	22.4	118.2	12.3	4.6	6.1	23.0	89.9	9.8	94.4	100.0	100.0
1974	2.3	14.5	4.7	21.5	113.5	12.9	4.8	6.6	24.3	95.1	10.5	100.3	100.0	100.0
1975	2.2	12.7	4.5	19.4	102.3	14.1	4.9	6.9	25.9	101.4	10.8	104.0	100.0	100.0
1976	2.2	11.9	4.2	18.3	96.9	14.2	5.4	7.0	26.5	103.8	10.2	98.2	100.0	100.0
1977	2.2	11.8	4.1	18.0	95.3	14.6	5.4	7.0	27.0	105.6	10.4	99.9	100.0	100.0
1978	2.1	11.9	4.2	18.3	96.8	15.1	5.3	7.1	27.5	107.4	10.0	95.5	100.0	100.0
1979	1.9	11.0	4.1	17.1	90.3	15.4	5.6	7.4	28.4	111.2	11.1	106.6	100.0	100.0
1980	2.0	10.6	4.2	16.8	88.8	15.8	5.6	7.3	28.7	112.1	10.9	104.5	100.0	100.0
1981	1.9	10.4	4.8	17.1	90.5	15.6	5.5	7.5	28.7	112.3	11.0	105.5	100.0	100.0
1982	2.0	11.4	4.8	18.2	96.4	15.2	5.7	7.8	28.7	112.3	10.5	100.2	100.0	100.0
1983	2.1	13.0	5.1	20.2	106.8	15.2	5.4	7.4	28.0	109.6	9.9	95.2	100.0	100.0
1984	2.2	14.4	5.4	22.1	116.7	14.7	5.0	7.5	27.1	106.0	10.1	96.9	100.0	100.0
1985	2.4	15.9	5.8	24.0	127.0	14.3	4.7	7.3	26.3	102.9	9.3	89.2	100.0	100.0
1986	2.2	17.1	5.5	24.8	131.3	13.6	4.8	7.6	26.1	101.9	8.8	84.6	100.0	100.0
1987	2.3	17.1	4.6	23.9	126.6	14.2	4.4	7.1	25.7	100.6	8.8	84.5	100.0	100.0
1988	2.0	15.2	4.6	21.8	115.2	15.7	4.9	7.6	28.1	110.0	8.6	82.7	100.0	100.0
1989	1.8	13.9	4.8	20.5	108.4	16.2	5.4	8.0	29.6	115.8	9.2	88.1	100.0	100.0
1990	1.7	12.9	4.6	19.3	101.9	16.7	5.3	7.8	29.8	116.5	9.3	89.6	100.0	100.0
1991	1.6	12.5	4.5	18.6	98.5	16.7	5.6	7.4	29.8	116.4	9.0	86.0	100.0	100.0
1992	1.7	12.3	4.4	18.4	97.2	16.0	5.3	6.9	28.2	110.3	9.0	86.6	100.0	100.0
1993	1.7	12.6	4.1	18.3	96.9	15.6	5.1	6.4	27.1	105.8	8.9	85.1	100.0	100.0
1994	1.8	12.2	3.9	17.9	94.7	15.3	5.3	5.7	26.3	102.9	8.9	85.7	100.0	100.0
1995	2.0	12.4	4.0	18.4	97.2	14.4	5.3	5.4	25.1	98.0	8.7	83.3	100.0	100.0
1996	2.0	12.5	4.4	18.9	99.6	13.4	5.1	4.9	23.4	91.6	8.3	79.6	100.0	100.0
1997	2.1	13.0	4.4	19.4	102.7	12.5	4.8	4.6	21.9	85.5	7.8	74.9	100.0	100.0
1998	2.1	13.1	4.9	20.2	106.7	11.8	4.5	4.4	20.7	81.0	7.7	73.5	100.0	100.0
1999	2.2	12.9	5.1	20.2	106.8	11.2	4.1	4.3	19.6	76.4	7.9	75.7	100.0	100.0
2000	2.3	12.1	5.0	19.4	102.4	10.8	4.3	3.9	19.0	74.1	7.8	74.5	100.0	100.0
2001	2.2	11.6	5.6	19.4	102.3	10.6	4.2	3.7	18.5	72.4	7.9	75.3	100.0	100.0
2002	2.1	10.8	5.6	18.5	98.0	11.0	4.1	3.5	18.6	72.8	8.7	83.2	100.0	100.0
2003	2.1	10.4	5.4	17.8	94.1	10.4	4.8	3.6	18.9	73.9	8.3	80.0	100.0	100.0

Note: The figures include students of only these departments shown as the table title, i.e., students of other departments, such as department of politics and economics, department of basic engineering, etc., are not included.

Source: Ministry of Education, Culture, Sports, Science and Technology (MEXT), Report on 'School Basic Survey'

Table 5-2-3: Trends in population of 18-years-old and university enrollments

(unit: 1,000 persons, %)

Year	18-years-old population	Number of Enrollment	Advancement rate (B/A)
1980	1,591	412	25.9
1981	1,638	413	25.2
1982	1,681	415	24.7
1983	1,794	420	23.4
1984	1,444	416	28.8
1985	1,860	412	22.2
1986	1,851	437	23.6
1987	1,894	466	24.6
1988	1,922	473	24.6
1989	1,979	477	24.1
1990	2,027	492	24.3
1991	2,068	522	25.2
1992	2,036	542	26.6
1993	1,925	555	28.8
1994	1,844	561	30.4
1995	1,758	569	32.3
1996	1,711	579	33.8
1997	1,647	587	35.6
1998	1,603	591	36.9
1999	1,534	590	38.4
2000	1,513	600	39.6
2001	1,518	604	39.8
2002	1,500	609	40.6
2003	1,447	605	41.8
2004	1,383	-	-
2005	1,358	-	-
2006	1,321	-	-
2007	1,239	-	-
2008	1,247	-	-
2009	1,219	-	-
2010	1,219	-	-
2011	1,198	-	-
2012	1,216	-	-

Notes: 1. Population aged 18 is based on media estimates.

2. Advancement rate is percentage of university enrollments to the 18-years-old population.

Sources:

1. 18-years-old population:

<Data up to 2002> 'Population Estimates,' Statistics Bureau, Ministry of Public Management, Home Affairs, Posts and Telecommunications (as of October each year)

<Data from 2003> 'Future Population Estimates of Japan' (estimate as of January 2002), National Institute of Population and Social Security Research, Ministry of Health, Labor and Welfare

2. Number of university enrollments:

Ministry of Education, Culture, Sports, Science and Technology (MEXT), report on 'School Basic Survey'

See: Table 5-2-3

Table 5-2-4: Trends in the number of university enrollments

(unit: persons)

FY	Total	Humanities	Social sciences	Science	Engineering	Agriculture	Health science	Mercantile mari	Home economics	Education	Art	Others
1980	412,437	56,161	166,453	12,716	79,209	14,418	21,592	359	7,982	32,350	10,670	10,527
1981	413,236	56,136	165,958	12,990	79,635	14,381	21,683	354	7,893	32,649	10,881	10,676
1982	414,536	57,224	164,228	13,303	81,163	14,188	21,779	365	8,015	32,823	10,888	10,560
1983	420,458	59,786	165,388	13,679	82,387	14,481	22,319	365	8,275	32,975	11,186	9,617
1984	416,002	59,736	162,764	13,597	80,454	14,556	22,457	360	8,089	33,335	11,253	9,401
1985	411,993	59,595	160,338	13,778	80,249	14,434	22,168	364	7,909	33,403	10,709	9,046
1986	436,896	63,976	172,539	13,966	84,878	14,768	22,214	378	8,754	33,888	11,292	10,243
1987	465,503	69,204	185,368	14,897	91,104	14,984	22,710	410	9,113	34,595	11,581	11,537
1988	472,965	72,217	191,021	14,950	91,578	14,875	22,033	406	8,949	34,210	11,499	11,227
1989	476,786	74,214	190,611	15,899	91,792	15,631	21,629	411	9,181	33,828	11,795	11,795
1990	492,340	76,115	196,659	16,940	95,401	16,527	21,651	222	9,218	34,946	12,230	12,431
1991	521,899	80,870	211,627	17,454	101,533	16,311	22,622	209	9,765	34,889	13,222	13,397
1992	541,604	86,813	219,150	18,313	104,316	16,607	22,561	216	10,115	35,532	13,672	14,309
1993	554,973	89,677	224,012	19,077	107,564	16,781	23,399	213	9,848	35,646	14,121	14,635
1994	560,815	90,864	227,216	19,679	107,276	16,846	24,053	222	10,130	35,412	14,862	14,255
1995	568,576	91,447	229,642	19,849	111,209	16,831	25,685	224	10,071	35,035	15,338	13,245
1996	579,148	96,338	234,420	19,878	111,712	16,779	26,232	211	10,349	34,627	15,395	13,207
1997	586,688	98,060	238,343	20,355	112,168	16,580	27,065	215	10,423	34,308	15,297	13,874
1998	590,743	99,243	238,357	20,669	112,817	16,570	28,506	210	10,616	32,629	15,131	15,995
1999	589,559	99,381	237,402	21,042	110,007	16,198	29,820	201	10,720	32,387	15,720	16,681
2000	599,655	98,407	241,275	20,795	107,566	16,147	31,573	174	11,473	32,086	17,395	22,764
2001	603,953	99,782	239,630	20,936	108,207	16,206	32,642	167	12,869	32,299	17,377	23,838
2002	609,337	99,666	239,733	20,883	106,295	16,334	34,919	174	13,720	33,493	18,029	26,091
2003	604,785	98,988	232,878	20,570	103,544	16,190	37,176	175	14,620	34,618	18,265	27,761

Source: MEXT, Report on ‘School Basic Survey’

Table 5-2-5: Trends in the ratio of female students to the total number of university enrollments

(unit: persons)

FY	Total	Humanities	Social science	Science	Engineering	agriculture	Health science	Mercantile marine	Home economics	Education	Art	Others
1980	95,079	32,991	13,627	2,208	1,602	1,918	7,747	5	7,910	16,696	6,699	3,676
1981	95,922	33,040	13,774	2,362	1,758	1,988	8,058	3	7,824	17,011	6,873	3,231
1982	97,272	33,754	13,808	2,531	2,065	2,089	8,141	14	7,960	16,806	6,832	3,272
1983	102,880	36,051	14,998	2,628	2,339	2,203	8,755	16	8,197	17,466	7,167	3,060
1984	103,770	36,286	16,046	2,599	2,399	2,242	8,822	21	8,032	17,271	7,219	2,833
1985	104,033	36,724	15,941	2,587	2,419	2,199	8,920	12	7,850	17,796	6,780	2,805
1986	113,119	40,471	18,387	2,696	2,555	2,359	9,282	11	8,691	18,135	7,231	3,301
1987	124,514	45,226	22,175	2,760	2,756	2,556	9,894	23	8,987	18,978	7,438	3,721
1988	132,008	48,556	26,629	2,893	3,244	2,974	9,441	14	8,815	18,724	7,478	3,240
1989	138,722	49,664	30,021	3,135	3,782	3,551	9,579	19	9,055	18,311	7,760	3,845
1990	148,646	51,712	33,924	3,339	4,852	4,051	9,965	12	9,082	19,322	8,215	4,172
1991	160,665	54,664	38,165	3,647	6,196	4,693	10,832	14	9,607	19,402	8,869	4,576
1992	172,608	58,190	42,759	4,103	7,195	5,311	11,006	12	9,896	20,044	9,114	4,978
1993	183,522	60,520	46,546	4,591	8,314	5,996	12,233	14	9,606	20,984	9,419	5,299
1994	190,709	61,520	50,601	5,126	8,922	6,148	13,042	15	9,795	20,584	9,921	5,035
1995	198,485	62,149	54,313	5,207	9,845	6,551	14,449	19	9,686	20,798	10,278	5,190
1996	207,874	65,598	58,161	5,264	10,882	6,721	14,860	14	9,993	20,523	10,579	5,279
1997	213,031	66,608	61,034	5,460	11,260	6,602	15,432	35	10,035	20,157	10,565	5,843
1998	217,608	67,388	63,668	5,417	11,515	6,510	16,469	22	10,194	19,171	10,588	6,666
1999	221,480	67,285	65,558	5,478	11,311	6,643	17,528	20	10,170	19,401	11,027	7,059
2000	232,501	65,998	71,502	5,521	11,309	6,703	18,965	21	10,786	19,581	11,946	10,169
2001	241,249	68,172	74,194	5,586	12,101	6,608	19,990	11	12,033	19,825	11,979	10,750
2002	248,653	68,411	75,934	5,700	11,844	6,895	21,485	10	12,906	21,077	12,578	11,813
2003	246,800	67,471	73,107	5,538	11,343	6,614	22,451	17	13,544	21,664	12,750	12,301

Source: MEXT, Report on ‘School Basic Survey’

Table 5-2-6: Career paths of university graduates

(A) Science

(unit: persons)

Year	Graduates	Enrolled in graduate schools	Unemployed	Others	Clinical interns	Employed
1968	6,033	1,218	309	169	0	4,337
1969	6,838	1,274	439	238	0	4,887
1970	7,209	1,380	537	276	0	5,016
1971	7,935	1,162	701	222	0	5,850
1972	9,084	1,479	1,048	451	0	6,106
1973	8,764	1,338	1,134	499	0	5,793
1974	9,053	1,394	682	564	0	6,413
1975	9,504	1,576	1,069	451	0	6,408
1976	10,012	1,803	1,392	670	0	6,147
1977	10,234	1,701	1,344	712	0	6,477
1978	10,688	1,785	1,584	557	0	6,762
1979	11,077	1,875	1,704	527	0	6,971
1980	11,554	1,941	1,427	596	0	7,590
1981	11,803	2,008	1,421	536	0	7,838
1982	11,755	2,164	1,361	553	0	7,677
1983	11,723	2,194	1,348	334	0	7,847
1984	12,234	2,279	1,315	336	0	8,304
1985	12,698	2,445	1,105	382	0	8,766
1986	12,814	2,613	950	400	0	8,851
1987	13,389	2,817	962	349	0	9,261
1988	13,388	3,007	863	259	0	9,259
1989	13,295	3,124	593	309	0	9,269
1990	13,420	3,325	561	282	0	9,252
1991	14,217	3,654	587	315	0	9,661
1992	14,176	3,950	617	272	0	9,337
1993	14,976	4,635	847	415	0	9,079
1994	16,034	5,511	1,224	623	0	8,676
1995	16,973	5,805	1,710	815	0	8,643
1996	18,028	6,236	2,005	749	0	9,038
1997	18,489	6,118	2,103	761	0	9,507
1998	18,695	6,285	1,947	783	0	9,680
1999	18,568	6,750	2,406	726	0	8,686
2000	18,241	6,923	2,896	795	0	7,627
2001	19,157	7,256	2,885	629	0	8,387
2002	19,369	7,405	3,156	478	0	8,330
2003	19,549	7,876	3,274	631	0	7,768

(B) Engineering

(unit: persons)

Year	Graduates	Enrolled in graduate schools	Unemployed	Others	Clinical interns	Employed
1968	38,352	3,761	316	626	0	33,649
1969	43,414	4,359	437	1,174	0	37,444
1970	48,481	4,806	647	1,045	0	41,983
1971	55,850	4,352	873	866	0	49,759
1972	59,698	5,229	1,140	1,814	0	51,515
1973	62,961	5,877	1,439	2,650	0	52,995
1974	62,953	5,602	1,044	2,362	0	53,945
1975	65,422	6,614	2,263	2,311	0	54,234
1976	67,036	7,433	3,515	2,768	0	53,320
1977	69,221	7,270	3,297	1,997	0	56,657
1978	71,167	6,998	3,179	2,375	0	58,615
1979	74,128	6,945	2,442	2,320	0	62,421
1980	73,508	7,213	2,025	2,139	0	62,131
1981	75,188	7,597	2,056	1,896	0	63,639
1982	73,593	8,249	1,610	1,353	0	62,381
1983	69,620	8,327	1,716	1,357	0	58,220
1984	70,486	9,225	1,630	1,237	0	58,394
1985	71,396	9,905	1,381	894	0	59,216
1986	73,316	10,507	1,402	1,128	0	60,279
1987	75,843	11,431	1,553	976	0	61,883
1988	76,362	12,314	1,341	885	0	61,822
1989	75,678	12,484	1,122	816	0	61,256
1990	80,136	13,466	1,057	597	0	65,016
1991	86,115	15,466	979	771	0	68,899
1992	87,404	17,139	1,185	815	0	68,265
1993	87,463	19,256	1,707	1,065	0	65,435
1994	90,286	21,842	3,153	1,341	0	63,950
1995	96,373	22,708	4,654	2,217	0	66,794
1996	99,428	23,845	6,071	1,655	0	67,857
1997	101,940	23,769	6,056	1,671	0	70,444
1998	101,526	24,602	6,431	1,916	0	68,577
1999	102,431	26,647	10,754	2,052	0	62,978
2000	103,156	28,602	14,319	2,219	0	58,016
2001	103,513	28,508	13,192	1,788	0	60,025
2002	103,682	29,260	14,580	1,429	0	58,413
2003	101,401	30,182	16,044	1,676	0	53,499

(C) Agriculture

(unit: persons)

Year	Graduates	Enrolled in graduate schools	Unemployed	Others	Clinical interns	Employed
1968	8,047	878	306	341	0	6,522
1969	8,478	920	505	356	0	6,697
1970	9,072	1,074	350	577	0	7,071
1971	11,135	1,120	528	546	0	8,941
1972	11,884	1,351	911	497	0	9,125
1973	11,283	1,172	879	633	0	8,599
1974	11,950	1,146	780	660	0	9,364
1975	11,757	1,270	976	1,239	0	8,272
1976	12,213	1,430	2,063	446	0	8,274
1977	13,104	1,326	1,968	499	0	9,311
1978	13,636	1,258	2,366	555	0	9,457
1979	14,075	1,198	1,408	1,220	0	10,249
1980	13,861	1,199	1,325	379	0	10,958
1981	14,260	1,348	1,274	422	0	11,216
1982	13,599	1,932	1,026	422	0	10,219
1983	13,267	2,094	1,111	459	0	9,603
1984	13,699	2,340	1,033	494	0	9,832
1985	13,449	2,349	1,094	402	0	9,604
1986	13,518	2,461	1,033	348	0	9,676
1987	13,867	2,686	1,037	298	0	9,846
1988	13,161	1,728	926	237	0	10,270
1989	12,886	1,838	631	278	0	10,139
1990	14,297	2,016	496	350	0	11,435
1991	14,854	2,282	747	257	0	11,568
1992	14,544	2,557	685	333	0	10,969
1993	15,229	2,928	959	446	1	10,895
1994	15,812	3,237	1,487	507	0	10,581
1995	15,989	3,297	1,912	547	0	10,233
1996	16,193	3,366	2,142	567	0	10,118
1997	16,344	3,245	2,013	878	0	10,208
1998	16,683	3,343	2,431	515	0	10,394
1999	16,551	3,699	3,069	385	0	9,398
2000	16,562	3,879	3,410	312	0	8,961
2001	16,285	3,928	2,915	288	0	9,154
2002	16,393	4,100	3,132	184	0	8,977
2003	15,933	4,160	3,259	271	0	8,243

(D) Health sciences

(unit: persons)

Year	Graduates	Enrolled in graduate schools	Unemployed	Others	Clinical interns	Employed
1968	8,388	615	498	129	2,723	4,423
1969	9,353	791	2,287	158	1,284	4,833
1970	10,141	782	1,615	523	1,801	5,420
1971	11,313	933	1,466	602	2,120	6,192
1972	12,431	1,040	1,609	889	2,695	6,198
1973	12,628	994	1,962	606	2,685	6,381
1974	12,781	1,025	1,934	795	2,764	6,263
1975	12,898	1,042	2,259	663	2,624	6,310
1976	14,063	1,257	2,601	807	2,906	6,492
1977	15,289	1,318	2,645	753	3,748	6,825
1978	16,618	1,393	2,782	803	4,308	7,332
1979	18,161	1,633	2,819	853	4,887	7,969
1980	18,478	1,528	2,701	591	5,296	8,362
1981	19,797	1,637	2,912	656	5,755	8,837
1982	19,651	1,672	2,697	809	5,537	8,936
1983	19,986	1,855	2,658	653	5,862	8,958
1984	20,408	1,988	2,326	607	6,932	8,555
1985	20,546	1,912	2,462	560	6,920	8,692
1986	20,673	2,103	2,645	597	6,907	8,421
1987	21,399	2,193	2,435	570	7,179	9,022
1988	21,723	2,173	2,873	421	7,025	9,231
1989	21,339	2,233	2,661	306	7,100	9,039
1990	22,132	2,211	2,562	250	7,307	9,802
1991	22,044	2,230	2,578	437	7,249	9,550
1992	21,391	2,459	2,560	404	7,029	8,939
1993	21,767	2,529	2,563	534	7,053	9,088
1994	22,043	2,739	3,008	651	6,978	8,667
1995	22,784	2,837	3,251	862	6,732	9,102
1996	22,523	3,018	3,509	542	6,716	8,738
1997	23,571	2,988	3,866	670	6,851	9,196
1998	23,768	3,053	3,810	637	6,632	9,636
1999	25,291	3,211	4,653	406	6,450	10,571
2000	25,924	3,396	5,046	351	5,929	11,202
2001	26,337	3,482	3,980	373	6,628	11,874
2002	28,664	3,781	4,219	384	6,979	13,301
2003	30,479	4,118	3,267	307	8,184	14,603

(E) Natural science (science + engineering+ agriculture + health sciences)

(unit: persons)

Year	Graduates	Enrolled in graduate schools	Unemployed	Others	Clinical interns	Employed
1968	60,820	6,472	1,429	1,265	2,723	48,931
1969	68,083	7,344	3,668	1,926	1,284	53,861
1970	74,903	8,042	3,149	2,421	1,801	59,490
1971	86,233	7,567	3,568	2,236	2,120	70,742
1972	93,097	9,099	4,708	3,651	2,695	72,944
1973	95,636	9,381	5,414	4,388	2,685	73,768
1974	96,737	9,167	4,440	4,381	2,764	75,985
1975	99,581	10,502	6,567	4,664	2,624	75,224
1976	103,324	11,923	9,571	4,691	2,906	74,233
1977	107,848	11,615	9,254	3,961	3,748	79,270
1978	112,109	11,434	9,911	4,290	4,308	82,166
1979	117,441	11,651	8,373	4,920	4,887	87,610
1980	117,401	11,881	7,478	3,705	5,296	89,041
1981	121,048	12,590	7,663	3,510	5,755	91,530
1982	118,598	14,017	6,694	3,137	5,537	89,213
1983	114,596	14,470	6,833	2,803	5,862	84,628
1984	116,827	15,832	6,304	2,674	6,932	85,085
1985	118,089	16,611	6,042	2,238	6,920	86,278
1986	120,321	17,684	6,030	2,473	6,907	87,227
1987	124,498	19,127	5,987	2,193	7,179	90,012
1988	124,634	19,222	6,003	1,802	7,025	90,582
1989	123,198	19,679	5,007	1,709	7,100	89,703
1990	129,985	21,018	4,676	1,479	7,307	95,505
1991	137,230	23,632	4,891	1,780	7,249	99,678
1992	137,515	26,105	5,047	1,824	7,029	97,510
1993	139,435	29,348	6,076	2,460	7,054	94,497
1994	144,175	33,329	8,872	3,122	6,978	91,874
1995	152,119	34,647	11,527	4,441	6,732	94,772
1996	156,172	36,465	13,727	3,513	6,716	95,751
1997	160,344	36,120	14,038	3,980	6,851	99,355
1998	160,672	37,283	14,619	3,851	6,632	98,287
1999	162,841	40,307	20,882	3,569	6,450	91,633
2000	163,883	42,800	25,671	3,677	5,929	85,806
2001	165,292	43,174	22,972	3,078	6,628	89,440
2002	168,108	44,546	25,087	2,475	6,979	89,021
2003	167,362	46,336	25,844	2,885	8,184	84,113

Note: 1) 'Employed' includes person who continues education while being employed.
2) In this table, 'unemployed' includes 'persons with a temporary job.'
Source: MEXT, Report on 'School Basic Survey'

Table 5-2-7: Trends in employment rate of university graduates by industry

(A) Science

(unit: persons)

Year	Employed (1968-2002)													Total
	Agricultre, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade, eating and drinking places	Finance and insurance	Real estate	Transport and communications	Electricity, gas, water	Services		Government, n.e.c.	Others	
											Imformation-related, etc.			
1968	2	30	64	2,067	297	76	3	65	14	1,314	182	147	258	4,337
1969	12	32	87	2,448	353	122	13	87	26	1,352	251	155	200	4,887
1970	2	45	107	2,924	307	126	0	71	17	1,172	185	183	62	5,016
1971	28	28	107	3,494	335	170	2	67	41	1,291	325	252	35	5,850
1972	4	54	137	2,915	347	259	1	95	12	1,492	311	404	165	5,885
1973	6	33	202	2,427	418	213	14	113	19	1,743	390	387	218	5,793
1974	8	32	166	2,757	424	323	15	108	24	1,994	585	473	89	6,413
1975	6	18	103	2,346	537	349	10	121	33	2,314	660	465	106	6,408
1976	11	23	129	1,836	658	323	11	53	32	2,514	560	376	181	6,147
1977	4	14	94	2,020	699	282	30	70	28	2,675	679	372	189	6,477
1978	4	26	146	1,839	695	268	11	89	42	2,968	850	541	133	6,762
1979	13	18	137	2,120	510	190	14	71	23	3,002	828	655	218	6,971
1980	42	5	172	2,165	586	172	10	76	29	3,569	919	623	141	7,590
1981	28	33	228	2,563	539	169	3	44	21	3,390	1,146	668	152	7,838
1982	4	72	174	2,997	514	152	4	45	20	3,247	1,274	334	114	7,677
1983	16	56	134	3,056	307	143	8	64	30	3,417	1,274	422	194	7,847
1984	20	24	124	2,903	497	200	8	97	7	3,862	1,669	468	94	8,304
1985	4	33	90	3,440	271	172	7	65	11	4,153	1,905	448	72	8,766
1986	8	17	71	3,557	296	236	4	133	45	3,938	1,928	446	100	8,851
1987	18	44	78	3,610	346	250	6	141	30	4,326	2,368	321	91	9,261
1988	29	22	133	3,083	338	380	13	291	77	4,397	2,621	377	118	9,258
1989	4	11	115	3,831	364	488	21	229	34	3,613	2,187	505	53	9,268
1990	15	18	114	4,022	326	586	14	309	48	3,146	1,923	397	258	9,253
1991	4	19	109	4,302	299	534	44	338	33	3,427	2,184	346	207	9,662
1992	27	17	148	4,467	259	377	26	272	30	3,126	2,200	476	111	9,336
1993	22	30	187	3,904	447	332	4	205	46	3,359	2,268	473	71	9,080
1994	5	14	307	3,057	856	535	24	188	48	2,967	2,119	481	194	8,676
1995	11	3	324	2,658	1,026	486	34	274	39	3,151	2,277	416	221	8,643
1996	20	6	296	2,437	1,136	492	54	316	20	3,601	2,708	431	229	9,038
1997	17	4	254	2,385	1,069	506	40	313	29	4,232	3,337	429	229	9,507
1998	10	10	192	2,539	1,008	450	33	318	25	4,521	3,749	366	208	9,680
1999	12	8	123	2,198	812	404	21	290	21	4,103	3,443	359	335	8,686
2000	20	0	95	1,662	771	370	13	223	19	3,870	3,220	335	249	7,627
2001	27	3	134	1,977	908	332	26	185	18	4,073	3,358	399	305	8,387
2002	24	2	104	1,874	882	380	47	187	17	4,298	3,548	386	129	8,330

(unit: persons)

Year	Employed (after 2003)													Total
	Agricultre, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade	Finance and insurance	Real estate	Transport	Electricity, gas, water	Service-related[1]		Government, n.e.c	Others	
											Information and communications			
2003	16	2	99	1,518	851	328	43	77	21	4,256	2,267	383	174	7,768

(B) Engineering

(unit: persons)

Year	Employed (1968-2002)													Total
	Agricultre, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade, eating and drinking places	Finance and insurance	Real estate	Transport and communications	Electricity, gas, water	Services	Imformation-related, etc.	Government, n.e.c.	Others	
1968	16	137	5,955	20,759	1,722	106	167	989	355	1,370	621	1,097	976	33,649
1969	41	134	6,672	22,906	2,170	143	144	856	352	1,373	647	1,163	1,490	37,444
1970	1	218	6,612	28,782	1,911	218	98	833	618	1,002	389	1,414	276	41,983
1971	112	84	10,226	31,104	1,797	265	143	1,378	528	1,704	1,196	2,032	386	49,759
1972	67	234	12,488	27,773	2,539	312	204	1,218	695	1,737	1,055	2,990	877	51,134
1973	16	175	13,025	27,875	2,584	348	327	1,426	691	2,739	1,741	3,097	692	52,995
1974	58	125	13,210	27,547	3,068	380	253	1,054	768	3,007	1,873	3,363	1,112	53,945
1975	27	201	11,609	27,848	4,210	641	220	1,308	635	3,487	2,712	3,266	782	54,234
1976	25	233	10,641	27,834	3,824	641	224	1,485	822	3,867	2,433	2,280	1,444	53,320
1977	115	178	10,366	30,295	3,993	725	255	1,107	700	4,249	3,045	3,348	1,326	56,657
1978	138	251	11,098	30,528	3,841	612	242	1,402	777	4,610	3,071	4,042	1,074	58,615
1979	150	144	12,625	27,828	6,798	566	248	1,824	858	5,438	4,271	4,862	1,080	62,421
1980	78	213	12,178	31,473	5,322	457	101	1,322	717	5,521	4,121	4,207	542	62,131
1981	85	217	12,069	35,254	3,745	255	317	1,299	667	5,706	4,509	3,589	436	63,639
1982	79	295	12,302	35,717	2,925	221	254	1,110	698	5,493	4,601	2,955	332	62,381
1983	66	157	11,077	33,477	2,752	260	213	605	778	5,600	4,770	2,822	413	58,220
1984	61	193	10,225	33,176	2,888	323	333	600	530	7,180	6,398	2,552	333	58,394
1985	43	247	9,352	35,373	2,058	454	216	740	728	6,887	5,881	2,762	356	59,216
1986	18	263	9,109	35,916	2,108	367	246	859	612	8,150	7,086	2,283	348	60,279
1987	64	166	9,252	36,197	2,269	586	284	1,070	688	8,592	7,713	2,369	346	61,883
1988	48	65	9,897	32,829	2,820	1,193	253	1,531	803	9,375	8,611	2,778	229	61,821
1989	40	110	9,783	33,077	2,455	1,017	309	1,760	758	8,931	8,028	2,799	218	61,257
1990	24	140	9,913	36,535	2,330	1,480	317	1,642	783	8,606	7,898	2,910	335	65,015
1991	9	103	10,493	38,429	2,067	1,409	422	2,012	950	9,642	8,984	3,000	365	68,901
1992	46	158	11,086	37,281	2,281	916	313	1,929	968	9,518	8,885	3,338	430	68,264
1993	37	133	12,185	34,125	2,502	638	174	1,451	970	9,254	8,554	3,533	432	65,434
1994	44	75	14,566	28,357	4,072	847	266	1,423	770	9,392	8,628	3,073	1,065	63,950
1995	69	56	15,223	26,998	5,383	1,003	480	1,646	622	10,974	10,020	2,856	1,484	66,794
1996	51	58	15,156	25,773	5,948	1,003	453	1,674	510	13,328	12,393	2,722	1,181	67,857
1997	50	66	15,075	25,943	6,050	805	479	1,876	488	15,940	15,151	2,522	1,150	70,444
1998	60	81	13,295	26,904	5,531	661	477	1,650	430	16,379	15,595	2,044	1,065	68,577
1999	48	37	10,881	23,491	4,920	725	502	1,389	358	17,359	16,577	1,894	1,374	62,978
2000	69	34	10,023	19,880	4,892	701	532	1,359	340	17,016	16,176	1,736	1,434	58,016
2001	66	31	9,419	20,730	5,182	637	704	1,162	271	18,356	17,557	1,708	1,759	60,025
2002	65	18	8,835	19,149	5,026	688	647	1,237	278	19,189	18,358	1,791	1,490	58,413

(unit: persons)

Year	Employed (after 2003)													Total
	Agricultre, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade	Finance and insurance	Real estate	Transport	Electricity, gas, water	Service-related[1)]	Information and communications	Government, n.e.c	Others	
2003	72	22	7,383	15,978	5,004	616	828	659	282	19,737	9,767	1,924	994	53,499

(C) Agriculture

(unit: persons)

Year	Employed (1968-2002)													Total
	Agricultre, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade, eating and drinking places	Finance and insurance	Real estate	Transport and communications	Electricity, gas, water	Services	Imformation-related, etc.	Government, n.e.c.	Others	
1968	717	7	375	2,144	612	95	28	61	8	1,233	385	965	277	6,522
1969	797	0	350	2,045	708	42	19	49	9	1,206	453	991	481	6,697
1970	476	0	473	2,606	672	114	35	47	1	1,168	543	1,381	93	7,066
1971	982	8	566	3,118	949	196	81	115	15	1,272	404	1,556	83	8,941
1972	828	2	607	3,130	855	140	65	51	6	1,378	454	1,838	206	9,106
1973	795	22	483	2,877	774	162	93	98	15	1,487	475	1,692	101	8,599
1974	820	4	668	2,829	968	213	82	94	5	1,611	668	1,882	188	9,364
1975	673	42	620	2,632	956	173	58	59	17	1,475	586	1,370	197	8,272
1976	860	8	568	2,545	1,227	167	42	90	6	1,734	667	823	204	8,274
1977	985	8	692	2,713	1,593	213	57	71	7	1,739	758	1,088	145	9,311
1978	1,089	2	498	2,583	1,558	150	45	119	7	1,876	954	1,418	112	9,457
1979	1,132	0	596	2,569	1,229	120	14	84	7	2,241	1,185	1,982	275	10,249
1980	1,006	8	756	2,807	1,376	123	32	79	30	2,105	918	2,564	72	10,958
1981	984	18	656	2,953	1,372	197	29	80	28	2,363	1,277	2,456	80	11,216
1982	787	10	676	3,058	1,185	157	11	42	4	2,042	1,242	2,157	90	10,219
1983	975	8	678	2,977	929	113	24	58	16	1,808	1,033	1,896	121	9,603
1984	1,021	4	555	2,886	1,037	163	16	76	20	1,904	1,012	2,018	132	9,832
1985	816	4	406	2,884	804	130	12	132	66	2,001	1,216	2,240	109	9,604
1986	608	8	426	3,130	802	131	23	70	15	2,084	1,307	2,316	63	9,676
1987	569	3	372	3,172	923	218	19	89	15	2,022	1,353	2,373	71	9,846
1988	509	4	505	3,221	950	248	58	144	27	1,961	1,434	2,546	97	10,270
1989	397	10	444	3,351	1,041	260	97	100	13	1,897	1,357	2,475	53	10,138
1990	418	6	499	4,002	1,034	426	47	158	12	2,310	1,761	2,458	67	11,437
1991	453	6	523	4,097	1,027	337	71	181	3	2,411	1,839	2,417	42	11,568
1992	464	3	539	3,918	907	240	39	179	3	2,370	1,916	2,215	92	10,969
1993	553	3	514	3,628	1,055	244	39	146	17	2,431	1,824	2,145	120	10,895
1994	560	4	721	3,152	1,492	310	47	125	26	2,335	1,636	1,682	127	10,581
1995	551	1	700	2,861	1,536	341	44	114	13	2,330	1,699	1,517	225	10,233
1996	566	5	703	2,761	1,640	285	45	118	12	2,471	1,767	1,296	216	10,118
1997	532	2	795	2,699	1,748	269	54	129	10	2,473	1,870	1,276	221	10,208
1998	499	4	655	2,899	1,882	296	49	183	16	2,627	2,024	1,081	203	10,394
1999	495	4	502	2,578	1,821	310	37	123	14	2,383	1,783	966	165	9,398
2000	525	1	431	2,423	1,720	304	45	144	17	2,368	1,730	842	141	8,961
2001	532	4	417	2,592	1,762	293	47	109	12	2,348	1,638	821	217	9,154
2002	463	3	324	2,429	1,724	250	74	158	16	2,530	1,903	768	238	8,977

(unit: persons)

Year	Employed (after 2003)													Total
	Agricultre, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade	Finance and insurance	Real estate	Transport	Electricity, gas, water	Service-related[1]	Information and communications	Government, n.e.c	Others	
2003	456	0	281	2,095	1,405	217	67	82	12	2,699	302	717	212	8,243

(D) Health sciences

(unit: persons)

Year	Employed (1968-2002)													Total
	Agricultre, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade, eating and drinking places	Finance and insurance	Real estate	Transport and communications	Electricity, gas, water	Services		Government, n.e.c.	Others	
											Imformation-related, etc.			
1968	0	0	0	1,253	460	4	0	1	2	2,572	29	78	53	4,423
1969	0	0	1	1,335	438	4	0	0	0	2,861	49	138	56	4,833
1970	0	0	0	2,196	319	2	0	6	0	2,651	7	230	16	5,420
1971	3	0	6	2,350	586	9	1	1	8	2,846	18	363	19	6,192
1972	0	0	19	1,981	547	3	3	0	3	3,053	19	305	27	5,941
1973	0	0	20	1,584	486	16	8	3	0	3,708	36	420	136	6,381
1974	2	0	0	1,936	425	13	0	11	7	3,346	17	399	124	6,263
1975	0	1	6	1,606	376	16	0	1	2	3,997	37	245	60	6,310
1976	0	0	2	1,364	375	8	0	0	2	4,488	24	151	102	6,492
1977	0	0	0	1,424	528	13	0	2	2	4,585	21	194	77	6,825
1978	0	0	4	1,465	552	22	0	0	2	4,917	31	223	147	7,332
1979	0	0	0	1,348	590	8	3	24	0	5,768	43	203	25	7,969
1980	0	0	0	1,845	571	0	0	11	0	5,594	25	256	85	8,362
1981	4	0	9	2,037	620	29	0	0	0	5,975	5	114	49	8,837
1982	0	0	0	2,359	660	5	0	10	5	5,528	61	305	64	8,936
1983	0	0	0	2,300	617	6	0	0	0	5,769	35	231	35	8,958
1984	0	0	15	2,286	665	0	0	0	0	5,348	73	187	54	8,555
1985	0	5	10	2,248	742	0	0	0	24	5,433	82	200	30	8,692
1986	0	0	0	2,229	672	26	0	5	0	5,237	72	215	37	8,421
1987	0	0	0	2,323	925	33	0	10	5	5,393	57	275	58	9,022
1988	5	5	0	2,858	866	11	0	6	11	5,059	92	337	74	9,232
1989	5	5	9	2,805	843	32	0	9	14	5,010	86	245	64	9,041
1990	0	4	9	3,537	742	73	0	4	5	5,151	211	259	18	9,802
1991	5	0	27	3,565	807	41	0	9	5	4,668	219	391	32	9,550
1992	0	0	4	3,418	759	31	0	9	0	4,336	85	340	40	8,937
1993	5	0	14	2,995	767	23	0	5	0	4,958	142	312	9	9,088
1994	0	0	6	2,408	1,042	17	2	4	2	4,734	116	280	172	8,667
1995	4	0	7	1,905	1,363	41	3	4	1	5,450	140	247	77	9,102
1996	2	0	8	1,563	1,328	22	2	8	0	5,516	133	228	61	8,738
1997	4	5	6	1,516	1,263	21	6	12	2	6,084	196	227	50	9,196
1998	1	0	11	1,449	1,420	19	10	6	0	6,291	200	395	34	9,636
1999	4	0	2	1,154	1,541	18	3	7	3	7,390	232	423	26	10,571
2000	0	0	6	1,075	1,742	12	1	4	1	8,155	246	181	25	11,202
2001	3	4	6	1,081	1,598	14	4	11	1	8,558	214	295	299	11,874
2002	3	0	3	1,038	1,471	20	3	11	0	10,320	265	319	113	13,301

(unit: persons)

Year	Employed (after 2003)													Total
	Agricultre, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade	Finance and insurance	Real estate	Transport	Electricity, gas, water	Service-related[1]		Government, n.e.c	Others	
											Information and communications			
2003	1	0	4	867	2,058	22	9	5	0	11,395	32	203	39	14,603

(E) Natural science (science + engineering + agriculture + health sciences)

(unit: persons)

Year	Employed (1968-2002)													Total
	Agricultre, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade, eating and drinking places	Finance and insurance	Real estate	Transport and communications	Electricity, gas, water	Services	Imformation-related, etc.	Government, n.e.c.	Others	
1968	735	174	6,394	26,223	3,091	281	198	1,116	379	6,489	1,217	2,287	1,564	48,931
1969	850	166	7,110	28,734	3,669	311	176	992	387	6,792	1,400	2,447	2,227	53,861
1970	479	263	7,192	36,508	3,209	460	133	957	636	5,993	1,124	3,208	447	59,485
1971	1,125	120	10,905	40,066	3,667	640	227	1,561	592	7,113	1,943	4,203	523	70,742
1972	899	290	13,251	35,799	4,288	714	273	1,364	716	7,660	1,839	5,537	1,275	72,066
1973	817	230	13,730	34,763	4,262	739	442	1,640	725	9,677	2,642	5,596	1,147	73,768
1974	888	161	14,044	35,069	4,885	929	350	1,267	804	9,958	3,143	6,117	1,513	75,985
1975	706	262	12,338	34,432	6,079	1,179	288	1,489	687	11,273	3,995	5,346	1,145	75,224
1976	896	264	11,340	33,579	6,084	1,139	277	1,628	862	12,603	3,684	3,630	1,931	74,233
1977	1,104	200	11,152	36,452	6,813	1,233	342	1,250	737	13,248	4,503	5,002	1,737	79,270
1978	1,231	279	11,746	36,415	6,646	1,052	298	1,610	828	14,371	4,906	6,224	1,466	82,166
1979	1,295	162	13,358	33,865	9,127	884	279	2,003	888	16,449	6,327	7,702	1,598	87,610
1980	1,126	226	13,106	38,290	7,855	752	143	1,488	776	16,789	5,983	7,650	840	89,041
1981	1,101	268	12,962	42,807	6,276	650	349	1,423	716	17,434	6,937	6,827	717	91,530
1982	870	377	13,152	44,131	5,284	535	269	1,207	727	16,310	7,178	5,751	600	89,213
1983	1,057	221	11,889	41,810	4,605	522	245	727	824	16,594	7,112	5,371	763	84,628
1984	1,102	221	10,919	41,251	5,087	686	357	773	557	18,294	9,152	5,225	613	85,085
1985	863	289	9,858	43,945	3,875	756	235	937	829	18,474	9,084	5,650	567	86,278
1986	634	288	9,606	44,832	3,878	760	273	1,067	672	19,409	10,393	5,260	548	87,227
1987	651	213	9,702	45,302	4,463	1,087	309	1,310	738	20,333	11,491	5,338	566	90,012
1988	591	96	10,535	41,991	4,974	1,832	324	1,972	918	20,792	12,758	6,038	518	90,581
1989	446	136	10,351	43,064	4,703	1,797	427	2,098	819	19,451	11,658	6,024	388	89,704
1990	457	168	10,535	48,096	4,432	2,565	378	2,113	848	19,213	11,793	6,024	678	95,507
1991	471	128	11,152	50,393	4,200	2,321	537	2,540	991	20,148	13,226	6,154	646	99,681
1992	537	178	11,777	49,084	4,206	1,564	378	2,389	1,001	19,350	13,086	6,369	673	97,506
1993	617	166	12,900	44,652	4,771	1,237	217	1,807	1,033	20,002	12,788	6,463	632	94,497
1994	609	93	15,600	36,974	7,462	1,709	339	1,740	846	19,428	12,499	5,516	1,558	91,874
1995	635	60	16,254	34,422	9,308	1,871	561	2,038	675	21,905	14,136	5,036	2,007	94,772
1996	639	69	16,163	32,534	10,052	1,802	554	2,116	542	24,916	17,001	4,677	1,687	95,751
1997	603	77	16,130	32,543	10,130	1,601	579	2,330	529	28,729	20,554	4,454	1,650	99,355
1998	570	95	14,153	33,791	9,841	1,426	569	2,157	471	29,818	21,568	3,886	1,510	98,287
1999	559	49	11,508	29,421	9,094	1,457	563	1,809	396	31,235	22,035	3,642	1,900	91,633
2000	614	35	10,555	25,040	9,125	1,387	591	1,730	377	31,409	21,372	3,094	1,849	85,806
2001	628	42	9,976	26,380	9,450	1,276	781	1,467	302	33,335	22,767	3,223	2,580	89,440
2002	555	23	9,266	24,490	9,103	1,338	771	1,593	311	36,337	24,074	3,264	1,970	89,021

(unit: persons)

Year	Employed (after 2003)													Total
	Agricultre, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade	Finance and insurance	Real estate	Transport	Electricity, gas, water	Service-related[1]	Information and communications	Government, n.e.c	Others	
2003	545	24	7,767	20,458	9,318	1,183	947	823	315	38,087	12,368	3,227	1,419	84,113

Note: 1) 'Service-related' includes 'information and communications,' 'eating and drinking places/accommodations', 'medical, health care and welfare', 'education, learning support', 'compound services', 'services, n.e.c.' among the major groups after the 11th revision of the Japan standard Industrial Classification (revised in March, 2002, applied from October 1, 2002).

2) As the 'Employed' in the previously shown Table 5-2-6 is the number selected from each department, classified by industry, and expanded to the total number of persons employed, it may differ from the total itemized number of persons employed in this table.

Source: MEXT, Report on 'School Basic Survey'

Table 5-2-8: Trends in employment rate of university graduates by occupation

(A) Science

(unit: persons)

Year	Employed														Total
	Professional and technical workers					Managers and officials	Clerical and related workers	Sales workers	Service workers	Protective service workers	Agricultural, forestry and fisheries workers	Workers in transport and communications occupations	Production process workers and laborers	Others	
		Scientific researchers	Engineers and technicians	Professors and teachers	Public health and medical workers										
1968	3,372	207	2,113	946	22	12	391	247	35	13	1	19	4	243	4,337
1969	3,954	211	2,632	925	73	21	394	172	41	35	3	22	44	201	4,887
1970	4,224	369	2,856	824	33	49	356	282	20	13	0	13	11	48	5,016
1971	4,985	331	3,579	845	15	81	415	242	75	12	0	4	18	18	5,850
1972	4,531	276	3,025	1,123	42	72	689	341	43	8	0	20	70	110	5,884
1973	4,122	175	2,674	1,124	43	65	812	414	73	25	4	14	100	164	5,793
1974	4,854	339	3,184	1,232	37	149	822	329	124	27	2	18	14	74	6,413
1975	4,522	290	2,673	1,455	58	31	1,136	424	51	61	6	10	80	87	6,408
1976	4,062	330	1,898	1,683	81	18	909	790	44	72	2	8	104	138	6,147
1977	4,270	207	2,230	1,695	78	36	1,099	827	20	81	4	6	8	126	6,477
1978	4,091	278	1,812	1,865	68	10	1,388	960	54	95	2	8	32	122	6,762
1979	4,671	362	2,272	1,826	79	45	1,028	776	59	108	0	8	67	209	6,971
1980	5,119	325	2,299	2,352	95	5	1,142	999	89	49	15	9	10	153	7,590
1981	5,617	253	3,231	2,029	36	43	1,027	895	93	50	4	31	43	35	7,838
1982	5,863	189	3,759	1,830	59	5	720	808	168	62	4	4	13	30	7,677
1983	6,276	301	3,919	1,885	53	24	639	625	38	42	13	23	14	153	7,847
1984	6,586	208	4,281	1,991	55	12	882	593	56	31	4	12	8	120	8,304
1985	7,382	71	5,040	2,092	35	10	741	330	102	28	0	15	0	158	8,766
1986	7,098	97	5,029	1,862	40	10	903	418	122	40	0	33	18	209	8,851
1987	7,884	245	5,663	1,849	6	17	458	628	65	20	4	18	77	90	9,261
1988	7,224	174	5,262	1,692	40	28	856	556	94	49	13	30	17	390	9,257
1989	6,938	135	5,442	1,291	38	29	1,224	589	90	29	7	66	0	298	9,270
1990	6,900	296	5,402	1,149	10	21	1,243	470	126	29	0	51	11	400	9,251
1991	7,498	173	6,114	1,113	47	11	1,292	502	100	11	0	80	4	163	9,661
1992	7,213	353	6,055	760	20	8	1,320	350	240	23	4	51	4	125	9,338
1993	7,040	176	5,917	877	23	15	1,403	384	94	23	4	31	4	82	9,080
1994	5,751	151	4,841	635	47	17	1,667	560	191	48	4	30	1	407	8,676
1995	5,430	133	4,493	646	42	43	1,601	793	275	54	0	17	9	421	8,643
1996	5,345	81	4,443	642	15	32	1,995	918	230	61	2	57	6	392	9,038
1997	5,674	73	4,748	675	21	21	2,080	901	342	84	3	51	12	339	9,507
1998	6,076	92	5,291	542	40	15	1,919	845	314	76	1	52	28	354	9,680
1999	5,504	57	4,834	457	30	18	1,794	677	237	83	4	45	15	309	8,686
2000	4,734	34	4,082	434	49	21	1,499	663	224	83	10	27	8	358	7,627
2001	5,135	49	4,447	486	38	29	1,651	784	249	113	14	28	8	376	8,387
2002	4,989	59	4,170	519	37	25	1,734	949	279	104	9	31	10	200	8,330
2003	4,616	56	3,750	568	73	28	1,368	1,007	283	122	6	31	10	297	7,768

(B) Engineering

(unit: persons)

Year	Employed: Professional and technical workers	Scientific researchers	Engineers and technicians	Professors and teachers	Public health and medical workers	Managers and officials	Clerical and related workers	Sales workers	Service workers	Protective service workers	Agricultural, forestry and fisheries workers	Workers in transport and communications occupations	Production process workers and laborers	Others	Total
1968	30,281	62	29,598	542	8	114	508	996	288	91	5	266	78	1,022	33,649
1969	32,369	89	31,597	538	15	459	620	1,533	346	136	14	307	221	1,439	37,444
1970	38,716	264	37,709	631	45	410	441	1,561	86	1	0	223	433	112	41,983
1971	46,192	283	45,028	419	31	654	667	887	283	107	0	232	618	119	49,759
1972	44,272	393	43,112	547	22	524	1,011	1,878	200	197	0	356	2,090	605	51,133
1973	46,576	248	45,170	621	61	547	1,551	1,961	434	238	0	400	816	472	52,995
1974	46,582	459	44,947	637	20	729	1,606	2,690	475	180	18	262	725	678	53,945
1975	45,612	244	44,625	632	18	348	2,110	2,966	252	478	0	324	1,638	506	54,234
1976	43,932	327	42,381	1,008	28	489	2,009	3,589	346	428	13	389	697	1,428	53,320
1977	46,910	296	45,425	927	69	338	2,131	4,298	519	356	12	343	721	1,029	56,657
1978	47,640	236	45,971	1,185	56	331	2,548	4,652	669	697	0	452	966	660	58,615
1979	46,794	291	45,564	812	47	239	3,366	7,311	719	727	18	521	1,709	1,017	62,421
1980	49,847	131	48,445	1,091	42	305	3,696	5,466	563	520	68	382	808	476	62,131
1981	54,180	142	53,012	876	41	219	2,662	4,205	292	410	38	185	786	662	63,639
1982	54,494	134	53,488	577	55	102	2,258	3,353	611	244	27	253	619	420	62,381
1983	51,724	271	50,560	616	16	141	1,513	2,794	553	293	25	223	455	499	58,220
1984	52,309	76	51,348	628	21	53	1,677	2,896	350	209	17	183	245	455	58,394
1985	52,785	61	51,698	847	12	183	1,625	2,618	614	212	21	246	490	422	59,216
1986	54,746	33	53,553	850	51	123	1,581	1,939	654	189	12	257	321	457	60,279
1987	56,672	58	55,531	765	52	165	1,256	2,378	395	216	33	271	60	437	61,883
1988	54,374	760	52,604	671	30	336	2,516	2,652	604	230	0	432	294	383	61,821
1989	55,760	262	54,519	662	36	400	1,683	1,818	556	189	9	394	93	354	61,256
1990	59,471	245	58,387	522	17	343	1,919	1,905	427	85	4	320	241	299	65,014
1991	63,251	188	62,361	396	18	270	2,591	1,276	508	102	0	372	191	337	68,898
1992	61,721	414	60,548	445	0	84	2,319	1,557	1,069	177	8	541	247	542	68,265
1993	59,497	542	58,205	382	24	199	2,546	1,569	598	186	8	306	199	327	65,435
1994	54,575	227	53,578	357	26	157	2,753	2,710	1,164	134	10	376	301	1,770	63,950
1995	55,706	170	54,801	360	33	194	2,510	3,998	1,409	210	14	505	439	1,809	66,794
1996	55,718	214	54,720	338	29	206	3,022	4,673	1,650	248	24	406	237	1,673	67,857
1997	58,301	200	57,259	299	41	90	2,938	4,596	1,733	318	24	519	210	1,715	70,444
1998	56,402	383	55,114	255	49	89	3,292	4,245	2,053	241	15	579	180	1,481	68,577
1999	51,497	297	50,474	258	22	133	2,862	3,853	2,159	281	26	464	193	1,510	62,978
2000	46,473	375	45,461	239	38	153	2,918	4,022	1,843	326	42	400	127	1,712	58,016
2001	47,115	267	46,111	216	52	76	3,288	4,744	1,978	372	26	360	172	1,894	60,025
2002	45,262	272	44,147	281	57	104	3,157	4,963	1,873	465	39	391	311	1,848	58,413
2003	40,107	246	38,892	304	83	93	2,700	5,451	2,050	656	34	432	476	1,500	53,499

(C) Agriculture

(unit: persons)

Year	Employed														Total
	Professional and technical workers					Managers and officials	Sales workers	Service workers	Service workers	Protective service workers	Agricultural, forestry and fisheries workers	Workers in transport and communications occupations	Production process workers and laborers	Others	
		Scientific researchers	Engineers and technicians	Professors and teachers	Public health and medical workers										
1968	4,387	336	3,239	371	368	52	841	696	54	19	144	41	37	251	6,522
1969	4,430	172	3,489	289	389	30	636	784	70	27	176	14	39	491	6,697
1970	4,759	299	3,848	208	327	42	969	1,120	55	9	39	3	41	34	7,071
1971	5,535	413	4,406	256	383	93	1,299	1,425	102	28	341	36	42	40	8,941
1972	6,092	291	5,012	305	391	58	1,197	1,209	65	24	209	27	27	202	9,110
1973	5,560	368	4,312	346	197	172	1,150	1,030	73	68	206	32	145	163	8,599
1974	5,265	307	4,212	313	286	47	1,923	1,332	100	58	313	19	126	181	9,364
1975	4,609	340	3,462	309	96	39	1,651	1,314	35	60	236	10	171	147	8,272
1976	4,087	242	2,860	404	251	55	1,262	1,832	68	69	429	25	229	218	8,274
1977	4,391	318	3,112	462	207	83	1,657	2,126	45	111	512	11	186	189	9,311
1978	4,164	130	3,107	354	210	79	1,744	2,438	38	115	614	10	132	123	9,457
1979	5,466	253	3,846	423	47	77	1,840	1,768	56	70	550	21	84	317	10,249
1980	5,994	525	4,566	439	171	36	2,263	1,820	51	79	415	17	131	152	10,958
1981	5,758	297	4,428	406	212	4	2,736	1,892	93	65	448	16	132	72	11,216
1982	5,815	382	4,889	413	77	21	2,024	1,703	93	64	361	12	106	20	10,219
1983	5,444	164	4,785	350	81	56	1,695	1,486	160	117	437	8	167	33	9,603
1984	5,444	244	4,543	452	20	68	1,739	1,724	136	79	427	4	170	41	9,832
1985	5,690	199	4,821	540	55	51	1,813	1,342	100	64	368	24	103	49	9,604
1986	6,196	243	5,372	510	56	12	1,513	1,387	94	44	276	19	43	92	9,676
1987	6,111	281	5,178	439	34	24	1,560	1,522	124	61	243	28	65	108	9,846
1988	5,980	201	5,318	353	58	62	2,132	1,417	120	58	252	39	66	144	10,270
1989	6,206	220	5,576	307	43	10	1,904	1,438	150	37	184	17	30	163	10,139
1990	7,602	344	6,358	265	603	26	1,908	1,504	128	41	90	35	9	90	11,433
1991	7,137	397	5,771	289	643	28	2,321	1,578	122	25	155	23	8	170	11,567
1992	6,822	378	5,576	226	606	45	1,987	1,454	226	48	173	28	25	162	10,970
1993	7,092	299	5,779	241	716	105	1,838	1,359	104	68	150	40	11	128	10,895
1994	5,679	379	4,072	306	757	163	2,155	1,847	192	51	250	26	42	176	10,581
1995	5,187	197	3,787	256	747	28	2,135	1,932	300	62	272	12	80	225	10,233
1996	5,022	130	3,678	275	836	45	2,064	1,927	290	64	350	23	88	245	10,118
1997	5,041	112	3,766	221	823	39	1,887	1,900	346	100	246	33	74	542	10,208
1998	4,967	145	3,696	181	849	26	2,180	1,903	473	79	235	51	52	428	10,394
1999	4,372	128	3,219	161	763	59	2,088	1,740	326	78	254	24	50	407	9,398
2000	4,139	182	2,923	163	781	48	1,880	1,796	269	80	268	14	51	416	8,961
2001	4,078	110	2,967	193	719	81	1,806	1,968	387	99	318	14	30	373	9,154
2002	3,891	120	2,686	128	826	134	1,790	1,820	421	114	254	21	57	475	8,977
2003	3,579	103	2,367	171	796	79	1,570	1,831	405	111	294	6	42	326	8,243

(D) Health sciences

(unit: persons)

Year	Employed														Total
	Professional and technical workers					Managers and officials	Sales workers	Service workers	Service workers	Protective service workers	Agricultural, forestry and fisheries workers	Workers in transport and communications occupations	Production process workers and laborers	Others	
		Scientific researchers	Engineers and technicians	Professors and teachers	Public health and medical workers										
1968	4,075	220	1,053	444	2,347	24	18	259	17	0	0	0	0	30	4,423
1969	4,375	104	1,105	382	2,764	42	49	258	51	0	0	0	0	58	4,833
1970	4,693	285	1,214	335	2,832	6	51	638	1	6	0	0	0	25	5,420
1971	5,717	492	949	391	3,856	8	78	361	0	0	3	1	14	10	6,192
1972	5,385	291	868	485	3,702	3	155	356	9	0	4	3	1	23	5,939
1973	5,890	195	708	464	4,514	4	103	260	7	4	0	0	3	110	6,381
1974	5,878	256	702	459	4,351	5	62	182	17	4	1	6	1	107	6,263
1975	6,012	278	578	830	4,323	3	72	184	6	0	0	1	3	29	6,310
1976	6,097	253	571	497	4,775	18	91	160	2	2	0	0	0	122	6,492
1977	6,284	343	601	585	4,693	12	122	336	2	2	0	0	2	65	6,825
1978	6,710	277	704	454	5,271	12	117	326	6	8	0	0	0	153	7,332
1979	7,506	404	377	625	6,088	8	138	292	5	0	0	3	0	17	7,969
1980	7,955	224	884	357	6,464	0	118	218	17	0	0	0	4	50	8,362
1981	8,451	295	969	558	6,605	5	99	240	4	5	0	0	5	28	8,837
1982	8,233	255	1,228	449	6,296	15	90	543	13	5	0	4	0	33	8,936
1983	8,317	185	1,186	295	6,623	0	109	467	32	0	4	0	0	29	8,958
1984	7,793	293	1,162	258	6,067	18	150	522	9	4	0	0	5	54	8,555
1985	8,145	365	905	244	6,610	0	141	361	10	0	0	0	0	35	8,692
1986	7,836	331	975	237	6,283	11	144	348	32	0	0	0	0	50	8,421
1987	8,324	261	1,207	565	6,236	4	146	430	20	6	0	0	0	92	9,022
1988	8,556	353	1,209	245	6,709	11	190	337	33	5	0	5	5	91	9,233
1989	8,302	403	1,010	286	6,513	0	245	401	9	14	0	0	9	59	9,039
1990	8,823	575	1,197	256	6,736	0	394	544	0	4	0	0	5	32	9,802
1991	8,525	570	1,316	223	6,387	14	322	603	9	5	0	0	9	64	9,551
1992	8,080	390	1,167	204	6,242	0	233	581	0	13	0	0	0	31	8,938
1993	8,240	317	1,075	204	6,593	5	422	389	0	5	0	5	0	23	9,089
1994	7,734	203	640	210	6,653	5	300	404	27	9	0	3	0	185	8,667
1995	8,030	163	623	183	6,757	2	379	442	127	13	1	0	3	105	9,102
1996	8,053	128	470	137	7,139	1	236	345	26	11	1	0	6	59	8,738
1997	8,417	82	576	143	7,297	10	291	355	41	12	3	5	1	61	9,196
1998	8,847	41	466	148	7,805	2	323	326	36	4	1	0	1	96	9,636
1999	9,792	50	431	124	9,068	10	286	322	63	4	0	1	2	91	10,571
2000	10,414	62	416	126	9,644	2	266	420	52	6	4	0	4	34	11,202
2001	10,718	40	460	151	9,854	0	435	354	71	15	0	2	6	273	11,874
2002	12,349	25	369	180	11,373	16	414	377	70	15	1	2	3	54	13,301
2003	13,677	26	347	202	12,544	5	388	403	67	19	1	1	1	41	14,603

(E) Natural science (science + engineering + agriculture + health sciences)

(unit: persons)

Year	Breakdown of persons employed														Total
	Specialized/technical professionals					Managers and officials	Clerical and related workers	Sales workers	Service workers	Protective service workers	Agricultural, forestry and fisheries workers	Workers in transport and communications occupations	Production process workers and laborers	Others	
		Scientific researchers	Engineers	Professors and teachers	Public health and medical workers										
1968	42,115	825	36,003	2,303	2,745	202	1,758	2,198	394	123	150	326	119	1,546	48,931
1969	45,128	576	38,823	2,134	3,241	552	1,699	2,747	508	198	193	343	304	2,189	53,861
1970	52,392	1,217	45,627	1,998	3,237	507	1,817	3,601	162	29	39	239	485	219	59,490
1971	62,429	1,519	53,962	1,911	4,285	836	2,459	2,915	460	147	344	273	692	187	70,742
1972	60,280	1,251	52,017	2,460	4,157	657	3,052	3,784	317	229	213	406	2,188	940	72,066
1973	62,148	986	52,864	2,555	4,815	788	3,616	3,665	587	335	210	446	1,064	909	73,768
1974	62,579	1,361	53,045	2,641	4,694	930	4,413	4,533	716	269	334	305	866	1,040	75,985
1975	60,755	1,152	51,338	3,226	4,495	421	4,969	4,888	344	599	242	345	1,892	769	75,224
1976	58,178	1,152	47,710	3,592	5,135	580	4,271	6,371	460	571	444	422	1,030	1,906	74,233
1977	61,855	1,164	51,368	3,669	5,047	469	5,009	7,587	586	550	528	360	917	1,409	79,270
1978	62,605	921	51,594	3,858	5,605	432	5,797	8,376	767	915	616	470	1,130	1,058	82,166
1979	64,437	1,310	52,059	3,686	6,261	369	6,372	10,147	839	905	568	553	1,860	1,560	87,610
1980	68,915	1,205	56,194	4,239	6,772	346	7,219	8,503	720	648	498	408	953	831	89,041
1981	74,006	987	61,640	3,869	6,894	271	6,524	7,232	482	530	490	232	966	797	91,530
1982	74,405	960	63,364	3,269	6,487	143	5,092	6,407	885	375	392	273	738	503	89,213
1983	71,761	921	60,450	3,146	6,773	221	3,956	5,372	783	452	479	254	636	714	84,628
1984	72,132	821	61,334	3,329	6,163	151	4,448	5,735	551	323	448	199	428	670	85,085
1985	74,002	696	62,464	3,723	6,712	244	4,320	4,651	826	304	389	285	593	664	86,278
1986	75,876	704	64,929	3,459	6,430	156	4,141	4,092	902	273	288	309	382	808	87,227
1987	78,991	845	67,579	3,618	6,328	210	3,420	4,958	604	303	280	317	202	727	90,012
1988	76,134	1,488	64,393	2,961	6,837	437	5,694	4,962	851	342	265	506	382	1,008	90,581
1989	77,206	1,020	66,547	2,546	6,630	439	5,056	4,246	805	269	200	477	132	874	89,704
1990	82,796	1,460	71,344	2,192	7,366	390	5,464	4,423	681	159	94	406	266	821	95,500
1991	86,411	1,328	75,562	2,021	7,095	323	6,526	3,959	739	143	155	475	212	734	99,677
1992	83,836	1,535	73,346	1,635	6,868	137	5,859	3,942	1,535	261	185	620	276	860	97,511
1993	81,869	1,334	70,976	1,704	7,356	324	6,209	3,701	796	282	162	382	214	560	94,499
1994	73,739	960	63,131	1,508	7,483	342	6,875	5,521	1,574	242	264	435	344	2,538	91,874
1995	74,353	663	63,704	1,445	7,579	267	6,625	7,165	2,111	339	287	534	531	2,560	94,772
1996	74,138	553	63,311	1,392	8,019	284	7,317	7,863	2,196	384	377	486	337	2,369	95,751
1997	77,433	467	66,349	1,338	8,182	160	7,196	7,752	2,462	514	276	608	297	2,657	99,355
1998	76,292	661	64,567	1,126	8,743	132	7,714	7,319	2,876	400	252	682	261	2,359	98,287
1999	71,165	532	58,958	1,000	9,883	220	7,030	6,592	2,785	446	284	534	260	2,317	91,633
2000	65,760	653	52,882	962	10,512	224	6,563	6,901	2,388	495	324	441	190	2,520	85,806
2001	67,046	466	53,985	1,046	10,663	186	7,180	7,850	2,685	599	358	404	216	2,916	89,440
2002	66,491	476	51,372	1,108	12,293	279	7,095	8,109	2,643	698	303	445	381	2,577	89,021
2003	61,979	431	45,356	1,245	13,496	205	6,026	8,692	2,805	908	335	470	529	2,164	84,113

Notes: As the ‘number of persons employed’ in the previously shown Table 5-2-6 is the number selected from each department, classified by occupation, and expanded to the total number of persons employed, it may differ from the total itemized number of persons employed in this table.
Source: MEXT, Report on ‘School Basic Survey’

Table 5-3-1: Trends in the number of enrollments by major (master's courses)

(A) Trends in the number of enrollments in master's courses of graduate schools

(unit: persons)

FY	Total	Humanities	Social sciences	Science	Engineering	Agriculture	Health science	Mercantile marine	Home economics	Education	Art	Others
1968	10,974	1,811	1,662	1,401	4,180	869	378	-	88	367	218	-
1969	11,999	1,894	1,740	1,489	4,661	985	440	-	106	420	264	-
1970	12,357	1,913	1,768	1,408	5,071	1,033	463	-	95	348	258	-
1971	13,129	2,160	1,876	1,344	5,286	1,155	476	-	101	420	311	-
1972	14,723	2,228	2,021	1,536	6,243	1,316	512	-	124	427	316	-
1973	14,457	2,182	1,966	1,449	6,180	1,214	500	-	122	482	362	-
1974	14,448	2,197	1,861	1,494	6,133	1,217	492	-	122	511	421	-
1975	15,770	2,171	1,808	1,642	7,096	1,393	528	20	137	535	440	-
1976	16,941	2,144	1,916	1,736	7,875	1,546	547	26	99	583	469	-
1977	16,687	2,059	1,848	1,766	7,650	1,414	602	34	115	617	507	75
1978	16,258	1,989	1,814	1,760	7,379	1,360	576	24	137	620	490	109
1979	16,187	2,031	1,658	1,798	7,174	1,290	733	22	123	723	499	136
1980	16,844	2,036	1,573	1,858	7,572	1,257	774	21	127	948	528	150
1981	17,857	2,151	1,621	1,922	7,902	1,419	838	14	137	1,125	578	150
1982	19,717	2,129	1,758	2,050	8,585	2,168	884	14	118	1,273	591	147
1983	20,549	2,143	1,806	2,124	8,870	2,349	937	33	120	1,441	568	158
1984	22,201	2,125	1,857	2,174	9,884	2,469	1,016	25	153	1,728	603	167
1985	23,594	2,220	1,982	2,357	10,687	2,442	1,045	23	140	1,888	604	206
1986	25,164	2,327	2,094	2,557	11,422	2,610	1,107	22	172	1,965	650	238
1987	26,644	2,315	2,271	2,775	12,275	2,855	1,169	36	163	1,964	608	213
1988	27,342	2,380	2,401	2,968	13,109	1,904	1,232	49	170	2,225	663	241
1989	28,177	2,337	2,553	3,125	13,459	1,929	1,333	44	191	2,283	671	252
1990	30,733	2,400	2,927	3,291	14,697	2,104	1,376	55	206	2,684	713	280
1991	34,927	2,692	3,457	3,614	16,741	2,433	1,500	64	233	2,978	730	485
1992	38,709	3,046	3,849	3,935	18,471	2,701	1,742	71	255	3,173	765	701
1993	44,401	3,458	4,463	4,668	20,942	3,102	1,880	89	254	3,668	932	945
1994	50,852	3,832	5,505	5,274	23,463	3,332	2,073	24	351	4,170	1,054	1,778
1995	53,842	4,230	6,112	5,669	24,339	3,366	2,193	26	384	4,555	1,043	1,925
1996	56,567	4,414	6,466	6,014	25,454	3,502	2,426	19	396	4,780	1,076	2,020
1997	57,065	4,526	7,014	5,881	25,350	3,379	2,500	16	443	4,655	1,198	2,103
1998	60,241	4,716	8,068	5,971	26,095	3,491	2,728	18	443	4,741	1,284	2,686
1999	65,382	5,039	8,946	6,270	28,145	3,767	3,048	11	472	4,925	1,307	3,452
2000	70,336	5,251	10,039	6,285	30,031	3,938	3,424	15	486	5,212	1,437	4,218
2001	72,561	5,481	10,357	6,273	30,003	3,877	4,146	12	463	5,541	1,513	4,895
2002	73,636	5,320	9,726	6,675	30,352	3,980	4,566	18	477	5,395	1,669	5,458
2003	75,698	5,382	9,510	6,864	31,424	4,030	5,075	12	485	5,255	1,851	5,810

(B) Number of enrollment in professional degree courses of graduate schools

(unit: persons)

FY	Total	Humanities	Social sciences	Science	Engineering	Agriculture	Health science	Mercantile marine	Home economics	Education	Art	Others
2003	572	0	486	0	0	0	43	-	0	0	0	43

Source: MEXT, Report on 'School Basic Survey'

Table 5-3-2: Trends in the number of enrollments by major (doctorate courses)

(unit: persons)

FY	Total	Humanities	Social sciences	Science	Engineering	Agriculture	Health science	Home economics	Education	Art	Others
1968	3,773	525	430	689	793	272	939	-	122	3	-
1969	3,513	558	457	741	763	264	640	-	86	4	-
1970	3,336	485	506	725	678	285	533	-	118	6	-
1971	3,791	595	548	746	753	282	728	2	135	2	-
1972	3,979	602	601	743	747	290	865	3	121	7	-
1973	4,076	676	536	766	726	317	901	8	144	2	-
1974	4,182	708	575	735	740	299	962	7	151	5	-
1975	4,158	715	539	625	761	276	1,066	14	158	4	-
1976	4,466	684	569	745	774	297	1,233	9	150	5	-
1977	4,539	714	537	725	800	297	1,324	10	116	14	2
1978	4,623	670	540	716	737	340	1,474	7	127	8	4
1979	4,845	736	573	666	686	313	1,706	4	131	19	11
1980	4,669	723	492	657	638	294	1,696	12	123	15	19
1981	4,753	757	496	622	625	272	1,800	10	128	22	21
1982	4,914	726	511	623	635	293	1,945	17	120	17	27
1983	5,322	802	513	646	650	287	2,236	13	132	20	23
1984	5,749	808	558	695	715	328	2,445	13	143	13	31
1985	5,877	803	538	689	832	358	2,448	16	138	18	37
1986	6,645	829	552	701	1,089	417	2,820	12	148	19	58
1987	6,848	837	557	845	1,062	402	2,906	13	141	21	64
1988	7,170	900	559	802	1,244	495	2,899	18	145	26	82
1989	7,478	899	607	929	1,258	502	2,973	27	153	31	99
1990	7,813	917	606	929	1,399	580	3,076	21	165	24	96
1991	8,505	930	642	1,021	1,715	675	3,206	16	160	28	112
1992	9,481	1,066	742	1,076	2,010	775	3,395	25	193	23	176
1993	10,681	1,047	813	1,317	2,410	844	3,660	37	207	32	314
1994	11,852	1,142	868	1,399	2,711	912	4,056	46	206	37	475
1995	13,074	1,266	1,000	1,614	3,082	1,017	4,184	50	231	61	569
1996	14,345	1,398	1,225	1,697	3,248	987	4,490	54	329	59	858
1997	14,683	1,503	1,333	1,686	3,238	1,110	4,482	64	338	63	866
1998	15,491	1,593	1,371	1,736	3,229	1,102	4,799	97	348	69	1,147
1999	16,276	1,602	1,514	1,786	3,310	1,143	5,189	78	347	71	1,236
2000	17,023	1,710	1,581	1,764	3,402	1,192	5,339	61	373	117	1,484
2001	17,128	1,663	1,562	1,608	3,399	1,160	5,395	75	377	128	1,761
2002	17,234	1,587	1,681	1,630	3,274	1,112	5,561	68	374	153	1,794
2003	18,232	1,648	1,700	1,650	3,571	1,092	6,001	88	429	183	1,870

Source: MEXT, Report on 'School Basic Survey'

Table 5-3-3: Trends in advancement rate to graduate schools

(unit: %)

Year	Science		Engineering	
	From undergraduate to master's courses	From master's to doctorate courses	From undergraduate to master's courses	From master's to doctorate courses
1968	20.2	52.9	9.8	19.5
1969	18.6	57.0	10.0	18.3
1970	19.1	54.5	9.9	16.1
1971	14.6	52.1	7.8	14.8
1972	16.3	52.4	8.8	14.2
1973	15.3	51.4	9.3	12.6
1974	15.4	47.4	8.9	11.3
1975	16.6	44.8	10.1	11.3
1976	18.0	53.4	11.1	12.5
1977	16.6	48.0	10.5	10.4
1978	16.7	43.7	9.8	8.5
1979	16.9	39.7	9.4	8.6
1980	16.8	38.3	9.8	7.8
1981	17.0	36.3	10.1	8.1
1982	18.4	35.6	11.2	7.8
1983	18.7	34.4	12.0	7.4
1984	18.6	34.5	13.1	7.3
1985	19.3	30.7	13.9	8.3
1986	20.4	32.4	14.3	9.3
1987	21.0	34.0	15.1	8.4
1988	22.5	31.6	16.1	8.9
1989	23.5	30.9	16.5	8.2
1990	24.8	29.7	16.8	8.1
1991	25.7	31.1	18.0	8.9
1992	27.9	30.9	19.6	8.8
1993	30.9	33.2	22.0	9.4
1994	34.4	34.4	24.2	9.6
1995	34.2	33.3	23.6	9.7
1996	34.6	31.8	24.0	9.5
1997	33.1	29.0	23.3	8.6
1998	33.6	28.3	24.2	8.6
1999	36.4	29.0	26.0	8.8
2000	38.0	29.3	27.7	9.6
2001	37.9	26.0	27.5	8.5
2002	38.2	24.6	28.2	8.0
2003	40.3	25.4	29.8	8.7

Note: ‘From undergraduate to master’s courses’ was calculated using the figures of Table 5-2-6, and ‘from master’s to doctor’s courses’ was calculated using the figures of Table 5-3-4.
Source: MEST, Report on ‘School Basic Survey’

Table 5-3-4: Trends in employment rate of graduates in master's courses by industry

(A) Science

(uniti: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1968	1,288	681	47	22	538
1969	1,281	730	46	33	472
1970	1,302	710	60	28	504
1971	1,389	723	92	30	544
1972	1,350	708	129	26	487
1973	1,455	748	110	73	524
1974	1,482	703	106	63	610
1975	1,382	619	97	42	624
1976	1,472	786	149	63	474
1977	1,594	765	136	46	647
1978	1,625	710	174	41	700
1979	1,666	661	150	66	789
1980	1,649	632	166	42	809
1981	1,665	605	144	46	870
1982	1,716	611	154	29	922
1983	1,813	624	159	25	1,005
1984	1,910	659	122	17	1,112
1985	1,992	612	150	22	1,208

(uniti: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1986	2,019	655	121	20	1,223
1987	2,213	753	124	30	1,306
1988	2,377	752	116	50	1,459
1989	2,598	802	107	63	1,626
1990	2,805	833	81	62	1,829
1991	2,913	907	108	48	1,850
1992	3,067	949	108	41	1,969
1993	3,327	1,104	141	82	2,000
1994	3,632	1,250	200	113	2,069
1995	4,264	1,420	380	86	2,378
1996	4,887	1,553	412	115	2,807
1997	5,267	1,529	396	146	3,196
1998	5,503	1,557	462	128	3,356
1999	5,251	1,525	534	128	3,064
2000	5,351	1,566	596	161	3,028
2001	5,633	1,463	597	144	3,429
2002	5,741	1,415	584	143	3,599
2003	5,722	1,456	662	123	3,481

(unit: persons)

Year	Employed (1968-2002)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade, eating and drinking places	Finance and insurance	Real estate	Transport and communications	Electricity, gas, water	Services	Information-related, etc.	Government, n.e.c.	Others
1968	1	5	5	207	2	0	0	3	0	281	8	13	21
1969	1	3	2	241	2	2	1	2	3	201	5	9	5
1970	0	5	2	278	2	4	1	3	0	184	11	20	5
1971	0	6	2	348	2	1	1	12	1	144	13	17	10
1972	0	9	4	295	2	1	0	8	0	129	16	29	10
1973	0	9	4	255	2	1	0	19	2	171	11	34	27
1974	0	9	5	349	3	2	0	8	3	178	14	40	13
1975	1	4	8	307	8	3	0	15	2	225	17	35	16
1976	1	6	8	188	3	3	0	15	4	191	11	31	24
1977	0	5	11	307	8	9	0	10	2	242	33	35	18
1978	1	9	2	328	6	3	0	14	7	263	44	48	19
1979	0	8	9	391	11	5	0	15	5	289	41	45	11
1980	0	3	5	438	7	3	1	20	3	276	38	44	9
1981	2	11	10	501	16	4	0	19	5	251	38	47	4
1982	0	22	10	631	6	3	0	17	2	195	46	29	7
1983	0	18	6	668	5	2	0	17	3	234	53	27	25
1984	0	21	8	725	8	2	1	24	3	272	69	38	10
1985	0	19	6	783	4	9	1	18	4	299	71	51	14
1986	0	15	5	823	6	8	0	20	4	280	84	50	12
1987	4	9	11	880	7	15	0	38	6	287	93	37	12
1988	4	6	8	914	7	37	1	74	5	306	116	72	25
1989	1	11	7	1,107	10	31	0	77	6	299	92	60	17
1990	3	19	19	1,237	8	48	0	83	12	284	106	71	45
1991	2	12	14	1,295	12	31	1	77	13	299	129	79	15
1992	3	11	14	1,365	6	31	0	64	23	318	126	97	37
1993	2	10	21	1,391	13	19	0	49	16	345	172	104	30
1994	1	11	25	1,291	24	13	0	62	13	455	212	123	51
1995	4	9	24	1,308	33	29	0	106	10	645	320	152	58
1996	3	6	49	1,409	46	49	1	163	17	842	459	162	60
1997	7	6	35	1,615	68	54	1	193	15	942	621	191	69
1998	2	9	43	1,804	56	75	2	153	8	984	640	133	87
1999	6	10	34	1,626	57	72	2	138	10	896	607	152	61
2000	7	8	28	1,399	71	87	0	127	10	1,077	762	142	72
2001	9	2	34	1,769	79	90	5	82	13	1,110	797	156	80
2002	9	7	30	1,885	71	90	3	103	19	1,141	876	174	67

(unit: persons)

Year	Employed (after 2003)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade	Finance and insurance	Real estate	Transport	Electricity, gas, water	Service-related[1)]	Information and communications	Government, n.e.c.	Others
2003	11	8	35	1,584	90	80	1	21	10	1,414	616	169	58

(B) Engineering

(uniti: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1968	3,918	764	54	120	2,980
1969	3,965	726	65	133	3,041
1970	3,891	626	86	103	3,076
1971	4,660	690	84	152	3,734
1972	4,915	698	95	117	4,005
1973	5,436	686	159	206	4,385
1974	6,090	687	116	164	5,123
1975	6,060	686	191	165	5,018
1976	5,799	726	434	160	4,479
1977	6,923	718	331	195	5,679
1978	7,640	653	344	216	6,427
1979	7,613	652	224	136	6,601
1980	7,135	559	177	105	6,294
1981	6,976	565	133	71	6,207
1982	7,363	574	127	82	6,580
1983	7,703	569	158	67	6,909
1984	8,311	609	134	37	7,531
1985	8,628	720	170	72	7,666

(uniti: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1986	9,620	892	149	92	8,487
1987	10,413	874	196	148	9,195
1988	11,129	995	178	132	9,824
1989	11,915	982	138	165	10,630
1990	12,774	1,041	149	179	11,405
1991	13,141	1,171	161	176	11,633
1992	14,351	1,266	181	300	12,604
1993	16,234	1,530	213	317	14,174
1994	17,978	1,718	348	377	15,535
1995	20,197	1,967	525	397	17,308
1996	22,622	2,139	658	328	19,497
1997	23,337	2,011	662	307	20,357
1998	24,421	2,101	674	368	21,278
1999	24,242	2,145	1,141	424	20,532
2000	24,762	2,367	1,491	353	20,551
2001	26,957	2,283	1,428	386	22,860
2002	28,538	2,281	1,617	353	24,287
2003	28,498	2,493	2,069	437	23,499

(unit: persons)

Year	Employed (1968-2002)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade, eating and drinking places	Finance and insurance	Real estate	Transport and communications	Electricity, gas, water	Services	Information-related, etc.	Government, n.e.c.	Others
1968	0	21	186	2,029	16	0	4	92	34	388	18	143	67
1969	0	12	223	2,065	12	8	6	115	46	348	25	171	35
1970	0	17	256	2,157	12	5	11	109	60	295	41	123	31
1971	1	15	308	2,696	7	3	15	143	67	244	37	146	89
1972	0	18	353	2,803	19	5	11	140	104	276	41	181	95
1973	1	21	436	2,885	26	9	7	183	111	397	65	203	106
1974	1	19	443	3,533	24	12	25	217	143	364	98	230	112
1975	0	28	390	3,537	29	10	15	224	112	343	76	227	103
1976	3	24	387	2,840	25	14	17	222	128	473	169	172	174
1977	1	24	485	3,821	40	24	19	222	160	559	203	236	88
1978	3	26	597	4,195	71	14	16	245	178	577	215	400	105
1979	2	41	626	4,369	54	15	13	258	181	509	200	429	104
1980	0	65	495	4,400	39	10	12	218	209	491	206	302	53
1981	1	36	505	4,515	12	7	12	177	175	415	181	278	74
1982	1	26	535	4,807	25	8	15	204	194	411	194	278	76
1983	0	44	600	5,034	32	14	10	164	203	407	201	294	107
1984	2	38	685	5,473	29	7	20	207	193	511	283	298	68
1985	0	47	623	5,608	57	16	26	218	245	501	254	291	34
1986	2	32	678	6,182	58	27	14	288	245	601	330	332	28
1987	4	27	706	6,536	72	72	23	362	338	656	360	362	37
1988	1	23	730	6,585	83	114	27	531	411	831	504	427	61
1989	3	38	685	7,260	71	174	38	672	387	757	464	424	121
1990	3	31	768	7,808	97	182	43	651	443	768	522	480	131
1991	0	43	790	8,201	71	126	30	548	403	873	604	451	97
1992	1	39	938	8,831	67	89	26	665	500	836	583	460	152
1993	4	46	1,128	10,029	72	58	34	574	582	992	708	525	130
1994	1	53	1,269	10,696	138	62	39	640	682	1,187	840	629	139
1995	4	34	1,548	11,040	177	74	35	963	705	1,692	1,293	749	287
1996	6	45	1,736	12,149	269	91	38	1,077	691	2,334	1,992	787	274
1997	6	40	1,741	12,850	252	87	31	1,140	625	2,534	2,180	779	272
1998	6	40	1,640	14,167	252	106	40	974	551	2,534	2,260	690	278
1999	8	38	1,369	13,580	225	129	51	964	547	2,726	2,384	660	235
2000	9	29	1,399	12,946	258	134	50	1,002	465	3,300	2,917	708	251
2001	10	34	1,552	14,518	338	180	68	897	433	3,762	3,411	710	358
2002	7	39	1,523	15,511	324	190	101	906	451	4,164	3,744	759	312

(unit: persons)

Year	Employed (after 2003)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade	Finance and insurance	Real estate	Transport	Electricity, gas, water	Service-related[1)]	Information and communications	Government, n.e.c.	Others
2003	20	24	1,354	14,504	352	167	90	348	468	5,245	2,857	734	193

(C) Agriculture

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1968	672	275	82	12	303
1969	720	258	73	16	373
1970	741	285	47	60	349
1971	832	280	86	14	452
1972	926	268	117	30	511
1973	1,131	328	121	64	618
1974	1,205	278	123	22	782
1975	1,116	262	163	38	653
1976	1,121	274	226	42	579
1977	1,297	297	261	33	706
1978	1,392	322	251	45	774
1979	1,266	287	212	39	728
1980	1,234	267	211	26	730
1981	1,156	261	154	31	710
1982	1,116	260	126	30	700
1983	1,263	255	159	41	808
1984	2,029	286	186	71	1,486
1985	2,180	300	211	43	1,626

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1986	2,300	346	178	95	1,681
1987	2,265	340	202	89	1,634
1988	2,436	406	190	61	1,779
1989	2,657	400	179	94	1,984
1990	1,735	379	81	37	1,238
1991	1,753	395	80	35	1,243
1992	1,909	418	99	22	1,370
1993	2,252	547	129	42	1,534
1994	2,479	590	211	83	1,595
1995	2,819	718	268	121	1,712
1996	2,985	700	352	114	1,819
1997	3,056	717	358	84	1,897
1998	3,175	731	478	63	1,903
1999	3,016	735	459	78	1,744
2000	3,168	808	483	55	1,822
2001	3,362	801	488	48	2,025
2002	3,515	756	499	88	2,172
2003	3,471	741	534	87	2,109

(unit: persons)

Year	Employed (1968-2002)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade, eating and drinking places	Finance and insurance	Real estate	Transport and communications	Electricity, gas, water	Services	Information-related, etc.	Government, n.e.c.	Others
1968	16	1	7	107	3	1	0	0	0	125	4	31	12
1969	5	0	4	119	4	0	0	1	0	160	12	67	13
1970	12	0	12	153	3	1	1	0	0	116	11	48	3
1971	16	0	11	189	6	3	0	0	0	131	17	73	23
1972	18	0	22	194	5	3	1	3	0	143	15	111	11
1973	27	1	17	222	9	2	2	3	0	174	18	149	12
1974	41	1	21	299	13	4	5	2	3	217	35	163	13
1975	25	3	18	272	14	2	0	1	1	181	17	126	10
1976	18	1	15	232	7	2	0	1	0	170	31	92	41
1977	29	0	38	288	19	3	1	0	0	211	28	110	7
1978	33	2	26	310	14	4	0	1	3	179	35	184	18
1979	33	1	14	258	23	1	0	3	2	191	47	182	20
1980	21	2	22	316	18	4	1	3	1	184	49	148	10
1981	16	0	16	321	11	5	0	4	0	194	39	119	24
1982	24	0	21	315	18	5	0	1	5	175	39	126	10
1983	28	0	23	393	5	1	1	0	2	180	41	159	16
1984	71	2	17	545	21	36	0	3	0	428	103	342	21
1985	42	2	10	549	18	19	0	0	2	593	352	377	14
1986	29	1	28	601	17	44	1	2	3	560	360	372	23
1987	36	2	24	573	17	27	0	1	4	569	432	368	13
1988	23	1	20	657	18	27	0	3	1	630	505	384	15
1989	30	1	27	797	34	31	4	7	5	557	414	446	45
1990	35	4	30	722	24	9	0	10	2	196	79	193	13
1991	26	1	40	743	21	6	3	8	5	182	74	197	11
1992	28	0	32	831	22	13	1	13	2	186	109	227	15
1993	43	2	48	842	29	4	3	7	9	223	108	307	17
1994	52	0	44	769	37	11	2	7	7	259	148	379	28
1995	68	0	66	817	48	4	2	9	2	317	170	351	28
1996	69	0	54	873	51	5	3	11	2	361	200	363	27
1997	61	0	81	882	57	13	1	14	2	377	226	361	48
1998	56	1	76	924	74	12	3	20	5	377	244	318	37
1999	64	1	61	834	74	11	2	18	3	361	225	280	35
2000	61	2	57	813	82	15	4	11	5	402	254	311	59
2001	62	0	60	929	110	14	3	28	6	498	308	292	23
2002	94	2	56	1,055	89	13	2	19	7	456	289	313	66

(unit: persons)

Year	Employed (after 2003)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade	Finance and insurance	Real estate	Transport	Electricity, gas, water	Service-related[1)]	Information and communications	Government, n.e.c.	Others
2003	82	0	40	986	107	15	5	6	5	520	90	312	31

(D) Health sciences

(uniti: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1968	323	111	10	1	201
1969	316	115	14	8	179
1970	354	92	27	11	224
1971	415	110	27	8	270
1972	462	120	28	9	305
1973	436	111	44	6	275
1974	483	129	38	7	309
1975	485	126	38	7	314
1976	486	165	53	5	263
1977	521	152	51	9	309
1978	522	147	38	8	329
1979	564	163	46	5	350
1980	572	150	54	13	355
1981	703	171	46	1	485
1982	734	180	45	7	502
1983	791	172	34	10	575
1984	839	175	48	5	611
1985	901	197	45	1	658

(uniti: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1986	981	200	39	12	730
1987	1,007	208	36	3	760
1988	1,062	197	34	16	815
1989	1,137	180	52	6	899
1990	1,187	197	40	5	945
1991	1,290	212	31	9	1,038
1992	1,328	236	54	21	1,017
1993	1,436	268	51	55	1,062
1994	1,709	306	101	58	1,244
1995	1,815	303	98	74	1,340
1996	1,959	396	133	108	1,322
1997	2,033	398	160	45	1,430
1998	2,285	447	171	45	1,622
1999	2,321	458	218	54	1,591
2000	2,544	523	259	48	1,714
2001	2,815	558	238	62	1,957
2002	3,116	630	243	54	2,189
2003	3,733	726	361	73	2,573

(unit: persons)

Year	Employed (1968-2002)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade, eating and drinking places	Finance and insurance	Real estate	Transport and communications	Electricity, gas, water	Services		Government, n.e.c.	Others
											Information-related, etc.		
1968	0	0	0	136	5	0	0	0	0	53	3	5	2
1969	0	0	0	116	2	0	0	0	0	57	0	4	0
1970	0	0	0	146	0	0	0	0	0	62	0	12	4
1971	0	0	0	181	2	0	0	0	0	75	4	6	6
1972	0	0	0	203	2	0	0	0	0	86	3	11	3
1973	0	0	0	184	5	0	0	0	0	65	1	21	0
1974	0	0	0	189	0	0	0	0	1	101	0	18	0
1975	2	1	0	179	0	2	0	0	0	110	0	12	8
1976	1	0	1	142	6	0	0	0	0	90	0	21	2
1977	0	0	0	169	10	0	0	0	0	118	3	10	2
1978	0	0	0	183	2	1	0	0	0	126	0	12	5
1979	0	0	0	210	4	0	0	0	0	113	6	10	13
1980	0	0	0	226	4	0	0	1	0	112	1	4	8
1981	0	0	0	326	7	0	0	0	0	140	3	11	1
1982	0	0	0	334	3	2	0	0	0	150	3	6	7
1983	0	0	0	414	6	1	0	0	0	143	3	9	2
1984	0	0	0	465	2	1	0	0	0	132	2	8	3
1985	0	0	0	505	11	0	1	0	1	117	3	18	5
1986	0	0	0	569	11	1	0	0	0	125	5	21	3
1987	0	0	0	610	13	1	0	0	0	110	10	25	1
1988	0	2	0	670	5	0	0	0	0	110	2	25	3
1989	0	0	0	705	11	2	0	0	1	133	4	33	14
1990	0	0	0	789	5	3	0	0	0	118	3	26	4
1991	0	0	0	860	6	0	0	0	0	135	9	36	1
1992	0	0	1	849	8	1	0	2	1	112	1	40	3
1993	0	0	0	816	12	3	0	0	1	174	9	54	2
1994	0	0	0	901	22	0	0	0	0	257	11	63	1
1995	1	0	1	867	28	3	0	0	0	359	16	69	12
1996	0	0	0	806	40	1	0	0	0	403	14	71	1
1997	0	0	1	802	56	1	0	1	0	477	22	86	6
1998	0	0	1	806	74	2	1	1	2	636	33	96	3
1999	1	0	0	713	74	0	0	4	0	692	30	90	17
2000	0	0	0	707	63	0	0	2	1	863	52	55	23
2001	0	0	1	781	79	1	0	2	0	1,020	61	63	10
2002	0	1	1	859	66	1	0	3	0	1,164	79	87	7

(unit: persons)

Year	Employed (after 2003)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade	Finance and insurance	Real estate	Transport	Electricity, gas, water	Service-related[1]		Government, n.e.c.	Others
											Information and communications		
2003	1	0	0	868	132	3	1	2	0	1,461	12	83	22

(E) Natural science (science + engineering + agriculture + health sciences)

(uniti: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1968	6,201	1,831	193	155	4,022
1969	6,282	1,829	198	190	4,065
1970	6,288	1,713	220	202	4,153
1971	7,296	1,803	289	204	5,000
1972	7,653	1,794	369	182	5,308
1973	8,458	1,873	434	349	5,802
1974	9,260	1,797	383	256	6,824
1975	9,043	1,693	489	252	6,609
1976	8,878	1,951	862	270	5,795
1977	10,335	1,932	779	283	7,341
1978	11,179	1,832	807	310	8,230
1979	11,109	1,763	632	246	8,468
1980	10,590	1,608	608	186	8,188
1981	10,500	1,602	477	149	8,272
1982	10,929	1,625	452	148	8,704
1983	11,570	1,620	510	143	9,297
1984	13,089	1,729	490	130	10,740
1985	13,701	1,829	576	138	11,158

(uniti: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1986	14,920	2,093	487	219	12,121
1987	15,898	2,175	558	270	12,895
1988	17,004	2,350	518	259	13,877
1989	18,307	2,364	476	328	15,139
1990	18,501	2,450	351	283	15,417
1991	19,097	2,685	380	268	15,764
1992	20,655	2,869	442	384	16,960
1993	23,249	3,449	534	496	18,770
1994	25,798	3,864	860	631	20,443
1995	29,095	4,408	1,271	678	22,738
1996	32,453	4,788	1,555	665	25,445
1997	33,693	4,655	1,576	582	26,880
1998	35,384	4,836	1,785	604	28,159
1999	34,830	4,863	2,352	684	26,931
2000	35,825	5,264	2,829	617	27,115
2001	38,767	5,105	2,751	640	30,271
2002	40,910	5,082	2,943	638	32,247
2003	41,424	5,416	3,626	720	31,662

Note: 'Number of persons employed' includes 'employed and in higher education' (persons who continue education while being employed).
Source: Ministry of Education, Culture, Sports, Science and Technology, 'Basic Survey of Schools'

(unit: persons)

Year	Employed (1968-2002)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade, eating and drinking places	Finance and insurance	Real estate	Transport and communications	Electricity, gas, water	Services	Information-related, etc.	Government, n.e.c.	Others
1968	17	27	198	2,479	26	1	4	95	34	847	33	192	102
1969	6	15	229	2,541	20	10	7	118	49	766	42	251	53
1970	12	22	270	2,734	17	10	13	112	60	657	63	203	43
1971	17	21	321	3,414	17	7	16	155	68	594	71	242	128
1972	18	27	379	3,495	28	9	12	151	104	634	75	332	119
1973	28	31	457	3,546	42	12	9	205	113	807	95	407	145
1974	42	29	469	4,370	40	18	30	227	150	860	147	451	138
1975	28	36	416	4,295	51	17	15	240	115	859	110	400	137
1976	23	31	411	3,402	41	19	17	238	132	924	211	316	241
1977	30	29	534	4,585	77	36	20	232	162	1,130	267	391	115
1978	37	37	625	5,016	93	22	16	260	188	1,145	294	644	147
1979	35	50	649	5,228	92	21	13	276	188	1,102	294	666	148
1980	21	70	522	5,380	68	17	14	242	213	1,063	294	498	80
1981	19	47	531	5,663	46	16	12	200	180	1,000	261	455	103
1982	25	48	566	6,087	52	18	15	222	201	931	282	439	100
1983	28	62	629	6,509	48	18	11	181	208	964	298	489	150
1984	73	61	710	7,208	60	46	21	234	196	1,343	457	686	102
1985	42	68	639	7,445	90	44	28	236	252	1,510	680	737	67
1986	31	48	711	8,175	92	80	15	310	252	1,566	779	775	66
1987	44	38	741	8,599	109	115	23	401	348	1,622	895	792	63
1988	28	32	758	8,826	113	178	28	608	417	1,877	1,127	908	104
1989	34	50	719	9,869	126	238	42	756	399	1,746	974	963	197
1990	41	54	817	10,556	134	242	43	744	457	1,366	710	770	193
1991	28	56	844	11,099	110	163	34	633	421	1,489	816	763	124
1992	32	50	985	11,876	103	134	27	744	526	1,452	819	824	207
1993	49	58	1,197	13,078	126	84	37	630	608	1,734	997	990	179
1994	54	64	1,338	13,657	221	86	41	709	702	2,158	1,211	1,194	219
1995	77	43	1,639	14,032	286	110	37	1,078	717	3,013	1,799	1,321	385
1996	78	51	1,839	15,237	406	146	42	1,251	710	3,940	2,665	1,383	362
1997	74	46	1,858	16,149	433	155	33	1,348	642	4,330	3,049	1,417	395
1998	64	50	1,760	17,701	456	195	46	1,148	566	4,531	3,177	1,237	405
1999	79	49	1,464	16,753	430	212	55	1,124	560	4,675	3,246	1,182	348
2000	77	39	1,484	15,865	474	236	54	1,142	481	5,642	3,985	1,216	405
2001	81	36	1,647	17,997	606	285	76	1,009	452	6,390	4,577	1,221	471
2002	110	49	1,610	19,310	550	294	106	1,031	477	6,925	4,988	1,333	452

(unit: persons)

Year	Employed (after 2003)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade	Finance and insurance	Real estate	Transport	Electricity, gas, water	Service-related[1)]	Information and communications	Government, n.e.c.	Others
2003	114	32	1,429	17,942	681	265	97	377	483	8,640	3,575	1,298	304

Note: 'Service-related' includes 'information and communications,' 'eating and drinking places/accommodations,' 'medical, health care and welfare,' 'education, learning support,' 'compound services,' 'services, n.e.c.' among the major groups after the 11th revision of the Japan Standard Industrial classification (revised in March, 2002, applied from October 1, 2002).
Source: MEXT, Report on 'School Basic Survey'

Table 5-3-5: Trends in employment rate of graduates in doctorate courses by industry

(A) Science

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Clinical interns	Employed
1968	321	0	81	13	—	227
1969	355	0	106	10	—	239
1970	391	0	153	19	—	219
1971	461	0	193	7	—	261
1972	518	0	238	37	—	243
1973	506	0	242	46	—	218
1974	509	0	191	65	—	253
1975	494	1	201	52	—	240
1976	485	1	262	53	—	169
1977	567	8	277	59	0	223
1978	500	2	299	29	0	170
1979	555	2	302	20	0	231
1980	589	2	309	19	0	259
1981	607	1	313	66	0	227
1982	569	0	302	26	0	241
1983	582	0	297	53	0	232
1984	529	1	241	39	0	248
1985	610	0	278	45	0	287
1986	564	0	241	25	0	298
1987	605	3	258	61	0	283
1988	589	1	248	42	0	298
1989	675	1	256	90	0	328
1990	634	0	240	73	0	321
1991	674	2	273	52	0	347
1992	730	4	243	53	0	430
1993	770	0	276	86	0	408
1994	863	2	280	76	0	505
1995	956	10	409	70	0	467
1996	1,016	2	405	72	0	537
1997	1,145	5	499	115	0	526
1998	1,301	4	494	170	0	633
1999	1,406	7	542	109	0	748
2000	1,456	13	633	137	0	673
2001	1,510	7	637	90	0	776
2002	1,607	5	662	137	0	803
2003	1,500	5	645	130	0	720

(unit: persons)

Year	Employed (1968-2002)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade, eating and drinking places	Finance and insurance	Real estate	Transport and communications	Electricity, gas, water	Services	Information-related, etc.	Government, n.e.c.	Others
1968	0	0	0	12	0	0	0	1	0	208	0	0	6
1969	0	0	0	24	0	0	0	0	1	204	2	6	4
1970	0	0	0	47	0	0	0	3	0	158	3	8	3
1971	0	2	1	56	0	0	0	0	0	189	14	5	8
1972	1	0	0	44	0	0	0	0	0	179	9	9	10
1973	0	0	2	42	1	0	0	0	1	149	10	9	14
1974	1	0	1	54	0	0	0	1	1	163	4	7	25
1975	0	1	1	56	1	0	0	3	0	167	5	4	7
1976	0	3	0	24	0	0	0	2	0	135	2	3	2
1977	0	1	0	35	1	0	0	1	0	160	8	4	21
1978	0	1	0	35	0	0	0	0	0	116	1	13	5
1979	0	1	2	46	2	0	0	1	0	160	2	19	0
1980	0	2	1	61	0	0	0	2	0	177	9	12	4
1981	0	4	1	74	2	0	0	1	0	126	5	18	1
1982	0	0	1	71	1	0	0	5	1	149	10	11	2
1983	0	2	2	77	0	0	0	0	0	147	7	4	0
1984	0	3	3	83	1	0	0	1	0	124	4	9	24
1985	0	6	0	98	0	1	0	3	0	122	7	28	29
1986	0	0	0	81	0	0	0	1	0	151	9	45	20
1987	0	2	0	73	1	1	0	1	1	178	14	18	8
1988	0	1	0	71	0	0	0	2	1	186	13	27	10
1989	0	1	2	83	1	0	0	2	1	184	10	38	16
1990	0	2	3	104	0	0	0	2	0	176	8	19	15
1991	0	0	1	90	0	1	0	4	0	210	16	39	2
1992	0	0	6	115	0	0	0	2	3	245	19	47	12
1993	0	1	4	112	0	0	0	1	2	205	7	72	11
1994	3	1	4	117	0	1	0	1	0	315	19	40	23
1995	0	1	4	113	0	0	0	5	1	280	18	53	10
1996	0	0	5	96	0	1	0	2	3	352	25	44	34
1997	2	2	7	108	0	0	0	3	0	334	28	54	16
1998	0	0	1	147	1	3	0	9	0	387	37	53	32
1999	0	1	10	137	1	4	1	6	0	439	54	74	75
2000	0	0	8	132	1	3	0	10	1	406	47	84	28
2001	1	1	11	134	4	6	0	6	0	511	57	40	62
2002	0	1	8	143	2	5	0	5	3	497	63	38	101

(unit: persons)

Year	Employed (after 2003)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade	Finance and insurance	Real estate	Transport	Electricity, gas, water	Service-related[1]	Information and communications	Government, n.e.c.	Others
2003	0	1	10	121	1	2	4	2	0	536	17	26	17

(B) Engineering

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Clinical interns	Employed
1968	407	0	35	18	—	354
1969	461	0	38	38	—	385
1970	590	0	68	81	—	441
1971	533	0	68	17	—	448
1972	544	0	92	14	—	438
1973	513	0	109	31	—	373
1974	598	0	117	15	—	466
1975	570	0	126	40	—	404
1976	551	2	160	46	—	343
1977	659	2	167	56	0	434
1978	573	1	161	70	0	341
1979	656	0	135	93	0	428
1980	657	1	175	47	0	434
1981	685	6	159	82	0	438
1982	621	6	92	103	0	420
1983	579	6	94	66	0	413
1984	563	4	139	8	0	412
1985	552	1	114	26	0	411

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Clinical interns	Employed
1986	588	1	126	59	0	402
1987	638	0	131	98	0	409
1988	721	1	141	87	0	492
1989	915	0	194	97	0	624
1990	937	4	150	142	0	641
1991	1,048	0	96	202	0	750
1992	1,141	3	134	206	0	798
1993	1,354	2	146	203	0	1,003
1994	1,550	3	194	235	0	1,118
1995	1,783	5	214	338	0	1,226
1996	2,127	12	305	329	0	1,481
1997	2,434	5	381	349	0	1,699
1998	2,767	2	438	520	0	1,807
1999	2,990	13	801	333	0	1,843
2000	2,903	13	981	184	0	1,725
2001	3,048	4	996	262	0	1,786
2002	3,073	5	1,041	307	0	1,720
2003	3,212	15	1,168	250	0	1,779

(unit: persons)

Year	Employed (1968-2002)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade, eating and drinking places	Finance and insurance	Real estate	Transport and communications	Electricity, gas, water	Services	Information-related, etc.	Government, n.e.c.	Others
1968	0	0	3	51	0	0	0	1	4	270	1	21	4
1969	0	0	4	62	1	1	0	5	1	287	0	17	7
1970	0	1	7	145	0	0	0	4	1	255	0	18	10
1971	0	0	13	126	0	0	0	6	0	261	1	9	33
1972	0	0	6	104	0	2	1	11	6	250	3	8	50
1973	0	1	10	93	0	0	0	11	3	219	3	5	31
1974	0	2	16	122	0	2	0	14	3	226	17	22	59
1975	0	0	6	124	0	0	0	8	8	176	4	26	56
1976	1	1	12	81	0	0	0	12	1	183	5	21	31
1977	0	0	9	156	1	0	0	11	2	204	9	5	46
1978	0	0	8	108	1	0	0	19	4	177	6	8	16
1979	0	0	17	183	0	0	0	13	0	197	6	6	12
1980	1	4	15	174	0	0	0	9	3	191	7	24	13
1981	1	0	7	179	0	1	2	12	0	182	7	20	34
1982	0	0	11	140	0	0	0	10	0	212	12	21	26
1983	0	3	17	155	0	0	0	13	1	176	6	28	20
1984	0	3	17	148	2	0	0	7	5	199	14	12	19
1985	0	0	4	139	1	0	0	7	2	188	10	40	30
1986	0	1	4	151	0	1	0	7	3	215	7	9	11
1987	0	1	8	110	0	2	0	8	3	237	12	30	10
1988	0	2	20	138	1	0	0	7	3	276	16	27	18
1989	0	1	11	207	0	0	0	10	4	306	13	36	49
1990	0	8	21	218	0	1	0	11	4	297	20	35	46
1991	0	0	31	242	1	1	0	15	9	366	18	45	40
1992	0	4	31	313	1	0	1	18	7	340	23	50	33
1993	0	1	37	357	4	0	1	16	15	447	39	86	39
1994	3	1	39	423	5	0	0	12	12	515	37	68	40
1995	2	1	61	468	3	1	0	17	21	511	35	82	59
1996	2	6	65	514	3	2	0	24	28	620	76	115	102
1997	2	5	79	619	3	1	0	19	26	739	77	112	94
1998	2	4	69	711	4	3	0	32	15	744	114	128	95
1999	3	4	72	613	4	3	0	30	21	846	76	162	85
2000	1	3	71	609	6	3	0	33	11	698	101	161	129
2001	0	9	69	620	7	0	0	38	15	743	113	163	122
2002	0	3	97	629	3	3	0	41	14	695	100	119	116

(unit: persons)

Year	Employed (after 2003)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade	Finance and insurance	Real estate	Transport	Electricity, gas, water	Service-related[1)]	Information and communications	Government, n.e.c.	Others
2003	0	4	73	567	3	3	1	7	11	926	66	100	84

(C) Agriculture

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Clinical interns	Employed
1968	109	0	31	15	—	63
1969	130	0	71	1	—	58
1970	154	0	49	37	—	68
1971	172	0	54	15	—	103
1972	164	0	80	9	—	75
1973	220	0	60	70	—	90
1974	242	0	95	19	—	128
1975	196	0	95	5	—	96
1976	176	0	95	3	—	78
1977	234	1	133	6	0	94
1978	282	1	133	25	0	123
1979	224	0	113	25	0	86
1980	218	0	102	11	0	105
1981	292	0	151	37	0	104
1982	282	0	169	24	0	89
1983	227	0	102	40	0	85
1984	251	0	113	31	0	107
1985	251	0	101	37	0	113

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Clinical interns	Employed
1986	230	0	83	33	0	114
1987	241	7	89	31	0	114
1988	295	3	79	40	0	173
1989	360	1	89	81	0	189
1990	332	8	88	54	0	182
1991	394	4	123	23	0	244
1992	465	18	145	35	0	267
1993	452	19	131	36	0	266
1994	548	23	119	81	0	325
1995	601	19	199	61	0	322
1996	676	17	251	37	0	371
1997	780	3	302	54	0	421
1998	865	3	372	40	0	450
1999	882	5	392	59	0	426
2000	990	6	437	81	0	466
2001	953	4	401	73	0	475
2002	1,042	0	409	88	0	545
2003	1,093	9	489	70	0	525

(unit: persons)

Year	Employed (1968-2002)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade, eating and drinking places	Finance and insurance	Real estate	Transport and communications	Electricity, gas, water	Services	Information-related, etc.	Government, n.e.c.	Others
1968	1	0	0	9	0	0	0	0	0	49	0	3	1
1969	0	0	0	9	0	1	0	0	0	45	1	1	2
1970	2	0	0	10	0	0	0	0	0	48	1	2	6
1971	0	0	1	12	1	0	0	0	0	57	1	3	29
1972	0	0	1	10	0	0	0	0	0	56	0	6	2
1973	0	0	0	13	0	0	0	0	0	65	1	7	5
1974	7	0	1	11	3	0	0	0	0	100	2	4	2
1975	1	0	0	11	1	1	0	0	0	77	1	1	4
1976	3	0	2	7	0	0	0	0	0	52	1	12	2
1977	2	0	0	13	1	0	0	0	1	62	2	15	0
1978	1	0	3	20	0	0	0	0	0	68	0	31	0
1979	0	0	2	13	0	0	0	1	0	47	1	17	6
1980	5	0	2	29	0	0	0	0	0	50	4	16	3
1981	5	0	1	19	0	0	0	0	0	60	2	8	11
1982	1	0	1	31	0	0	0	0	0	43	1	12	1
1983	2	0	1	32	0	0	0	0	0	34	5	10	6
1984	3	0	2	22	0	0	0	0	0	67	1	5	8
1985	7	0	0	31	0	0	0	0	0	70	6	5	0
1986	0	0	0	28	0	0	0	0	0	73	5	11	2
1987	1	0	0	17	1	0	0	1	0	65	1	29	0
1988	4	0	0	26	0	0	0	0	1	113	3	28	1
1989	7	0	1	58	0	0	0	1	0	102	3	14	6
1990	3	1	2	40	1	0	0	0	0	105	9	23	7
1991	0	0	1	58	0	0	0	0	0	132	7	37	16
1992	12	0	1	59	1	1	0	0	0	136	17	33	24
1993	12	0	2	53	1	0	0	0	1	149	5	32	16
1994	12	0	3	71	1	1	0	1	0	160	23	42	34
1995	3	1	1	74	4	0	0	0	0	171	26	47	21
1996	15	0	3	86	1	0	0	0	1	174	16	66	25
1997	9	0	9	71	3	1	0	2	3	202	18	85	36
1998	10	0	3	62	2	2	0	0	0	251	20	78	42
1999	6	0	2	68	1	1	0	0	0	230	28	90	28
2000	8	0	7	76	3	1	1	1	2	278	35	57	32
2001	9	0	1	68	2	1	0	0	2	294	35	60	38
2002	13	0	4	95	0	1	0	0	0	341	33	66	25

(unit: persons)

Year	Employed (after 2003)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade	Finance and insurance	Real estate	Transport	Electricity, gas, water	Service-related[1)]	Information and communications	Government, n.e.c.	Others
2003	16	0	3	92	3	0	1	0	1	321	1	57	31

(D) Health sciences

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Clinical interns	Employed
1968	1,421	0	657	2	—	762
1969	1,548	0	772	34	—	742
1970	1,401	0	503	52	—	846
1971	1,047	0	370	11	—	666
1972	1,145	0	438	18	—	689
1973	695	0	203	34	—	458
1974	558	0	116	20	—	422
1975	677	0	162	27	—	488
1976	810	5	152	53	—	600
1977	791	2	165	31	31	562
1978	802	1	167	31	16	587
1979	969	2	195	11	24	737
1980	1,036	0	166	17	24	829
1981	1,149	0	214	13	19	903
1982	1,332	0	175	12	53	1,092
1983	1,522	0	214	24	46	1,238
1984	1,536	1	263	21	59	1,192
1985	1,713	4	273	45	22	1,369
1986	1,888	2	274	21	80	1,511
1987	2,038	1	325	26	68	1,618
1988	2,301	0	398	35	71	1,797
1989	2,304	2	381	55	90	1,776
1990	2,622	1	445	63	81	2,032
1991	2,681	11	457	54	34	2,125
1992	2,684	2	482	56	18	2,126
1993	2,757	3	528	77	18	2,131
1994	2,858	9	556	86	48	2,159
1995	2,956	3	625	106	31	2,191
1996	3,153	9	619	109	63	2,353
1997	3,370	5	625	114	16	2,610
1998	3,559	4	703	114	1	2,737
1999	3,876	2	813	167	21	2,873
2000	3,977	11	836	220	51	2,859
2001	4,173	7	924	211	22	3,009
2002	4,310	7	911	163	8	3,221
2003	4,561	25	929	233	82	3,292

(unit: persons)

Year	Employed (1968-2002)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade, eating and drinking places	Finance and insurance	Real estate	Transport and communications	Electricity, gas, water	Services	Information-related, etc.	Government, n.e.c.	Others
1968	0	0	0	8	0	0	0	0	0	754	0	0	0
1969	0	0	0	9	0	0	0	0	0	733	0	0	0
1970	0	0	0	11	0	0	0	0	0	832	0	1	2
1971	0	0	0	28	0	0	0	0	0	628	0	1	9
1972	0	0	0	27	0	0	0	0	0	656	4	2	4
1973	0	0	0	15	1	0	0	0	0	430	1	3	9
1974	0	0	0	13	0	0	0	0	0	394	5	3	12
1975	0	0	0	23	0	0	0	0	0	463	0	0	2
1976	0	0	0	13	1	0	0	0	0	558	2	4	24
1977	0	0	0	17	1	0	0	0	0	526	2	11	7
1978	0	0	0	18	1	0	0	0	0	554	1	8	6
1979	0	0	0	25	0	0	0	0	0	701	1	1	10
1980	0	0	0	25	0	0	0	0	0	794	1	9	1
1981	0	0	0	39	0	0	0	0	0	847	4	7	10
1982	0	0	0	39	0	1	0	0	0	1,046	1	3	3
1983	0	0	0	76	1	0	0	0	0	1,159	1	1	1
1984	0	0	0	49	2	0	0	0	0	1,130	2	3	8
1985	0	0	0	52	1	0	0	0	0	1,292	5	19	5
1986	0	0	0	57	2	0	0	0	0	1,406	2	37	9
1987	0	0	0	58	1	0	0	0	0	1,540	4	13	6
1988	0	0	0	59	1	1	0	0	0	1,678	10	53	5
1989	0	0	0	64	0	0	0	0	0	1,686	9	19	7
1990	0	0	0	101	1	0	0	0	0	1,866	0	61	3
1991	0	0	0	84	0	1	0	0	0	1,969	5	60	11
1992	0	0	0	70	1	0	0	0	0	1,958	1	84	13
1993	0	0	0	62	1	0	0	0	1	1,948	3	113	6
1994	0	0	0	82	0	0	0	0	0	1,980	4	90	7
1995	0	0	0	77	1	0	0	0	0	2,027	2	66	20
1996	0	0	0	93	1	0	0	0	0	2,227	1	21	11
1997	0	0	0	88	2	1	0	0	1	2,445	15	32	41
1998	0	0	0	95	1	1	0	0	0	2,588	33	29	23
1999	0	0	0	85	2	0	0	0	0	2,677	24	48	61
2000	0	0	0	88	0	0	0	1	1	2,710	40	29	30
2001	0	0	0	102	3	1	0	0	0	2,817	57	38	48
2002	0	0	1	101	5	1	0	0	0	2,999	10	46	68

(unit: persons)

Year	Employed (after 2003)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade	Finance and insurance	Real estate	Transport	Electricity, gas, water	Service-related[1)]	Information and communications	Government, n.e.c.	Others
2003	0	0	0	112	3	0	0	0	0	3,082	1	37	58

(E) Natural science (science + engineering + agriculture + health sciences)

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Clinical interns	Employed
1968	2,258	0	804	48	—	1,406
1969	2,494	0	987	83	—	1,424
1970	2,536	0	773	189	—	1,574
1971	2,213	0	685	50	—	1,478
1972	2,371	0	848	78	—	1,445
1973	1,934	0	614	181	—	1,139
1974	1,907	0	519	119	—	1,269
1975	1,937	1	584	124	—	1,228
1976	2,022	8	669	155	—	1,190
1977	2,251	13	742	152	31	1,313
1978	2,157	5	760	155	16	1,221
1979	2,404	4	745	149	24	1,482
1980	2,500	3	752	94	24	1,627
1981	2,733	7	837	198	19	1,672
1982	2,804	6	738	165	53	1,842
1983	2,910	6	707	183	46	1,968
1984	2,879	6	756	99	59	1,959
1985	3,126	5	766	153	22	2,180

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Clinical interns	Employed
1986	3,270	3	724	138	80	2,325
1987	3,522	11	803	216	68	2,424
1988	3,906	5	866	204	71	2,760
1989	4,254	4	920	323	90	2,917
1990	4,525	13	923	332	81	3,176
1991	4,797	17	949	331	34	3,466
1992	5,020	27	1,004	350	18	3,621
1993	5,333	24	1,081	402	18	3,808
1994	5,819	37	1,149	478	48	4,107
1995	6,296	37	1,447	575	31	4,206
1996	6,972	40	1,580	547	63	4,742
1997	7,729	18	1,807	632	16	5,256
1998	8,492	13	2,007	844	1	5,627
1999	9,154	27	2,548	668	21	5,890
2000	9,326	43	2,887	622	51	5,723
2001	9,684	22	2,958	636	22	6,046
2002	10,032	17	3,023	695	8	6,289
2003	10,366	54	3,231	683	82	6,316

Note: ‘Number of persons employed’ includes ‘employed and those in higher education’ (persons who continue education while being employed).
Source: Ministry of Education, Culture, Sports, Science and Technology, ‘Basic Survey Report on Schools’

(unit: persons)

Year	Employed (1968-2002)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade, eating and drinking places	Finance and insurance	Real estate	Transport and communications	Electricity, gas, water	Services		Government, n.e.c.	Others
											Information-related, etc.		
1968	1	0	3	80	0	0	0	2	4	1,281	1	24	11
1969	0	0	4	104	1	2	0	5	2	1,269	3	24	13
1970	2	1	7	213	0	0	0	7	1	1,293	4	29	21
1971	0	2	15	222	1	0	0	6	0	1,135	16	18	79
1972	1	0	7	185	0	2	1	11	6	1,141	16	25	66
1973	0	1	12	163	2	0	0	11	4	863	15	24	59
1974	8	2	18	200	3	2	0	15	4	883	28	36	98
1975	1	1	7	214	2	1	0	11	8	883	10	31	69
1976	4	4	14	125	1	0	0	14	1	928	10	40	59
1977	2	1	9	221	4	0	0	12	3	952	21	35	74
1978	1	1	11	181	2	0	0	19	4	915	8	60	27
1979	0	1	21	267	2	0	0	15	0	1,105	10	43	28
1980	6	6	18	289	0	0	0	11	3	1,212	21	61	21
1981	6	4	9	311	2	1	2	13	0	1,215	18	53	56
1982	1	0	13	281	1	1	0	15	1	1,450	24	47	32
1983	2	5	20	340	1	0	0	13	1	1,516	19	43	27
1984	3	6	22	302	5	0	0	8	5	1,520	21	29	59
1985	7	6	4	320	2	1	0	10	2	1,672	28	92	64
1986	0	1	4	317	2	1	0	8	3	1,845	23	102	42
1987	1	3	8	258	3	3	0	10	4	2,020	31	90	24
1988	4	3	20	294	2	1	0	9	5	2,253	42	135	34
1989	7	2	14	412	1	0	0	13	5	2,278	35	107	78
1990	3	11	26	463	2	1	0	13	4	2,444	37	138	71
1991	0	0	33	474	1	3	0	19	9	2,677	46	181	69
1992	12	4	38	557	3	1	1	20	10	2,679	60	214	82
1993	12	2	43	584	6	0	1	17	19	2,749	54	303	72
1994	18	2	46	693	6	2	0	14	12	2,970	83	240	104
1995	5	3	66	732	8	1	0	22	22	2,989	81	248	110
1996	17	6	73	789	5	3	0	26	32	3,373	118	246	172
1997	13	7	95	886	8	3	0	24	30	3,720	138	283	187
1998	12	4	73	1,015	8	9	0	41	15	3,970	204	288	192
1999	9	5	84	903	8	8	1	36	21	4,192	182	374	249
2000	9	3	86	905	10	7	1	45	15	4,092	223	331	219
2001	10	10	81	924	16	8	0	44	17	4,365	262	301	270
2002	13	4	110	968	10	10	0	46	17	4,532	206	269	310

(unit: persons)

Year	Employed (after 2003)												
	Agriculture, forestry and fisheries	Mining	Construction	Manufacturing	Wholesale and retail trade	Finance and insurance	Real estate	Transport	Electricity, gas, water	Service-related[1)]		Government, n.e.c.	Others
											Information and communications		
2003	16	5	86	892	10	5	6	9	12	4,865	85	220	190

Note: ‘Service-related’ includes ‘information and communications,’ ‘eating and drinking places/accommodations,’ ‘education, learning support,’ ‘compound services,’ ‘services, n.e.c.’ among the major groups after the 11th revision of the Japan standard Industrial Classification (revised in March, 2002, applied from October 1, 2002).
Source: MEXT, Report on ‘School Basic Survey’

Table 5-3-6: Trends in the ratio of unemployed to graduates in doctorate curses

(unit: %)

Year	Science	Engineering	Agriculture	Health sciences
1968	25.2	8.6	28.4	46.2
1969	29.9	8.2	54.6	49.9
1970	39.1	11.5	31.8	35.9
1971	41.9	12.8	31.4	35.3
1972	45.9	16.9	48.8	38.3
1973	47.8	21.2	27.3	29.2
1974	37.5	19.6	39.3	20.8
1975	40.7	22.1	48.5	23.9
1976	54.0	29.0	54.0	18.8
1977	48.9	25.3	56.8	20.9
1978	59.8	28.1	47.2	20.8
1979	54.4	20.6	50.4	20.1
1980	52.5	26.6	46.8	16.0
1981	51.6	23.2	51.7	18.6
1982	53.1	14.8	59.9	13.1
1983	51.0	16.2	44.9	14.1
1984	45.6	24.7	45.0	17.1
1985	45.6	20.7	40.2	15.9
1986	42.7	21.4	36.1	14.5
1987	42.6	20.5	36.9	15.9
1988	42.1	19.6	26.8	17.3
1989	37.9	21.2	24.7	16.5
1990	37.9	16.0	26.5	17.0
1991	40.5	9.2	31.2	17.0
1992	33.3	11.7	31.2	18.0
1993	35.8	10.8	29.0	19.2
1994	32.4	12.5	21.7	19.5
1995	42.8	12.0	33.1	21.1
1996	39.9	14.3	37.1	19.6
1997	43.6	15.7	38.7	18.5
1998	38.0	15.8	43.0	19.8
1999	38.5	26.8	44.4	21.0
2000	43.5	33.8	44.1	21.0
2001	42.2	32.7	42.1	22.1
2002	41.2	33.9	39.3	21.1
2003	43.0	36.4	44.7	20.4

Note: ‘Unemployed’ is a person who has finished a doctorate course, excluding ‘enrolled in higher education,’ ‘employed,’ or ‘deceased and unknown.’
Source: MEXT, Report on ‘School Basic Survey’

Table 5-3-7: Trends in employment rate of graduates in master's courses by occupation

(A) Science

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1968	1,288	681	47	22	538
1969	1,281	730	46	33	472
1970	1,302	710	60	28	504
1971	1,389	723	92	30	544
1972	1,350	708	129	26	487
1973	1,455	748	110	73	524
1974	1,482	703	106	63	610
1975	1,382	619	97	42	624
1976	1,472	786	149	63	474
1977	1,594	765	136	46	647
1978	1,625	710	174	41	700
1979	1,666	661	150	66	789
1980	1,649	632	166	42	809
1981	1,665	605	144	46	870
1982	1,716	611	154	29	922
1983	1,813	624	159	25	1,005
1984	1,910	659	122	17	1,112
1985	1,992	612	150	22	1,208
1986	2,019	655	121	20	1,223
1987	2,213	753	124	30	1,306
1988	2,377	752	116	50	1,459
1989	2,598	802	107	63	1,626
1990	2,805	833	81	62	1,829
1991	2,913	907	108	48	1,850
1992	3,067	949	108	41	1,969
1993	3,327	1,104	141	82	2,000
1994	3,632	1,250	200	113	2,069
1995	4,264	1,420	380	86	2,378
1996	4,887	1,553	412	115	2,807
1997	5,267	1,529	396	146	3,196
1998	5,503	1,557	462	128	3,356
1999	5,251	1,525	534	128	3,064
2000	5,351	1,566	596	161	3,028
2001	5,633	1,463	597	144	3,429
2002	5,741	1,415	584	143	3,599
2003	5,722	1,456	662	123	3,481

(unit: persons

Year	Employed													
	Professional and technical workers					Managers and officials	Clerical and related workers	Sales workers	Service workers	Protective service workers	Agricultural, forestry and fisheries workers	Workers in transport and communications occupations	Production process workers and laborers	Others
		Scientific researchers	Engineers and technicians	Professors and teachers	Public health and medical workers									
1968	512	42	216	250	1	0	3	0	2	0	1	2	0	18
1969	463	52	235	169	2	0	1	2	2	1	0	0	0	3
1970	488	50	267	160	2	0	5	0	0	1	0	1	0	9
1971	522	79	328	109	3	2	2	0	1	2	0	8	0	7
1972	463	68	284	104	1	0	7	1	3	2	0	5	0	6
1973	479	61	278	133	4	2	9	2	3	2	0	10	0	17
1974	575	76	351	141	3	2	19	2	0	0	0	1	0	11
1975	576	63	325	174	3	0	29	1	0	2	0	4	0	12
1976	423	41	222	154	1	1	15	1	4	1	0	12	0	17
1977	571	70	308	180	0	3	36	2	7	1	0	7	3	17
1978	593	64	327	194	0	1	56	12	7	2	0	9	0	20
1979	686	87	366	217	4	2	78	2	3	1	0	10	0	7
1980	761	117	431	201	6	0	19	9	7	1	0	6	0	6
1981	796	145	458	179	3	1	24	11	16	3	0	14	1	4
1982	885	143	603	126	1	0	11	3	12	0	0	2	0	9
1983	952	110	664	157	5	2	18	1	3	0	0	3	3	23
1984	1,060	125	742	180	5	3	18	7	5	0	0	4	7	8
1985	1,158	174	758	207	1	2	18	2	10	2	0	4	0	12
1986	1,150	138	840	155	5	4	37	9	8	1	0	1	1	12
1987	1,242	151	907	167	5	5	24	11	3	1	1	11	1	7
1988	1,354	190	982	167	0	11	45	1	4	1	0	14	3	26
1989	1,487	204	1,099	171	4	7	44	18	24	2	0	12	1	31
1990	1,725	241	1,282	158	6	6	44	1	5	3	1	22	0	22
1991	1,716	180	1,373	140	3	12	44	14	21	2	0	21	3	17
1992	1,812	301	1,345	146	2	7	66	2	22	4	0	19	1	36
1993	1,800	204	1,454	120	5	4	102	35	18	2	0	17	3	19
1994	1,767	224	1,339	164	5	7	184	20	19	7	0	21	0	44
1995	1,983	398	1,333	212	6	16	238	15	35	9	0	28	1	53
1996	2,232	291	1,611	275	13	12	323	21	74	9	1	47	1	87
1997	2,619	278	2,055	215	11	6	324	55	52	17	1	54	3	65
1998	2,779	333	2,155	238	11	1	328	39	78	14	0	24	0	93
1999	2,561	215	2,085	201	10	4	310	44	53	14	2	26	2	48
2000	2,494	224	1,974	202	13	5	291	47	86	11	1	22	4	67
2001	2,847	196	2,371	210	10	5	300	57	108	18	2	14	4	74
2002	3,014	216	2,537	181	15	14	305	86	64	11	1	18	1	85
2003	2,842	217	2,244	250	25	23	284	79	106	15	4	17	1	110

(B) Engineering

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1968	3,918	764	54	120	2,980
1969	3,965	726	65	133	3,041
1970	3,891	626	86	103	3,076
1971	4,660	690	84	152	3,734
1972	4,915	698	95	117	4,005
1973	5,436	686	159	206	4,385
1974	6,090	687	116	164	5,123
1975	6,060	686	191	165	5,018
1976	5,799	726	434	160	4,479
1977	6,923	718	331	195	5,679
1978	7,640	653	344	216	6,427
1979	7,613	652	224	136	6,601
1980	7,135	559	177	105	6,294
1981	6,976	565	133	71	6,207
1982	7,363	574	127	82	6,580
1983	7,703	569	158	67	6,909
1984	8,311	609	134	37	7,531
1985	8,628	720	170	72	7,666

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1986	9,620	892	149	92	8,487
1987	10,413	874	196	148	9,195
1988	11,129	995	178	132	9,824
1989	11,915	982	138	165	10,630
1990	12,774	1,041	149	179	11,405
1991	13,141	1,171	161	176	11,633
1992	14,351	1,266	181	300	12,604
1993	16,234	1,530	213	317	14,174
1994	17,978	1,718	348	377	15,535
1995	20,197	1,967	525	397	17,308
1996	22,622	2,139	658	328	19,497
1997	23,337	2,011	662	307	20,357
1998	24,421	2,101	674	368	21,278
1999	24,242	2,145	534	424	20,532
2000	24,762	2,367	1,491	353	20,551
2001	26,957	2,283	1,428	386	22,860
2002	28,538	2,281	1,617	353	24,287
2003	28,498	2,493	2,069	437	23,499

(unit: persons)

Year	Employed													
	Professional and technical workers					Managers and officials	Clerical and related workers	Sales workers	Service workers	Protective service workers	Agricultural, forestry and fisheries workers	Workers in transport and communications occupations	Production process workers and laborers	Others
		Scientific researchers	Engineers and technicians	Professors and teachers	Public health and medical workers									
1968	2,873	36	2,481	341	0	1	2	8	10	12	0	12	0	62
1969	2,933	137	2,510	268	11	18	12	3	2	6	0	12	0	55
1970	2,994	38	2,748	207	0	2	17	2	1	4	0	20	0	36
1971	3,589	50	3,359	172	2	2	8	0	11	1	0	39	1	83
1972	3,859	50	3,599	204	0	1	32	3	5	2	0	20	2	81
1973	4,172	52	3,837	269	3	2	48	2	5	5	0	61	3	87
1974	4,924	79	4,607	221	1	9	17	7	18	6	0	49	5	88
1975	4,703	60	4,404	216	0	14	76	12	24	7	0	68	30	84
1976	4,148	132	3,730	235	2	10	71	11	36	4	0	81	2	116
1977	5,298	235	4,745	293	2	20	69	15	74	8	1	60	5	129
1978	5,917	344	5,222	301	5	26	104	35	83	14	2	86	10	150
1979	6,193	366	5,535	252	9	8	84	35	42	31	1	94	13	100
1980	5,976	370	5,338	228	6	23	122	23	35	14	0	49	5	47
1981	5,918	453	5,264	180	3	15	49	16	20	7	0	55	1	126
1982	6,336	390	5,745	169	1	18	64	3	28	6	0	38	3	84
1983	6,676	299	6,165	174	5	5	31	14	21	4	0	36	1	121
1984	7,244	328	6,692	186	2	7	67	18	30	8	0	41	5	111
1985	7,418	98	7,083	188	0	11	75	10	26	5	0	22	0	99
1986	8,117	112	7,765	200	2	4	76	23	78	4	0	91	1	93
1987	8,733	134	8,327	207	1	40	105	29	83	5	1	101	4	94
1988	9,243	235	8,724	240	1	34	112	50	107	5	0	144	6	123
1989	9,785	225	9,279	219	1	53	163	55	234	6	1	207	3	123
1990	10,783	276	10,157	199	2	87	146	38	85	7	0	177	0	82
1991	11,008	339	10,415	190	1	71	137	35	115	30	0	145	0	92
1992	11,840	455	11,092	172	3	56	217	41	124	8	0	184	18	116
1993	13,514	441	12,800	181	7	59	190	36	73	4	4	182	1	111
1994	14,929	566	14,103	188	6	85	134	61	72	6	0	130	2	116
1995	16,279	642	15,354	200	8	80	252	70	159	18	0	260	16	174
1996	18,186	586	17,282	172	13	51	364	79	131	17	4	331	44	290
1997	19,101	695	18,091	157	20	44	320	86	130	37	1	362	4	272
1998	19,981	987	18,734	113	9	52	498	76	127	22	1	233	9	279
1999	19,293	1,076	17,901	139	47	39	461	84	169	34	1	285	13	153
2000	19,333	1,074	17,927	136	7	47	435	98	163	39	2	223	3	208
2001	21,223	1,133	19,838	114	9	41	688	182	294	32	2	152	15	231
2002	22,557	996	21,263	150	21	32	729	215	235	43	2	171	20	283
2003	21,739	1,103	20,310	139	17	55	640	265	319	42	4	137	38	260

(C) Agriculture

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1968	672	275	82	12	303
1969	720	258	73	16	373
1970	741	285	47	60	349
1971	832	280	86	14	452
1972	926	268	117	30	511
1973	1,131	328	121	64	618
1974	1,205	278	123	22	782
1975	1,116	262	163	38	653
1976	1,121	274	226	42	579
1977	1,297	297	261	33	706
1978	1,392	322	251	45	774
1979	1,266	287	212	39	728
1980	1,234	267	211	26	730
1981	1,156	261	154	31	710
1982	1,116	260	126	30	700
1983	1,263	255	159	41	808
1984	2,029	286	186	71	1,486
1985	2,180	300	211	43	1,626
1986	2,300	346	178	95	1,681
1987	2,265	340	202	89	1,634
1988	2,436	406	190	61	1,779
1989	2,657	400	179	94	1,984
1990	1,735	379	81	37	1,238
1991	1,753	395	80	35	1,243
1992	1,909	418	99	22	1,370
1993	2,252	547	129	42	1,534
1994	2,479	590	211	83	1,595
1995	2,819	718	268	121	1,712
1996	2,985	700	352	114	1,819
1997	3,056	717	358	84	1,897
1998	3,175	731	478	63	1,903
1999	3,016	735	534	78	1,744
2000	3,168	808	483	55	1,822
2001	3,362	801	488	48	2,025
2002	3,515	756	499	88	2,172
2003	3,471	741	534	87	3,481

(unit: persons)

Year	Employed: Professional and technical workers					Managers and officials	Clerical and related workers	Sales workers	Service workers	Protective service workers	Agricultural, forestry and fisheries workers	Workers in transport and communications occupations	Production process workers and laborers	Others
		Scientific researchers	Engineers and technicians	Professors and teachers	Public health and medical workers									
1968	271	50	122	89	7	2	16	2	0	0	1	0	0	11
1969	345	57	160	101	16	2	11	3	1	0	0	0	0	11
1970	330	53	193	68	11	0	9	2	0	0	0	1	0	7
1971	390	54	232	74	6	9	26	3	4	0	0	0	0	20
1972	466	88	277	82	9	9	22	1	1	0	4	0	4	4
1973	570	85	367	90	16	2	26	6	6	0	2	2	1	3
1974	673	92	444	103	17	7	53	17	5	0	3	1	2	21
1975	566	91	359	95	3	6	53	8	3	2	7	0	0	8
1976	471	84	265	96	15	1	48	7	4	3	3	1	4	37
1977	617	121	356	104	6	5	46	14	11	2	6	0	1	4
1978	597	88	376	81	17	1	123	27	8	2	2	0	1	13
1979	576	104	340	103	5	6	77	32	15	1	5	0	1	15
1980	617	111	384	85	7	4	47	40	8	1	4	2	0	7
1981	614	108	371	32	9	2	52	25	10	1	2	0	0	4
1982	621	126	373	74	45	2	53	10	2	1	3	2	0	6
1983	716	124	454	83	43	0	51	22	6	1	5	1	0	6
1984	1,331	174	543	64	546	3	79	37	11	1	9	0	3	12
1985	1,501	169	618	87	604	4	69	16	11	3	11	0	0	11
1986	1,528	227	598	68	622	8	81	35	9	0	8	0	2	10
1987	1,510	235	590	56	611	26	52	14	7	2	8	0	0	15
1988	1,652	216	705	69	643	2	81	14	2	3	7	2	3	13
1989	1,772	223	794	69	679	3	106	32	23	1	9	1	1	36
1990	1,099	238	775	65	8	3	97	13	5	1	1	5	0	14
1991	1,119	285	770	41	9	11	87	10	8	0	2	3	0	3
1992	1,209	356	806	39	2	16	84	13	25	0	2	8	0	13
1993	1,338	365	902	56	3	16	108	22	22	2	3	3	1	19
1994	1,378	284	1,007	64	5	46	108	20	11	3	6	4	2	17
1995	1,457	281	1,080	73	6	13	126	45	25	3	8	5	0	30
1996	1,463	261	1,088	70	13	10	202	51	22	6	3	3	1	58
1997	1,478	241	1,135	57	13	34	203	61	26	11	10	8	1	65
1998	1,490	268	1,103	57	18	12	189	93	40	4	7	5	10	53
1999	1,302	188	1,020	46	5	18	214	93	39	2	12	4	1	59
2000	1,395	311	978	56	10	18	194	77	27	8	11	1	21	70
2001	1,535	292	1,096	69	17	45	244	98	46	13	15	1	0	28
2002	1,660	296	1,238	55	11	41	237	112	45	5	17	5	1	49
2003	1,585	309	1,121	62	18	21	293	94	23	14	17	1	1	60

(D) Health sciences

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1968	323	111	10	1	201
1969	316	115	14	8	179
1970	354	92	27	11	224
1971	415	110	27	8	270
1972	462	120	28	9	305
1973	436	111	44	6	275
1974	483	129	38	7	309
1975	485	126	38	7	314
1976	486	165	53	5	263
1977	521	152	51	9	309
1978	522	147	38	8	329
1979	564	163	46	5	350
1980	572	150	54	13	355
1981	703	171	46	1	485
1982	734	180	45	7	502
1983	791	172	34	10	575
1984	839	175	48	5	611
1985	901	197	45	1	658

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1986	981	200	39	12	730
1987	1,007	208	36	3	760
1988	1,062	197	34	16	815
1989	1,137	180	52	6	899
1990	1,187	197	40	5	945
1991	1,290	212	31	9	1,038
1992	1,328	236	54	21	1,017
1993	1,436	268	51	55	1,062
1994	1,709	306	101	58	1,244
1995	1,815	303	98	74	1,340
1996	1,959	396	133	108	1,322
1997	2,033	398	160	45	1,430
1998	2,285	447	171	45	1,622
1999	2,321	458	534	54	1,591
2000	2,544	523	259	48	1,714
2001	2,815	558	238	62	1,957
2002	3,116	630	243	54	2,189
2003	3,733	726	361	73	2,573

(unit: persons)

Year	Employed													
	Professional and technical workers					Managers and officials	Clerical and related workers	Sales workers	Service workers	Protective service workers	Agricultural, forestry and fisheries workers	Workers in transport and communications occupations	Production process workers and laborers	Others
		Scientific researchers	Engineers and technicians	Professors and teachers	Public health and medical workers									
1968	198	28	127	35	8	2	0	1	0	0	0	0	0	0
1969	174	16	106	45	7	0	1	2	0	2	0	0	0	0
1970	216	24	130	35	25	0	1	6	0	0	0	0	0	1
1971	265	39	151	36	37	0	2	0	3	0	0	0	0	0
1972	300	59	127	50	61	1	3	0	0	0	0	0	0	1
1973	269	63	144	32	30	0	3	1	0	0	0	0	0	2
1974	304	45	142	51	66	0	4	0	1	0	0	0	0	0
1975	306	45	134	61	66	2	3	1	0	2	0	0	0	0
1976	250	29	104	43	72	0	5	1	0	1	1	0	0	5
1977	300	23	131	55	87	0	0	4	1	1	0	0	0	3
1978	323	69	128	54	71	0	1	1	0	0	0	0	0	4
1979	339	56	141	47	94	0	5	2	0	0	0	0	0	4
1980	343	93	116	46	87	0	2	3	2	1	0	1	0	3
1981	478	118	199	60	98	1	2	2	0	1	0	0	0	1
1982	491	113	208	52	112	0	4	3	0	0	0	0	0	4
1983	561	112	268	59	111	0	8	6	0	0	0	0	0	0
1984	602	134	279	35	152	0	3	2	3	0	0	0	0	1
1985	641	164	251	47	178	4	3	2	1	4	0	0	0	3
1986	722	151	341	55	174	2	1	4	0	0	0	0	0	1
1987	741	197	346	34	157	2	4	9	0	1	0	0	0	3
1988	800	259	329	44	162	0	5	4	0	3	0	0	0	3
1989	860	239	394	44	182	6	8	7	1	1	0	0	0	16
1990	923	315	297	42	265	4	9	5	0	1	0	0	1	2
1991	1,024	297	342	52	330	0	5	3	5	0	0	0	0	1
1992	1,001	329	324	33	303	1	12	0	1	1	0	1	0	0
1993	1,036	281	336	66	343	1	14	1	3	0	0	0	0	7
1994	1,203	344	321	68	466	2	29	4	1	1	0	0	0	4
1995	1,283	448	300	102	433	5	27	12	3	2	0	0	0	8
1996	1,273	331	330	85	513	4	19	11	9	1	0	0	0	5
1997	1,368	282	361	94	612	3	32	20	1	1	0	0	0	5
1998	1,534	274	368	142	732	1	38	25	2	5	0	0	0	17
1999	1,491	209	396	133	742	2	40	31	5	5	1	1	0	15
2000	1,632	179	400	163	861	2	38	21	6	2	0	1	0	12
2001	1,861	216	445	228	934	2	41	33	7	1	0	0	0	12
2002	2,080	235	481	243	1,076	8	50	26	4	5	0	0	0	16
2003	2,407	241	528	289	1,251	9	57	42	11	2	1	1	0	43

(E) Natural science

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1968	6,201	1,831	193	155	4,022
1969	6,282	1,829	198	190	4,065
1970	6,288	1,713	220	202	4,153
1971	7,296	1,803	289	204	5,000
1972	7,653	1,794	369	182	5,308
1973	8,458	1,873	434	349	5,802
1974	9,260	1,797	383	256	6,824
1975	9,043	1,693	489	252	6,609
1976	8,878	1,951	862	270	5,795
1977	10,335	1,932	779	283	7,341
1978	11,179	1,832	807	310	8,230
1979	11,109	1,763	632	246	8,468
1980	10,590	1,608	608	186	8,188
1981	10,500	1,602	477	149	8,272
1982	10,929	1,625	452	148	8,704
1983	11,570	1,620	510	143	9,297
1984	13,089	1,729	490	130	10,740
1985	13,701	1,829	576	138	11,158

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Employed
1986	14,920	2,093	487	219	12,121
1987	15,898	2,175	558	270	12,895
1988	17,004	2,350	518	259	13,877
1989	18,307	2,364	476	328	15,139
1990	18,501	2,450	351	283	15,417
1991	19,097	2,685	380	268	15,764
1992	20,655	2,869	442	384	16,960
1993	23,249	3,449	534	496	18,770
1994	25,798	3,864	860	631	20,443
1995	29,095	4,408	1,271	678	22,738
1996	32,453	4,788	1,555	665	25,445
1997	33,693	4,655	1,576	582	26,880
1998	35,384	4,836	1,785	604	28,159
1999	34,830	4,863	534	684	26,931
2000	35,825	5,264	2,829	617	27,115
2001	38,767	5,105	2,751	640	30,271
2002	40,910	5,082	2,943	638	32,247
2003	41,424	5,416	3,626	720	31,662

(unit: persons)

Year	Employed													
	Professional and technical workers					Managers and officials	Clerical and related workers	Sales workers	Service workers	Protective service workers	Agricultural, forestry and fisheries workers	Workers in transport and communications occupations	Production process workers and laborers	Others
		Scientific researchers	Engineers and technicians	Professors and teachers	Public health and medical workers									
1968	3,854	156	2,946	715	16	5	21	11	12	12	2	14	0	91
1969	3,915	262	3,011	583	36	20	25	10	5	9	0	12	0	69
1970	4,028	165	3,338	470	38	2	32	10	1	5	0	22	0	53
1971	4,766	222	4,070	391	48	13	38	3	19	3	0	47	1	110
1972	5,088	265	4,287	440	71	11	64	5	9	4	4	25	6	92
1973	5,490	261	4,626	524	53	6	86	11	14	7	2	73	4	109
1974	6,476	292	5,544	516	87	18	93	26	24	6	3	51	7	120
1975	6,151	259	5,222	546	72	22	161	22	27	13	7	72	30	104
1976	5,292	286	4,321	528	90	12	139	20	44	9	4	94	6	175
1977	6,786	449	5,540	632	95	28	151	35	93	12	7	67	9	153
1978	7,430	565	6,053	630	93	28	284	75	98	18	4	95	11	187
1979	7,794	613	6,382	619	112	16	244	71	60	33	6	104	14	126
1980	7,697	691	6,269	560	106	27	190	75	52	17	4	58	5	63
1981	7,806	824	6,292	451	113	19	127	54	46	12	2	69	2	135
1982	8,333	772	6,929	421	159	20	132	19	42	7	3	42	3	103
1983	8,905	645	7,551	473	164	7	108	43	30	5	5	40	4	150
1984	10,237	761	8,256	465	705	13	167	64	49	9	9	45	15	132
1985	10,718	605	8,710	529	783	21	165	30	48	14	11	26	0	125
1986	11,517	628	9,544	478	803	18	195	71	95	5	8	92	4	116
1987	12,226	717	10,170	464	774	73	185	63	93	9	10	112	5	119
1988	13,049	900	10,740	520	806	47	243	69	113	12	7	160	12	165
1989	13,904	891	11,566	503	866	69	321	112	282	10	10	220	5	206
1990	14,530	1,070	12,511	464	281	100	296	57	95	12	2	204	1	120
1991	14,867	1,101	12,900	423	343	94	273	62	149	32	2	169	3	113
1992	15,862	1,441	13,567	390	310	80	379	56	172	13	2	212	19	165
1993	17,688	1,291	15,492	423	358	80	414	94	116	8	7	202	5	156
1994	19,277	1,418	16,770	484	482	140	455	105	103	17	6	155	4	181
1995	21,002	1,769	18,067	587	453	114	643	142	222	32	8	293	17	265
1996	23,154	1,469	20,311	602	552	77	908	162	236	33	8	381	46	440
1997	24,566	1,496	21,642	523	656	87	879	222	209	66	12	424	8	407
1998	25,784	1,862	22,360	550	770	66	1,053	233	247	45	8	262	19	442
1999	24,647	1,688	21,402	519	804	63	1,025	252	266	55	16	316	16	275
2000	24,854	1,788	21,279	557	891	72	958	243	282	60	14	247	28	357
2001	27,466	1,837	23,750	621	970	93	1,273	370	455	64	19	167	19	345
2002	29,311	1,743	25,519	629	1,123	95	1,321	439	348	64	20	194	22	433
2003	28,573	1,870	24,203	740	1,311	108	1,274	480	459	73	26	156	40	473

Note: ‘Number of persons employed’ includes ‘employed and in higher education’ (persons who continue education while being employed).

Source: Ministry of Education, Culture, Sports, Science and Technology, ‘Basic Survey of Schools’

Table 5-3-8: Trends in employment rate of graduates in doctorate courses by occupation

(A) Science

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Clinical interns	Employed
1968	321	0	81	13	—	227
1969	355	0	106	10	—	239
1970	391	0	153	19	—	219
1971	461	0	193	7	—	261
1972	518	0	238	37	—	243
1973	506	0	242	46	—	218
1974	509	0	191	65	—	253
1975	494	1	201	52	—	240
1976	485	1	262	53	—	169
1977	567	8	277	59	0	223
1978	500	2	299	29	0	170
1979	555	2	302	20	0	231
1980	589	2	309	19	0	259
1981	607	1	313	66	0	227
1982	569	0	302	26	0	241
1983	582	0	297	53	0	232
1984	529	1	241	39	0	248
1985	610	0	278	45	0	287
1986	564	0	241	25	0	298
1987	605	3	258	61	0	283
1988	589	1	248	42	0	298
1989	675	1	256	90	0	328
1990	634	0	240	73	0	321
1991	674	2	273	52	0	347
1992	730	4	243	53	0	430
1993	770	0	276	86	0	408
1994	863	2	280	76	0	505
1995	956	10	409	70	0	467
1996	1,016	2	405	72	0	537
1997	1,145	5	499	115	0	526
1998	1,301	4	494	170	0	633
1999	1,406	7	542	109	0	748
2000	1,456	13	633	137	0	673
2001	1,510	7	637	90	0	776
2002	1,607	5	662	137	0	803
2003	1,500	5	645	130	0	720

(unit: persons)

Year	Employed													
	Professional and technical workers					Managers and officials	Clerical and related workers	Sales workers	Service workers	Protective service workers	Agricultural, forestry and fisheries workers	Workers in transport and communications occupations	Production process workers and laborers	Others
		Scientific researchers	Engineers and technicians	Professors and teachers	Public health and medical workers									
1968	223	29	10	178	0	0	0	0	0	0	0	1	0	3
1969	236	23	22	183	3	1	0	0	0	0	0	0	0	2
1970	215	22	45	148	0	0	0	0	0	0	0	0	0	4
1971	250	24	61	164	0	1	0	0	0	0	0	0	0	10
1972	227	43	30	154	0	0	0	0	0	0	0	0	0	16
1973	206	44	44	117	1	1	1	0	1	0	0	0	0	9
1974	228	61	50	116	0	0	2	0	0	0	1	0	0	22
1975	233	37	53	139	2	0	0	1	1	0	0	0	0	5
1976	166	21	29	114	2	0	1	0	0	1	0	0	1	0
1977	207	28	41	136	0	1	0	1	0	0	0	0	0	14
1978	162	28	32	102	0	0	7	0	0	0	0	0	0	1
1979	220	37	40	142	1	0	9	2	0	0	0	0	0	0
1980	258	54	55	148	0	0	0	0	0	0	0	0	0	1
1981	220	55	53	108	2	1	2	0	3	0	0	0	0	1
1982	228	74	46	101	3	0	5	1	6	0	0	0	0	1
1983	229	53	62	111	0	0	3	0	0	0	0	0	0	0
1984	223	59	68	94	0	0	0	1	1	0	0	0	0	23
1985	263	82	74	103	1	0	2	0	1	0	0	0	0	21
1986	273	78	76	117	0	1	0	1	3	0	0	0	0	20
1987	271	76	74	115	1	0	1	1	0	1	0	1	0	8
1988	283	65	86	129	0	0	3	0	0	0	0	0	0	12
1989	309	110	76	121	0	2	2	0	3	0	0	0	0	12
1990	313	92	109	107	0	0	5	0	3	0	0	0	0	0
1991	336	101	95	133	1	2	0	0	4	0	0	2	0	3
1992	426	128	122	171	3	1	1	0	2	0	0	0	0	0
1993	391	175	86	129	0	0	7	3	1	1	0	0	0	5
1994	486	220	78	182	0	2	12	0	1	0	0	0	0	4
1995	443	175	114	152	0	3	16	0	0	0	0	0	0	5
1996	499	228	82	186	1	0	19	0	1	0	0	0	0	18
1997	489	222	97	166	0	4	12	0	4	1	0	1	1	14
1998	588	276	132	171	1	1	18	0	5	0	0	2	0	19
1999	695	389	137	154	1	2	14	0	2	1	0	2	0	32
2000	558	264	136	147	2	2	34	0	47	1	0	1	0	30
2001	670	321	162	167	1	4	16	2	11	1	0	0	0	72
2002	680	392	148	128	1	1	27	7	5	2	0	1	0	80
2003	680	392	159	120	2	3	13	3	8	1	0	0	0	12

(B) Engineering

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Clinical interns	Employed
1968	407	0	35	18	—	354
1969	461	0	38	38	—	385
1970	590	0	68	81	—	441
1971	533	0	68	17	—	448
1972	544	0	92	14	—	438
1973	513	0	109	31	—	373
1974	598	0	117	15	—	466
1975	570	0	126	40	—	404
1976	551	2	160	46	—	343
1977	659	2	167	56	0	434
1978	573	1	161	70	0	341
1979	656	0	135	93	0	428
1980	657	1	175	47	0	434
1981	685	6	159	82	0	438
1982	621	6	92	103	0	420
1983	579	6	94	66	0	413
1984	563	4	139	8	0	412
1985	552	1	114	26	0	411
1986	588	1	126	59	0	402
1987	638	0	131	98	0	409
1988	721	1	141	87	0	492
1989	915	0	194	97	0	624
1990	937	4	150	142	0	641
1991	1,048	0	96	202	0	750
1992	1,141	3	134	206	0	798
1993	1,354	2	146	203	0	1,003
1994	1,550	3	194	235	0	1,118
1995	1,783	5	214	338	0	1,226
1996	2,127	12	305	329	0	1,481
1997	2,434	5	381	349	0	1,699
1998	2,767	2	438	520	0	1,807
1999	2,990	13	801	333	0	1,843
2000	2,903	13	981	184	0	1,725
2001	3,048	4	996	262	0	1,786
2002	3,073	5	1,041	307	0	1,720
2003	3,212	15	1,168	250	0	1,779

(unit: persons)

Year	Employed													
	Professional and technical workers					Managers and officials	Clerical and related workers	Sales workers	Service workers	Protective service workers	Agricultural, forestry and fisheries workers	Workers in transport and communications occupations	Production process workers and laborers	Others
		Scientific researchers	Engineers and technicians	Professors and teachers	Public health and medical workers									
1968	340	5	75	259	0	0	2	0	3	8	0	0	0	1
1969	382	22	94	264	0	0	2	0	0	1	0	0	0	0
1970	417	18	160	239	0	0	1	0	0	3	0	1	0	19
1971	413	37	113	256	0	0	0	0	0	0	0	2	0	33
1972	391	26	130	235	0	0	0	0	0	0	0	1	0	46
1973	342	32	104	206	0	0	1	0	0	0	0	1	0	29
1974	399	37	170	187	0	0	1	0	0	0	0	10	0	56
1975	330	32	146	148	0	0	24	0	0	0	0	4	0	46
1976	312	28	100	181	1	0	0	0	0	0	1	3	0	27
1977	392	55	157	177	0	0	4	1	4	0	0	0	0	33
1978	319	41	112	159	0	0	0	0	0	0	0	5	0	17
1979	422	28	211	179	1	1	0	0	0	0	0	4	0	1
1980	427	63	182	177	0	1	0	0	0	0	1	4	0	1
1981	424	52	202	166	1	1	1	0	0	0	0	4	0	8
1982	407	59	169	178	0	2	1	0	0	2	0	0	0	8
1983	405	49	179	173	1	0	2	0	0	0	0	2	0	4
1984	397	46	169	179	0	1	0	0	0	0	0	2	0	12
1985	377	50	156	167	0	0	4	0	0	4	0	0	0	26
1986	376	32	167	174	0	0	1	0	19	1	0	2	1	2
1987	390	34	149	201	1	0	0	0	11	2	0	1	0	5
1988	441	52	169	217	0	0	3	0	31	3	0	1	0	13
1989	559	96	187	271	0	2	2	0	18	0	0	2	0	41
1990	596	58	288	249	1	5	3	1	4	0	0	3	0	29
1991	688	77	307	302	0	9	3	1	9	2	0	3	0	35
1992	724	91	344	286	0	1	14	2	13	4	0	10	0	30
1993	961	173	397	378	1	2	4	1	3	0	0	7	1	24
1994	1,070	206	454	402	0	5	1	1	3	3	0	1	0	34
1995	1,167	163	597	402	0	9	2	2	6	5	0	2	0	33
1996	1,400	268	641	465	2	7	12	0	7	3	0	3	3	46
1997	1,584	276	773	520	5	12	5	0	9	3	1	4	0	81
1998	1,710	329	838	509	4	6	10	2	6	4	0	5	0	64
1999	1,773	447	733	576	7	6	20	1	10	0	0	8	0	25
2000	1,628	474	727	414	5	5	21	2	10	5	0	4	0	50
2001	1,674	411	759	487	5	16	22	5	9	2	0	5	0	53
2002	1,620	342	831	426	5	13	13	2	7	4	0	2	1	58
2003	1,661	414	744	481	3	12	18	1	18	7	0	4	1	57

(C) Agriculture

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Clinical interns	Employed
1968	109	0	31	15	―	63
1969	130	0	71	1	―	58
1970	154	0	49	37	―	68
1971	172	0	54	15	―	103
1972	164	0	80	9	―	75
1973	220	0	60	70	―	90
1974	242	0	95	19	―	128
1975	196	0	95	5	―	96
1976	176	0	95	3	―	78
1977	234	1	133	6	0	94
1978	282	1	133	25	0	123
1979	224	0	113	25	0	86
1980	218	0	102	11	0	105
1981	292	0	151	37	0	104
1982	282	0	169	24	0	89
1983	227	0	102	40	0	85
1984	251	0	113	31	0	107
1985	251	0	101	37	0	113

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Clinical interns	Employed
1986	230	0	83	33	0	114
1987	241	7	89	31	0	114
1988	295	3	79	40	0	173
1989	360	1	89	81	0	189
1990	332	8	88	54	0	182
1991	394	4	123	23	0	244
1992	465	18	145	35	0	267
1993	452	19	131	36	0	266
1994	548	23	119	81	0	325
1995	601	19	199	61	0	322
1996	676	17	251	37	0	371
1997	780	3	302	54	0	421
1998	865	3	372	40	0	450
1999	882	5	392	59	0	426
2000	990	6	437	81	0	466
2001	953	4	401	73	0	475
2002	1,042	0	409	88	0	545
2003	1,093	9	489	70	0	525

(unit: persons)

Year	Employed													
	Professional and technical workers					Managers and officials	Clerical and related workers	Sales workers	Service workers	Protective service workers	Agricultural, forestry and fisheries workers	Workers in transport and communications occupations	Production process workers and laborers	Others
		Scientific researchers	Engineers and technicians	Professors and teachers	Public health and medical workers									
1968	62	6	11	43	2	0	0	0	0	0	0	0	0	1
1969	56	10	10	33	2	0	0	0	0	0	0	0	0	2
1970	66	9	11	41	3	0	0	0	0	0	0	0	0	2
1971	72	12	9	50	1	0	2	0	0	0	0	0	0	29
1972	74	24	9	41	0	0	0	0	0	0	0	0	0	1
1973	87	22	14	48	0	0	2	0	0	0	0	0	0	1
1974	122	26	19	76	1	1	2	0	0	0	1	0	0	2
1975	91	19	8	64	0	0	0	1	0	0	0	0	0	4
1976	74	23	10	38	2	0	2	1	1	0	0	0	0	0
1977	82	40	7	35	0	2	9	1	0	0	0	0	0	0
1978	111	29	21	58	1	0	12	0	0	0	0	0	0	0
1979	75	19	16	38	1	0	2	0	2	0	0	1	0	6
1980	99	21	31	44	0	0	2	0	0	0	1	0	0	3
1981	101	32	20	45	1	0	3	0	0	0	0	0	0	0
1982	87	25	26	35	1	0	2	0	0	0	0	0	0	0
1983	82	16	34	22	2	0	1	0	1	0	0	0	0	1
1984	94	29	22	42	1	0	5	0	0	0	0	0	0	8
1985	113	31	31	45	3	0	0	0	0	0	0	0	0	0
1986	111	37	23	44	5	0	0	1	2	0	0	0	0	0
1987	109	45	14	48	2	0	2	0	0	0	0	0	0	3
1988	166	50	26	88	2	2	4	0	0	0	1	0	0	0
1989	187	46	54	83	4	0	1	0	0	0	0	0	0	1
1990	171	66	18	76	10	2	6	0	0	0	0	0	0	3
1991	234	90	38	98	0	0	3	0	0	0	0	0	0	7
1992	236	89	46	90	3	0	6	2	4	0	0	0	0	19
1993	254	88	48	115	2	2	3	0	1	0	0	0	0	6
1994	297	135	42	105	11	5	2	0	1	0	0	1	0	19
1995	296	127	52	101	8	0	6	2	2	0	0	0	0	16
1996	355	172	62	111	8	4	1	0	0	0	0	0	0	11
1997	376	164	73	128	10	2	11	3	0	0	0	0	0	29
1998	383	159	64	147	12	7	16	2	2	0	1	0	0	39
1999	398	198	64	114	20	3	5	1	7	0	0	0	0	12
2000	434	242	68	113	5	5	4	0	6	0	0	0	0	17
2001	435	226	62	131	12	4	3	1	1	0	0	0	0	31
2002	493	255	82	134	15	4	29	0	2	1	1	0	0	15
2003	484	271	65	123	19	6	12	1	1	1	0	0	0	20

(D) Health sciences

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Clinical interns	Employed
1968	1,421	0	657	2	−	762
1969	1,548	0	772	34	−	742
1970	1,401	0	503	52	−	846
1971	1,047	0	370	11	−	666
1972	1,145	0	438	18	−	689
1973	695	0	203	34	−	458
1974	558	0	116	20	−	422
1975	677	0	162	27	−	488
1976	810	5	152	53	−	600
1977	791	2	165	31	31	562
1978	802	1	167	31	16	587
1979	969	2	195	11	24	737
1980	1,036	0	166	17	24	829
1981	1,149	0	214	13	19	903
1982	1,332	0	175	12	53	1,092
1983	1,522	0	214	24	46	1,238
1984	1,536	1	263	21	59	1,192
1985	1,713	4	273	45	22	1,369
1986	1,888	2	274	21	80	1,511
1987	2,038	1	325	26	68	1,618
1988	2,301	0	398	35	71	1,797
1989	2,304	2	381	55	90	1,776
1990	2,622	1	445	63	81	2,032
1991	2,681	11	457	54	34	2,125
1992	2,684	2	482	56	18	2,126
1993	2,757	3	528	77	18	2,131
1994	2,858	9	556	86	48	2,159
1995	2,956	3	625	106	31	2,191
1996	3,153	9	619	109	63	2,353
1997	3,370	5	625	114	16	2,610
1998	3,559	4	703	114	1	2,737
1999	3,876	2	813	167	21	2,873
2000	3,977	11	836	220	51	2,859
2001	4,173	7	924	211	22	3,009
2002	4,310	7	911	163	8	3,221
2003	4,561	25	929	233	82	3,292

(unit: persons)

Year	Employed: Professional and technical workers					Managers and officials	Clerical and related workers	Sales workers	Service workers	Protective service workers	Agricultural, forestry and fisheries workers	Workers in transport and communications occupations	Production process workers and laborers	Others
		Scientific researchers	Engineers and technicians	Professors and teachers	Public health and medical workers									
1968	762	4	8	331	419	0	0	0	0	0	0	0	0	0
1969	742	1	9	302	430	0	0	0	0	0	0	0	0	0
1970	841	34	9	369	429	0	3	0	0	0	0	0	0	2
1971	659	11	20	236	392	0	1	0	0	0	0	0	0	6
1972	683	25	18	257	383	0	2	0	0	0	0	0	0	4
1973	454	23	11	188	231	0	1	0	0	0	0	0	0	3
1974	408	20	11	218	156	0	2	0	0	0	0	0	0	12
1975	486	26	17	245	198	0	0	0	1	0	0	0	0	1
1976	577	20	9	235	313	0	0	0	0	0	0	0	0	23
1977	559	14	17	251	273	0	0	0	0	0	0	0	0	3
1978	584	15	13	276	277	0	0	0	0	0	0	0	0	3
1979	731	26	13	345	346	0	1	0	0	0	0	0	0	5
1980	827	38	8	389	392	0	1	0	0	0	0	0	0	1
1981	890	51	13	425	400	0	2	0	1	0	0	0	0	10
1982	1,090	30	19	425	614	0	0	0	0	0	0	0	0	2
1983	1,236	38	28	422	743	0	0	0	1	0	0	0	0	1
1984	1,182	49	30	418	684	0	0	1	0	1	0	0	0	8
1985	1,361	49	27	408	873	6	1	0	0	1	0	0	0	0
1986	1,496	56	24	504	910	6	1	1	0	0	0	0	0	7
1987	1,612	68	23	509	1,006	6	0	0	0	0	0	0	0	0
1988	1,793	58	25	581	1,120	1	0	1	0	0	0	0	0	2
1989	1,768	80	27	546	1,105	0	0	0	0	0	0	0	0	8
1990	2,025	109	37	609	1,266	0	1	1	3	0	0	0	0	2
1991	2,111	98	26	578	1,400	2	2	0	2	0	0	0	0	8
1992	2,114	122	20	582	1,388	1	3	1	2	0	0	0	0	5
1993	2,126	105	33	565	1,421	2	2	0	0	0	0	0	0	1
1994	2,151	110	27	590	1,418	0	4	0	1	1	0	0	0	2
1995	2,182	90	26	604	1,462	0	1	0	1	1	0	0	0	6
1996	2,346	108	26	547	1,664	0	1	1	1	1	0	0	0	3
1997	2,577	151	32	533	1,861	1	2	0	1	1	0	0	0	28
1998	2,713	202	31	562	1,913	0	1	0	1	0	0	0	0	22
1999	2,808	191	40	556	2,014	1	5	0	2	0	0	0	0	57
2000	2,833	160	54	555	2,040	5	7	0	0	0	0	0	0	14
2001	2,961	240	44	553	2,117	1	7	0	2	0	0	0	0	38
2002	3,141	272	54	655	2,135	2	5	2	13	0	0	0	0	58
2003	3,270	332	48	659	2,204	0	13	0	1	1	0	0	0	7

(E) Natural science

(unit: persons)

Year	Graduates	Enrolled in higher education	Unemployed	Others	Clinical interns	Employed
1968	2,258	0	804	48	—	1,406
1969	2,494	0	987	83	—	1,424
1970	2,536	0	773	189	—	1,574
1971	2,213	0	685	50	—	1,478
1972	2,371	0	848	78	—	1,445
1973	1,934	0	614	181	—	1,139
1974	1,907	0	519	119	—	1,269
1975	1,937	1	584	124	—	1,228
1976	2,022	8	669	155	—	1,190
1977	2,251	13	742	152	31	1,313
1978	2,157	5	760	155	16	1,221
1979	2,404	4	745	149	24	1,482
1980	2,500	3	752	94	24	1,627
1981	2,733	7	837	198	19	1,672
1982	2,804	6	738	165	53	1,842
1983	2,910	6	707	183	46	1,968
1984	2,879	6	756	99	59	1,959
1985	3,126	5	766	153	22	2,180
1986	3,270	3	724	138	80	2,325
1987	3,522	11	803	216	68	2,424
1988	3,906	5	866	204	71	2,760
1989	4,254	4	920	323	90	2,917
1990	4,525	13	923	332	81	3,176
1991	4,797	17	949	331	34	3,466
1992	5,020	27	1,004	350	18	3,621
1993	5,333	24	1,081	402	18	3,808
1994	5,819	37	1,149	478	48	4,107
1995	6,296	37	1,447	575	31	4,206
1996	6,972	40	1,580	547	63	4,742
1997	7,729	18	1,807	632	16	5,256
1998	8,492	13	2,007	844	1	5,627
1999	9,154	27	2,548	668	21	5,890
2000	9,326	43	2,887	622	51	5,723
2001	9,684	22	2,958	636	22	6,046
2002	10,032	17	3,023	695	8	6,289
2003	10,366	54	3,231	683	82	6,316

(unit: persons)

Year	Employed													
	Professional and technical workers					Managers and officials	Clerical and related workers	Sales workers	Service workers	Protective service workers	Agricultural, forestry and fisheries workers	Workers in transport and communications occupations	Production process workers and laborers	Others
		Scientific researchers	Engineers and technicians	Professors and teachers	Public health and medical workers									
1968	1,387	44	104	811	421	0	2	0	3	8	0	1	0	5
1969	1,416	56	135	782	435	1	2	0	0	1	0	0	0	4
1970	1,539	83	225	797	432	0	4	0	0	3	0	1	0	27
1971	1,394	84	203	706	393	1	3	0	0	0	0	2	0	78
1972	1,375	118	187	687	383	0	2	0	0	0	0	1	0	67
1973	1,089	121	173	559	232	1	5	0	1	0	0	1	0	42
1974	1,157	144	250	597	157	1	7	0	0	0	2	10	0	92
1975	1,140	114	224	596	200	0	24	2	2	0	0	4	0	56
1976	1,129	92	148	568	318	0	3	1	1	1	1	3	1	50
1977	1,240	137	222	599	273	3	13	3	4	0	0	0	0	50
1978	1,176	113	178	595	278	0	19	0	0	0	0	5	0	21
1979	1,448	110	280	704	349	1	12	2	2	0	0	5	0	12
1980	1,611	176	276	758	392	1	3	0	0	0	2	4	0	6
1981	1,635	190	288	744	404	2	8	0	4	0	0	4	0	19
1982	1,812	188	260	739	618	2	8	1	6	2	0	0	0	11
1983	1,952	156	303	728	746	0	6	0	2	0	0	2	0	6
1984	1,896	183	289	733	685	1	5	2	1	1	0	2	0	51
1985	2,114	212	288	723	877	6	7	0	1	5	0	0	0	47
1986	2,256	203	290	839	915	7	2	3	24	1	0	2	1	29
1987	2,382	223	260	873	1,010	6	3	1	11	3	0	2	0	16
1988	2,683	225	306	1,015	1,122	3	10	1	31	3	1	1	0	27
1989	2,823	332	344	1,021	1,109	4	5	0	21	0	0	2	0	62
1990	3,105	325	452	1,041	1,277	7	15	2	10	0	0	3	0	34
1991	3,369	366	466	1,111	1,401	13	8	1	15	2	0	5	0	53
1992	3,500	430	532	1,129	1,394	3	24	5	21	4	0	10	0	54
1993	3,732	541	564	1,187	1,424	6	16	4	5	1	0	7	1	36
1994	4,004	671	601	1,279	1,429	12	19	1	6	4	0	2	0	59
1995	4,088	555	789	1,259	1,470	12	25	4	9	6	0	2	0	60
1996	4,600	776	811	1,309	1,675	11	33	1	9	4	0	3	3	78
1997	5,026	813	975	1,347	1,876	19	30	3	14	5	1	5	1	152
1998	5,394	966	1,065	1,389	1,930	14	45	4	14	4	1	7	0	144
1999	5,674	1,225	974	1,400	2,042	12	44	2	21	1	0	10	0	126
2000	5,453	1,140	985	1,229	2,052	17	66	2	63	6	0	5	0	111
2001	5,740	1,198	1,027	1,338	2,135	25	48	8	23	3	0	5	0	194
2002	5,934	1,261	1,115	1,343	2,156	20	74	11	27	7	1	3	1	211
2003	6,095	1,409	1,016	1,383	2,228	21	56	5	28	10	0	4	1	96

Note: 'Employed' includes persons who continue education while being employed.

Source: MEXT, Report on 'School Basic Survey'

Table 5-4-1: Trends in the number of doctorates conferred

(unit: number)

FY		1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Science	Number	651	685	657	651	676	717	843	782	814	822	791	762	774	807	860
	(%)	14.8	15.7	15.8	14.4	14.7	14.0	15.8	13.8	14.0	13.1	12.0	11.2	10.7	10.8	10.8
Engineering	Number	845	853	930	1,000	986	1,079	1,043	1,166	1,195	1,186	1,236	1,278	1,290	1,291	1,404
	(%)	19.2	19.6	22.4	22.1	21.5	21.0	19.6	20.6	20.6	18.9	18.7	18.8	17.8	17.3	17.6
Agriculture	Number	318	374	347	417	346	424	450	386	367	463	471	455	462	547	620
	(%)	7.2	8.6	8.4	9.2	7.5	8.3	8.5	6.8	6.3	7.4	7.1	6.7	6.4	7.3	7.8
Health science	Number	2,402	2,234	2,031	2,259	2,371	2,640	2,733	3,103	3,200	3,537	3,853	4,008	4,394	4,502	4,727
	(%)	54.5	51.3	49.0	49.9	51.6	51.4	51.4	54.9	55.1	56.4	58.4	58.9	60.7	60.2	59.3
Humanities and social sciences	Number	153	171	134	162	174	212	185	152	167	187	172	197	208	214	236
	(%)	3.5	3.9	3.2	3.6	3.8	4.1	3.5	2.7	2.9	3.0	2.6	2.9	2.9	2.9	3.0
Others	Number	38	35	49	40	39	66	68	59	69	74	76	110	105	116	131
	(%)	0.9	0.8	1.2	0.9	0.8	1.3	1.3	1.0	1.2	1.2	1.2	1.6	1.5	1.6	1.6
Total	Number	4,407	4,352	4,148	4,529	4,592	5,138	5,322	5,648	5,812	6,269	6,599	6,810	7,233	7,477	7,978

(unit: number)

FY		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Science	Number	820	837	881	876	835	892	1,009	1,168	1,135	1,243	1,315	1,481	1,542	1,579	1,586	1,602
	(%)	9.6	9.1	9.2	8.7	7.9	8.2	8.7	9.4	8.7	9.2	9.4	10.0	10.0	10.3	9.9	9.9
Engineering	Number	1,493	1,547	1,717	1,774	1,967	2,094	2,362	2,783	3,009	3,312	3,411	3,580	3,934	3,800	3,964	3,955
	(%)	17.5	16.9	17.9	17.7	18.5	19.2	20.4	22.3	23.1	24.5	24.5	24.2	25.4	24.7	24.7	24.4
Agriculture	Number	564	614	671	734	719	870	824	922	1,008	1,108	1,043	1,094	1,100	1,147	1,241	1,248
	(%)	6.6	6.7	7.0	7.3	6.8	8.0	7.1	7.4	7.7	8.2	7.5	7.4	7.1	7.5	7.7	7.7
Health science	Number	5,233	5,657	5,789	6,084	6,436	6,356	6,656	6,712	6,861	6,679	6,800	7,108	7,091	6,825	7,053	6,962
	(%)	61.3	61.8	60.3	60.6	60.5	58.4	57.5	53.8	52.6	49.4	48.8	48.0	45.8	44.4	43.9	43.0
Humanities and social sciences	Number	260	292	301	272	312	359	448	544	609	703	748	852	1,004	1,098	1,211	1,324
	(%)	3.0	3.2	3.1	2.7	2.9	3.3	3.9	4.4	4.7	5.2	5.4	5.8	6.5	7.1	7.5	8.2
Others	Number	163	210	243	296	364	314	277	357	422	487	604	685	799	908	1,021	1,092
	(%)	1.9	2.3	2.5	2.9	3.4	2.9	2.4	2.9	3.2	3.6	4.3	4.6	5.2	5.9	6.4	6.7
Total	Number	8,533	9,157	9,602	10,036	10,633	10,885	11,576	12,486	13,044	13,532	13,921	14,800	15,470	15,357	16,076	16,183

Note: 1) 'Health sciences' consist of medicine, dentistry, pharmacy, and healthcare.
2) 'Others' includes education, arts, and home economics.
Source: Until 1986, 'Compilation of Higher Education Statistical Data (1989)' by Educational Research Center, Hiroshima University, and after 1987, data from the Ministry of Education, Culture, Sports, Science and Technology (MEXT).

Table 5-4-2: Trends in the number of doctorates conferred (by course/by dissertation)

(unit: number)

FY		1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Science	Course Doc.	348	344	349	345	354	388	441	425	469	457	433	429	397	459	497
	Dissertaion Doc.	303	341	308	306	322	329	402	357	345	365	358	333	377	348	363
	Total	651	685	657	651	676	717	843	782	814	822	791	762	774	807	860
Engineering	Course Doc.	428	381	436	479	456	490	485	523	545	523	541	506	489	447	480
	Dissertaion Doc.	417	472	494	521	530	589	558	643	650	663	695	772	801	844	924
	Total	845	853	930	1,000	986	1,079	1,043	1,166	1,195	1,186	1,236	1,278	1,290	1,291	1,404
Agriculture	Course Doc.	95	135	133	132	124	148	174	163	145	178	176	146	171	174	214
	Dissertaion Doc.	223	239	214	285	222	276	276	223	222	285	295	309	291	373	406
	Total	318	374	347	417	346	424	450	386	367	463	471	455	462	547	620
Health sciences	Course Doc.	995	819	612	634	671	731	710	811	937	1,071	1,201	1,331	1,444	1,542	1,703
	Dissertaion Doc.	1,407	1,415	1,419	1,625	1,700	1,909	2,023	2,292	2,263	2,466	2,652	2,677	2,950	2,960	3,024
	Total	2,402	2,234	2,031	2,259	2,371	2,640	2,733	3,103	3,200	3,537	3,853	4,008	4,394	4,502	4,727
Humanities and social sciences	Course Doc.	26	34	26	30	38	45	36	32	34	40	44	50	47	47	51
	Dissertaion Doc.	127	137	108	132	136	167	149	120	133	147	128	147	161	167	185
	Total	153	171	134	162	174	212	185	152	167	187	172	197	208	214	236
Others	Course Doc.	11	7	19	14	12	12	13	20	24	21	29	54	53	56	59
	Dissertaion Doc.	27	28	30	26	27	54	55	39	45	53	47	56	52	60	72
	Total	38	35	49	40	39	66	68	59	69	74	76	110	105	116	131
Total	Course Doc.	1,903	1,720	1,575	1,634	1,655	1,814	1,859	1,974	2,154	2,290	2,424	2,516	2,601	2,725	3,004
	Dissertaion Doc.	2,504	2,632	2,573	2,895	2,937	3,324	3,463	3,674	3,658	3,979	4,175	4,294	4,632	4,752	4,974
	Total	4,407	4,352	4,148	4,529	4,592	5,138	5,322	5,648	5,812	6,269	6,599	6,810	7,233	7,477	7,978

(unit: number)

FY		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Science	Course Doc.	479	464	518	531	522	586	638	761	811	908	995	1,163	1,242	1,319	1,343	1,376
	Dissertaion Doc.	341	373	363	345	313	306	371	407	324	335	320	318	300	260	243	226
	Total	820	837	881	876	835	892	1,009	1,168	1,135	1,243	1,315	1,481	1,542	1,579	1,586	1,602
Engineering	Course Doc.	505	621	788	792	882	983	1,184	1,432	1,613	1,940	2,143	2,350	2,684	2,680	2,791	2,934
	Dissertaion Doc.	988	926	929	982	1,085	1,111	1,178	1,351	1,396	1,372	1,268	1,230	1,250	1,120	1,173	1,021
	Total	1,493	1,547	1,717	1,774	1,967	2,094	2,362	2,783	3,009	3,312	3,411	3,580	3,934	3,800	3,964	3,955
Agriculture	Course Doc.	172	247	287	304	337	385	376	446	508	587	641	694	745	776	819	886
	Dissertaion Doc.	392	367	384	430	382	485	448	476	500	521	402	400	355	371	422	362
	Total	564	614	671	734	719	870	824	922	1,008	1,108	1,043	1,094	1,100	1,147	1,241	1,248
Health sciences	Course Doc.	1,960	2,110	2,110	2,467	2,475	2,503	2,624	2,670	2,736	2,872	3,175	3,372	3,580	3,613	3,836	3,914
	Dissertaion Doc.	3,273	3,547	3,679	3,617	3,961	3,853	4,032	4,042	4,125	3,807	3,625	3,736	3,511	3,212	3,217	3,048
	Total	5,233	5,657	5,789	6,084	6,436	6,356	6,656	6,712	6,861	6,679	6,800	7,108	7,091	6,825	7,053	6,962
Humanities and social sciences	Course Doc.	57	69	75	64	102	109	146	178	256	322	343	446	564	657	718	801
	Dissertaion Doc.	203	223	226	208	210	250	302	366	353	381	405	406	440	441	493	523
	Total	260	292	301	272	312	359	448	544	609	703	748	852	1,004	1,098	1,211	1,324
Others	Course Doc.	79	97	171	191	230	213	166	231	279	348	419	518	619	725	813	896
	Dissertaion Doc.	84	113	72	105	134	101	111	126	143	139	185	167	180	183	208	196
	Total	163	210	243	296	364	314	277	357	422	487	604	685	799	908	1,021	1,092
Total	Course Doc.	3,252	3,608	3,949	4,349	4,548	4,779	5,134	5,718	6,203	6,977	7,716	8,543	9,434	9,770	10,320	10,807
	Dissertaion Doc.	5,281	5,549	5,653	5,687	6,085	6,106	6,442	6,768	6,841	6,555	6,205	6,257	6,036	5,587	5,756	5,376
	Total	8,533	9,157	9,602	10,036	10,633	10,885	11,576	12,486	13,044	13,532	13,921	14,800	15,470	15,357	16,076	16,183

Note: Same as Table 5-4-1.

Source: Same as Table 5-4-1.

Table 5-4-3: International comparison of the number of doctorate recipients per 1 million population (FY2000)

(A) Number of doctorates

Country	Number of doctorates									Population
	FY	Total	Humanities and Arts	Law and Economics	Science	Engineering	Agriculture	Medicine	Others	(1,000 persons)
Japan	2000	16,076	644	610	1,586	3,964	1,241	7,053	978	126,926
U.S.	2000	44,904	10,659	6,292	9,600	6,500	1,139	2,855	7,859	282,434
Germany	2000	26,017	2,696	3,261	7,386	2,398	1,003	8,618	655	82,188
U.K.	2000	11,500	1,500	1,500	4,100	1,800	300	1,600	800	59,756

(B) Number of doctorates per 1 million population

Country	Number of doctorates (per 1 million population)								
	FY	Total	Humanities and Art	Law and Economics	Science	Engineering	Agriculture	Medicine	Others
Japan	2000	126.7	5.1	4.8	12.5	31.2	9.8	55.6	7.7
U.S.	2000	159.0	37.7	22.3	34.0	23.0	4.0	10.1	27.8
Germany	2000	316.6	32.8	39.7	89.9	29.2	12.2	104.9	8.0
U.K.	2000	192.4	25.1	25.1	68.6	30.1	5.0	26.8	13.4

Note: <Japan>Number of doctorates conferred during April, 2000 through March, 2001.
<U.S.>Number of doctorates conferred in the school year starting from September, 2000. It includes Ph.D.(Doctor of Philosophy) and D.Sc.(Doctor of Science), but excludes first professional degrees, such as M.D.(Doctor of Medicine).
<Germany>Number of persons who have passed the exam for the doctorate degree during the winter semester of 2000 through the summer semester of 2001.
<U.K.>Number of doctorates in 2000 (calendar year).
Population of each country is the same as Reference Statistics A.
Source: MEXT, 'International Comparison of Education Indicators 2004'

Table 6-1-1: Trends in total R&D expenditure for selected countries

(A) Nominal value (national currency)

Year	Japan (million yen)	U.S. (million dollars)	Germany (million euros)	France (million euros)	U.K. (million pounds)	China (million yuan)	Republic of Korea (million won)	EU (million dollars)
1970	1,355,505	26,271	-	-	-	-	-	-
1971	1,532,372	26,952	-	-	-	-	-	-
1972	1,791,871	28,740	-	-	-	-	-	-
1973	2,215,836	30,952	-	-	-	-	-	-
1974	2,716,032	33,359	-	-	-	-	-	-
1975	2,974,573	35,671	-	-	-	-	-	-
1976	3,320,685	39,435	-	-	-	-	-	-
1977	3,651,319	43,421	-	-	-	-	-	-
1978	4,045,864	48,774	-	-	-	-	-	-
1979	4,583,630	55,457	-	-	-	-	-	-
1980	5,246,248	63,273	-	-	-	-	-	-
1981	5,982,356	72,267	19,420	9,524 a,*	6,024 a	-	-	51,917 b
1982	6,528,700	80,848	20,819	11,409 *	-	-	-	—
1983	7,180,782	90,075	21,809	12,908 *	6,662	-	-	60,842 b
1984	7,893,931	102,344	22,876	14,665 *	-	-	-	66,694 b
1985	8,890,299	114,778	25,629	16,147 *	7,959 a	-	-	74,232 b
1986	9,192,932	120,337	27,283	17,266 *	8,623	-	-	79,135 b
1987	9,836,640	126,299	29,212	18,502 *	9,221	-	-	85,656 b
1988	10,627,572	133,930	30,660	19,915 *	10,035	-	-	92,587 b
1989	11,815,482	141,914	32,578	21,885 *	11,069	-	-	100,991 b
1990	13,078,315	152,051	34,051	23,959 *	11,991	-	-	109,389 b
1991	13,771,524	160,914	38,024	24,863 *	11,838	15,946 m,v	4,158,441 g	114,776 a,b
1992	13,909,493	165,358	38,842	25,821 *	12,367	19,803 m,v	4,989,031 g	120,538 a,b
1993	13,709,139	165,716	38,888	26,484 *	13,189	24,801 m,v	6,152,983 g	121,093 b
1994	13,596,030	169,217	39,165	26,764 *	13,684	30,626 m,v	7,894,746 g	124,002 b
1995	14,408,236	183,614	40,658	27,303 *	14,034	34,869 m,v	9,440,606 g	130,824
1996	15,079,315	197,344	41,363	27,835 *	14,336	40,448 m,v	10,878,050 g	134,891 b
1997	15,741,499	212,156	42,859	27,756 a,*	14,657	50,916 m,v	12,185,807 g	143,841
1998	16,139,925	226,367	44,649	28,319 *	15,454	55,112 m,v	11,336,617 g	150,528 b
1999	16,010,588	243,562	48,191	29,528	16,929	67,890 m,v	11,921,752 g	162,503 b
2000	16,289,336	264,616	50,619 c	30,954 a	17,544	89,567 a,v	13,848,501 g	175,708 b
2001	16,527,998	281,767 Pr	52,399 c	32,227 p	18,815	104,248	16,110,522 g	186,324 b,p
2002	16,675,053	291,663 Pr	52,763 c	-	-	-	-	-

(B) National value (OECD purchansing power parity equivalent)

Year	Japan (million yen)	U.S. (million yen)	Germany (million yen)	France (million yen)	U.K. (million yen)	China (million yen)	Republic of Korea (million yen)	EU (million yen)
1970	1,355,505	5,823,887	-	-	-	-	—	-
1971	1,532,372	5,978,789	-	-	-	-	—	-
1972	1,791,871	6,464,287	-	-	-	-	—	-
1973	2,215,836	7,431,730	-	-	-	-	—	-
1974	2,716,032	8,876,263	-	-	-	-	—	-
1975	2,974,573	9,302,212	-	-	-	-	—	-
1976	3,320,685	10,514,672	-	-	-	-	—	-
1977	3,651,319	11,612,208	-	-	-	-	—	-
1978	4,045,864	12,738,208	-	-	-	-	—	-
1979	4,583,630	13,732,706	-	-	-	-	—	-
1980	5,246,248	15,130,093	-	-	-	-	—	-
1981	5,982,356	17,449,250	3,813,176	2,646,505 a,*	2,762,929 a	-	—	12,535,538 b
1982	6,528,700	18,730,315	3,996,027	2,878,844 *	-	-	—	—
1983	7,180,782	20,325,316	4,138,571	3,023,666 *	2,788,443	-	—	13,728,992 b
1984	7,893,931	22,658,174	4,370,153	3,280,906 *	-	-	—	14,765,627 b
1985	8,890,299	25,067,159	4,903,455	3,485,672 *	3,157,531 a	-	—	16,211,929 b
1986	9,192,932	26,101,781	5,168,869	3,600,076 *	3,373,697	-	—	17,164,724 b
1987	9,836,640	26,543,478	5,448,926	3,750,394 *	3,439,688	-	—	18,001,790 b
1988	10,627,572	27,294,305	5,675,687	3,942,590 *	3,553,581	-	—	18,868,775 b
1989	11,815,482	28,265,295	6,024,162	4,276,248 *	3,733,505	-	—	20,114,639 b
1990	13,078,315	29,695,560	6,229,075	4,640,714 *	3,888,166	-	—	21,363,574 b
1991	13,771,524	31,066,105	6,855,552	4,834,441 *	3,597,431	2,525,049 m,v	1,335,077 g	22,158,592 a,b
1992	13,909,493	31,113,927	6,919,664	4,965,823 *	3,778,803	2,943,713 m,v	1,485,885 g	22,680,551 a,b
1993	13,709,139	30,542,553	6,666,030	4,871,360 *	3,814,247	3,217,646 m,v	1,716,702 g	22,318,202 b
1994	13,596,030	30,558,729	6,686,932	4,788,820 *	3,829,505	3,311,609 m,v	2,046,184 g	22,393,325 b
1995	14,408,236	31,203,712	6,704,345	4,711,453 *	3,647,293	3,286,398 m,v	2,196,228 g	22,232,445
1996	15,079,315	32,683,146	6,608,467	4,601,220 *	3,686,736	3,537,600 m,v	2,420,165 g	22,339,904 b
1997	15,741,499	34,583,889	7,034,348	4,562,845 a,*	3,795,490	4,321,963 m,v	2,637,822 g	23,447,784
1998	16,139,925	37,952,850	7,543,971	4,807,581 *	4,009,018	4,916,525 m,v	2,432,307 g	25,237,563 b
1999	16,010,588	39,465,739	7,987,584	4,917,425	4,216,914	6,120,968 m,v	2,558,971 g	26,331,287 b
2000	16,289,336	41,160,675	8,332,860 c	5,113,416 a	4,228,302	7,821,667 a,v	2,951,137 g	27,331,151 b
2001	16,527,998	42,201,399 Pr	8,211,780 c	5,257,968 p	4,399,000	8,961,002	3,332,764 g	27,906,524 b,p
2002	16,675,053	42,768,296 Pr	8,054,218 c	-	-	-	-	-

(C) Real value (1995 base; OECD purchasing power parity equivalent)

Year	Japan (million yen)	U.S. (million yen)	Germany (million yen)	France (million yen)	U.K. (million yen)	China (million yen)	Republic of Korea (million yen)	EU (million yen)
1981	7,295,556	19,340,459	2,171,467	913,762 a,*	787,419 a	-	-	-
1982	7,818,802	20,384,960	2,439,126	1,218,640 *	-	-	-	-
1983	8,438,052	21,836,686	2,638,186	1,503,552 *	986,875	-	-	-
1984	9,021,635	23,923,705	2,823,464	1,829,708 *	-	-	-	-
1985	9,944,406	26,007,455	3,231,715	2,123,241 *	1,301,063 a	-	-	-
1986	10,113,237	26,662,710	3,551,850	2,386,625 *	1,458,910	-	-	-
1987	10,833,304	27,168,977	3,870,896	2,630,835 *	1,641,564	-	-	-
1988	11,627,540	27,824,350	4,123,440	2,914,203 *	1,898,619	-	-	-
1989	12,677,556	28,406,519	4,484,533	3,304,434 *	2,249,595	-	-	-
1990	13,708,926	29,296,866	4,838,339	3,721,065 *	2,623,956	-	-	-
1991	14,023,955	29,919,071	5,505,695	3,977,324 *	2,759,688	-	727,488 g	-
1992	13,923,416	30,022,706	5,907,233	4,210,778 *	2,998,715	-	940,110 g	-
1993	13,654,521	29,366,102	6,130,971	4,419,325 *	3,287,151	-	1,241,030 g	-
1994	13,528,388	29,373,911	6,329,638	4,544,698 *	3,463,867	-	1,713,552 g	-
1995	14,408,236	31,203,712	6,704,345	4,711,453 *	3,647,293	-	2,196,228 g	-
1996	15,200,922	32,911,692	6,890,167	4,870,660 *	3,852,456	-	2,629,324 g	-
1997	15,820,602	34,700,860	7,187,425	4,923,787 a,*	4,049,184	-	3,038,971 g	-
1998	16,237,349	36,567,717	7,570,066	5,067,661 *	4,389,855	-	2,969,610 g	-
1999	16,354,022	38,755,982	8,211,126	5,314,674	4,918,835	-	3,059,096 g	-
2000	16,968,058	41,256,281	8,603,124 c	5,624,604 a	5,170,479	-	3,514,836 g	-
2001	17,489,945	42,906,827 Pr	9,034,374 c	5,961,714 p	5,672,197	-	4,190,144 g	-
2002	17,930,165	43,902,360 Pr	9,243,230 c	-	-	-	-	-

Note: Pr: Preliminary figure

a: The data lack continuity with the data until previous year.

b: OECD estimates/calculates based on data for each country.

c: Government estimates or modified as necessary to comply with the OECD standard.

g: Excludes R&D expenditure for social science and human science.

m: Undervalued or based on undervalued data.

v: Adding up these figures does not make the total figure.

p: Provisional figure.

1) R&D expenditure includes human/social science. As for Japan, it includes software industry from 1996.

2) Germany is the former federal district before 1990, and Germany after 1991.

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development’

<U.S.>NSF, “National Patterns of R&D Resources 2002 Data Update”

<Germany>Bundesministerium für Bildung und Forschung, “Faktenbericht Forschung 2002.” After 2000, “Main Science and Technology Indicators 2003/01” by OECD.

<France, U.K., China, Korea, EU>OECD, “Main Science and Technology Indicators 2003/01.” After 1991 for U.K., ONS, “Gross domestic expenditure on research and development 2001”

1) Real values were calculated by a deflator (using Reference Statistics D).

2) Purchasing power parity is the same as in Reference Statistics E.

Table 6-1-2: R&D expenditure as a percentage of GDP by country (1999-2000)

(unit: %)

Ranking	Country	Ratio to GDP
1	Sweden	3.9
2	Finland	3.4
3	Japan	3.0
4	U.S.	2.7
5	Republic of Korea	2.7
6	Switzerland	2.6
7	Germany	2.5
8	OECD	2.3
9	Denmark	2.2
10	France	2.2
11	Belgium	2.0
12	Netherlands	1.9
13	EU	1.9
14	Canada	1.9
15	U.K.	1.8
16	Austria	1.8
17	Australia	1.5
18	Norway	1.5
19	Czech Republic	1.3
20	Ireland	1.1
21	Italy	1.1
22	Spain	0.9
23	Hungary	0.8
24	Portugal	0.8
25	Poland	0.7
26	Greece	0.7
27	Slovak Republic	0.7
28	Mexico	0.4

Note: Data of 1999 for OECD, Denmark, Belgium, Greece, the Slovak Republic, and Mexico. Data of 2000 for other countries.
<Japan, U.S., Canada>Post-secondary non-tertiary education is included in the data for higher education.
<Greece, Denmark>Annual average growth rate for 1992-1999.
<OECD>Excludes Hungary, Poland, and the Slovak Republic.
<Belgium>Data for higher education reported only direct public spending.
<EU>Excludes Belgium, Denmark, and Greece.
Source: “STI Scoreboard 2003” by OECD

Table 6-1-3: Trends in R&D expenditure per GDP for selected countries

(unit: %)

Year	Japan	U.S.	Germany	France	U.K.	China	Republic of Korea	EU
1972	1.86	2.32	—	—	—	—	—	—
1973	1.90	2.24	—	—	—	—	—	—
1974	1.96	2.22	—	—	—	—	—	—
1975	1.95	2.18	—	—	—	—	—	—
1976	1.94	2.16	—	—	—	—	—	—
1977	1.92	2.14	—	—	—	—	—	—
1978	1.94	2.13	—	—	—	—	—	—
1979	2.04	2.16	—	—	—	—	—	—
1980	2.13	2.27	—	—	—	—	—	—
1981	2.28	2.31	2.43	1.93	2.38	—	—	1.69
1982	2.38	2.48	2.50	2.02	-	—	—	—
1983	2.51	2.55	2.50	2.06	2.20	—	—	1.73
1984	2.57	2.60	2.50	2.16	-	—	—	1.78
1985	2.72	2.72	2.68	2.22	2.24	—	—	1.86
1986	2.69	2.70	2.70	2.21	2.26	—	—	1.88
1987	2.74	2.66	2.80	2.24	2.20	—	—	1.92
1988	2.75	2.62	2.79	2.24	2.14	—	—	1.91
1989	2.85	2.59	2.79	2.29	2.15	—	—	1.93
1990	2.91	2.62	2.67	2.37	2.15	—	—	1.94
1991	2.92	2.68	2.53	2.37	2.02	0.74	1.92	1.90
1992	2.87	2.61	2.41	2.38	2.02	0.74	2.03	1.88
1993	2.85	2.49	2.35	2.40	2.05	0.72	2.22	1.87
1994	2.77	2.39	2.26	2.34	2.01	0.65	2.44	1.82
1995	2.88	2.48	2.26	2.31	1.95	0.60	2.50	1.80
1996	2.93	2.52	2.26	2.30	1.88	0.60	2.60	1.80
1997	3.02	2.55	2.29	2.22	1.81	0.68	2.69	1.80
1998	3.15	2.59	2.31	2.17	1.80	0.70	2.55	1.81
1999	3.15	2.63	2.44	2.18	1.87	0.83	2.47	1.86
2000	3.17	2.70	2.49	2.18	1.84	1.00	2.65	1.89
2001	3.30	2.79	2.53	2.18	1.89	1.09	2.92	1.93
2002	3.35	2.78	2.50	—	—	—	—	—

Note: Same as Table 1-1-1.
R&D expenditure is the same as in Table 6-1-1. GDP is the same as in Reference Statistics C.
Source: Same as Table 6-1-1. GDP is the same as in Reference Statistics C.

Table 6-1-4: Trends in the number of researchers for selected countries

(unit: persons)

Year	Japan (HC)	Japan (FTE)	U.S.	Germany	France	U.K.	China	Republic of Korea	EU
1970	218,339	-	543,800	-	58,500	-	-	-	-
1971	242,155	-	523,500	90,206	60,100	-	-	-	-
1972	247,309	-	515,000	-	61,200	-	-	-	-
1973	279,186	-	514,600	101,019	62,700	-	-	-	-
1974	292,097	-	520,600	-	64,100	-	-	-	-
1975	310,111	-	527,400	103,736	65,300	-	-	-	-
1976	316,860	-	535,200	-	67,000	-	-	-	-
1977	329,447	-	560,600	110,972	67,981	-	-	-	-
1978	331,467	-	586,600	-	-	-	-	-	-
1979	341,488	-	614,500	116,888	72,889	-	-	-	-
1980	363,534	-	651,200	-	-	-	-	-	-
1981	379,405	-	683,200	128,200	85,500 a	127,000	-	-	488,437 b
1982	392,625	-	711,800	-	90,076	128,000	-	-	—
1983	406,042	-	751,600	134,525	92,682	127,000	-	-	519,636 b
1984	435,340	-	-	-	98,210	129,000	-	-	-
1985	447,719	-	801,900	147,418	102,253	131,000	-	-	559,406 b
1986	473,296	-	-	-	104,953	134,000	-	-	-
1987	487,779	-	895,739	165,614	109,359	134,000	-	-	612,506 a,b
1988	513,267	-	-	-	115,163	137,000	-	-	
1989	535,008	-	943,036	176,402	120,430	133,000	-	-	657,949 b
1990	560,276	-	-	-	123,938	133,000	-	-	-
1991	582,815	-	981,659	241,869	129,780	128,000 a	471,400 m,v		746,543 a,b
1992	598,333	-	-	-	141,710	129,000 a	471,900 m,v		761,020 a,b
1993	622,410	-	1,013,772	-	145,898	131,000	489,200 m,v		769,833 b
1994	641,083	-	-	-	149,193	134,000 a	552,000 m,v		-
1995	658,866	-	1,036,095	231,128	151,249	145,673	522,000 m,v	100,456 g	816,967 b
1996	673,421	-	-	230,189	154,827	144,735	548,000 m,v	99,433 g	833,320 b
1997	695,623	-	1,159,908	235,792	154,742 a	145,641	588,700 m,v	102,660 g	849,277 a,b
1998	704,514	-	-	237,712	155,727	157,662	485,500 m,v	92,541 g	884,860 b
1999	732,658	-	1,261,227	254,691	160,424	-	531,100 m,v	100,210 g	925,723 b
2000	739,504	-	-	257,774 c	172,070 a	-	695,062 a	108,370 g	971,497 b,p
2001	728,215	-	-	259,597 c	-	-	742,700	136,337 g	-
2002	792,699	611,220	-	-	-	-	-	-	-
2003	791,224	612,049	-	-	-	-	-	-	-

Note: The figures are the total number of researchers of both natural science and human/social science for each country.

a: The data lack continuity with the data until the previous year.

b: OECD estimates/calculates based on data for each country.

c: Government estimates or modifies as necessary to comply with the OECD standard.

g: Excludes R&D expenditure for social science and human science.

m: Undervalued or based on undervalued data.

v: Adding up these figures does not make the total figure.

p: Provisional figure.

<Japan>1) As the contents and period of the statistical survey were changed, using the number of full-time researchers as of the 1st day of April until 2000, and after 2001, the number of researchers as of the 31st day of March.

2) Japanese researchers (FTE value) were calculated based on 'Survey on the data for full-time equivalents in universities and colleges' conducted in 2002. For business enterprises, public organizations, and nonprofit organizations, the number of researchers (FTE value) was added up in the 'Report on the Survey of Research and Development' by the Ministry of Public Management, Home Affairs, Posts and Telecommunications.

3) Japan includes the software industry since 1997.

<Germany>Former federal district before 1990, and Germany after 1991.

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Science and Technology-Academic Policy Bureau, Ministry of Education, Culture, Sports, Science and Technology, 'Survey on the data for full-time equivalents in universities and colleges' (November, 2003)

<U.S.>NSF, "National Patterns of R&D Resources 1992, 1996, 2002 Data Update"

<Germany>Bundesministerium für Forschung und Technologie, Bundesbericht Forschung 1996, "Faktenbericht Forschung 2002"

<France>OECD, "Basic Science and Technology Statistics 1996/1998/2001." For Germany after 1999, and for France after 1981, OECD, "Main Science and Technology Indicators 2003/01"

<U.K., China, Korea, EU>OECD, "Main Science and Technology Indicators 2003/01"

Table 6-1-5: Trends in the number of researchers per capita for selected countries

(unit: persons/10,000 persons)

Year	Japan (HC)	Japan (FTE)	U.S.	Germany	France	U.K.	China	Republic of Korea	EU
1981	32.2	-	29.7	20.8	15.4	22.5	-	-	14.3
1982	33.1	-	30.7	-	16.2	22.7	-	-	-
1983	34.0	-	32.1	21.9	16.5	22.5	-	-	15.2
1984	36.2	-	-	-	17.4	22.8	-	-	-
1985	37.0	-	33.6	24.2	18.1	23.1	-	-	16.3
1986	38.9	-	-	-	18.4	23.6	-	-	-
1987	39.9	-	36.9	27.1	19.1	23.5	-	-	17.7
1988	41.8	-	-	-	20.0	24.0	-	-	-
1989	43.4	-	38.1	28.4	20.8	23.2	-	-	18.9
1990	45.3	-	-	-	21.3	23.1	-	-	-
1991	47.0	-	38.7	30.2	22.2	22.1	4.1	-	20.3
1992	48.0	-	-	-	24.1	22.2	4.0	-	20.6
1993	49.8	-	39.0	-	24.7	22.5	4.1	-	20.8
1994	51.2	-	-	-	25.2	22.9	4.6	-	-
1995	52.5	-	38.9	28.3	25.4	24.9	4.3	22.3	21.9
1996	53.5	-	-	28.1	26.0	24.6	4.5	21.8	22.3
1997	55.1	-	42.5	28.7	25.9	24.7	4.8	22.3	22.6
1998	55.7	-	-	29.0	25.9	26.6	3.9	20.0	23.5
1999	57.8	-	45.2	31.0	26.6	-	4.2	21.5	24.6
2000	58.3	-	-	31.4	28.4	-	5.5	23.1	25.7
2001	57.2	-	-	31.5		-	5.8	28.8	-
2002	62.2	48.0	-	-	-	-	-	-	-

Note: The number of researchers is the same as in Table 6-1-4, and the population is the same as in Reference Statistics A.
Source: Number of researchers is the same as in Table 6-1-4, and the population is the same as in Reference Statistics A.

Table 6-1-6: Relative number of researchers by country (Researchers per capita and researchers per working population)

(unit: persons

Number of reserachers	Japan (HC) (2002)	Japan (FTE) (2002)	U.S. (1999)	Germany (2001)	France (2000)	U.K. (1998)	China (2001)	Republic of Korea (2001)	EU (1999)
Industry	461,962	430,688	1,015,700	154,020	81,012	91,271	388,500	100,169	466,600
Universities and colleges	280,710	135,594	186,027	68,277	61,583	49,023	167,600	23,083	317,899
Government research organizaions	35,992	33,750	47,700	37,300	26,132	14,368	186,600	12,040	129,114
Non-profit private research organizaions	14,035	11,188	11,800	-	3,343	3,000	-	1,045	12,110
Total	792,699	612,049	1,261,227	259,597	172,070	157,662	742,700	136,337	925,723

Per 10,000 population	12,744	12,744	27,295	8,234	6,059	5,924	127,627	4,734	37,690
	Japan (HC) (2002)	Japan (FTE) (2002)	U.S. (1999)	Germany (2001)	France (2000)	U.K. (1998)	China (2001)	Republic of Korea (2001)	EU (1999)
Industry	36.3	33.8	37.2	18.7	13.4	15.4	3.0	21.2	12.4
Universities and colleges	22.0	10.6	6.8	8.3	10.2	8.3	1.3	4.9	8.4
Government research organizaions	2.8	2.6	1.7	4.5	4.3	2.4	1.5	2.5	3.4
Non-profit private research organizaions	1.1	0.9	0.4	-	0.6	0.5	-	-	0.3
Total	62.2	48.0	46.2	31.5	28.4	26.6	5.8	28.8	24.6

Per 10,000 labor population	6,622	6,622	13,937	4,012	2,657	2,889	73,705	2,218	17,415
	Japan (HC) (2002)	Japan (FTE) (2002)	U.S. (1999)	Germany (2001)	France (2000)	U.K. (1998)	China (2001)	Republic of Korea (2001)	EU (1999)
Industry	69.8	65.0	72.9	38.4	30.5	31.6	5.3	45.2	26.8
Universities and colleges	42.4	20.5	13.3	17.0	23.2	17.0	2.3	10.4	18.3
Government research organizaions	5.4	5.1	3.4	9.3	9.8	5.0	2.5	5.4	7.4
Non-profit private research organizaions	2.1	1.7	0.8	-	1.3	1.0	-	-	0.7
Total	119.7	92.4	90.5	64.7	64.8	54.6	10.1	61.5	53.2

Note: Researchers of Japanese universities (FTE value) were calculated based on 'Survey on the data for full-time equivalents in universities and colleges' conducted in 2002. However, the full-time conversion factor of faculties for 'medical offices, etc.' has been substituted.

<Japan>'Government research organization' means 'public organization' in the 'Report on the Survey of Research and Development' by the Ministry of Public Management, Home Affairs, Posts and Telecommunications.

'Nonprofit private research organization' means 'Nonprofit organization' in the 'Report on the Survey of Research and Development' by the Ministry of Public Management, Home Affairs, Posts and Telecommunications.

Source: Reference Statistics A for population, and B for labor population. The number of researchers by sector is the same as in Table 6-1-11.

Table 6-1-7: R&D expenditure by performing sector and source of funding for selected countries

(A) R&D expenditure in Japan (2002)

(unit: million yen)

Sector	Source		Performance	
	Amount	Ratio (%)	Amount	Ratio (%)
Industry	11,547,679	69.3	11,576,840	69.4
Government	3,452,681	20.7	1,483,211	8.9
Universities	1,494,977	9.0	3,282,338	19.7
Non-profit private research organizations	120,022	0.7	332,664	2.0
Foreign countries	59,694	0.4	-	-
Total	16,675,053	100.0	16,675,053	100.0

(B) R&D expenditure in U.S. (2002)

(unit: million dollars)

Sector	Source		Performance	
	Amount	Ratio (%)	Amount	Ratio (%)
Industry	193,420	66.3	213,116	73.1
Government	81,004	27.8	21,566	7.4
Universities	9,932	3.4	43,550	14.9
Non-profit private research organizations	7,308	2.5	13,431	4.6
Foreign countries	291,663	100	291,663	100.0

(C) R&D expenditure in Germany (2001)

(unit: million euros)

Sector	Source		Performance	
	Amount	Ratio (%)	Amount	Ratio (%)
Industry	34,871	66.5	37,210	71.0
Government	16,250	31.0	6,923	13.2
Universities	-	-	8,266	15.8
Non-profit private research organizations	212	0.4	-	0.0
Foreign countries	1,066	2.0	-	-
Total	52,399	100.0	52,399	100.0

(D) R&D expenditure in France (2000)

(unit: million euros)

Sector	Source		Performance	
	Amount	Ratio (%)	Amount	Ratio (%)
Industry	16,256	52.5	19,348	62.5
Government	11,967	38.7	5,361	17.3
Universities	237	0.8	5,804	18.8
Non-profit private research organizations	270	0.9	439	1.4
Foreign countries	2,224	7.2	-	-
Total	30,954	100.0	30,954	100.0

(E) R&D expenditure in U.K. (2001)

(unit: million pounds)

Sector	Source		Performance	
	Amount	Ratio (%)	Amount	Ratio (%)
Industry	8,691	46.2	12,682	67.4
Government	5,674	30.2	1,829	9.7
Universities	177	0.9	4,035	21.4
Non-profit private research organizations	889	4.7	269	1.4
Foreign countries	3,386	18.0	-	-
Total	18,815	100.0	18,815	100.0

(F) R&D expenditure in China (2001)

(unit: million yuan)

Sector	Performance	
	Amount	Ratio (%)
Industry	63,003	60.4
Government	10,238	9.8
Universities	31,007	29.7
Total	104,248	100.0

(G) R&D expenditure in Republic of Korea (2000)

(unit: million won)

Sector	Source		Performance	
	Amount	Ratio (%)	Amount	Ratio (%)
Industry	10,023,405	72.4	10,254,655	74.0
Government	3,315,453	23.9	1,843,876	13.3
Universities	455,269	3.3	1,561,864	11.3
Non-profit private research organizations	46,129	0.3	188,106	1.4
Foreign countries	8,245	0.1	-	-
Total	13,848,501	100.0	13,848,501	100.0

(H) R&D ecpenditure in EU (2000)

(unit: million dollars)

Sector	Performance	
	Amount	Ratio (%)
Industry	113,288	64.5
Government	23,698	13.5
Universities	37,206	21.2
Others	1,515.3	0.9
Total	175,708	100.0

Note: Amount of R&D expenditure is the total amount of R&D expenditure for natural science and human/social science (excluding Korea).

<Japan>1)Source industry includes national government, local public entities, government-affiliated firms, independent administrative agencies, government financial corporation and public corporation.

2) Source government includes national government, local public entities, national and public universities (including junior colleges), national and public research institutes, research institutes of government-affiliated firms and independent administrative agencies, and others.

3) Source universities are private universities.

4) Performing government includes research institutes of national, public, and government-affiliated firms, independent administrative agencies (not run on a stand-alone basis (national government and local public entity-affiliated)).

5) Performing universities are national, public, and private universities (including junior colleges).

<U.S.>1) R&D expenditures are preliminary figures. Source is federal government (However, part of R&D expenditure used by universities is funded by the state government).

2) Universities are private universities and state universities.

3) Performing government is federal government research institutes.

4) Figures of Federal Fund R&D Center (FFRDC's) under the supervision of universities are compiled for each R&D-implementing department.

<Germany>1) Source governments are federal and state government. Performing government is federal, state, local government administrative agencies and nonprofit private research organizations.

2) Itemized figures may not always be consistent.

3) Government estimates or modified as necessary to comply with the OECD standard.

4) R&D expenditure is the total expenditure for natural science and human/social science.

<France>1) Performing government includes public research organizations. Performing universities include technical colleges (*grandes ecoles*) and National Science and Research Center.

2) The data lack continuity with the data until the previous year.

<U.K.>Performing government includes central and local government, Research Council and Higher Education Fund Distribution Committee. Universities are private universities.

<Korea>Excludes R&D expenditure for human/social science.

<EU>Provisional figure. OECD estimates/calculates based on the data for each country.

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

<U.S.>NSF, "National Patterns of R&D Resources 2002 Data Update"

<Germany>OECD, "Basic Science and Technology Statistics 2002/2"

<France>OECD, "Basic Science and Technology Statistics 2002/2"

<U.K.>ONS, "Gross domestic expenditure on research and development 2001"

<China>OECD, "Main Science and Technology Indicators 2003/1"

<Korea>"Basic Science and Technology Statistics 2002/2"

<EU>OECD, "Main Science and Technology Indicators 2003/1"

Table 6-1-8: R&D expenditure flow in selected countries

(A) Japan (2002)

(million yen)

		Performer				
		Industries	Government	Universities	Non-profit private research	Total
Source	Industries	11,336,216 (10,665,184)	41,268	88,415	81,779	11,547,679
	Government	169,865	1,438,063 (691,221)	1,672,855 (1,363,572)	171,898	3,452,681
	Universities	324	57	1,494,552 (1,494,301)	44	1,494,977
	Non-profit private research institutes	13,459	3,696	25,515	77,352 (67,838)	120,022
	Foreign countries	56,978	125	999	1,592	59,694
	Total	11,576,840	1,483,211	3,282,338	332,664	16,675,053

(B) U.S. (2002)

(OECD Purchasing power parity equivalent/millon yen)

		Performer				
		Industries	Government	Universities	Non-profit private research	Total
Source	Industries	27,848,376	-	343,422	170,538	28,362,335
	Government	3,402,102	3,162,352	4,554,954	1,121,179	12,240,733
	Universities	-	-	1,093,758	—	1,093,758
	Non-profit private research	-	-	393,864	677,752	1,071,616
	Total	31,250,478	3,162,352	6,385,998	1,969,468	42,768,296

(C) Germany (2001)

(OECD Purchasing power parity equivalent/millon yen)

		Performer				
		Industries	Government	Universities	Non-profit private research	Total
Source	Industries	5,294,578	23,790	146,499	-	5,464,866
	Government	402,762	1,017,326	1,126,526	-	2,546,614
	Universities	-	-	-	-	-
	Non-profit private research	11,660	21,611	-	-	33,271
	Foreign countries	122,427	22,254	22,332	-	167,013
	Total	5,831,426	1,084,981	1,295,373	-	8,211,780

(D) France (2000)

(OECD Purchasing power parity equivalent/millon yen)

		Performer				
		Industries	Government	Universities	Non-profit private research	Total
Source	Industries	2,588,739	59,272	25,886	11,448	2,685,346
	Government	316,912	771,978	877,390	10,655	1,976,952
	Universities	727	1,602	32,907	3,899	39,118
	Non-profit private research	925	1,421	2,808	39,399	44,553
	Foreign countries	288,978	51,409	19,873	7,186	367,462
	Total	3,196,281	885,683	958,865	72,587	5,113,416

(E) U.K. (2001)

(OECD Purchasing power parity equivalent/millon yen)

		Performer				
		Industries	Government	Universities	Non-profit private research	Total
Source	Industries	1,909,702	53,541	58,451	10,054	2,031,980
	Government	351,639	344,625	620,513	9,352	1,326,597
	Universities	0	2,338	38,811	468	41,383
	Non-profit private research	935	14,730	154,310	37,642	207,851
	Foreign countries	702,811	12,158	71,076	5,377	791,656
	Total	2,965,088	427,625	943,394	62,893	4,399,000

(F) Republic of Korea (2000)

(OECD Purchasing power parity equivalent/millon yen)

		Performer				
		Industries	Government	Universities	Non-profit private research	Total
Source	Industries	2,027,804	37,316	52,900	17,983	2,136,003
	Government	152,977	354,290	182,314	16,948	706,528
	Universities	1,937	218	94,739	124	97,019
	Non-profit private research	1,715	979	2,154	4,983	9,830
	Foreign countries	850	130	729	48	1,757
	Total	2,185,283	392,933	332,836	40,086	2,951,137

Note: Purchasing power parity equivalent is extracted from Reference Statistics E.
Same as in Table 6-1-7.
Source: Same as in Table 6-1-7.

Table 6-1-9: Trends in R&D expenditure by performing sector and source of funding for selected countries

(A) Shares of funding

FY	Japan: R&D expenditure (million yen)						Share of each sector (%)				
	Industries	Universities	Government	Non-profit private research institutes	Foreign countries	total	Industries	Universities	Government	Non-profit private research institutes	Foreign countries
1981	3,726,055	595,874	1,612,428	41,857	6,144	5,982,358	62.3	10.0	27.0	0.7	0.1
1982	4,160,607	648,503	1,666,164	46,427	6,999	6,528,700	63.7	9.9	25.5	0.7	0.1
1983	4,678,481	726,251	1,721,433	46,397	8,220	7,180,782	65.2	10.1	24.0	0.6	0.1
1984	5,278,561	774,824	1,777,780	55,175	7,590	7,893,931	66.9	9.8	22.5	0.7	0.1
1985	6,122,856	822,526	1,867,253	69,525	8,140	8,890,299	68.9	9.3	21.0	0.8	0.1
1986	6,311,267	834,556	1,955,311	83,898	7,900	9,192,932	68.7	9.1	21.3	0.9	0.1
1987	6,736,995	897,565	2,111,840	81,997	8,243	9,836,640	68.5	9.1	21.5	0.8	0.1
1988	7,491,731	932,707	2,117,781	77,031	8,323	10,627,572	70.5	8.8	19.9	0.7	0.1
1989	8,538,189	989,319	2,202,420	75,811	9,742	11,815,482	72.3	8.4	18.6	0.6	0.1
1990	9,561,155	1,079,991	2,346,562	80,334	10,274	13,078,315	73.1	8.3	17.9	0.6	0.1
1991	10,007,054	1,156,988	2,504,463	90,975	12,044	13,771,524	72.7	8.4	18.2	0.7	0.1
1992	9,882,934	1,231,821	2,696,717	84,615	13,405	13,909,493	71.1	8.9	19.4	0.6	0.1
1993	9,343,887	1,290,876	2,965,849	96,722	11,807	13,709,139	68.2	9.4	21.6	0.7	0.1
1994	9,271,442	1,298,770	2,918,177	93,657	13,984	13,596,030	68.2	9.6	21.5	0.7	0.1
1995	9,669,186	1,346,427	3,292,400	84,856	15,366	14,408,236	67.1	9.3	22.9	0.6	0.1
1996	10,406,983	1,398,874	3,160,551	98,805	14,102	15,079,315	69.0	9.3	21.0	0.7	0.1
1997	10,966,857	1,426,725	3,203,852	100,281	43,783	15,741,499	69.7	9.1	20.4	0.6	0.3
1998	11,028,650	1,463,121	3,498,492	101,573	48,089	16,139,925	68.3	9.1	21.7	0.6	0.3
1999	10,871,375	1,466,493	3,503,749	110,452	58,519	16,010,588	67.9	9.2	21.9	0.7	0.4
2000	11,107,141	1,464,836	3,540,764	112,223	64,374	16,289,336	68.2	9.0	21.7	0.7	0.4
2001	11,388,957	1,481,021	3,476,943	116,167	64,909	16,527,998	68.9	9.0	21.0	0.7	0.4
2002	11,547,679	1,494,977	3,452,681	120,022	59,694	16,675,053	69.3	9.0	20.7	0.7	0.4

FY	U.S.: R&D expenditure (million yen)						Share of each sector (%)				
	Industries	Universities	Government	Non-profit private research institutes	Foreign countries	total	Industries	Universities	Government	Non-profit private research institutes	Foreign countries
1981	8,679,835	255,460	8,280,710	233,487	-	17,449,250	49.7	1.5	47.5	1.3	-
1982	9,427,246	279,630	8,769,757	253,682	-	18,730,315	50.3	1.5	46.8	1.4	-
1983	10,213,767	306,205	9,530,051	275,292	-	20,325,316	50.3	1.5	46.9	1.4	-
1984	11,553,800	335,188	10,470,085	299,101	-	22,658,174	51.0	1.5	46.2	1.3	-
1985	12,658,721	380,666	11,702,143	325,630	-	25,067,159	50.5	1.5	46.7	1.3	-
1986	13,229,296	437,933	12,077,309	357,244	-	26,101,781	50.7	1.7	46.3	1.4	-
1987	13,151,210	475,391	12,528,495	388,593	-	26,543,478	49.5	1.8	47.2	1.5	-
1988	13,853,393	514,991	12,501,823	424,098	-	27,294,305	50.8	1.9	45.8	1.6	-
1989	14,931,128	568,039	12,301,460	464,668	-	28,265,295	52.8	2.0	43.5	1.6	-
1990	16,250,522	622,421	12,317,180	505,632	-	29,695,560	54.7	2.1	41.5	1.7	-
1991	17,819,466	667,409	12,028,622	550,608	-	31,066,105	57.4	2.1	38.7	1.8	-
1992	18,106,545	671,358	11,750,278	585,745	-	31,113,927	58.2	2.2	37.8	1.9	-
1993	17,794,618	683,409	11,440,464	624,246	-	30,542,553	58.3	2.2	37.5	2.0	-
1994	17,914,971	710,979	11,271,282	661,678	-	30,558,729	58.6	2.3	36.9	2.2	-
1995	18,841,458	698,121	10,997,450	666,852	-	31,203,712	60.4	2.2	35.2	2.1	-
1996	20,439,553	734,172	10,807,545	701,877	-	32,683,146	62.5	2.2	33.1	2.1	-
1997	22,206,581	788,324	10,840,923	748,060	-	34,583,889	64.2	2.3	31.3	2.2	-
1998	24,788,132	866,806	11,460,615	837,298	-	37,952,850	65.3	2.3	30.2	2.2	-
1999	26,451,518	911,937	11,199,097	903,025	-	39,465,739	67.0	2.3	28.4	2.3	-
2000	28,578,029	965,957	10,649,642	967,046	-	41,160,675	69.4	2.3	25.9	2.3	-
2001	28,887,380 pr	1,022,957 pr	11,279,038 pr	1,012,024 pr	-	42,201,399 pr	68.5	2.4	26.7	2.4	-
2002	28,362,335 pr	1,093,758 pr	12,240,733 pr	1,071,616 pr	-	42,768,296 pr	66.3	2.6	28.6	2.5	-

FY	Germany: R&D expenditure (million yen)						Share of each sector (%)				
	Industries	Universities	Government	Non-profit private research institutes	Foreign countries	total	Industries	Universities	Government	Non-profit private research institutes	Foreign countries
1981	2,167,580	-	1,593,640	15,335	36,443	3,813,058	56.8	-	41.8	0.4	1.0
1982	2,271,895 c	-	1,667,260 c	15,989 c	40,922 c	3,996,084 c	56.9	-	41.7	0.4	1.0
1983	2,438,206	-	1,637,591	16,339	46,606	4,138,609	58.9	-	39.6	0.4	1.1
1984	2,603,542 c	-	1,700,245 c	14,939 c	51,484 c	4,370,191 c	59.6	-	38.9	0.3	1.2
1985	2,995,778	-	1,837,691	12,991	57,110	4,903,551	61.1	-	37.5	0.3	1.2
1986	3,211,413 c	-	1,874,949 c	18,699 c	62,766 c	5,168,774 c	62.1	-	36.3	0.4	1.2
1987	3,471,928	-	1,883,976	22,663	70,378	5,448,963	63.7	-	34.6	0.4	1.3
1988	3,614,631 c	-	1,938,416 c	26,694 c	95,872 c	5,675,613 c	63.7	-	34.2	0.5	1.7
1989	3,823,396	-	2,041,813	30,714	128,220	6,024,162	63.5	-	33.9	0.5	2.1
1990	3,958,008 c	-	2,105,878 c	33,202 c	131,877 c	6,228,983 c	63.5	-	33.8	0.5	2.1
1991	4,241,052 a	-	2,446,086 a	35,248 a	132,968 a,o	6,855,516 a,o	61.9	-	35.7	0.5	1.9
1992	4,285,464 c	-	2,469,431 a,c	25,778 a,c	138,956 a,c	6,919,718 a,c	61.9	-	35.7	0.4	2.0
1993	4,127,237	-	2,408,002	20,930	109,775 o	6,665,995 o	61.9	-	36.1	0.3	1.6
1994	4,105,536 c	-	2,443,953 c	22,196 c	115,265 c,o	6,686,932 c,o	61.4	-	36.5	0.3	1.7
1995	4,098,014	-	2,466,944	17,116	122,237 c,o	6,704,312 c,o	61.1	-	36.8	0.3	1.8
1996	4,016,302 c	-	2,439,603 c	20,099 c	132,415 c,o	6,608,420 c,o	60.8	-	36.9	0.3	2.0
1997	4,316,525	-	2,525,219	23,191	169,347 o	7,034,364 o	61.4	-	35.9	0.3	2.4
1998	4,702,660 c	-	2,630,058 c	26,071 c	185,233 c,o	7,544,022 c,o	62.3	-	34.9	0.3	2.5
1999	5,188,607	-	2,599,765	33,978	165,185	7,987,535	65.0	-	32.5	0.4	2.1
2000	5,483,334 c	-	2,636,443 c	34,257 c	178,809 c	8,332,860 c	65.8	-	31.6	0.4	2.1
2001	5,464,866 c	-	2,546,614 c	33,271 c	167,013 c	8,211,780 c	66.5	-	31.0	0.4	2.0

FY	France: R&D expenditure (million yen)						Share of each sector (%)				
	Industries	Universities	Government	Non-profit private research institutes	Foreign countries	total	Industries	Universities	Government	Non-profit private research institutes	Foreign countries
1981	1,082,867	5,224	1,413,190 a	11,866	133,330	2,646,505 a	40.9	0.2	53.4	0.4	5.0
1982	1,198,589	6,283	1,555,145	12,264	106,588	2,878,844	41.6	0.2	54.0	0.4	3.7
1983	1,268,604	6,910	1,627,562	12,977	107,589	3,023,666	42.0	0.2	53.8	0.4	3.6
1984	1,347,571	4,989	1,762,391	16,622	149,310	3,280,906	41.1	0.2	53.7	0.5	4.6
1985	1,444,675	10,232	1,844,015	18,025	168,725	3,485,672	41.4	0.3	52.9	0.5	4.8
1986	1,482,728	10,029	1,890,768	14,470	202,081	3,600,076	41.2	0.3	52.5	0.4	5.6
1987	1,569,357	9,122	1,938,360	11,960	221,596	3,750,394	41.8	0.2	51.7	0.3	5.9
1988	1,707,078	8,671	1,968,523	13,423	244,895	3,942,590	43.3	0.2	49.9	0.3	6.2
1989	1,876,414	8,930	2,057,746	18,837	314,322	4,276,248	43.9	0.2	48.1	0.4	7.4
1990	2,018,177	12,881	2,240,188	19,718	349,750	4,640,714	43.5	0.3	48.3	0.4	7.5
1991	2,055,920	16,100	2,357,440	19,580	385,382	4,834,441	42.5	0.3	48.8	0.4	8.0
1992	2,313,415 a	21,674	2,158,217 a	40,905 a	431,632	4,965,823	46.6	0.4	43.5	0.8	8.7
1993	2,291,803	24,078	2,118,054	40,724	396,701	4,871,360	47.0	0.5	43.5	0.8	8.1
1994	2,331,142	27,161	1,992,562	40,992	396,981	4,788,820	48.7	0.6	41.6	0.9	8.3
1995	2,277,770	36,549	1,975,851	42,555	378,745	4,711,453	48.3	0.8	41.9	0.9	8.0
1996	2,232,440	35,077	1,909,276	40,681	383,746	4,601,220	48.5	0.8	41.5	0.9	8.3
1997	2,355,498 a	33,651	1,772,020 a	39,750	361,943	4,562,845 a	51.6	0.7	38.8	0.9	7.9
1998	2,570,084	42,798	1,794,832	44,054	355,812	4,807,581	53.5	0.9	37.3	0.9	7.4
1999	2,661,016	50,493	1,816,582	44,514	344,805	4,917,425	54.1	1.0	36.9	0.9	7.0
2000	2,685,346 a	39,118 a	1,976,952 a	44,553 a	367,462 a	5,113,416 a	52.5	0.8	38.7	0.9	7.2

FY	U.K.: R&D expenditure (million yen)						Share of each sector (%)				
	Industries	Universities	Government	Non-profit private research institutes	Foreign countries	total	Industries	Universities	Government	Non-profit private research institutes	Foreign countries
1981	1,161,774	34,448	1,328,876 a,b	48,117	189,761	2,762,929	42.0	1.2	48.1	1.7	6.9
1982	-	-	-	-	-	-	-	-	-	-	-
1983	1,202,791	15,236	1,367,036	56,381	147,000	2,788,443	43.1	0.5	49.0	2.0	5.3
1984	-	-	-	-	-	-	-	-	-	-	-
1985	1,448,838 a	19,440	1,373,461	63,873 a	251,920	3,157,531 a	45.9	0.6	43.5	2.0	8.0
1986	1,593,146 a	21,127	1,385,395 a	63,773	310,257	3,373,697	47.2	0.6	41.1	1.9	9.2
1987	1,678,625	24,247	1,357,821	68,264	310,732	3,439,688	48.8	0.7	39.5	2.0	9.0
1988	1,828,669	27,267	1,297,491	71,532	328,622	3,553,581	51.5	0.8	36.5	2.0	9.2
1989	1,888,508	27,321	1,359,631	79,601	378,444	3,733,505	50.6	0.7	36.4	2.1	10.1
1990	1,928,681	27,238	1,381,983	93,062	457,527	3,888,166	49.6	0.7	35.5	2.4	11.8
1991	1,829,104	27,350	1,290,918	102,107	437,295	3,686,774	49.6	0.7	35.0	2.8	11.9
1992	1,936,916 a	30,372	1,249,324 a	132,947	429,214 a	3,778,498 a	51.3	0.8	33.1	3.5	11.4
1993	1,970,892	29,672	1,225,047	138,006	451,266	3,814,305	51.7	0.8	32.1	3.6	11.8
1994	1,927,094	32,351	1,253,405	143,928	472,811	3,829,561	50.3	0.8	32.7	3.8	12.3
1995	1,758,388	30,875	1,197,910	132,986	527,342	3,647,163	48.2	0.8	32.8	3.6	14.5
1996	1,753,257	30,937	1,162,777	140,336	599,635	3,686,736	47.6	0.8	31.5	3.8	16.3
1997	1,895,725	31,774	1,165,086	149,779	553,022	3,795,387	49.9	0.8	30.7	3.9	14.6
1998	1,908,344	33,776	1,228,699	161,175	677,128	4,009,148	47.6	0.8	30.6	4.0	16.9
1999	2,045,835	35,496	1,231,397	174,590	729,497	4,216,814	48.5	0.8	29.2	4.1	17.3
2000	2,084,266	37,983	1,221,686	196,472	687,846	4,228,254	49.3	0.9	28.9	4.6	16.3
2001	2,031,980	41,383	1,326,597	207,851	791,656	4,399,000	46.2	0.9	30.2	4.7	18.0

Year	Republic of Korea: R&D expenditure (million yen)						Share of each sector (%)				
	Industries	Universities	Government	Non-profit private research institutes	Foreign countries	total	Industries	Universities	Government	Non-profit private research institutes	Foreign countries
1995	1,674,802 g	57,953 g	418,163 g	45,000 g	310 g	2,196,228 g	76.3	2.6	19.0	2.0	0.0
1996	1,882,209 g	4,814 g	490,087 g	40,022 g	3,034 g	2,420,165 g	77.8	0.2	20.3	1.7	0.1
1997	1,911,227 g	95,571 g	604,577 g	23,893 g	2,553 g	2,637,822 g	72.5	3.6	22.9	0.9	0.1
1998	1,681,471 g	108,720 g	630,709 g	9,597 g	1,809 g	2,432,307 g	69.1	4.5	25.9	0.4	0.1
1999	1,790,167 g	98,464 g	637,223 g	31,542 g	1,576 g	2,558,971 g	70.0	3.8	24.9	1.2	0.1
2000	2,136,003 g	97,019 g	706,528 g	9,830 g	1,757 g	2,951,137 g	72.4	3.3	23.9	0.3	0.1

Note: Same as Table 6-1-8.
Pr.: Preliminary figure
a: The data lack continuity with the data until the previous year.
b: OECD estimates/calculates based on the data for each country.
c: Government estimates or estimates modified as necessary to comply with the OECD standard.
g: Excludes R&D expenditure for human/social science.
m: Undervalued or based on undervalued data..
p: Provisional figure.
v: Adding up these figures will not make the total figure.
Source: Same as Table 6-1-8.

(B) Proportion of performance

FY	Japan: R&D expenditure (million yen)					Proportion by sector (%)			
	Industries	Universities	Government research institutes	Non-profit private research	Total	Industries	Universities	Government research institutes	Non-profit private research
1970	823,265	365,877	147,525	18,838	1,355,505	60.7	27.0	10.9	1.4 #
1971	895,020	423,441	190,586	23,325	1,532,372	58.4	27.6	12.4	1.5
1972	1,044,928	478,684	242,836	25,424	1,791,872	58.3	26.7	13.6	1.4
1973	1,301,927	574,163	307,659	32,088	2,215,837	58.8	25.9	13.9	1.4
1974	1,589,053	717,585	325,158	84,236	2,716,032	58.5	26.4	12.0	3.1
1975	1,684,847	839,798	364,005	85,923	2,974,573	56.6	28.2	12.2	2.9
1976	1,882,231	934,016	402,536	101,902	3,320,685	56.7	28.1	12.1	3.1
1977	2,109,500	1,012,297	440,691	88,831	3,651,319	57.8	27.7	12.1	2.4
1978	2,291,002	1,151,074	502,957	100,831	4,045,864	56.6	28.5	12.4	2.5
1979	2,664,913	1,258,326	565,787	94,604	4,583,630	58.1	27.5	12.3	2.1
1980	3,142,256	1,340,074	618,378	145,540	5,246,248	59.9	25.5	11.8	2.8
1981	3,629,793	1,445,645	661,397	245,521	5,982,356	60.7	24.2	11.1	4.1
1982	4,039,018	1,540,422	673,082	276,178	6,528,700	61.9	23.6	10.3	4.2
1983	4,560,127	1,649,646	691,359	279,651	7,180,783	63.5	23.0	9.6	3.9
1984	5,136,634	1,724,187	725,685	307,425	7,893,931	65.1	21.8	9.2	3.9
1985	5,939,947	1,789,780	810,759	349,812	8,890,299	66.8	20.1	9.1	3.9
1986	6,120,163	1,832,575	840,223	399,971	9,192,932	66.6	19.9	9.1	4.4
1987	6,494,268	1,957,921	943,179	441,273	9,836,641	66.0	19.9	9.6	4.5
1988	7,219,318	2,014,073	935,255	458,925	10,627,571	67.9	19.0	8.8	4.3
1989	8,233,820	2,129,372	953,755	498,535	11,815,482	69.7	18.0	8.1	4.2
1990	9,267,166	2,296,992	976,867	537,291	13,078,315	70.9	17.6	7.5	4.1
1991	9,743,048	2,407,927	1,047,096	573,453	13,771,524	70.7	17.5	7.6	4.2
1992	9,560,685	2,576,281	1,160,101	612,427	13,909,493	68.7	18.5	8.3	4.4
1993	9,053,608	2,758,712	1,278,640	618,179	13,709,139	66.0	20.1	9.3	4.5
1994	8,980,253	2,752,551	1,226,426	636,800	13,596,030	66.1	20.2	9.0	4.7
1995	9,395,896	2,982,187	1,390,132	640,021	14,408,236	65.2	20.7	9.6	4.4
1996	10,058,409	3,013,120	1,328,535	679,251	15,079,315	66.7	20.0	8.8	4.5
1997	10,658,357	3,059,199	1,306,976	716,967	15,741,499	67.7	19.4	8.3	4.6
1998	10,800,063	3,222,879	1,402,914	714,068	16,139,925	66.9	20.0	8.7	4.4
1999	10,630,161	3,209,086	1,481,731	689,609	16,010,588	66.4	20.0	9.3	4.3
2000	10,860,215	3,208,418	1,513,633	707,069	16,289,336	66.7	19.7	9.3	4.3
2001	11,451,011	3,233,392	1,482,024	361,570	16,527,998	69.3	19.6	9.0	2.2
2002	11,576,840	3,282,338	1,483,211	332,664	16,675,053	69.4	19.7	8.9	2.0

Year	U.S.: R&D expenditure (million yen)					Proportion by sector (%)			
	Industries	Universities	Government research institutes	Non-profit private research	Total	Industries	Universities	Government research institutes	Non-profit private research
1970	4,005,183	697,199	920,879	201,068	5,823,887	68.8	12.0	15.8	3.5
1971	4,063,944	732,042	978,053	204,972	5,978,789	68.0	12.2	16.4	3.4
1972	4,397,694	796,677	1,051,740	218,400	6,464,287	68.0	12.3	16.3	3.4
1973	5,101,991	910,958	1,161,388	257,393	7,431,730	68.7	12.3	15.6	3.5
1974	6,089,842	1,102,116	1,365,538	318,767	8,876,263	68.6	12.4	15.4	3.6
1975	6,307,437	1,209,228	1,450,186	335,621	9,302,212	67.8	13.0	15.6	3.6
1976	7,198,291	1,377,159	1,570,468	369,020	10,514,672	68.5	13.1	14.9	3.5
1977	7,976,189	1,577,052	1,661,026	397,940	11,612,208	68.7	13.6	14.3	3.4
1978	8,697,939	1,781,688	1,818,252	440,329	12,738,208	68.3	14.0	14.3	3.5
1979	9,465,828	1,932,984	1,850,029	483,865	13,732,706	68.9	14.1	13.5	3.5
1980	10,642,214	2,109,313	1,872,580	505,986	15,130,093	70.3	13.9	12.4	3.3
1981	12,509,799	2,310,244	2,077,723	551,725	17,449,250	71.7	13.2	11.9	3.2
1982	13,587,633	2,365,615	2,201,127	575,940	18,730,315	72.5	12.6	11.8	3.1
1983	14,727,646	2,526,138	2,443,777	627,755	20,325,316	72.5	12.4	12.0	3.1
1984	16,560,144	2,765,411	2,638,111	694,729	22,658,174	73.1	12.2	11.6	3.1
1985	18,397,536	3,061,269	2,859,471	749,101	25,067,159	73.4	12.2	11.4	3.0
1986	19,049,309	3,381,777	2,929,095	741,817	26,101,781	73.0	13.0	11.2	2.8
1987	19,367,645	3,609,773	2,855,706	710,143	26,543,478	73.0	13.6	10.8	2.7
1988	19,771,201	3,841,745	2,922,832	758,730	27,294,305	72.4	14.1	10.7	2.8
1989	20,326,498	4,065,698	3,033,589	839,709	28,265,295	71.9	14.4	10.7	3.0
1990	21,429,683	4,275,312	3,060,546	930,019	29,695,560	72.2	14.4	10.3	3.1
1991	22,578,788	4,510,854	2,943,977	1,032,486	31,066,105	72.7	14.5	9.5	3.3
1992	22,411,857	4,639,109	2,982,916	1,080,232	31,113,927	72.0	14.9	9.6	3.5
1993	21,637,595	4,749,581	3,046,772	1,108,789	30,542,553	70.8	15.6	10.0	3.6
1994	21,597,361	4,859,831	2,953,533	1,148,004	30,558,729	70.7	15.9	9.7	3.8
1995	22,449,835	4,753,955	2,872,698	1,127,565	31,203,712	71.9	15.2	9.2	3.6
1996	23,959,205	4,821,221	2,746,726	1,156,159	32,683,146	73.3	14.8	8.4	3.5
1997	25,680,684	4,947,565	2,741,692	1,213,947	34,583,889	74.3	14.3	7.9	3.5
1998	28,364,837	5,323,227	2,910,925	1,353,860	37,952,850	74.7	14.0	7.7	3.6
1999	29,605,705	5,479,561	2,892,499	1,488,136	39,465,739	75.0	13.9	7.3	3.8
2000	31,038,032	5,720,303	2,717,280	1,685,059	41,160,675	75.4	13.9	6.6	4.1
2001	31,445,971 pr	6,008,188 pr	2,865,179 pr	1,882,061 pr	42,201,399 pr	74.5	14.2	6.8	4.5
2002	31,250,478 pr	6,385,998 pr	3,162,352 pr	1,969,468 pr	42,768,296 pr	73.1	14.9	7.4	4.6

Year	Germany: R&D expenditure (million yen)					Proportion by sector (%)			
	Industries	Universities	Government research institutes	Non-profit private research	Total	Industries	Universities	Government research institutes	Non-profit private research
1981	2,629,933	650,557	532,450		3,813,058	69.0	17.1	14.0	
1982	2,808,716 c	647,706 c	535,843	c	3,996,084 c	70.3	16.2	13.4	
1983	2,916,564	653,169	568,989		4,138,609	70.5	15.8	13.7	
1984	3,090,934 c	683,720 c	591,927	c	4,370,191 c	70.7	15.6	13.5	
1985	3,542,354	714,406	646,772		4,903,551	72.2	14.6	13.2	
1986	3,724,511 c	755,561 c	674,683	c	5,168,774 c	72.1	14.6	13.1	
1987	3,941,611	785,106	722,227		5,448,963	72.3	14.4	13.3	
1988	4,107,765 c	816,625 c	738,265	c	5,675,613 c	72.4	14.4	13.0	
1989	4,357,227	857,710	809,188		6,024,162	72.3	14.2	13.4	
1990	4,489,558 c	909,327 c	830,098	c	6,228,983 c	72.1	14.6	13.3	
1991	4,763,584 a,o	1,107,951 a	983,854	a	6,855,516 a,o	69.5	16.2	14.4	
1992	4,762,440 c	1,177,476 c	979,784	a	6,919,718 a,c	68.8	17.0	14.2	
1993	4,490,519 o	1,168,458 o	1,007,001	o	6,665,995 o	67.4	17.5	15.1	
1994	4,468,711 c	1,205,304	1,012,866	o	6,686,932 c,o	66.8	18.0	15.1	
1995	4,454,519 o	1,216,570	1,033,206	o	6,704,312 c,o	66.4	18.1	15.4	
1996	4,378,463 c	1,222,590	1,007,351	o	6,608,420 c,o	66.3	18.5	15.2	
1997	4,744,931	1,259,975	1,029,458	o	7,034,364 o	67.5	17.9	14.6	
1998	5,125,352 c	1,312,511	1,106,175	o	7,544,022 c,o	67.9	17.4	14.7	
1999	5,572,894	1,315,479	1,099,178	o	7,987,535	69.8	16.5	13.8	
2000	5,860,444 c	1,341,005	1,131,411		8,332,860 c	70.3	16.1	13.6	
2001	5,831,426 c	1,295,373 c	1,084,981	c	8,211,780 c	71.0	15.8	13.2	

Year	France: R&D expenditure (million yen)					Proportion by sector (%)			
	Industries	Universities	Government research institutes	Non-profit private research	Total	Industries	Universities	Government research institutes	Non-profit private research
1981	1,559,192	434,475 a	624,438	28,372	2,646,505 a	58.9	16.4	23.6	1.1
1982	1,667,663	458,905	725,149	27,152	2,878,844	57.9	15.9	25.2	0.9
1983	1,717,629	479,056	798,942	28,039	3,023,666	56.8	15.8	26.4	0.9
1984	1,875,168	503,636	870,043	32,059	3,280,906	57.2	15.4	26.5	1.0
1985	2,046,869	524,286	880,819	33,697	3,485,672	58.7	15.0	25.3	1.0
1986	2,113,741	541,482	911,492	33,381	3,600,076	58.7	15.0	25.3	0.9
1987	2,208,747	562,200	946,305	33,122	3,750,394	58.9	15.0	25.2	0.9
1988	2,344,458	581,650	982,371	34,111	3,942,590	59.5	14.8	24.9	0.9
1989	2,580,384	635,932	1,022,689	37,243	4,276,248	60.3	14.9	23.9	0.9
1990	2,803,871	676,354	1,122,253	38,235	4,640,714	60.4	14.6	24.2	0.8
1991	2,972,261	729,192	1,095,071	37,897	4,834,441	61.5	15.1	22.7	0.8
1992	3,102,849 a	758,625	1,038,501 a	65,926 a	4,965,823	62.5	15.3	20.9	1.3
1993	3,005,522	771,053	1,029,008	65,776	4,871,360	61.7	15.8	21.1	1.4
1994	2,961,406	774,853	987,881	64,628	4,788,820	61.8	16.2	20.6	1.3
1995	2,873,085	787,086	988,918	62,365	4,711,453	61.0	16.7	21.0	1.3
1996	2,831,805	774,832	932,595	61,988	4,601,220	61.5	16.8	20.3	1.3
1997	2,853,344 a	794,591 a	851,668 a	63,225	4,562,845 a	62.5	17.4	18.7	1.4
1998	2,993,243	846,503	896,177	71,658	4,807,581	62.3	17.6	18.6	1.5
1999	3,106,672	843,968	892,129	74,673	4,917,425	63.2	17.2	18.1	1.5
2000	3,196,281	958,865 a	885,683 a	72,587	5,113,416 a	62.5	18.8	17.3	1.4
2001	3,283,022 p	972,439 p	930,623 p	71,901 p	5,257,968 p	62.4	18.5	17.7	1.4

Year	U.K.: R&D expenditure (million yen)					Proportion by sector (%)			
	Industries	Universities	Government research institutes	Non-profit private research	Total	Industries	Universities	Government research institutes	Non-profit private research
1981	1,739,588	374,476 a	570,154	78,711	2,762,929 a	63.0	13.6	20.6	2.8
1982	-	-	-	-	-	-	-	-	-
1983	1,742,615	397,805	567,994	80,030	2,788,443	62.5	14.3	20.4	2.9
1984	-	-	-	-	-	-	-	-	-
1985	2,032,023	464,168 a	578,028	83,312	3,157,531 a	64.4	14.7	18.3	2.6
1986	2,328,293 a	503,922	474,188 a	67,294	3,373,697	69.0	14.9	14.1	2.0
1987	2,363,130	544,620	471,507	60,430	3,439,688	68.7	15.8	13.7	1.8
1988	2,451,209	557,737	481,601	63,387	3,553,581	69.0	15.7	13.6	1.8
1989	2,580,298	569,689	517,409	66,110	3,733,505	69.1	15.3	13.9	1.8
1990	2,697,170	607,333	507,786	75,876	3,888,166	69.4	15.6	13.1	2.0
1991	2,472,132	613,855	533,932 a	66,855	3,686,774	67.1	16.7	14.5	1.8
1992	2,495,165 a	650,680	564,177	68,475	3,778,498 a	66.0	17.2	14.9	1.8
1993	2,520,949	668,628	557,663	67,065	3,814,305	66.1	17.5	14.6	1.8
1994	2,474,458	734,054	573,978	47,071	3,829,561	64.6	19.2	15.0	1.2
1995	2,369,155	700,767	531,163	46,078	3,647,163	65.0	19.2	14.6	1.3
1996	2,390,875	718,034	532,257	45,570	3,686,736	64.9	19.5	14.4	1.2
1997	2,474,462	749,232	522,440	49,227	3,795,387	65.2	19.7	13.8	1.3
1998	2,628,613	788,625	539,223	52,661	4,009,148	65.6	19.7	13.4	1.3
1999	2,815,211	827,989	516,098	57,541	4,216,814	66.8	19.6	12.2	1.4
2000	2,773,944	878,438	514,415	61,434	4,228,254	65.6	20.8	12.2	1.5
2001	2,965,088	943,394	427,625	62,893	4,399,000	67.4	21.4	9.7	1.4

Year	Republic of Korea: R&D expenditure (million yen)					Proportion by sector (%)			
	Industries	Universities	Government research institutes	Non-profit private research	Total	Industries	Universities	Government research institutes	Non-profit private research
1995	1,619,224	179,342 g	372,439 g	25,223 g	2,196,228 g	73.7	8.2	17.0	1.1
1996	1,771,757	226,669 g	392,450 g	29,290 g	2,420,165 g	73.2	9.4	16.2	1.2
1997	1,914,715	275,259 g	416,152 g	31,696 g	2,637,822 g	72.6	10.4	15.8	1.2
1998	1,710,433	271,426 g	424,648 g	25,800 g	2,432,307 g	70.3	11.2	17.5	1.1
1999	1,826,896	307,251 g	369,815 g	55,009 g	2,558,971 g	71.4	12.0	14.5	2.1
2000	2,185,283	332,836 g	392,933 g	40,086 g	2,951,137 g	74.0	11.3	13.3	1.4

Note: Same as Table 6-1-8.
Pr.: Preliminary figure
a: The data lack continuity with the data until the previous year.
b: OECD estimates/calculates based on the data for each country.
c: Government estimates or estimates modified as necessary to comply with the OECD standard.
g: Excludes R&D expenditure for human/social science.
m: Undervalued or based on undervalued data.
p: Provisional figure
v: Adding up these figures will not make the total figure.
Source: Same as Table 6-1-8.

Table 6-1-10: Trends in R&D expenditure by performing sector for the EU and China

Year	China: R&D expenditure (million yen)					Proportion by sector (%)			
	Industries	Universities	Governement research institutes	Others	Total	Industries	Universities	Government research institutes	Others
1991	1,005,522 m	217,256	1,251,282	50,989	2,525,049 m,v	39.8	8.6	49.6	-
1992	1,230,375 m	284,664	1,361,781	66,892	2,943,713 m,v	41.8	9.7	46.3	-
1993	1,341,626 m	360,414	1,444,379	71,226	3,217,646 m,v	41.7	11.2	44.9	-
1994	1,428,298 m	418,357	1,393,155	71,799	3,311,609 m,v	43.1	12.6	42.1	-
1995	1,435,331 m	398,300	1,382,080	70,687	3,286,398 m,v	43.7	12.1	42.1	-
1996	1,529,946 m	417,886	1,514,203	75,566	3,537,600 m,v	43.2	11.8	42.8	-
1997	1,990,365 m	489,442	1,754,386	87,770	4,321,963 m,v	46.1	11.3	40.6	-
1998	2,203,836 m	510,726	2,092,235	109,728	4,916,525 m,v	44.8	10.4	42.6	-
1999	3,035,239 m	572,517	2,354,981	158,231	6,120,968 m,v	49.6	9.4	38.5	-
2000	4,689,917 a,v	670,120 v	2,461,629 v	—	7,821,667 a,v	60.0	8.6	31.5	-
2001	5,415,644	880,043	2,665,315	—	8,961,002	60.4	9.8	29.7	-

Year	EU: R&D expenditure (million yen)					Proportion by sector (%)			
	Industries	Universitites	Government research institutes	Others	Total	Industries	Universities	Governement research institutes	Others
1981	7,775,633 b	2,232,399 a,b	2,356,942 b	170,564	12,535,538 b	62.0	17.8	18.8	1.4
1982	-	-	-	—	-	-	—	-	-
1983	8,539,769 b	2,419,384 b	2,598,120 b	171,719	13,728,992 b	62.2	17.6	18.9	1.3
1984	9,246,959 b	-	2,765,411 b	—	14,765,627 b	62.6	-	18.7	-
1985	10,369,681 b	2,746,581 a,b	2,908,370 b	187,297	16,211,929 b	64.0	16.9	17.9	1.2
1986	11,168,583 a,b	2,917,772 b	2,901,786 a,b	176,583	17,164,724 b	65.1	17.0	16.9	1.0
1987	11,691,265 b	3,098,487 b	3,035,942 b	176,096	18,001,790 b	64.9	17.2	16.9	1.0
1988	12,302,450 b	3,239,408 b	3,144,745 b	182,173	18,868,775 b	65.2	17.2	16.7	1.0
1989	13,122,089 b	3,479,156 b	3,334,099 b	179,295	20,114,639 b	65.2	17.3	16.6	0.9
1990	13,853,156 b	3,795,792 b	3,515,927 b	198,698	21,363,574 b	64.8	17.8	16.5	0.9
1991	14,060,504 a,b	4,148,731 a,b	3,760,660 a,b	188,697	22,158,592 a,b	63.5	18.7	17.0	0.9
1992	14,296,661 a,b	4,433,656 a,b	3,725,023 a,b	225,210	22,680,551 a,b	63.0	19.5	16.4	1.0
1993	13,909,656 b	4,500,786 b	3,675,424 b	232,337	22,318,202 b	62.3	20.2	16.5	1.0
1994	13,913,100 b	4,624,108 b	3,654,905 b	201,212	22,393,325 b	62.1	20.6	16.3	0.9
1995	13,825,351 b	4,617,355 a,b	3,593,540 b	196,198	22,232,445	62.2	20.8	16.2	0.9
1996	13,949,644 b	4,689,706 b	3,505,625 b	194,929	22,339,904 b	62.4	21.0	15.7	0.9
1997	14,737,634 b	5,028,680 b	3,476,581 b	204,889	23,447,784	62.9	21.4	14.8	0.9
1998	15,889,808 b	5,387,827 b	3,736,822 b	223,106	25,237,563 b	63.0	21.3	14.8	0.9
1999	16,904,585 b	5,490,094 b	3,701,868 b	234,741	26,331,287 b	64.2	20.9	14.1	0.9
2000	17,621,863 b	5,787,392 b,p	3,686,193 b	235,703	27,331,151 b	64.5	21.2	13.5	0.9
2001	17,991,883 b,p	—	3,668,192 b,p	—	27,906,524 b,p	64.5	—	13.1	—

Note: a: The data lack continuity with the data until the previous year.

b: OECD estimates/calculates based on the data for each country.

m: Undervalued or based on undervalued data.

p: Provisional figure

v: Adding up these figures will not make the total figure.

1) Includes R&D expenditure for human/social science.

2) 'Others' of China and EU are the figures of the total minus industries, universities, and government research institutes.

Source: OECD, "Main Science and Technology Indicators 2003/1"

Table 6-1-11: Number of researchers by sector for selected countries

Year		Industries	Government research institutes	Universities	Non-profit private research institutes
2003	Japan (HC)	58.1%	4.6%	35.6%	1.7%
2003	Japan (FTE)	70.5%	5.5%	22.2%	1.8%
1999	U.S.	80.5%	3.8%	14.7%	0.9%
2001	Germany	59.3%	14.4%	26.3%	-
2000	France	47.1%	15.2%	35.8%	1.9%
1998	U.K.	57.9%	9.1%	31.1%	1.9%
2001	China	52.3%	25.1%	22.6%	-
2001	Republic of Korea	73.5%	8.8%	16.9%	0.8%
1999	EU	50.4%	13.9%	34.3%	1.3%

(unit: persons)

Year		Industries	Government research institutes	Universities	Non-profit private research institutes	Total number of researchers
2003	Japan (HC)	460,053	36,052	281,304	13,815	791,224
2003	Japan (FTE)	431,190	33,891	136,014	10,954	612,049
1999	U.S.	1,015,700	47,700	186,027	11,800	1,261,227
2001	Germany	154,020 c	37,300 c,o	68,277 c	-	259,597 c
2000	France	81,012	26,132 a,d	61,583 a	3,343	172,070
1998	U.K.	91,271	14,368	49,023	3,000	157,662
2001	China	388,500	186,600	167,600	—	742,700
2001	Republic of Korea	100,169	12,040 g	23,083 g	1,045	136,337 g
1999	EU	466,600 b	129,114 b	317,899 b	12,110	925,723 b

Note: a: The data lack continuity with the data until the previous year.
b: OECD estimates/calculates based on the data for each country.
c: Government estimates or estimates modified as necessary to comply with the OECD standard.
d: Excludes defense-related.
g: Excludes R&D expenditure for human/social science.
o: Includes other classes.
1) Researchers in Japanese universities (FTE) were calculated based on the 'Survey on the data for full-time equivalents in universities and colleges' conducted in 2002.
2) Figure of nonprofit private research institutes for EU is the figure that subtracted industries, government research institutes, and universities from the total.
Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'
Ministry of Education, Culture, Sports, Science and Technology, Science and Technology-Academic Policy Bureau, 'Survey on the Data for Full-time Equivalents at Universities' (November, 2003)
<U.S.>NSF, "National Patterns of R&D Resources: 2002 Data Update"
<France, U.K., China, Korea, EU>OECD, "Main Science and Technology Indicators 2003/1"

Table 6-2-1: R&D expenditure per researcher for selected countries

(unit: million yen/ person)

Year	Japan (HC)	Japan (FTE)	U.S.	Germany	France	U.K.	China	Republic of Koea	EU
1970	6.2	-	11.9	-	-	-	-	-	-
1971	6.3	-	12.6	-	-	-	-	-	-
1972	7.2	-	13.8	-	-	-	-	-	-
1973	7.9	-	15.8	-	-	-	-	-	-
1974	9.3	-	18.7	-	-	-	-	-	-
1975	9.6	-	19.3	-	-	-	-	-	-
1976	10.5	-	21.4	-	-	-	-	-	-
1977	11.1	-	22.4	-	-	-	-	-	-
1978	12.2	-	23.4	-	-	-	-	-	-
1979	13.4	-	24.0	-	-	-	-	-	-
1980	14.4	-	24.9	-	-	-	-	-	-
1981	15.8	-	25.5	29.7	31.0	21.8	-	-	25.7
1982	16.6	-	26.3	-	32.0	-	-	-	-
1983	17.7	-	27.0	30.8	32.6	22.0	-	-	26.4
1984	18.1	-	-	-	33.4	-	-	-	-
1985	19.9	-	31.3	33.3	34.1	24.1	-	-	29.0
1986	19.4	-	-	-	34.3	25.2	-	-	-
1987	20.2	-	29.6	32.9	34.3	25.7	-	-	29.4
1988	20.7	-	-	-	34.2	25.9	-	-	-
1989	22.1	-	30.0	34.2	35.5	28.1	-	-	30.6
1990	23.3	-	-	-	37.4	29.2	-	-	-
1991	23.6	-	31.6	28.3	37.3	28.1	5.4	-	29.7
1992	23.2	-	-	-	35.0	29.3	6.2	-	29.8
1993	22.0	-	30.1	-	33.4	29.1	6.6	-	29.0
1994	21.2	-	-	-	32.1	28.6	6.0	-	-
1995	21.9	-	30.1	29.0	31.2	25.0	6.3	21.9	27.2
1996	22.4	-	-	28.7	29.7	25.5	6.5	24.3	26.8
1997	22.6	-	29.8	29.8	29.5	26.1	7.3	25.7	27.6
1998	22.9	-	-	31.7	30.9	25.4	10.1	26.3	28.5
1999	21.9	-	31.3	31.4	30.7	-	11.5	25.5	28.4
2000	22.0	-	-	32.3	29.7	-	11.3	27.2	28.1
2001	22.4	-	-	31.6	-	-	12.1	24.4	-
2002	20.9	27.0	-	-	-	-	-	-	-
2003	21.1	27.2	-	-	-	-	-	-	-

Note: Same as Table 6-1-1 and Table 6-1-4.

The calculation method of R&D expenditure per researcher for Japan after 2001 is different from that of 2000 and before, because of the change in the contents and period of the 'Survey of Research and Development' by the Bureau of Statistics, the Ministry of Public Management, Home Affairs, Posts and Telecommunications, from the survey of 2002 (targeting 2001). Until 2000, R&D expenditure per researcher was calculated by annual R&D expenditure in the reference year divided by the number of full-time researchers at the start of the new fiscal year (April 1st), and after 2001, it was divided by the number of researchers at the end of the fiscal year (March 31st).

Source: Same as Table 6-1-1 and Table 6-1-4.

Table 6-2-2: Trends in R&D expenditure per researcher in Japan

(unit: million yen)

FY	Industries	Universities and colleges	Government research institutes	Non-profit private research institutes
1970	8.8	3.7	6.5	8.7
1971	8.0	4.0	8.1	10.2
1972	9.3	4.5	9.8	9.9
1973	10.4	4.6	11.6	12.3
1974	12.2	5.5	11.4	30.9
1975	11.5	6.2	13.8	32.5
1976	13.0	6.6	15.0	33.5
1977	13.9	6.9	16.5	22.9
1978	14.9	7.8	18.5	28.4
1979	16.9	8.2	20.7	26.0
1980	18.1	8.5	22.0	38.6
1981	19.6	9.0	23.0	50.5
1982	20.9	9.4	23.2	37.3
1983	22.7	9.7	24.0	46.8
1984	22.9	9.8	25.2	44.8
1985	25.7	9.9	28.1	48.6
1986	24.3	9.9	29.1	52.9
1987	24.9	10.3	32.6	52.4
1988	25.8	10.3	32.4	47.6
1989	28.0	10.6	32.6	46.2
1990	29.5	11.2	33.3	46.7
1991	29.4	11.5	35.5	46.2
1992	28.1	12.0	39.2	45.5
1993	25.4	12.4	42.8	43.8
1994	24.5	12.0	41.0	43.2
1995	24.9	12.7	45.9	39.4
1996	26.2	12.4	43.8	42.2
1997	26.6	12.3	43.2	42.8
1998	26.7	12.7	46.4	42.2
1999	24.8	12.5	47.9	42.8
2000	25.0	12.4	48.8	44.9
2001	24.8	11.5	41.2	25.8
2002	25.2	11.7	41.1	24.1

Note: Same as Table 6-2-1(A).
Source: Same as Table 6-2-1(A).

Table 6-2-3: Trends in R&D expenditure by character of work for selected countries

FY	Japan: R&D expenditure				Composition ratio (%)		
	Basic research	Applied research	Development research	Total	Basic	Applied	Development
1980	707,641	1,164,869	2,726,504	4,599,014	15.4	25.3	59.3
1981	768,152	1,349,650	3,150,661	5,268,463	14.6	25.6	59.8
1982	861,300	1,509,826	3,490,056	5,861,183	14.7	25.8	59.5
1983	944,858	1,642,246	3,891,265	6,478,368	14.6	25.3	60.1
1984	1,009,651	1,793,723	4,349,565	7,152,938	14.1	25.1	60.8
1985	1,080,846	2,014,856	4,993,118	8,088,820	13.4	24.9	61.7
1986	1,157,250	2,044,128	5,192,495	8,393,873	13.8	24.4	61.9
1987	1,306,645	2,181,749	5,506,339	8,994,733	14.5	24.3	61.2
1988	1,347,078	2,361,349	6,051,139	9,759,566	13.8	24.2	62.0
1989	1,452,953	2,604,269	6,859,136	10,916,358	13.3	23.9	62.8
1990	1,577,700	2,923,559	7,590,357	12,091,566	13.0	24.2	62.8
1991	1,694,909	3,129,088	7,893,543	12,717,540	13.3	24.6	62.1
1992	1,783,077	3,115,674	7,895,840	12,794,591	13.9	24.4	61.7
1993	1,851,322	3,009,147	7,666,569	12,527,038	14.8	24.0	61.2
1994	1,858,568	3,052,779	7,514,304	12,425,651	15.0	24.6	60.5
1995	2,041,337	3,238,596	7,922,894	13,202,826	15.5	24.5	60.0
1996	2,016,004	3,366,285	8,463,489	13,845,778	14.6	24.3	61.1
1997	2,071,982	3,545,547	8,888,775	14,506,304	14.3	24.4	61.3
1998	2,139,520	3,648,374	9,062,521	14,850,414	14.4	24.6	61.0
1999	2,150,664	3,463,393	9,097,874	14,711,931	14.6	23.5	61.8
2000	2,205,448	3,585,494	9,197,692	14,988,634	14.7	23.9	61.4
2001	2,203,655	3,525,765	9,359,615	15,089,034	14.6	23.4	62.0
2002	2,298,896	3,503,195	9,541,534	15,343,625	15.0	22.8	62.2

Year	U.S.: R&D expenditure (million dollars)				Composition ratio (%)		
	Basic research	Applied research	Development research	Total	Basic	Applied	Development
1981	9,844	16,393	46,030	72,267	13.6	22.7	63.7
1982	10,863	18,286	51,698	80,847	13.4	22.6	63.9
1983	12,110	20,394	57,571	90,075	13.4	22.6	63.9
1984	13,503	22,517	66,323	102,343	13.2	22.0	64.8
1985	14,885	25,404	74,489	114,778	13.0	22.1	64.9
1986	17,286	27,252	75,799	120,337	14.4	22.6	63.0
1987	18,551	27,914	79,833	126,298	14.7	22.1	63.2
1988	19,813	29,545	84,572	133,930	14.8	22.1	63.1
1989	21,908	32,279	87,727	141,914	15.4	22.7	61.8
1990	23,069	34,974	94,008	152,051	15.2	23.0	61.8
1991	27,201	38,632	95,081	160,914	16.9	24.0	59.1
1992	27,628	37,938	99,793	165,359	16.7	22.9	60.3
1993	28,754	37,286	99,677	165,717	17.4	22.5	60.1
1994	29,580	36,614	103,023	169,217	17.5	21.6	60.9
1995	29,562	40,999	113,053	183,614	16.1	22.3	61.6
1996	32,816	43,178	121,350	197,344	16.6	21.9	61.5
1997	36,741	46,689	128,726	212,156	17.3	22.0	60.7
1998	42,284	44,577	139,505	226,366	18.7	19.7	61.6
1999	46,877	50,937	145,749	243,563	19.2	20.9	59.8
2000	54,376	54,380 p	155,861 p	264,617	20.5	20.6	58.9
2001	58,980 p	58,163 p	164,625 p	281,768	20.9	20.6	58.4

Year	Germany: R&D expenditure (million euros)			Composition ratio (%)	
	Basic research	Not classifiable	Total	Basic	Not classifiable
1981	3,703 v	13,208 v	16,911 v	21.9	78.1
1983	3,899	15,179	19,078 v	20.4	79.6
1985	4,256	17,987	22,243 v	19.1	80.9
1987	4,856 a	20,453 a	25,309 a,v	19.2	80.8
1989	5,560	22,734	28,294 v	19.6	80.4
1991	7,055 a	26,705 a	33,761 a,v	20.9	79.1
1993	7,255	27,829	35,084 v	20.7	79.3

Year	France: R&D expenditure (million euros)				Composition ratio (%)		
	Basic research	Applied research	Development research	Total	Basic	Applied	Development
1986	3,437 k	5,812 k	8,017 k	17,266 k	19.9	33.7	46.4
1987	3,770 k	6,082 k	8,651 k	18,502 k	20.4	32.9	46.8
1988	4,048 k	6,718 k	9,149 k	19,915 k	20.3	33.7	45.9
1989	4,432 k	6,911 k	10,541 k	21,885 k	20.3	31.6	48.2
1990	4,822 k	7,468 k	11,670 k	23,959 k	20.1	31.2	48.7
1991	5,045 k	7,683 k	12,135 k	24,863 k	20.3	30.9	48.8
1992	5,375 k	8,181 k	12,266 k	25,821 k	20.8	31.7	47.5
1993	5,745 k	7,749 k	12,989 k	26,484 k	21.7	29.3	49.0
1994	5,946 k	7,778 k	13,040 k	26,764 k	22.2	29.1	48.7
1995	6,061 k	8,069 k	13,172 k	27,303 k	22.2	29.6	48.2
1996	6,118 k	7,933 k	13,785 k	27,835 k	22.0	28.5	49.5
1997	6,111 a	8,227 a	13,418 a	27,756 a,k	22.0	29.6	48.3
1998	7,102 k	7,577 k	13,640 k	28,319 k	25.1	26.8	48.2
1999	7,209 k	8,126 k	14,193 k	29,528 k	24.4	27.5	48.1
2000	7,305 a	10,093 a	13,555 a	30,954 a,k	23.6	32.6	43.8

Year	Republic of Korea: R&D expenditure (million won)				Composition ratio (%)		
	Basic research	Applied research	Development research	Total	Basic	Applied	Development
1995	1,176,819 g	2,362,110 g	5,901,677 g	9,440,606 g,k	12.5	25.0	62.5
1996	1,439,020 g	2,927,270 g	6,511,761 g	10,878,050 g,k	13.2	26.9	59.9
1997	1,616,490 g	3,470,560 g	7,098,757 g	12,185,807 g,k	13.3	28.5	58.3
1998	1,585,367 g	2,848,458 g	6,902,792 g	11,336,617 g,k	14.0	25.1	60.9
1999	1,625,477 g	3,065,197 g	7,231,078 g	11,921,752 g,k	13.6	25.7	60.7
2000	1,746,138 g	3,370,089 g	8,732,274 g	13,848,501 g,k	12.6	24.3	63.1

Note: a: The data lack continuity with the data until the previous year.
k: Used the total internal expenditure instead of current internal R&D expenditure.
g: Excludes R&D expenditure for human/social science.
p: Provisional figure.
v. Adding up these figures will not make the total figure.
1) After 1996, Japan includes software industry.
2) R&D expenditure of Japan is aimed only at natural science. However, it includes expenditure by departments other than natural science. R&D expenditure for other countries is the total of natural science and human science.
3) Figure for Germany includes only basic research expenditure.
Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'
<U.S.>NSF, "National Patterns of R&D Resources: 2002 Data Update." After 1998, OECD, "Basic Science and Technology Statistics 2002/2"
<Germany, France, Korea>OECD, "Basic S & T Statistics 2002/2"

Table 6-2-4: Trends in basic research expenditure by performing sector for selected countries

Japan (%)					
Year	Industries	Government research institutes	Universities	Non-profit private research institites	Total
1975	24.3	14.4	60.0	1.2	100.0
1980	22.2	12.6	62.7	2.4	100.0
1985	32.5	9.2	55.1	3.1	100.0
1990	37.3	8.4	48.6	5.6	100.0
1991	39.0	8.6	46.7	5.7	100.0
1992	36.8	10.4	47.5	5.3	100.0
1993	32.7	12.5	48.7	6.1	100.0
1994	32.6	11.8	49.0	6.6	100.0
1995	30.6	13.6	50.1	5.8	100.0
1996	30.7	12.7	50.9	5.7	100.0
1997	32.1	13.1	49.9	4.8	100.0
1998	28.1	15.5	51.9	4.5	100.0
1999	28.6	16.7	50.1	4.6	100.0
2000	28.3	18.3	48.6	4.7	100.0
2001	29.9	18.2	48.9	3.0	100.0
2002	29.8	19.4	48.1	2.7	100.0

U.S. (%)					
Year	industries	Government research institutes	Universities	Non-profit private research	Total
1975	15.0	15.6	60.6	8.8	100.0
1980	15.0	13.7	62.5	8.7	100.0
1985	19.2	13.1	59.4	8.3	100.0
1990	22.2	10.1	59.1	8.6	100.0
1991	28.8	8.7	54.3	8.1	100.0
1992	25.3	8.8	57.2	8.7	100.0
1993	24.1	9.1	57.8	9.1	100.0
1994	23.7	8.6	58.4	9.3	100.0
1995	20.6	9.1	60.2	10.1	100.0
1996	25.0	8.2	56.9	10.0	100.0
1997	28.4	7.5	54.8	9.3	100.0
1998	32.2	7.1	51.6	9.1	100.0
1999	32.7	7.1	50.3	9.8	100.0
2000	35.7	6.8	47.5	10.0	100.0
2001	34.7 p	6.7 pr	48.0 pr	10.6 pr	100.0 p

Germany (%)					
Year	industries	Government research institutes	Universities	Non-profit private research	Total
1981	18.1	21.9	59.4	0.6	100.0 v
1983	17.2	24.0	58.2	0.6	100.0
1985	16.0	24.5	58.9	0.6	100.0
1987	19.3	24.6	55.2	0.9 a	100.0 a
1989	22.3	24.1	52.9	0.8	100.0
1991	19.4 a	24.6 a	55.7 a	0.3 a	100.0 a
1993	15.9	23.5	60.6 a	0.0	100.0

Republic of Korea (%)					
Year	industries	Government research institutes	Universities	Non-profit private research	Total
1996	44.9 k	21.4 g,k	31.4 g,k	2.2 g,k	100.0 0
1997	44.4 k	24.1 g,k	29.7 g,k	1.8 g,k	100.0 0
1998	32.6 k	34.6 g,k,s	32.0 g,k	0.8 g,k,s	100.0 0
1999	39.4 k	28.0 g,k	30.2 g,k	2.4 g,k	100.0 0
2000	36.1 k	23.7 g,k	37.9 g,k	2.3 g,k	100.0 0

France (%)					
Year	industries	Government research institutes	Universities	Non-profit private research	Total
1986	8.8 k	21.4 k	67.5 k	2.2 k	100.0 k
1987	10.7 k	21.6 k	65.6 k	2.1 k	100.0 k
1988	13.2 k	20.3 k	64.6 k	1.9 k	100.0 k
1989	11.3 k	21.5 k	65.2 k	2.0 k	100.0 k
1990	12.7 k	20.8 k	64.3 k	2.2 k	100.0 k
1991	12.7 k	19.2 k	66.0 k	2.1 k	100.0 k
1992	13.2 a,k	19.2 a,k	65.1 k	2.5 a,k	100.0 k
1993	12.4 k	20.6 k	64.2 k	2.8 k	100.0 k
1994	13.3 k	19.7 k	64.0 k	3.0 k	100.0 k
1995	11.5 k	20.5 k	65.2 k	2.8 k	100.0 k
1996	11.7 k	19.1 k	66.6 k	2.6 k	100.0 k
1997	12.5 a,k	17.2 a,k	68.0 k	2.3 k	100.0 a,k
1998	11.0 k	26.3 k	60.4 k	2.3 k	100.0 k
1999	11.7 k	25.0 k	60.8 k	2.5 k	100.0 k
2000	11.0 k	17.0 a,k	69.6 a,k	2.5 k	100.0 a,k

Note: Same as Table 6-2-3.

Pr. Preliminary figure.

Source: Same as Table 6-2-3.

NSF, “National Patterns of R&D Resources: 2002 Data Update” for U.S. government research institutes, universities, and nonprofit private research institutes.

Table 6-2-5: Number of researchers by field of research and by sector in Japan

(A)2003

(unit: persons)

	Human/social science		
	Human science	Social science	Total
Business enterprises	—	—	4,015
Universities and colleges	34,514	31,251	65,765
Non-profit organizations/public institutes	644	1,924	2,568
Total	35,158	33,175	72,348

	Natural science					
	Science					
	Math/physics	Chemistry	Biology	Geoscience	Other science	Total
Business enterprises	19,670	59,174	5,878	464	3,114	88,300
Universities and colleges	11,315	4,566	5,508	—	4,092	25,481
Non-profit organizations/public institutes	2,721	4,690	2,698	655	1,040	11,804
Total	33,706	68,430	14,084	1,119	8,246	125,585

	Natural science						
	Engineering						
	Machinery/ marine vessels/ aviation	Electricity/ Communication	Civil engineering/ construction	Materials	Textiles	Other engineering	Total
Business enterprises	113,365	158,302	10,025	20,059	2,970	32,099	336,820
Universities and colleges	7,659	13,894	7,219	2,083	—	14,535	45,390
Non-profit organizations/public institutes	3,694	3,785	3,630	1,411	462	3,579	16,561
Total	124,718	175,981	20,874	23,553	3,432	50,213	398,771

	Natural science			
	Agriculture			
	Agriculture/forestry/ animal octor/ livestock	Fishery	Other agriculture	Total
Business enterprises	6,827	1,116	6,369	14,312
Universities and colleges	9,858	1,119	1,013	11,990
Non-profit organizations/public institutes	9,450	2,066	1,710	13,226
Total	26,135	4,301	9,092	39,528

	Natural science						
	Health science						
	Medical/dental	Pharmaceutical	Other health science	Total	Total	Others	Grand total
Business enterprises	631	14,475	1,499	16,605	458,417	—	460,053
Universities and colleges	73,870	4,628	8,504	87,002	169,863	22,164	257,792
Non-profit organizations/public institutes	2,181	1,120	716	4,017	45,608	1,691	49,867
Total	76,682	20,223	10,719	107,624	673,888	23,855	767,712

Note: Actual number of researchers.
Researchers of universities exclude part-time researchers, research assistants, technical staff, clerical staff and other related persons.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

(B)1987～2003

(unit: persons)

Year	Business enterprises						Universities and colleges				Non-profit organizaions/ public institutes	Total
	Electricity/ communicatino	Machinery/ marine vessels/ aviation	Chemistry	Math/ physics	Others	Total	Medical/ dental	Human/ social science	Others	Total		
1987	77,612	64,760	51,967	14,389	52,118	260,846	68,232	43,300	78,065	189,597	37,336	487,779
1988	85,475	69,115	53,351	15,272	56,085	279,298	70,396	44,755	80,277	195,428	38,541	513,267
1989	92,192	72,232	55,434	16,223	58,121	294,202	72,259	46,145	82,326	200,730	40,076	535,008
1990	98,108	77,316	59,954	17,852	60,718	313,948	73,178	47,811	84,520	205,509	40,819	560,276
1991	104,629	80,841	60,425	18,598	66,503	330,996	74,342	48,995	86,561	209,898	41,921	582,815
1992	107,288	83,028	62,547	19,526	68,420	340,809	75,259	50,190	89,013	214,462	43,062	598,333
1993	112,004	87,269	62,703	20,279	74,151	356,406	77,261	51,698	93,047	222,006	43,998	622,410
1994	117,000	88,147	66,192	21,111	74,828	367,278	78,236	53,679	97,249	229,164	44,641	641,083
1995	120,370	91,505	67,332	20,716	76,716	376,639	79,907	54,919	100,876	235,702	46,525	658,866
1996	125,353	94,834	66,275	21,353	76,285	384,100	81,065	56,876	104,921	242,862	46,459	673,420
1997	135,318	93,571	67,195	21,901	82,376	400,361	81,448	58,612	108,215	248,275	46,987	695,623
1998	135,605	92,968	72,959	21,410	81,290	404,232	82,225	60,538	110,402	253,165	47,117	704,514
1999	161,204	96,893	67,876	23,092	80,130	429,195	80,727	62,751	112,962	256,440	47,023	732,658
2000	165,782	96,696	65,534	22,483	83,263	433,758	79,302	64,510	115,200	259,012	46,734	736,932
2001	156,696	98,391	64,745	21,403	80,128	421,363	77,514	65,425	116,820	259,759	47,093	728,215
2002	168,425	113,247	60,909	19,950	99,431	461,962	76,001	64,938	116,894	257,833	50,027	769,822
2003	158,302	113,365	59,174	19,670	109,542	460,053	73,870	65,765	118,157	257,792	49,867	767,712

Note: 1) The classification of organizations until 2001 was changed from ‘companies and others’ to ‘business enterprises’ and from ‘research institutes’ to ‘nonprofit organizations /public institutes,’ since the ‘Survey Report of Science and Technology’ started being conducted by the Ministry of Public Management, Home Affairs, Posts and Telecommunications in 2002.

2) Until 2001, profit-making private research institutes were included in ‘research institutes’ and after 2001, it is included in ‘business enterprises.’

3) Same as Figure 6-2-5(A) except above 1) and 2).

Source: Same as Figure 6-2-5(A).

Table 6-2-6: Research assistants per researcher for selected countries

(unit: persons)

Country/Year	Researchers	Research supporters				Number fo research supporter per researcher
		Total	Research assistants	Technical staff	Other related persons	
Japan (2003)	791,224	241,602	76,490	74,664	90,448	0.31

Country/Year	Researchers	Research supporters			Number of research supporter per researcher
		Total	Technical staff	Other related persons	
U.S. (1999)	1,261,227	-	-	-	-
Germany (2000	259,214	226,751			0.87
France (2000)	172,070	155,396	-	-	0.90
U.K. (1998)	157,662	-	-	-	-
Republic of Korea (2000)	108,370	29,707	-	-	0.27

Note: Note for researchers is the same as in Table 6-1-4.

Japanese figures are actual numbers.

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development’

<U.S., France, U.K., Korea>OECD, “Basic Science and Technology Statistics 2002/2”

Table 6-2-7: Trends in the number of research assistants per researcher in Japan

(unit: persons)

Year		Number of research supporter per researcher			Total
		Research assistants	Technical staff	Clerical staff and other related persons	
1985	Companies	0.35	0.32	0.17	0.84
	Research institutes	0.23	0.32	0.46	1.01
	Universities and colleges	0.07	0.07	0.15	0.29
1986	Companies	0.32	0.31	0.16	0.79
	Research institutes	0.24	0.31	0.45	1.01
	Universities and colleges	0.06	0.07	0.15	0.28
1987	Companies	0.32	0.30	0.16	0.77
	Research institutes	0.24	0.32	0.47	1.03
	Universities and colleges	0.06	0.07	0.14	0.27
1988	Companies	0.29	0.28	0.15	0.72
	Research institutes	0.23	0.30	0.45	0.98
	Universities and colleges	0.06	0.06	0.13	0.26
1989	Companies	0.28	0.28	0.15	0.71
	Research institutes	0.22	0.27	0.46	0.96
	Universities and colleges	0.05	0.06	0.13	0.25
1990	Companies	0.27	0.25	0.15	0.67
	Research institutes	0.21	0.26	0.47	0.95
	Universities and colleges	0.05	0.06	0.13	0.24
1991	Companies	0.26	0.27	0.15	0.69
	Research institutes	0.21	0.26	0.47	0.95
	Universities and colleges	0.05	0.06	0.13	0.24
1992	Companies	0.26	0.25	0.14	0.65
	Research institutes	0.21	0.24	0.48	0.93
	Universities and colleges	0.05	0.06	0.13	0.23
1993	Companies	0.25	0.24	0.15	0.64
	Research institutes	0.19	0.23	0.49	0.91
	Universities and colleges	0.04	0.06	0.12	0.22
1994	Companies	0.22	0.22	0.15	0.59
	Research institutes	0.17	0.24	0.49	0.90
	Universities and colleges	0.04	0.05	0.12	0.22
1995	Companies	0.20	0.20	0.14	0.53
	Research institutes	0.13	0.22	0.45	0.80
	Universities and colleges	0.04	0.05	0.11	0.21

(unit: persons)

Year		Number of research supporter per researcher			Total
		Research assistants	Technical staff	Clerical staff and other related persons	
1996	Companies	0.18	0.19	0.13	0.49
	Research institutes	0.13	0.22	0.45	0.80
	Universities and colleges	0.04	0.05	0.11	0.20
1997	Companies	0.17	0.18	0.12	0.47
	Research institutes	0.14	0.22	0.45	0.80
	Universities and colleges	0.03	0.04	0.10	0.17
1998	Companies	0.16	0.16	0.12	0.45
	Research institutes	0.15	0.22	0.45	0.82
	Universities and colleges	0.04	0.05	0.10	0.19
1999	Companies	0.16	0.16	0.10	0.43
	Research institutes	0.16	0.21	0.48	0.86
	Universities and colleges	0.04	0.05	0.10	0.19
2000	Companies	0.15	0.14	0.10	0.39
	Research institutes	0.17	0.22	0.48	0.86
	Universities and colleges	0.04	0.05	0.10	0.19
2001	Companies	0.14	0.14	0.10	0.38
	Research institutes	0.18	0.22	0.45	0.85
	Universities and colleges	0.04	0.05	0.11	0.19
2002	Companies	0.14	0.12	0.09	0.36
	Research institutes	0.19	0.17	0.45	0.80
	Universities and colleges	0.03	0.04	0.10	0.18
2003	Companies	0.12	0.12	0.09	0.33
	Research institutes	0.21	0.18	0.45	0.84
	Universities and colleges	0.03	0.04	0.10	0.18

Note: 1) Actual numbers
2)Note for researchers is the same as in Table 6-1-4.
3) The nomenclature was changed from ‘companies and others’ to ‘business enterprises,’ and from ‘research institutes’ to ‘nonprofit organizations /public institutes’ in 2002.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development’

Table 7-1-1: Number of scientific papers published, by country: Top 25 countries (total for 1998-2002)

Ranking	Country	Number of scientific papers published (number): Natural science/ engineering	Human/ social science
1	U.S.	1,110,991	156,957
2	Japan	341,317	2,883
3	Germany	311,091	11,878
4	U.K.	305,265	40,201
5	France	223,882	9,968
6	Canada	149,596	16,908
7	Italy	147,945	3,854
8	Chian	127,595	3,398
9	Russia	119,667	2,446
10	Spain	103,861	4,411
11	Australia	94,570	10,736
12	Netherlands	86,826	6,631
13	India	78,903	1,442
14	Sweden	70,463	3,648
15	Switzerland	65,285	2,168
16	Republic of Korea	62,400	1,188
17	Taiwan	47,109	1,291
18	Brazil	47,009	1,500
19	Belgium	46,901	2,550
20	Poland	44,983	557
21	Israel	42,658	3,852
22	Denmark	36,235	1,707
23	Finland	33,694	1,856
24	Austria	33,344	1,349
25	Turkey	26,811	704

Note: 1) 'Country' is the location of the organization to which the author belongs.
2) International collaboration papers are redundantly reported for each country to which co-authors belong.
3) 'China' includes scientific papers of Hong Kong.
Source: Recompiled by NISTEP based on the data recorded in the "National Science Indicators, 1981-2002" of Institute for Scientific Information.

Table 7-1-2: Growth in the number of scientific papers published, by country and region (natural sciences and engineering)

	Number of scientific papers published		Number of increases	Rate of increase
	(A) 1998-1992	(B) 1998-2002	(B) － (A)	{(B)－(A)}/(A)
U.S.	973,820	1,110,991	137,171	14.1%
Japan	222,133	341,317	119,184	53.7%
U.K.	223,118	305,265	82,147	36.8%
Germany	208,252	311,091	102,839	49.4%
France	150,168	223,882	73,714	49.1%
EU countries	871,303	1,279,700	408,397	46.9%
Asia-Oceania countries	433,323	779,661	346,338	79.9%
Latin America countries	46,943	110,727	63,784	135.9%
Total	2,627,202	3,391,691	764,489	29.1%

Note: 1) Figures for EU countries are the total of the current 15 member countries. Asia-Oceania countries include Japan.
2) Collaboration papers of multiple countries/areas are redundantly reported in each country/area. Therefore, the sum of each country/area may not be consistent with the total number.
Source: Recompiled by NISTEP based on the "National Science Indicators, 1981-2002 (Deluxe version)" of Institute for Scientific Information.

Table 7-1-3: Trends in the share of scientific papers published for selected countries (natural sciences and engineering)

Year	a. Japan	b. U.S.	c. U.K.	d. Germany	e. France	f. Canada	g. Italy	h. USSR	i. Russia	j. China	Others (*)	EU	Total
	Number of scientific papers published (number)												
1981	26,744	154,203	35,603	32,778	22,108	17,837	9,416	21,739	-	1,614	83,373	127,730	405,415
1982	27,981	157,001	36,242	33,709	22,467	18,437	10,033	22,540	-	2,577	83,984	131,846	414,971
1983	29,219	157,935	37,452	33,634	22,286	19,155	10,824	23,871	-	2,884	86,141	134,867	423,401
1984	30,227	159,082	36,832	33,014	22,282	19,972	11,286	22,973	-	3,175	84,734	134,507	423,577
1985	33,696	169,013	40,099	36,128	23,853	21,709	11,922	32,418	-	3,657	80,571	145,770	453,066
1986	35,417	174,936	41,123	36,967	25,767	22,767	12,526	31,371	-	4,449	84,923	152,192	470,246
1987	35,582	174,157	40,945	37,304	25,781	23,356	12,866	29,488	-	5,176	84,370	152,993	469,025
1988	39,853	181,423	41,393	37,985	27,066	24,248	14,259	31,947	-	6,258	85,196	157,826	489,628
1989	41,202	187,596	42,337	40,117	28,497	25,145	15,584	32,217	-	7,114	88,807	166,331	508,616
1990	43,764	193,009	43,850	41,394	29,342	25,837	16,194	31,668	-	8,145	89,007	172,190	522,210
1991	45,706	201,258	45,689	43,187	30,832	27,079	17,654	31,507	-	8,131	83,809	179,241	534,852
1992	51,608	210,534	49,849	45,569	34,431	29,288	20,027	34,255	-	9,538	86,797	195,715	571,896
1993	51,356	209,217	49,901	45,095	34,589	28,966	20,171	124	21,462	10,142	92,420	196,655	563,443
1994	55,381	216,215	54,286	48,724	37,880	30,254	22,602	0	24,072	10,990	97,270	214,053	597,674
1995	58,335	224,243	56,662	52,016	40,054	31,051	24,269	1	24,303	13,270	100,721	226,146	624,925
1996	60,975	221,273	58,509	54,501	40,864	30,840	25,988	0	24,242	14,836	102,748	234,231	634,776
1997	61,454	219,398	57,233	57,511	42,260	29,536	26,429	0	24,540	17,370	102,966	239,078	638,697
1998	66,532	221,457	60,075	61,681	44,378	29,493	28,243	0	24,415	19,166	107,560	251,783	663,000
1999	68,293	222,394	61,572	62,099	45,372	30,435	28,861	0	23,966	22,347	110,957	256,382	676,296
2000	67,670	219,730	62,196	61,750	44,377	29,824	28,968	0	25,216	24,560	108,877	254,477	673,168
2001	70,123	226,163	61,735	63,539	45,710	29,747	30,864	0	22,976	28,659	112,101	261,249	691,617
2002	68,699	221,247	59,687	62,022	44,045	30,097	31,009	0	23,094	32,863	114,847	255,809	687,610
	Share of number of scientific papers published (%)												
1981	6.6	38.0	8.8	8.1	5.5	4.4	2.3	5.4	-	0.4	20.6	31.5	100.0
1982	6.7	37.8	8.7	8.1	5.4	4.4	2.4	5.4	-	0.6	20.2	31.8	100.0
1983	6.9	37.3	8.8	7.9	5.3	4.5	2.6	5.6	-	0.7	20.3	31.9	100.0
1984	7.1	37.6	8.7	7.8	5.3	4.7	2.7	5.4	-	0.7	20.0	31.8	100.0
1985	7.4	37.3	8.9	8.0	5.3	4.8	2.6	7.2	-	0.8	17.8	32.2	100.0
1986	7.5	37.2	8.7	7.9	5.5	4.8	2.7	6.7	-	0.9	18.1	32.4	100.0
1987	7.6	37.1	8.7	8.0	5.5	5.0	2.7	6.3	-	1.1	18.0	32.6	100.0
1988	8.1	37.1	8.5	7.8	5.5	5.0	2.9	6.5	-	1.3	17.4	32.2	100.0
1989	8.1	36.9	8.3	7.9	5.6	4.9	3.1	6.3	-	1.4	17.5	32.7	100.0
1990	8.4	37.0	8.4	7.9	5.6	4.9	3.1	6.1	-	1.6	17.0	33.0	100.0
1991	8.5	37.6	8.5	8.1	5.8	5.1	3.3	5.9	-	1.5	15.7	33.5	100.0
1992	9.0	36.8	8.7	8.0	6.0	5.1	3.5	6.0	-	1.7	15.2	34.2	100.0
1993	9.1	37.1	8.9	8.0	6.1	5.1	3.6	0.0	3.8	1.8	16.4	34.9	100.0
1994	9.3	36.2	9.1	8.2	6.3	5.1	3.8	0.0	4.0	1.8	16.3	35.8	100.0
1995	9.3	35.9	9.1	8.3	6.4	5.0	3.9	0.0	3.9	2.1	16.1	36.2	100.0
1996	9.6	34.9	9.2	8.6	6.4	4.9	4.1	0.0	3.8	2.3	16.2	36.9	100.0
1997	9.6	34.4	9.0	9.0	6.6	4.6	4.1	0.0	3.8	2.7	16.1	37.4	100.0
1998	10.0	33.4	9.1	9.3	6.7	4.4	4.3	0.0	3.7	2.9	16.2	38.0	100.0
1999	10.1	32.9	9.1	9.2	6.7	4.5	4.3	0.0	3.5	3.3	16.4	37.9	100.0
2000	10.1	32.6	9.2	9.2	6.6	4.4	4.3	0.0	3.7	3.6	16.2	37.8	100.0
2001	10.1	32.7	8.9	9.2	6.6	4.3	4.5	0.0	3.3	4.1	16.2	37.8	100.0
2002	10.0	32.2	8.7	9.0	6.4	4.4	4.5	0.0	3.4	4.8	16.7	37.2	100.0

Note: 1) Collaboration papers of multiple countries/areas are redundantly reported in each country/area.

2) Figures for 'Others' are the difference in the total number subtracted by the number of each country of a. through j. (excluding EU).

Source: Recompiled by NISTEP based on the "National Science Indicators, 1981-2002 (Deluxe version)" of Institute for Scientific Information.

Table 7-1-4: Trends in citation count for selected countries (natural sciences and engineering; 1985-2002)

Year	Japan	U.S.	Germany	France	U.K.	Canada	Italy	Russia	USSR	China	EU	Total
Share of frequency of citations of scientific papers (%)												
1981-85	6.0	52.9	7.4	5.0	10.6	4.6	2.1	—	1.4	0.2	31.6	100.0
1982-86	6.2	52.9	7.4	5.1	10.6	4.7	2.2	—	1.4	0.2	31.8	100.0
1983-87	6.3	53.2	7.4	5.2	10.6	4.8	2.2	—	1.3	0.3	31.9	100.0
1984-88	6.6	53.6	7.3	5.3	10.5	4.9	2.2	—	1.4	0.3	31.8	100.0
1985-89	6.8	53.8	7.5	5.3	10.2	4.9	2.3	—	1.4	0.4	31.7	100.0
1986-90	7.0	54.1	7.5	5.4	10.1	4.9	2.4	—	1.3	0.4	31.8	100.0
1987-91	7.2	54.4	7.5	5.5	9.9	4.9	2.5	—	1.3	0.5	31.8	100.0
1988-92	7.4	54.2	7.6	5.6	9.9	5.0	2.7	—	1.3	0.5	32.2	100.0
1989-93	7.5	54.0	7.8	5.7	10.2	5.1	2.9	—	1.3	0.6	33.1	100.0
1990-94	7.6	53.8	8.1	5.9	10.4	5.2	3.0	0.2	1.2	0.6	34.0	100.0
1991-95	7.7	53.6	8.3	6.2	10.5	5.4	3.3	0.4	1.0	0.7	34.9	100.0
1992-96	7.8	52.9	8.6	6.3	10.8	5.5	3.5	0.8	0.6	0.8	35.9	100.0
1993-97	7.8	52.4	8.9	6.5	10.9	5.5	3.7	1.3	—	0.8	36.8	100.0
1994-98	7.9	51.7	9.2	6.7	11.0	5.5	3.9	1.4	—	0.9	37.6	100.0
1995-99	8.1	50.9	9.6	6.8	11.1	5.4	4.1	1.4	—	1.1	38.4	100.0
1996-00	8.4	50.1	10.0	7.0	11.2	5.4	4.3	1.4	—	1.2	39.1	100.0
1997-01	8.6	49.2	10.3	7.0	11.4	5.3	4.4	1.5	—	1.5	39.7	100.0
1998-02	8.8	48.6	10.5	7.1	11.4	5.3	4.6	1.5	—	1.7	40.0	100.0
Share of scientific papers published (%)												
1981-85	7.0	37.6	8.0	5.3	8.8	4.6	2.5	—	5.8	0.7	31.8	100.0
1982-86	7.2	37.4	7.9	5.3	8.8	4.7	2.6	—	6.1	0.8	32.0	100.0
1983-87	7.3	37.3	7.9	5.4	8.8	4.8	2.7	—	6.3	0.9	32.2	100.0
1984-88	7.6	37.2	7.9	5.4	8.7	4.9	2.7	—	6.4	1.0	32.2	100.0
1985-89	7.8	37.1	7.9	5.5	8.6	4.9	2.8	—	6.6	1.1	32.4	100.0
1986-90	8.0	37.0	7.9	5.5	8.5	4.9	2.9	—	6.4	1.3	32.6	100.0
1987-91	8.2	37.1	7.9	5.6	8.5	5.0	3.0	—	6.2	1.4	32.8	100.0
1988-92	8.5	37.1	7.9	5.7	8.5	5.0	3.2	—	6.2	1.5	33.2	100.0
1989-93	8.6	37.1	8.0	5.8	8.6	5.0	3.3	0.8	4.8	1.6	33.7	100.0
1990-94	8.9	36.9	8.0	6.0	8.7	5.1	3.5	1.6	3.5	1.7	34.3	100.0
1991-95	9.1	36.7	8.1	6.1	8.9	5.1	3.6	2.4	2.3	1.8	35.0	100.0
1992-96	9.3	36.1	8.2	6.3	9.0	5.0	3.8	3.1	1.1	2.0	35.6	100.0
1993-97	9.4	35.6	8.4	6.4	9.0	4.9	3.9	3.9	0.0	2.2	36.3	100.0
1994-98	9.6	34.9	8.7	6.5	9.1	4.8	4.0	3.8	0.0	2.4	36.9	100.0
1995-99	9.7	34.2	8.9	6.6	9.1	4.7	4.1	3.8	0.0	2.7	37.3	100.0
1996-00	9.9	33.6	9.1	6.6	9.1	4.6	4.2	3.7	0.0	3.0	37.6	100.0
1997-01	10.0	33.2	9.2	6.6	9.1	4.5	4.3	3.6	0.0	3.4	37.8	100.0
1998-02	10.1	32.8	9.2	6.6	9.0	4.4	4.4	3.5	0.0	3.8	37.7	100.0

Note: 1) Used 5-year cumulative value (5-year-window data) to compare the citation data on the same level.

2) Scientific papers produced by collaboration between several countries are redundantly reported in each country.

Source: Recompiled by NISTEP based on the “National Science Indicators, 1981-2002 (Deluxe version)” of Institute for Scientific Information.

Table 7-1-5: Trends in relative citation index (RCI) for selected countries

Year	Japan	U.S.	Germany	France	U.K.	Canada	Italy	Russia	USSR	China	EU
1981-85	0.86	1.41	0.93	0.94	1.21	1.01	0.84	-	0.24	0.29	0.99
1982-86	0.86	1.41	0.93	0.96	1.21	1.02	0.85	-	0.23	0.30	0.99
1983-87	0.86	1.43	0.93	0.97	1.21	1.00	0.84	-	0.22	0.31	0.99
1984-88	0.86	1.44	0.93	0.97	1.20	1.00	0.82	-	0.22	0.32	0.99
1985-89	0.87	1.45	0.94	0.97	1.18	1.00	0.81	-	0.21	0.33	0.98
1986-90	0.88	1.46	0.95	0.98	1.18	0.99	0.83	-	0.20	0.33	0.97
1987-91	0.88	1.47	0.95	0.98	1.17	0.99	0.83	-	0.20	0.36	0.97
1988-92	0.88	1.46	0.96	0.97	1.17	1.00	0.85	-	0.22	0.36	0.97
1989-93	0.86	1.46	0.98	0.98	1.18	1.01	0.86	0.03	0.27	0.38	0.98
1990-94	0.85	1.46	1.01	0.99	1.19	1.03	0.88	0.10	0.34	0.38	0.99
1991-95	0.85	1.46	1.02	1.00	1.19	1.06	0.90	0.18	0.42	0.38	1.00
1992-96	0.84	1.46	1.04	1.01	1.20	1.09	0.92	0.26	0.49	0.39	1.01
1993-97	0.83	1.47	1.06	1.02	1.21	1.11	0.94	0.34	0.56	0.38	1.01
1994-98	0.83	1.48	1.06	1.03	1.22	1.14	0.97	0.35	1.26	0.38	1.02
1995-99	0.83	1.49	1.08	1.04	1.23	1.16	0.99	0.38	1.23	0.39	1.03
1996-00	0.85	1.49	1.10	1.05	1.23	1.19	1.02	0.39	-	0.41	1.04
1997-01	0.86	1.48	1.12	1.06	1.26	1.19	1.04	0.41	-	0.43	1.05
1998-02	0.88	1.48	1.14	1.07	1.27	1.19	1.05	0.42	-	0.46	1.06

Note: (Relative citation index：RCI) = (Frequency of citation per scientific papers in a country) ÷ (Frequency of citation per scientific paper in the world). The human/social science field was excluded.

Five-year cumulative value (5-year-window data) was used to compare the citation data on the same level.

Source: Recompiled by NISTEP based on the “National Science Indicators, 1981-2002 (Deluxe version)” of Institute for Scientific Information.

Table 7-1-6: Breakdown of scientific papers by field in Japan, the U.S., and the EU

(unit: %)

	1981	1982	1983	1987	1985	1986	1987	1988	1989	1990	1991
Japan											
Clinical medicine	14.4	15.6	16.4	16.8	17.8	18.7	20.7	20.4	22.6	22.0	24.6
Biology/Life science	28.8	29.4	29.6	30.3	29.7	29.3	30.4	28.5	29.0	28.6	29.1
Physics/Material science	19.3	18.9	20.3	19.0	19.9	20.2	20.7	24.7	21.8	23.4	22.5
Chemistry	28.7	27.3	25.8	25.9	24.9	24.7	23.7	21.9	22.7	22.6	21.1
Engineering/Computer science	10.6	10.8	10.6	11.2	11.6	11.2	9.8	10.5	10.5	10.5	11.0
Earth/Cosmology	2.2	2.5	2.6	2.7	3.0	3.2	3.0	2.7	3.0	2.9	2.8
Others	11.8	11.7	11.0	11.5	11.3	10.5	10.5	10.4	10.3	9.9	10.1
Natural science/Engineering as a whole	98.7	98.4	98.6	98.8	99.0	98.9	98.9	99.1	99.0	99.1	99.1
Human/Soial science	1.3	1.6	1.4	1.2	1.0	1.1	1.1	0.9	1.0	0.9	0.9
Whole field	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
U.S.											
Clinical medicine	31.6	32.1	32.4	33.5	32.7	32.5	33.8	32.9	33.3	32.6	32.3
Biology/Life science	27.2	27.2	27.3	27.8	27.6	27.5	27.9	28.2	28.4	28.5	28.4
Physics/Material science	10.4	10.3	10.2	9.7	10.6	10.6	10.7	11.9	11.8	12.1	12.5
Chemistry	9.6	9.6	9.3	9.6	9.5	9.7	9.4	9.5	9.2	9.4	9.5
Engineering/Computer science	7.5	7.2	8.1	7.9	8.6	8.4	8.8	8.9	9.0	9.6	9.2
Earth/Cosmology	6.6	6.6	6.5	6.5	6.4	6.4	6.4	6.1	6.1	6.3	6.2
Others	14.1	14.0	13.4	13.3	12.8	12.8	12.2	12.0	11.6	11.7	11.2
Natural science/Engineering as a whole	84.4	84.2	84.3	84.8	84.7	84.9	85.4	86.1	86.1	86.4	86.2
Human/Soial science	15.6	15.8	15.7	15.2	15.3	15.1	14.6	13.9	13.9	13.6	13.8
Whole field	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EU											
Clinical medicine	31.7	32.2	31.8	32.2	33.3	33.8	34.9	34.8	35.7	35.7	35.0
Biology/Life science	26.7	26.9	26.9	27.4	27.3	27.3	27.7	27.5	27.8	28.0	27.9
Physics/Material science	12.7	12.9	12.8	13.0	12.6	12.8	12.6	13.8	14.0	14.1	14.4
Chemistry	15.3	15.0	14.8	14.6	14.9	14.2	13.9	14.3	13.7	13.7	13.9
Engineering/Computer science	7.0	7.1	7.4	7.5	8.1	7.5	7.9	7.9	7.5	8.5	8.7
Earth/Cosmology	4.6	4.7	4.9	5.0	5.0	5.0	5.2	4.9	5.2	5.4	5.4
Others	12.2	12.0	12.1	11.8	11.5	11.7	11.3	10.8	10.7	10.4	10.2
Natural science/Engineering as a whole	93.9	93.4	93.3	93.5	93.5	93.5	93.8	94.1	94.4	94.5	93.9
Human/Soial science	6.1	6.6	6.7	6.5	6.5	6.5	6.2	5.9	5.6	5.5	6.1
Whole field	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Whole SCI Database											
Clinical medicine	27.5	28.0	28.0	28.7	28.9	29.1	30.3	29.8	30.4	30.2	30.2
Biology/Life science	26.1	26.2	26.3	26.6	26.6	26.5	26.9	26.6	26.8	26.9	26.7
Physics/Material science	13.1	13.2	13.2	12.9	13.3	13.4	13.2	14.9	14.7	15.1	15.1
Chemistry	14.6	14.4	14.2	14.4	14.3	14.2	13.8	13.9	13.7	13.7	13.7
Engineering/Computer science	7.4	7.2	7.9	7.8	8.5	8.1	8.5	8.5	8.6	9.3	9.3
Earth/Cosmology	5.5	5.6	5.6	5.6	5.6	5.6	5.8	5.4	5.6	5.7	5.6
Others	13.5	13.4	13.0	12.9	12.4	12.5	12.1	11.8	11.5	11.3	11.1
Natural science/Engineering as a whole	90.2	90.0	90.1	90.4	90.3	90.4	90.8	91.2	91.4	91.5	91.1
Human/Soial science	9.8	10.0	9.9	9.6	9.7	9.6	9.2	8.8	8.6	8.5	8.9
Whole field	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(unit: %)

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Japan											
Clinical medicine	24.1	26.4	27.4	26.3	28.7	29.4	29.9	30.3	29.7	29.8	30.0
Biology/Life science	27.9	28.4	27.7	26.9	26.0	26.4	26.2	25.7	26.2	26.0	25.5
Physics/Material science	24.1	23.3	24.5	23.7	25.0	26.4	24.3	25.5	24.4	26.0	25.4
Chemistry	20.4	19.5	18.9	18.6	19.3	18.3	18.6	18.3	19.2	18.0	18.3
Engineering/Computer science	11.1	11.4	10.8	13.2	11.6	11.2	12.1	11.1	10.7	11.0	10.8
Earth/Cosmology	2.6	2.8	2.8	2.9	2.9	3.0	3.1	3.2	3.7	3.8	3.8
Others	9.8	9.8	9.4	8.9	8.8	8.3	8.3	7.9	8.0	8.1	8.1
Natural science/Engineering as a whole	99.2	99.2	99.2	99.2	99.3	99.2	99.2	99.2	99.1	99.2	99.1
Human/Soial science	0.8	0.8	0.8	0.8	0.7	0.8	0.8	0.8	0.9	0.8	0.9
Whole field	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
U.S.											
Clinical medicine	32.7	33.3	33.5	33.7	33.8	34.6	34.5	34.6	34.3	34.8	34.1
Biology/Life science	28.5	28.4	28.3	27.5	27.9	27.9	28.2	28.0	28.1	28.0	28.0
Physics/Material science	12.6	12.3	12.5	11.9	11.6	11.7	11.9	11.5	11.3	11.3	11.5
Chemistry	9.3	9.6	9.2	9.1	9.2	9.1	9.2	9.1	9.3	8.9	9.3
Engineering/Computer science	9.9	9.3	9.9	10.2	9.8	9.7	9.7	9.6	8.9	9.7	9.0
Earth/Cosmology	6.1	6.5	6.6	6.8	6.9	6.9	6.8	7.4	7.4	7.5	7.4
Others	11.3	10.9	10.9	11.0	11.0	10.7	10.8	10.7	10.9	10.6	10.9
Natural science/Engineering as a whole	86.9	87.1	87.7	87.0	87.5	87.4	87.7	87.8	87.5	87.8	87.4
Human/Soial science	13.1	12.9	12.3	13.0	12.5	12.6	12.3	12.2	12.5	12.2	12.6
Whole field	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
EU											
Clinical medicine	35.4	34.7	34.7	34.5	34.7	35.2	34.8	34.8	34.5	34.4	34.1
Biology/Life science	27.4	28.0	27.3	27.0	26.6	26.4	26.3	26.3	25.8	25.7	25.7
Physics/Material science	14.9	15.4	15.6	15.4	15.4	15.9	15.8	16.0	15.7	16.1	16.4
Chemistry	13.7	13.8	13.7	13.6	13.7	13.5	13.3	13.0	12.9	13.0	13.1
Engineering/Computer science	9.2	8.9	9.7	9.8	10.0	9.7	9.9	9.8	9.7	10.1	9.9
Earth/Cosmology	5.4	5.6	5.8	5.9	6.2	6.3	6.4	7.1	7.0	7.2	7.1
Others	10.1	10.0	9.8	9.8	9.9	9.6	9.9	9.5	9.8	9.4	9.6
Natural science/Engineering as a whole	94.1	94.2	94.3	93.9	94.0	93.8	93.9	94.0	93.3	93.6	93.6
Human/Soial science	5.9	5.8	5.7	6.1	6.0	6.2	6.1	6.0	6.7	6.4	6.4
Whole field	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Whole SCI Database											
Clinical medicine	30.3	30.4	30.7	30.5	30.9	31.5	31.4	31.4	31.0	31.0	30.7
Biology/Life science	26.4	26.8	26.2	25.7	25.5	25.2	25.4	25.1	25.0	24.7	24.6
Physics/Material science	15.7	15.7	16.0	15.8	15.8	16.4	16.2	16.4	16.2	16.6	17.0
Chemistry	13.6	13.5	13.4	13.3	13.7	13.5	13.5	13.4	13.5	13.6	13.9
Engineering/Computer science	10.0	9.8	10.5	10.9	10.8	10.5	10.9	10.7	10.4	10.9	10.5
Earth/Cosmology	5.6	5.8	5.9	6.0	6.1	6.1	6.0	6.6	6.6	6.7	6.6
Others	11.0	10.7	10.6	10.5	10.5	10.3	10.4	10.1	10.4	9.9	10.1
Natural science/Engineering as a whole	91.6	91.6	92.0	91.6	91.9	91.8	92.1	92.3	91.9	92.1	92.1
Human/Soial science	8.4	8.4	8.0	8.4	8.1	8.2	7.9	7.7	8.1	7.9	7.9
Whole field	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Recompiled by NISTEP based on the “National Science Indicators, 1981-2002 (Deluxe version)” of Institute for Scientific Information.

Table 7-1-7: Trends in the relative comparative advantage (RCA) of Japanese scientific papers by field

	1981	1982	1983	1987	1985	1986	1987	1988	1989	1990	1991
Japan											
Clinical medicine	0.48	0.51	0.53	0.53	0.56	0.59	0.62	0.63	0.68	0.67	0.75
Biology/Life science	1.01	1.02	1.03	1.04	1.02	1.01	1.04	0.98	1.00	0.98	1.00
Physics/Material science	1.35	1.31	1.40	1.35	1.36	1.39	1.43	1.53	1.37	1.43	1.37
Chemistry	1.80	1.73	1.66	1.64	1.59	1.59	1.58	1.45	1.53	1.52	1.42
Engineering/Computer science	1.31	1.37	1.24	1.31	1.25	1.27	1.07	1.14	1.13	1.05	1.09
Earth/cosmology	0.36	0.42	0.43	0.44	0.49	0.53	0.48	0.47	0.50	0.47	0.46
Others	0.80	0.79	0.77	0.81	0.83	0.77	0.80	0.81	0.82	0.81	0.84
Natural science/Engineering as a whole	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
U.S.											
Clinical medicine	1.22	1.22	1.23	1.24	1.20	1.19	1.18	1.17	1.16	1.14	1.13
Biology/Life science	1.11	1.11	1.11	1.11	1.10	1.10	1.10	1.12	1.12	1.12	1.12
Physics/Material science	0.85	0.83	0.83	0.80	0.85	0.84	0.86	0.84	0.85	0.85	0.87
Chemistry	0.70	0.71	0.70	0.71	0.71	0.73	0.72	0.72	0.72	0.72	0.74
Engineering/Computer science	1.08	1.07	1.11	1.08	1.08	1.10	1.11	1.11	1.12	1.10	1.04
Earth/cosmology	1.29	1.27	1.26	1.24	1.23	1.21	1.18	1.21	1.18	1.17	1.17
Others	1.12	1.11	1.10	1.10	1.10	1.09	1.07	1.07	1.07	1.09	1.07
Natural science/Engineering as a whole	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Japan											
Clinical medicine	0.73	0.80	0.83	0.80	0.86	0.87	0.89	0.90	0.89	0.92	0.92
Biology/Life science	0.98	0.98	0.98	0.97	0.94	0.97	0.96	0.95	0.98	0.99	0.97
Physics/Material science	1.42	1.37	1.42	1.39	1.47	1.49	1.40	1.45	1.41	1.54	1.50
Chemistry	1.39	1.33	1.31	1.29	1.31	1.26	1.28	1.27	1.32	1.27	1.28
Engineering/Computer science	1.03	1.08	0.96	1.12	1.00	0.99	1.04	0.97	0.96	1.01	0.98
Earth/cosmology	0.43	0.44	0.45	0.45	0.45	0.45	0.49	0.46	0.52	0.55	0.54
Others	0.82	0.84	0.81	0.78	0.77	0.75	0.74	0.73	0.71	0.74	0.74
Natural science/Engineering as a whole	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
U.S.											
Clinical medicine	1.13	1.15	1.14	1.16	1.15	1.16	1.15	1.16	1.17	1.21	1.19
Biology/Life science	1.14	1.11	1.14	1.13	1.15	1.16	1.17	1.17	1.18	1.21	1.21
Physics/Material science	0.85	0.82	0.82	0.79	0.77	0.75	0.77	0.74	0.74	0.76	0.77
Chemistry	0.72	0.75	0.72	0.72	0.71	0.71	0.72	0.71	0.72	0.71	0.74
Engineering/Computer science	1.04	1.00	1.00	0.99	0.96	0.97	0.94	0.95	0.90	1.00	0.94
Earth/cosmology	1.15	1.18	1.18	1.21	1.20	1.19	1.19	1.19	1.18	1.23	1.21
Others	1.08	1.07	1.07	1.10	1.10	1.09	1.09	1.11	1.10	1.10	1.13
Natural science/Engineering as a whole	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Note: (Relative Comparative Advantage: RCA) = (Share of scientific papers of each country by field) / (Share of scientific papers in the world by field)
Source: Calculated by NISTEP based on Table 7-1-6.

Table 7-2-1: Trends in the number of patent applications worldwide

(unit: 10,000)

Year	Total number of patent applications in the world	Cross-border applications	Domestic applications
1985	120.3	53.2	67.0
1986	126.8	56.2	70.6
1987	136.0	62.4	73.6
1988	146.1	71.8	74.3
1989	153.2	80.0	73.2
1990	166.8	97.3	71.3
1991	158.9	98.5	61.3
1992	179.0	113.1	65.5
1993	198.4	130.9	67.3
1994	232.7	165.9	66.6
1995	279.3	206.9	71.9
1996	344.5	271.5	73.0
1997	442.7	362.9	68.7
1998	586.6	507.0	78.5
1999	707.2	624.5	82.7
2000	951.4	858.9	90.8
2001	1,182.9	1,089.0	93.9

Note: <Until 1993> Japan Patent Office and WIPO data.
<Since 1994> WIPO "Industrial Property Statistics"

Table 7-2-2: Trends in the number of patents filed and granted in Japan

	Number of patent applicatons filed			Number of patents registered		
Year	Japanese	Foreigners	Total	Japanese	Foreigners	Total
1970	100,522	30,309	130,831	21,390	9,488	30,878
1971	78,425	27,360	105,785	24,795	11,652	36,447
1972	101,328	29,072	130,400	29,101	12,353	41,454
1973	115,221	29,593	144,814	30,937	11,391	42,328
1974	121,509	27,810	149,319	30,873	8,753	39,626
1975	135,118	24,703	159,821	36,992	9,736	46,728
1976	135,762	25,254	161,016	32,465	7,852	40,317
1977	135,991	25,015	161,006	43,047	9,561	52,608
1978	141,517	24,575	166,092	37,648	7,856	45,504
1979	150,623	23,946	174,569	34,863	9,241	44,104
1980	165,730	25,290	191,020	38,032	8,074	46,106
1981	191,645	26,616	218,261	42,080	8,824	50,904
1982	210,922	26,591	237,513	42,223	8,378	50,601
1983	227,743	27,213	254,956	45,578	9,123	54,701
1984	256,205	28,562	284,767	51,690	10,110	61,800
1985	274,373	28,622	302,995	42,323	7,777	50,100
1986	290,202	29,887	320,089	51,276	8,624	59,900
1987	311,006	30,089	341,095	54,087	8,313	62,400
1988	308,908	30,491	339,399	47,912	7,388	55,300
1989	317,566	33,641	351,207	54,743	8,558	63,301
1990	333,230	34,360	367,590	50,370	9,031	59,401
1991	335,933	33,463	369,396	30,453	5,647	36,100
1992	338,019	33,875	371,894	78,994	13,106	92,100
1993	332,345	34,141	366,486	77,311	11,089	88,400
1994	319,938	33,363	353,301	72,757	9,463	82,220
1995	334,612	34,603	369,215	94,804	14,296	109,100
1996	340,101	36,514	376,615	187,681	27,419	215,100
1997	350,807	40,765	391,572	129,937	17,749	147,686
1998	359,381	42,551	401,932	125,704	15,744	141,448
1999	360,180	45,475	405,655	133,960	16,099	150,059
2000	387,364	49,501	436,865	112,269	13,611	125,880
2001	386,767	52,408	439,175	109,375	12,367	121,742
2002	369,458	51,586	421,044	108,515	11,503	120,018

Source: Japan Patent Office, 'Patent Office Administration Annual Report 2003'

Table 7-2-3: Trends in the number of domestic and foreign patent applications originating in selected countries (1991-2000)

(A) Domestically filed patent applidcations

(unit: number)

	Japan	U.S.	Germany	France	U.K.
1991	335,933	89,024	43,404	15,819	24,253
1992	338,107	94,017	45,911	15,978	24,092
1993	332,460	102,245	46,865	16,042	24,401
1994	320,175	109,981	49,402	16,130	24,747
1995	335,061	127,476	51,948	16,140	25,355
1996	340,861	111,883	56,757	17,090	25,269
1997	351,487	125,808	62,052	18,669	26,591
1998	360,338	141,342	67,790	20,298	28,889
1999	361,094	156,393	74,232	20,998	31,326
2000	388,879	175,582	78,754	21,471	33,658

(B) Internationally filed patent applications

(unit: number)

	Japan	U.S.	Germany	France	U.K.
1991	132,971	319,255	141,581	62,137	83,782
1992	129,096	399,123	160,632	67,503	93,491
1993	127,541	500,792	170,764	70,386	115,235
1994	139,556	614,884	194,660	80,317	155,572
1995	152,410	806,131	223,971	94,144	191,169
1996	190,895	1,136,091	255,394	115,177	226,702
1997	306,570	1,464,992	377,481	160,538	297,054
1998	431,753	2,064,887	537,251	239,019	371,285
1999	545,927	2,432,350	741,946	314,312	429,493
2000	743,932	3,620,012	909,565	361,822	571,693

Note: Figures for Germany, France, and U.K. include applications filed in the European Patent Office.
Source: Japan Patent Office, 'Japanese Patent Office Annual Report,' 'Patent Office Administration Annual Report'

Table 7-2-4: Foreign patent applications originating in Japan and the U.S. by destination (2000)

Number of patent applications filed from Japan	Number of patent applicaions filed	Cumulative frequency (%)
U.S.	56,586	7.6
Germany	26,621	11.2
U.K.	24,219	14.4
Sweden	21,724	17.4
Spain	21,721	20.3
Switzerland	21,693	23.2
Denmark	21,553	26.1
Austria	21,535	29.0
France	21,268	31.8
European Patent Office	20,772	34.6
Italy	20,122	37.3
Netherlands	19,759	40.0
Belgium	19,477	42.6
Republic of Korea	18,496	45.1
China	14,291	47.0
Canada	5,519	47.8
Australia	4,451	48.4
Singapore	3,358	48.8
New Zealand	2,898	49.2
Russia	2,888	49.6
Norway	2,868	50.0
Brazil	2,843	50.4
Others	369,270	49.6
Total number of international applications	743,932	100.0

Number of patent applications filed from U.S.	Number of patent applications filed	Cumulative frequency (%)
U.K.	79,990	2.2
Germany	78,559	4.4
Sweden	76,031	6.5
Spain	76,000	8.6
Switzerland	75,783	10.7
Austria	75,779	12.8
Denmark	75,742	14.9
France	48,765	16.2
Italy	48,245	17.5
European Patent Office	48,234	18.9
Netherlands	47,969	20.2
Belgium	47,875	21.5
Japan	45,920	22.8
Republic of Korea	40,143	23.9
Canada	39,715	25.0
China	38,706	26.1
Australia	33,987	27.0
New Zealand	31,303	27.9
Norway	30,806	28.7
Brazil	30,400	29.6
Russia	29,809	30.4
Singapore	29,718	31.2
Others	2,490,533	68.8
Total number of international applications	3,620,012	100.0

Note: Includes number of applications to PCT (Patent Cooperation Treaty) and European Patent Office.
Source: Japan Patent Office, 'Patent Office Administration Annual Report'

Table 7-2-5: Patents filed and granted in selected countries and region by source country (2000)

(A) Number of patent applications

(unit: number)

Receiving country	Nationality of inventor							
	Japan	U.S.	Germany	France	U.K.	China	Others	Total number of applications
Japan	388,879	45,920	13,436	4,664	5,517	614	27,174	486,204
U.S.	56,586	175,582	23,102	7,862	10,286	916	57,439	331,773
Germany	26,621	78,559	78,754	10,032	11,922	1,150	55,512	262,550
France	21,268	48,765	25,111	13,870	7,241	636	43,287	160,178
U.K.	24,219	79,990	28,429	9,770	33,658	1,154	56,003	233,223
China	14,291	38,706	9,227	3,568	5,457	25,592	25,465	122,306
European Patent O	20,772	48,234	19,847	6,365	4,224	622	628	100,692

(B) Number of registrations

(unit: number)

Receiving country	Nationality of inventor							
	Japan	U.S.	Germany	France	U.K.	China	Others	Total number of applications
Japan	112,269	6,007	2,112	793	449	20	4,250	125,880
U.S.	31,296	85,071	10,234	3,819	3,667	119	23,409	157,496
Germany	6,723	7,787	16,901	2,167	1,410	11	6,597	41,585
France	5,262	7,387	5,900	10,303	1,386	16	6,166	36,404
U.K.	6,302	8,825	5,454	2,067	4,170	15	6,938	33,756
China	2,343	1,550	776	408	199	6,475	8,080	13,356
European Patent O	5,498	7,428	5,129	1,366	1,167	11	6,935	27,523

(C) Share of applications

(unit: number)

Receiving country	Nationality of inventor							
	Japan	U.S.	Germany	France	U.K.	China	Others	Total number of applications
Japan	80.0	9.4	2.8	1.0	1.1	0.1	5.6	100.0
U.S.	17.1	52.9	7.0	2.4	3.1	0.3	17.3	100.0
Germany	10.1	29.9	30.0	3.8	4.5	0.4	21.1	100.0
France	13.3	30.4	15.7	8.7	4.5	0.4	27.0	100.0
U.K.	10.4	34.3	12.2	4.2	14.4	0.5	24.0	100.0
China	11.7	31.6	7.5	2.9	4.5	20.9	20.8	100.0
European Patent O	20.6	47.9	19.7	6.3	4.2	0.6	0.6	100.0

(D) Share of registrations

(unit: number)

Receiving country	Nationality of inventor							
	Japan	U.S.	Germany	France	U.K.	China	Others	Total number of applications
Japan	89.2	4.8	1.7	0.6	0.4	0.0	3.4	100.0
U.S.	19.9	54.0	6.5	2.4	2.3	0.1	14.9	100.0
Germany	16.2	18.7	40.6	5.2	3.4	0.0	15.9	100.0
France	14.5	20.3	16.2	28.3	3.8	0.0	16.9	100.0
U.K.	18.7	26.1	16.2	6.1	12.4	0.0	20.6	100.0
China	17.5	11.6	5.8	3.1	1.5	48.5	60.5	100.0
European Patent O	20.0	27.0	18.6	5.0	4.2	0.0	25.2	100.0

Note: 1) Germany, France, and U.K. are members of EPC (European Patent Convention).

2) Includes patent applications to PCT (Patent Cooperation Treaty) and the European Patent Office.

3) Figures of the European Patent Office are based on the 'Table of patent applications filed at the European Patent Office by nationality/number of registrations and designated states.'

Source: Patent Office, 'Patent Office Administration Annual Report'

Table 7-2-6: Patents filed in Japan, the U.S., and Europe by field of technology (2001; 2000 for Japan only)

	European Patent Office		Japan Patent Office		U.S. Patent and Trademark Office	
	2000	2001	1999	2000	2000	2001
	Ratio by fields					
Electricity	20	21	23	22	24	22
Physics	18	19	23	25	27	28
Mechanical engineering	8	8	9	8	6	6
Solid structures	3	3	5	4	2	2
Textiles; Paper	2	1	1	1	1	1
Chemistry, metallurgy	17	17	11	11	11	11
Processing operations; transportation	18	17	19	18	15	15
Daily necessities	14	14	10	11	15	15
Total number of applications	100,709	110,025	436,865	439,175	295,926	326,508

Source: WIPO, “Trilateral Statistical Reports 2000, 2001”

Table 7-2-7: Trends in the patents granted in the U.S. by source country

(A) Trend in the number (all fields)

(unit: number)

Year	U.S.	Japan	Germany	France	U.K.	Republic of Korea	China	Others	Total
1980	37,216.2	7,136.0	5,801.8	2,096.0	2,417.1	1.0	9.5	7,133.5	61,811.1
1981	39,070.5	8,401.8	6,334.0	2,183.3	2,505.8	2.3	15.5	7,245.6	65,758.8
1982	33,756.1	8,161.6	5,480.2	1,983.4	2,151.8	0.0	14.0	6,333.1	57,880.2
1983	32,743.6	8,803.0	5,492.2	1,899.2	1,956.3	1.8	26.3	5,930.0	56,852.4
1984	38,325.7	11,112.4	6,308.6	2,157.3	2,279.1	3.3	28.5	6,972.6	67,187.5
1985	39,549.4	12,755.6	6,703.9	2,400.5	2,503.9	1.3	39.5	7,700.0	71,654.1
1986	38,102.8	13,219.6	6,858.4	2,366.9	2,411.2	9.1	48.7	7,836.2	70,852.9
1987	43,479.1	16,569.2	7,882.6	2,870.1	2,780.9	24.4	84.2	9,261.4	82,951.9
1988	40,451.9	16,157.8	7,357.2	2,647.4	2,591.9	49.5	96.8	8,567.3	77,919.8
1989	50,133.9	20,177.2	8,331.9	3,138.9	3,103.3	52.6	159.8	10,446.9	95,544.5
1990	47,332.3	19,519.6	7,619.7	2,858.6	2,796.3	49.9	224.3	9,965.3	90,366.0
1991	51,136.2	21,026.3	7,669.8	3,039.9	2,800.3	53.4	402.5	10,392.1	96,520.5
1992	52,167.2	21,917.6	7,314.6	3,023.9	2,424.6	46.6	536.7	10,017.7	97,448.9
1993	55,172.1	20,945.1	6,591.7	2,809.2	2,264.0	60.2	764.9	9,744.0	98,351.2
1994	55,941.7	22,380.6	6,729.2	2,777.5	2,250.0	57.0	950.8	10,600.6	101,687.4
1995	55,584.2	21,794.7	6,609.8	2,820.8	2,502.5	71.6	1,166.2	10,882.0	101,431.8
1996	60,922.9	23,088.8	6,851.2	2,800.0	2,485.1	54.6	1,493.6	11,965.9	109,662.1
1997	61,477.5	23,208.5	7,016.6	2,968.8	2,713.4	69.1	1,902.9	12,651.7	112,008.5
1998	79,986.2	30,876.1	9,105.6	3,689.9	3,504.2	89.7	3,267.3	16,998.2	147,517.2
1999	83,572.4	31,142.2	9,365.9	3,825.4	3,603.9	113.1	3,567.6	18,294.0	153,484.5
2000	84,721.7	31,341.7	10,255.5	3,838.3	3,692.8	157.5	3,330.8	20,154.1	157,492.4
2001	87,345.4	33,254.4	11,265.0	4,062.9	3,981.2	237.9	3,544.7	22,338.0	166,029.5
2002	86,654.9	34,888.7	11,301.0	4,036.3	3,855.2	335.6	3,792.2	22,460.1	167,324.0

(B) Trend in share (all fields)

（unit：%）

Year	U.S.	Japan	Germany	France	U.K.	Republic of Korea	China	Others	Total
1980	60.2	11.5	9.4	3.4	3.9	0.0	0.0	11.5	100.0
1981	59.4	12.8	9.6	3.3	3.8	0.0	0.0	11.0	100.0
1982	58.3	14.1	9.5	3.4	3.7	0.0	0.0	10.9	100.0
1983	57.6	15.5	9.7	3.3	3.4	0.0	0.0	10.4	100.0
1984	57.0	16.5	9.4	3.2	3.4	0.0	0.0	10.4	100.0
1985	55.2	17.8	9.4	3.4	3.5	0.0	0.1	10.7	100.0
1986	53.8	18.7	9.7	3.3	3.4	0.0	0.1	11.1	100.0
1987	52.4	20.0	9.5	3.5	3.4	0.0	0.1	11.2	100.0
1988	51.9	20.7	9.4	3.4	3.3	0.1	0.1	11.0	100.0
1989	52.5	21.1	8.7	3.3	3.2	0.1	0.2	10.9	100.0
1990	52.4	21.6	8.4	3.2	3.1	0.1	0.2	11.0	100.0
1991	53.0	21.8	7.9	3.1	2.9	0.1	0.4	10.8	100.0
1992	53.5	22.5	7.5	3.1	2.5	0.0	0.6	10.3	100.0
1993	56.1	21.3	6.7	2.9	2.3	0.1	0.8	9.9	100.0
1994	55.0	22.0	6.6	2.7	2.2	0.1	0.9	10.4	100.0
1995	54.8	21.5	6.5	2.8	2.5	0.1	1.1	10.7	100.0
1996	55.6	21.1	6.2	2.6	2.3	0.0	1.4	10.9	100.0
1997	54.9	20.7	6.3	2.7	2.4	0.1	1.7	11.3	100.0
1998	54.2	20.9	6.2	2.5	2.4	0.1	2.2	11.5	100.0
1999	54.5	20.3	6.1	2.5	2.3	0.1	2.3	11.9	100.0
2000	53.8	19.9	6.5	2.4	2.3	0.1	2.1	12.8	100.0
2001	52.6	20.0	6.8	2.4	2.4	0.1	2.1	13.5	100.0
2002	51.8	20.9	6.8	2.4	2.3	0.2	2.3	13.4	100.0

Source: Recompiled by NISTEP based on CHI Research, Inc., “TP2-Int'l Technology Indicators Database for Data Years 1980-2002.”

Table 7-2-8: Trends in the relative citation index (RCI) of U.S. patents

(A) Frequency of citation

(unit: number)

Year	U.S.	Japan	Germany	France	U.K.	China	Republic of Korea	Others	Total
1980	335,196.7	56,490.2	36,736.7	13,880.5	17,642.7	5.0	78.0	46,017.5	506,047.3
1981	353,442.3	73,677.5	41,134.0	14,435.4	18,869.7	21.0	125.0	47,218.7	548,923.6
1982	315,295.2	72,259.7	35,639.8	13,472.1	16,179.3	-	44.0	43,739.9	496,630.0
1983	311,317.0	77,077.1	35,527.0	13,228.6	15,432.1	14.2	117.3	40,736.6	493,449.9
1984	369,958.9	98,352.9	40,636.1	15,441.0	17,444.1	23.3	164.5	47,224.3	589,245.1
1985	386,837.9	116,497.4	44,158.5	15,812.8	19,564.4	14.3	337.0	54,012.5	637,234.8
1986	391,243.5	119,093.2	44,691.9	15,968.1	20,450.5	52.3	397.7	54,237.4	646,134.6
1987	473,451.2	155,352.0	51,089.9	19,595.0	22,002.3	184.5	553.3	66,529.5	788,757.7
1988	440,601.9	150,860.9	46,037.5	17,732.5	19,497.5	365.7	559.6	59,826.5	735,482.1
1989	531,646.6	176,565.3	49,832.2	20,779.8	23,371.7	450.0	1,024.5	68,938.3	872,608.4
1990	492,237.8	166,880.6	43,670.4	18,182.6	20,202.4	381.6	1,401.3	65,150.0	808,106.7
1991	512,944.3	167,569.5	43,129.2	17,973.9	18,738.8	338.5	2,831.5	68,153.7	831,679.4
1992	517,905.6	166,070.4	38,494.4	17,486.8	16,059.3	233.6	3,527.9	65,216.8	824,994.8
1993	523,688.6	149,920.7	31,731.5	15,472.4	15,405.3	393.9	4,718.3	60,335.7	801,666.4
1994	508,253.0	148,172.2	32,264.8	15,698.2	13,259.7	355.2	6,279.0	61,948.6	786,230.7
1995	460,256.1	134,714.5	27,996.0	13,582.7	13,994.2	218.8	6,873.1	59,586.6	717,222.0
1996	442,910.2	125,743.3	25,612.5	12,403.7	12,087.0	174.7	7,900.0	59,355.7	686,187.1
1997	356,584.3	103,171.6	20,112.3	9,902.8	10,525.7	182.3	7,503.3	48,738.7	556,721.0
1998	354,112.4	105,404.1	20,963.6	8,764.8	9,515.2	244.1	9,770.7	52,329.2	561,104.1
1999	241,306.5	72,995.3	14,283.2	5,965.1	6,751.8	187.5	7,650.0	38,261.4	387,400.8
2000	135,598.4	43,405.1	9,180.0	3,455.5	3,931.5	129.0	4,353.3	24,509.4	224,562.2
2001	54,231.1	18,765.7	4,049.5	1,466.8	1,607.6	149.2	2,086.4	11,190.7	93,547.0
2002	4,106.4	1,782.8	319.8	121.8	124.7	19.7	205.5	1,033.8	7,714.5

(B) Relative Citation Index (RCI)

Year	U.S.	Japan	Germany	France	U.K.	China	Republic of Korea	Others	Total
1980	1.10	0.97	0.77	0.81	0.89	0.61	1.00	0.79	1.00
1981	1.08	1.05	0.78	0.79	0.90	1.09	0.97	0.78	1.00
1982	1.09	1.03	0.76	0.79	0.88	-	0.37	0.80	1.00
1983	1.10	1.01	0.75	0.80	0.91	0.91	0.51	0.79	1.00
1984	1.10	1.01	0.73	0.82	0.87	0.81	0.66	0.77	1.00
1985	1.10	1.03	0.74	0.74	0.88	1.24	0.96	0.79	1.00
1986	1.13	0.99	0.71	0.74	0.93	0.63	0.90	0.76	1.00
1987	1.15	0.99	0.68	0.72	0.83	0.80	0.69	0.76	1.00
1988	1.15	0.99	0.66	0.71	0.80	0.78	0.61	0.74	1.00
1989	1.16	0.96	0.65	0.72	0.82	0.94	0.70	0.72	1.00
1990	1.16	0.96	0.64	0.71	0.81	0.86	0.70	0.73	1.00
1991	1.16	0.92	0.65	0.69	0.78	0.74	0.82	0.76	1.00
1992	1.17	0.90	0.62	0.68	0.78	0.59	0.78	0.77	1.00
1993	1.16	0.88	0.59	0.68	0.83	0.80	0.76	0.76	1.00
1994	1.18	0.86	0.62	0.73	0.76	0.81	0.85	0.76	1.00
1995	1.17	0.87	0.60	0.68	0.79	0.43	0.83	0.77	1.00
1996	1.16	0.87	0.60	0.71	0.78	0.51	0.85	0.79	1.00
1997	1.17	0.89	0.58	0.67	0.78	0.53	0.79	0.78	1.00
1998	1.16	0.90	0.61	0.62	0.71	0.72	0.79	0.81	1.00
1999	1.14	0.93	0.60	0.62	0.74	0.66	0.85	0.83	1.00
2000	1.12	0.97	0.63	0.63	0.75	0.57	0.92	0.85	1.00
2001	1.10	1.00	0.64	0.64	0.72	1.11	1.04	0.89	1.00
2002	1.03	1.11	0.61	0.65	0.70	1.27	1.18	1.00	1.00

Note: (Relative Citation Index: RCI) = (frequency of citation per patent of each country) ÷ (frequency of citation per patent in the world)
Source: Recompiled by NISTEP based on CHI Research, Inc., “TP2-Int’l Technology Indicators Database for Data Years 1980-2002.”

Table 7-2-9: Japanese and U.S. patents granted in the U.S. by field of technology (2002)

(unit: number)

IPC code	Field	Japan	U.S.	Entire world
A61	Medicine and veterinary medicine	1,019.0	8,542.4	13,333.5
B65	Transportaion; packaging; stockpiling	469.2	2,315.1	4,127.3
C07	Organic chemistry	793.9	2,885.6	5,743.3
C08	Organic high polymer	888.7	1,632.4	3,661.1
F16	Machine parts or units/means	931.5	1,987.7	4,545.5
G01	Measuring; testins	1,492.1	4,641.7	8,420.5
G03	Photography; film	2,025.2	1,053.5	3,595.5
G06	Calculation; counting	2,366.8	8,705.2	13,121.9
H01	Basic electric elements	5,692.1	7,855.1	18,499.5
H04	Telecommunications technology	2,180.8	4,912.2	9,542.7

Note: Formal names of the fields are as follows.
A61: Medicine or veterinary medicine; hygienics
B65: Transportation; packaging; stockpiling; handling of laminated or linear materials
C07: Organic chemistry
C08: Organic high polymer; regulation or chemical processing of it; and resulting synthetic materials
F16: Engineering parts or units; general means of effectively producing and maintaining machine function; generally, heat insulators
G01: Measuring; testing
G03: Photo shoots; filming; analogous art using waves other than light waves; electrophotography; holography
G06: Computers; calculation; counting
H01: Basic electric elements
H04: Telecommunications technology
Source: Recompiled by NISTEP based on CHI Research, Inc., “TP2-Int’l Technology Indicators Database for Data Years 1980-2002.”

Table 7-2-10: Citation index of the Japanese and U.S. patents granted in the U.S. by field of technology (2002)

IPC code	Fields	Japan	U.S.
A61	Medicine and veterinary medicine	1.0	2.0
B65	Transportaion; packaging; stockpiling	1.2	1.4
C07	Organic chemistry	0.5	0.9
C08	Organic high polymer	0.8	1.2
F16	Machine parts or units/means	1.3	1.2
G01	Measuring; testins	1.2	1.5
G03	Photography; film	1.6	1.8
G06	Calculation; counting	1.8	3.4
H01	Basic electric elements	1.8	2.2
H04	Telecommunications technology	1.8	3.2

Note: 1) Formal names of the fields are as follows.
A61: Medicine or veterinary medicine; hygienics
B65: Transportation; packaging; stockpiling; handling of laminated or linear materials
C07: Organic chemistry
C08: Organic high polymer; regulation or chemical processing of it; and resulting synthetic materials
F16: Engineering parts or units; general means of effectively producing and maintaining machine function; generally, heat insulators
G01: Measuring; testing
G03: Photo shoots; filming; analogous art using waves other than light waves; electrophotography; holography
G06: Computers; calculation; counting
H01: Basic electric elements
H04: Telecommunications technology
2) (Relative Citation Index) = (frequency of citation of each field) ÷ (number of patent registrations of each field)
Source: Recompiled by NISTEP based on CHI Research, Inc., "TP2-Int'l Technology Indicators Database for Data Years 1980-2002."

Table 7-2-11: Comparison of citations of Japanese and U.S. patents granted in the U.S. by field of technology (total of 1998-2002)

(A) Share of number of patent registrations

(unit: %)

IPC code	Fields	Japan	U.S.	Entire world
		Total	Total	Total
A61	Medicine and veterinary medicine	7.20	66.47	100.00
B65	Transportaion; packaging; stockpiling	11.03	57.36	100.00
C07	Organic chemistry	13.49	50.62	100.00
C08	Organic high polymer	23.47	45.62	100.00
F16	Machine parts or units/means	19.88	46.58	100.00
G01	Measuring; testing	17.08	57.03	100.00
G03	Photography; film	55.25	30.14	100.00
G06	Calculation; counting	19.20	66.94	100.00
H01	Basic electirc elements	29.73	43.44	100.00
H04	Telecommunications technology	24.76	51.41	100.00
	Total	20.88	53.96	100.00

(B) Share of cfitation frequency

(unit: %)

IPC code	Fields	Japan	U.S.	Entire world
		Total	Total	Total
A61	Medicine and veterinary medicine	4.26	77.69	100.00
B65	Transportaion; packaging; stockpiling	10.57	65.32	100.00
C07	Organic chemistry	9.29	62.03	100.00
C08	Organic high polymer	19.62	55.47	100.00
F16	Machine parts or units/means	23.09	49.36	100.00
G01	Measuring; testing	15.54	67.26	100.00
G03	Photography; film	55.10	33.90	100.00
G06	Calculation; counting	12.05	79.26	100.00
H01	Basic electirc elements	26.74	49.52	100.00
H04	Telecommunications technology	17.24	64.15	100.00
	Total	17.26	65.02	100.00

Note: 1) Frequency of citation of scientific papers and the number of patent registrations are 5-year duplicate data (1998-2002).
2) Calculated by NISTEP. The formula is (Citation index) = (Frequency of patent citation of each field) ÷ (Number of patent registrations of each field).
Source: Recompiled by NISTEP based on CHI Research, Inc., "TP2-Int'l Technology Indicators Database for Data Years 1980-2002."

Table 7-3-1: Trends in the total value of technology trade in selected countries

(A) OECD Purchasing power parity equivalents

(unit: million yen)

Export value of technological trade					
Year	Japan	U.S.	Germany	France	U.K.
1981	175,106	1,758,760	211,924 *	208,526 *	220,172
1982	184,921	1,298,065	242,211 *	215,776 *	217,505
1983	240,887	1,303,799	282,256 *	223,072 *	257,418
1984	277,512	1,367,540	306,308 *	270,051 *	315,158 a
1985	234,220	1,458,454	337,286 *	264,291 *	320,950
1986	224,078	1,759,756	604,642 a,*	250,725 *	281,304
1987	215,575	2,140,098	660,541 *	250,421 *	321,177 a
1988	246,255	2,475,298	672,567 *	265,860 *	342,079
1989	329,348	2,752,159	780,286 *	294,528 *	388,562
1990	339,352	3,248,620	957,493 a,*	304,852 *	376,787
1991	370,552	3,440,141	961,101 *	291,331 *	402,044
1992	377,691	3,921,463	1,037,736 *	312,320 *	549,694
1993	400,362	3,998,532	1,048,124 *	288,398 *	570,301
1994	462,128	4,823,893	1,159,649 *	282,093 *	682,001
1995	562,077	5,147,370	1,284,705 *	284,991 *	694,685
1996	703,033	5,377,522	1,327,349 *	308,600 *	2,031,099 a
1997	831,563	5,416,549	1,796,213 *	317,261 *	2,214,316
1998	916,098	5,973,080	2,040,719 *	395,537 *	2,511,408
1999	960,800	5,979,441	2,012,684	430,652	2,577,626
2000	1,057,853	6,160,817	2,408,050	491,624	2,553,997
2001	1,246,814	5,791,465	2,433,653 p	582,781 0	2,778,045 p
2002	1,386,769	-	-	-	-

(unit: million yen)

Import value of technological trade					
Year	Japan	U.S.	Germany	France	U.K.
1981	259,632	156,946	335,626 *	228,089 *	182,101
1982	282,613	184,180	341,233 *	251,659 *	179,810
1983	279,280	212,787	381,502 *	247,106 *	201,749
1984	281,447	258,586	397,643 *	301,417 *	300,758 a
1985	293,173	255,524	475,231 *	314,481 *	285,245
1986	260,577	303,885	678,927 a,*	301,516 *	255,482
1987	283,245	390,274	740,843 *	321,753 *	354,749 a
1988	312,195	530,072	795,429 *	334,320 *	373,241
1989	329,925	503,507	995,287 *	355,043 *	426,339
1990	371,907	612,266	1,049,161 a,*	403,151 *	498,059
1991	394,661	778,998	1,220,690 *	409,978 *	396,574
1992	413,908	971,099	1,438,981 *	433,266 *	508,139
1993	362,974	927,431	1,490,652 *	404,978 *	511,015
1994	370,693	1,056,807	1,452,088 *	385,154 *	580,695
1995	391,715	1,175,828	1,591,247 *	392,344 *	581,373
1996	451,169	1,297,926	1,735,396 *	408,789 *	1,261,658 a
1997	438,400	1,493,349	2,155,325 *	443,761 *	1,284,412
1998	430,054	1,883,668	2,465,827 *	477,008 *	1,389,433
1999	410,296	2,043,108	2,677,335	495,416	1,291,055
2000	443,287	2,506,667	3,227,689	474,113	1,231,327
2001	548,379	2,450,155	3,608,871 p	491,416	1,252,716 p
2002	541,713	-	-	-	-

(B) National currency

Year	Japan (million yen)	U.S. (million dollars)	Germany (million euros)	France (million euros)	U.K. (million pounds)
			Export value of technological trade		
1981	175,106	7,284	1,079 *	750 *	480
1982	184,921	5,603	1,262 *	855 *	502
1983	240,887	5,778	1,487 *	952 *	615
1984	277,512	6,177	1,603 *	1,207 *	766 a
1985	234,220	6,678	1,763 *	1,224 *	809
1986	224,078	8,113	3,192 a,*	1,203 *	719
1987	215,575	10,183	3,541 *	1,235 *	861 a
1988	246,255	12,146	3,633 *	1,343 *	966
1989	329,348	13,818	4,220 *	1,507 *	1,152
1990	339,352	16,634	5,234 a,*	1,574 *	1,162
1991	370,552	17,819	5,331 *	1,498 *	1,323
1992	377,691	20,841	5,825 *	1,624 *	1,799
1993	400,362	21,695	6,115 *	1,568 *	1,972
1994	462,128	26,712	6,792 *	1,577 *	2,437
1995	562,077	30,289	7,791 *	1,652 *	2,673
1996	703,033	32,470	8,308 *	1,867 *	7,898 a
1997	831,563	33,228	10,944 *	1,930 *	8,551
1998	916,098	35,626	12,078 *	2,330 *	9,681
1999	960,800	36,902	12,143	2,586	10,348
2000	1,057,853	39,607	14,628	2,976	10,597
2001	1,246,814	38,668	15,529 p	3,572	11,882 p
2002	1,386,769	-	-	-	-

Year	Japan (million yen)	U.S. (million dollars)	Germany (million euros)	France (million euros)	U.K. (million pounds)
			Import value of technological trade		
1981	259,632	650	1,709 *	821 *	397
1982	282,613	795	1,778 *	997 *	415
1983	279,280	943	2,010 *	1,055 *	482
1984	281,447	1,168	2,082 *	1,347 *	731 a
1985	293,173	1,170	2,484 *	1,457 *	719
1986	260,577	1,401	3,584 a,*	1,446 *	653
1987	283,245	1,857	3,972 *	1,587 *	951 a
1988	312,195	2,601	4,297 *	1,689 *	1,054
1989	329,925	2,528	5,382 *	1,817 *	1,264
1990	371,907	3,135	5,735 a,*	2,081 *	1,536
1991	394,661	4,035	6,771 *	2,109 *	1,305
1992	413,908	5,161	8,077 *	2,253 *	1,663
1993	362,974	5,032	8,696 *	2,202 *	1,767
1994	370,693	5,852	8,505 *	2,153 *	2,075
1995	391,715	6,919	9,650 *	2,274 *	2,237
1996	451,169	7,837	10,862 *	2,473 *	4,906 a
1997	438,400	9,161	13,132 *	2,699 *	4,960
1998	430,054	11,235	14,594 *	2,810 *	5,356
1999	410,296	12,609	16,153	2,975	5,183
2000	443,287	16,115	19,607	2,870	5,109
2001	548,379	16,359	23,028 p	3,012	5,358 p
2002	541,713	-	-	-	-

Note: Reinserted Table 1-2-4.
a: The data lack continuity with the data until the previous year.
p: Provisional figure.
*: 'Pre-EMU' of Europe should not be used for cross-country comparison when using the statistics of the area. Reference Statistics E for purchasing power parity equivalent should be used.
<Japan>Covers patents, expertise, and technical guidance.
Data lack continuity in 1996 and 2001 as several industry sectors were added for the survey.
<U.S.>Covers only loyalty and license.
<Germany>West Germany until 1990.
Until 1985, it covered patents, licenses, trademarks, and design. After 1986, technical services, computer services, and R&D in industrial sector were included in addition to these.
<France>Definition unclear.
<U.K.>Included oil business since 1984. After 1996, included patent, invention, license, trademark, design, technology-related services and R&D.
Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'
<U.S., Germany, France, U.K.>OECD, "Main S&T Indicators 2003/1"

Table 7-3-2: Trends in technology trade balance for selected countries

Year	Japan	U.S.	Germany	France	U.K.
1981	0.67	11.21	0.63	0.91	1.21
1982	0.65	7.05	0.71	0.86	1.21
1983	0.86	6.13	0.74	0.90	1.28
1984	0.99	5.29	0.77	0.90	1.05
1985	0.80	5.71	0.71	0.84	1.13
1986	0.86	5.79	0.89	0.83	1.10
1987	0.76	5.48	0.89	0.78	0.91
1988	0.79	4.67	0.85	0.80	0.92
1989	1.00	5.47	0.78	0.83	0.91
1990	0.91	5.31	0.91	0.76	0.76
1991	0.94	4.42	0.79	0.71	1.01
1992	0.91	4.04	0.72	0.72	1.08
1993	1.10	4.31	0.70	0.71	1.12
1994	1.25	4.56	0.80	0.73	1.17
1995	1.43	4.38	0.81	0.73	1.19
1996	1.56	4.14	0.76	0.75	1.61
1997	1.90	3.63	0.83	0.71	1.72
1998	2.13	3.17	0.83	0.83	1.81
1999	2.34	2.93	0.75	0.87	2.00
2000	2.39	2.46	0.75	1.04	2.07
2001	2.27	2.36	0.67	1.19	2.22
2002	2.56	-	-	-	-

Note: Same as Table 7-3-1.
Source: Same as Table 7-3-1.

Table 7-3-3: Technology trade as a percentage of total trade

(unit; million national currency)

	Japan (2002)	U.S. (2001)	Germany (2001)	France (2001)	U.K. (2001)
Total export value	55,829,100	1,034,400	731,470	412,147	271,708
Export value of technological tra	1,386,769	38,668 p	15,529 p	3,572	11,882 p
Ratio of technology export	2.5%	3.7%	2.1%	0.9%	4.4%
Total import value	49,417,200	1,383,000	690,230	388,709	299,328
Import value of technological tra	541,713	16,359 p	23,028 p	3,012	5,358 p
Ratio of technology import	1.1%	1.2%	3.3%	0.8%	1.8%

Note: Import and export value of technology is the same as Table 7-3-1.

p: Provisional figure.

Source: Import and export value of technology is the same as Table 7-3-1.

Total import and export value: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

<U.S., Germany, France, U.K.>OECD, "Annual National Accounts 2003/3"

Table 7-3-4: Trends in technology trade in the U.S and Japan (technology trade between parent companies and their subsidiaries and between unaffiliated companies)

(A) Technological trade value

(unit: trillion yen)

Year	Export value of technological trade					
	Japan			U.S.		
	Total	Between parents and subsideiaries	Other than parent-subsidiary companies	Total	Between parents and subsidiaries	Other than parent-subsidiary companies
1987	-	-	-	2.08	1.60	0.48
1988	-	-	-	2.41	1.87	0.54
1989	-	-	-	2.60	2.03	0.57
1990	0.34	-	-	3.25	2.59	0.66
1991	0.37	-	-	3.50	2.78	0.72
1992	0.38	-	-	3.71	2.96	0.75
1993	0.40	-	-	3.75	2.89	0.85
1994	0.46	-	-	4.82	3.66	1.16
1995	0.56	-	-	5.15	3.88	1.26
1996	0.70	-	-	5.38	4.07	1.31
1997	0.83	-	-	5.48	4.06	1.43
1998	0.92	-	-	6.07	4.49	1.57
1999	0.96	-	-	5.91	4.26	1.65
2000	1.06	-	-	-	-	-
2001	1.25	0.71	0.54	-	-	-
2002	1.39	0.97	0.42	-	-	-

(unit: trillion yen)

Year	Export value of technological trade					
	Japan			U.S.		
	Total	Between parents and subsideiaries	Other than parent-subsidiary companies	Total	Between parents and subsidiaries	Other than parent-subsidiary companies
1987	-	-	-	0.39	0.27	0.11
1988	-	-	-	0.53	0.29	0.24
1989	-	-	-	0.52	0.35	0.16
1990	0.37	-	-	0.61	0.43	0.18
1991	0.39	-	-	0.79	0.58	0.21
1992	0.41	-	-	0.95	0.64	0.32
1993	0.36	-	-	0.88	0.62	0.26
1994	0.37	-	-	1.06	0.71	0.35
1995	0.39	-	-	1.18	0.89	0.28
1996	0.45	-	-	1.30	0.90	0.40
1997	0.44	-	-	1.57	1.17	0.39
1998	0.43	-	-	1.96	1.47	0.50
1999	0.41	-	-	2.15	1.65	0.50
2000	0.44	-	-	-	-	-
2001	0.55	0.10	0.45	-	-	-
2002	0.54	0.09	0.45	-	-	-

(B) Trade balance of technology

Year	Trade balance of technology					
	Japan			U.S.		
	Total	Between parents and subsideiaries	Other than parent-subsidiary companies	Total	Between parents and subsidiaries	Other than parent-subsidiary companies
1987	-	-	-	5.38	5.89	4.18
1988	-	-	-	4.57	6.49	2.25
1989	-	-	-	5.02	5.74	3.47
1990	0.91	-	-	5.31	6.01	3.64
1991	0.94	-	-	4.44	4.80	3.44
1992	0.91	-	-	3.89	4.65	2.36
1993	1.10	-	-	4.27	4.67	3.29
1994	1.25	-	-	4.56	5.15	3.35
1995	1.43	-	-	4.38	4.35	4.47
1996	1.56	-	-	4.14	4.54	3.26
1997	1.90	-	-	3.50	3.45	3.63
1998	2.13	-	-	3.09	3.06	3.17
1999	2.34	-	-	2.75	2.58	3.31
2000	2.39	-	-	-	-	-
2001	2.27	7.43	1.19	-	-	-
2002	2.56	10.53	0.94	-	-	-

Note: <Japan>Parent-subsidiary companies are companies whose parent holds more than 50% of shares.
<U.S.>Parent-subsidiary companies are companies whose subsidiary is established in one country, and of which more than 10% of its share is directly or indirectly owned or held by a company in another country.
Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'
<U.S.>NSF, "Science & Engineering Indicators 2002"

Table 8-1-1: Trends in the authorship pattern of SCI papers

(unit: number, %)

Number of authors	Number of scientific papers			Ratio to total		
	1981	1991	2001	1981	1991	2001
1 author (single a	91,619	77,534	63,981	23.6	16.1	10.6
2 authors	117,609	121,338	117,901	30.3	25.1	19.6
3 authors	85,542	104,473	117,272	22.1	21.7	19.5
4 authors	48,655	73,968	97,174	12.5	15.3	16.1
5 authors	23,271	45,071	70,417	6.0	9.3	11.7
6 or more author	21,071	60,124	136,036	5.4	12.5	22.6
Total	387,767	482,508	602,781	100	100	100

Source: Compiled by NISTEP based on Thomson ISI, “Science Citation Index, Compact Disk Edition”

Table 8-1-2: Trends in the average number of authors per paper by field of research

(unit: authors)

Year	Clinical medicine	Biology/ life science/ agriculture	Physics/ material science/ chemistry	Engineering/ computer science	Earth/ environment	Other natural science	Human/social science	All fields
1981	3.10516	2.67616	2.73590	2.32944	2.13652	2.05642	1.07784	2.69669
1982	3.19917	2.71502	2.76878	2.36603	2.20807	2.11696	1.11798	2.75848
1983	3.26607	2.80546	2.81092	2.38480	2.21904	2.13557	1.11765	2.80989
1984	3.35086	2.87812	2.87801	2.38507	2.26275	2.20397	1.13953	2.88310
1985	3.41200	2.91510	2.92318	2.49703	2.26602	2.26094	1.19391	2.92800
1986	3.51594	3.00483	2.96121	2.51278	2.34380	2.35654	1.19372	3.00492
1987	3.61727	3.11136	3.05179	2.58756	2.35909	2.36209	1.14173	3.09470
1988	3.69966	3.18134	3.11642	2.64328	2.39459	2.40029	1.14189	3.14964
1989	3.77965	3.26962	3.16592	2.76360	2.47228	2.45685	1.23125	3.23512
1990	3.83621	3.33450	3.27320	2.79150	2.54280	2.43480	1.12057	3.30403
1991	3.92314	3.42828	3.19116	2.79283	2.53167	2.44796	1.15942	3.32258
1992	4.11525	3.52972	3.44992	2.82261	2.57671	2.42163	1.11486	3.47867
1993	4.19669	3.58878	3.53246	2.87130	2.71054	2.51668	1.17391	3.55561
1994	4.32086	3.68818	3.52025	2.88582	2.78542	2.58460	1.19540	3.62123
1995	4.38092	3.80960	3.73947	3.05956	2.81224	2.65951	1.67401	3.75212
1996	4.55906	3.88130	3.73986	3.06757	2.87237	2.69219	1.16216	3.83168
1997	4.65233	3.94439	3.86081	3.21791	3.02288	2.71587	1.11392	3.94162
1998	4.62837	4.05626	3.90811	3.24379	3.09053	2.77663	1.12114	3.97312
1999	4.68647	4.13562	3.96282	3.29155	3.14010	2.77480	1.12994	4.02819
2000	4.77175	4.21052	4.04693	3.25696	3.18880	2.78510	1.18440	4.08939
2001	4.93553	4.35506	4.09123	3.42225	3.24860	2.83904	1.20671	4.18893

Source: Compiled by NISTEP based on Thomson ISI, “Science Citation Index, Compact Disk Edition”

Table 8-1-3: Change in authorship of papers (Trends in the number of SCI papers by authorship)

(A) Number of scientific papers

(unit: number)

Year	Total	Single authorship	Collaboration			
			Total	Collaboration within a single institute	Collaboration among domestic institutes	International collaboration
1981	389,301	91,619	296,148	174,321	95,598	20,465
1982	402,030	91,289	309,486	178,499	102,958	22,575
1983	416,541	92,750	322,055	183,095	108,828	24,753
1984	368,813	77,674	289,687	161,050	101,479	24,040
1985	439,355	91,265	346,755	190,819	121,018	29,634
1986	437,217	84,880	350,801	189,731	124,454	31,492
1987	428,868	79,468	348,261	183,831	126,553	33,244
1988	453,376	81,238	371,202	192,858	136,001	36,961
1989	462,223	77,106	384,181	196,481	142,633	40,467
1990	476,512	77,686	397,933	199,377	149,335	44,817
1991	483,592	77,534	404,974	195,000	155,186	50,438
1992	511,876	79,024	431,878	204,922	164,239	59,188
1993	505,838	75,469	428,952	198,377	165,574	62,246
1994	532,621	77,361	453,596	204,885	176,532	69,610
1995	543,620	73,795	468,243	205,643	184,921	75,657
1996	549,282	69,543	478,090	203,765	191,000	81,334
1997	551,041	66,427	482,666	199,269	194,365	87,145
1998	575,126	67,519	505,697	203,972	205,350	94,613
1999	586,324	66,595	517,831	201,999	212,220	101,815
2000	592,095	67,087	523,205	199,426	216,036	105,747
2001	604,485	63,981	538,800	197,701	225,536	113,759

(B) Ratio

(unit: %)

Year	Single authorship	Collaboration			
		Total	Collaboration within a single institute	Collaboration among domestic institutes	International collaboration
1981	23.5	76.1	44.8	24.6	5.3
1982	22.7	77.0	44.4	25.6	5.6
1983	22.3	77.3	44.0	26.1	5.9
1984	21.1	78.5	43.7	27.5	6.5
1985	20.8	78.9	43.4	27.5	6.7
1986	19.4	80.2	43.4	28.5	7.2
1987	18.5	81.2	42.9	29.5	7.8
1988	17.9	81.9	42.5	30.0	8.2
1989	16.7	83.1	42.5	30.9	8.8
1990	16.3	83.5	41.8	31.3	9.4
1991	16.0	83.7	40.3	32.1	10.4
1992	15.4	84.4	40.0	32.1	11.6
1993	14.9	84.8	39.2	32.7	12.3
1994	14.5	85.2	38.5	33.1	13.1
1995	13.6	86.1	37.8	34.0	13.9
1996	12.7	87.0	37.1	34.8	14.8
1997	12.1	87.6	36.2	35.3	15.8
1998	11.7	87.9	35.5	35.7	16.5
1999	11.4	88.3	34.5	36.2	17.4
2000	11.3	88.4	33.7	36.5	17.9
2001	10.6	89.1	32.7	37.3	18.8

Note: Reinserted Table 1-3-1.
(Collaboration) = (collaboration among domestic institutes) + (collaboration within a single institute) + (international collaboration)
Source: Compiled by NISTEP based on Thomson ISI, “Science Citation Index, Compact Disk Edition.”

Table 8-1-4: Trends in the percentage of authorship of papers for five selected countries

(A) Number of scientific papers

1. Japan (unit: number)

Year	Total	Form of collaboration				
		Single authorship	Collaboration			
			Joint authorship	Collaboration within a single institute	Collaboration among domestic institutes	International collaboration
1981	25,683	3,557	22,124	14,508	6,323	1,293
1982	27,358	3,548	23,810	15,272	6,996	1,542
1983	28,525	3,599	24,926	15,607	7,620	1,699
1984	26,435	3,130	23,305	14,199	7,326	1,780
1985	32,493	3,731	28,762	16,996	9,477	2,289
1986	33,057	3,419	29,638	17,051	10,172	2,415
1987	32,509	3,321	29,188	16,474	10,102	2,612
1988	36,708	3,518	33,190	18,115	11,998	3,077
1989	37,729	3,361	34,368	18,210	12,731	3,427
1990	40,244	3,382	36,862	19,144	13,791	3,927
1991	41,512	3,290	38,222	18,862	14,923	4,437
1992	46,340	3,504	42,836	20,848	16,653	5,335
1993	46,034	3,482	42,552	19,837	16,896	5,819
1994	49,762	3,591	46,171	20,751	18,667	6,753
1995	51,093	3,415	47,678	20,776	19,512	7,390
1996	53,995	3,441	50,554	21,586	21,208	7,760
1997	54,307	3,139	51,168	20,943	21,400	8,825
1998	59,274	3,331	55,943	22,142	24,028	9,773
1999	60,888	3,293	57,595	21,844	25,056	10,695
2000	61,094	3,392	57,702	21,119	25,287	11,296
2001	63,371	3,390	59,981	20,891	26,719	12,371

2. U.S. (unit: number)

Year	Total	Form of collaboration				
		Single authorship	Collaboration			
			Joint authorship	Collaboration within a single institute	Collaboration among domestic institutes	International collaboration
1981	141,397	31,594	109,802	54,281	45,574	9,947
1982	148,026	32,278	115,742	55,830	48,808	11,104
1983	152,371	33,135	119,229	56,500	50,439	12,290
1984	140,818	28,649	112,169	52,006	47,995	12,168
1985	160,957	32,322	128,630	58,636	55,205	14,788
1986	160,601	30,238	130,362	58,619	56,113	15,630
1987	158,249	27,793	130,456	57,163	56,722	16,571
1988	166,113	28,694	137,419	58,958	60,258	18,203
1989	169,056	26,917	142,139	60,284	62,249	19,606
1990	175,291	27,577	147,714	61,514	64,682	21,518
1991	179,509	27,427	152,082	60,578	67,083	24,421
1992	184,595	26,906	157,689	61,147	69,257	27,285
1993	184,652	26,088	158,564	60,418	69,138	29,008
1994	189,129	25,308	163,820	60,209	71,692	31,919
1995	192,741	24,155	168,586	60,400	73,881	34,305
1996	190,198	22,624	167,574	57,997	73,373	36,204
1997	187,957	21,540	166,417	55,682	72,654	38,081
1998	191,086	21,396	169,690	55,229	73,418	41,043
1999	192,660	21,116	171,544	53,867	73,875	43,802
2000	193,398	21,100	172,298	52,511	73,917	45,870
2001	198,964	20,196	178,768	52,624	76,574	49,570

3. Germany (unit: number)

Year	Total	Form of collaboration				
		Single authorship	Collaboration			
			Joint authorship	Collaboration within a single institute	Collaboration among domestic institutes	International collaboration
1981	28,857	7,148	21,705	13,066	4,753	3,886
1982	29,487	7,114	22,373	13,136	4,949	4,288
1983	30,545	6,751	23,794	13,749	5,302	4,743
1984	26,827	5,632	21,195	11,921	4,730	4,544
1985	32,818	6,516	26,301	14,645	5,867	5,789
1986	31,743	5,839	25,903	13,984	5,710	6,209
1987	31,917	5,515	26,402	13,716	6,128	6,558
1988	32,817	5,346	27,471	14,181	6,266	7,024
1989	34,473	5,084	29,389	14,757	6,832	7,800
1990	35,578	5,023	30,555	14,864	7,105	8,586
1991	36,837	5,131	31,706	14,718	7,340	9,648
1992	39,801	5,162	34,639	15,686	7,817	11,136
1993	38,984	4,675	34,309	15,027	7,744	11,538
1994	42,736	4,976	37,759	15,981	8,639	13,139
1995	44,539	4,796	39,743	16,177	9,279	14,287
1996	46,404	4,568	41,836	16,178	9,731	15,927
1997	48,961	4,363	44,598	16,484	10,671	17,443
1998	53,167	4,640	48,527	17,354	11,800	19,373
1999	53,432	4,506	48,926	16,483	11,826	20,617
2000	53,958	4,609	49,349	15,878	12,058	21,413
2001	54,852	4,374	50,478	15,233	12,126	23,119

4. France (unit: number)

Year	Total	Form of collaboration				
		Single authorship	Collaboration			
			Joint authorship	Collaboration within a single institute	Collaboration among domestic institutes	International collaboration
1981	20,337	3,192	17,145	8,561	5,521	3,063
1982	20,497	3,134	17,363	8,515	5,483	3,365
1983	20,877	3,115	17,762	8,317	5,795	3,650
1984	18,543	2,507	16,036	7,378	5,136	3,522
1985	22,227	2,991	19,236	8,547	6,242	4,447
1986	22,810	2,887	19,923	8,633	6,539	4,751
1987	22,534	2,623	19,911	8,331	6,638	4,942
1988	24,390	2,790	21,600	8,704	7,225	5,671
1989	25,084	2,431	22,653	8,825	7,468	6,360
1990	25,915	2,613	23,302	8,830	7,737	6,735
1991	27,019	2,543	24,476	8,910	7,857	7,709
1992	30,445	2,928	27,517	9,430	8,706	9,381
1993	30,763	2,804	27,959	9,409	8,912	9,638
1994	33,421	2,954	30,466	9,939	9,723	10,804
1995	34,986	2,921	32,065	10,069	10,215	11,781
1996	35,872	2,722	33,150	10,003	10,427	12,720
1997	36,819	2,721	34,098	9,866	10,507	13,725
1998	39,115	2,924	36,191	10,109	11,194	14,888
1999	39,811	2,988	36,823	9,621	11,444	15,758
2000	39,410	2,862	36,548	9,165	10,842	16,541
2001	40,317	2,934	37,383	8,874	11,052	17,457

5. U.K. (unit: number)

Year	Total	Form of collaboration				
		Single authorship	Collaboration			
			Joint authorship	Collaboration within a single institute	Collaboration among domestic institutes	International collaboration
1981	33,629	9,128	24,499	14,139	5,971	4,389
1982	34,583	8,957	25,624	14,627	6,355	4,642
1983	36,105	8,890	27,215	15,258	6,995	4,962
1984	32,511	7,437	25,074	13,661	6,554	4,859
1985	38,280	9,020	29,260	15,696	7,837	5,727
1986	37,933	8,276	29,656	15,466	8,175	6,015
1987	37,624	7,648	29,975	15,001	8,571	6,403
1988	38,117	7,212	30,905	15,181	8,869	6,855
1989	38,685	6,968	31,717	15,174	9,165	7,378
1990	40,094	6,847	33,247	15,213	9,904	8,130
1991	41,192	6,919	34,273	15,018	10,184	9,071
1992	44,063	6,866	37,197	15,378	11,129	10,690
1993	44,364	6,340	38,024	15,789	11,194	11,041
1994	47,729	6,660	41,068	16,665	11,969	12,434
1995	48,718	6,293	42,425	16,387	12,300	13,738
1996	50,408	6,193	44,215	16,672	12,400	15,143
1997	49,335	5,897	43,438	15,554	12,010	15,874
1998	51,872	5,957	45,915	15,955	12,667	17,293
1999	53,407	6,064	47,343	15,613	12,999	18,731
2000	54,445	5,918	48,527	15,660	13,144	19,723
2001	53,359	5,415	47,944	14,373	12,918	20,653

(B) Ratio

1. Japan (unit: %)

Year	Form of collaboration			
	Single authorship	Collaboration within a single institute		
		Collaboration within a single institute	Collaboration among domestic institutes	International collaboration
1981	13.8%	56.5%	24.6%	5.0%
1982	13.0%	55.8%	25.6%	5.6%
1983	12.6%	54.7%	26.7%	6.0%
1984	11.8%	53.7%	27.7%	6.7%
1985	11.5%	52.3%	29.2%	7.0%
1986	10.3%	51.6%	30.8%	7.3%
1987	10.2%	50.7%	31.1%	8.0%
1988	9.6%	49.3%	32.7%	8.4%
1989	8.9%	48.3%	33.7%	9.1%
1990	8.4%	47.6%	34.3%	9.8%
1991	7.9%	45.4%	35.9%	10.7%
1992	7.6%	45.0%	35.9%	11.5%
1993	7.6%	43.1%	36.7%	12.6%
1994	7.2%	41.7%	37.5%	13.6%
1995	6.7%	40.7%	38.2%	14.5%
1996	6.4%	40.0%	39.3%	14.4%
1997	5.8%	38.6%	39.4%	16.3%
1998	5.6%	37.4%	40.5%	16.5%
1999	5.4%	35.9%	41.2%	17.6%
2000	5.6%	34.6%	41.4%	18.5%
2001	5.3%	33.0%	42.2%	19.5%

2. U.S. (unit: %)

Year	Form of collaboration			
	Single authorship	Collaboration within a single institute		
		Collaboration within a single institute	Collaboration among domestic institutes	International collaboration
1981	22.3%	38.4%	32.2%	7.0%
1982	21.8%	37.7%	33.0%	7.5%
1983	21.7%	37.1%	33.1%	8.1%
1984	20.3%	36.9%	34.1%	8.6%
1985	20.1%	36.4%	34.3%	9.2%
1986	18.8%	36.5%	34.9%	9.7%
1987	17.6%	36.1%	35.8%	10.5%
1988	17.3%	35.5%	36.3%	11.0%
1989	15.9%	35.7%	36.8%	11.6%
1990	15.7%	35.1%	36.9%	12.3%
1991	15.3%	33.7%	37.4%	13.6%
1992	14.6%	33.1%	37.5%	14.8%
1993	14.1%	32.7%	37.4%	15.7%
1994	13.4%	31.8%	37.9%	16.9%
1995	12.5%	31.3%	38.3%	17.8%
1996	11.9%	30.5%	38.6%	19.0%
1997	11.5%	29.6%	38.7%	20.3%
1998	11.2%	28.9%	38.4%	21.5%
1999	11.0%	28.0%	38.3%	22.7%
2000	10.9%	27.2%	38.2%	23.7%
2001	10.2%	26.4%	38.5%	24.9%

3. Germany (unit: %)

Year	Form of collaboration			
	Single authorship	Collaboration within a single institute		
		Collaboration within a single institute	Collaboration among domestic institutes	International collaboration
1981	24.8%	45.3%	16.5%	13.5%
1982	24.1%	44.5%	16.8%	14.5%
1983	22.1%	45.0%	17.4%	15.5%
1984	21.0%	44.4%	17.6%	16.9%
1985	19.9%	44.6%	17.9%	17.6%
1986	18.4%	44.1%	18.0%	19.6%
1987	17.3%	43.0%	19.2%	20.5%
1988	16.3%	43.2%	19.1%	21.4%
1989	14.7%	42.8%	19.8%	22.6%
1990	14.1%	41.8%	20.0%	24.1%
1991	13.9%	40.0%	19.9%	26.2%
1992	13.0%	39.4%	19.6%	28.0%
1993	12.0%	38.5%	19.9%	29.6%
1994	11.6%	37.4%	20.2%	30.7%
1995	10.8%	36.3%	20.8%	32.1%
1996	9.8%	34.9%	21.0%	34.3%
1997	8.9%	33.7%	21.8%	35.6%
1998	8.7%	32.6%	22.2%	36.4%
1999	8.4%	30.8%	22.1%	38.6%
2000	8.5%	29.4%	22.3%	39.7%
2001	8.0%	27.8%	22.1%	42.1%

4. France (unit: %)

Year	Form of collaboration			
	Single authorship	Collaboration within a single institute		
		Collaboration within a single institute	Collaboration among domestic institutes	International collaboration
1981	15.7%	42.1%	27.1%	15.1%
1982	15.3%	41.5%	26.8%	16.4%
1983	14.9%	39.8%	27.8%	17.5%
1984	13.5%	39.8%	27.7%	19.0%
1985	13.5%	38.5%	28.1%	20.0%
1986	12.7%	37.8%	28.7%	20.8%
1987	11.6%	37.0%	29.5%	21.9%
1988	11.4%	35.7%	29.6%	23.3%
1989	9.7%	35.2%	29.8%	25.4%
1990	10.1%	34.1%	29.9%	26.0%
1991	9.4%	33.0%	29.1%	28.5%
1992	9.6%	31.0%	28.6%	30.8%
1993	9.1%	30.6%	29.0%	31.3%
1994	8.8%	29.7%	29.1%	32.3%
1995	8.3%	28.8%	29.2%	33.7%
1996	7.6%	27.9%	29.1%	35.5%
1997	7.4%	26.8%	28.5%	37.3%
1998	7.5%	25.8%	28.6%	38.1%
1999	7.5%	24.2%	28.7%	39.6%
2000	7.3%	23.3%	27.5%	42.0%
2001	7.3%	22.0%	27.4%	43.3%

5. U.K. (unit: %)

Year	Form of collaboration			
	Single authorship	Collaboration within a single institute		
		Collaboration within a single institute	Collaboration among domestic institutes	International collaboration
1981	27.1%	42.0%	17.8%	13.1%
1982	25.9%	42.3%	18.4%	13.4%
1983	24.6%	42.3%	19.4%	13.7%
1984	22.9%	42.0%	20.2%	14.9%
1985	23.6%	41.0%	20.5%	15.0%
1986	21.8%	40.8%	21.6%	15.9%
1987	20.3%	39.9%	22.8%	17.0%
1988	18.9%	39.8%	23.3%	18.0%
1989	18.0%	39.2%	23.7%	19.1%
1990	17.1%	37.9%	24.7%	20.3%
1991	16.8%	36.5%	24.7%	22.0%
1992	15.6%	34.9%	25.3%	24.3%
1993	14.3%	35.6%	25.2%	24.9%
1994	14.0%	34.9%	25.1%	26.1%
1995	12.9%	33.6%	25.2%	28.2%
1996	12.3%	33.1%	24.6%	30.0%
1997	12.0%	31.5%	24.3%	32.2%
1998	11.5%	30.8%	24.4%	33.3%
1999	11.4%	29.2%	24.3%	35.1%
2000	10.9%	28.8%	24.1%	36.2%
2001	10.1%	26.9%	24.2%	38.7%

Source: Compiled by NISTEP based on Thomson ISI, “Science Citation Index, Compact Disk Edition”

Table 8-1-5: Trends in the percentage of internationally co-authored papers by field of research

(A) Entire world

1. Number of scientific papers (unit: number)

Year	Clinical medicine						Biologi/life science/agriculture					
	Total number of scientific papers	Single authorship	Collaboration				Total number of scientific papers	Single authorship	Collaboration			
			Total	Collaboration within a single institute	Dollaboration among domestic institutes	International collaboration			Total	Collaboration within a single institute	Collaboration among domestic institutes	International collaboration
1981	98,519	18,478	79,440	37,238	37,800	3,669	121,207	24,894	96,009	56,356	32,486	6,424
1982	104,225	18,625	85,090	39,294	40,926	4,261	127,235	25,410	101,588	58,461	35,446	7,230
1983	107,373	18,626	88,200	39,980	43,001	4,618	130,362	24,515	105,593	59,440	37,575	8,134
1984	99,768	16,260	83,103	36,982	41,268	4,326	116,798	20,399	96,223	53,198	34,954	7,736
1985	114,883	18,548	96,003	41,939	47,946	5,551	137,131	24,011	112,916	61,487	41,456	9,614
1986	114,525	16,813	97,321	42,008	48,889	5,871	139,113	22,914	115,959	61,744	43,308	10,621
1987	115,338	15,967	99,095	41,571	50,536	6,396	137,108	20,674	116,200	60,120	44,410	11,391
1988	111,723	14,652	96,779	39,778	49,594	6,550	142,155	20,895	121,067	60,793	47,482	12,512
1989	122,960	15,631	107,071	43,960	54,708	7,868	149,062	20,167	128,691	63,605	50,846	13,926
1990	124,344	15,718	108,344	43,726	55,661	8,465	154,561	20,168	134,198	64,308	53,950	15,668
1991	128,864	16,090	112,441	44,262	58,043	9,544	157,534	19,399	137,875	63,880	56,510	17,148
1992	137,905	15,935	121,687	46,712	62,870	11,632	154,752	18,162	136,399	61,836	55,606	18,751
1993	137,280	15,771	120,996	45,214	62,934	12,407	164,539	18,807	145,319	64,467	59,731	20,869
1994	146,346	16,574	129,114	47,158	67,542	13,874	170,429	18,558	151,361	65,048	63,079	22,938
1995	142,701	16,073	125,929	44,494	66,571	14,364	172,950	17,014	155,517	65,071	65,340	24,859
1996	153,041	14,988	137,331	46,673	73,716	16,397	179,242	16,990	161,802	66,243	68,515	26,746
1997	156,592	15,008	140,742	47,119	75,007	18,079	181,149	16,453	164,224	65,089	69,558	29,335
1998	164,135	15,261	147,984	48,309	79,370	19,743	192,675	16,602	175,652	67,502	75,426	32,447
1999	167,724	15,389	151,495	48,021	81,688	21,147	194,449	16,216	177,708	65,705	77,062	34,644
2000	168,533	15,044	152,713	47,513	82,298	22,272	193,557	15,349	177,721	64,345	77,714	35,398
2001	171,047	13,790	156,552	46,556	85,067	24,278	195,993	14,380	181,167	62,668	80,695	37,591

Year	Physics/material science/chemistry						Collaboration					
	Total number of scientific papers	Single authorship	Collaboration				Total number of scientific papers	Single authorship	Collaboration			
			Total	Collaboration within a single institute	Collaboration among domestic institutes	International collaboration			Total	Collaboration within a single institute	Collaboration among domestic institutes	International collaboration
1981	110,276	22,745	87,175	60,093	17,700	7,226	40,192	12,767	27,231	16,709	6,569	1,755
1982	112,181	23,177	88,696	60,157	18,469	7,716	39,390	11,882	27,380	16,533	6,744	1,796
1983	116,399	23,566	92,300	61,881	19,782	8,319	44,763	13,824	30,674	18,544	7,696	2,112
1984	101,859	20,045	81,258	53,293	18,312	8,315	36,944	11,131	25,578	15,681	6,699	1,957
1985	124,475	23,996	99,974	64,750	22,839	10,043	46,609	13,173	33,223	19,823	8,501	2,500
1986	127,233	23,280	103,384	66,139	24,106	10,704	44,103	11,651	32,182	18,666	8,669	2,583
1987	124,363	22,476	101,434	63,492	24,652	11,299	42,886	11,000	31,756	18,548	8,378	2,750
1988	135,686	22,899	112,512	70,157	27,917	12,274	45,116	10,851	34,122	19,059	9,476	3,075
1989	140,092	22,801	116,992	71,345	29,587	14,069	45,610	10,461	35,020	19,557	9,923	3,436
1990	145,152	22,892	121,968	72,930	31,711	15,490	47,529	10,456	36,947	20,330	10,724	3,744
1991	154,476	24,223	129,933	73,461	35,950	18,911	49,539	10,906	38,454	20,321	11,741	4,452
1992	161,890	23,961	137,632	77,010	37,395	22,323	55,224	11,893	43,179	23,253	12,990	5,383
1993	162,806	23,370	139,089	75,370	39,087	23,728	55,371	11,900	43,249	23,247	13,120	5,800
1994	172,465	24,994	147,091	77,604	41,779	26,806	50,107	11,408	38,467	19,615	12,193	5,871
1995	166,632	22,708	143,625	73,646	41,891	27,422	62,119	11,183	50,714	26,601	15,851	7,605
1996	184,761	22,966	161,447	80,604	47,991	32,205	59,877	10,355	49,326	25,258	15,640	7,861
1997	185,388	21,962	162,884	78,198	49,333	34,821	61,484	9,556	51,580	25,614	16,803	8,553
1998	195,116	22,654	171,983	80,691	53,273	37,520	68,732	9,993	58,376	28,326	19,329	10,239
1999	200,810	22,082	178,245	80,725	56,461	40,576	71,001	9,943	60,768	28,904	20,245	11,148
2000	202,971	22,548	179,985	79,319	58,332	41,907	70,872	10,609	59,942	27,882	20,186	11,152
2001	210,476	21,488	188,646	80,568	62,566	45,151	76,355	10,166	65,887	29,378	23,093	12,767

2. Ratio (unit: %)

Year	Clinical medicine: Single authorhip	Clinical medicine: Collaboration within a single institute	Clinical medicine: Collaboration among domestic institutes	Clinical medicine: Internaional collaboration	Biology/life science/agriculture: Single authorhip	Biology/life science/agriculture: Collaboration within a single institute	Biology/life science/agriculture: Collaboration among domestic institutes	Biology/life science/agriculture: Internaional collaboration
1981	18.8	37.8	38.4	3.7	20.5	46.5	26.8	5.3
1982	17.9	37.7	39.3	4.1	20.0	45.9	27.9	5.7
1983	17.3	37.2	40.0	4.3	18.8	45.6	28.8	6.2
1984	16.3	37.1	41.4	4.3	17.5	45.5	29.9	6.6
1985	16.1	36.5	41.7	4.8	17.5	44.8	30.2	7.0
1986	14.7	36.7	42.7	5.1	16.5	44.4	31.1	7.6
1987	13.8	36.0	43.8	5.5	15.1	43.8	32.4	8.3
1988	13.1	35.6	44.4	5.9	14.7	42.8	33.4	8.8
1989	12.7	35.8	44.5	6.4	13.5	42.7	34.1	9.3
1990	12.6	35.2	44.8	6.8	13.0	41.6	34.9	10.1
1991	12.5	34.3	45.0	7.4	12.3	40.5	35.9	10.9
1992	11.6	33.9	45.6	8.4	11.7	40.0	35.9	12.1
1993	11.5	32.9	45.8	9.0	11.4	39.2	36.3	12.7
1994	11.3	32.2	46.2	9.5	10.9	38.2	37.0	13.5
1995	11.3	31.2	46.7	10.1	9.8	37.6	37.8	14.4
1996	9.8	30.5	48.2	10.7	9.5	37.0	38.2	14.9
1997	9.6	30.1	47.9	11.5	9.1	35.9	38.4	16.2
1998	9.3	29.4	48.4	12.0	8.6	35.0	39.1	16.8
1999	9.2	28.6	48.7	12.6	8.3	33.8	39.6	17.8
2000	8.9	28.2	48.8	13.2	7.9	33.2	40.2	18.3
2001	8.1	27.2	49.7	14.2	7.3	32.0	41.2	19.2

Year	Physics/material science/chemistry: Single authorhip	Physics/material science/chemistry: Collaboration within a single institute	Physics/material science/chemistry: Collaboration among domestic institutes	Physics/material science/chemistry: Internaional collaboration	Engineering/computer science: Single authorhip	Engineering/computer science: Collaboration within a single institute	Engineering/computer science: Collaboration among domestic institutes	Engineering/computer science: Internaional collaboration
1981	20.6	54.5	16.1	6.6	31.8	41.6	16.3	4.4
1982	20.7	53.6	16.5	6.9	30.2	42.0	17.1	4.6
1983	20.2	53.2	17.0	7.1	30.9	41.4	17.2	4.7
1984	19.7	52.3	18.0	8.2	30.1	42.4	18.1	5.3
1985	19.3	52.0	18.3	8.1	28.3	42.5	18.2	5.4
1986	18.3	52.0	18.9	8.4	26.4	42.3	19.7	5.9
1987	18.1	51.1	19.8	9.1	25.6	43.2	19.5	6.4
1988	16.9	51.7	20.6	9.0	24.1	42.2	21.0	6.8
1989	16.3	50.9	21.1	10.0	22.9	42.9	21.8	7.5
1990	15.8	50.2	21.8	10.7	22.0	42.8	22.6	7.9
1991	15.7	47.6	23.3	12.2	22.0	41.0	23.7	9.0
1992	14.8	47.6	23.1	13.8	21.5	42.1	23.5	9.7
1993	14.4	46.3	24.0	14.6	21.5	42.0	23.7	10.5
1994	14.5	45.0	24.2	15.5	22.8	39.1	24.3	11.7
1995	13.6	44.2	25.1	16.5	18.0	42.8	25.5	12.2
1996	12.4	43.6	26.0	17.4	17.3	42.2	26.1	13.1
1997	11.8	42.2	26.6	18.8	15.5	41.7	27.3	13.9
1998	11.6	41.4	27.3	19.2	14.5	41.2	28.1	14.9
1999	11.0	40.2	28.1	20.2	14.0	40.7	28.5	15.7
2000	11.1	39.1	28.7	20.6	15.0	39.3	28.5	15.7
2001	10.2	38.3	29.7	21.5	13.3	38.5	30.2	16.7

(B) Japan

1. Number of scientific papers (unit: number)

Clinical medicine

Year	Total number of scientific papers	Single authorship	Collaboration: Total	Collaboration: Collaboration within a single institute	Collaboration: Collaboration among domestic institutes	Collaboration: International collaboration
1981	4,868	347	4,521	2,701	1,599	221
1982	5,458	322	5,136	2,955	1,872	309
1983	5,625	313	5,312	3,007	1,975	330
1984	5,559	285	5,274	2,868	2,054	352
1985	6,710	323	6,387	3,449	2,500	438
1986	6,849	292	6,557	3,500	2,593	464
1987	7,038	304	6,734	3,476	2,736	522
1988	6,897	273	6,624	3,276	2,787	561
1989	8,756	321	8,435	4,159	3,567	709
1990	8,659	305	8,354	3,940	3,648	766
1991	9,770	313	9,457	4,339	4,213	905
1992	11,030	317	10,713	4,864	4,740	1,109
1993	11,366	340	11,026	4,801	5,009	1,216
1994	12,340	380	11,960	5,069	5,466	1,425
1995	11,652	272	11,380	4,536	5,435	1,409
1996	13,711	309	13,402	5,291	6,506	1,605
1997	13,952	314	13,638	5,061	6,791	1,786
1998	15,311	285	15,026	5,527	7,557	1,942
1999	15,721	294	15,427	5,407	7,880	2,140
2000	15,856	375	15,481	5,294	7,874	2,313
2001	15,964	294	15,670	5,112	8,075	2,483

Biology/life science/agriculture

Year	Total number of scientific papers	Single authorhip	Collaboration: Total	Collaboration: Collaboration within a single institute	Collaboration: Collaboration among domestic institutes	Collaboration: Internaional collaboration
1981	7,322	892	6,429	4,022	1,972	435
1982	7,885	940	6,945	4,316	2,132	497
1983	8,313	901	7,412	4,365	2,464	583
1984	7,824	791	7,033	4,096	2,363	574
1985	9,293	855	8,438	4,742	2,909	787
1986	9,642	865	8,777	4,663	3,260	854
1987	10,135	870	9,265	4,895	3,435	935
1988	10,813	802	10,011	5,000	3,953	1,058
1989	11,549	802	10,747	5,141	4,364	1,242
1990	12,050	827	11,223	5,137	4,720	1,366
1991	12,952	688	12,264	5,440	5,276	1,548
1992	13,452	687	12,765	5,589	5,425	1,751
1993	14,366	787	13,579	5,639	5,909	2,031
1994	15,318	807	14,511	5,690	6,543	2,278
1995	15,481	778	14,703	5,499	6,675	2,529
1996	16,023	782	15,241	5,521	7,103	2,617
1997	16,210	690	15,520	5,357	7,182	2,981
1998	18,172	667	17,505	5,918	8,205	3,382
1999	18,151	618	17,533	5,643	8,280	3,610
2000	18,342	638	17,704	5,406	8,563	3,735
2001	18,923	617	18,306	5,346	8,829	4,131

Physics/material science/chemistry

Year	Total number of scientific papers	Single authorship	Collaboration: Total	Collaboration: Collaboration within a single institute	Collaboration: Collaboration among domestic institutes	Collaboration: International collaboration
1981	10,420	1,450	8,969	6,465	2,033	471
1982	10,633	1,376	9,257	6,516	2,191	550
1983	11,086	1,416	9,670	6,754	2,340	576
1984	10,087	1,191	8,896	6,059	2,214	623
1985	12,424	1,605	10,819	7,115	2,987	717
1986	12,842	1,467	11,375	7,400	3,160	815
1987	12,476	1,461	11,015	6,927	3,200	888
1988	15,101	1,545	13,556	8,322	4,174	1,060
1989	14,977	1,614	13,363	8,069	4,175	1,119
1990	16,396	1,582	14,814	8,794	4,615	1,405
1991	17,355	1,581	15,774	8,782	5,286	1,706
1992	18,454	1,607	16,847	9,200	5,596	2,051
1993	19,142	1,731	17,411	9,172	5,947	2,292
1994	20,626	1,723	18,903	9,749	6,455	2,699
1995	20,021	1,589	18,432	9,229	6,417	2,786
1996	23,371	1,721	21,650	10,698	7,731	3,221
1997	23,343	1,610	21,733	10,316	7,574	3,843
1998	25,220	1,707	23,513	10,645	8,644	4,224
1999	26,571	1,695	24,876	10,793	9,375	4,708
2000	27,306	1,743	25,563	10,706	9,768	5,089
2001	28,257	1,740	26,517	10,625	10,497	5,395

Engineering/computer science

Year	Total number of scientific papers	Single authorhip	Collaboration: Total	Collaboration: Collaboration within a single institute	Collaboration: Collaboration among domestic institutes	Collaboration: Internaional collaboration
1981	3,012	462	2,550	1,622	807	121
1982	3,234	464	2,770	1,802	835	133
1983	3,419	503	2,916	1,800	968	148
1984	3,134	434	2,700	1,638	890	172
1985	3,987	462	3,525	2,121	1,168	236
1986	3,949	461	3,488	1,984	1,308	196
1987	3,372	398	2,974	1,777	981	216
1988	4,003	401	3,602	2,039	1,292	271
1989	3,870	423	3,447	1,838	1,251	358
1990	4,273	472	3,801	2,039	1,370	392
1991	4,124	475	3,649	1,806	1,404	439
1992	4,648	514	4,134	2,011	1,570	553
1993	4,471	486	3,985	1,853	1,529	603
1994	3,990	421	3,569	1,593	1,401	575
1995	5,426	512	4,914	2,281	1,870	763
1996	5,234	484	4,750	2,133	1,865	752
1997	5,647	413	5,234	2,352	2,000	882
1998	6,811	537	6,274	2,637	2,533	1,104
1999	6,748	552	6,196	2,530	2,473	1,193
2000	6,236	555	5,681	2,176	2,281	1,224
2001	7,227	478	6,749	2,531	2,801	1,417

2. Ratio (unit: %)

Year	Clinical medicine: Single authorhip	Clinical medicine: Collaboration within a single institute	Clinical medicine: Collaboration among domestic institutes	Clinical medicine: Internaional collaboration	Biology/life science/agriculture: Single authorhip	Biology/life science/agriculture: Collaboration within a single institute	Biology/life science/agriculture: Collaboration among domestic institutes	Biology/life science/agriculture: Internaional collaboration
1981	7.1	55.5	32.8	4.5	12.2	54.9	26.9	5.9
1982	5.9	54.1	34.3	5.7	11.9	54.7	27.0	6.3
1983	5.6	53.5	35.1	5.9	10.8	52.5	29.6	7.0
1984	5.1	51.6	36.9	6.3	10.1	52.4	30.2	7.3
1985	4.8	51.4	37.3	6.5	9.2	51.0	31.3	8.5
1986	4.3	51.1	37.9	6.8	9.0	48.4	33.8	8.9
1987	4.3	49.4	38.9	7.4	8.6	48.3	33.9	9.2
1988	4.0	47.5	40.4	8.1	7.4	46.2	36.6	9.8
1989	3.7	47.5	40.7	8.1	6.9	44.5	37.8	10.8
1990	3.5	45.5	42.1	8.8	6.9	42.6	39.2	11.3
1991	3.2	44.4	43.1	9.3	5.3	42.0	40.7	12.0
1992	2.9	44.1	43.0	10.1	5.1	41.5	40.3	13.0
1993	3.0	42.2	44.1	10.7	5.5	39.3	41.1	14.1
1994	3.1	41.1	44.3	11.5	5.3	37.1	42.7	14.9
1995	2.3	38.9	46.6	12.1	5.0	35.5	43.1	16.3
1996	2.3	38.6	47.5	11.7	4.9	34.5	44.3	16.3
1997	2.3	36.3	48.7	12.8	4.3	33.0	44.3	18.4
1998	1.9	36.1	49.4	12.7	3.7	32.6	45.2	18.6
1999	1.9	34.4	50.1	13.6	3.4	31.1	45.6	19.9
2000	2.4	33.4	49.7	14.6	3.5	29.5	46.7	20.4
2001	1.8	32.0	50.6	15.6	3.3	28.3	46.7	21.8

Year	Physics/material science/chemistry: Single authorhip	Physics/material science/chemistry: Collaboration within a single institute	Physics/material science/chemistry: Collaboration among domestic institutes	Physics/material science/chemistry: Internaional collaboration	Engineering/computer science: Single authorhip	Engineering/computer science: Collaboration within a single institute	Engineering/computer science: Collaboration among domestic institutes	Engineering/computer science: Internaional collaboration
1981	13.9	62.0	19.5	4.5	15.3	53.9	26.8	4.0
1982	12.9	61.3	20.6	5.2	14.3	55.7	25.8	4.1
1983	12.8	60.9	21.1	5.2	14.7	52.6	28.3	4.3
1984	11.8	60.1	21.9	6.2	13.8	52.3	28.4	5.5
1985	12.9	57.3	24.0	5.8	11.6	53.2	29.3	5.9
1986	11.4	57.6	24.6	6.3	11.7	50.2	33.1	5.0
1987	11.7	55.5	25.6	7.1	11.8	52.7	29.1	6.4
1988	10.2	55.1	27.6	7.0	10.0	50.9	32.3	6.8
1989	10.8	53.9	27.9	7.5	10.9	47.5	32.3	9.3
1990	9.6	53.6	28.1	8.6	11.0	47.7	32.1	9.2
1991	9.1	50.6	30.5	9.8	11.5	43.8	34.0	10.6
1992	8.7	49.9	30.3	11.1	11.1	43.3	33.8	11.9
1993	9.0	47.9	31.1	12.0	10.9	41.4	34.2	13.5
1994	8.4	47.3	31.3	13.1	10.6	39.9	35.1	14.4
1995	7.9	46.1	32.1	13.9	9.4	42.0	34.5	14.1
1996	7.4	45.8	33.1	13.8	9.2	40.8	35.6	14.4
1997	6.9	44.2	32.4	16.5	7.3	41.7	35.4	15.6
1998	6.8	42.2	34.3	16.7	7.9	38.7	37.2	16.2
1999	6.4	40.6	35.3	17.7	8.2	37.5	36.6	17.7
2000	6.4	39.2	35.8	18.6	8.9	34.9	36.6	19.6
2001	6.2	37.6	37.1	19.1	6.6	35.0	38.8	19.6

(C) U.S.

1.Number of scientific papers (unit: number)

Year	Clinical medicine: Total number of scientific papers	Single authorship	Collaboration: Total	Collaboration within a single institute	Collaboration among domestic institutes	International collaboration	Biology/life science/agriculture: Total number of scientific papers	Single authorhip	Collaboration: Total	Collaboration within a single institute	Collaboration among domestic institutes	Internaional collaboration
1981	41,099	7,199	33,900	13,227	18,727	1,946	50,347	8,997	41,350	21,145	16,969	3,236
1982	43,859	7,417	36,439	14,101	20,133	2,205	53,043	9,391	43,651	21,550	18,376	3,725
1983	44,614	7,611	37,003	14,027	20,585	2,391	53,892	9,153	44,738	21,691	18,926	4,121
1984	43,047	6,813	36,234	13,659	20,261	2,314	49,086	7,660	41,426	19,630	17,763	4,033
1985	48,086	7,678	40,408	14,825	22,707	2,876	56,061	8,759	47,300	21,874	20,545	4,880
1986	47,285	7,102	40,183	14,645	22,484	3,054	57,074	8,502	48,572	22,107	21,172	5,293
1987	47,887	6,723	41,164	14,675	23,143	3,346	56,000	7,546	48,454	21,340	21,356	5,758
1988	46,021	6,195	39,826	13,811	22,600	3,415	58,854	8,054	50,800	21,619	22,851	6,330
1989	49,451	6,492	42,959	14,700	24,351	3,908	60,964	7,550	53,414	22,369	23,965	7,080
1990	50,267	6,680	43,587	14,736	24,575	4,276	63,009	7,497	55,512	22,766	25,019	7,727
1991	52,065	6,956	45,109	14,950	25,304	4,855	65,530	7,388	58,142	22,934	26,555	8,653
1992	55,006	6,976	48,030	15,513	26,501	6,016	62,799	6,914	55,885	21,275	25,409	9,201
1993	55,583	6,975	48,608	15,556	26,665	6,387	66,698	7,270	59,428	22,294	26,849	10,285
1994	57,562	6,805	50,756	15,488	28,064	7,204	68,460	6,917	61,542	22,366	28,006	11,170
1995	56,904	6,436	50,468	15,159	27,769	7,540	69,221	6,311	62,910	22,303	28,522	12,085
1996	58,919	6,217	52,702	15,181	29,077	8,444	70,204	6,314	63,890	22,224	28,908	12,758
1997	59,846	6,135	53,711	15,341	29,042	9,328	71,098	6,369	64,729	21,786	29,220	13,723
1998	61,462	6,278	55,184	15,096	29,915	10,173	73,912	6,374	67,538	21,969	30,242	15,327
1999	62,205	6,439	55,766	15,046	29,912	10,808	73,691	6,080	67,611	20,918	30,469	16,224
2000	62,548	6,465	56,083	14,600	30,037	11,446	73,720	5,886	67,834	20,884	30,205	16,745
2001	65,247	6,002	59,245	14,963	31,588	12,694	75,502	5,566	69,936	20,663	31,438	17,835

Year	Physics/material science/chemistry: ımber of scientific	Single authorship	Collaboration: Total	Collaboration within a single institute	Collaboration among domestic institutes	International collaboration	Biology/life science/agriculture: Total number of scientific papers	Single authorhip	Collaboration: Total	Collaboration within a single institute	Collaboration among domestic institutes	Internaional collaboration
	30,289	7,120	23,168	13,676	6,338	3,154	14,862	4,785	10,077	5,982	3,207	888
1982	31,320	7,451	23,869	13,908	6,576	3,385	14,706	4,444	10,261	5,928	3,422	911
1983	32,165	7,408	24,757	14,002	7,011	3,744	17,283	5,625	11,658	6,690	3,884	1,084
1984	30,273	6,802	23,471	12,923	6,746	3,802	14,589	4,587	10,002	5,774	3,261	967
1985	35,405	7,648	27,756	15,085	8,064	4,607	17,482	5,169	12,312	6,907	4,059	1,346
1986	36,709	7,625	29,083	15,690	8,554	4,839	15,527	4,137	11,390	6,193	3,908	1,289
1987	36,116	6,896	29,220	15,344	8,824	5,052	15,219	3,799	11,420	6,174	3,810	1,436
1988	38,632	6,818	31,814	16,785	9,655	5,374	15,917	3,778	12,139	6,284	4,311	1,544
1989	39,886	6,696	33,190	17,181	9,943	6,066	16,485	3,777	12,708	6,580	4,436	1,692
1990	41,426	6,756	34,670	17,400	10,645	6,625	16,978	3,655	13,323	6,829	4,698	1,796
1991	46,191	7,201	38,990	18,404	12,510	8,076	17,785	3,762	14,023	6,660	5,147	2,216
1992	46,380	6,785	39,595	18,188	12,558	8,849	19,127	3,825	15,302	7,196	5,608	2,498
1993	47,018	6,425	40,593	18,199	12,925	9,469	19,116	3,802	15,314	7,063	5,575	2,676
1994	48,156	6,679	41,477	17,795	13,147	10,535	17,546	3,401	14,145	6,170	5,262	2,713
1995	45,453	5,933	39,520	16,389	12,641	10,490	20,805	3,540	17,265	7,657	6,279	3,329
1996	49,202	5,898	43,304	17,659	13,736	11,909	19,171	3,118	16,053	6,889	5,898	3,266
1997	48,845	5,716	43,129	16,795	13,570	12,764	19,875	2,975	16,900	7,070	6,263	3,567
1998	49,308	5,583	43,725	16,857	13,497	13,371	20,776	2,902	17,874	7,199	6,475	4,200
1999	50,177	5,354	44,823	16,471	13,778	14,574	21,716	3,029	18,687	7,374	6,875	4,438
2000	50,548	5,467	45,081	15,888	13,999	15,194	20,339	2,879	17,460	6,598	6,362	4,500
2001	51,677	5,059	46,618	15,988	14,361	16,269	22,790	2,880	19,910	7,387	7,251	5,272

2. Ratio (unit: %)

Year	Clinical medicine				Biology/life science/agriculture			
		Collaboration				Collaboration		
	Single authorhip	Collaboration within a single institute	Collaboration among domestic institutes	Internaional collaboration	Single authorhip	Collaboration within a single institute	Collaboration among domestic institutes	Internaional collaboration
1981	17.5	32.2	45.6	4.7	17.9	42.0	33.7	6.4
1982	16.9	32.2	45.9	5.0	17.7	40.6	34.6	7.0
1983	17.1	31.4	46.1	5.4	17.0	40.2	35.1	7.6
1984	15.8	31.7	47.1	5.4	15.6	40.0	36.2	8.2
1985	16.0	30.8	47.2	6.0	15.6	39.0	36.6	8.7
1986	15.0	31.0	47.5	6.5	14.9	38.7	37.1	9.3
1987	14.0	30.6	48.3	7.0	13.5	38.1	38.1	10.3
1988	13.5	30.0	49.1	7.4	13.7	36.7	38.8	10.8
1989	13.1	29.7	49.2	7.9	12.4	36.7	39.3	11.6
1990	13.3	29.3	48.9	8.5	11.9	36.1	39.7	12.3
1991	13.4	28.7	48.6	9.3	11.3	35.0	40.5	13.2
1992	12.7	28.2	48.2	10.9	11.0	33.9	40.5	14.7
1993	12.5	28.0	48.0	11.5	10.9	33.4	40.3	15.4
1994	11.8	26.9	48.8	12.5	10.1	32.7	40.9	16.3
1995	11.3	26.6	48.8	13.3	9.1	32.2	41.2	17.5
1996	10.6	25.8	49.4	14.3	9.0	31.7	41.2	18.2
1997	10.3	25.6	48.5	15.6	9.0	30.6	41.1	19.3
1998	10.2	24.6	48.7	16.6	8.6	29.7	40.9	20.7
1999	10.4	24.2	48.1	17.4	8.3	28.4	41.3	22.0
2000	10.3	23.3	48.0	18.3	8.0	28.3	41.0	22.7
2001	9.2	22.9	48.4	19.5	7.4	27.4	41.6	23.6

Year	Physics/material science/chemistry				Engineering/computer science			
		Collaboration				Collaboration		
	Single authorhip	Collaboration within a single institute	Collaboration among domestic institutes	Internaional collaboration	Single authorhip	Collaboration within a single institute	Collaboration among domestic institutes	Internaional collaboration
1981	23.5	45.2	20.9	10.4	32.2	40.3	21.6	6.0
1982	23.8	44.4	21.0	10.8	30.2	40.3	23.3	6.2
1983	23.0	43.5	21.8	11.6	32.5	38.7	22.5	6.3
1984	22.5	42.7	22.3	12.6	31.4	39.6	22.4	6.6
1985	21.6	42.6	22.8	13.0	29.6	39.5	23.2	7.7
1986	20.8	42.7	23.3	13.2	26.6	39.9	25.2	8.3
1987	19.1	42.5	24.4	14.0	25.0	40.6	25.0	9.4
1988	17.6	43.4	25.0	13.9	23.7	39.5	27.1	9.7
1989	16.8	43.1	24.9	15.2	22.9	39.9	26.9	10.3
1990	16.3	42.0	25.7	16.0	21.5	40.2	27.7	10.6
1991	15.6	39.8	27.1	17.5	21.2	37.4	28.9	12.5
1992	14.6	39.2	27.1	19.1	20.0	37.6	29.3	13.1
1993	13.7	38.7	27.5	20.1	19.9	36.9	29.2	14.0
1994	13.9	37.0	27.3	21.9	19.4	35.2	30.0	15.5
1995	13.1	36.1	27.8	23.1	17.0	36.8	30.2	16.0
1996	12.0	35.9	27.9	24.2	16.3	35.9	30.8	17.0
1997	11.7	34.4	27.8	26.1	15.0	35.6	31.5	17.9
1998	11.3	34.2	27.4	27.1	14.0	34.7	31.2	20.2
1999	10.7	32.8	27.5	29.0	13.9	34.0	31.7	20.4
2000	10.8	31.4	27.7	30.1	14.2	32.4	31.3	22.1
2001	9.8	30.9	27.8	31.5	12.6	32.4	31.8	23.1

Source: Compiled by NISTEP based on Thomson ISI, “Science Citation Index, Compact Disk Edition”

Table 8-1-6: Trends in the international co-authorship ratio by country

(A) Ratio of international collaboration to total scientific papers

Year	Total	U.S.	Japan	Germany	U.K.	France	Italy	Canada	China	Russia
1981	5.3%	7.0%	5.0%	-	13.1%	15.1%	16.6%	16.5%	10.5%	-
1982	5.6%	7.5%	5.6%	-	13.4%	16.4%	16.9%	17.2%	12.9%	-
1983	5.9%	8.1%	6.0%	-	13.7%	17.5%	18.0%	16.7%	18.6%	-
1984	6.5%	8.6%	6.7%	-	14.9%	19.0%	19.7%	18.1%	23.6%	-
1985	6.7%	9.2%	7.0%	-	15.0%	20.0%	20.1%	18.5%	22.5%	-
1986	7.2%	9.7%	7.3%	-	15.9%	20.8%	22.3%	19.0%	22.4%	-
1987	7.8%	10.5%	8.0%	-	17.0%	21.9%	24.5%	19.8%	20.8%	-
1988	8.2%	11.0%	8.4%	-	18.0%	23.3%	23.8%	20.7%	22.4%	-
1989	8.8%	11.6%	9.1%	-	19.1%	25.4%	25.1%	21.8%	23.2%	-
1990	9.4%	12.3%	9.8%	-	20.3%	26.0%	27.0%	23.7%	23.0%	-
1991	10.4%	13.6%	10.7%	26.2%	22.0%	28.5%	28.3%	24.8%	27.3%	-
1992	11.6%	14.8%	11.5%	28.0%	24.3%	30.8%	30.0%	26.5%	26.8%	15.3%
1993	12.3%	15.7%	12.6%	29.6%	24.9%	31.3%	31.4%	28.1%	26.3%	18.0%
1994	13.1%	16.9%	13.6%	30.7%	26.1%	32.3%	32.3%	29.1%	27.1%	20.4%
1995	13.9%	17.8%	14.5%	32.1%	28.2%	33.7%	33.4%	30.2%	27.3%	23.4%
1996	14.8%	19.0%	14.4%	34.3%	30.0%	35.5%	33.6%	31.5%	29.2%	26.2%
1997	15.8%	20.3%	16.3%	35.6%	32.2%	37.3%	35.7%	34.5%	28.1%	29.0%
1998	16.5%	21.5%	16.5%	36.4%	33.3%	38.1%	37.1%	35.3%	28.0%	31.2%
1999	17.4%	22.7%	17.6%	38.6%	35.1%	39.6%	38.4%	36.1%	27.5%	33.9%
2000	17.9%	23.7%	18.5%	39.7%	36.2%	42.0%	38.2%	37.3%	25.6%	32.9%
2001	18.8%	24.9%	19.5%	42.1%	38.7%	43.3%	39.4%	39.9%	26.4%	37.8%

(B) Number of internaitonal collaboration

(unit: number)

Year	Total	U.S.	Japan	Germany	U.K.	France	Italy	Canada	China	Russia
1981	20,465	9,947	1,293	-	4,389	3,063	1,428	2,685	146	-
1982	22,575	11,104	1,542	-	4,642	3,365	1,600	2,941	300	-
1983	24,753	12,290	1,699	-	4,962	3,650	1,926	3,045	475	-
1984	24,040	12,168	1,780	-	4,859	3,522	1,923	3,083	531	-
1985	29,634	14,788	2,289	-	5,727	4,447	2,297	3,740	672	-
1986	31,492	15,630	2,415	-	6,015	4,751	2,534	3,924	741	-
1987	33,244	16,571	2,612	-	6,403	4,942	2,845	4,147	737	-
1988	36,961	18,203	3,077	-	6,855	5,671	3,096	4,534	1,071	-
1989	40,467	19,606	3,427	-	7,378	6,360	3,518	4,808	1,204	-
1990	44,817	21,518	3,927	-	8,130	6,735	4,029	5,447	1,413	-
1991	50,438	24,421	4,437	9,648	9,071	7,709	4,493	5,802	1,701	-
1992	59,188	27,285	5,335	11,136	10,690	9,381	5,406	6,634	1,895	3,825
1993	62,246	29,008	5,819	11,538	11,041	9,638	5,642	7,033	2,005	3,864
1994	69,610	31,919	6,753	13,139	12,434	10,804	6,521	7,508	2,105	4,850
1995	75,657	34,305	7,390	14,287	13,738	11,781	7,163	7,863	2,472	5,297
1996	81,334	36,204	7,760	15,927	15,143	12,720	7,755	8,228	2,778	5,590
1997	87,145	38,081	8,825	17,443	15,874	13,725	8,277	8,596	3,339	6,266
1998	94,613	41,043	9,773	19,373	17,293	14,888	9,247	8,847	3,810	6,660
1999	101,815	43,802	10,695	20,617	18,731	15,758	9,898	9,375	4,429	7,029
2000	105,747	45,870	11,296	21,413	19,723	16,541	9,994	9,619	5,297	7,306
2001	113,759	49,570	12,371	23,119	20,653	17,457	10,939	10,207	6,287	7,553

(C) Total number of scientific papers

(unit: number)

Year	Total	U.S.	Japan	Germany	U.K.	France	Italy	Canada	China	Russia
1981	389,301	141,397	25,683	-	33,629	20,337	8,621	16,273	1,396	-
1982	402,030	148,026	27,358	-	34,583	20,497	9,484	17,061	2,317	-
1983	416,541	152,371	28,525	-	36,105	20,877	10,706	18,223	2,559	-
1984	368,813	140,818	26,435	-	32,511	18,543	9,749	17,058	2,254	-
1985	439,355	160,957	32,493	-	38,280	22,227	11,413	20,260	2,981	-
1986	437,217	160,601	33,057	-	37,933	22,810	11,344	20,645	3,314	-
1987	428,868	158,249	32,509	-	37,624	22,534	11,621	20,915	3,536	-
1988	453,376	166,113	36,708	-	38,117	24,390	12,997	21,935	4,777	-
1989	462,223	169,056	37,729	-	38,685	25,084	13,990	22,073	5,192	-
1990	476,512	175,291	40,244	-	40,094	25,915	14,920	22,995	6,146	-
1991	483,592	179,509	41,512	36,837	41,192	27,019	15,862	23,432	6,241	-
1992	511,876	184,595	46,340	39,801	44,063	30,445	17,995	25,078	7,070	24,973
1993	505,838	184,652	46,034	38,984	44,364	30,763	17,994	24,994	7,619	21,487
1994	532,621	189,129	49,762	42,736	47,729	33,421	20,184	25,831	7,763	23,807
1995	543,620	192,741	51,093	44,539	48,718	34,986	21,450	26,061	9,042	22,645
1996	549,282	190,198	53,995	46,404	50,408	35,872	23,099	26,109	9,519	21,366
1997	551,041	187,957	54,307	48,961	49,335	36,819	23,217	24,947	11,887	21,611
1998	575,126	191,086	59,274	53,167	51,872	39,115	24,914	25,056	13,590	21,371
1999	586,324	192,660	60,888	53,432	53,407	39,811	25,762	25,934	16,114	20,722
2000	592,095	193,398	61,094	53,958	54,445	39,410	26,133	25,812	20,689	22,190
2001	604,485	198,964	63,371	54,852	53,359	40,317	27,753	25,587	23,806	19,992

Source: Compiled by NISTEP based on Thomson ISI, "Science Citation Index, Compact Disk Edition"

Table 8-2-1: Trends in the science linkage of U.S. patents for selected countries

Year	U.S.	Japan	Germany	France	U.K.	Entire world
1985	0.39	0.17	0.19	0.25	0.29	0.31
1986	0.43	0.19	0.18	0.27	0.36	0.33
1987	0.52	0.21	0.25	0.33	0.37	0.40
1988	0.58	0.24	0.28	0.35	0.46	0.44
1989	0.68	0.28	0.28	0.33	0.49	0.51
1990	0.72	0.27	0.29	0.34	0.62	0.53
1991	0.79	0.30	0.32	0.39	0.64	0.58
1992	0.90	0.33	0.35	0.47	0.74	0.67
1993	1.15	0.39	0.44	0.45	0.83	0.85
1994	1.17	0.44	0.47	0.67	0.87	0.89
1995	1.61	0.56	0.63	0.69	1.27	1.21
1996	1.97	0.58	0.70	1.02	1.53	1.46
1997	2.85	0.59	0.79	1.08	2.07	1.99
1998	3.01	0.59	0.87	1.27	2.08	2.11
1999	2.81	0.51	0.83	1.26	2.10	2.01
2000	2.82	0.51	0.84	1.17	2.26	1.97
2001	3.03	0.57	0.86	1.21	2.53	2.08
2002	3.23	0.49	0.87	1.28	2.29	2.15

Note: (Science linkage) = (citation frequency of scientific papers) / (number of U.S. Patents)
Note: (Science linkage) = (citation frequency of scientific papers) / (number of U.S. Patents)
Source: CHI Research, Inc., "TP2-Int'l Technology Indicators Database for Data Years 1980-2002."

Table 8-2-2: Science linkage in major fields in Japan and the U.S.

(A) Japan

IPC Code	A01	A61	C01	C07	C12	G06	H01
Year	Agriculture, forestry and fisheries	Medical/veterinary medicine	Inorganic chemistry	Organic chemistry	Biochemistry/ microbiology	Calculation/counting	Basic electirc elements
1985	0.16	0.45	0.32	0.85	1.48	0.19	0.35
1986	0.16	0.40	0.39	0.69	2.11	0.36	0.39
1987	0.16	0.61	0.33	0.90	2.59	0.22	0.40
1988	0.17	0.68	0.30	1.00	2.59	0.19	0.57
1989	0.33	0.85	0.47	1.04	2.16	0.37	0.56
1990	0.40	0.53	0.93	1.04	2.42	0.31	0.62
1991	0.49	0.79	0.70	1.21	3.04	0.33	0.63
1992	0.64	0.86	1.40	1.23	3.20	0.44	0.66
1993	0.55	1.00	1.55	1.45	3.52	0.50	0.72
1994	0.51	1.06	1.07	1.71	3.90	0.55	0.81
1995	0.89	1.27	0.85	1.95	5.15	0.83	0.91
1996	0.66	1.39	1.18	2.13	4.80	0.98	0.96
1997	0.66	1.57	0.76	2.40	5.97	0.87	0.82
1998	1.26	1.74	1.24	2.81	6.77	0.80	0.77
1999	1.27	1.58	1.03	2.54	5.69	0.72	0.67
2000	1.41	2.31	0.55	2.99	5.84	0.69	0.69
2001	1.87	2.68	0.70	3.68	6.59	0.78	0.73
2002	1.16	1.83	1.19	2.99	6.80	0.63	0.61

(B) U.S.

IPC Dode	A01	A61	C01	C07	C12	G06	H01
Year	Agriculture, forestry and fisheries	Medical/veterinary medicine	Inorganic chemistry	Organic chemistry	Biochemistry/microbiol ogy	Calculation/counting	Basic electirc elements
1985	0.27	1.08	0.72	1.38	5.13	0.50	0.55
1986	0.41	0.95	0.88	1.63	5.00	0.52	0.59
1987	0.40	1.26	0.82	1.98	5.37	0.67	0.66
1988	0.35	1.49	1.00	1.99	6.77	0.70	0.71
1989	0.51	1.73	1.31	2.09	8.10	0.87	0.96
1990	0.59	1.74	1.86	2.54	8.07	1.08	0.99
1991	0.96	1.98	2.03	2.66	8.83	0.86	0.99
1992	0.98	2.28	2.14	3.48	9.32	1.18	1.05
1993	1.20	2.68	1.82	4.49	12.83	1.13	1.20
1994	1.44	2.60	2.49	4.91	13.67	1.24	1.19
1995	1.33	3.58	2.72	6.54	15.53	1.91	1.47
1996	2.61	4.57	2.51	8.87	18.00	2.10	1.42
1997	3.31	6.23	3.30	13.01	22.53	2.14	1.73
1998	4.64	7.21	3.82	14.21	23.33	2.04	1.43
1999	5.24	6.91	3.43	13.04	21.52	1.90	1.43
2000	5.63	7.15	3.08	14.20	23.20	2.01	1.44
2001	6.75	7.84	2.92	14.82	24.78	2.11	1.44
2002	6.03	8.24	3.53	15.83	24.32	1.97	1.62

Note: (Science linkage) = (citation frequency of scientific papers) ÷ (number of U.S. Patents).
Formal names of the fields are as follows.
A01: Agriculture; forestry; livestock farming; commercial hunting; hunting; fisheries
A61: Medicine or veterinary medicine; hygienics
C01: Inorganic chemistry
C07: Organic chemistry
C12: Biochemistry; beer; distilled liquor; wine; vinegar; microbiology; enzymology; mutation or genetic engineering
G06: Computer; calculation; counting
H01: Basic electric elements
Source: CHI Research, Inc., “TP2-Int'l Technology Indicators Database for Data Years 1980-2002”

Table 9-1-1: Trends in the ratio of R&D expenditure funded by the government for selected countries

(unit: %)

Year	Japan	U.S.	Germany	France	U.K.
1981	27.0	46.7	41.8	53.4 a	48.1 a,b
1982	29.5	46.1	41.7 c	54.0	-
1983	24.0	46.2	39.6	53.8	49.0 b
1984	22.5	45.5	38.9 c	53.7	-
1985	21.0	46.0	37.5	52.9	43.5 a
1986	21.3	45.5	36.3 c	52.5	41.1 a
1987	21.5	46.4	34.6	51.7	39.5
1988	19.9	44.9	34.2 c	49.9	36.5
1989	18.6	42.6	33.9	48.1	36.4
1990	17.9	40.6	33.8 c	48.3	35.5
1991	18.2	37.8	35.7 a,o	48.8	33.7
1992	19.4	36.8	35.7 a,c	43.5 a	33.1
1993	21.6	36.5	36.1 o	43.5	32.1
1994	21.5	35.9	36.5 c,o	41.6	32.7
1995	22.9	34.3	36.8 c,o	41.9	32.8
1996	21.0	32.1	36.9 c,o	41.5	31.5
1997	20.4	30.4	35.9 o	38.8 a	30.7
1998	21.7	29.3	34.9 c,o	37.3	30.7
1999	21.9	27.5	32.5	36.9	29.2
2000	21.7	25.0	31.6 c	38.7 a	28.9
2001	21.0	25.9	31.0 c	-	30.2
2002	20.7	27.8	-	-	-

Note: R&D expenditure is the total expenditure of natural science and human/social science (for each country).

a: The data lack continuity with the data until the previous year.

b: OECD estimates/calculations based on data of each country.

c: Government estimates or estimates modified as necessary to comply with OECD standards.

<Japan>1) Government includes government, local public entities, national, public, or government-affiliated research institute, national and public universities (including junior college).

2) Japan includes software industry since 1996.

<U.S.>R&D expenditure for 2001 and 2002 is preliminary figure. Government includes federal government and federal government research institutes.

<Germany>Until 1990, former federal district, and after 1991, Germany. Government is federal and state government.

<France>Government is public research institutes.

<U.K.>Government includes central and local government.

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

<U.S.>NSF, "National Patterns of R&D Resources 2002 Data Update"

<Germany, France, U.K.>OECD, "Basic Science and Technology Statistics 2002/2"

However, ONS "Gross domestic expenditure on Research and Development 2001" for U.K. after 1991.

Table 9-1-2: Change in the performing sectors of government-funded R&D for selected countries

(A) Japan

(unit: %)

FY	Industries	Government research insitutes	Universities	Non-profit private research institutes
1981	4.3	40.4	51.8	3.5
1982	2.7	41.5	54.6	1.2
1983	4.6	39.5	52.5	3.5
1984	5.0	40.0	51.9	3.2
1985	5.2	41.1	50.2	3.5
1986	5.6	40.5	49.4	4.5
1987	5.1	41.5	48.4	4.9
1988	5.0	40.7	48.9	5.3
1989	4.7	40.1	49.6	5.7
1990	5.1	39.3	49.5	6.2
1991	5.3	40.9	47.6	6.2
1992	3.8	42.3	47.3	6.5
1993	4.3	42.0	47.1	6.6
1994	3.7	41.8	47.5	7.1
1995	4.5	41.9	47.4	6.1
1996	3.6	41.3	48.7	6.4
1997	4.4	40.4	48.6	6.7
1998	6.4	39.5	48.1	6.0
1999	5.4	41.5	47.5	5.6
2000	5.2	42.3	46.8	5.6
2001	4.6	42.2	47.3	5.8
2002	4.9	41.7	48.5	5.0

(B) U.S.

(unit: %)

Year	Industries	Government research insitutes	Universities	Non-profit private research institutes
1981	48.6	25.5	21.2	4.7
1982	49.8	25.5	20.1	4.6
1983	49.7	26.0	19.6	4.6
1984	50.2	25.6	19.5	4.7
1985	51.6	24.8	19.1	4.5
1986	51.0	24.7	20.3	4.1
1987	52.5	23.2	20.7	3.5
1988	50.4	23.8	22.0	3.8
1989	47.2	25.2	23.3	4.3
1990	45.6	25.4	24.1	4.8
1991	43.4	25.1	26.0	5.5
1992	40.6	26.0	27.6	5.8
1993	37.7	27.3	29.1	5.9
1994	37.0	26.9	30.1	6.0
1995	37.2	26.8	30.1	5.8
1996	37.3	26.2	30.7	5.8
1997	37.0	26.0	31.0	5.9
1998	36.4	26.2	31.2	6.2
1999	33.6	26.6	32.6	7.1
2000	28.9	26.4	35.9	8.8
2001	28.1	26.2	35.8	9.8
2002	28.6	26.6	35.3	9.4

(C) Germany

(unit: %)

Year	Industries	Government research institutes and non-profit research institutes	Universities
1981	27.8	32.0	40.1 o
1982	31.4	31.1 c	37.5 c,o
1983	28.7	33.4	37.8 o
1984	28.3	33.6 c	38.1 c,o
1985	29.5	33.7	36.8 o
1986	27.2	34.8 c	38.0 c,o
1987	24.8	36.2 a	39.0 o
1988	24.2	36.6 c	39.3 c,o
1989	23.5	37.5	39.0 o
1990	22.9	37.4 c	39.8 c,o
1991	19.5	38.4 a	42.1 a,o
1992	19.0	37.3 a	43.7 c,o
1993	16.7	39.3	44.0 o
1994	16.4	39.0	44.6 o
1995	15.9	39.4	44.7 o
1996	16.1	39.2	44.8 o
1997	17.3	38.5	44.2 o
1998	16.8	39.6	43.6 o
1999	16.4	39.6	44.0 o
2000	16.0 c	40.2	43.7 o
2001	15.8 c	39.9 c	44.2 c

(D) France

(unit: %)

FY	Industries	Government research insitutes	Universities	Non-profit private research institutes
1981	27.2	41.7	30.0 a	1.1
1982	25.9	44.6	28.8	0.7
1983	23.7	46.9	28.7	0.7
1984	23.9	47.5	27.9	0.6
1985	26.0	45.9	27.4	0.6
1986	25.5	46.2	27.5	0.8
1987	25.3	46.4	27.5	0.8
1988	24.8	46.6	27.9	0.8
1989	24.1	46.3	28.9	0.6
1990	24.7	46.6	28.1	0.6
1991	28.1	42.5	28.8	0.5
1992	23.6 a	43.4 a	32.6	0.4 a
1993	21.7	44.4	33.6	0.3
1994	19.3	44.7	35.7	0.4
1995	18.5	45.0	36.1	0.4
1996	19.4	43.7	36.5	0.4
1997	16.7 a	42.1 a	40.7	0.5
1998	15.0	42.6	41.9	0.5
1999	17.0	41.3	41.1	0.6
2000	16.0	39.0 a	44.4 a	0.5

(E) U.K.

(unit: %)

FY	Industries	Government research insitutes	Universities	Non-profit private research institutes
1981	39.3	34.6 b	22.9 a	3.3
1982	-	-	-	-
1983	38.5	33.4 b	24.8	3.2
1984	-	-	-	-
1985	34.0	32.9 a	27.8 a	5.3 a
1986	39.3 a	27.4 a	29.2	4.0
1987	34.8	29.8	31.8	3.6
1988	32.1	31.0	33.1	3.8
1989	32.5	32.3	31.4	3.7
1990	32.7	30.9	32.3	4.1
1991	28.0	34.2 a	34.3	3.6
1992	25.0 a	37.7	36.5	0.8
1993	22.8	38.6	37.8 a	0.8
1994	20.3	38.9	40.2	0.6
1995	20.7	39.0	39.7	0.6
1996	18.6	39.7	41.0	0.6
1997	20.3	37.1	41.9	0.6
1998	23.1	34.9	41.4	0.6
1999	23.4	32.1	43.6	0.8
2000	20.0	32.7	46.5	0.8
2001	26.5	26.0	46.8	0.7

Note: R&D expenditure is the total amount of natural science and human/social science (for each country).

a: Data lack continuity with the data until the previous year.

b: OECD estimates/calculations based on data of each country.

<Japan>1) Government includes government, local public entities, national, public, or government-affiliated corporation/independent administrative agency research institutes, and national and public universities (including junior college).

2) Japan includes software industry since 1996.

<U.S.>R&D expenditure for 2001 and 2002 is preliminary figure. Government includes federal government and federal government research institutes.

<Germany>Until 1990, former federal district, after 1991, Germany. Government means federal and state government.

<France>Government means public research institutes.

<U.K.>Government means central and local government.

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development’

<U.S.>NSF, “National Patterns of R&D Resources 2002 Data Update”

<Germany, France, U.K.>OECD, “Basic Science and Technology Statistics 2002/2”

However, ONS “Gross domestic expenditure on Research and Development 2001” for U.K. in 2001.

Table 9-1-3: Trends in government budget appropriations for science and technology for selected countries

(1) Naitonal currencies

	Japan			U.S.		
	Total S&T budget	Public only	Ratio of public (%)	Total S&T budget	Public only	Ratio of public (%)
FY	(million yen)			(million dollars)		
1983	1,461,859	1,422,407	97.3	38,768	13,832	35.7
1984	1,483,839	1,439,232	97.0	44,214	14,927	33.8
1985	1,532,869	1,474,192	96.2	49,887	16,189	32.5
1986	1,606,386	1,540,253	95.9	53,249	16,323	30.7
1987	1,662,336	1,588,201	95.5	57,069	17,917	31.4
1988	1,715,746	1,633,046	95.2	59,106	19,007	32.2
1989	1,815,199	1,722,131	94.9	62,115	21,450	34.5
1990	1,920,871	1,816,603	94.6	63,781	23,856	37.4
1991	2,022,631	1,907,586	94.3	65,898	26,570	40.3
1992	2,134,676	2,007,687	94.1	68,398	28,337	41.4
1993	2,266,265	2,129,090	93.9	69,884	28,635	41.0
1994	2,358,474	2,217,686	94.0	68,331	30,567	44.7
1995	2,499,549	2,345,050	93.8	68,791	31,587	45.9
1996	2,810,452	2,645,173	94.1	69,049	31,248	45.3
1997	3,002,611	2,827,271	94.2	71,653	32,062	44.7
1998	3,032,179	2,888,003	95.2	73,569	33,746	45.9
1999	3,156,728	3,010,199	95.4	77,637	36,332	46.8
2000	3,285,987	3,149,906	95.9	78,664	36,084	45.9
2001	3,468,512	3,319,524	95.7	86,756	41,043	47.3
2002	3,544,427	3,400,949	96.0	98,029	45,107	46.0
2003	3,597,366	3,436,554	95.5	107,057	48,798	45.6

	Germany (fedearl and state governemt)		Germany (federal and state government)		Germany (federal government)		Germany (federal government)	
	Total S&T budget	Public only	Total S&T budget	Public only	Total S&T budget	Public only	Total S&T budget	Public only
FY	(million marks)		(million euros)		(million marks)		(million euros)	
1983	-	-	-	-	-	-	-	-
1984	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-
1986	-	-	-	-	-	-	-	-
1987	22,048	19,241	-	-	-	-	-	-
1988	22,258	19,499	-	-	-	-	-	-
1989	23,636	20,613	12,085	10,539	14,185	11,030	7,249	5,636
1990	25,119	21,734	-	-	-	-	-	-
1991	29,450	26,215	15,058	13,404	17,002	13,809	8,689	7,056
1992	31,103	27,982	-	-	-	-	-	-
1993	31,382	28,708	16,045	14,678	16,897	14,235	-	-
1994	30,932	28,284	-	-	-	-	-	-
1995	31,639	28,773	16,177	14,711	16,547	13,673	8,456	6,986
1996	32,194	28,991	-	-	16,740	13,825	-	-
1997	31,312	28,324	16,010	14,477	16,062	13,220	8,271	6,818
1998	31,455	28,711	16,017	14,614	16,171	13,506	8,224	6,902
1999	-	-	16,322	14,963	16,770	14,062	8,240	7,041
2000	-	-	16,308	15,000	16,849	14,241	8,427	7,235
2001	-	-	16,935	15,680	-	-	9,026	7,788
2002	-	-	-	-	-	-	9,051	7,892

	France		U.K.	
	Total S&T budget	Public only	Total S&T budget	Public only
FY	(million francs)		(million pounds)	
1983	46,738	28,578	-	-
1984	54,441	34,201	-	-
1985	60,121	37,751	-	-
1986	61,872	37,412	4,255	2,330
1987	64,655	38,035	4,408	2,412
1988	71,767	39,357	4,497	2,533
1989	75,008	42,028	4,772	2,632
1990	78,054	43,354	4,955	2,793
1991	77,733	44,733	5,027	2,814
1992	79,900	48,000	5,078	2,997
1993	80,186	50,586	5,402	3,124
1994	80,168	50,768	5,200	3,169
1995	78,261	52,361	5,642	3,572
1996	78,535	53,035	5,759	3,616
1997	76,111	52,311	5,905	3,594
1998	72,957	53,057	5,707	3,611
1999	73,934	53,934	6,192	3,847
2000	11,291	8,331	6,565	4,186
2001	11,915	8,535	7,200	4,834
2002	-	8,720	7,263	5,158
2003	-	8,846	7,830	5,725

Note: <Japan>Initial budget amount for each year.

<U.S.>Preliminary figure for 2002, and proposed amount for 2003.

<Germany>1) Figures for federal government after 2000 are estimates.

2) The values for the mark and the euro are mixed in the data for Germany, but only the euro was used for the figure.

<France>Euro value after 2000.

<U.K.>Estimates for 2001, and plan for 2002 on cross-cutting review.

Source: <Japan>Ministry of Education, Culture, Sports, Science and Technology, 'Science and Technology Manual,' 'Science and Technology Budget for 2002'

<U.S.>NSF, "Federal R&D Funding by Budget Function Fiscal Years 2001-2003"

<Germany>>Bundesministerium für Bildung und Forschung, "Bundesbericht Forschung 2000," "Faktenbericht 2002"

<France>Appendix for Budget Package 1996-2003, Ministry of Education, Culture, Sports, Science and Technology, 'Science and Technology Manual'

<U.K.>OST, "SET Statistics"

(2) OECD purchasing power parity equivalents

	Japan		U.S.	
	Total S&T budget	Public only	Total S&T budget	Public only
FY	(million yen)		(million yen)	
1983	1,461,859	1,422,407	8,747,953	3,121,174
1984	1,483,839	1,439,232	9,788,639	3,304,723
1985	1,532,869	1,474,192	10,895,166	3,535,627
1986	1,606,386	1,540,253	11,550,012	3,540,552
1987	1,662,336	1,588,201	11,993,838	3,765,505
1988	1,715,746	1,633,046	12,045,525	3,873,537
1989	1,815,199	1,722,131	12,371,569	4,272,239
1990	1,920,871	1,816,603	12,456,429	4,659,077
1991	2,022,631	1,907,586	12,722,288	5,129,612
1992	2,134,676	2,007,687	12,869,836	5,331,918
1993	2,266,265	2,129,090	12,880,082	5,277,619
1994	2,358,474	2,217,686	12,339,827	5,520,064
1995	2,499,549	2,345,050	11,690,473	5,367,955
1996	2,810,452	2,645,173	11,435,611	5,175,121
1997	3,002,611	2,827,271	11,680,316	5,226,448
1998	3,032,179	2,888,003	12,334,582	5,657,800
1999	3,156,728	3,010,199	12,579,983	5,887,001
2000	3,285,987	3,149,906	12,236,069	5,612,770
2001	3,468,512	3,319,524	12,993,817	6,147,220
2002	3,544,427	3,400,949	14,374,514	6,614,310
2003	3,597,366	3,436,554	15,246,747	6,949,729

	Germany (fedearl and state governemt)		Germany (federal and state government)		Germany (federal government)		Germany (federal government)	
	Total S&T budget	Public only	Total S&T budget	Public only	Total S&T budget	Public only	Total S&T budget	Public only
FY	(million yen)		(million yen)		(million yen)		(million yen)	
1983	-	-	-	-	-	-	-	-
1984	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-
1986	-	-	-	-	-	-	-	-
1987	2,102,431	1,834,730	-	-	-	-	-	-
1988	2,106,841	1,845,675	-	-	-	-	-	-
1989	2,234,300	1,948,501	2,234,680	1,948,875	1,340,909	1,042,623	1,340,523	1,042,181
1990	2,349,446	2,032,907	—	—	-	-	—	—
1991	2,715,157	2,416,947	2,714,798	2,416,679	1,567,520	1,273,163	1,566,551	1,272,236
1992	2,832,706	2,548,461	—	—	-	-	—	—
1993	2,750,320	2,515,970	2,750,440	2,516,080	1,480,862	1,247,565	—	—
1994	2,699,845	2,468,719	—	—	-	-	—	—
1995	2,667,061	2,425,467	2,667,491	2,425,852	1,394,873	1,152,596	1,394,328	1,152,013
1996	2,630,394	2,368,695	—	—	1,367,758	1,129,532	—	—
1997	2,573,759	2,328,154	2,627,618	2,376,027	1,320,276	1,086,672	1,357,467	1,118,973
1998	2,546,729	2,324,564	2,706,260	2,469,274	1,309,248	1,093,495	1,389,507	1,166,191
1999	-	-	2,705,396	2,480,078	1,338,334	1,122,280	1,365,784	1,167,035
2000	-	-	2,684,627	2,469,288	1,326,634	1,121,293	1,387,164	1,190,938
2001	-	-	2,654,012	2,457,270	-	-	1,414,524	1,220,541
2002	-	-	—	—	-	-	1,381,624	1,204,641

	Fnance		U.K.	
	Total S&T budget	Public only	Total S&T budget	Public only
FY	(million yen)		(million yen)	
1983	1,668,996	1,020,509	-	-
1984	1,856,562	1,166,332	-	-
1985	1,978,639	1,242,421	-	-
1986	1,966,648	1,189,169	1,664,665	911,481
1987	1,997,964	1,175,355	1,644,231	899,780
1988	2,165,816	1,187,733	1,592,295	896,947
1989	2,234,444	1,251,989	1,609,499	887,724
1990	2,304,800	1,280,169	1,606,726	905,747
1991	2,304,181	1,325,987	1,527,769	855,081
1992	2,342,484	1,407,250	1,551,488	915,811
1993	2,248,416	1,418,432	1,562,340	903,400
1994	2,186,597	1,384,707	1,455,346	886,825
1995	2,058,797	1,377,451	1,466,298	928,404
1996	1,979,089	1,336,487	1,481,098	929,836
1997	1,868,830	1,284,444	1,529,227	930,681
1998	1,774,100	1,290,190	1,480,592	936,856
1999	1,764,616	1,287,260	1,542,391	958,265
2000	1,865,230	1,376,249	1,582,191	1,008,825
2001	1,944,027	1,392,571	1,683,380	1,130,203
2002	—	1,382,677	1,628,965	1,156,850
2003	—	1,358,884	1,688,307	1,234,426

Note: Same as Table 9-1-3(1).

Reference Statistics E is used for purchasing power parity equivalents.

Source: Same as Table 9-1-3(1).

Table 9-1-4: Trends in the government science and technology budget as a percentage of GDP for selected countries

	Japan (100 million yen)			U.S. (100 million yen)			Germany (100 million euros)		
FY	Total S&T budget	GDP	Ratio to GDP (%)	Total S&T budget	GDP	Ratio to GDP (%)	Total S&T budget	GDP	Ratio to GDP (%)
1983	14,619	2,902,988	0.50	388	35,349	1.10	-	8,722	-
1984	14,838	3,104,322	0.48	442	39,327	1.12	-	9,150	-
1985	15,329	3,309,689	0.46	499	42,130	1.18	-	9,553	-
1986	16,064	3,458,524	0.46	532	44,529	1.20	-	10,102	-
1987	16,623	3,626,036	0.46	571	47,425	1.20	-	10,433	-
1988	17,157	3,886,613	0.44	591	51,083	1.16	-	10,985	-
1989	18,152	4,175,071	0.43	621	54,891	1.13	121	11,683	1.03
1990	19,209	4,514,728	0.43	638	58,032	1.10	-	12,749	-
1991	20,226	4,749,933	0.43	659	59,862	1.10	151	15,022	1.00
1992	21,347	4,836,074	0.44	684	63,189	1.08	-	16,132	-
1993	22,663	4,878,912	0.46	699	66,423	1.05	160	16,542	0.97
1994	23,585	4,916,396	0.48	683	70,543	0.97	-	17,355	-
1995	24,995	5,040,375	0.50	688	74,005	0.93	162	18,013	0.90
1996	28,105	5,167,288	0.54	690	78,132	0.88	-	18,337	-
1997	30,026	5,211,532	0.58	717	83,184	0.86	160	18,716	0.86
1998	30,322	5,144,179	0.59	736	87,815	0.84	160	19,294	0.83
1999	31,567	5,106,873	0.62	776	92,686	0.84	163	19,786	0.82
2000	32,860	5,154,244	0.64	787	98,729	0.80	163	20,300	0.80
2001	34,685	5,025,863	0.69	868	102,081	0.85	169	20,737	0.82
2002	35,444	4,990,328	0.71	980	103,658	0.95	-	21,104	-
2003	35,974	-	-	1,071	107,732	0.99	-	21,664	-

	France (100 million francs)			U.K. (100 million pounds)		
FY	Total S&T budget	GDP	Ratio to GDP (%)	Total S&T budget	GDP	Ratio to GDP (%)
1983	467	41,009	1.14	-	3,025	-
1984	544	44,608	1.22	-	3,242	-
1985	601	47,712	1.26	-	3,550	-
1986	619	51,354	1.20	43	3,813	1.12
1987	647	54,164	1.19	44	4,196	1.05
1988	718	58,731	1.22	45	4,684	0.96
1989	750	62,703	1.20	48	5,142	0.93
1990	781	66,209	1.18	50	5,573	0.89
1991	777	68,841	1.13	50	5,861	0.86
1992	799	71,260	1.12	51	6,109	0.83
1993	802	72,265	1.11	54	6,423	0.84
1994	802	74,997	1.07	52	6,813	0.76
1995	783	77,524	1.01	56	7,192	0.78
1996	785	79,514	0.99	58	7,622	0.76
1997	761	82,071	0.93	59	8,111	0.73
1998	730	85,658	0.85	57	8,594	0.66
1999	739	88,565	0.83	62	9,025	0.69
2000	113	14,169	0.80	66	9,504	0.69
2001	119	14,637	0.81	72	9,909	0.73
2002	-	15,064	-	73	10,380	0.70
2003	-	15,590	-	78	10,865	0.72

Note: 'Ratio to GDP' figures may not be consistent with the quotient of the 'science and technology budget' divided by 'GDP,' as the figures were rounded off.

<S&T budget>Same as Figure 9-1-3, the federal and state government for Germany.

<GDP>Same as Reference Statistics C.

Source: <S&T budget>Same as Figure 9-1-3.

<GDP>Same as Reference Statistics C. The franc value of France is based on OECD, "National Accounts 2002/2."

Table 9-1-5: Science and technology budget by socio-economic objective

(A) Ratio in the latest available year

(unit: %)

	Japan 2002	U.S. 2002	Germany 2002	France 2001	U.K. 2000	Republic of Korea 2000
Exploration and development of earch	1.8	1.1	1.8	0.8	1.3	1.5
Infrastructure and basic plan for land use	4.1	1.8	1.8	0.6	1.2	4.0
Control and protection of the environment	0.9	0.6	3.1	2.9	1.6	3.8
Protection and improvement of human health	3.9	24.9	4.1	5.8	14.6	6.5
Production/supply/rational use of energy	17.3	1.6	3.3	3.9	0.5	5.0
Agricultural production/technology	3.5	2.2	2.3	2.1	4.1	9.1
Industrial production/technoloyg	7.5	0.5	12.5	6.3	1.7	24.3
Social structure/relationship	0.8	0.8	4.8	0.8	4.1	3.0
Space exploraion/development	6.0	6.7	4.8	9.8	2.2	2.4
Research financed by general university funds	34.9	0.0	39.8	21.6	19.6	0.0
Research with no direction	15.4	5.8	16.4	19.8	12.1	0.0
Other research for the public	0.0	0.0	0.0	2.3	0.3	0.0
Defense	4.1	54.0	5.3	23.2	36.6	20.5
Total	100.0	100.0	100.0	100.0	100.0	100.0

Note: As for Republic of Korea, the total of each category does not make 100% due to unclassified categories.
Source: OECD, "Basic Science and Technology Statistics 2002/2"

(B) Time series

A. Japan

(unit: million yen)

Year	Exploration and development of earth	Infrastructure and basic plan for land use	Control and protection of environment	Protection and improvement of human health	Production/supply/rational use of energy	Agricultural production/technology	Industrial production/technology
1988	17,395 h	29,416 h	7,752 h	44,059 h	383,349 h	66,642 h	82,670 h
1989	18,791 h	30,687 h	7,831 h	48,370 h	402,452 h	68,037 h	83,111 h
1990	20,728 h	32,628 h	9,099 h	51,242 h	433,339 h	70,108 h	82,558 h
1991	20,586 h	38,166 h	10,745 h	56,144 h	441,993 h	73,557 h	85,556 h
1992	22,785 h	39,970 h	11,362 h	61,338 h	455,660 h	76,177 h	82,663 h
1993	24,554 h	43,250 h	12,117 h	64,343 h	480,770 h	81,030 h	85,239 h
1994	27,586 h	42,534 h	12,816 h	69,891 h	484,523 h	82,660 h	86,542 h
1995	31,646 h	47,526 h	13,972 h	70,813 h	510,077 h	85,418 h	93,820 h
1996	37,875 h	66,261 h	16,196 h	99,367 h	653,634 h	94,944 h	94,721 h
1997	40,486 h	80,729 h	17,078 h	120,756 h	605,329 h	100,894 h	197,427 h
1998	40,827 h	84,342 h	18,526 h	110,471 h	603,474 h	104,501 h	208,023 h
1999	46,750 h	111,996 h	22,429 h	117,102 h	608,322 h	109,176 h	205,485 h
2000	55,289 h	123,035 h	26,247 h	127,527 h	593,330 h	113,754 h	221,917 h
2001	66,373 h	152,774 h	29,433 h	135,026 h	603,271 h	122,517 h	260,742 h
2002	62,546 h,p	146,598 h,p	30,606 h,p	138,648 h,p	611,555 h,p	122,442 h,p	265,118 h,p

(unit: million yen)

Year	Social structure/relationship	Space exploration/development	Research financed by general university funds	Research with no derection	Other research for the public	Defense	Total
1988	17,926 h	104,447 h	749,197 g,h	130,194 h	— h	82,700 h,m	1,715,746 g,h
1989	19,137 h	115,737 h	785,883 g,h	142,094 h	— h	93,068 h,m	1,815,199 g,h
1990	19,476 h	125,770 h	819,688 g,h	151,966 h	— h	104,268 h,m	1,920,871 g,h
1991	21,439 h	138,176 h	859,747 g,h	161,478 h	— h	115,045 h,m	2,022,631 g,h
1992	21,937 h	151,863 h	907,209 g,h	176,724 h	— h	126,989 h,m	2,134,676 g,h
1993	23,579 h	165,935 h	950,926 g,h	197,348 h	— h	137,175 h,m	2,266,265 g,h
1994	26,145 h	177,548 h	992,748 g,h	214,693 h	— h	140,788 h,m	2,358,474 g,h
1995	29,160 h	184,386 h	1,036,663 g,h	241,570 h	— h	154,499 h,m	2,499,549 g,h
1996	28,872 h	186,367 h	1,095,843 g,h	270,851 h	243 h	165,279 h,m	2,810,452 g,h
1997	28,162 h	189,126 h	1,122,780 g,h	324,263 h	242 h	175,340 h,m	3,002,610 g,h
1998	28,891 h	190,976 h	1,135,015 g,h	362,857 h	101 h	144,176 h,m	3,032,179 g,h
1999	27,146 h	198,419 h	1,156,116 g,h	405,774 h	1,482 h	146,529 h,m	3,156,728 g,h
2000	29,933 h	182,650 h	1,164,087 g,h	459,690 h	50,780 h	136,081 h,m	3,284,320 g,h
2001	30,706 h	233,278 h	1,205,738 h	479,667 h	—	148,988 h,m	3,468,512 h
2002	28,447 h,p	212,402 h,p	1,233,347 h,p	543,500 h,p	—	143,478 h,m,p	3,538,686 h,p

B. U.S.

(unit: million dollars)

Year	Exploration and development of earth	Infrastructure and basic plan for land use	Control and protection of environment	Protection and improvement of human health	Production/suppl y/rational use of energy	Agricultural production/techn ology	Industrial production/techn ology
1981	498 h,j	973 h,j	271 h,j	4,014 h,j	3,501 h,j	951 h,j	106 h,j
1982	476 h,j	854 h,j	222 h,j	4,008 h,j	3,012 h,j	960 h,j	104 h,j
1983	477 h,j	920 h,j	208 h,j	4,455 h,j	2,578 h,j	1,012 h,j	107 h,j
1984	513 h,j	1,086 h,j	222 h,j	4,997 h,j	2,581 h,j	989 h,j	110 h,j
1985	568 h,j	1,080 h,j	258 h,j	5,611 h,j	2,388 h,j	1,069 h,j	114 h,j
1986	556 h,j	1,006 h,j	268 h,j	5,748 h,j	2,286 h,j	1,054 h,j	111 h,j
1987	573 h,j	1,007 h,j	284 h,j	6,771 h,j	2,053 h,j	1,097 h,j	110 h,j
1988	563 h,j	1,004 h,j	300 h,j	7,271 h,j	2,126 h,j	1,179 h,j	122 h,j
1989	627 h,j	1,138 h,j	331 h,j	7,985 h,j	2,419 h,j	1,202 h,j	128 h,j
1990	670 h,j	1,112 h,j	394 h,j	8,524 h,j	2,726 h,j	1,305 h,j	140 h,j
1991	781 h,j	1,318 h,j	440 h,j	9,445 h,j	2,953 h,j	1,413 h,j	178 h,j
1992	828 h,j	1,596 h,j	487 h,j	10,300 h,j	3,153 h,j	1,535 h,j	192 h,j
1993	848 h,j	1,760 h,j	509 h,j	10,530 h,j	2,677 h,j	1,597 h,j	220 h,j
1994	983 h,j	1,956 h,j	553 h,j	11,258 h,j	2,873 h,j	1,719 h,j	380 h,j
1995	902 h,j	1,903 h,j	549 h,j	11,664 h,j	2,844 h,j	1,731 h,j	525 h,j
1996	814 h,j	1,845 h,j	482 h,j	12,126 h,j	2,521 h,j	1,681 h,j	432 h,j
1997	813 h,j	1,833 h,j	570 h,j	12,937 h,j	2,372 h,j	1,706 h,j	409 h,j
1998	986 h,j	1,875 h,j	571 h,j	14,163 h,j	948 a,h,j	1,546 h,j	398 h,j
1999	929 h,j	1,784 h,j	553 h,j	16,197 h,j	1,131 h,j	1,648 h,j	432 h,j
2000	1,122 h,j	1,682 h,j	537 h,j	18,514 h,j	996 h,j	1,766 h,j	406 h,j
2001	1,022 h,j	1,694 h,j	574 h,j	21,477 h,j	1,314 h,j	2,158 h,j	429 h,j
2002	1,095 h,j,p	1,744 h,j,p	592 h,j,p	24,414 h,j,p	1,547 h,j,p	2,176 h,j,p	444 h,j,p

(unit: million dollars)

Year	Social structure/relations hip	Space exploration/devel opment	Research financed by general university funds	Research with no derection	Other research for the public	Defense	Total
1981	557 h,j	3,111 h,j	―	1,340 h,j	―	18,413 h,j	33,735 h,l,j
1982	466 h,j	2,584 h,j	―	1,359 h,j	―	22,070 h,j	36,115 h,l,j
1983	441 h,j	2,134 h,j	―	1,502 h,j	―	24,936 h,j	38,768 h,l,j
1984	450 h,j	2,300 h,j	―	1,676 h,j	―	29,287 h,j	44,214 h,l,j
1985	515 h,j	2,725 h,j	―	1,862 h,j	―	33,698 h,j	49,887 h,l,j
1986	528 h,j	2,894 h,j	―	1,873 h,j	―	36,926 h,j	53,249 h,l,j
1987	581 h,j	3,398 h,j	―	2,042 h,j	―	39,152 h,j	57,069 h,l,j
1988	600 h,j	3,683 h,j	―	2,160 h,j	―	40,099 h,j	59,106 h,l,j
1989	692 h,j	4,555 h,j	―	2,373 h,j	―	40,665 h,j	62,115 h,l,j
1990	810 h,j	5,765 h,j	―	2,410 h,j	―	39,925 h,j	63,781 h,l,j
1991	895 h,j	6,511 h,j	―	2,635 h,j	―	39,328 h,j	65,897 h,l,j
1992	821 h,j	6,744 h,j	―	2,659 h,j	―	40,083 h,j	68,398 h,l,j
1993	816 h,j	6,988 h,j	―	2,691 h,j	―	41,249 h,j	69,884 h,l,j
1994	719 h,j	7,414 h,j	―	2,712 h,j	―	37,764 h,j	68,331 h,l,j
1995	759 h,j	7,916 h,j	―	2,794 h,j	―	37,204 h,j	68,791 h,l,j
1996	657 h,j	7,844 h,j	―	2,846 h,j	―	37,801 h,j	69,049 h,l,j
1997	633 h,j	7,844 h,j	―	2,944 h,j	―	39,591 h,j	71,653 h,l,j
1998	699 h,j	8,198 h,j	―	4,360 a,h,j	―	39,823 h,j	73,569 h,l,j
1999	722 h,j	8,245 h,j	―	4,690 h,j	―	41,306 h,j	77,637 h,l,j
2000	722 h,j	5,363 h,j	―	4,977 h,j	―	42,580 h,j	78,664 h,l,j
2001	784 h,j	6,126 h,j	―	5,468 h,j	―	45,713 h,j	86,756 h,l,j
2002	823 h,j,p	6,556 h,j,p	―	5,717 h,j,p	―	52,922 h,j,p	98,029 h,l,j,p

C. Germany

(unit: million euros)

Year	Exploration and development of earth	Infrastructure and basic plan for land use	Control and protection of environment	Protection and improvement of human health	Production/suppl y/rational use of energy	Agricultural production/techn ology	Industrial production/techn ology
1981	257	339	163	371	1,381	180	987
1982	232	339	171	404	1,814	196	1,154
1983	182 a	218 a	274 a	311 a	1,482 a	236 a	1,185 a
1984	198	222	296	320	1,509	204 a	1,190
1985	227	206	338	326	1,359	213 a	1,521
1986	224	205	353	335	1,132	221	1,592
1987	204	238	360	320	911	221	1,713
1988	250	239	387	356	800	233	1,591
1989	263	239	411	417	777	250	1,547
1990	301	248	453	445	769	249	1,608
1991	374 a	304 a	513 a	485 a	778 a	478 a	1,862 a
1992	433 c	271 c	596 c	527 c	747 c	401 c	2,209 c
1993	440	268	604	515	672	417	1,992
1994	451	267	582	503	604	419	1,975
1995	370	246	580	520	556	421	2,157
1996	356	242	615	557	578	425	2,225
1997	325 s	273 s	563 s	530 s	563 s	432 s	2,040 s
1998	294	275	552	519	589	433	1,998
1999	293	280	563	543	594	417	2,092
2000	280	270	542	582	556	410	2,002
2001	298 p	283 p	532 p	681 p	577 p	409 p	2,052 p
2002	314 p	301 p	529 p	700 p	563 p	395 p	2,138 p

(unit: million euros)

Year	Social structure/relations hip	Space exploration/devel opment	Research financed by general university funds	Research with no derection	Other research for the public	Defense	Total
1981	374	375	—	—	—	804	9,071
1982	378	412	—	—	—	842	9,871
1983	241 a	393 a	3,215 a	1,083 a	5 a	938 a	9,763 a
1984	232 a	390	3,236	1,135	5	990	9,926 a
1985	247	419	3,380	1,225	9	1,283	10,753 a
1986	250	493	3,451	1,335	16	1,324	10,932
1987	296	593	3,372 a	1,593	15	1,435	11,273 a
1988	295	628	3,535	1,642	14	1,411	11,380
1989	298	683	3,961	1,680	13	1,546	12,085
1990	324	752	4,182	1,684	99	1,730	12,843
1991	374 a	811 a	4,994 a	2,284 a	145 a	1,654 a	15,057 a
1992	390 c	940 c	5,599 c	2,138 c	58 c	1,596 c	15,903 c
1993	403	935	5,949	2,457	27	1,367	16,045
1994	404	869	5,992	2,289	107	1,354	15,815
1995	388	833	6,104	2,431	105	1,465	16,177
1996	393	809	6,009	2,569	44	1,638	16,461
1997	396 s	763 s	6,161 s	2,477 s	—	1,533 s	16,009 s
1998	412	760	6,209	2,531	44	1,403	16,017
1999	549	736	6,253	2,606	37	1,359	16,322
2000	587	768	6,350	2,621	17	1,267	16,253
2001	767 p	795 p	6,620 p	2,741 p	9 p	1,214 p	16,978 p
2002	815 p	831 p	6,829 p	2,820 p	—	914 p	17,146 p

D. France

(unit: million euros)

Year	Exploration and development of earth	Infrastructure and basic plan for land use	Control and protection of environment	Protection and improvement of human health	Production/supply/rational use of energy	Agricultural production/technology	Industrial production/technology
1981	173	226	34 b	302 b	450	239	536
1982	213	255	41 b	370 b	530	292	803
1983	148 a	274	29	349 a	670	305	1,002
1984	140 a	293 a	36 a	364 a	736 a	354 a	1,055 a
1985	151	320	49	409	805	364	1,249
1986	152	347	46	367	750	370	1,239
1987	200	116	95	369	477	486	1,486
1988	216	116	94	377	469	492	1,521
1989	208	107	91	422	445	517	1,692
1990	219	135	92	471	405	547	1,682
1991	236	136	98	492	449	590	1,800
1992	147 a	81 a	150 a	620 a	533 a	534 a	1,012 a
1993	154	83	173	621	533	538	963
1994	107	82	187	608	559	532	885
1995	105	83	255	656	583	452	794
1996	93	66	260	670	610	469	629
1997	97	84	261	700	605	477	593
1998	113	81	278	708	654	490	726
1999	93	83	203	708	630	383	789
2000	76	96	241	737	666	323	842
2001	112 p	93 p	421 p	843 p	572 p	308 p	916 p

(unit: million euros)

Year	Social structure/relationship	Space exploration/development	Research financed by general university funds	Research with no derection	Other research for the public	Defense	Total
1981	75	256	—	—	41	2,389 a	6,220 a
1982	103	312	—	—	49	2,637	7,285
1983	113	408	915	1,356	117	2,768	8,455 a
1984	152 a	533 a	1,154 a	1,364 a	151 a	3,086 a	9,418 a
1985	264	580	1,226	1,481	171	3,410	10,478
1986	300	654	1,312	1,575	120	3,729	10,961
1987	60	766	1,335	1,758	100	4,058	11,306
1988	59	828	1,394	1,865	51	4,444	11,925
1989	63	984	1,481	1,975	53	4,726	12,765
1990	67	1,096	1,600	2,078	50	5,641	14,084
1991	63	1,222	1,765	2,165	60	5,122	14,198
1992	105 a	1,336 a	1,802 a	2,315 a	188 a	4,902 a	13,725 a
1993	113	1,387	1,892	2,446	189	4,541	13,634
1994	89	1,455	1,955	2,432	240	4,510	13,640
1995	101	1,381	2,047	2,531	249	3,955	13,193
1996	112	1,434	2,097	2,452	316	3,897	13,105
1997	118	1,461	2,175	2,510	313	3,163 a	12,557 a
1998	135	1,404	2,286	2,553	305	2,970	12,703
1999	124	1,417	2,346	2,808	375	2,931	12,892
2000	121	1,437	3,098	2,978	265	2,963	13,842
2001	118 p	1,427 p	3,144 p	2,887 p	336 p	3,385 p	14,561 p

E. U.K.

(unit: million pounds)

Year	Exploration and development of earth	Infrastructure and basic plan for land use	Control and protection of environment	Protection and improvement of human health	Production/supply/rational use of energy	Agricultural production/technology	Industrial production/technology
1981	64 a	60 a	42 a	133 a	227 a	191 a	224 a
1982	67	61	49	142	224	202	218
1983	69	57	44	152	221	207	258
1984	74	60	52	158	208	206	288
1985	77	54	53	163	205	204	435 a
1986	79	66	49	190	188	198	444
1987	85	67	56	204	170	196	412
1988	96	67	58	218	177	206	395
1989	120	72	53	258	158	195	452
1990	139	74	70	287	142	198	475
1991	144	64	72	298	133	216	399
1992	121	86	70	342	120	261	394
1993	99	97	109	383	97	285	459
1994	107	98	117	397	56	263	184 a
1995	105	94	132	763 a	52	282	166
1996	95	99	129	835	43	257	145
1997	81	99	136	846	41	269	103
1998	79	104	143	853	28	256	62
1999	80	104	147	929	29	261	57
2000	86	76	102	952	31	267	109

(unit: million pounds)

Year	Social structure/relationship	Space exploration/development	Research financed by general university funds	Research with no derection	Other research for the public	Defense	Total
1981	27 a	69 a	540 a	194 a	53 a	1,571 a	3,395 a
1982	26	73	600	211	58	1,588	3,519
1983	33	74	616	268	11	1,786	3,795
1984	44	81	630	281	11	1,962	4,054
1985	56	128	669	184 a	12	2,111	4,351 a
1986	62	124	720	193	14	2,041	4,367
1987	71	130	796	209	14	2,009	4,418
1988	96	146	830	216	14	1,873	4,392
1989	100	145	830	223	12	2,021	4,638
1990	112	154	863	255	11	2,155	4,934
1991	116	134	950	257	36	2,209	5,027
1992	142	149	963	337	24	2,065	5,073
1993	149	187	968	267	34	2,269	5,402
1994	142	162	1,017	614 a	22	2,022	5,200
1995	137	153	1,019	654	25	2,062	5,642
1996	121	164	1,028	681	21	2,144	5,759
1997	115	164	1,033	671	22	2,312	5,892
1998	155	143	1,085	677	26	2,100	5,707
1999	218	143	1,157	701	21	2,347	6,192
2000	270	146	1,276	789	22	2,384	6,510

F. Republic of Korea

(unit: million won)

Year	Exploration and development of earth	Infrastructure and basic plan for land use	Control and protection of environment	Protection and improvement of human health	Production/suppl y/rational use of energy	Agricultural production/techn ology	Industrial production/techn ology
1999	52,890	99,277	107,181	161,760	184,779	295,641	744,404
2000	55,191	150,146	140,767	245,499	188,533	342,397	910,300

(unit: million won)

Year	Social structure/relations hip	Space exploration/devel opment	Research financed by general university funds	Research with no derection	Other research for the public	Defense	Total
1999	94,331	69,722	—	—	—	733,751	3,274,013
2000	112,689	90,986	—	—	—	770,239	3,749,497

Note: a: The data lack continuity with the data until the previous year.
b: OECD estimates/calculations based on the data of each country.
c: Government estimates or estimates modified as necessary to comply with OECD standards.
g: Excludes R&D expenditure for human/social science.
h: Federal central government only.
i: Excludes a part of general expenditure for higher education, in which education is inseparable from research.
j: Excludes most of or all capital expenditure.
m: Undervalued or based on undervalued data.
s: Each data item is not amended and is excluded from the revised total figures.
p: Provisional figure
Adding up these figures will not make a total figure for Republic of Korea, as it has unclassified categories.
Source: OECD, “Basic Science and Technology Statistics 2002/2”

Table 9-1-6: Trends in the growth rate of Japan’s science and technology budget

(unit: million yen)

FY	Total science and technology budget		General accounts of the left		General expenditure	
	Amount	Growth ratio over the previous year (%)	Amount	Growth ratio over the previous year (%)	Amount	Growth ratio over the previous year (%)
1987	1,662,336	-	799,543	-	32,583,000	-
1988	1,715,746	3.2	822,463	2.9	32,982,107	1.2
1989	1,815,199	5.8	862,451	4.9	34,080,487	3.3
1990	1,920,871	5.8	903,831	4.8	35,373,115	3.8
1991	2,022,631	5.3	953,933	5.5	37,036,529	4.7
1992	2,134,676	5.5	1,011,009	6.0	38,698,811	4.5
1993	2,266,265	6.2	1,076,370	6.5	39,916,800	3.1
1994	2,358,474	4.1	1,130,331	5.0	40,854,842	2.3
1995	2,499,549	6.0	1,209,075	7.0	42,141,740	3.1
1996	2,810,452	12.4	1,342,019	11.0	43,140,901	2.4
1997	3,002,611	6.8	1,481,073	10.4	43,806,700	1.5
1998	3,032,179	1.0	1,500,309	1.3	44,536,213	1.7
1999	3,156,728	4.1	1,594,754	6.3	48,687,800	9.3
2000	3,285,987	4.1	1,724,816	8.2	48,091,352	-1.2
2001	3,468,512	5.6	1,837,570	6.5	48,658,880	1.2
2002	3,544,427	2.2	1,852,905	0.8	47,547,206	-2.3
2003	3,597,366	1.5	1,885,191	1.7	47,592,209	0.1

Note: 1) Initial budget amount for each year.
2) The scope of expenditure was redefined in 1996 and in 2001 following the establishment of ‘Basic Program for Science and Technology (1st and 2nd phase).’
Source: Ministry of Education, Culture, Sports, Science and Technology, ‘Science and Technology Manual’

Table 9-1-7: Trends in the S&T budget under the Basic Plan for Science and Technology

Government S&T expenditure during the 1st phase of Basic Program for Science and Technology

(unit: 100 million yen)

FY	Initial budget	Supplementary budget				Total	Competitive funds	
		Primary supplementary budget	Secondary supplementary budget	Tertiary supplementary budget	Reserve funds for public work, etc.	Amount (100 million yen)	Amount (100 million yen)	Ratio (%)
1996	28,105	1,555	-	-	-	29,660	1,699	5.7
1997	30,026	-	-	-	-	30,026	2,158	7.2
1998	30,322	6,202	-	5,112	-	41,636	2,324	5.6
1999	31,567	1	5,880	-	157	37,605	2,614	6.9
2000	32,860	4,480	-	-	196	37,536	2,938	7.8

Government S&T expenditure during the 2nd phase Basic Program for Science and Technology (unit: 100 million yen)

FY	Initial budget	Supplementary budget				Total	Competitive funds	
		Primary supplementary budget	Secondary supplementary budget	Tertiary supplementary budget	Reserve funds for public work, etc.	Amount (100 million yen)	Amount (100 million yen)	Ratio (%)
2001	34,685	701	5,380	-	-	40,766	3,265	8.0
2002	35,444	3,238	-	-	-	38,682	3,443	8.9

Note: Supplementary budget includes only additional amount.

Source: Data from Ministry of Education, Culture, Sports, Science and Technology.

Table 9-1-8: Breakdown of the S&T budget (FY2003)

	Budget (million yen)	Ratio (%)
S&T budget out of general account	1,885,191	52.4
Outlays for promoting science and technology	1,229,782	34.2
Other R&D expenditure	655,409	18.2
S&T budget out of special accout	1,712,175	47.6
Special account for national schools	1,068,221	29.7
Other special accounts	643,954	17.9
Total S&T budget	3,597,366	100.0

Source: Data from Ministry of Education, Culture, Sports, Science and Technology.

Table 9-1-9: Trends in the S&T budget by government ministry/agency

(unit: million yen)

agencies (at te time)	FY 1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Congress	533	533	533	536	547	549	560	564	592	611
Science Council of J	867	951	1,051	1,042	1,096	1,201	1,123	1,177	1,350	1,306
National Police Age	1,020	1,055	1,143	1,209	1,305	1,358	1,435	1,439	1,516	2,147
Hokkaido Developm	147	149	148	150	158	164	164	169	211	220
Defense Agency	93,068	104,268	115,045	126,989	137,175	140,788	154,499	165,279	175,340	144,176
Economic Planning	764	809	850	930	965	986	991	1,008	1,065	1,032
Science and Techno	466,623	494,775	552,561	551,778	581,577	605,238	646,120	692,800	734,486	740,132
Environment Agency	7,882	9,217	10,900	11,847	12,597	13,427	14,733	17,017	17,985	19,575
Naional Land Agenc	-	-	-	-	-	-	-	379	473	696
Ministry of Justice	871	939	1,006	1,006	1,141	1,353	1,433	1,437	2,014	2,062
Ministry of Foreign A	6,408	7,059	8,160	8,251	9,533	9,467	10,866	12,080	12,987	12,432
Ministry of Finance	1,087	1,087	1,193	1,434	1,542	2,652	2,526	1,859	2,170	2,405
Ministry of Educatio	854,322	894,301	936,324	992,108	1,046,345	1,100,356	1,157,384	1,241,241	1,288,963	1,311,084
Ministry of Health ar	48,370	51,242	56,144	61,338	64,343	69,891	70,813	75,146	91,512	95,120
Ministry of Agricultu	68,037	70,108	73,557	76,177	81,030	82,660	85,418	94,944	100,894	104,501
Ministry of Internatio	233,649	251,548	255,913	259,223	280,712	283,653	302,553	421,349	472,214	492,782
Ministry of Transpor	16,303	17,402	20,514	22,515	24,220	22,932	21,862	23,147	23,120	23,051
Ministry of Posts and	30,447	30,657	33,904	32,733	34,971	34,966	39,536	47,198	57,677	60,547
Ministry of Labor	4,557	4,190	5,046	3,787	4,340	4,085	4,529	3,744	4,338	3,888
Ministry of Construc	5,689	5,979	6,624	6,936	8,010	8,055	8,276	33,716	38,933	39,547
Ministry of Home Aff	555	565	616	631	658	692	727	758	771	866
Total	1,815,199	1,920,871	2,022,631	2,134,676	2,266,265	2,358,474	2,499,549	2,810,452	3,002,611	3,032,179

(unit: million yen)

Ministries and agencies	FY 1999	2000
Congress	887	836
Capbinet Secretariat	1,374	50,644
Prime Minister's Office	-	1,079
Science Council of Japan	1,326	1,257
National Police Agency	2,200	1,896
Hokkaido Development Agency	227	389
Defense Agency	146,529	92,664
Economic Planning Agency	1,055	3,670
Science and Technology Agency	773,837	770,277
Environment Agency	23,467	26,597
Okinawa Development Agency	-	50
National Land Agency	855	1,672
Ministry of Justice	2,094	2,068
Ministry of Foreign Affairs	13,742	11,331
Ministry of Finance	2,342	2,333
Ministry of Education	1,348,729	1,369,618
Ministry of Health and Welfare	101,716	109,532
Ministry of Agriculture, forestry and Fisheries	109,176	115,152
Ministry of International Trade and Industry	508,272	508,954
Ministry of Transport	23,844	21,871
Ministry of Posts and Telecommunications	74,375	82,039
Ministry of Labor	4,378	4,234
Ministry of Constrction	41,277	41,622
Ministry of Home Affiars	1,026	2,866
Cabinet Office		980
Naitonal Police Agenyc		359
Defense Agency		43,417
Ministry of Public Management, Home Affairs, Posts and Telecommunications		1,582
Ministry of Finance		147
Ministry of Educaion, Culture, Sports, Science and Technology		13,108
Ministry of Health, Labor and Welfare		3,080
Ministry of Economy, Trade and Industry		20,006
Ministry of Land, Infrastructure and Transport		5,532
Ministry of the Evnironment		1,127
Total	3,156,728	3,285,987

Ministries and agencies	FY 2001	2002	2003
Congress	772	875	988
Cabinet Secretariat	77,333	67,678	64,440
Cabinet Office	7,029	7,082	8,448
National Police Agency	2,328	2,271	2,230
Defense Agency	148,988	143,478	160,812
Ministry of Public Management, Home Affairs, Posts and Telecommunications	84,527	77,593	80,061
Ministry of Justice	2,340	2,207	2,178
Ministry of Foreign Affairs	11,153	9,989	10,403
Ministry of Finance	3,502	3,238	1,650
Ministry of Education, Culture, Sports, Science and Technology	2,212,062	2,265,813	2,290,193
Ministry of Health, Labor and Welfare	123,894	128,052	133,994
Ministry of Agriculture, Forestry and Fisheries	122,517	122,442	118777
Ministry of Economy, Trade and Insustry	561,284	601,042	611,296
Ministry of Land, Infrastructure and Transport	81,351	82,062	80,659
Ministry of the Environment	29,433	30,606	31,236
Total	3,468,512	3,544,427	3,597,366

Note: 1) Initial budget for each year.

2) The budget for the Japan Key Technology Center is redundantly reported at the Ministry of International Trade and Industry, and the Ministry of Posts and Telecommunications (however, accounting is made to avoid overlaps).

3) S&T budget is compiled by the Ministry of Education, Culture, Sports, Science and Technology, based on data collected from each ministry and agencies .

4) The S&T budget spent on government-affiliated firms out of the industrial investment special account, which is handled by the Ministry of Finance, is earmarked at each presiding office and the ministries of each government-affiliated firm. However, the Bio-oriented Technology Research Advancement Institution, under the cojurisdiction of the Ministry of Finance and the Ministry of Agriculture, Forestry, and Fisheries, is earmarked at the Ministry of Agriculture, Forestry, and Fisheries.

5) The integrated value of each column and total value may not be consistent because of rounding-off.

Source: Ministry of Education, Culture, Sports, Science and Technology, 'Science and Technology Manual,' and data from Ministry of Education, Culture, Sports, Science and Technology

Table 9-1-10: S&T budgets of ministries and local governments (FY2002)

(A) By ministries and agencies (2003)

Bt ministries and agencies	Budget (million yen)	Share (%)
Ministry of Educaiton, Culture, Sports, Science and Technology	2,290,193	63.7%
Ministry of Economy, Trade and Industry	611,296	17.0%
Defense Agency	160,812	4.5%
Ministry of Health, Labor and Welfare	133,994	3.7%
Ministry of Agriculture, Forestry and Fisheries	118,777	3.3%
Others	282,293	7.8%
Total	3,597,366	100.0%

(B) Comparison with local governments (2002)

By ministries and agencies	Budget (1 million yen)
Ministry of Educaiton, Culture, Sports, Science and Technology	2,265,813
Ministry of Economy, Trade and Industry	601,042
Defense Agency	143,478
Ministry of Health, Labor and Welfare	128,052
Ministry of Agriculture, Forestry and Fisheries	122,442
Ministry of Land, Infrastructure and Transport	82,062
Ministry of Public Management, Home Affairs, Posts and Telecommunicaitons	77,593
Cabinet Secretariat	67,678
Ministry of the Environment	30,606
Ministry of Foreign Affairs	9,989
Cabinet Office	7,082
Ministry of Finance	3,238
National Police Agency	2,271
Ministry of Justice	2,207
Congress	875
47 prefectural and city governments	417,306
12 major cities	95,418

Note: 1) Initial budget amount.

2) Local government budget does not include national treasury disbursement.

Source: Data from Ministry of Education, Culture, Sports, Science and Technology. Japan Association for the Advancement of Research Cooperation, 'Field survey of science and technology advancement in the region'

Table 9-2-1: Trends in R&D expenditure by government research institutes in selected countries

(A) National currencies

Year	Japan (million yen)	U.S. (million dollars)	Germany (million euros)	France (million euros)	U.K. (million pounds)	China (million yuan)	Republic of Korea (million won)	EU (million dollars)
1970	147,525	4,154	-	-	-	-	-	-
1971	190,586	4,409	-	-	-	-	-	-
1972	242,836	4,676	-	-	-	-	-	-
1973	307,659	4,837	-	-	-	-	-	-
1974	325,158	5,132	-	-	-	-	-	-
1975	364,005	5,561	-	-	-	-	-	-
1976	402,536	5,890	-	-	-	-	-	-
1977	440,691	6,211	-	-	-	-	-	-
1978	502,957	6,962	-	-	-	-	-	-
1979	565,787	7,471	-	-	-	-	-	-
1980	618,378	7,831	-	-	-	-	-	-
1981	661,397	8,605	2,712	2,247	1,243	-	-	9,761 b
1982	673,082	9,501	2,792 c	2,874		-	-	-
1983	691,359	10,830	2,998	3,411	1,357	-	-	11,514 b
1984	725,685	11,916	3,099 c	3,889		-	-	-
1985	810,759	13,093	3,381	4,080	1,457	-	-	13,317 b
1986	840,223	13,504	3,561 c	4,372	1,212 a	-	-	13,378 a,b
1987	943,179	13,588	3,872	4,668	1,264	-	-	14,446 b
1988	935,255	14,342	3,988 c	4,962	1,360	-	-	15,431 b
1989	953,755	15,231	4,376	5,234	1,534	-	-	16,740 b
1990	976,867	15,671	4,538 c	5,794	1,566	-	-	18,003 b
1991	1,047,096	15,249	5,457 a	5,632	1,757 a	7,902	-	19,479 a,b
1992	1,160,101	15,853	5,500 a	5,400 a	1,846	9,161	-	19,797 a,b
1993	1,278,640	16,531	5,875 o	5,594	1,928	11,133	-	19,942 b
1994	1,226,426	16,355	5,932 o	5,521	2,051	12,884	-	20,239 b
1995	1,390,132	16,904	6,266 o	5,731	2,044	14,664	1,600,948 g	21,146 b
1996	1,328,535	16,585	6,305 o	5,642	2,070	17,313	1,763,967 g	21,167 b
1997	1,306,976	16,819	6,272 o	5,181 a	2,018	20,668	1,922,476 g	21,327 b
1998	1,402,914	17,362	6,547 o	5,279	2,079	23,453	1,979,219 g	22,288 b
1999	1,481,731	17,851	6,632 o	5,357	2,072	26,120	1,722,897 g	22,846 b
2000	1,513,633	17,469	6,873	5,361 a	2,134	28,188 v	1,843,876 g	23,698 b
2001	1,482,024	19,130 pr	6,923 c	5,704 p	1,829	31,007	1,991,268 g	24,492 b,p
2002	1,483,211	21,566 pr	-	-	-	-	-	-

(B) OECD Purchasing power parity equivalents

Year	Japan (million yen)	U.S. (million yen)	Germany (million yen)	France (million yen)	U.K. (million yen)	China (million yen)	Republic of Korea (million yen)	EU (million yen)
1970	147,525	1,022,092	-	-	-	-	-	-
1971	190,586	1,079,552	-	-	-	-	-	-
1972	242,836	1,155,262	-	-	-	-	-	-
1973	307,659	1,266,926	-	-	-	-	-	-
1974	325,158	1,496,183	-	-	-	-	-	-
1975	364,005	1,590,858	-	-	-	-	-	-
1976	402,536	1,708,336	-	-	-	-	-	-
1977	440,691	1,799,376	-	-	-	-	-	-
1978	502,957	1,960,854	-	-	-	-	-	-
1979	565,787	1,985,680	-	-	-	-	-	-
1980	618,378	2,003,898	-	-	-	-	-	-
1981	661,397	2,077,723	532,450	624,394	570,154	-	-	2,356,942 b
1982	673,082	2,201,127	535,843 c	725,180	-	-	-	-
1983	691,359	2,443,777	568,989	798,931	567,994	-	-	2,598,120 b
1984	725,685	2,638,111	591,927 c	869,949	-	-	-	-
1985	810,759	2,859,471	646,772	880,861	578,028	-	-	2,908,370 b
1986	840,223	2,929,095	674,683 c	911,488	474,188 a	-	-	2,901,786 a,b
1987	943,179	2,855,706	722,227	946,310	471,507	-	-	3,035,942 b
1988	935,255	2,922,832	738,265 c	982,278	481,601	-	-	3,144,745 b
1989	953,755	3,033,589	809,188	1,022,715	517,409	-	-	3,334,099 b
1990	976,867	3,060,546	830,098 c	1,122,257	507,786	-	-	3,515,927 b
1991	1,047,096	2,943,977	983,854 a	1,095,065	533,932 a	1,251,282	-	3,760,660 a,b
1992	1,160,101	2,982,916	979,784 a	1,038,489 a	564,177	1,361,781	-	3,725,023 a,b
1993	1,278,640	3,046,772	1,007,001 o	1,028,956	557,663	1,444,379	-	3,675,424 b
1994	1,226,426	2,953,533	1,012,866 o	987,825	573,978	1,393,155	-	3,654,905 b
1995	1,390,132	2,872,698	1,033,206 o	988,897	531,163	1,382,080	372,439 g	3,593,540 b
1996	1,328,535	2,746,726	1,007,351 o	932,605	532,257	1,514,203	392,450 g	3,505,625 b
1997	1,306,976	2,741,692	1,029,458 o	834,419 a	522,440	1,754,386	416,152 g	3,476,581 b
1998	1,402,914	2,910,925	1,106,175 o	842,027	539,223	2,092,235	424,648 g	3,736,822 b
1999	1,481,731	2,892,499	1,099,178 o	815,193	516,098	2,354,981	369,815 g	3,701,868 b
2000	1,513,633	2,717,280	1,131,411	885,683 a	514,415	2,461,629 v	392,933 g	3,686,193 b
2001	1,482,024	2,865,179 pr	1,084,981 c	930,623 p	427,625	2,665,315	411,931 g	3,668,192 b,p
2002	1,483,211	3,162,352 pr	-	-	-	-	-	-

Note: Pr.: Preliminary figure.
a: The data lack continuity with the data until the previous year.
b: OECD estimates/calculations based on data of each country.
c: Government estimates are modified as necessary to comply with OECD standards.
m: Undervalued or based on undervalued data.
p: Provisional figure.
v: Adding up these figures does not make the total.
1) R&D expenditure includes human/social science.
2) The figures for Japan include the software industry since 1996.
3) Former federal district before 1990, and Germany after 1991.
Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications,
'Report on the Survey of Research and Development'
<U.S.>NSF, "National Patterns of R&D Resources 2002 Data Update"
<Germany, France, U.K., Republic of Korea>OECD, "Basic Science and Technology Statistics 2002/2"
ONS, "Gross domestic expenditure on Research and Development 2001" for U.K. in 2001.
<China, EU>OECD, "Main Science and Technology Indicators 2003/1"

Table 9-2-2: Trends in R&D expenditure by Japan's government research institutes

FY	R&D expenditure (million yen)			
	National	Public	Government-affiliated firms/independent administrative agencies	Total
1970	54,562	57,481	35,482	147,525
1971	61,362	67,648	61,575	190,586
1972	71,736	76,303	94,797	242,836
1973	86,959	95,527	125,174	307,659
1974	108,784	115,215	101,158	325,158
1975	124,132	118,750	121,124	364,005
1976	130,195	124,922	147,420	402,536
1977	148,171	139,287	153,232	440,691
1978	164,070	145,281	193,606	502,957
1979	186,925	159,938	218,924	565,787
1980	194,293	177,176	246,908	618,378
1981	201,256	191,162	268,979	661,397
1982	203,343	189,702	280,038	673,082
1983	208,767	191,567	291,025	691,359
1984	215,853	199,622	310,209	725,685
1985	235,950	206,935	367,874	810,759
1986	244,828	209,212	386,183	840,223
1987	308,246	215,583	419,348	943,179
1988	272,506	223,677	439,072	935,255
1989	284,261	240,902	428,592	953,755
1990	318,959	270,303	387,605	976,867
1991	321,988	282,730	442,378	1,047,096
1992	373,004	288,631	498,466	1,160,101
1993	422,193	300,054	556,394	1,278,640
1994	404,172	300,515	521,740	1,226,426
1995	484,917	291,893	613,322	1,390,132
1996	447,366	288,807	592,361	1,328,535
1997	474,120	279,099	553,757	1,306,976
1998	474,238	291,222	637,454	1,402,914
1999	488,781	286,482	706,468	1,481,731
2000	499,508	273,139	740,986	1,513,633
2001	214,302	260,076	1,007,645	1,482,024
2002	202,161	249,788	1,031,261	1,483,211

Note: Until 2000, the figures for 'government-affiliated firms/independent administrative agencies' include figures for 'government-affiliated firms' only.
As part of the government reorganization in 2001, some of the national research institutes became independent administrative agencies.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 9-2-3: Trends in R&D expenditure per researcher in Japan's government research institutes

	R&D expenditure/number of researchers (million yen)							
Year	National	National (FTE)	Public	Public (FTE)	Government-affiliated firms/ independent administrative agencies	Government-affiliated firms/ independent administrative agencies (FTE)	Total	Total (FTE)
1970	5.9	-	4.8	-	24.6	-	7.3	-
1971	6.3	-	5.5	-	41.8	-	9.1	-
1972	7.4	-	5.7	-	54.6	-	10.8	-
1973	8.9	-	6.8	-	46.1	-	12.8	-
1974	11.2	-	7.6	-	28.2	-	14.4	-
1975	12.6	-	8.1	-	60.3	-	17.0	-
1976	13.2	-	8.5	-	69.8	-	18.8	-
1977	14.9	-	9.4	-	73.6	-	19.8	-
1978	16.0	-	9.8	-	90.0	-	22.2	-
1979	18.2	-	10.8	-	97.3	-	24.2	-
1980	18.6	-	11.7	-	102.7	-	27.2	-
1981	18.8	-	12.3	-	103.9	-	31.5	-
1982	19.0	-	12.1	-	105.6	-	32.7	-
1983	19.3	-	12.5	-	105.2	-	33.7	-
1984	20.0	-	13.1	-	115.0	-	35.9	-
1985	22.2	-	13.4	-	135.6	-	40.3	-
1986	22.7	-	13.6	-	138.9	-	42.9	-
1987	28.8	-	14.1	-	143.7	-	47.9	-
1988	25.3	-	14.9	-	139.9	-	48.2	-
1989	26.1	-	15.8	-	135.0	-	49.6	-
1990	29.4	-	17.9	-	115.2	-	51.6	-
1991	29.6	-	18.7	-	125.9	-	54.9	-
1992	34.1	-	19.2	-	137.6	-	59.9	-
1993	38.0	-	19.9	-	148.4	-	63.5	-
1994	36.1	-	20.2	-	136.0	-	62.3	-
1995	43.2	-	19.5	-	150.2	-	67.1	-
1996	39.8	-	19.3	-	142.2	-	66.2	-
1997	41.7	-	19.0	-	132.7	-	66.9	-
1998	41.6	-	20.3	-	143.2	-	70.1	-
1999	42.6	-	19.7	-	145.3	-	70.2	-
2000	43.9	-	18.6	-	150.1	-	71.7	-
2001	57.2	61.7	17.7	17.5	91.8	65.3	59.0	54.6
2002	60.7	61.9	16.2	17.2	61.5	63.9	51.2	43.8

Note: 1) As part of the government reorganization in 2001, some of the national research institutes became independent administrative agencies.

2)The calculation method for R&D expenditure per researcher before 2000 and after 2001 is different, as the contents and period of 'Survey of Research and Development' conducted by the Statistics Bureau, and the Ministry of Public Management, Home Affairs, Posts and Telecommunications was changed in 2002 (targeting 2001). Until 2000, R&D expenditure per researcher was calculated by dividing R&D expenditure for the reference year by the number of full-time researchers as of the 1st day of April, the start of the fiscal year, and after 2001, divided by the number of researchers as of 31st day of March, the end of the fiscal year.

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 9-2-4: Trends in the number of researchers in government research institutes for selected countries

(unit: persons)

Year	Japan (HC)	Japan (FTE)	U.S.	Germany	France	U.K.	China	Republic of Korea	EU
1981	28,792	—	59,200 h	17,771	15,700	20,000	—	—	78,037 b
1982	29,011	—	60,000 h	-	18,358	20,000	—	—	—
1983	28,831	—	61,300 h	18,601	19,127	20,000	—	—	84,943 b
1984	28,761	—	62,100 h	-	20,135	19,000	—	—	—
1985	28,818	—	52,100	19,223	21,215	19,000	—	—	89,595 b
1986	28,890	—	51,600	-	21,723	15,000 a	—	—	—
1987	28,909	—	54,300	20,574	22,200	15,000	—	—	92,141 b
1988	28,909	—	54,200	-	23,229	15,000	—	—	—
1989	29,288	—	58,800	23,076	24,249	15,000	—	—	100,805 b
1990	29,322	—	59,400	-	24,922	15,000	—	—	—
1991	29,516	—	58,300	37,371	25,949	15,000 a	200,700	—	119,780 a,b
1992	29,603	—	61,800	34,800	25,499 a	15,000 a	208,000	—	115,901 a,b
1993	29,894	—	60,000	34,011	25,720	14,000 a	194,000	—	115,906 a,b
1994	29,907	—	—	35,383	26,403	14,000	194,700	—	119,437 b
1995	30,263	—	53,900	37,324	27,195	13,673	184,900	12,711 g	123,862 b
1996	30,346	—	52,100	37,687	27,803	13,021	179,800	12,322 g	124,885 b
1997	30,241	—	49,800	37,402	24,249 a,d	12,496	193,100	12,323 g	122,245 a,b
1998	30,212	—	48,400	38,210	24,216 d	14,368	162,200	10,098 g	126,399 b
1999	30,910	—	47,700	37,846	25,187 d	14,980	166,800	11,745 g	129,114 b
2000	30,987	—	—	37,567 c,o	26,132 a,d	14,978	193,353	11,564 g	129,519 b,p
2001	31,228	—	—	37,300 c,o	—	9,987 a	186,600	12,040 g	—
2002	35,992	33,750	—	—	—	—	—	—	—
2003	36,052	33,891	—	—	—	—	—	—	—

Note: a: The data lack continuity with the data until the previous year.
b: OECD estimates/calculations based on data of each country.
c: Government estimates are modified as necessary to comply with OECD standards.
d: Excludes defense-related .
g: Excludes R&D for social science and human science.
o: Includes other classes.
p: Provisional figure
<Japan>1) Japan started to include software industry from 1997.　The figures for 2002 are as of March 31, 2002.
<U.S.>Federal government only.
<Germany>Former federal district before 1990, and Germany after 1991.
Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'
<U.S.>NSF, "National Patterns of R&D Resources 2002 data update"
During 1981-1984, OECD, "Main Science and Technology Indicators 2003/01"
For 1985 and 1986, NSF, "National Patterns of R&D Resources 1996"
<Germany, France, U.K., China, Republic of Korea, EU>OECD, "Main Science and Technology Indicators 2003/01"

Table 9-2-5: Trends in the number of researchers in Japan's government research institutes

Year	Number of researchers (persons)							
	Naitonal	National (FTE)	Public	Public (FTE)	Government-affiliated firms/independent administrative agencies	Government-affiliated firms/independent administrative agencies (FTE)	Total	Total (FTE)
1961	7,506	-	6,710	-	710	-	14,926	-
1962	7,838	-	7,749	-	730	-	16,317	-
1963	8,275	-	8,787	-	783	-	17,845	-
1964	8,383	-	8,933	-	841	-	18,157	-
1965	8,878	-	9,687	-	933	-	19,498	-
1966	8,896	-	10,045	-	838	-	19,779	-
1967	9,127	-	10,645	-	1,119	-	20,891	-
1968	9,174	-	11,171	-	1,193	-	21,538	-
1969	9,353	-	11,467	-	1,350	-	22,170	-
1970	9,308	-	11,951	-	1,441	-	22,700	-
1971	9,668	-	12,282	-	1,474	-	23,424	-
1972	9,701	-	13,424	-	1,737	-	24,862	-
1973	9,800	-	14,116	-	2,714	-	26,630	-
1974	9,730	-	15,099	-	3,585	-	28,414	-
1975	9,817	-	14,581	-	2,010	-	26,408	-
1976	9,897	-	14,762	-	2,113	-	26,772	-
1977	9,948	-	14,743	-	2,082	-	26,773	-
1978	10,262	-	14,835	-	2,151	-	27,248	-
1979	10,281	-	14,785	-	2,249	-	27,315	-
1980	10,465	-	15,204	-	2,404	-	28,073	-
1981	10,706	-	15,497	-	2,589	-	28,792	-
1982	10,704	-	15,655	-	2,652	-	29,011	-
1983	10,795	-	15,269	-	2,767	-	28,831	-
1984	10,777	-	15,287	-	2,697	-	28,761	-
1985	10,641	-	15,464	-	2,713	-	28,818	-
1986	10,770	-	15,340	-	2,780	-	28,890	-
1987	10,697	-	15,294	-	2,918	-	28,909	-
1988	10,766	-	15,004	-	3,139	-	28,909	-
1989	10,899	-	15,215	-	3,174	-	29,288	-
1990	10,864	-	15,094	-	3,364	-	29,322	-
1991	10,895	-	15,107	-	3,514	-	29,516	-
1992	10,943	-	15,037	-	3,623	-	29,603	-
1993	11,096	-	15,048	-	3,750	-	29,894	-
1994	11,210	-	14,862	-	3,835	-	29,907	-
1995	11,223	-	14,957	-	4,083	-	30,263	-
1996	11,243	-	14,936	-	4,167	-	30,346	-
1997	11,370	-	14,698	-	4,173	-	30,241	-
1998	11,412	-	14,347	-	4,453	-	30,212	-
1999	11,471	-	14,576	-	4,863	-	30,910	-
2000	11,373	-	14,678	-	4,936	-	30,987	-
2001	11,463	-	14,661	-	5,104	-	31,228	-
2002	3,747	3,473	16,102	14,853	16,143	15,424	35,992	33,750
2003	3,311	3,264	15,972	14,492	16,769	16,135	36,052	33,891

Note: 1)Until 2001, the figures for 'Government-affiliated firms/independent administrative agencies ' are for 'Government-affiliated firms' only.

2) After 2001, some of the national research institutes became independent administrative agencies.

3) As the contents and period of statistics survey were changed, the number of full-time researchers as of the 1st day of April until 2000 was used, and after 2001, the number of researchers as of the 31st day of March was used.

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 9-2-6: Trends in the number of researchers in Japan's government research institutes by field of research

(unit: persons)

Year	Human/ social science	Naatural science				
		Science				
	Total	Math/Physics	Chemistry	Biology	Other science	Total
1981	987	1,543	3,245	472	644	5,904
1982	982	1,532	3,258	483	741	6,014
1983	888	1,614	3,248	494	491	5,847
1984	985	1,650	3,173	470	689	5,982
1985	965	1,555	3,081	501	702	5,839
1986	983	1,678	3,086	464	571	5,799
1987	947	1,658	3,092	508	529	5,787
1988	937	1,668	2,991	523	559	5,741
1989	1,024	1,642	3,078	506	571	5,797
1990	1,018	1,685	3,077	618	550	5,930
1991	993	1,694	3,021	642	565	5,922
1992	1,010	1,750	3,134	673	562	6,119
1993	975	1,760	3,132	665	535	6,092
1994	903	1,786	3,126	695	553	6,160
1995	901	1,737	3,120	709	547	6,113
1996	848	1,895	3,277	735	565	6,472
1997	856	1,787	3,221	854	576	6,438
1998	837	1,727	3,181	1,046	581	6,535
1999	855	1,828	3,140	1,086	622	6,676
2000	893	1,864	3,260	1,093	588	6,805
2001	944	1,858	3,407	1,014	666	6,945
2002	944	2,044	3,586	1,558	1,035	8,223
2003	963	2,325	3,706	1,737	1,085	8,853

(unit: persons)

Year	Natural science							Natural science	Others	
	Engineering					Agriculture	Health science			
	Machinery/ marine essels/ aviation	Electricity/ communications	Civil engineering/ construction	Other engineering	Total	Total	Total	Total	Total	Grand total
1981	2,188	1,640	547	2,918	7,293	11,497	1,788	26,482	1,323	28,792
1982	2,144	1,637	556	2,755	7,092	11,789	1,866	26,761	1,268	29,011
1983	2,040	1,565	556	2,743	6,904	11,586	1,761	26,116	1,087	28,073
1984	2,139	1,698	621	2,707	7,165	11,653	1,852	26,652	1,215	28,761
1985	2,140	1,745	670	2,744	7,299	11,678	1,827	26,643	1,210	28,818
1986	2,189	1,754	673	2,861	7,477	11,634	1,822	26,732	1,175	28,890
1987	2,286	1,757	661	3,010	7,714	11,444	1,785	26,730	1,232	28,909
1988	2,253	1,830	647	3,062	7,792	11,381	1,904	26,818	1,154	28,909
1989	2,316	1,934	699	2,935	7,884	11,356	1,938	26,975	1,289	29,288
1990	2,394	2,031	693	2,771	7,889	11,351	2,009	27,179	1,125	29,322
1991	2,473	2,098	710	2,806	8,087	11,386	2,015	27,410	1,113	29,516
1992	2,556	2,018	702	2,762	8,038	11,433	1,927	27,517	1,076	29,603
1993	2,724	1,816	745	2,949	8,234	11,492	1,986	27,804	1,115	29,894
1994	2,696	1,847	793	2,971	8,307	11,480	1,919	27,866	1,138	29,907
1995	2,761	1,861	782	3,036	8,440	11,666	1,932	28,151	1,211	30,263
1996	2,524	2,059	793	2,823	8,199	11,583	1,994	28,248	1,250	30,346
1997	2,535	2,037	811	2,927	8,310	11,442	1,902	28,092	1,293	30,241
1998	2,589	2,044	810	3,046	8,489	11,529	1,886	28,439	936	30,212
1999	2,624	2,093	825	3,266	8,808	11,542	1,949	28,975	1,080	30,910
2000	2,573	2,065	733	3,085	8,456	11,639	2,192	29,092	1,002	30,987
2001	2,381	1,983	738	3,327	8,429	11,543	2,274	29,191	1,093	31,228
2002	2,629	2,229	828	3,974	9,660	12,519	3,078	33,480	1,568	35,992
2003	2,697	2,176	885	3,884	9,642	11,910	3,120	33,525	1,564	36,052

Note: The number of researchers is the actual number.

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 10-1-1: Trends in R&D expenditure by the university sector as a percentage of the total for selected countries

(unit: %)

FY	Japan	U.S.	Germany	France	U.K.	China	Republic of Kor	EU
1970	27.0	12.0	−	−	−	−	−	−
1971	27.6	12.2	−	−	−	−	−	−
1972	26.7	12.3	−	−	−	−	−	−
1973	25.9	12.3	−	−	−	−	−	−
1974	26.4	12.4	−	−	−	−	−	−
1975	28.2	13.0	−	−	−	−	−	−
1976	28.1	13.1	−	−	−	−	−	−
1977	27.7	13.6	−	−	−	−	−	−
1978	28.5	14.0	−	−	−	−	−	−
1979	27.5	14.1	−	−	−	−	−	−
1980	25.5	13.9	−	−	−	−	−	−
1981	24.2	13.2	17.1	16.4 a	13.6 a	−	−	17.8 a,b
1982	23.6	12.6	16.2 c	15.9	−	−	−	—
1983	23.0	12.4	15.8	15.8	14.3	−	−	17.6 b
1984	21.8	12.2	15.6 c	15.4	−	−	−	−
1985	20.1	12.2	14.6	15.0	14.7 a	−	−	16.9 a,b
1986	19.9	13.0	14.6 c	15.0	14.9	−	−	17.0 b
1987	19.9	13.6	14.4	15.0	15.8	−	−	17.2 b
1988	19.0	14.1	14.4 c	14.8	15.7	−	−	17.2 b
1989	18.0	14.4	14.2	14.9	15.3	−	−	17.3 b
1990	17.6	14.4	14.6 c	14.6	15.6	−	−	17.8 b
1991	17.5	14.5	16.2 a	15.1	16.7	8.6		18.7 a,b
1992	18.5	14.9	17.0 c	15.3	17.2	9.7		19.5 a,b
1993	20.1	15.6	17.5 o	15.8	17.5	11.2		20.2 b
1994	20.2	15.9	18.0	16.2	19.2	12.6		20.6 b
1995	20.7	15.2	18.1	16.7	19.2	12.1	8.2 g	20.8 a,b
1996	20.0	14.8	18.5	16.8	19.5	11.8	9.4 g	21.0 b
1997	19.4	14.3	17.9	17.4 a	19.7	11.3	10.4 g	21.4 b
1998	20.0	14.0	17.4	17.6	19.7	10.4	11.2 g	21.3 b
1999	20.0	13.9	16.5	17.2	19.6	9.4	12.0 g	20.9 b
2000	19.7	13.9	16.1	18.8 a	20.8	8.6	11.3 g	21.2 b,p
2001	19.6	14.2 pr	15.8 c	18.5 p	21.4	9.8	—	—
2002	19.7	14.9 pr	—	−	—	—	—	—

Note: Same as Table 6-1-1 and Table 6-1-7.

Pr: Preliminary figure.

a: The data lack continuity with the data until the previous year.

b: OECD estimates/calculations based on data of each country.

c: Government estimates or modified as necessary to comply with OECD standards.

m: Undervalued or based on undervalued data.

Source: Same as Table 6-1-1 and Table 6-1-7.

Table 10-1-2: Breakdown of hours worked by university teaching staff by type of activity (yearly average for FY2002)

(unit: %)

Hours for research activity	Hours for educational acitivity	Hours for social services/ social contribution			Hours for other acitivities	
		Social services/ social contribution related to research	Social services/ social contribution related to education	Other social services/ social contribution	Administrative work for the school at which they teach full time	Other activities related to their duties
46.5	23.7	3.4	2.8	3.6	11.6	8.3

Note: The indicators are a compilation of values of self-enumeration by respondents to a questionnaire survey (sample survey) for university faculties.
Source: Science and Technology-Academic Policy Bureau, Ministry of Education, Culture, Sports, Science and Technology, "Report on Survey for FTE data of Researchers in Universities and Colleges. (FY2002)"

Table 10-1-3: Breakdown of hours worked by university teaching staff by type of activity (by university ownership)

(unit: %)

Founding body of university	Research activities	Educational activities	Social services/social contribution			Other activities		Total working hours
			Education-related activities	Research-related activities	Other activities	Administrative work for the school	Others	
National	50.7	20.4	2.7	3.9	3.1	11.1	8.0	100.0
Public	47.2	22.7	3.2	3.5	4.0	11.6	7.8	100.0
Private	42.7	26.8	2.8	3.0	4.0	12.1	8.6	100.0

Note: Same as Table 10-1-2.
Source: Same as Table 10-1-2.

Table 10-1-4: Breakdown of hours worked by university teaching staff by type of activity (by type of institution)

(unit: %)

Founding body of university	Research activities	Educational activities	Social services/social contribution			Other activities		Total working hours
			Education-related activities	Research-related activities	Other activities	Administrative work for the school	Others	
Faculty	47.5	22.9	2.8	3.5	4.2	11.3	7.7	100.0
Junior college	34.2	33.3	3.2	2.2	1.4	15.0	10.6	100.0
Technical college	35.2	38.8	2.1	1.8	0.2	12.3	9.6	100.0
Research institutes attached to universities	63.4	11.1	1.7	5.0	1.4	9.1	8.4	100.0
Inter-university research institutes	69.1	5.1	2.5	2.2	0.0	9.3	11.7	100.0
Others	48.9	15.1	3.9	4.9	1.0	12.4	13.7	100.0

Note: Same as Table 10-1-2.
Source: Same as Table 10-1-2.

Table 10-2-1: Trends in R&D expenditure in the higher education sector for selected countries

(A) National currencies

Year	Japan (million yen)	U.S. (million dollars)	Germany (million euros)	France (million euros)	U.K. (million pounds)	China (million yuan)	Republic of Korea (million won)	EU (million dollars)
1970	365,877	3,145	-	-	-	-	-	-
1971	423,441	3,300	-	-	-	-	-	-
1972	478,684	3,542	-	-	-	-	-	-
1973	574,163	3,794	-	-	-	-	-	-
1974	717,585	4,142	-	-	-	-	-	-
1975	839,798	4,637	-	-	-	-	-	-
1976	934,016	5,165	-	-	-	-	-	-
1977	1,012,297	5,897	-	-	-	-	-	-
1978	1,151,074	6,822	-	-	-	-	-	-
1979	1,258,326	7,806	-	-	-	-	-	-
1980	1,340,074	8,821	-	-	-	-	-	-
1981	1,445,645	9,568	3,313	1,564 a	816 a	-	-	9,246 a,b
1982	1,540,422	10,211	3,375 c	1,819	—	-	-	-
1983	1,649,646	11,195	3,442	2,045	950	-	-	10,722 b
1984	1,724,187	12,491	3,579 c	2,251	—	-	-	-
1985	1,789,780	14,017	3,734	2,429	1,170 a	-	-	12,576 a,b
1986	1,832,575	15,591	3,988 c	2,597	1,288	-	-	13,452 b
1987	1,957,921	17,176	4,209	2,774	1,460	-	-	14,743 b
1988	2,014,073	18,851	4,411 c	2,938	1,575	-	-	15,895 b
1989	2,129,372	20,413	4,638	3,255	1,689	-	-	17,468 b
1990	2,296,992	21,891	4,971 c	3,492	1,873	-	-	19,436 b
1991	2,407,927	23,365	6,145 a	3,750	2,020	1,372	-	21,489 a,b
1992	2,576,281	24,655	6,610 c	3,945	2,130	1,915	-	23,563 a,b
1993	2,758,712	25,770	6,817 o	4,192	2,312	2,778	-	24,420 b
1994	2,752,551	26,911	7,059	4,331	2,623	3,869	-	25,606 b
1995	2,982,187	27,974	7,378	4,561	2,696	4,226	770,912 g	27,170 a,b
1996	3,013,120	29,111	7,652	4,687	2,792	4,778	1,018,821 g	28,317 b
1997	3,059,199	30,351	7,677	4,834 a	2,893	5,766	1,271,599 g	30,849 b
1998	3,222,879	31,750	7,768	4,986	3,040	5,725	1,265,074 g	32,135 b
1999	3,209,086	33,817	7,937	5,068	3,324	6,350	1,431,421 g	33,882 b
2000	3,208,418	36,775	8,146	5,804 a	3,645	7,674 v	1,561,864 g	37,206 b,p
2001	3,233,392	40,115 pr	8,266 c	5,960 p	4,035	10,238	-	-
2002	3,282,338	43,550 pr	-	-	-	-	-	-

(B) OECD Putchasing power parity equivalents

Year	Japan (million yen)	U.S. (million yen)	Germany (million yen)	France (million yen)	U.K. (million yen)	China (million yen)	Republic of Koreallion yen)	EU (million yen)
1970	365,877	697,199	-	-	-	-	-	-
1971	423,441	732,042	-	-	-	-	-	-
1972	478,684	796,677	-	-	-	-	-	-
1973	574,163	910,958	-	-	-	-	-	-
1974	717,585	1,102,116	-	-	-	-	-	-
1975	839,798	1,209,228	-	-	-	-	-	-
1976	934,016	1,377,159	-	-	-	-	-	-
1977	1,012,297	1,577,052	-	-	-	-	-	-
1978	1,151,074	1,781,688	-	-	-	-	-	-
1979	1,258,326	1,932,984	-	-	-	-	-	-
1980	1,340,074	2,109,313	-	-	-	-	-	-
1981	1,445,645	2,310,244	650,557	434,475 a	374,476 a	-	-	2,232,399 a,b
1982	1,540,422	2,365,615	647,706 c	458,905	-	-	-	—
1983	1,649,646	2,526,138	653,169	479,056	397,805	-	-	2,419,384 b
1984	1,724,187	2,765,411	683,720 c	503,636	-	-	-	—
1985	1,789,780	3,061,269	714,406	524,286	464,168 a	-	-	2,746,581 a,b
1986	1,832,575	3,381,777	755,561 c	541,482	503,922	-	-	2,917,772 b
1987	1,957,921	3,609,773	785,106	562,200	544,620	-	-	3,098,487 b
1988	2,014,073	3,841,745	816,625 c	581,650	557,737	-	-	3,239,408 b
1989	2,129,372	4,065,698	857,710	635,932	569,689	-	-	3,479,156 b
1990	2,296,992	4,275,312	909,327 c	676,354	607,333	-	-	3,795,792 b
1991	2,407,927	4,510,854	1,107,951 a	729,192	613,855	217,256	-	4,148,731 a,b
1992	2,576,281	4,639,109	1,177,476 c	758,625	650,680	284,664	-	4,433,656 a,b
1993	2,758,712	4,749,581	1,168,458 o	771,053	668,628	360,414	-	4,500,786 b
1994	2,752,551	4,859,831	1,205,304	774,853	734,054	418,357	-	4,624,108 b
1995	2,982,187	4,753,955	1,216,570	787,086	700,767	398,300	179,342 g	4,617,355 a,b
1996	3,013,120	4,821,221	1,222,590	774,832	718,034	417,886	226,669 g	4,689,706 b
1997	3,059,199	4,947,565	1,259,975	794,591 a	749,232	489,442	275,259 g	5,028,680 b
1998	3,222,879	5,323,227	1,312,511	846,503	788,625	510,726	271,426 g	5,387,827 b
1999	3,209,086	5,479,561	1,315,479	843,968	827,989	572,517	307,251 g	5,490,094 b
2000	3,208,418	5,720,303	1,341,005	958,865 a	878,438	670,120 v	332,836 g	5,787,392 b,p
2001	3,233,392	6,008,188 pr	1,295,373 c	972,439 p	943,394	880,043	-	-
2002	3,282,338	6,385,998 pr	-	-	-	-	-	-

Note: Same as Table 6-1-1 and Table 6-1-7.

Source: Same as Table 6-1-1 and Table 6-1-7.

Table 10-2-2: R&D expenditure in the higher education sector as a percentage of GDP for selected countries

(Unit: %)

Year	Japan	U.S.	Germany	France	U.K.	China	Republic of Korea	EU
1981	—	0.31	0.41	0.32	0.32	—	—	0.30
1982	—	0.31	0.41	0.32	—	—	—	—
1983	—	0.32	0.39	0.33	0.31	—	—	0.31
1984	—	0.32	0.39	0.33	—	—	—	—
1985	—	0.33	0.39	0.33	0.33	—	—	0.32
1986	—	0.35	0.39	0.33	0.34	—	—	0.32
1987	—	0.36	0.40	0.34	0.35	—	—	0.33
1988	—	0.37	0.40	0.33	0.34	—	—	0.33
1989	—	0.37	0.40	0.34	0.33	—	—	0.33
1990	—	0.38	0.39	0.35	0.34	—	—	0.35
1991	—	0.39	0.41	0.36	0.34	0.06	—	0.36
1992	—	0.39	0.41	0.36	0.35	0.07	—	0.37
1993	—	0.39	0.41	0.38	0.36	0.08	—	0.38
1994	—	0.38	0.41	0.38	0.38	0.08	—	0.38
1995	—	0.38	0.41	0.39	0.37	0.07	0.20	0.37
1996	0.41	0.37	0.42	0.39	0.37	0.07	0.24	0.38
1997	0.40	0.37	0.41	0.39	0.36	0.08	0.28	0.39
1998	0.44	0.36	0.40	0.38	0.35	0.07	0.28	0.39
1999	0.44	0.36	0.40	0.37	0.37	0.08	0.30	0.39
2000	0.43	0.37	0.40	0.41	0.38	0.09	0.30	0.40
2001	0.45	0.40	0.40	0.40	0.41	0.11	—	—
2002	-	0.42	—	—	—	—	—	—

Note: Same as Table 6-1-1, Table 6-1-7, and Reference Statistics C.

Source: Same as Table 6-1-1, Table 6-1-7, and Reference Statistics C.

For Japan*, data of OECD used, “Main Science and Technology Indicators 2003/1”

Table 10-2-3: Trends in the percentage of R&D expenditure in the higher education sector by source of funding in selected countries

(A) Japan

(unit: %)

FY	Industries	Governments	Universities	Non-profit private research institutes	Foreign countries
1981	0.98	57.76	41.21	0.05	0.01
1982	1.08	56.78	42.09	0.04	0.01
1983	1.16	54.76	44.01	0.06	0.01
1984	1.49	53.50	44.89	0.10	0.02
1985	1.55	52.41	45.95	0.09	0.01
1986	1.68	52.67	45.54	0.10	0.01
1987	1.82	52.23	45.84	0.11	0.01
1988	2.15	51.42	46.30	0.11	0.02
1989	2.15	51.29	46.44	0.10	0.01
1990	2.32	50.54	47.01	0.11	0.01
1991	2.37	49.46	48.05	0.12	0.01
1992	2.51	49.55	47.81	0.10	0.02
1993	2.43	50.65	46.78	0.12	0.01
1994	2.32	50.33	47.18	0.16	0.01
1995	2.36	52.35	45.15	0.14	0.01
1996	2.32	51.09	46.42	0.15	0.02
1997	2.38	50.86	46.58	0.16	0.03
1998	2.23	52.22	45.39	0.14	0.02
1999	2.23	51.89	45.69	0.17	0.02
2000	2.47	51.70	45.64	0.16	0.03
2001	2.71	50.86	45.79	0.63	0.02
2002	2.69	50.97	45.53	0.78	0.03

(B) U.S.

(unit: %)

Year	Industries	Governments	Universities	Non-profit private research institutes
1981	3.28	80.83	11.06	4.84
1982	3.55	79.40	11.82	5.23
1983	3.86	78.71	12.12	5.31
1984	4.15	78.50	12.12	5.24
1985	4.49	77.98	12.43	5.09
1986	4.78	77.28	12.95	5.00
1987	4.84	76.86	13.17	5.14
1988	4.95	76.32	13.41	5.32
1989	5.20	75.30	13.97	5.54
1990	5.33	74.41	14.56	5.71
1991	5.32	74.08	14.80	5.81
1992	5.35	74.31	14.47	5.87
1993	5.40	74.28	14.39	5.94
1994	5.41	74.04	14.63	5.92
1995	5.53	74.01	14.69	5.78
1996	5.74	73.31	15.23	5.72
1997	5.95	72.23	15.93	5.88
1998	6.14	71.52	16.28	6.06
1999	6.19	70.90	16.64	6.26
2000	5.99	70.79	16.89	6.34
2001	5.66	71.06	17.03	6.25
2002	5.38	71.33	17.13	6.17

(C) Germany

(unit: %)

Year	Industries	Governments	countries
1981	1.77	98.23 o	-
1982	3.48 c	96.52 c,o	-
1983	5.19	94.82 o	-
1984	5.29 c	94.72 c,o	-
1985	5.40	94.60 o	-
1986	5.77 c	94.23 c,o	-
1987	6.38	93.62 o	-
1988	6.84 c	93.16 c,o	-
1989	7.12	92.88 o	-
1990	7.89 c	92.11 c,o	-
1991	7.04 a	92.96 a,o	-
1992	7.63 c	91.67 c,o	0.70 c
1993	8.41	90.62 o	0.97
1994	8.29	90.45 o	1.26
1995	8.20	90.74 o	1.06
1996	9.22	89.32 o	1.46
1997	9.74	88.56 o	1.70
1998	10.54	87.43 o	2.03
1999	11.31	86.97 o	1.72
2000	11.63	85.94 o	2.43
2001	11.31 c	86.97 c	1.72 c

(D) France

(unit: %)

Year	Industries	Governments	Universities	Non-profit private research institutes	Foreign countries
1981	1.32	97.67 a	0.86	0.12	0.03
1982	1.31	97.57	0.91	0.13	0.08
1983	1.29	97.56	0.98	0.10	0.06
1984	1.53	97.70	0.53	0.08	0.16
1985	1.92	96.43	1.40	0.11	0.12
1986	2.02	96.16	1.44	0.12	0.27
1987	3.54	94.80	1.25	0.09	0.32
1988	4.02	94.28	1.00	0.09	0.62
1989	4.64	93.57	1.01	0.08	0.70
1990	4.86	92.91	1.57	0.08	0.59
1991	4.18	93.08	1.74	0.08	0.91
1992	3.66 a	92.63	2.14	0.08	1.49
1993	3.29	92.27	2.33	0.19	1.92
1994	3.15	91.69	2.52	0.37	2.27
1995	3.34	90.61	4.00	0.48	1.57
1996	3.19	89.99	3.84	0.53	2.46
1997	3.05 a	90.80	3.61	0.34	2.21
1998	3.36	88.92	4.50	0.37	2.85
1999	3.42	88.52	5.20	0.29	2.57
2000	2.70	91.50 a	3.43 a	0.29 a	2.07 a

(E) U.K.

(unit: %)

Year	Industries	Governments	Universities	Non-profit private research institutes	Foreign countries
1981	2.80 a	81.26 a	9.20 a	4.92 a	1.81 a
1982	-	-	-	-	-
1983	3.07	85.33	3.83	5.60	2.17
1984	-	-	-	-	-
1985	5.21	82.14 a	4.19	6.41	2.05
1986	5.67	80.28	4.19	7.38	2.48
1987	5.68	79.25	4.45	7.95	2.60
1988	7.30	77.02	4.89	7.56	3.24
1989	7.70	74.96	4.80	8.41	4.14
1990	7.58	73.47	4.48	9.56	4.91
1991	7.77	72.03	4.46	10.45	5.30
1992	7.75	70.11	4.56	11.54	6.05
1993	7.61	69.29 a	4.33	12.24	6.53
1994	5.97	68.65	4.29	13.50	7.60
1995	6.30	67.86	4.24	13.96	7.65
1996	6.74	66.46	4.15	14.54	8.10
1997	7.10	65.15	4.07	15.11	8.57
1998	7.28	64.44	4.02	15.22	9.04
1999	7.29	64.91	4.05	15.78	7.98
2000	7.10	64.70	4.04	16.40	7.75
2001	6.20	65.77	4.11	16.36	7.53

(F) Republic of Korea

(unit: %)

Year	Industries	Governments	Universities	Non-profit private research institutes	Foreign countries
1995	22.44 g	43.94 g	31.98 g	1.62 g	0.02 g
1996	50.52 g	43.98 g	2.02 g	3.20 g	0.29 g
1997	14.91 g	48.09 g	34.56 g	1.91 g	0.53 g
1998	13.06 g	46.30 g	39.88 g	0.54 g	0.22 g
1999	10.79 g	56.37 g	31.97 g	0.65 g	0.22 g
2000	15.89 g	54.78 g	28.46 g	0.65 g	0.22 g

Note: Same as note on source in Table 6-1-7.
Source: Same as Table 6-1-7.

Table 10-2-4: Trends in the number of researchers in the higher education sector for selected countries

(unit: persons)

Year	Japan (HC)	Japan (FTE)	U.S.	Germany	France	U.K.	China	Republic of Korea	EU
1981	160,863	-	98,300	28,470	32,700 a	25,000 a	-	-	156,249 b
1982	163,264	-	99,500	-	33,023	25,000	-	-	-
1983	170,103	-	100,400	28,955	33,858	25,000	-	-	167,646 b
1984	175,841	-	103,400	-	35,095	25,000	-	-	-
1985	180,606	-	95,200	29,438	35,666	25,000	-	-	169,699 b
1986	185,070	-	-	-	36,335	25,000	-	-	-
1987	189,597	-	130,339	36,646 a	36,507	26,000	-	-	185,408 a,b
1988	195,428	-	-	-	38,241	26,000	-	-	-
1989	200,730	-	142,036	38,835	39,757	27,000	-	-	204,131 b
1990	205,509	-	-	-	39,883	28,000	132,700	-	-
1991	209,898	-	138,259	62,171 a	42,146	29,000	117,500	-	243,755 a,b
1992	214,462	-	-	-	48,151	31,000	127,700	-	-
1993	222,006	-	174,972	-	49,868	32,000	157,900	-	-
1994	229,164	-	-	-	52,119	42,000 a	132,200	-	-
1995	235,702	-	181,395	64,434	53,726	47,000	131,600	19,406 g	292,831 b
1996	242,862	-	-	66,110	54,592	47,000	156,900	19,483 g	302,614 b
1997	248,275	-	178,608	65,704	54,916 a	47,651	161,000	19,573 g	296,842 a,b
1998	253,165	-	-	65,973	56,288	49,023	168,400	21,525 g	308,339 b
1999	256,440	-	186,027	66,695	56,717	-	147,866	21,723 g	317,899 b
2000	259,012	-	-	67,087 c	61,583 a	-	167,600	23,674 g	-
2001	259,759	—	-	68,277 c	—	-	167,600	23,083 g	-
2003	257,833	135,594	-	—	—	-	-	-	-
2003	257,792	136,014	-	—	—	-	-	-	-

Note: Figures are total number of researchers of both natural science and human/social science for each country.

a: The data lack continuity with the data until the previous year.

b: OECD estimates/calculations based on data of each country.

c: Government estimates are modified as necessary to comply with OECD standards.

g: Excludes R&D for social science and human science.

<Japan>1) As the contents and period of statistical survey were changed, the number of full-time researchers as of the 1st day of April until 2000 was used, and after 2001, the number of researchers as of the 31st day of March was used.

2) Number of researchers in Japanese universities (FTE value) was calculated based on the ‘Survey of Full Time Equivalent Data at Universities’ conducted in 2002. However, full-time conversion factor of faculty for ‘medical office, etc.’ was substituted.

<Germany>Former federal district before 1990, and Germany after 1991.

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development,’ Science and Technology-Academic Policy Bureau, Ministry of Education, Culture, Sports, Science and Technology, NISTEP, ‘Report on the Survey of Full Time Equivalent Data at Universities’

<U.S.>NSF, “National Patterns of R&D Resources 2002” during 1985-1995, and OECD, “Main Science and Technology Indicators 2003/01” for other period.

<Germany, France, and U.K.>OECD, “Main Science and Technology Indicators 2003/01”

Table 10-2-5: Trends in the percentage of R&D expenditure by universities by university ownership

(A) Total

FY	R&D expenditure (million yen)				Ratio of R&D expenditure (%)			
	National	Public	Private	Total	National	Public	Private	Total
1970	179,040	25,369	161,468	365,877	48.9	6.9	44.1	100.0
1971	195,487	29,461	198,494	423,441	46.2	7.0	46.9	100.0
1972	215,131	32,368	231,185	478,684	44.9	6.8	48.3	100.0
1973	254,889	36,791	282,483	574,163	44.4	6.4	49.2	100.0
1974	333,171	44,029	340,385	717,585	46.4	6.1	47.4	100.0
1975	381,472	48,788	409,538	839,798	45.4	5.8	48.8	100.0
1976	415,654	51,406	466,955	934,016	44.5	5.5	50.0	100.0
1977	455,191	57,578	499,528	1,012,297	45.0	5.7	49.3	100.0
1978	518,622	58,042	574,411	1,151,074	45.1	5.0	49.9	100.0
1979	560,089	64,970	633,268	1,258,326	44.5	5.2	50.3	100.0
1980	594,339	67,734	678,001	1,340,074	44.4	5.1	50.6	100.0
1981	643,472	72,582	729,591	1,445,645	44.5	5.0	50.5	100.0
1982	675,850	75,986	788,586	1,540,422	43.9	4.9	51.2	100.0
1983	711,364	78,097	860,184	1,649,646	43.1	4.7	52.1	100.0
1984	749,826	81,964	892,398	1,724,187	43.5	4.8	51.8	100.0
1985	756,686	88,645	944,449	1,789,780	42.3	5.0	52.8	100.0
1986	786,462	90,608	955,505	1,832,575	42.9	4.9	52.1	100.0
1987	843,900	96,756	1,017,264	1,957,921	43.1	4.9	52.0	100.0
1988	860,678	97,888	1,055,508	2,014,073	42.7	4.9	52.4	100.0
1989	899,221	114,331	1,115,819	2,129,372	42.2	5.4	52.4	100.0
1990	961,724	126,936	1,208,331	2,296,992	41.9	5.5	52.6	100.0
1991	1,001,800	124,153	1,281,974	2,407,927	41.6	5.2	53.2	100.0
1992	1,077,675	138,430	1,360,176	2,576,281	41.8	5.4	52.8	100.0
1993	1,191,676	144,959	1,422,077	2,758,712	43.2	5.3	51.5	100.0
1994	1,163,036	160,477	1,429,038	2,752,551	42.3	5.8	51.9	100.0
1995	1,311,399	177,474	1,493,313	2,982,187	44.0	6.0	50.1	100.0
1996	1,296,359	173,288	1,543,474	3,013,120	43.0	5.8	51.2	100.0
1997	1,300,615	182,796	1,575,788	3,059,199	42.5	6.0	51.5	100.0
1998	1,406,556	184,576	1,631,747	3,222,879	43.6	5.7	50.6	100.0
1999	1,395,167	184,088	1,629,831	3,209,086	43.5	5.7	50.8	100.0
2000	1,385,637	188,106	1,634,675	3,208,418	43.2	5.9	50.9	100.0
2001	1,390,794	186,617	1,655,980	3,223,392	43.1	5.8	51.4	100.0
2002	1,435,972	183,965	1,662,401	3,282,338	43.7	5.6	50.6	100.0

(B) Natural science

FY	R&D expenditure (million yen)				Ratio of R&D expenditure (%)			
	National	Public	Private	Total	National	Public	Private	Total
1971	143,129	18,593	88,710	250,433	57.2	7.4	35.4	100.0
1972	158,872	19,922	110,102	288,896	55.0	6.9	38.1	100.0
1973	187,809	23,466	146,954	358,229	52.4	6.6	41.0	100.0
1974	245,135	27,052	173,054	445,241	55.1	6.1	38.9	100.0
1975	284,293	29,574	202,414	516,281	55.1	5.7	39.2	100.0
1976	317,986	31,877	237,790	587,654	54.1	5.4	40.5	100.0
1977	351,945	35,745	242,007	629,698	55.9	5.7	38.4	100.0
1978	399,275	35,676	277,667	712,618	56.0	5.0	39.0	100.0
1979	434,641	39,081	303,960	777,683	55.9	5.0	39.1	100.0
1980	461,765	41,374	320,761	823,900	56.0	5.0	38.9	100.0
1981	505,040	45,516	334,803	885,359	57.0	5.1	37.8	100.0
1982	529,884	47,081	371,245	948,211	55.9	5.0	39.2	100.0
1983	561,246	49,491	417,620	1,028,356	54.6	4.8	40.6	100.0
1984	585,463	52,182	426,130	1,063,775	55.0	4.9	40.1	100.0
1985	589,212	56,310	429,888	1,075,410	54.8	5.2	40.0	100.0
1986	610,800	57,532	453,532	1,121,864	54.4	5.1	40.4	100.0
1987	659,914	61,932	487,733	1,209,579	54.6	5.1	40.3	100.0
1988	675,343	61,927	502,281	1,239,551	54.5	5.0	40.5	100.0
1989	705,507	74,274	531,850	1,311,631	53.8	5.7	40.5	100.0
1990	754,426	85,349	566,572	1,406,347	53.6	6.1	40.3	100.0
1991	783,564	83,387	593,882	1,460,833	53.6	5.7	40.7	100.0
1992	846,905	94,844	624,293	1,566,041	54.1	6.1	39.9	100.0
1993	946,353	97,935	641,251	1,685,538	56.1	5.8	38.0	100.0
1994	925,191	109,292	651,043	1,685,526	54.9	6.5	38.6	100.0
1995	1,065,700	124,935	684,033	1,874,668	56.8	6.7	36.5	100.0
1996	1,040,261	118,260	724,811	1,883,332	55.2	6.3	38.5	100.0
1997	1,045,085	128,936	732,400	1,906,422	54.8	6.8	38.4	100.0
1998	1,123,947	129,233	759,030	2,012,211	55.9	6.4	37.7	100.0
1999	1,116,797	128,560	744,529	1,989,887	56.1	6.5	37.4	100.0
2000	1,112,497	132,675	744,155	1,989,327	55.9	6.7	37.4	100.0
2001	1,119,296	129,875	766,177	2,015,348	55.5	6.4	38.0	100.0
2002	1,167,311	129,166	771,986	2,068,462	56.4	6.2	37.3	100.0

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development’

Table 10-2-6: Breakdown of university researchers in Japan (2003)

	Number	Ratio (%)
Full-time researchers	257,792	100.0
Faculty	171,288	66.4
Department	144,610	56.1
National	66,032	25.6
Public	12,783	5.0
Private	92,473	35.9
Junior college	13,978	5.4
Research institutes attached to universities	3,745	1.5
Others	8,955	3.5
Graduate students attending doctor's courses	65,817	25.5
National	46,873	18.2
Public	3,586	1.4
Private	15,358	6.0
Medical office staffs	20,687	8.0
National	9,481	3.7
Public	1,710	0.7
Private	9,496	3.7

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 10-2-7: Comparison of the number of university researchers in Japan and the U.S.

(A) Japan

	Statistical value	Values shown in the Figure 10-2-7	
Nunber of researchers in universities	(2003)	HC value	FTE value
Facluty	171,288	-	-
Department	144,610	144,610	67,244
Research institutes attached to universities	3,745	3,745	2,655
Junior college	13,978	-	-
Others	8,955	-	-
Medical office staffs	20,687	-	-
Department/research institutes attached to universities	20,045	20,045	9,508
Others	642	-	-
Graduate students attending doctor's course	65,817	-	-
Totalo	257,792	168,400	79,407

(B) U.S.

	Statistical value	Values shown in the Figure 10-2-7	
Number of doctors employed by four-year college	(2001)	Statistical value	Estimated value
Researchers whose principal occupation is R&D	95,690	95,690	71,768
Researchers whose principal occupation is other than R&D	149,370	-	-
among them, researchers to whom R&D is a secondary job	79,539	-	19,885
Total	245,060	95,690	91,652

Source: <Japan>: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'
Science and Technology-Academic Policy Bureau, Ministry of Education, Culture, Sports, Science and Technology, 'Report on the Survey of Full Time Equivalent Data at Universities.' 'Estimated value' is compiled by NISTEP based on the above data.
<U.S.>NSF, "Characteristics of Doctoral Scientists and Engineers in the United States: 2001"
'Estimated value' is compiled by NISTEP based on the above data.

Table 10-2-8: Trends in intramural R&D expenditure in universities by source of funding

(unit: million yen)

FY	R&D funds for internal use	Self-preserving R&D funds	R&D funds received				R&D funds paid outside			
			Number of universities/colleges		R&D funds		Number of universities/colleges		R&D funds	
				Internal use		Internal use		Self-financed		Self-financed
1986	1,832,575	1,651,290	1,556	1,553	192,072	181,968	149	81	2,254	683
1987	1,957,921	1,771,980	1,596	1,591	198,065	186,673	136	71	1,932	732
1988	2,014,073	1,815,703	1,641	1,641	212,503	199,259	146	69	2,213	889
1989	2,129,372	1,923,802	1,711	1,709	223,958	206,603	137	68	3,009	1,033
1990	2,296,992	2,080,535	1,732	1,729	235,436	217,686	151	77	2,984	1,229
1991	2,407,927	2,191,149	1,772	1,770	236,485	218,194	151	77	3,528	1,416
1992	2,576,281	2,346,511	1,812	1,805	250,546	231,335	144	71	3,904	1,565
1993	2,758,712	2,518,307	1,848	1,844	259,687	241,668	152	72	4,397	1,263
1994	2,752,551	2,510,834	1,873	1,870	262,636	243,041	158	76	3,923	1,324
1995	2,982,187	2,697,637	1,954	1,951	303,626	285,996	164	75	3,623	1,447
1996	3,013,120	2,723,033	2,024	2,015	310,405	292,140	158	80	4,193	2,053
1997	3,059,199	2,745,737	2,078	2,054	334,254	314,858	162	78	3,896	1,395
1998	3,222,879	2,884,809	2,249	2,228	357,255	339,201	145	72	3,532	1,130
1999	3,209,086	2,855,518	2,300	2,289	373,535	354,080	125	64	2,392	512
2000	3,208,418	2,829,387	2,376	2,361	403,381	379,601	117	53	2,322	569
2001	3,233,392	2,842,259	2,520	2,505	418,313	391,519	127	53	2,931	386
2002	3,282,338	2,859,049	2,589	2,582	450,976	424,465	163	63	4,984	1,176

(unit: million yen)

FY	R&D funds received											
	From government/local public entities			From government-affiliated firms/ independent administrative agencies			From private sector			From foreign countries		
	Number of universities/ colleges	R&D funds	R&D funds for internal use	Number of universities/ colleges	R&D funds	R&D funds for internal use	Number of universities/ colleges	R&D funds	R&D funds for internal use	Number of universities/ colleges	R&D funds	R&D funds for internal use
1986	1,499	153,621	148,164	169	1,797	1,279	807	36,500	32,388	40	154	137
1987	1,527	155,150	147,891	174	1,722	1,636	846	40,981	36,981	40	213	164
1988	1,577	159,486	152,107	195	1,949	1,823	875	50,533	44,836	37	535	493
1989	1,637	166,960	157,130	210	2,207	2,079	912	54,490	47,110	48	301	283
1990	1,648	169,230	160,178	211	2,350	2,131	947	63,556	55,150	53	300	227
1991	1,703	165,644	156,064	225	2,773	2,639	972	67,674	59,156	62	394	335
1992	1,741	171,922	161,641	240	2,608	2,351	1,000	75,443	66,825	70	574	519
1993	1,769	178,050	168,199	250	3,431	3,260	1,030	77,847	69,884	60	359	325
1994	1,805	183,365	172,297	255	3,454	3,122	1,028	75,464	67,391	59	352	231
1995	1,863	214,069	204,185	331	9,753	9,496	1,070	79,357	71,958	57	446	357
1996	1,929	214,237	204,006	363	13,954	13,553	1,119	81,635	74,109	54	578	472
1997	1,981	228,034	218,060	413	22,015	21,205	1,150	83,311	74,788	56	894	804
1998	2,149	257,002	247,895	450	17,092	16,366	1,256	82,458	74,285	45	704	655
1999	2,210	268,218	259,613	493	19,166	18,305	1,274	85,469	75,507	49	682	655
2000	2,272	287,856	278,304	510	20,115	18,863	1,319	94,438	81,486	49	971	947
2001	3,195	254,343	245,789	1,168	54,574	52,667	2,117	110,833	92,348	63	760	715
2002	3,265	279,776	269,819	1,333	51,307	50,065	2,320	118,822	103,583	66	1,072	999

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 10-2-9: Trends in R&D expenditure in universities by type of cost

(unit: million yen)

FY	Intramural expenditure on R&D								
	Total amount	Labor costs	Materials	Expenditure on tangible fixed assets				Lease payment	Other expenses
				Total	Land, building, etc.	Machinery/instruments/ equipment, etc.	Others		
1986	1,832,575	1,218,858	106,421	256,308	90,981	137,844	27,483	－	250,989
1987	1,957,921	1,281,643	113,392	293,026	97,835	173,043	22,148	－	269,859
1988	2,014,073	1,346,699	121,329	269,643	87,566	159,423	22,654	－	276,403
1989	2,129,372	1,422,366	133,209	280,713	85,621	165,619	29,473	－	293,083
1990	2,296,992	1,542,607	137,359	293,755	92,689	171,042	30,024	－	323,271
1991	2,407,927	1,631,914	142,279	294,449	93,101	167,813	33,535	－	339,284
1992	2,576,281	1,729,922	155,682	327,966	101,815	194,359	31,791	－	362,710
1993	2,758,712	1,798,222	169,827	401,885	123,182	247,794	30,908	－	388,778
1994	2,752,551	1,861,740	169,958	319,537	111,860	189,155	18,522	－	401,316
1995	2,982,187	1,920,783	186,877	435,446	130,498	284,266	20,682	－	439,081
1996	3,013,120	1,965,009	186,126	419,826	159,105	242,251	18,471	－	442,160
1997	3,059,199	2,014,776	195,124	395,719	140,435	238,422	16,862	－	453,580
1998	3,222,879	2,068,481	206,434	466,372	162,014	267,446	36,912	－	481,592
1999	3,209,086	2,086,089	219,074	409,563	150,869	244,787	13,907	－	494,360
2000	3,208,418	2,105,484	216,542	375,125	138,177	218,921	18,028	－	511,267
2001	3,233,392	2,109,802	217,515	371,196	136,683	217,846	16,667	40,449	494,430
2002	3,282,338	2,100,077	229,670	381,533	146,524	226,073	8,936	42,318	528,740

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 10-2-10: Trends in R&D expenditure in universities by field of study

(unit: million yen)

FY	Total	Field of science						
		Natural science					Human/ social science	Others
		Science	Engineering	Agriculture	Health science	Total antural science		
1970	365,877	25,705	83,709	22,967	85,062	217,444	100,659	47,774
1971	423,441	28,415	95,396	26,400	100,222	250,433	115,410	57,599
1972	478,684	30,291	105,271	29,314	124,020	288,896	125,740	64,048
1973	574,163	38,098	122,200	33,409	164,522	358,229	147,823	68,111
1974	717,585	54,798	156,415	41,638	192,390	445,241	184,747	87,597
1975	839,798	65,465	185,149	45,604	220,063	516,281	180,116	143,401
1976	934,016	76,786	201,839	50,058	258,970	587,654	190,845	155,517
1977	1,012,297	95,016	222,007	55,602	257,073	629,698	200,296	182,304
1978	1,151,074	105,288	249,097	60,477	297,756	712,618	235,443	203,013
1979	1,258,326	116,618	274,836	66,220	320,009	777,683	264,903	215,741
1980	1,340,074	109,394	301,575	70,946	341,985	823,900	286,763	229,411
1981	1,445,645	131,467	319,279	72,245	362,368	885,359	320,580	239,706
1982	1,540,422	142,574	330,106	75,731	399,800	948,211	338,038	254,174
1983	1,649,646	147,985	358,749	80,672	440,951	1,028,356	352,730	268,560
1984	1,724,187	155,118	370,732	86,935	450,990	1,063,775	380,186	280,226
1985	1,789,780	162,031	371,364	85,337	456,678	1,075,410	412,344	302,025
1986	1,832,575	163,376	393,056	88,030	477,403	1,121,864	408,550	302,161
1987	1,957,921	175,609	431,438	91,551	510,982	1,209,579	432,503	315,839
1988	2,014,073	179,200	444,840	92,435	523,076	1,239,551	453,115	321,408
1989	2,129,372	187,047	481,826	99,800	542,957	1,311,631	482,419	335,322
1990	2,296,992	204,660	503,494	106,028	592,166	1,406,347	529,233	361,411
1991	2,407,927	212,565	529,219	104,142	614,906	1,460,833	572,765	374,329
1992	2,576,281	230,821	566,503	114,971	653,746	1,566,041	617,124	393,115
1993	2,758,712	260,385	617,913	117,512	689,728	1,685,538	662,393	410,780
1994	2,752,551	262,195	606,056	116,026	701,249	1,685,526	672,572	394,452
1995	2,982,187	300,440	673,989	123,252	776,988	1,874,668	709,143	398,375
1996	3,013,120	300,972	679,801	117,345	785,214	1,883,332	725,628	404,160
1997	3,059,199	299,515	686,727	120,681	799,498	1,906,422	756,734	396,042
1998	3,222,879	295,534	733,488	136,578	846,610	2,012,211	807,908	402,760
1999	3,209,086	290,706	741,822	134,196	823,164	1,989,887	818,250	400,949
2000	3,208,418	292,139	737,809	127,320	832,059	1,989,327	829,317	389,774
2001	3,233,392	284,793	745,305	127,174	858,076	2,015,348	837,772	380,273
2002	3,282,338	305,532	767,590	131,410	863,930	2,068,462	841,448	372,428

Note: Classification of learning field is classification by the kind of organization of the faculty, etc.

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 10-2-11: Trends in R&D expenditure per researcher in universities

(A) Total R&D expenditure

(unit: 1,000 yen/person)

FY	National	Public	Private	Total	Field of science						
					Natural science					Human/ social science	Others
					Science	Engineering	Agriculture	Health science	Total natural science		
1980	7,924	6,231	9,041	8,331	10,263	10,667	10,038	6,043	8,031	9,162	8,506
1981	8,461	6,542	9,585	8,855	11,956	11,571	10,226	6,199	8,504	9,964	8,885
1982	8,539	6,466	9,956	9,056	12,756	11,747	10,499	6,302	8,626	10,282	9,312
1983	8,715	6,504	10,463	9,381	13,021	12,579	11,189	6,573	9,006	10,452	9,622
1984	8,972	6,715	10,521	9,547	13,499	12,870	12,006	6,399	9,014	11,052	9,942
1985	8,903	7,182	10,764	9,671	14,002	12,651	11,452	6,260	8,864	11,674	10,626
1986	9,049	7,162	10,613	9,666	14,165	13,061	11,881	6,349	9,030	11,250	10,402
1987	9,438	7,531	10,919	10,019	14,811	13,925	12,178	6,572	9,442	11,424	10,721
1988	9,415	7,384	10,988	10,034	14,672	13,780	12,011	6,577	9,410	11,576	10,761
1989	9,592	8,518	11,347	10,361	14,930	14,478	12,829	6,741	9,779	11,777	11,025
1990	10,087	9,334	11,969	10,943	16,206	14,699	12,994	7,235	10,274	12,518	11,760
1991	10,288	9,222	12,372	11,228	16,061	14,876	12,469	7,430	10,441	13,097	12,149
1992	10,561	9,718	12,866	11,605	16,173	15,037	12,883	7,689	10,734	13,612	12,773
1993	11,212	9,855	13,147	12,038	16,100	15,556	12,825	7,984	11,129	13,928	13,620
1994	10,615	10,382	12,911	11,678	15,949	14,537	12,217	7,911	10,786	13,640	13,098
1995	11,503	11,067	13,237	12,279	17,125	15,487	12,780	8,576	11,622	13,777	13,241
1996	11,070	10,253	13,507	12,136	16,528	15,171	11,600	8,602	11,454	13,479	13,461
1997	10,870	10,396	13,593	12,084	15,852	14,959	11,669	8,657	11,382	13,598	13,191
1998	11,677	10,493	13,783	12,568	17,597	15,563	12,733	9,182	12,059	13,698	13,161
1999	11,582	10,172	13,531	12,390	17,266	15,368	12,260	9,030	11,901	13,283	13,276
2000	11,398	10,462	13,599	12,352	17,240	15,053	11,598	9,266	11,931	13,132	13,047
2001	11,493	10,292	13,953	12,541	16,961	14,948	11,991	9,723	12,176	13,440	12,681
2002	11,733	10,176	14,169	12,733	17,819	15,277	12,189	10,021	12,583	13,254	12,445

(B) R&D expenditure without labor costs

(unit: 1,000 yen/person)

FY	National	Public	Private	Total	Field of science						
					Natural science					Human/ social science	Others
					Science	Engineering	Agriculture	Health science	Total natural science		
1980	3,129	1,111	3,219	3,035	5,108	4,316	3,802	2,417	3,316	2,663	2,399
1981	3,474	1,208	3,390	3,281	6,611	4,827	3,768	2,391	3,576	2,980	2,501
1982	3,497	1,369	3,502	3,353	7,191	4,679	3,969	2,515	3,639	2,949	2,684
1983	3,624	1,216	3,691	3,491	7,332	5,301	4,295	2,623	3,866	2,834	2,749
1984	3,513	1,260	3,630	3,416	7,290	5,072	4,579	2,417	3,672	3,108	2,718
1985	3,419	1,427	3,763	3,449	7,675	4,803	4,105	2,267	3,509	3,490	3,143
1986	3,377	1,357	3,365	3,237	7,474	5,011	4,271	2,242	3,520	2,807	2,566
1987	3,714	1,603	3,474	3,460	7,985	5,672	4,434	2,347	3,796	2,891	2,735
1988	3,607	1,464	3,313	3,325	7,807	5,466	4,209	2,252	3,669	2,747	2,564
1989	3,662	2,306	3,384	3,440	7,958	5,875	4,698	2,354	3,887	2,678	2,498
1990	3,743	2,600	3,587	3,594	8,439	5,707	4,696	2,537	4,004	2,898	2,728
1991	3,756	2,054	3,693	3,618	8,118	5,815	3,904	2,539	3,981	3,057	2,768
1992	3,996	2,548	3,806	3,812	8,323	6,001	4,583	2,630	4,177	3,201	2,986
1993	4,742	2,356	3,900	4,191	8,839	6,601	4,484	2,882	4,590	3,438	3,376
1994	4,138	2,666	3,580	3,779	8,289	5,639	4,041	2,750	4,182	3,070	2,852
1995	5,140	3,319	3,742	4,370	9,835	6,707	4,464	3,346	5,025	3,172	2,909
1996	4,763	2,677	3,896	4,222	9,349	6,469	3,763	3,246	4,832	2,945	3,167
1997	4,480	2,908	3,945	4,125	8,566	6,259	3,901	3,238	4,708	3,054	2,863
1998	5,127	2,836	4,112	4,502	10,223	6,736	5,011	3,530	5,204	3,309	2,969
1999	5,062	2,545	3,878	4,336	9,901	6,740	4,878	3,253	5,035	3,047	3,089
2000	4,912	2,367	3,854	4,246	9,663	6,483	4,233	3,333	4,962	2,921	3,053
2001	4,951	2,325	4,063	4,358	9,367	6,469	4,425	3,652	5,130	3,035	2,845
2002	5,380	2,275	4,114	4,586	10,458	6,877	4,873	3,803	5,507	3,067	2,750

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development’

Table 10-2-12: Trends in the number of university researchers by specialty

(unit: persons)

Year	Human/ social science	Natural science				
		Science				
	Total	Math/Physics	Chemistry	Biology	Other science	Total
1987	43,300	9,261	3,942	3,294	2,380	18,877
1988	44,755	9,528	4,035	3,387	2,430	19,380
1989	46,145	9,776	4,087	3,496	2,520	19,879
1990	47,811	9,860	4,153	3,556	2,539	20,108
1991	48,995	10,028	4,249	3,771	2,299	20,347
1992	50,190	10,414	4,310	3,999	2,310	21,033
1993	51,698	10,718	4,414	4,060	2,809	22,001
1994	53,679	11,005	4,611	4,278	2,972	22,866
1995	54,919	11,209	4,613	4,504	3,125	23,451
1996	56,876	11,501	4,762	4,763	3,554	24,580
1997	58,612	11,870	4,846	4,956	3,373	25,045
1998	60,538	11,961	4,855	5,201	3,460	25,477
1999	62,751	12,147	4,907	5,553	3,548	26,155
2000	64,510	11,966	4,866	5,475	3,757	26,064
2001	65,425	11,713	4,732	5,437	3,991	25,873
2002	64,938	11,442	4,795	5,465	3,988	25,690
2003	65,765	11,315	4,566	5,508	4,092	25,481

(unit; persons)

Year	Natural science								Others	
	Engineering					Agriculture	Health science			
	Machinery/marine vessels/aviation	Electricity/communications	Civil engineerign/construction	Other engineering	Total	Total	Total	Total	Total	Grand total
1987	5,443	6,546	4,377	9,425	25,791	8,057	75,347	128,072	18,225	189,597
1988	5,582	6,869	4,471	9,627	26,549	8,281	77,878	132,088	18,585	195,428
1989	5,768	7,280	4,581	10,039	27,668	8,527	79,809	135,883	18,702	200,730
1990	5,839	7,744	4,599	10,474	28,656	8,686	80,888	138,338	19,360	205,509
1991	5,950	8,108	4,869	10,640	29,567	9,096	82,187	141,197	19,706	209,898
1992	6,144	8,657	4,947	10,918	30,666	9,255	83,171	144,125	20,147	214,462
1993	6,396	9,283	5,213	11,858	32,750	9,977	85,562	150,290	20,018	222,006
1994	6,791	10,072	5,474	12,630	34,967	10,303	86,953	155,089	20,396	229,164
1995	6,891	10,770	5,667	13,534	36,862	10,643	89,301	160,257	20,526	235,702
1996	7,058	11,288	6,030	14,203	38,579	10,792	91,313	165,264	20,722	242,862
1997	7,213	11,437	6,268	15,133	40,051	11,246	92,152	168,494	21,169	248,275
1998	7,286	11,913	6,425	15,582	41,206	11,428	93,225	171,336	21,291	253,165
1999	7,341	12,289	6,637	15,676	41,943	11,634	92,595	172,327	21,362	256,440
2000	7,497	12,750	6,799	16,213	43,259	11,927	91,573	172,823	21,679	259,012
2001	7,580	13,253	7,022	16,351	44,206	11,964	90,377	172,420	21,914	259,759
2002	7,567	13,585	7,119	16,302	44,573	11,775	88,813	170,851	22,044	257,833
2003	7,659	13,894	7,219	16,618	45,390	11,990	87,002	169,863	22,164	257,792

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 10-2-13: Number of post-doctoral researchers in universities (2003)

(unit: persons)

Type of university	total	Number of researchers with doctor's degree	Researchers without doctor's degree	
			Grand total	Among them, graduate students who attend doctor's courses
National	128,159	47,956	80,203	46,873
	(100.0%)	(37.4%)	(62.6%)	(36.6%)
Public	22,217	6,705	15,512	3,586
	(100.0%)	(30.2%)	(69.8%)	(16.1%)
Private	130,928	39,007	91,921	15,358
	(100.0%)	(29.8%)	(70.2%)	(11.7%)
Total	281,304	93,668	187,636	65,817
	(100.0%)	(33.3%)	(66.7%)	(23.4%)

Note: The figures are actual numbers.
The survey was taken as of March 31, 2003.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 10-2-14: Breakdown of university teaching staff by educational attainment (FY2001)

(unit: persons)

Specialty	Total	Graduate school under the new system		Universities under the new system	Universities under the old system	Foreign universities	Others
		Doctor's courses	Master's courses				
Total	151,593	63,942	40,333	39,637	338	5,951	1,392
Human science	23,098	8,938	8,902	1,878	73	3,239	68
Social science	19,665	10,229	5,452	2,743	107	1,072	62
Science	14,764	8,839	4,239	1,360	22	262	42
Engineering	25,895	12,601	8,672	3,800	38	479	305
Agriculture	6,412	2,947	2,276	1,060	18	66	45
Health science	46,059	16,870	4,776	23,751	25	228	409
Others	15,700	3,518	6,016	5,045	55	605	461

(unit: %)

Specialty	Total	Graduate school under the new system		Universities under the new system	Universities under the old system	Foreign universities	Others
		Doctor's courses	Master's courses				
Total	100.0	42.2	26.6	26.1	0.2	3.9	0.9
Human science	100.0	38.7	38.5	8.1	0.3	14.0	0.3
Social science	100.0	52.0	27.7	13.9	0.5	5.5	0.3
Science	100.0	59.9	28.7	9.2	0.1	1.8	0.3
Engineering	100.0	48.7	33.5	14.7	0.1	1.8	1.2
Agriculture	100.0	46.0	35.5	16.5	0.3	1.0	0.7
Health science	100.0	36.6	10.4	51.6	0.1	0.5	0.9
Others	100.0	22.4	38.3	32.1	0.4	3.9	2.9

Note: The total number of teachers in departments, graduate schools, teaching hospitals, attached laboratories, etc.
Source: Ministry of Education, Culture, Sports, Science and Technology, 'Statistical Survey on School Teachers 2001'

Table 10-2-15: Trends in the number of research assistants per university researcher

(unit: persons)

Year		Human/social science	Science	Engineering	Agriculture	Health science	Others
	Research assistants	0.03	0.12	0.08	0.05	0.06	0.06
1987	Technicians	0.01	0.14	0.16	0.18	0.05	0.02
	Clerical staff and others	0.19	0.23	0.18	0.17	0.07	0.16
	Research assistants	0.03	0.11	0.08	0.05	0.06	0.06
1988	Technicians	0.01	0.12	0.16	0.18	0.05	0.02
	Clerical staff and others	0.19	0.22	0.17	0.17	0.07	0.16
	Research assistants	0.03	0.08	0.07	0.04	0.06	0.05
1989	Technicians	0.01	0.12	0.15	0.17	0.05	0.02
	Clerical staff and others	0.18	0.22	0.17	0.17	0.07	0.16
	Research assistants	0.02	0.08	0.06	0.08	0.06	0.05
1990	Technicians	0.01	0.12	0.14	0.14	0.05	0.02
	Clerical staff and others	0.17	0.22	0.16	0.15	0.07	0.16
	Research assistants	0.02	0.09	0.05	0.03	0.06	0.05
1991	Technicians	0.01	0.12	0.13	0.16	0.05	0.02
	Clerical staff and others	0.17	0.23	0.16	0.15	0.07	0.15
	Research assistants	0.02	0.08	0.05	0.04	0.06	0.05
1992	Technicians	0.01	0.12	0.13	0.15	0.05	0.02
	Clerical staff and others	0.16	0.22	0.15	0.15	0.07	0.15
	Research assistants	0.02	0.05	0.04	0.03	0.06	0.04
1993	Technicians	0.01	0.11	0.12	0.14	0.05	0.02
	Clerical staff and others	0.16	0.21	0.14	0.14	0.07	0.15
	Research assistants	0.02	0.05	0.04	0.04	0.06	0.05
1994	Technicians	0.01	0.09	0.11	0.13	0.05	0.02
	Clerical staff and others	0.16	0.18	0.13	0.15	0.07	0.15
	Research assistants	0.02	0.04	0.04	0.03	0.06	0.04
1995	Technicians	0.01	0.09	0.11	0.12	0.05	0.02
	Clerical staff and others	0.15	0.17	0.12	0.13	0.06	0.14
	Research assistants	0.02	0.03	0.03	0.03	0.05	0.04
1996	Technicians	0.01	0.09	0.10	0.10	0.04	0.02
	Clerical staff and others	0.15	0.17	0.12	0.12	0.06	0.13
	Research assistants	0.02	0.03	0.03	0.03	0.05	0.04
1997	Technicians	0.01	0.09	0.09	0.10	0.04	0.02
	Clerical staff and others	0.14	0.17	0.12	0.11	0.06	0.13
	Research assistants	0.02	0.04	0.03	0.03	0.06	0.04
1998	Technicians	0.01	0.09	0.10	0.10	0.04	0.02
	Clerical staff and others	0.14	0.15	0.12	0.10	0.06	0.12
	Research assistants	0.02	0.04	0.03	0.02	0.05	0.03
1999	Technicians	0.01	0.09	0.10	0.09	0.04	0.02
	Clerical staff and others	0.13	0.17	0.12	0.10	0.07	0.12
	Research assistants	0.02	0.04	0.03	0.02	0.05	0.04
2000	Technicians	0.01	0.10	0.10	0.09	0.05	0.02
	Clerical staff and others	0.13	0.18	0.11	0.10	0.07	0.12
	Research assistants	0.02	0.04	0.03	0.02	0.06	0.03
2001	Technicians	0.00	0.09	0.09	0.10	0.05	0.02
	Clerical staff and others	0.13	0.17	0.11	0.11	0.07	0.12
	Research assistants	0.01	0.04	0.02	0.04	0.06	0.04
2002	Technicians	0.01	0.09	0.09	0.10	0.05	0.02
	Clerical staff and others	0.13	0.18	0.11	0.12	0.07	0.12
	Research assistants	0.01	0.05	0.02	0.04	0.06	0.04
2003	Technicians	0.00	0.09	0.09	0.10	0.05	0.01
	Clerical staff and others	0.13	0.17	0.11	0.14	0.08	0.12

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development’

Table 10-3-1: Trends in the percentage of externally-funded R&D expenditure in universities by source of funding

FY	Ratio of R&D funds by funding source (%)		
	From government	From private sector	From foreign countries
1980	92.2	7.7	0.1
1981	91.6	8.3	0.1
1982	90.5	9.4	0.0
1983	88.8	11.1	0.1
1984	83.9	15.8	0.2
1985	83.4	16.4	0.1
1986	81.9	18.0	0.1
1987	79.6	20.3	0.1
1988	76.8	22.9	0.2
1989	76.5	23.4	0.1
1990	74.1	25.8	0.1
1991	72.3	27.5	0.2
1992	70.5	29.3	0.2
1993	70.5	29.3	0.1
1994	71.7	28.2	0.1
1995	73.8	26.1	0.1
1996	74.1	25.7	0.2
1997	74.9	24.8	0.3
1998	70.8	28.9	0.2
1999	78.3	21.5	0.2
2000	77.5	22.3	0.2
2001	75.3	24.5	0.2
2002	75.1	24.4	0.2

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development’

Table 10-3-2: Trends in universities' intramural R&D expenditure funded by the business sector

(unit: million yen)

FY	Total amount	National universities	Public universities	Private universities
1986	25,974	19,231	687	6,056
1987	29,584	22,450	816	6,317
1988	36,725	26,824	901	9,001
1989	38,391	28,879	917	8,595
1990	45,244	33,375	1,368	10,503
1991	49,152	35,701	1,668	11,782
1992	55,845	40,169	2,276	13,399
1993	56,389	40,187	2,473	13,729
1994	53,098	37,279	2,736	13,083
1995	57,698	40,112	2,336	15,250
1996	56,408	39,293	2,729	14,387
1997	60,384	42,584	2,734	15,067
1998	59,375	40,436	2,719	16,221
1999	61,896	43,223	2,919	15,755
2000	67,534	46,087	3,116	18,330
2001	71,966	48,756	3,657	19,553
2002	77,816	52,920	4,330	20,567

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 10-3-3: Trends in the number of joint research projects between national universities and business enterprises

(unit: numbers)

FY	Number of contracts	Number of universities involved	Number of private enterprises involved
1983	56	21	52
1984	160	35	128
1985	216	45	168
1986	272	54	200
1987	396	57	274
1988	583	76	372
1989	705	80	445
1990	869	81	542
1991	1,139	89	683
1992	1,241	89	748
1993	1,392	90	819
1994	1,488	89	867
1995	1,707	96	981
1996	2,001	105	1,098
1997	2,362	111	1,255
1998	2,568	115	1,374
1999	3,129	121	1,618
2000	4,029	125	1,965
2001	5,264	139	2,508

Source: NISTEP, 'Business-Academia Collaboration 1983-2001 (Survey data-96)'

Table 10-3-4: Trends in the number of joint research projects between national universities and business enterprises by field of research

(unit: number)

FY	Engineering	Agriculture	Health science
1983	34	1	4
1984	101	5	8
1985	124	15	14
1986	160	18	18
1987	250	22	35
1988	407	29	39
1989	491	29	55
1990	603	42	66
1991	835	50	67
1992	907	59	73
1993	980	79	94
1994	1,011	102	99
1995	1,092	124	138
1996	1,250	141	172
1997	1,506	137	198
1998	1,590	165	205
1999	1,790	227	283
2000	2,220	294	490
2001	2,731	410	687

Source: NISTEP, 'Business-Academia Collaboration 1983-2001 (Survey Data-96)'

Table 10-3-5: Trends in the percentage of Japanese business enterprises as research partners of national universities by size of business

(unit: %)

FY	1983-1986	1986-1989	1989-1992	1992-1995	1995-1998	1998-2001
Large enterprises	87.3	83.9	78.6	75.9	72.2	66.6
Medium-and small sezed enterprises	11.2	13.7	18.2	19.6	21.7	24.8
Small enterprises	1.4	2.3	3.1	4.5	6.1	8.6

Source: NISTEP, 'Business-Academia Collaboration 1983-2001 (Survey Data-96)'

Table 11-1-1: R&D expenditure in the business sector for selected countries

(A) National currencies

Year	Japan (millon yen)	U.S. (million dollars)	Germany (million euros)	France (million euros)	U.K. (million pounds)	China (million yuan)	Korea (million won)	European Union (million dollars)
1981	3,629,793	51,810	13,394	5,611	3,793	-	-	32,203
1982	4,039,018	58,650	14,633	6,609	-	-	-	-
1983	4,560,127	65,268	15,369	7,333	4,163	-	-	37,845
1984	5,136,634	74,800	16,180	8,382	-	-	-	41,767
1985	5,939,947	84,239	18,515	9,482	5,122	-	-	47,481
1986	6,120,163	87,823	19,659	10,138	5,951	-	-	51,491
1987	6,494,268	92,155	21,131	10,896	6,335	-	-	55,629
1988	7,219,318	97,015	22,190	11,842	6,922	-	-	60,367
1989	8,233,820	102,055	23,563	13,206	7,650	-	-	65,883
1990	9,267,166	109,727	24,542	14,476	8,318	-	-	70,933
1991	9,743,048	116,952	26,421	15,286	8,135	6,350	-	72,830
1992	9,560,685	119,110	26,733	16,134	8,166	8,277	-	75,981
1993	9,053,608	117,400	26,197	16,340	8,717	10,341	-	75,470
1994	8,980,253	119,594	26,173	16,551	8,842	13,209	-	77,043
1995	9,395,896	132,103	27,014	16,649	9,116	15,229	6,960,322	81,353
1996	10,058,409	144,668	27,405	17,131	9,297	17,493	7,963,612	84,229
1997	10,658,357	157,539	28,910	17,357	9,556	23,448	8,845,307	90,409
1998	10,800,063	169,180	30,334	17,632	10,133	24,704	7,972,073	94,774
1999	10,630,161	182,711	33,623	18,655	11,302	33,665	8,511,157	104,326
2000	10,860,215	199,539	35,600	19,348	11,510	53,705	10,254,655	113,288
2001	11,451,011	209,955	36,350	20,122	12,682	63,003	12,273,579	120,127
2002	11,576,840	213,116	36,950	-	-	-	-	-

(B) Purchasing power parity equivalents

(unit: million yen)

Year	Japan	U.S.	Germany	France	U.K.	China	Korea	European Union
1981	3,629,793	12,509,799	2,629,933	1,559,192	1,739,588	-	-	7,775,633
1982	4,039,018	13,587,633	2,808,716	1,667,663	-	-	-	-
1983	4,560,127	14,727,646	2,916,564	1,717,629	1,742,615	-	-	8,539,769
1984	5,136,634	16,560,144	3,090,934	1,875,168	-	-	-	9,246,959
1985	5,939,947	18,397,536	3,542,354	2,046,869	2,032,023	-	-	10,369,681
1986	6,120,163	19,049,309	3,724,511	2,113,741	2,328,293	-	-	11,168,583
1987	6,494,268	19,367,645	3,941,611	2,208,747	2,363,130	-	-	11,691,265
1988	7,219,318	19,771,201	4,107,765	2,344,458	2,451,209	-	-	12,302,450
1989	8,233,820	20,326,498	4,357,227	2,580,384	2,580,298	-	-	13,122,089
1990	9,267,166	21,429,683	4,489,558	2,803,871	2,697,170	-	-	13,853,156
1991	9,743,048	22,578,788	4,763,584	2,972,261	2,472,132	1,005,522	-	14,060,504
1992	9,560,685	22,411,857	4,762,440	3,102,849	2,495,165	1,230,375	-	14,296,661
1993	9,053,608	21,637,595	4,490,519	3,005,522	2,520,949	1,341,626	-	13,909,656
1994	8,980,253	21,597,361	4,468,711	2,961,406	2,474,458	1,428,298	-	13,913,100
1995	9,395,896	22,449,835	4,454,519	2,873,085	2,369,155	1,435,331	1,619,224	13,825,351
1996	10,058,409	23,959,205	4,378,463	2,831,805	2,390,875	1,529,946	1,771,757	13,949,644
1997	10,658,357	25,680,684	4,744,931	2,853,344	2,474,462	1,990,365	1,914,715	14,737,634
1998	10,800,063	28,364,837	5,125,352	2,993,243	2,628,613	2,203,836	1,710,433	15,889,808
1999	10,630,161	29,605,705	5,572,894	3,106,672	2,815,211	3,035,239	1,826,896	16,904,585
2000	10,860,215	31,038,032	5,860,444	3,196,281	2,773,944	4,689,917	2,185,283	17,621,863
2001	11,451,011	31,445,821	5,696,650	3,283,022	2,965,111	5,415,644	2,539,020	17,991,883
2002	11,576,840	31,250,478	5,640,433	-	-	-	-	-

(C) Ratio of R&D expenditure per nominal GDP

(unit: %)

Year	Japan	U.S.	Germany	France	U.K.	China	Republic of Korea	European Union
1981	1.39	1.66	1.67	1.14	1.50	-	-	1.05
1982	1.47	1.80	1.76	1.17	-	-	-	-
1983	1.59	1.85	1.76	1.17	1.38	-	-	1.08
1984	1.67	1.90	1.77	1.23	-	-	-	1.11
1985	1.81	2.00	1.94	1.30	1.44	-	-	1.19
1986	1.79	1.97	1.95	1.29	1.56	-	-	1.23
1987	1.81	1.94	2.03	1.32	1.51	-	-	1.25
1988	1.87	1.90	2.02	1.33	1.48	-	-	1.25
1989	1.99	1.86	2.02	1.38	1.49	-	-	1.26
1990	2.06	1.89	1.93	1.43	1.49	-	-	1.26
1991	2.06	1.95	1.76	1.46	1.39	0.29	-	1.21
1992	1.98	1.88	1.66	1.49	1.34	0.31	-	1.18
1993	1.88	1.76	1.58	1.48	1.36	0.30	-	1.17
1994	1.83	1.69	1.51	1.45	1.30	0.28	-	1.13
1995	1.88	1.79	1.50	1.41	1.27	0.26	1.84	1.12
1996	1.96	1.85	1.49	1.41	1.22	0.26	1.90	1.12
1997	2.05	1.90	1.54	1.39	1.18	0.31	1.95	1.13
1998	2.11	1.93	1.57	1.35	1.18	0.32	1.79	1.14
1999	2.09	1.97	1.70	1.38	1.25	0.41	1.76	1.19
2000	2.12	2.03	1.75	1.36	1.21	0.60	1.96	1.22
2001	2.29	2.08	1.75	1.36	1.28	0.66	2.23	1.24
2002	2.33	2.03	1.75	-	-	-	-	-

Note: 1) GDP is the same as Reference Statistics C.

2) Purchasing power parity is the same as Reference Statistics E.

<Japan>1) Fiscal year basis.

2) Includes software for 1996-2000.

3) In the year 2001, there were changes in the classification and addition of the industry sector in the Industrial Classification for the Survey of Research and Development.

4) In 2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.

<U.S.>Excludes capital expenditure.

<Germany>Data of West Germany until 1990.

<France>1) There was a change in industrial structure during 1991-1992. (France Télécom and GIAT Industries were moved from the category of Government to Business Enterprise).

2) The estimation method was changed in 1997.

<U.K.>1) There was a change in industrial structure during 1985-1986, and in 2000. ("United Kingdom Atomic Energy Authority" was moved from the category of Government to Business Enterprise).

2) The Defence Evaluation and Research Agency (DERA) was dissolved and three quarters of it became a private limited company and moved to the category of Business Enterprise.

3) Research institutes were reclassified during 1991-1992.

<European Union>National currency is U.S. dollar purchasing power parity equivalents.

<China>1) Data are of large- and medium-sized enterprises until 1999. After 2000, data are of all the industries and enterprises above a certain size.

2) Excludes human/social science field.

<Republic of Korea> Excludes human/social science field.

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

<U.S., Germany, France, U.K., European Union, China, and Republic of Korea>OECD, "Main Science and Technology Indicators Vol. 2003 release 01"

Table 11-1-2: R&D expenditure in the business sector by character of the work for selected countries (All industries)

(unit: million yen)

	Japan				U.S.			
Year	Basic research	Applied research	Development	Total	Basic research	Applied research	Development	Total
1981	189,297	791,340	2,649,157	3,629,793	389,709	2,583,330	9,536,760	12,509,799
1982	221,386	886,110	2,931,522	4,039,018	441,106	2,854,909	10,291,619	13,587,633
1983	259,849	1,001,164	3,299,115	4,560,127	501,617	3,142,611	11,083,418	14,727,646
1984	290,030	1,128,585	3,718,020	5,136,634	577,391	3,490,250	12,492,503	16,560,144
1985	351,657	1,303,180	4,285,110	5,939,947	625,052	3,986,835	13,785,649	18,397,536
1986	371,257	1,321,836	4,427,070	6,120,163	877,817	4,286,057	13,885,435	19,049,309
1987	429,203	1,407,164	4,657,901	6,494,268	908,538	4,163,975	14,295,132	19,367,645
1988	474,913	1,568,789	5,175,616	7,219,318	917,079	4,228,345	14,625,777	19,771,201
1989	524,321	1,767,809	5,941,690	8,233,820	1,038,881	4,519,412	14,768,205	20,326,498
1990	589,072	2,023,938	6,654,157	9,267,166	1,001,498	4,840,511	15,587,674	21,429,683
1991	660,219	2,159,736	6,923,093	9,743,048	1,513,014	5,298,733	15,767,042	22,578,788
1992	656,014	2,111,237	6,793,435	9,560,685	1,317,503	4,923,609	16,170,745	22,411,857
1993	605,047	1,936,170	6,512,391	9,053,608	1,275,217	4,549,793	15,812,585	21,637,595
1994	606,380	1,991,048	6,382,824	8,980,253	1,267,193	4,242,216	16,087,952	21,597,361
1995	624,004	2,071,564	6,700,328	9,395,896	1,036,476	4,665,585	16,747,774	22,449,835
1996	619,790	2,218,713	7,219,907	10,058,409	1,359,038	4,842,751	17,757,417	23,959,205
1997	665,953	2,298,707	7,693,697	10,658,357	1,698,581	5,321,188	18,660,916	25,680,684
1998	600,746	2,360,466	7,838,851	10,800,063	2,279,347	5,125,555	20,959,935	28,364,837
1999	614,213	2,183,879	7,832,069	10,630,161	2,485,952	5,775,114	21,344,639	29,623,853
2000	624,975	2,311,626	7,923,614	10,860,215	3,020,289	5,751,258	22,266,485	31,087,185
2001	657,950	2,329,509	8,438,490	11,425,949	3,066,325	5,824,565	22,555,081	31,445,821
2002	686,171	2,250,394	8,614,430	11,550,996	-	-	-	-

(unit: million yen)

	Germany					France				
Year	Basic research	Applied research	Development	Unclassified	Total	Basic research	Applied research	Development	Unclassified	Total
1981	131,714	-	-	2,198,093	2,329,787	44,017	456,595	1,058,580	-	1,559,192
1982	-	-	-	-	-	46,658	498,624	1,122,332	-	1,667,663
1983	127,484	-	-	2,468,891	2,596,394	51,276	526,233	1,140,097	-	1,717,629
1984	-	-	-	-	-	-	-	-	1,875,168	1,875,168
1985	130,502	-	-	2,992,889	3,123,372	-	-	-	2,046,869	2,046,869
1986	-	-	-	-	-	63,406	642,585	1,407,750	-	2,113,741
1987	175,003	-	-	3,306,997	3,482,019	81,730	653,802	1,473,234	-	2,208,747
1988	-	-	-	-	-	105,521	726,785	1,512,171	-	2,344,458
1989	228,888	-	-	3,639,443	3,868,330	97,603	739,651	1,743,131	-	2,580,384
1990	-	-	-	-	-	118,559	807,658	1,877,673	-	2,803,871
1991	246,320	-	-	4,047,956	4,294,366	124,831	817,371	2,030,059	-	2,972,261
1992	-	-	-	-	-	136,524	874,995	2,091,310	-	3,102,849
1993	197,900	-	-	3,931,788	4,129,688	130,762	754,388	2,120,354	-	3,005,522
1994	-	-	-	-	-	141,369	744,221	2,075,798	-	2,961,406
1995	210,012	-	-	3,912,489	4,122,501	120,675	732,641	2,019,786	-	2,873,085
1996	-	-	-	-	-	118,455	711,902	2,001,465	-	2,831,805
1997	230,517	-	-	4,166,742	4,397,177	125,810	778,875	1,948,659	-	2,853,344
1998	-	-	-	-	-	133,215	840,018	2,020,026	-	2,993,243
1999	261,783	-	-	4,831,187	5,092,970	140,503	911,447	2,054,723	-	3,106,672
2000	-	-	-	-	-	132,586	1,157,199	1,906,496	-	3,196,281
2001	-	-	-	-	-	-	-	-	-	3,283,022
2002	-	-	-	-	-	-	-	-	-	-

(unit: million yen)

Year	U.K.					Republic of Korea				
	Basic research	Applied research	Development	Unclassified	Total	Basic research	Applied research	Development	Unclassified	Total
1981	-	-	-	-	1,591,339	-	-	-	-	-
1982	-	-	-	-	-	-	-	-	-	-
1983	-	-	-	-	1,612,859	-	-	-	-	-
1984	-	-	-	-	-	-	-	-	-	-
1985	-	-	-	-	1,827,552	-	-	-	-	-
1986	-	-	-	-	2,116,630	-	-	-	-	-
1987	-	-	-	2,132,599	2,132,599	-	-	-	-	-
1988	-	-	-	2,211,719	2,211,719	-	-	-	-	-
1989	109,081	633,269	1,538,566	-	2,297,645	-	-	-	-	-
1990	83,658	569,071	1,704,295	-	2,423,173	-	-	-	-	-
1991	68,375	482,575	1,582,043	-	2,238,746	-	-	-	-	-
1992	-	-	-	2,319,471	2,224,749	-	-	-	-	-
1993	100,930	745,845	1,478,675	-	2,227,990	-	-	-	-	-
1994	128,173	708,307	1,451,037	-	2,188,729	-	-	-	-	-
1995	91,221	707,160	1,343,370	-	2,106,406	-	-	-	1,619,224	1,619,224
1996	101,838	758,898	1,317,463	-	2,143,995	143,901	466,092	1,161,763	-	1,771,757
1997	106,689	796,543	1,285,448	-	2,188,680	155,209	509,430	1,250,075	-	1,914,715
1998	114,143	926,375	1,318,613	-	2,359,131	110,835	360,389	1,239,209	-	1,710,433
1999	124,547	979,189	1,406,385	-	2,510,121	137,361	392,665	1,296,871	-	1,826,896
2000	120,024	853,662	1,516,202	-	2,489,888	134,282	473,552	1,577,448	-	2,185,283
2001	-	-	-	-	-	-	-	-	-	-
2002	-	-	-	-	-	-	-	-	-	-

Note: Purchasing power parity is the same as Reference Statistics E.

<Japan, France, and Republic of Korea>Total R&D expenditure (current expenditure for R&D + capital expenditure for R&D)

<U.S., Germany, and U.K.>Current expenditure for R&D

<Japan>1) Fiscal year basis.

2) Includes software for the year 1996-2000.

3) In the year 2001, there were changes in the classification and addition of the industry sector in the Industrial Classification for the Survey of Research and Development.

4) In 2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.

5) Until 2000, all industrial R&D expenditure was defined as ‘research expenditure used for natural science.’

6) After 2001, it is indicated as ‘expenditure used for natural science out of industrial R&D expenditure.’

<U.S.> The total for each category may not be consistent with the grand total.

<Germany>1) West Germany until 1990.

2) The total for each category may not be consistent with the grand total.

<France>1) There was a change in the classification for the survey in 1991 (France Télécom and GIAT Industries were moved from the category of Government to Business Enterprise).

2) The statistical method was changed in 1998 (Estimation method of R&D expenditure, evaluation method of the defense field, evaluation method of R&D activities in large enterprises).

3) The total for each category may not be consistent with the grand total.

<U.K.>1) There was a change in classification for the survey during 1985-1986. The “United Kingdom Atomic Energy Authority (UKAEA)” was moved from the category of Government to Business Enterprise).

2) The total for each category may not be consistent with the grand total.

<Republic of Korea>1) Excludes human/social science field.

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development’

<U.S., Germany, France, U.K., Republic of Korea>OECD, “Basic Science and Technology Statistics Vol. 2002 release 01”

Table 11-1-3: R&D expenditure in the business sector by type of cost for selected countries (All industries)

(unit: million yen)

Year	Japan				
	Labor costs	Other current expenditure	Land and buildings	Appliances/ equipment	Total R&D expenditure
1981	1,605,200	1,443,081	133,263	448,249	3,629,793
1982	1,750,005	1,645,554	134,167	509,293	4,039,018
1983	1,984,924	1,871,318	151,929	551,956	4,560,127
1984	2,160,262	2,179,427	141,931	655,014	5,136,634
1985	2,415,522	2,547,070	199,882	777,473	5,939,947
1986	2,528,734	2,631,672	197,117	762,641	6,120,163
1987	2,685,538	2,797,492	219,863	791,376	6,494,268
1988	2,936,934	3,222,824	177,066	882,495	7,219,318
1989	3,247,537	3,700,816	294,590	990,877	8,233,820
1990	3,591,997	4,239,672	313,585	1,121,913	9,267,166
1991	3,767,837	4,449,658	414,832	1,110,721	9,743,048
1992	3,926,126	4,390,143	310,395	934,021	9,560,685
1993	3,962,040	4,066,171	252,572	772,825	9,053,608
1994	4,022,383	4,023,547	183,381	750,941	8,980,253
1995	4,167,244	4,215,127	162,271	851,254	9,395,896
1996	4,375,519	4,627,918	170,737	884,235	10,058,409
1997	4,532,908	4,968,356	199,520	957,574	10,658,357
1998	4,665,438	5,069,873	146,813	917,939	10,800,063
1999	4,627,391	5,015,771	146,737	840,264	10,630,161
2000	4,532,255	5,276,718	169,785	881,459	10,860,215
2001	4,731,473	5,683,944	169,381	866,213	11,451,011
2002	4,745,939	5,860,607	157,555	812,739	11,576,840

(unit: million yen)

Year	U.S.				Germany			
	Labor costs	Other current expenditure	Total capital expenditure	Total R&D expenditure	Labor costs	Other current expenditure	Total capital expenditure	Total R&D expenditure
1981	5,752,383	6,757,416	-	12,509,799	1,520,774	809,014	254,945	2,629,933
1982	-	-	-	13,587,633	-	-	-	2,808,716
1983	6,716,482	8,011,164	-	14,727,646	1,685,430	910,964	288,157	2,916,564
1984	-	-	-	16,560,144	-	-	-	3,090,934
1985	7,910,947	10,486,589	-	18,397,536	2,034,908	1,088,464	384,734	3,542,354
1986	-	-	-	19,049,309	-	-	-	3,724,511
1987	8,056,945	11,310,700	-	19,367,645	2,289,493	1,192,433	430,027	3,941,611
1988	-	-	-	19,771,201	-	-	-	4,107,765
1989	8,110,264	12,216,235	-	20,326,498	2,520,300	1,348,123	484,071	4,357,227
1990	-	-	-	21,429,683	-	-	-	4,489,558
1991	9,392,770	13,186,018	-	22,578,788	2,743,843	1,550,522	437,595	4,763,584
1992	-	-	-	22,411,857	-	-	-	4,762,440
1993	9,152,703	12,484,892	-	21,637,595	2,664,801	1,464,871	315,697	4,490,519
1994	-	-	-	21,597,361	-	-	-	4,468,711
1995	10,124,883	12,324,951	-	22,449,835	2,645,741	1,476,776	299,468	4,454,519
1996	-	-	-	23,959,205	-	-	-	4,378,463
1997	12,069,917	13,610,768	-	25,680,684	2,919,306	1,477,953	347,672	4,744,931
1998	13,615,122	14,749,715	-	28,364,837	-	-	-	5,125,352
1999	13,271,485	16,352,367	-	29,605,705	3,302,538	1,790,432	479,908	5,572,894
2000	-	-	-	31,038,032	-	-	-	5,860,444
2001	-	-	-	31,445,821	-	-	-	5,831,426

(unit: million yen)

Year	France				
	Labor costs	Other current expenditure	Land and buildings	Appliances/ equipment	Total R&D expenditure
1981	866,838	576,141	28,817	87,395	1,559,192
1982	931,639	602,335	30,129	103,560	1,667,663
1983	962,539	626,654	24,455	103,958	1,717,629
1984	-	-	-	-	1,875,168
1985	1,099,756	777,849	30,870	138,373	2,046,869
1986	1,104,441	825,130	35,758	148,412	2,113,741
1987	1,144,489	870,858	43,237	150,184	2,208,747
1988	1,186,206	947,468	47,514	163,250	2,344,458
1989	1,257,463	1,063,586	49,964	209,391	2,580,384
1990	1,334,385	1,234,866	40,211	194,409	2,803,871
1991	1,440,884	1,304,698	45,207	181,472	2,972,261
1992	1,539,578	1,336,128	38,655	188,488	3,102,849
1993	1,525,165	1,270,207	40,779	169,371	3,005,522
1994	1,491,304	1,269,598	33,047	167,456	2,961,406
1995	1,469,977	1,192,165	34,772	176,171	2,873,085
1996	1,450,715	1,172,001	33,639	175,451	2,831,805
1997	1,515,534	1,118,231	35,624	183,939	2,853,344
1998	1,592,250	1,185,475	33,240	182,278	2,993,243
1999	1,625,153	1,270,307	31,508	179,705	3,106,672
2000	1,695,838	1,251,443	26,547	222,470	3,196,281
2001	-	-	-	-	3,283,022

(unit: million yen)

Year	U.K.					
	Labor costs	Other current expenditure	Land and buildings	Appliances/ equipment	Total capital expenditure	Total R&D expenditure
1981	781,014	810,325	45,869	102,380	148,249	1,739,588
1982	-	-	-	-	-	-
1983	787,531	825,328	-	-	129,797	1,742,615
1984	-	-	-	-	-	-
1985	858,512	969,040	40,149	164,165	204,313	2,032,023
1986	991,804	1,124,827	-	-	211,546	2,328,293
1987	984,756	1,147,844	-	-	230,606	2,363,130
1988	1,014,585	1,197,134	-	-	239,349	2,451,209
1989	1,088,784	1,208,861	81,423	201,263	282,652	2,580,298
1990	1,134,575	1,288,597	-	-	273,997	2,697,170
1991	1,066,952	1,171,794	-	-	233,386	2,472,132
1992	1,070,972	1,154,388	-	-	270,417	2,495,165
1993	1,096,065	1,132,215	109,028	184,220	293,248	2,520,949
1994	1,066,239	1,122,769	106,624	179,106	285,730	2,474,458
1995	931,705	1,174,702	63,153	199,595	262,749	2,369,155
1996	954,087	1,189,908	65,577	181,302	246,880	2,390,875
1997	953,728	1,234,952	87,526	198,359	285,885	2,474,462
1998	1,040,778	1,318,353	86,126	183,407	269,533	2,628,613
1999	1,118,682	1,391,440	93,161	211,979	305,140	2,815,211
2000	1,114,677	1,375,211	95,923	188,230	284,152	2,773,944
2001	-	-	-	-	-	-

(unit: million yen)

Year	Republic of Korea				
	Labor costs	Other current expenditure	Land and buildings	Appliances/ equipment	Total R&D expenditure
1981	-	-	-	-	-
1982	-	-	-	-	-
1983	-	-	-	-	-
1984	-	-	-	-	-
1985	-	-	-	-	-
1986	-	-	-	-	-
1987	-	-	-	-	-
1988	-	-	-	-	-
1989	-	-	-	-	-
1990	-	-	-	-	-
1991	-	-	-	-	-
1992	-	-	-	-	-
1993	-	-	-	-	-
1994	-	-	-	-	-
1995	-	-	-	-	1,619,224
1996	598,928	711,508	106,381	354,939	1,771,757
1997	664,640	812,201	74,607	363,267	1,914,715
1998	603,558	697,437	56,186	353,252	1,710,433
1999	-	-	-	-	1,826,896
2000	-	-	-	-	2,185,283
2001	-	-	-	-	-

Note: Purchasing power parity is the same as Reference Statistics E.

<Japan>1) Fiscal year basis.

2) Includes software for the year 1996-2000.

3) In the year 2001, there were changes in the classification and addition of the industry sector in the Industrial Classification for the Survey of Research and Development.

4) In 2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.

5) Because of different classification of data in Japan from that of other countries, Japanese data were reclassified as follows.

Japan (Ministry of Public Management, Home Affairs, Posts and Telecommunications) data: table above

Labor costs

Cost of raw materials + other expense (+lease expense (after 2001): Other current expenditure (other current costs)

Land, building, etc.: Land and buildings

Machinery/appliances/equipment + other tangible fixed assets: Instruments and equipment

<U.S.>1) Total R&D expenditure excludes most of or all capital expenditure.

2) After 1999: The industrial classification was changed from SIC to NAICS. Also, exclude R&D expenditure for agriculture field.

3) The total for each category may not be consistent with the grand total.

<Germany>1) West Germany until 1990.

2) The total for each category may not be consistent with the grand total.

<France>1) There was a change in classification for the survey in 1992 (France Télécom and GIAT Industries were moved from the category of Government to Business Enterprise).

2) The statistical method was changed in 1998 (Estimation method of R&D expenditure, evaluation method of defense field, evaluation method of R&D activities in large enterprises).

3) The total for each category may not be consistent with the grand total.

<U.K.>1) There was a change in the classification for the survey during 1985-1986. ("United Kingdom Atomic Energy Authority (UKAEA)" was moved from the category of Government to Business Enterprise).

2) The figures for R&D expenditure were changed in 1992.

3) The total for each category may not be consistent with the grand total.

<Republic of Korea>1) Excludes human/social science field.

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

<U.S., Germany, France, U.K., and Republic of Korea>OECD, "Basic Science and Technology Statistics Vol. 2002 release 01"

Table 11-1-4: Comparison of R&D expenditure in all industries and the manufacturing sector for selected countries

(A) All industries

(unit: million yen)

Year	Japan	U.S.	Germany	France	U.K.	Republic of Korea
1987	6,494,268	19,367,645	3,941,611	2,208,747	2,363,130	-
1988	7,219,318	19,771,160	4,107,765	2,344,458	2,451,209	-
1989	8,233,820	20,326,439	4,357,227	2,580,384	2,580,298	-
1990	9,267,166	21,429,742	4,489,558	2,803,871	2,697,170	-
1991	9,743,048	22,578,788	4,763,584	2,972,261	2,472,132	-
1992	9,560,685	22,411,857	4,762,440	3,102,849	2,495,165	-
1993	9,053,608	21,637,411	4,490,519	3,005,522	2,520,949	-
1994	8,980,253	21,597,541	4,468,711	2,961,406	2,474,458	-
1995	9,395,896	22,449,835	4,454,519	2,873,085	2,369,155	1,619,224
1996	10,058,409	23,959,040	4,378,463	2,831,805	2,390,875	1,771,757
1997	10,658,357	25,680,684	4,744,931	2,853,344	2,474,462	1,914,715
1998	10,800,063	28,364,837	5,125,352	2,993,243	2,628,613	1,710,433
1999	10,630,161	29,623,853	5,572,894	3,106,672	2,815,211	1,826,896
2000	10,860,215	31,038,032	5,860,444	3,196,215	2,773,944	2,185,283
2001	11,451,011	-	-	-	2,965,088	-
2002	11,576,840	-	-	-	-	-

(B) Manufacturing

(unit: million yen)

Year	Japan	U.S.	Germany	France	U.K.	Republic of Korea
1987	6,101,202	17,719,120	3,741,427	2,047,638	1,864,803	-
1988	6,754,620	17,628,701	3,938,327	2,160,183	1,960,401	-
1989	7,706,193	17,531,916	4,183,648	2,375,272	2,056,818	-
1990	8,660,299	17,368,810	4,312,607	2,589,318	2,183,871	-
1991	9,195,415	17,086,995	4,544,183	2,737,474	1,971,324	-
1992	8,971,137	16,967,794	4,439,955	2,756,528	2,003,832	-
1993	8,454,623	16,759,183	4,223,899	2,665,051	2,014,272	-
1994	8,365,478	17,391,985	4,214,244	2,627,263	1,973,242	-
1995	8,774,360	17,714,234	4,212,221	2,537,601	1,860,031	1,349,497
1996	9,263,151	19,369,183	4,153,415	2,482,226	1,868,313	1,498,198
1997	9,816,437	20,523,486	4,434,861	2,435,064	1,970,123	1,595,637
1998	9,807,147	21,032,532	4,814,446	2,558,320	2,112,426	1,381,553
1999	9,521,573	19,859,906	5,063,649	2,662,964	2,240,601	1,490,728
2000	9,815,988	20,158,178	5,348,478	-	2,224,775	1,829,461
2001	9,884,858	-	-	-	2,347,147	-
2002	10,081,287	-	-	-	-	-

(C) Drugs and medicines

(unit: million yen)

Year	Japan	U.S.	Germany	France	U.K.	Republic of Korea
1987	380,701	861,672	-	157,846	252,913	-
1988	416,220	999,861	-	163,092	296,397	-
1989	455,950	1,156,731	-	186,490	319,080	-
1990	516,062	1,227,929	-	207,464	391,054	-
1991	590,105	1,363,160	-	227,574	364,362	-
1992	643,415	1,494,751	-	293,742	441,833	-
1993	629,179	1,685,668	-	324,155	485,565	-
1994	632,802	1,739,614	-	338,329	509,332	-
1995	642,190	1,735,957	206,137	344,388	471,180	22,533
1996	667,145	1,618,556	246,074	347,182	476,272	26,625
1997	643,291	1,939,626	310,661	358,261	557,010	26,441
1998	681,118	2,123,741	351,846	381,973	580,573	17,348
1999	689,449	1,993,768	346,365	409,269	631,453	35,988
2000	746,214	2,013,609	355,578	396,636	685,918	29,543
2001	810,935	-	-	-	-	-
2002	965,723	-	-	-	-	-

(D) General machinery

(unit: million yen)

Year	Japan	U.S.	Germany	France	U.K.	Republic of Korea
1987	418,769	510,278	-	80,555	143,616	-
1988	450,979	546,620	-	82,635	129,962	-
1989	558,974	543,560	-	91,662	195,630	-
1990	650,332	537,661	-	125,455	155,643	-
1991	674,413	686,291	-	127,262	148,905	-
1992	651,960	664,923	-	176,987	157,972	-
1993	661,115	632,356	-	164,625	171,495	-
1994	696,736	723,078	-	156,237	192,819	-
1995	705,222	856,677	504,928	139,398	151,516	81,970
1996	733,707	1,011,594	493,458	131,381	148,385	64,777
1997	790,057	959,926	523,731	125,941	161,069	67,357
1998	811,653	1,025,413	583,222	137,510	166,026	93,673
1999	811,364	1,025,200	564,075	138,322	159,918	53,133
2000	883,617	1,052,443	556,413	152,146	169,431	60,472
2001	815,322	-	-	-	-	-
2002	939,225	-	-	-	-	-

(E) Electrical machinery, equipment and supplies

(unit: million yen)

Year	Japan	U.S.	Germany	France	U.K.	Republic of Korea
1987	665,704	260,393	-	63,953	168,235	-
1988	741,825	289,226	-	75,310	156,520	-
1989	866,425	423,440	-	71,399	143,687	-
1990	996,204	672,613	-	79,646	162,777	-
1991	1,010,003	596,653	-	88,393	157,414	-
1992	967,371	512,174	-	99,908	159,805	-
1993	970,504	467,586	-	102,104	166,579	-
1994	1,007,125	481,089	-	102,542	158,677	-
1995	1,032,887	590,208	320,294	103,159	128,386	31,099
1996	1,093,333	556,467	218,402	96,271	126,011	31,986
1997	1,141,846	734,758	143,924	101,003	109,797	34,655
1998	1,124,146	812,350	157,168	109,499	109,733	41,100
1999	1,009,639	684,520	169,246	114,857	88,927	43,561
2000	1,067,084	595,503	176,159	112,003	101,707	37,627
2001	1,053,900	-	-	-	-	-
2002	733,354	-	-	-	-	-

(F) Communication and electronic equipment

(unit: million yen)

Year	Japan	U.S.	Germany	France	U.K.	Republic of Korea
1987	1,497,840	3,070,283	-	208,441	173,458	-
1988	1,709,769	2,589,994	-	199,796	204,681	-
1989	1,941,699	2,229,133	-	216,074	167,635	-
1990	2,150,049	1,944,407	-	223,289	192,284	-
1991	2,372,773	1,993,251	-	240,465	147,082	-
1992	2,253,142	2,001,657	-	305,954	146,361	-
1993	2,049,343	1,992,723	-	313,045	161,373	-
1994	2,057,642	2,288,785	-	337,596	144,684	-
1995	2,240,714	2,596,372	446,423	315,587	156,454	510,983
1996	2,400,304	3,169,542	479,942	326,089	170,244	581,655
1997	2,577,601	3,335,967	537,748	329,738	169,615	659,244
1998	2,588,619	3,576,169	573,591	385,368	200,269	597,574
1999	2,606,237	2,862,976	603,722	388,802	215,965	726,363
2000	2,752,918	4,012,379	628,434	438,265	246,796	802,909
2001	2,798,546	-	-	-	-	-
2002	4,075,743	-	-	-	-	-

(G) Precision instruments

(unit: million yen)

Year	Japan	U.S.	Germany	France	U.K.	Republic of Korea
1987	204,228	1,097,475	-	331,259	92,138	-
1988	238,753	1,126,988	-	352,870	97,737	-
1989	266,110	1,193,439	-	391,564	97,478	-
1990	335,825	1,377,842	-	419,712	86,901	-
1991	313,969	1,680,590	-	436,481	83,873	-
1992	327,219	1,795,432	-	361,648	86,472	-
1993	321,477	1,864,998	-	327,816	90,230	-
1994	333,506	2,066,119	-	320,222	76,400	-
1995	355,401	2,035,224	266,505	297,329	78,747	11,313
1996	366,297	2,012,058	247,528	267,606	78,950	12,191
1997	426,182	2,255,265	246,126	274,798	87,009	16,296
1998	473,722	2,486,928	262,347	212,037	88,202	15,956
1999	491,530	3,170,391	275,938	209,231	117,822	13,164
2000	486,859	2,985,135	287,228	218,059	115,685	22,718
2001	490,617	-	-	-	-	-
2002	452,884	-	-	-	-	-

(H) Motor vehicles

(unit: million yen)

Year	Japan	U.S.	Germany	France	U.K.	Republic of Korea
1987	814,766	1,950,194	-	222,610	177,934	-
1988	932,400	2,055,357	-	245,132	178,476	-
1989	1,087,197	2,194,895	-	293,766	183,825	-
1990	1,295,575	2,002,919	-	320,813	185,151	-
1991	1,286,120	2,005,433	-	342,994	183,852	-
1992	1,289,020	1,867,234	-	339,109	194,333	-
1993	1,093,556	2,159,705	-	359,453	197,234	-
1994	1,021,291	2,420,922	-	388,249	187,222	-
1995	1,169,269	2,549,706	943,849	370,721	206,612	341,246
1996	1,315,445	2,653,469	1,003,452	335,627	238,136	409,719
1997	1,445,220	2,478,021	1,147,564	336,183	239,274	426,342
1998	1,427,331	2,400,063	1,347,774	356,457	236,847	315,178
1999	1,335,053	2,961,040	1,561,351	414,831	264,040	241,305
2000	1,376,956	2,890,313	1,733,440	441,239	208,234	312,357
2001	1,492,376	-	-	-	-	-
2002	1,677,626	-	-	-	-	-

Note: 1) Purchasing power parity is the same as Reference Statistics E.

2) The industrial classification in Japan is based on the Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development,' in which the Japan Standard Industry Classification is partially modified.

3) The industrial classification of U.S., Germany, France (until 1999), U.K. (until 2000), and Republic of Korea is based on ISIC Rev.3.

4) The industrial classification of France (in 2000) is based on SIC in France.

5) The industrial classification of U.K. (in 2001) is based on SIC in U.K.

6) The Japan Standard Industry Classification is not consistent with ISIC Rev.3.

7) The Japanese title of each table is from the Ministry of Public Management, Home Affairs, Posts and Telecommunications data, and English title of each table is from OECD data.

<Japan>1) Fiscal year basis.

2) Includes software industry for the year 1996-2000.

3) In the year 2001, there were changes in the classification and addition of the industry sector in Industrial Classification for the Survey of Research and Development.

4) In 2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.

5) Along with these changes, the classification of 2001 for industrial classification was used for 2002 for this table as follows.

Table E: Electrical machinery and apparatus ← 'Other electrical machinery and apparatus, n.e.c.' in 2002.

Table F: Radio, television and communications equipment ← 'Applied electronics/electrical measuring instruments' + 'Information-communications equipment' + 'electronic parts/devices' in 2002

<U.S.>Table B-H: Industrial classification was changed in 1999.

<Germany>Data for West Germany only until 1990.

<France>1) Table A: GIAT Industries and France Télécom were moved from the category of Government to Business Enterprise.

2) Table B: In 2000 value, the manufacturing industry could not be selected from as ISIC Rev.3 and SIC of France are different.

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

<U.S., Germany, France (until 1999), U.K. (until 2000), Republic of Korea>OECD, "STAN database for industrial analysis, ANBERD, Research and Development Expenditure in Industry (ISIC Rev.3) Vol. 2002 release 01"

<France (2000)>Ministère de la Jeunesse de l'Education nationale et de la Recherche (MJENR), Le numéro spécial Recherche et Innovation de la revue Education et Formation (n ° 59, Septembre 2001)

<U.K. (2001)>Office for National Statistics, Expenditure on R&D performed in UK businesses: 1980-2001

Table 11-1-5: Trends in the number of researchers in the business sector for selected countries (All industries)

(unit: persons)

Year	Japan (HC)	Japan (FTE)	U.S.	Germany	France	U.K.
1981	-	184,889	498,800	77,017	35,095	77,000
1982	-	192,942	525,400	-	37,366	77,000
1983	-	201,137	562,500	81,867	38,269	77,000
1984	-	223,882	603,300	-	41,515	79,000
1985	-	231,097	646,800	93,546	43,863	81,000
1986	-	251,771	683,400	-	45,403	87,000
1987	-	260,846	702,200	107,113	49,157	87,000
1988	-	279,298	715,600	-	51,842	89,000
1989	-	294,202	733,000	113,247	54,352	85,000
1990	-	313,948	758,500	-	57,030	83,000
1991	-	330,996	776,400	141,084	59,594	80,000
1992	-	340,809	772,000	134,600	64,688	80,000
1993	-	356,406	766,600	128,956	66,455	82,000
1994	-	367,278	757,300	-	66,713	75,000
1995	-	376,639	789,400	129,370	66,618	82,000
1996	-	384,100	859,300	126,392	68,487	82,119
1997	-	400,361	918,600	132,687	72,023	82,695
1998	-	404,232	974,600	133,529	71,717	91,271
1999	-	429,195	1,015,700	150,150	75,390	92,133
2000	-	433,758	1,037,500	153,120	81,012	85,755
2001	-	421,363	1,041,300	154,020	-	93,165
2002	461,962	430,688	-	-	-	-
2003	460,053	431,190	-	-	-	-

(unit: persons)

Year	China	Republic of Korea	EU
1981	-	-	244,404
1982	-	-	-
1983	-	-	257,613
1984	-	-	-
1985	-	-	289,373
1986	-	-	-
1987	-	-	323,999
1988	-	-	-
1989	-	-	340,575
1990	-	-	-
1991	126,000	-	374,169
1992	135,600	-	375,771
1993	156,400	-	377,058
1994	186,900	-	-
1995	192,900	67,226	388,335
1996	223,700	66,218	394,045
1997	225,400	69,871	418,270
1998	149,000	60,064	437,827
1999	171,900	65,474	466,600
2000	353,843	71,894	484,204
2001	388,500	100,169	-
2002	-	-	-
2003	-	-	-

Note: <U.S., Germany, France, U.K., European Union, Republic of Korea, China>FTE value.

<Japan>1) Not actual data of whole industry.

2) Include software industry during 1997-2001.

3) In 2002, the Industrial Classification for the Survey of Research and Development was changed; change of definition of 'researcher,' the addition of industry sector, and change in classification surveyed.

4) In 2003, the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development were changed.

5) Until 2001, the number of full-time researchers (FTE), and after 2002, number of researchers (Head-counts and FTE).

6) The timing of the survey was as of April 1st until 2001, and as of March 31st after 2002.

<U.S.>1) Annual average until 2000, and figure as of January 1st after 2001.

2) The number of researchers is the number of scientists and engineers.

3) The estimation method of the number of researchers was changed in 1985.

<Germany>Data for West Germany until 1990.

<France>1) There was a change in the classification for the survey during 1991-1992 (France Télécom and GIAT Industries were moved from the category of Government to Business Enterprise).

2) The survey procedure for managerial class researchers was changed in 1997.

<U.K.>1) There was a change in the classification for the survey during 1985-1986 and in 2000 (“United Kingdom Atomic Energy Authority” was moved from the category of Government to Business Enterprise during 1985-1986).

2) In 2000, the Defence Evaluation and Research Agency (DERA) was dissolved and three quarters of it became private limited company and moved to the category of Business Enterprise.

3) Classification of research institutes was reclassified during 1991-1992.

<China>1) Excludes human/social science field.

2) Until 1999, used data of large- and medium-sized enterprises. After 2000, data of all the industry and enterprises above certain size were used.

<Republic of Korea>Excludes human/social science field.

<European Union>No definition of country.

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development’

<U.S.>Until 2000: OECD, “Main Science and Technology Indicators Vol. 2003 release 01”

2001: NSF, “Research & Development in Industry: 2000”

<Germany, France, U.K., European Union, China, Republic of Korea>OECD, “Main Science and Technology Indicators Vol. 2003 release 01”

Table 11-1-6: Trends in R&D expenditure per researcher (All industries)

(unit: 10,000 yen/person)

Year	Japan (HC)	Japan (FTE)	U.S.	Germany	France
1981	-	1,881	2,508	3,415	4,443
1982	-	2,008	2,586	-	4,463
1983	-	2,037	2,618	3,563	4,488
1984	-	2,223	2,745	-	4,517
1985	-	2,359	2,844	3,787	4,667
1986	-	2,346	2,787	-	4,656
1987	-	2,325	2,758	3,680	4,493
1988	-	2,454	2,763	-	4,522
1989	-	2,623	2,773	3,848	4,748
1990	-	2,800	2,825	-	4,916
1991	-	2,859	2,908	3,376	4,988
1992	-	2,683	2,903	3,538	4,797
1993	-	2,465	2,823	3,482	4,523
1994	-	2,384	2,852	-	4,439
1995	-	2,446	2,844	3,443	4,313
1996	-	2,512	2,788	3,464	4,135
1997	-	2,637	2,796	3,576	3,962
1998	-	2,516	2,910	3,838	4,174
1999	-	2,451	2,915	3,712	4,121
2000	-	2,577	2,992	3,827	3,945
2001	2,479	2,659	3,020	3,699	-
2002	2,516	2,685	-	-	-

(unit: 10,000 yen/person)

Year	U.K.	China	Republic of Korea	EU
1981	2,259	-	-	3,181
1982	-	-	-	-
1983	2,263	-	-	3,315
1984	-	-	-	-
1985	2,509	-	-	3,583
1986	2,676	-	-	-
1987	2,716	-	-	3,608
1988	2,754	-	-	-
1989	3,036	-	-	3,853
1990	3,250	-	-	-
1991	3,090	798	-	3,758
1992	3,119	907	-	3,805
1993	3,074	858	-	3,689
1994	3,299	764	-	-
1995	2,889	744	2,409	3,560
1996	2,911	684	2,676	3,540
1997	2,992	883	2,740	3,523
1998	2,880	1,479	2,848	3,629
1999	3,056	1,766	2,790	3,623
2000	3,235	1,325	3,040	3,639
2001	3,183	1,394	2,535	-
2002	-	-	-	-

Note: 1) Development costs: Same asTable 11-1-1.

2) Number of researcher: Same asTable 11-1-5.

3) Calculation formula: (R&D expenditure) ÷ (number of researcher)

4) The figure for Japan in 2001 is based on R&D expenditure for 2001 and the number of researchers in 2002.

5) The figure for Japan in 2002 is based on R&D expenditure for 2002 and the number of researchers in 2003.

Source: R&D expenditure: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

<U.S., Germany, France, U.K., European Union, China, Republic of Korea>OECD, "Main Science and Technology Indicators Vol. 2003 release 01"

Number of researchers: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

<U.S.>Until 2000: OECD, "Main Science and Technology Indicators Vol. 2003 release 01"

2001: NSF, "Research & Development in Industry: 2000 (Early Release Tables)"

<Germany, France, U.K., European Union, China, Republic of Korea>OECD, "Main Science and Technology Indicators Vol. 2003 release 01"

Table 11-2-1: Trends in R&D expenditure by industry and the number of business enterprises performing R&D in all industries in Japan

(A) R&D expenditure by industrial classification

(unit: million yen)

FY	All industries	Manufacturing	Manufacturing				
			Drugs and medicines	Chemical products	Drugs and medicines	Iron and steel	General machienery
1980	3,142,256	2,895,571	-	558,252	189,838	147,064	218,877
1981	3,629,793	3,374,224	-	617,354	218,435	169,653	242,096
1982	4,039,018	3,755,536	-	687,493	239,817	182,772	281,024
1983	4,560,127	4,257,191	-	774,532	289,896	186,088	311,678
1984	5,136,634	4,776,501	-	852,793	295,284	192,091	337,492
1985	5,939,947	5,543,618	-	936,360	341,880	240,409	382,698
1986	6,120,163	5,739,603	-	983,585	341,978	255,290	379,095
1987	6,494,268	6,101,202	-	1,095,887	380,701	245,176	418,769
1988	7,219,318	6,754,620	-	1,190,226	416,220	249,734	450,979
1989	8,233,820	7,706,193	-	1,313,882	455,950	268,131	558,974
1990	9,267,166	8,660,299	-	1,416,775	516,062	303,805	650,332
1991	9,743,048	9,195,415	-	1,547,707	590,105	360,054	674,413
1992	9,560,685	8,971,137	-	1,604,722	643,415	311,485	651,960
1993	9,053,608	8,454,623	-	1,561,433	629,179	286,114	661,115
1994	8,980,253	8,365,478	-	1,548,794	632,802	237,707	696,736
1995	9,395,896	8,774,360	-	1,554,884	642,190	213,541	705,222
1996	10,058,409	9,263,151	-	1,593,250	667,145	201,476	733,707
1997	10,658,357	9,816,437	-	1,609,252	643,291	213,631	790,057
1998	10,800,063	9,807,147	-	1,630,928	681,118	187,596	811,653
1999	10,630,161	9,521,573	-	1,588,074	689,449	168,267	811,364
2000	10,860,215	9,815,988	-	1,625,921	746,214	153,373	883,617
2001	11,451,011	9,884,858	-	1,682,219	810,935	135,345	815,322
2002	11,576,840	10,081,287	965,723	868,574	-	129,660	939,225

(unit: million yen)

FY	Manufacturing (continued)						
	Electrical machinery	Communication & electronicric equipment	Electrical machinery, equipment&supplies	Electronic equipment & electric measuring instruments	Information & communication electronics equipment	Electronic parts and devices	Transportration equipment
1980	817,224	535,984	-	-	-	-	510,454
1981	1,006,225	664,307	-	-	-	-	627,433
1982	1,176,356	790,587	-	-	-	-	671,923
1983	1,416,231	958,643	-	-	-	-	714,511
1984	1,634,539	1,096,368	-	-	-	-	808,177
1985	1,938,183	1,321,973	-	-	-	-	935,661
1986	1,979,973	1,360,418	-	-	-	-	989,796
1987	2,163,544	1,497,840	-	-	-	-	969,615
1988	2,451,594	1,709,769	-	-	-	-	1,086,442
1989	2,808,123	1,941,699	-	-	-	-	1,244,625
1990	3,146,253	2,150,049	-	-	-	-	1,496,073
1991	3,382,777	2,372,773	-	-	-	-	1,508,671
1992	3,220,513	2,253,142	-	-	-	-	1,498,626
1993	3,019,847	2,049,343	-	-	-	-	1,297,072
1994	3,064,767	2,057,642	-	-	-	-	1,219,994
1995	3,273,601	2,240,714	-	-	-	-	1,360,871
1996	3,493,638	2,400,304	-	-	-	-	1,511,241
1997	3,719,447	2,577,601	-	-	-	-	1,654,038
1998	3,712,765	2,588,619	-	-	-	-	1,632,044
1999	3,615,876	2,606,237	-	-	-	-	1,529,594
2000	3,820,002	2,752,918	-	-	-	-	1,552,637
2001	3,852,446	2,798,546	-	-	-	-	1,675,535
2002	-	-	939,995	206,641	2,233,089	636,013	1,737,925

(unit: million yen)

FY	Manufacturing (continued)		Software	Software and infomation processing	Services	Scientific research institutes	Services
	Transport equipment	Precision instruments			Software and infomation processing		Scientific research institutes
	Automobiles						
1980	419,775	99,338	-	-	-	-	-
1981	523,484	126,762	-	-	-	-	-
1982	569,505	134,239	-	-	-	-	-
1983	605,849	158,817	-	-	-	-	-
1984	686,658	167,431	-	-	-	-	-
1985	797,195	201,717	-	-	-	-	-
1986	840,426	199,185	-	-	-	-	-
1987	814,766	204,228	-	-	-	-	-
1988	932,400	238,753	-	-	-	-	-
1989	1,087,197	266,110	-	-	-	-	-
1990	1,295,575	335,825	-	-	-	-	-
1991	1,286,120	313,969	-	-	-	-	-
1992	1,289,020	327,219	-	-	-	-	-
1993	1,093,556	321,477	-	-	-	-	-
1994	1,021,291	333,506	-	-	-	-	-
1995	1,169,269	355,401	-	-	-	-	-
1996	1,315,445	366,297	177,158	-	-	-	-
1997	1,445,220	426,182	173,523	-	-	-	-
1998	1,427,331	473,722	328,764	-	-	-	-
1999	1,335,053	491,530	274,693	-	-	-	-
2000	1,376,956	486,859	210,480	-	-	-	-
2001	1,492,376	490,617	-	183,813	-	552,313	-
2002	1,677,626	452,884	-	-	196,983	-	485,319

(B) R&D expenditure by industry (Real value)

(unit: million yen)

FY	All industries	Manufacturing	Manufacturing				
			Drugs and medicines	Chemical products		Iron and steel	General machienery
					Drugs and medicines		
1980	3,855,057	3,552,413	-	684,888	232,902	180,425	268,528
1981	4,302,598	3,999,658	-	731,784	258,923	201,099	286,970
1982	4,648,447	4,322,192	-	791,226	276,002	210,350	323,426
1983	5,180,151	4,836,026	-	879,842	329,312	211,390	354,056
1984	5,682,460	5,284,059	-	943,412	326,661	212,503	373,354
1985	6,489,214	6,056,236	-	1,022,945	373,494	262,640	418,086
1986	6,892,881	6,464,272	-	1,107,770	385,155	287,522	426,959
1987	7,276,711	6,836,288	-	1,227,922	426,569	274,715	469,223
1988	7,918,563	7,408,856	-	1,305,508	456,534	273,923	494,660
1989	8,657,557	8,102,777	-	1,381,498	479,415	281,930	587,740
1990	9,461,776	8,842,165	-	1,446,527	526,899	310,185	663,989
1991	9,800,642	9,249,772	-	1,556,856	593,593	362,182	678,400
1992	9,588,860	8,997,575	-	1,609,451	645,311	312,403	653,881
1993	9,125,107	8,521,392	-	1,573,764	634,148	288,374	666,336
1994	9,006,717	8,390,130	-	1,553,358	634,667	238,408	698,789
1995	9,395,896	8,774,360	-	1,554,884	642,190	213,541	705,222
1996	9,939,139	9,153,311	-	1,574,358	659,234	199,087	725,007
1997	10,428,921	9,605,125	-	1,574,611	629,443	209,032	773,050
1998	10,789,274	9,797,350	-	1,629,299	680,438	187,409	810,842
1999	10,737,536	9,617,750	-	1,604,115	696,413	169,967	819,560
2000	10,925,770	9,875,240	-	1,635,735	750,718	154,299	888,951
2001	11,660,907	10,066,047	-	1,713,054	825,799	137,826	830,267
2002	11,693,778	10,183,118	975,478	877,347	-	130,970	948,712

(unit: million yen)

FY	Manufacturing (continued)						
	Electrical machinery	Communication & electronicric equipment	Electrical machinery, equipment&supplies	Electronic equipment & electric measuring instruments	Information & communication electronics equipment	Electronic parts and devices	Transportration equipment
1980	1,002,606	657,569	-	-	-	-	626,247
1981	1,192,735	787,440	-	-	-	-	743,732
1982	1,353,851	909,875	-	-	-	-	773,306
1983	1,608,791	1,088,986	-	-	-	-	811,660
1984	1,808,227	1,212,870	-	-	-	-	894,055
1985	2,117,407	1,444,216	-	-	-	-	1,022,182
1986	2,229,960	1,532,181	-	-	-	-	1,114,765
1987	2,424,212	1,678,303	-	-	-	-	1,086,436
1988	2,689,049	1,875,373	-	-	-	-	1,191,672
1989	2,952,637	2,041,625	-	-	-	-	1,308,677
1990	3,212,324	2,195,200	-	-	-	-	1,527,490
1991	3,402,774	2,386,799	-	-	-	-	1,517,589
1992	3,230,004	2,259,782	-	-	-	-	1,503,042
1993	3,043,696	2,065,527	-	-	-	-	1,307,315
1994	3,073,799	2,063,706	-	-	-	-	1,223,589
1995	3,273,601	2,240,714	-	-	-	-	1,360,871
1996	3,452,211	2,371,842	-	-	-	-	1,493,321
1997	3,639,381	2,522,115	-	-	-	-	1,618,433
1998	3,709,056	2,586,033	-	-	-	-	1,630,414
1999	3,652,400	2,632,563	-	-	-	-	1,545,044
2000	3,843,060	2,769,535	-	-	-	-	1,562,009
2001	3,923,061	2,849,843	-	-	-	-	1,706,247
2002	-	-	949,490	208,728	2,255,645	642,437	1,755,480

(unit: million yen)

FY	Manufacturing (continued)		Software	Software and infomation processing	Services	Scientific research institutes	Services
	Transport equipment	Precision instruments			Software and infomation processing		Scientific research institutes
	Automobiles						
1980	514,998	121,872	-	-	-	-	-
1981	620,515	150,258	-	-	-	-	-
1982	655,435	154,494	-	-	-	-	-
1983	688,224	180,411	-	-	-	-	-
1984	759,623	185,222	-	-	-	-	-
1985	870,912	220,370	-	-	-	-	-
1986	946,536	224,334	-	-	-	-	-
1987	912,931	228,834	-	-	-	-	-
1988	1,022,710	261,878	-	-	-	-	-
1989	1,143,147	279,805	-	-	-	-	-
1990	1,322,782	342,877	-	-	-	-	-
1991	1,293,723	315,825	-	-	-	-	-
1992	1,292,819	328,183	-	-	-	-	-
1993	1,102,192	324,016	-	-	-	-	-
1994	1,024,301	334,489	-	-	-	-	-
1995	1,169,269	355,401	-	-	-	-	-
1996	1,299,847	361,954	175,057	-	-	-	-
1997	1,414,110	417,008	169,788	-	-	-	-
1998	1,425,905	473,249	328,436	-	-	-	-
1999	1,348,538	496,495	277,468	-	-	-	-
2000	1,385,268	489,798	211,751	-	-	-	-
2001	1,519,731	499,610	-	187,182	-	562,437	-
2002	1,694,572	457,459	-	-	198,973	-	490,221

(C) Number of enterprises

(unit: companies)

Year	Companies promoting R&D	Total number of enterprises
1980	18,058	153,378
1981	17,468	151,576
1982	16,348	150,080
1983	15,532	189,891
1984	17,646	188,494
1985	14,921	186,901
1986	14,490	188,507
1987	13,635	184,457
1988	14,255	234,136
1989	14,761	234,102
1990	14,704	232,672
1991	13,849	225,372
1992	14,132	225,975
1993	14,378	320,884
1994	12,228	319,866
1995	13,102	167,977
1996	14,485	167,443
1997	15,035	162,803
1998	17,864	241,371
1999	20,720	336,820
2000	19,353	336,551
2001	22,789	367,021
2002	17,903	586,037
2003	14,258	554,813

(D) R&D expenditure deflator

FY	Deflator
1980	81.5
1981	84.4
1982	86.9
1983	88.0
1984	90.4
1985	91.5
1986	88.8
1987	89.2
1988	91.2
1989	95.1
1990	97.9
1991	99.4
1992	99.7
1993	99.2
1994	99.7
1995	100.0
1996	101.2
1997	102.2
1998	100.1
1999	99.0
2000	99.4
2001	98.2
2002	99.0

Note: <Table A, B>1) Fiscal year basis.

2) Whole industry during 1996-2000 includes the software industry

3) In the year 2001, there were changes in the classification and addition of the industry sector in Industrial Classification for the Survey of Research and Development.

4) In 2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.

<Table C> 1) Yearly base.

2) Industries surveyed were selected from the Japan Standard Industry Classification for the Survey of Research and Development report.

3) Japan Standard Industry Classification was revised in May, 1976, in January, 1984, in October, 1993, and in March, 2002.

4) Enterprises surveyed were selected from the Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Statistical Survey on Business establishments and Enterprises'

5) Until 2001: Data as of April 1st of each year.

Targets are companies with capital of not less than 10 million yen and government-affiliated firms.

Includes software industry for the year 1996-2000.

6) After 2002: Data as of March 31st of each year.

Targets are enterprises with capital of not less than 10 million yen, government-affiliated firms, and independent administrative agencies.

In the year 2002, there were changes in the classification and addition of the industry sector in Industrial Classification for the Survey of Research and Development.

In 2003, the industrial nomenclature of science and technology research survey was revised.

<Table D>1)Fiscal year basis.

2) The R&D expenditure deflator of 'enterprises' in the 'Report on the Survey of Research and Development' by Ministry of Public Management, Home Affairs, Posts and Telecommunications.

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 11-2-2: R&D expenditure in Japan's business sector by type of cost (All industries)

(unit: million yen)

FY	R&D expenditure for internal use (amount of expenditure)						Total amount
	Labor costs	Materials	Expenditure on tangible fixed assets			Other expense	
			Machinery/ appliances/ equipment	Land, building, etc.	Others		
1980	1,451,516	586,224	356,248	94,429	23,075	630,764	3,142,256
1981	1,605,200	721,560	422,040	133,263	26,209	721,521	3,629,793
1982	1,750,005	799,655	472,984	134,167	36,309	845,899	4,039,018
1983	1,984,924	894,876	526,457	151,929	25,499	976,442	4,560,127
1984	2,160,262	1,051,489	613,151	141,931	41,863	1,127,938	5,136,634
1985	2,415,522	1,215,087	714,998	199,882	62,475	1,331,983	5,939,947
1986	2,528,734	1,253,816	712,721	197,117	49,920	1,377,856	6,120,163
1987	2,685,538	1,317,993	720,374	219,863	71,002	1,479,499	6,494,268
1988	2,936,934	1,507,702	833,670	177,066	48,825	1,715,122	7,219,318
1989	3,247,537	1,741,359	932,391	294,590	58,486	1,959,457	8,233,820
1990	3,591,997	1,980,288	1,030,458	313,585	91,455	2,259,384	9,267,166
1991	3,767,837	2,024,936	1,009,415	414,832	101,306	2,424,722	9,743,048
1992	3,926,126	1,881,758	846,157	310,395	87,864	2,508,385	9,560,685
1993	3,962,040	1,692,797	699,276	252,572	73,549	2,373,374	9,053,608
1994	4,022,383	1,680,534	699,506	183,381	51,435	2,343,013	8,980,253
1995	4,167,244	1,791,220	772,299	162,271	78,955	2,423,907	9,395,896
1996	4,375,519	2,019,383	825,982	170,737	58,253	2,608,535	10,058,409
1997	4,532,908	2,110,672	894,815	199,520	62,759	2,857,684	10,658,357
1998	4,665,438	2,089,051	872,970	146,813	44,969	2,980,822	10,800,063
1999	4,627,391	2,088,392	774,775	146,737	65,489	2,927,379	10,630,161
2000	4,532,255	2,153,595	841,972	169,785	39,487	3,123,123	10,860,215
2001	4,731,473	2,379,628	812,285	169,381	53,928	3,304,316	11,451,011
2002	4,745,939	2,270,648	763,613	157,555	49,126	3,589,959	11,576,840

Note: 1) Includes software industry for the year 1996-2000.
2) In the year 2001, there were changes in the classification and addition of the industry sector in Industrial Classification for the Survey of Research and Development.
3) In 2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.
4) 'Other expense' after 2001 is the total for 'lease payments' and 'other expenses' stated in the 'Report on the Survey of Research and Development'
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 11-2-3: Trends in the share of external funding in the business sector (All industries)

(unit: million yen)

FY	R&D funds for internal use	Funds received	Ratio of received funds to R&D funds for internal use (%)	Self-financed R&D funds	Funds paid outside	Ratio of funds paid outside to self-financed R&D funds (%)
1980	3,142,256	133,706	4.3	3,243,274	234,725	7.2
1981	3,629,793	134,315	3.7	3,775,679	280,200	7.4
1982	4,039,018	150,371	3.7	4,240,110	351,463	8.3
1983	4,560,127	163,617	3.6	4,763,033	366,523	7.7
1984	5,136,634	190,426	3.7	5,337,577	391,370	7.3
1985	5,939,947	201,296	3.4	6,176,260	437,608	7.1
1986	6,120,163	223,814	3.7	6,393,674	497,325	7.8
1987	6,494,268	235,624	3.6	6,847,456	588,812	8.6
1988	7,219,318	238,917	3.3	7,624,854	644,452	8.5
1989	8,233,820	244,371	3.0	8,699,508	710,059	8.2
1990	9,267,166	279,579	3.0	9,742,373	754,786	7.7
1991	9,743,048	296,252	3.0	10,290,477	843,681	8.2
1992	9,560,685	287,333	3.0	10,112,916	839,564	8.3
1993	9,053,608	305,603	3.4	9,572,573	824,569	8.6
1994	8,980,253	292,615	3.3	9,516,642	829,005	8.7
1995	9,395,896	337,087	3.6	9,942,578	883,769	8.9
1996	10,058,409	333,426	3.3	10,733,233	1,008,250	9.4
1997	10,658,357	428,551	4.0	11,352,648	1,122,842	9.9
1998	10,800,063	523,609	4.8	11,380,478	1,104,024	9.7
1999	10,630,161	562,212	5.3	11,294,793	1,226,844	10.9
2000	10,860,215	551,419	5.1	11,636,992	1,328,196	11.4
2001	11,451,011	1,006,711	8.8	11,793,051	1,348,750	11.4
2002	11,576,840	911,656	7.9	12,198,099	1,532,915	12.6

Note: 1) Includes software industry for the year 1996-2000.

2) In the year 2001, there were changes in the classification and addition of the industry sector in the Industrial Classification for the Survey of Research and Development.

3) In 2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development’

Table 11-2-4: Trends in externally funded intramural expenditure on R&D in business enterprises

(unit: million yen)

FY	Total R&D funds received	From industries	Form universities	From governments	From foreign countries
1980	130,044	70,997	191	55,510	3,346
1981	130,283	60,408	165	65,080	4,631
1982	147,218	74,180	257	67,418	5,363
1983	161,187	78,365	228	76,080	6,515
1984	187,964	95,527	691	86,264	5,481
1985	198,687	97,098	139	95,216	6,234
1986	221,240	107,374	117	107,560	6,188
1987	233,676	121,982	95	105,550	6,048
1988	232,905	125,672	176	100,695	6,361
1989	239,150	133,415	227	97,615	7,892
1990	274,153	152,269	693	112,726	8,466
1991	283,915	152,360	36	121,480	10,040
1992	282,977	172,881	157	98,802	11,137
1993	295,732	168,510	150	117,313	9,758
1994	284,771	173,147	365	99,189	12,069
1995	289,811	174,460	173	101,988	13,189
1996	325,331	205,812	249	107,024	12,246
1997	418,422	246,426	1,949	128,995	41,053
1998	407,904	254,273	272	107,575	45,784
1999	504,080	317,953	307	129,487	56,331
2000	481,461	304,952	176	114,485	61,848

(unit: million yen)

FY	Total R&D funds received	From industries	Form universities	From governments	From private non-profit organizaions	From foreign countries
2001	955,753	764,444	1,641	109,381	18,129	62,160
2002	855,986	671,019	916	113,616	13,459	56,978

Note: Until 2000:

<Industries>Public corporation/special company, company, private research institutes, etc.

<Governments>1) Government/local public entities, national/public research institutes, research laboratories/associations of government-affiliated firms.

2) Include software industry for the year 1996-2000.

After 2001:

<Industries>Government financial corporation/public corporation, company, etc.

<Governments>1) Government, local public entities, national/public research institutes, research laboratories of government-affiliated firms/independent administrative agencies.

2) In the year 2001, there were changes in the classification and addition of the industry sector in the Industrial Classification for the Survey of Research and Development.

3) In 2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development’

Table 11-2-5: Trends in external funding from business enterprises

(unit: million yen)

FY	Total funds paid outside companies	To private institutes	To universities	To National/public research institutes
1980	158,464	145,101	7,897	5,465
1981	187,248	170,356	9,532	7,360
1982	237,798	213,023	12,119	12,655
1983	250,472	224,829	14,881	10,762
1984	305,757	270,638	20,871	14,248
1985	333,061	285,764	22,974	24,325
1986	370,851	312,139	25,974	32,739
1987	420,324	341,910	29,584	48,829
1988	453,384	358,394	36,725	58,265
1989	483,285	388,429	38,391	56,464
1990	501,943	425,715	45,244	30,985
1991	484,104	421,514	49,152	13,437
1992	538,697	467,235	55,845	15,618
1993	526,480	440,771	56,389	29,321
1994	500,462	443,274	53,098	4,090
1995	529,947	464,847	57,698	7,401
1996	610,710	532,960	56,408	21,341
1997	675,362	604,554	60,384	10,423
1998	683,830	609,218	59,375	15,236
1999	727,907	643,595	61,896	22,416
2000	740,246	660,024	67,534	12,689

(unit: million yen)

FY	Total funds paid outside companies	To enterprises	To universities	To public organizaitons	To private non-profit organizations
2001	895,988	751,118	71,966	7,643	65,261
2002	815,224	664,286	77,816	15,897	57,224

Note: Until 2000:

<Private sector>1) Companies, financially independent government-affiliated firms (private sector side) and private research institutes.

2) National/public research institutes: National/public research institutes and financially dependent government-affiliated firms (government/local public entities side).

3) Includes software industry for the year 1996-2000.

After 2001:

<Industries>Government financial corporation/public corporation, company, etc.

<Enterprises>1) Financially independent government-affiliated firms (private sector side)/independent administrative agencies.

2) In the year 2001, there were changes in the classification and addition of the industry sector in the Industrial Classification for the Survey of Research and Development.

3) In 2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 11-2-6: Trends in the number of researchers in Japan's business sector (All industries)

(A) FTE

(unit: person)

Year	All industries	Manufacturing	manufacturing: Drugs and medicines	manufacturing: Chemical products	manufacturing: Chemical products: Drugs and medicines	manufacturing: Iron and steel	manufacturing: General machinery
1980	173,244	163,867	-	31,556	9,309	4,434	15,273
1981	184,889	175,088	-	32,847	9,311	4,800	15,390
1982	192,942	183,483	-	33,970	9,610	4,613	15,660
1983	201,137	190,608	-	35,822	9,994	4,907	17,024
1984	223,882	213,303	-	37,594	10,903	4,963	19,588
1985	231,097	219,441	-	38,888	11,325	5,278	19,694
1986	251,771	239,792	-	42,523	12,713	5,405	21,313
1987	260,846	248,449	-	43,503	12,322	5,503	21,146
1988	279,298	267,242	-	46,914	13,516	6,060	23,184
1989	294,202	281,247	-	49,170	14,332	5,905	24,677
1990	313,948	300,377	-	52,196	14,932	5,946	27,382
1991	330,996	316,350	-	53,820	15,778	6,180	27,887
1992	340,809	325,838	-	55,592	16,892	6,429	29,015
1993	356,406	339,912	-	58,205	18,181	6,561	30,800
1994	367,278	351,146	-	59,240	18,607	6,319	31,510
1995	376,639	361,064	-	61,124	20,041	6,093	33,973
1996	384,100	368,960	-	60,056	20,071	5,509	34,728
1997	400,361	367,593	-	61,068	19,970	5,472	33,201
1998	404,232	367,382	-	58,782	18,080	5,806	35,636
1999	429,195	382,761	-	59,573	18,733	4,826	36,492
2000	433,758	389,104	-	58,751	18,815	4,700	37,632
2001	421,363	384,975	-	58,059	18,913	4,426	38,164
2002	430,688	382,594	-	57,860	19,611	4,224	36,401
2003	431,190	383,973	21,676	39,642	-	4,204	40,792

(unit: person)

Year	Manufacturing (continued): Electrical machinery	Electrical machinery: Communication & electronicric equipment	Electrical machinery, equipment&supplies	Electrical machinery, equipment&supplies: Electronic equipment & electric measuring instruments	Information& communication electronics equipment	Electronic parts and devices	Transportration equipment
1980	55,467	30,997	-	-	-	-	16,169
1981	58,873	38,830	-	-	-	-	17,682
1982	63,193	41,819	-	-	-	-	18,158
1983	68,243	45,542	-	-	-	-	18,615
1984	78,427	53,641	-	-	-	-	21,036
1985	80,077	54,558	-	-	-	-	22,123
1986	89,824	62,127	-	-	-	-	23,892
1987	94,067	67,224	-	-	-	-	25,148
1988	104,416	75,793	-	-	-	-	26,348
1989	112,387	82,181	-	-	-	-	27,993
1990	119,386	85,818	-	-	-	-	29,383
1991	125,983	90,068	-	-	-	-	32,112
1992	129,310	93,960	-	-	-	-	33,435
1993	134,918	97,892	-	-	-	-	35,669
1994	140,539	100,328	-	-	-	-	35,674
1995	145,010	103,959	-	-	-	-	35,623
1996	146,815	106,686	-	-	-	-	39,176
1997	147,795	106,555	-	-	-	-	38,448
1998	146,284	106,686	-	-	-	-	40,600
1999	155,726	113,478	-	-	-	-	41,312
2000	160,038	120,078	-	-	-	-	41,542
2001	160,766	119,031	-	-	-	-	42,186
2002	159,616	119,485	-	-	-	-	42,842
2003	-	-	40,629	10,964	86,862	31,688	45,747

(unit: person)

Year	Manufacturing (continued): Transport equipment – Automobiles	Manufacturing (continued): Precision instruments	Software	Software and infomation processing	Information & comunications: Software and infomation processing	Scientific research institutes	Services: Scientific research institutes
1980	12,026	6,188	-	-	-	-	-
1981	13,541	7,061	-	-	-	-	-
1982	13,601	8,096	-	-	-	-	-
1983	13,748	8,270	-	-	-	-	-
1984	16,157	10,107	-	-	-	-	-
1985	17,239	10,791	-	-	-	-	-
1986	18,985	11,545	-	-	-	-	-
1987	20,480	11,522	-	-	-	-	-
1988	21,560	11,049	-	-	-	-	-
1989	23,190	12,374	-	-	-	-	-
1990	24,497	13,796	-	-	-	-	-
1991	26,693	14,438	-	-	-	-	-
1992	27,932	14,841	-	-	-	-	-
1993	29,918	15,979	-	-	-	-	-
1994	30,089	17,593	-	-	-	-	-
1995	29,942	18,146	-	-	-	-	-
1996	33,218	20,174	-	-	-	-	-
1997	33,063	17,583	15,550	-	-	-	-
1998	35,143	17,325	13,542	-	-	-	-
1999	35,606	21,585	28,730	-	-	-	-
2000	36,934	23,306	25,311	-	-	-	-
2001	37,981	20,231	17,339	-	-	-	-
2002	38,509	20,658	-	14,139	-	12,797	-
2003	42,660	18,455	-	-	13,250	-	12,186

(B) Head-Counts

(unit: person)

Year	All industries	Manufacturing	manufacturing: Drugs and medicines	manufacturing: Chemical products	manufacturing: Chemical products – Drugs and medicines	manufacturing: Iron and steel	manufacturing: General machinery
2002	461,962	404,621	-	59,321	19,965	4,942	42,131
2003	460,053	404,961	21,889	40,977	-	4,917	45,945

(unit: person)

Year	Manufacturing (continued): Electrical machinery	Electrical machinery – Communication & electronicric equipment	Electrical machinery, equipment&supplies	Electronic equipment & electric measuring instruments	Information& communication electronics equipment	Electronic parts and devices	Transportration equipment
2002	165,299	122,802	-	-	-	-	45,106
2003	-	-	42,374	11,605	88,532	33,625	47,635

(unit: person)

Year	Manufacturing (continued): Transport equipment – Automobiles	Manufacturing (continued): Precision instruments	Software and infomation processing	Information & comunications: Software and infomation processing	Scientific research institutes	Services: Scientific research institutes
2002	40,121	22,101	17,004	-	12,927	-
2003	43,836	19,228	-	17,444	-	12,528

Note: The total for natural science and human/social science.

Until 2001: 1) Data show number of full-time researchers.

2) Timing of survey is as of April 1st of each year.

3) Includes software industry for the year 1997-2001.

After 2002: 1) The definition of 'researcher' was changed.

2) In the year 2002, there were changes in the classification and addition of the industry sector in the Industrial Classification for the Survey of Research and Development.

3) In 2003, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.

4) The data show number of researchers.

5) Timing of survey is as of March 31st of each year.

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 11-2-7: Trends in the number of researchers in Japan's manufacturing sector

(unit: person)

Year	Natural science								
	Physical science			Engineering and technology			Agricultural science		
	Manufacturing	Non-manufacturing	Total	Manufacturing	Non-manufacturing	Total	Manufacturing	Non-manufacturing	Total
1981	54,565	1,641	56,206	101,303	7,486	108,789	5,831	357	6,188
1982	53,702	1,704	55,406	108,624	7,234	115,858	5,921	215	6,136
1983	55,880	1,765	57,645	112,585	8,272	120,857	6,384	213	6,597
1984	60,110	1,720	61,830	126,878	8,073	134,951	6,354	348	6,702
1985	60,723	1,991	62,714	131,882	8,916	140,798	7,163	286	7,449
1986	66,249	1,895	68,144	144,421	9,373	153,794	7,417	260	7,677
1987	68,500	2,088	70,588	149,406	9,365	158,771	8,278	265	8,543
1988	70,774	1,949	72,723	162,896	9,238	172,134	9,342	305	9,647
1989	74,148	2,128	76,276	172,159	9,719	181,878	9,085	470	9,555
1990	80,227	2,181	82,408	183,538	10,535	194,073	8,501	312	8,813
1991	81,011	2,681	83,692	194,705	10,839	205,544	9,892	443	10,335
1992	84,220	3,005	87,225	199,290	11,003	210,293	9,053	349	9,402
1993	84,857	2,895	87,752	209,137	12,421	221,558	8,928	405	9,333
1994	89,540	2,920	92,460	213,136	12,057	225,193	9,198	397	9,595
1995	90,742	2,949	93,691	221,410	10,894	232,304	9,452	423	9,875
1996	91,043	2,313	93,356	229,189	11,173	240,362	8,887	473	9,360
1997	91,105	3,615	94,720	225,714	23,898	249,612	10,140	803	10,943
1998	91,381	8,544	99,925	227,626	22,224	249,850	8,726	2,207	10,933
1999	93,600	3,116	96,716	240,043	38,878	278,921	8,734	587	9,321
2000	91,250	2,681	93,931	246,297	38,983	285,280	8,569	509	9,078
2001	88,025	3,499	91,524	245,950	30,595	276,545	8,518	455	8,973
2002	83,409	6,349	89,758	289,258	48,384	337,642	14,204	875	15,079
2003	83,759	4,541	88,300	289,879	46,941	336,820	12,988	1,324	14,312

(unit: person)

Year	Natural science (continued)								
	Medical science			Others science			Natural science side		
	Manufacturing	Non-manufacturing	Total	Manufacturing	Non-manufacturing	Total	Manufacturing	Non-manufacturing	Total
1981	5,805	9	5,814	6,145	231	6,376	173,649	9,724	183,373
1982	6,101	10	6,111	7,262	158	7,420	181,610	9,321	190,931
1983	6,439	9	6,448	7,623	164	7,787	188,911	10,423	199,334
1984	7,266	7	7,273	9,894	327	10,221	210,502	10,475	220,977
1985	7,527	10	7,537	9,350	351	9,701	216,645	11,554	228,199
1986	8,033	9	8,042	10,608	352	10,960	236,728	11,889	248,617
1987	8,103	8	8,111	11,203	575	11,778	245,490	12,301	257,791
1988	9,123	11	9,134	11,862	431	12,293	263,997	11,934	275,931
1989	9,560	15	9,575	13,038	490	13,528	277,990	12,822	290,812
1990	10,159	13	10,172	14,748	339	15,087	297,173	13,380	310,553
1991	10,937	18	10,955	16,180	535	16,715	312,725	14,516	327,241
1992	11,907	26	11,933	17,800	468	18,268	322,270	14,851	337,121
1993	13,122	27	13,149	20,675	611	21,286	336,719	16,359	353,078
1994	13,364	22	13,386	22,845	593	23,438	348,083	15,989	364,072
1995	14,040	19	14,059	22,125	1,175	23,300	357,769	15,460	373,229
1996	13,968	22	13,990	22,332	1,049	23,381	365,420	15,028	380,448
1997	13,739	44	13,783	23,211	2,067	25,278	363,909	30,427	394,336
1998	12,434	45	12,479	23,080	2,527	25,607	363,247	35,547	398,794
1999	12,393	96	12,489	23,670	2,802	26,472	378,440	45,479	423,919
2000	12,459	16	12,475	25,444	1,241	26,685	384,019	43,430	427,449
2001	13,727	48	13,775	24,566	1,233	25,799	380,786	35,830	416,616
2002	15,568	369	15,937	-	-	-	402,439	55,978	458,417
2003	16,122	483	16,605	-	-	-	402,748	53,289	456,037

(unit: person)

Year	Social science & humanities			Total		
	Manufacturing	Non-manufacturing	Total	Manufacturing	Non-manufacturing	Total
1981	1,439	77	1,516	175,088	9,801	184,889
1982	1,873	138	2,011	183,483	9,459	192,942
1983	1,697	106	1,803	190,608	10,529	201,137
1984	2,801	104	2,905	213,303	10,579	223,882
1985	2,796	102	2,898	219,441	11,656	231,097
1986	3,064	90	3,154	239,792	11,979	251,771
1987	2,959	96	3,055	248,449	12,397	260,846
1988	3,245	122	3,367	267,242	12,056	279,298
1989	3,257	133	3,390	281,247	12,955	294,202
1990	3,204	191	3,395	300,377	13,571	313,948
1991	3,625	130	3,755	316,350	14,646	330,996
1992	3,568	120	3,688	325,838	14,971	340,809
1993	3,193	135	3,328	339,912	16,494	356,406
1994	3,063	143	3,206	351,146	16,132	367,278
1995	3,295	115	3,410	361,064	15,575	376,639
1996	3,540	111	3,651	368,960	15,140	384,100
1997	3,684	2,341	6,025	367,593	32,768	400,361
1998	4,135	1,303	5,438	367,382	36,850	404,232
1999	4,321	955	5,276	382,761	46,434	429,195
2000	5,085	1,224	6,309	389,104	44,654	433,758
2001	4,189	558	4,747	384,975	36,388	421,363
2002	2,182	1,363	3,545	404,621	57,341	461,962
2003	2,212	1,803	4,015	404,961	55,092	460,053

Note: <Until 2001>1) Includes software industry for the year 1996-2001.

2) Timing of survey is as of April 1st of each year.

3) The data show number of full-time researchers among researchers of research-related employees.

<After 2002>1) Timing of survey is as of March 31st of each year.

2) Data show real number (Head-Counts) of researchers.

3) In the year 2002, there were changes in the classification and addition of the industry sector in the Industrial Classification for the Survey of Research and Development.

4) In 2003, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.

5) There is no other data for natural science.

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development’

Table 11-2-8: Trends in R&D expenditure per researcher

(A) R&D expenditure per regular researcher (Researcher) (FTE)

(unit: 10,000 yen/person)

FY	All industries	Manufacturing	Manufacturing				
			Drugs and medicines	Chemical products	Chemical products: Drugs and medicines	Iron and steel	Machinery
1980	1,814	1,767	-	1,769	2,039	3,317	1,433
1981	1,963	1,927	-	1,879	2,346	3,534	1,573
1982	2,093	2,047	-	2,024	2,495	3,962	1,795
1983	2,267	2,233	-	2,162	2,901	3,792	1,831
1984	2,294	2,239	-	2,268	2,708	3,870	1,723
1985	2,570	2,526	-	2,408	3,019	4,555	1,943
1986	2,431	2,394	-	2,313	2,690	4,723	1,779
1987	2,490	2,456	-	2,519	3,090	4,455	1,980
1988	2,585	2,528	-	2,537	3,079	4,121	1,945
1989	2,799	2,740	-	2,672	3,181	4,541	2,265
1990	2,952	2,883	-	2,714	3,456	5,109	2,375
1991	2,944	2,907	-	2,876	3,740	5,826	2,418
1992	2,805	2,753	-	2,887	3,809	4,845	2,247
1993	2,540	2,487	-	2,683	3,461	4,361	2,146
1994	2,445	2,382	-	2,614	3,401	3,762	2,211
1995	2,495	2,430	-	2,544	3,204	3,505	2,076
1996	2,619	2,511	-	2,653	3,324	3,657	2,113
1997	2,662	2,670	-	2,635	3,221	3,904	2,380
1998	2,672	2,669	-	2,775	3,767	3,231	2,278
1999	2,477	2,488	-	2,666	3,680	3,487	2,223
2000	2,504	2,523	-	2,767	3,966	3,263	2,348
2001	2,659	2,584	-	2,907	4,135	3,204	2,240
2002	2,685	2,626	4,455	2,191	-	3,084	2,302

(unit: 10,000 yen/person)

Year	Manufacturing (continued)						
	Electrical machinery	Electrical machinery: Communication & electronicric equipment	Electrical machinery, equipment & supplies	Electrical machinery, equipment & supplies: Electronic equipment & electric measuring instruments	Information & communication electronics equipment	Electronic parts and devices	Transportration equipment
1980	1,473	1,729	-	-	-	-	3,157
1981	1,709	1,711	-	-	-	-	3,548
1982	1,862	1,890	-	-	-	-	3,700
1983	2,075	2,105	-	-	-	-	3,838
1984	2,084	2,044	-	-	-	-	3,842
1985	2,420	2,423	-	-	-	-	4,229
1986	2,204	2,190	-	-	-	-	4,143
1987	2,300	2,228	-	-	-	-	3,856
1988	2,348	2,256	-	-	-	-	4,123
1989	2,499	2,363	-	-	-	-	4,446
1990	2,635	2,505	-	-	-	-	5,092
1991	2,685	2,634	-	-	-	-	4,698
1992	2,491	2,398	-	-	-	-	4,482
1993	2,238	2,093	-	-	-	-	3,636
1994	2,181	2,051	-	-	-	-	3,420
1995	2,258	2,155	-	-	-	-	3,820
1996	2,380	2,250	-	-	-	-	3,858
1997	2,517	2,419	-	-	-	-	4,302
1998	2,538	2,426	-	-	-	-	4,020
1999	2,322	2,297	-	-	-	-	3,703
2000	2,387	2,293	-	-	-	-	3,738
2001	2,414	2,342	-	-	-	-	3,911
2002	-	-	2,314	1,885	2,571	2,007	3,799

(unit: 10,000 yen/person)

Year	Manufacturing (continued)				Information & comunications		Services
	Transport equipment / Automobiles	Precision instruments	Software	Software and infomation processing	Software and infomation processing	Scientific research institutes	Scientific research institutes
1980	3,491	1,605	-	-	-	-	-
1981	3,866	1,795	-	-	-	-	-
1982	4,187	1,658	-	-	-	-	-
1983	4,407	1,920	-	-	-	-	-
1984	4,250	1,657	-	-	-	-	-
1985	4,624	1,869	-	-	-	-	-
1986	4,427	1,725	-	-	-	-	-
1987	3,978	1,773	-	-	-	-	-
1988	4,325	2,161	-	-	-	-	-
1989	4,688	2,151	-	-	-	-	-
1990	5,289	2,434	-	-	-	-	-
1991	4,818	2,175	-	-	-	-	-
1992	4,615	2,205	-	-	-	-	-
1993	3,655	2,012	-	-	-	-	-
1994	3,394	1,896	-	-	-	-	-
1995	3,905	1,959	-	-	-	-	-
1996	3,960	1,816	-	-	-	-	-
1997	4,371	2,424	1,116	-	-	-	-
1998	4,061	2,734	2,428	-	-	-	-
1999	3,750	2,277	956	-	-	-	-
2000	3,728	2,089	832	-	-	-	-
2001	3,875	2,375	-	1,300	-	4,316	-
2002	3,933	2,454	-	-	1,487	-	3,983

(B) R&D expenditure per researcher (Head-Counts)

(unit: 10,000 yen/person)

FY	All industries	Manufacturing	Manufacturing				
			Drugs and medicines	Chemical products	Drugs and medicines	Iron and steel	General machinery
2001	2,479	2,443	-	2,836	4,062	2,739	1,935
2002	2,516	2,489	4,412	2,120	-	2,637	2,044

(unit: 10,000 yen/person)

Year	Manufacturing (continued)						
	Electrical machinery	Communication & electronicric equipment	Electrical machinery, equipment & supplies	Electronic equipment & electric measuring instruments	Information & communication electronics equipment	Electronic parts and devices	Transportration equipment
2001	2,331	2,279	-	-	-	-	3,715
2002	-	-	2,218	1,781	2,522	1,891	3,648

(unit: 10,000 yen/person)

Year	Manufacturing (continued)			Information & comunications		Services
	Transport equipment / Automobiles	Precision instruments	Software and infomation processing	Software and infomation processing	Scientific research institutes	Scientific research institutes
2001	3,720	2,220	1,081	-	4,273	-
2002	3,827	2,355	-	1,129	-	3,874

Note: 1) Number of researchers is the same asTable 11-2-6.

2) R&D expenditure is the same asTable 11-2-1.

3) In the calculation of R&D expenditure per researcher, the number of researchers and R&D expenditure are of each year until FY2000. For FY2001, the number of researchers of 2002 and R&D expenditure of 2001. For FY2002, the number of researchers of 2003 and R&D expenditure of 2002.

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, ‘Report on the Survey of Research and Development’

Table 11-2-9: R&D intensity

(A) R&D expenditure per saled amount (intensity of R&D expenditure) (bu industry)

(unit: %)

Classification of industry FY	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
All industries	1.54	1.67	1.84	2.03	1.99	2.31	2.57	2.59	2.60	2.72
Agriculture, forestry and fisheries	0.17	0.26	0.27	0.26	0.24	0.24	0.24	0.31	0.38	0.21
Mining	0.63	0.53	0.71	0.66	0.63	1.03	1.16	1.01	1.27	0.94
Construction	0.47	0.38	0.43	0.54	0.47	0.49	0.55	0.51	0.49	0.52
Manufacturing	1.74	1.92	2.15	2.31	2.34	2.69	3.03	3.14	3.15	3.29
Food products	0.58	0.55	0.63	0.70	0.60	0.77	0.85	0.99	0.89	1.07
Textile mill products	0.77	1.09	1.13	0.90	1.16	1.18	1.23	1.42	1.50	1.71
Pulp and paper products	0.41	0.43	0.52	0.63	0.66	0.71	0.80	0.77	0.87	0.79
Printing and publishing	0.26	0.21	0.39	0.43	0.61	0.68	0.64	0.80	0.63	0.71
Chemical products	2.55	2.87	3.05	3.34	3.46	3.79	4.31	4.53	4.63	4.84
Industrial chemicals and chemical fibers	1.85	2.01	2.17	2.32	2.47	2.80	3.56	3.76	3.92	4.09
Oil and paints	2.48	2.56	2.66	2.83	3.09	3.14	3.42	3.85	3.74	3.93
Drugs and medicines	5.45	5.85	5.56	6.59	6.49	7.04	6.89	6.96	6.94	7.50
Other chemical industries	2.19	3.03	3.43	3.40	3.76	3.61	3.87	4.00	4.11	4.11
Petroleum and coal products	0.30	0.18	0.20	0.26	0.27	0.38	0.62	0.64	0.83	0.72
Plastics products	-	-	-	-	1.94	1.75	2.09	2.16	2.21	2.73
Rubber products	2.10	2.33	2.47	2.40	2.62	2.86	2.92	3.25	3.19	3.25
Ceramics	1.30	1.39	1.64	1.82	1.96	2.61	2.87	2.82	2.73	2.75
Iron and steel	1.14	1.30	1.50	1.60	1.52	1.94	2.54	2.40	2.13	2.21
Non-ferrous metals and products	1.03	1.36	1.57	1.49	1.64	1.92	2.11	1.90	2.00	1.91
Fabricated metal products	1.15	1.22	1.43	1.31	1.46	1.59	1.61	1.50	1.48	1.36
General machinery	1.90	2.10	2.34	2.57	2.59	2.74	2.77	2.99	2.60	2.83
Electrical machinery	3.71	4.06	4.52	4.70	4.55	5.10	5.50	5.61	5.53	5.89
Electrical machinery,equipment and supplies	3.35	3.80	4.17	4.40	4.45	4.82	5.23	5.26	5.25	5.47
Communication & electronic equipment	3.94	4.21	4.72	4.85	4.60	5.25	5.63	5.78	5.66	6.10
Transportation equipment	2.34	2.62	2.69	2.66	2.76	2.90	3.21	3.22	3.31	3.40
Motor vehicles	2.38	2.82	3.02	2.89	2.90	2.96	3.20	3.17	3.31	3.48
Other transportation equipment	2.15	1.94	1.67	1.86	2.20	2.61	3.28	3.45	3.31	2.93
Precision instruments	3.02	3.47	3.97	4.02	4.08	4.49	4.59	4.91	4.85	5.16
Other manufacturing	1.26	1.20	1.42	1.40	0.92	0.97	1.07	1.12	1.14	1.19
Transport,communication and public utilities	0.89	0.94	0.80	1.04	0.84	0.98	0.96	0.84	0.95	1.06
Software	-	-	-	-	-	-	-	-	-	-

(unit: %)

Classification of industry FY	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
All industries	2.78	2.81	2.83	2.76	2.72	2.73	2.77	2.85	3.14	3.06	3.01
Agriculture, forestry and fisheries	0.50	0.25	0.28	0.43	0.39	0.43	0.42	0.53	0.63	0.59	0.58
Mining	1.33	1.41	1.38	1.17	0.98	0.98	0.87	1.15	1.58	1.20	0.99
Construction	0.54	0.46	0.55	0.54	0.50	0.45	0.46	0.39	0.43	0.58	0.48
Manufacturing	3.36	3.47	3.52	3.47	3.39	3.43	3.43	3.67	3.89	3.68	3.70
Food products	0.98	0.95	0.93	1.01	0.89	0.99	0.98	1.00	1.05	0.93	1.01
Textile mill products	1.76	1.81	2.31	1.98	1.83	1.76	1.44	1.77	1.59	2.17	2.17
Pulp and paper products	0.88	0.87	0.85	0.88	0.88	0.90	0.93	0.92	1.12	1.06	0.98
Printing and publishing	0.88	0.91	0.87	0.81	0.75	0.85	0.96	1.06	1.13	1.24	1.14
Chemical products	4.89	5.24	5.39	5.45	5.33	5.30	5.15	5.24	5.49	5.37	5.36
Industrial chemicals and chemical fibers	4.01	4.19	4.19	4.34	4.24	4.08	3.87	3.87	4.25	3.99	3.64
Oil and paints	3.90	4.20	4.38	4.48	4.42	4.47	4.33	4.57	4.25	4.47	4.43
Drugs and medicines	8.02	8.66	8.70	8.23	7.79	8.03	8.11	8.06	8.07	8.07	8.60
Other chemical industries	4.06	4.29	4.56	4.69	4.75	4.75	4.50	5.30	5.36	4.99	5.11
Petroleum and coal products	0.64	0.66	0.67	0.65	0.63	0.54	0.45	0.49	0.48	0.32	0.24
Plastics products	2.37	2.08	2.35	2.17	2.42	2.64	2.48	2.24	2.32	2.17	2.38
Rubber products	3.20	3.18	3.46	3.39	3.46	3.37	3.36	3.37	3.19	4.09	3.64
Ceramics	2.60	3.00	2.69	2.46	2.39	2.39	2.51	2.93	2.96	2.35	2.48
Iron and steel	2.33	2.84	2.58	2.72	2.19	1.96	1.84	1.92	2.01	1.88	1.64
Non-ferrous metals and products	1.80	2.17	2.23	2.41	2.18	2.35	2.21	2.44	2.45	2.43	2.37
Fabricated metal products	1.60	1.60	1.52	1.48	1.38	1.35	1.27	1.46	1.52	1.41	1.70
General machinery	2.99	3.14	3.10	3.34	3.23	3.26	3.26	3.41	3.76	3.96	3.93
Electrical machinery	5.86	6.31	6.17	6.04	5.86	5.82	5.81	6.05	6.32	5.75	5.65
Electrical machinery,equipment & supplies	5.36	5.66	5.66	5.81	5.82	5.83	5.64	6.13	6.08	5.90	5.64
Communication & electronic equipment	6.12	6.63	6.42	6.16	5.87	5.81	5.90	6.01	6.43	5.69	5.65
Transportation equipment	3.65	3.32	3.45	3.15	3.20	3.34	3.59	3.97	4.12	3.95	3.90
Motor vehicles	3.73	3.33	3.54	3.19	3.23	3.46	3.76	4.20	4.35	4.12	4.09
Other transportation equipment	3.20	3.24	2.97	2.96	3.05	2.74	2.77	2.90	3.03	3.09	2.86
Precision instruments	5.94	4.85	5.79	5.66	5.51	5.16	5.74	6.28	6.33	6.83	6.34
Other manufacturing	1.21	1.21	1.38	1.51	1.55	1.50	1.41	1.70	1.84	1.66	1.70
Transport,communication and public utilities	1.07	0.85	0.87	0.88	0.97	0.90	0.89	0.91	0.80	1.11	1.15
Software	-	-	-	-	-	-	9.83	7.84	10.08	8.35	5.79

(unit: %)

Classification of industry FY	2001
All industries	-
Whole industry except finance and insurance	3.29
Agriculture, forestry and fisheries	0.54
Mining	1.24
Construction	0.42
Manufacturing	4.03
Food products	0.96
Textile mill products	1.87
Pulp and paper products	1.09
Printing and publishing	1.07
Chemical products	5.73
Industrial chemicals and chemical fibers	4.07
Oil and paints	4.71
Drugs and medicines	8.52
Other chemical industries	5.07
Petroleum and coal products	0.26
Plastics products	2.83
Rubber products	4.02
Ceramics	2.84
Iron and steel	1.67
Non-ferrous metals and products	2.49
Fabricated metal products	1.49
General machinery	4.16
Electrical machinery	6.83
Electrical machinery,equipment and supplies	6.21
Communication and electronic equipment	7.09
Transportation equipment	4.25
Motor vehicles	4.44
Other transportation equipment	3.15
Precision instruments	6.58
Other manufacturing	1.79
Transport,communication and public utilities	1.14
Wholesale trade	0.35
Finance and insurance	-
Software and infomation processing	3.69
Professional services	1.29
Other business services	0.77
Scientific research institutes	75.59

(unit: %)

Classification of industry FY	2001#	2002
All industries	-	-
Whole industry except finance and insurance	3.29	3.06
Agriculture, forestry and fisheries	1.02	0.53
Mining	0.95	0.93
Construction	0.42	0.39
Manufacturing	4.04	3.99
Food products	1.03	1.08
Textiles mill products	1.94	2.25
Pulp and paper products	1.10	1.16
Printing	1.10	1.35
Drugs and medicines	8.49	8.91
Chemical products	4.35	3.59
Industrial chemicals and chemical fibers	4.05	3.90
Oil and paints	4.40	4.13
Other chemical industries	5.14	2.95
Petroleum and coal products	0.25	0.23
Plastic products	2.61	2.44
Rubber products	4.22	4.20
Ceramics	2.59	2.52
Iron and steel	1.66	1.50
Non-ferrous metals and products	2.44	2.45
Fabricated metal products	1.43	1.39
General machinery	4.27	4.43
Electrical machinery,equipment and supplies	5.69	5.20
Electronic equipment and electric measuring instruments	6.08	4.98
Miscellaneous electrical machinery and supplies	5.58	5.26
Information and communication electronics equipment	7.76	7.43
Electronic parts and devices	5.50	5.13
Transportation equipment	4.22	4.35
Motor vehicles	4.44	4.56
Other transportation equipment	1.99	1.87
Precision instruments	7.03	7.77
Other manufacturing	1.90	1.82
Electricity,gas,heat supply and water	0.45	0.44
Information and communications	2.63	1.97
Software and infomation processing	3.73	2.41
Communications	2.56	1.97
Broadcasting	0.15	0.17
Newspaper,publishing and other date processing	1.09	1.07
Transport	0.20	0.29
Wholesale trade	0.46	0.19
Finance and insurance	-	-
Services	19.65	13.20
Professional services	1.69	0.81
Scientific research institutes	67.77	84.41
Other business services	1.11	0.80

Note: <Table A>1) In the year 2001, there were changes in the classification and addition of the industry sector in the Industrial Classification for the Survey of Research and Development.

2) In 2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.

3) In 2001, complied in accordance with the revised Japan Standard Industry Classification (March, 2002).

4) Excludes 'government-affiliated firms' until 2000. After 2001, excludes 'government-affiliated firms/independent administrative agencies '

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

(B)Trend in number of researchers per 10,000 workers (researcher intensity) (by industry)

(unit: person/10,000 persons)

Classification of industry FY	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
All industries	293	311	321	336	379	364	401	429	444	458
Agriculture, forestry and fisheries	181	78	63	100	75	71	124	119	138	183
Mining	135	113	102	143	190	167	225	238	265	263
Construction	119	112	116	113	142	122	123	152	153	151
Manufacturing	325	350	361	393	423	432	468	501	537	556
Food products	154	191	190	202	200	185	225	241	232	215
Textile mill products	177	125	145	149	159	162	213	186	237	208
Pulp and paper products	147	149	162	174	216	192	172	200	204	202
Printing and publishing	74	67	77	99	74	133	108	130	134	165
Chemical products	567	588	637	656	697	719	784	808	849	899
Industrial chemicals and chemical fibers	499	527	557	598	628	654	711	746	804	839
Oil and paints	717	809	864	901	907	962	964	989	1,090	1,145
Drugs and medicines	628	638	662	645	703	725	796	784	819	829
Other chemical industries	527	536	656	662	718	715	821	874	847	1,013
Petroleum and coal products	242	356	262	283	315	312	394	426	461	488
Plastics products	-	-	-	-	-	384	338	388	365	420
Rubber products	327	311	359	360	357	377	392	413	418	418
Ceramics	228	209	214	234	277	276	355	335	362	381
Iron and steel	128	142	142	150	159	168	177	197	224	232
Non-ferrous metals and products	231	242	249	301	280	320	316	317	329	356
Fabricated metal products	189	227	206	236	209	246	260	303	293	273
General machinery	309	299	320	333	388	407	425	418	469	452
Electrical machinery	553	609	632	698	727	714	767	830	862	935
Electrical machinery,equipment and supplies	462	531	542	604	617	621	647	664	682	701
Communication and electronic equipment	656	659	691	756	793	768	836	921	958	1,065
Transportation equipment	257	275	279	281	319	335	325	394	438	437
Motor vehicles	273	296	298	303	344	354	331	402	453	450
Other transportation equipment	218	223	236	231	256	282	304	362	382	383
Precision instruments	406	405	437	515	541	650	664	666	670	704
Other manufacturing	168	274	273	254	310	217	257	288	358	320
Transport,communication and public utilities	45	42	41	45	45	60	76	71	50	53
Software	-	-	-	-	-	-	-	-	-	-

(unit: person/10,000 persons)

Classification of industry FY	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
All industries	479	489	499	519	545	562	576	588	557	661	680	698
Agriculture, forestry and fisheries	171	171	140	79	205	233	244	237	252	300	291	252
Mining	238	314	372	344	327	271	294	344	362	393	509	578
Construction	136	157	139	163	148	135	126	148	112	152	185	152
Manufacturing	577	582	593	622	654	678	698	693	721	751	776	830
Food products	230	238	236	235	274	248	259	242	260	275	221	263
Textile mill products	280	297	306	337	294	301	283	263	238	194	357	366
Pulp and paper products	201	201	200	237	264	270	275	269	296	310	306	322
Printing and publishing	136	174	171	194	142	190	212	246	255	243	263	269
Chemical products	938	962	973	960	987	1,029	1,048	1,061	1,075	1,080	1,111	1,122
Industrial chemicals and chemical fibers	853	862	903	884	927	975	1,005	1,023	1,041	1,074	1,064	1,022
Oil and paints	1,172	1,239	1,197	1,203	1,265	1,288	1,294	1,341	1,398	1,288	1,423	1,544
Drugs and medicines	875	900	933	934	947	993	1,013	1,029	980	959	1,019	1,055
Other chemical industries	1,088	1,154	1,070	1,018	1,009	1,045	1,041	1,004	1,112	1,209	1,172	1,194
Petroleum and coal products	455	466	441	427	447	464	454	450	535	503	402	481
Plastics products	377	363	370	358	424	435	468	408	404	463	432	528
Rubber products	481	477	435	492	524	565	549	602	647	572	532	593
Ceramics	372	405	434	450	411	445	456	473	569	493	515	536
Iron and steel	247	248	264	262	275	267	260	273	271	293	311	307
Non-ferrous metals and products	349	354	393	371	399	405	434	417	442	486	450	495
Fabricated metal products	255	250	271	268	312	289	302	271	312	312	353	362
General machinery	472	479	500	508	538	579	602	584	613	618	667	724
Electrical machinery	978	954	991	1,018	1,103	1,128	1,215	1,205	1,221	1,270	1,312	1,437
Electrical machinery,equipment and supplies	770	710	750	794	878	861	898	913	896	906	1,043	1,090
Communication and electronic equipment	1,094	1,106	1,127	1,140	1,229	1,286	1,402	1,376	1,411	1,493	1,435	1,617
Transportation equipment	445	452	443	496	511	522	544	589	609	630	659	684
Motor vehicles	458	465	458	517	534	540	579	617	655	669	701	728
Other transportation equipment	388	398	381	410	415	442	408	458	419	462	446	443
Precision instruments	831	808	765	877	933	934	957	1,072	1,091	1,132	1,287	1,170
Other manufacturing	315	353	316	374	349	421	402	398	428	521	552	492
Transport,communication and public utilities	63	69	78	76	83	82	82	84	102	123	127	136
Software	-	-	-	-	-	-	-	1,517	1,153	1,614	1,514	1,089

(unit: person/10,000 persons) H.C.

Classification of industry FY	2001◎	2001◎
All industries	735	787
Whole industry except finance and insurance	737	790
Agriculture, forestry and fisheries	150	161
Mining	671	685
Construction	157	207
Manufacturing	884	935
Food products	294	326
Textile mill products	377	410
Pulp and paper products	335	345
Printing and publishing	284	303
Chemical products	1,147	1,176
Industrial chemicals and chemical fibers	1,120	1,134
Oil and paints	1,472	1,563
Drugs and medicines	1,045	1,064
Other chemical industries	1,201	1,240
Petroleum and coal products	503	514
Plastics products	585	608
Rubber products	862	885
Ceramics	559	588
Iron and steel	337	394
Non-ferrous metals and products	522	576
Fabricated metal products	393	449
General machinery	758	877
Electrical machinery	1,518	1,572
Electrical machinery,equipment and supplies	1,085	1,149
Communication and electronic equipment	1,753	1,801
Transportation equipment	727	766
Motor vehicles	792	825
Other transportation equipment	422	485
Precision instruments	1,226	1,312
Other manufacturing	503	540
Transport,communication and public utilities	141	151
Wholesale trade	194	283
Finance and insurance	66	67
Software and infomation processing	761	915
Professional services	176	420
Other business services	50	73
Scientific research institutes	5,358	5,413

(unit: person/10,000 persons) H.C.

Classification of industry FY	2002	2002
All industries	754	804
Whole industry except finance/insurance	758	808
Agriculture, forestry and fisheries	216	230
Mining	450	461
Construction	145	175
Manufacturing	946	997
Food engineering	327	371
Textiles	430	550
Pulp and paper	378	395
Printing	400	407
Drugs and medicines	1,070	1,081
Chemical engineering	1,203	1,244
Industrial chemicals and chemical fibers	1,208	1,227
Oil and paints	1,511	1,649
Other chemical industries	1,029	1,046
Petroleum and coal products	462	469
Plastics products	567	631
Rubber products	719	759
Ceramics	512	545
Iron and steel	344	402
Non-ferrouw metal	668	698
Fabricated metal	352	417
General machinery	816	920
Electrical machinery,equipment and supplies	1,070	1,116
Electronic equipment and electric measuring instruments	1,629	1,725
Other electrical machinery and apparatus	950	985
Information and communication electronics equipment	2,093	2,133
Electronic parts/devices	1,204	1,278
Transportation equipment	865	901
Motor vehicles	895	919
Other transport equipment	595	732
Precision instruments	1,531	1,595
Other industries	526	574
Electricity/gas/heat supply/water utility	118	139
Information-communications	454	554
Software and infomation processing	430	566
Telecommunications	627	633
Broadcasting	94	128
Newspaper/publishing/other information/communications	189	210
Transportation	22	26
Wholesale	252	283
Finance/insurance	52	54
Services	706	761
Professional services	129	171
Academic research institutes	5,697	5,857
Other business/services	86	129

Note: <Table B>1) Until FY2001, the figures are as of April 1st of each year. After FY2001, below the sign ◎, the figures are as of March 31st of each year.
2)As for the sign ◎ of FY2001, there was a change in the definition of 'researcher,' addition of a category in the industrial classification, and a change in the Industrial Classification for the Survey of Research and Development.
3) In FY2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.
4) Excludes 'government-affiliated firms' until FY2001. After FY2001, below the sign ◎, excludes 'government-affiliated firms/independent administrative agencies .'
5) 'H.C.' means Head Counts.
Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 11-2-10: R&D expenditure by product group (all industries)

(unit: million yen)

FY	Communication and electronics equipment	Motor vehicles	Electric machinery, equipments supplies	Drugs and medicines	General machinery
1980	503,948	428,436	354,488	207,949	282,889
1981	604,221	521,821	451,915	242,975	304,560
1982	729,643	584,034	530,448	281,296	355,806
1983	906,778	652,772	555,054	334,371	407,143
1984	1,106,482	726,659	620,289	346,519	461,540
1985	1,372,511	853,317	687,485	386,281	496,757
1986	1,490,484	902,650	650,551	398,572	505,549
1987	1,613,089	890,673	698,145	460,189	521,239
1988	1,910,708	1,037,060	744,165	498,023	549,075
1989	2,258,036	1,194,162	840,447	566,890	642,538
1990	2,590,980	1,420,733	857,301	627,419	767,208
1991	2,657,226	1,417,647	1,017,297	701,812	795,173
1992	2,560,692	1,403,297	914,654	762,454	827,209
1993	2,491,633	1,223,950	869,920	758,236	725,080
1994	2,497,809	1,158,947	876,633	761,420	733,056
1995	2,735,202	1,314,918	857,809	769,192	752,763
1996	2,948,505	1,476,708	895,476	790,381	739,492
1997	3,243,823	1,619,463	972,714	793,079	785,816
1998	3,269,470	1,608,905	970,788	821,173	754,901
1999	3,396,744	1,510,087	839,166	814,945	757,806
2000	3,515,014	1,580,104	942,626	859,759	794,857
2001	3,368,094	2,168,652	997,743	938,969	700,807
2002	3,348,127	2,250,757	950,788	1,067,511	679,390

(unit: million yen)

FY	Chemical fertilizers & inorganic/ organic chemical products, chemical fibers	Precision instruments	Others	All products
1980	206,487	79,480	849,906	2,913,583
1981	216,593	88,267	942,381	3,372,733
1982	210,029	89,185	1,029,652	3,810,093
1983	224,501	123,623	1,107,520	4,311,762
1984	265,169	132,569	1,221,042	4,880,269
1985	304,025	154,064	1,380,959	5,635,399
1986	340,780	154,902	1,399,585	5,843,073
1987	357,952	170,217	1,483,128	6,194,632
1988	409,086	191,796	1,568,329	6,908,242
1989	452,454	184,238	1,730,707	7,869,472
1990	469,043	210,790	1,947,726	8,891,200
1991	489,841	206,375	2,064,228	9,349,599
1992	485,631	205,239	2,027,278	9,186,454
1993	479,410	203,540	1,990,678	8,742,447
1994	431,161	228,613	1,943,025	8,630,664
1995	424,944	245,689	1,924,200	9,024,717
1996	447,715	245,995	2,062,440	9,606,712
1997	474,079	266,347	2,118,644	10,273,965
1998	447,238	281,554	2,156,405	10,310,434
1999	397,183	294,790	2,098,408	10,109,129
2000	381,445	300,872	1,991,197	10,365,874
2001	398,377	300,418	2,149,940	11,023,000
2002	430,371	333,070	2,222,591	11,282,605

Note: The targets are companies (enterprises after 2001) with capital of not less than 100 million yen.

2) In FY2001, there were changes in the Industrial Classification for the Survey of Research and Development

3) In FY2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.

4) 'Electrical machinery and apparatus' is 'home electric appliances' and 'other electrical machinery and apparatus.'

5) After FY2001, Communications/electronics/electrical measuring instruments is 'Information-communications equipment/electronics parts.'

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 11-2-11: Trends in R&D expenditure by product group in selected industries

(A) Industrial classification: Communication and electronic equipment

(unit: million yen)

FY	Communicatin & electronics equipments	Electric equipments	Other products	All products
1980	283,423	203,983	29,989	517,395
1981	342,120	274,278	25,263	641,661
1982	416,890	322,627	30,877	770,394
1983	576,265	306,051	45,684	928,000
1984	660,004	345,753	64,817	1,070,574
1985	793,641	420,534	71,076	1,285,251
1986	889,489	392,849	50,705	1,333,043
1987	998,798	402,956	54,835	1,456,589
1988	1,174,026	439,131	55,214	1,668,371
1989	1,365,968	484,904	53,550	1,904,422
1990	1,543,520	499,513	65,674	2,108,707
1991	1,684,865	579,060	63,956	2,327,881
1992	1,631,609	509,186	67,786	2,208,581
1993	1,470,865	456,785	80,770	2,008,420
1994	1,474,066	467,107	78,167	2,019,340
1995	1,631,553	474,494	96,559	2,202,606
1996	1,764,998	490,699	106,387	2,362,084
1997	1,900,515	521,460	112,456	2,534,431
1998	1,912,547	546,234	92,484	2,551,265
1999	1,974,990	496,980	92,576	2,564,546
2000	2,031,730	563,738	102,348	2,697,816
2001	2,035,571	609,318	102,899	2,747,788
2002	2,250,300	575,572	211,465	3,037,337

(B) Industrial classification: Motor vehicles

(unit: million yen)

FY	Motor vihicles	General machienry	Other products	All products
1980	387,641	6,328	23,261	417,230
1981	482,676	7,861	30,549	521,086
1982	529,876	5,990	31,814	567,680
1983	561,024	8,239	34,490	603,753
1984	641,419	8,311	33,378	683,108
1985	727,640	14,009	43,624	785,273
1986	776,815	16,597	42,580	835,992
1987	767,932	12,140	30,540	810,612
1988	885,285	14,092	27,268	926,645
1989	1,028,079	16,043	30,211	1,074,333
1990	1,223,775	22,737	32,043	1,278,555
1991	1,231,116	21,879	25,158	1,278,153
1992	1,218,819	22,307	30,997	1,272,123
1993	1,040,474	19,461	26,769	1,086,704
1994	965,095	19,553	28,082	1,012,730
1995	1,093,416	20,131	31,928	1,145,475
1996	1,250,391	20,305	33,292	1,303,988
1997	1,372,413	23,741	37,471	1,433,625
1998	1,355,945	19,016	34,431	1,409,392
1999	1,261,930	19,322	36,417	1,317,669
2000	1,309,492	18,695	27,742	1,355,929
2001	1,406,708	17,489	55,406	1,479,603
2002	1,586,417	18,137	68,555	1,673,109

(C) Industrial classification: Drugs and medicines

(unit: million yen)

FY	Drugs and medicines	Other products	All products
1980	167,334	11,277	178,611
1981	193,054	12,037	205,091
1982	210,791	13,133	223,924
1983	259,440	14,549	273,989
1984	264,939	14,339	279,278
1985	302,260	20,857	323,117
1986	306,802	17,098	323,900
1987	345,745	20,919	366,664
1988	376,979	22,042	399,021
1989	414,891	22,685	437,576
1990	469,297	28,405	497,702
1991	541,619	25,942	567,561
1992	591,894	29,619	621,513
1993	575,276	28,272	603,548
1994	583,436	26,209	609,645
1995	591,683	24,349	616,032
1996	618,475	25,376	643,851
1997	602,078	20,335	622,413
1998	631,558	27,479	659,037
1999	637,452	31,468	668,920
2000	704,230	19,535	723,765
2001	767,803	19,315	787,118
2002	921,965	27,382	949,347

(D) Industrial classification: Electrical machinery, equipment and supplies

(unit: million yen)

FY	Electric equipments	Communicatin & electronics equipments	Motor vehicles	General machinery	Other products	All products
1980	113,222	105,790	19,306	15,709	17,162	271,189
1981	143,625	125,571	19,733	13,628	19,991	322,548
1982	165,459	141,555	27,770	18,419	18,048	371,251
1983	193,191	151,345	49,318	28,251	18,328	440,433
1984	202,590	213,147	53,746	27,615	25,075	522,173
1985	195,979	271,926	64,073	31,558	26,526	590,062
1986	182,886	289,506	72,619	23,778	25,135	593,924
1987	213,983	287,153	71,318	32,939	27,490	632,883
1988	225,045	334,971	82,722	37,865	33,632	714,235
1989	264,451	387,830	96,083	39,866	37,320	825,550
1990	273,213	474,337	114,702	32,928	43,905	939,085
1991	340,818	451,053	102,409	42,413	44,171	980,864
1992	306,942	443,757	101,016	43,211	40,054	934,980
1993	310,719	452,639	102,932	39,709	39,456	945,455
1994	313,306	467,930	112,788	39,139	34,404	967,567
1995	287,669	502,086	124,172	42,828	37,627	994,382
1996	308,136	530,096	130,239	45,400	40,420	1,054,291
1997	313,759	562,357	141,004	48,094	46,768	1,111,982
1998	295,929	542,300	136,599	58,315	44,690	1,077,833
1999	256,874	500,531	140,811	39,096	36,522	973,834
2000	287,910	512,577	154,689	37,286	39,584	1,032,046
2001	291,365	407,823	168,279	33,785	39,584	1,021,257
2002	266,634	185,844	178,635	28,973	41,764	701,850

(E)Industrial classification: General machinery

(unit: million yen)

FY	General machienry	Precision instruments	Motor vihicles	Communication & electronic equipment	Electrical machinery, equipment &supplies	Other industrial products	Fabricated metal products	Other products	All products
1980	135,554	3,433	7,925	8,255	7,706	664	5,344	14,508	183,389
1981	159,074	3,627	3,352	16,297	4,888	1,079	5,812	16,434	210,563
1982	185,379	5,404	4,393	17,263	7,540	1,865	8,969	16,023	246,836
1983	193,222	25,921	4,724	14,534	8,285	1,349	7,033	16,613	271,681
1984	210,170	26,623	5,391	16,805	12,679	1,958	5,191	15,779	294,596
1985	222,332	19,326	16,850	30,002	9,453	10,691	8,560	15,655	332,869
1986	221,913	20,939	15,233	37,027	12,886	5,217	9,779	17,199	340,193
1987	244,349	24,135	20,599	36,991	15,014	5,734	4,347	23,619	374,788
1988	254,526	24,034	25,572	40,096	16,708	6,218	5,001	23,671	395,826
1989	317,075	28,956	27,689	55,041	23,867	3,932	5,497	25,900	487,957
1990	358,478	34,968	30,917	84,305	30,865	6,463	5,621	31,815	583,432
1991	370,640	39,264	32,163	80,212	34,206	10,584	5,356	34,077	606,502
1992	367,975	41,425	33,691	63,233	33,641	12,882	6,352	31,971	591,170
1993	358,723	26,441	31,997	85,705	34,908	28,026	8,523	38,411	612,734
1994	370,031	52,479	31,376	57,981	41,393	36,209	9,200	33,462	632,131
1995	382,998	54,235	37,655	59,714	33,033	33,207	8,996	36,821	646,659
1996	377,225	63,376	40,741	73,807	36,039	32,061	12,894	31,018	667,161
1997	431,822	58,034	48,395	74,708	38,792	23,252	11,921	35,367	722,291
1998	417,890	64,114	53,569	62,893	35,497	34,165	22,673	33,165	723,966
1999	455,088	67,381	55,785	45,901	38,354	40,575	10,796	35,975	749,855
2000	493,015	74,977	62,096	54,965	47,323	23,909	9,145	32,295	797,725
2001	413,322	81,967	40,737	109,263	34,268	25,116	6,443	27,943	739,059
2002	482,516	78,128	24,496	153,086	54,214	32,430	2,944	73,762	901,576

(F) Industrial classification: Precision instruments

(unit: million yen)

FY	Precision instruments	General machienry	Electrical machinery, equipment & supplies	Communicatin & electronic equipment	Motor vehicles	Other products	All products
1980	63,713	7,900	3,544	4,072	2,633	2,223	84,085
1981	68,437	9,510	6,926	4,289	3,245	12,687	105,094
1982	65,583	15,023	9,687	9,976	4,235	14,882	119,386
1983	77,904	22,240	8,942	12,943	5,044	9,926	136,999
1984	79,361	18,661	14,688	17,958	3,795	12,315	146,778
1985	96,063	22,997	17,603	25,142	4,138	14,439	180,382
1986	98,235	38,466	14,641	14,521	4,730	8,286	178,879
1987	104,983	39,887	12,683	15,692	3,532	7,473	184,250
1988	113,164	55,747	10,036	27,884	3,777	7,923	218,531
1989	102,540	71,251	9,919	45,675	4,375	11,029	244,789
1990	109,852	99,893	10,011	59,176	5,273	32,341	316,546
1991	107,983	92,064	7,518	53,812	5,937	26,003	293,317
1992	101,623	114,518	5,494	56,718	5,831	25,511	309,695
1993	116,005	21,353	13,577	114,854	6,761	27,515	300,065
1994	120,250	20,856	8,581	129,011	7,156	24,521	310,375
1995	137,877	16,939	9,697	119,760	7,427	24,993	316,693
1996	129,141	23,888	11,219	137,131	6,407	34,664	342,450
1997	143,008	23,300	11,370	188,070	2,923	37,525	406,196
1998	162,333	29,068	22,268	184,519	4,685	36,793	439,666
1999	165,822	31,268	6,553	195,113	3,154	63,757	465,667
2000	164,820	24,725	6,346	229,591	3,581	34,426	463,489
2001	161,622	29,587	14,862	227,020	3,320	35,551	471,962
2002	180,365	24,791	9,897	191,744	-	34,313	441,110

Note: 1) The targets are companies (after 2001, enterprises) with capital 100 million yen or more.

2) In FY2001, there were changes in the classification of the Industrial Classification for the Survey of Research and Development.

3) In FY2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.

4) Along with these changes, industrial classification for FY2002 in this table represents the classification of FY2001 as follows.

D: Electrical machinery and apparatus ← 'Other electrical machinery and apparatus' in 2002.

E: Communications/electronics/electrical measuring instruments ← 'Applied electronics/electrical measuring instruments' + 'Information-communications equipment' + 'electronic parts/devices' in 2002.

5) Electrical machinery and apparatus is 'home electric appliances' and 'other electrical machinery and apparatus.'

6) After FY2001, Communications/electronics/electrical measuring instruments is 'Information-communications equipment/electronic parts/devices.'

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 11-3-1: Technology trade in Japan

(A) Export value of technological trade

(unit: million yen)

FY	Industrial chemicals & chemical fibers	Drugs and medicines	Iron and steel	General machinery	Electrical machinery, equipment & supplies	Miscellaneous electrical machinery and supplies	Communication & electronic equipment
1980	25,377	2,986	17,856	9,621	7,967	-	15,078
1981	18,676	8,265	24,501	5,336	9,985	-	18,681
1982	18,069	6,638	29,047	5,249	9,861	-	25,623
1983	17,257	9,948	40,151	10,717	11,731	-	23,820
1984	19,083	13,698	32,395	11,396	14,190	-	32,960
1985	19,784	13,068	26,195	11,714	17,742	-	41,717
1986	15,256	17,315	21,540	6,806	16,859	-	36,142
1987	18,908	16,101	9,993	8,741	21,307	-	39,819
1988	27,050	16,297	10,798	10,818	21,047	-	47,748
1989	29,451	18,904	21,572	13,210	28,164	-	58,544
1990	27,683	24,971	9,424	14,364	29,350	-	67,667
1991	24,850	28,488	10,527	15,113	32,270	-	73,489
1992	23,503	27,848	8,802	21,847	31,051	-	75,676
1993	22,201	31,020	13,294	18,425	46,669	-	80,709
1994	26,348	31,196	12,845	20,262	45,757	-	94,720
1995	26,732	36,677	16,923	22,081	62,182	-	152,840
1996	34,473	51,439	20,940	22,444	78,819	-	154,438
1997	37,850	61,184	15,319	29,727	74,376	-	171,632
1998	34,484	80,502	11,932	31,616	79,195	-	158,562
1999	33,572	103,599	11,544	29,377	77,892	-	126,581
2000	34,059	86,380	13,436	35,275	61,854	-	149,504
2001	36,376	110,845	9,601	50,347	83,883	-	156,003
2002	48,233	142,212	9,570	45,946	-	35,980	-

(unit: million yen)

FY	Electronic equipment & electric measuring instruments	Information & communication electronics equipment	Electronic parts and devices	motor vehicles	Precision instruments	Other industries	All industries
1980	-	-	-	8,442	873	71,412	159,612
1981	-	-	-	12,788	2,900	73,974	175,106
1982	-	-	-	15,469	2,418	72,547	184,921
1983	-	-	-	18,410	4,037	104,816	240,887
1984	-	-	-	27,189	1,802	124,799	277,512
1985	-	-	-	25,996	1,725	76,279	234,220
1986	-	-	-	40,238	1,850	68,072	224,078
1987	-	-	-	45,967	2,921	51,818	215,575
1988	-	-	-	54,187	4,611	53,699	246,255
1989	-	-	-	83,042	12,556	63,905	329,348
1990	-	-	-	88,901	4,322	72,670	339,352
1991	-	-	-	99,525	12,094	74,196	370,552
1992	-	-	-	113,409	5,058	70,497	377,691
1993	-	-	-	124,249	4,036	59,759	400,362
1994	-	-	-	160,190	5,633	65,177	462,128
1995	-	-	-	159,134	8,467	77,041	562,077
1996	-	-	-	197,558	10,397	132,525	703,033
1997	-	-	-	346,187	8,890	86,398	831,563
1998	-	-	-	430,801	8,426	80,580	916,098
1999	-	-	-	493,208	9,262	75,765	960,800
2000	-	-	-	582,507	7,729	87,109	1,057,853
2001	-	-	-	668,228	13,523	118,008	1,246,814
2002	9,468	135,954	61,157	768,236	11,141	118,872	1,386,769

(B) Import value of technological trade

(unit: million yen)

FY	Industrial chemicals & chemical fibers	Drugs and medicines	Iron and steel	General machinery	Electrical machinery, equipment & supplies	Miscellaneous electrical machinery and supplies	Communication & electronic equipment
1980	16,656	10,162	8,023	30,209	21,778	-	39,899
1981	14,754	11,067	14,808	30,810	25,062	-	43,752
1982	22,807	13,009	7,800	27,405	29,682	-	59,475
1983	17,575	12,365	17,581	28,493	27,735	-	64,186
1984	15,321	13,809	5,562	23,905	33,703	-	61,204
1985	13,557	13,085	4,698	24,483	24,064	-	60,134
1986	14,925	12,633	5,780	25,413	30,422	-	60,842
1987	14,905	13,638	8,013	21,298	34,466	-	74,989
1988	20,477	18,249	7,867	22,592	34,467	-	79,311
1989	23,242	21,483	4,776	32,986	28,517	-	92,036
1990	21,036	22,514	6,489	30,533	37,427	-	122,442
1991	25,132	29,161	5,956	33,208	31,688	-	129,571
1992	22,226	34,300	3,467	27,907	42,221	-	136,658
1993	18,658	34,591	3,403	25,554	24,431	-	134,729
1994	13,888	32,545	2,342	23,270	25,725	-	151,656
1995	16,574	36,726	4,187	21,066	26,298	-	173,448
1996	19,205	37,077	3,020	23,295	40,157	-	182,167
1997	20,113	36,828	5,210	21,932	32,982	-	185,960
1998	16,378	38,486	4,880	23,581	41,984	-	163,015
1999	15,008	36,954	2,419	28,775	37,809	-	164,465
2000	12,714	39,017	2,269	38,841	35,491	-	180,875
2001	10,032	65,359	2,242	30,615	42,015	-	180,991
2002	8,132	41,684	2,013	49,485	-	23,068	-

(unit: million yen)

FY	Electronic equipment & electric measuring instruments	Information & communication electronics equipment	Electronic parts and devices	motor vehicles	Precision instruments	Other industries	All industries
1980	-	-	-	10,363	2,948	99,491	239,529
1981	-	-	-	10,855	3,769	104,755	259,632
1982	-	-	-	16,094	3,515	102,826	282,613
1983	-	-	-	10,644	4,405	96,296	279,280
1984	-	-	-	10,290	4,386	113,267	281,447
1985	-	-	-	11,391	5,059	136,702	293,173
1986	-	-	-	11,289	4,154	95,119	260,577
1987	-	-	-	8,402	6,677	100,857	283,245
1988	-	-	-	6,560	7,265	115,407	312,195
1989	-	-	-	7,248	8,302	111,335	329,925
1990	-	-	-	7,560	11,389	112,517	371,907
1991	-	-	-	8,029	12,743	119,173	394,661
1992	-	-	-	17,194	22,051	107,884	413,908
1993	-	-	-	8,748	22,747	90,113	362,974
1994	-	-	-	8,700	10,618	101,949	370,693
1995	-	-	-	7,511	11,911	93,994	391,715
1996	-	-	-	8,556	12,836	124,856	451,169
1997	-	-	-	7,536	15,085	112,754	438,400
1998	-	-	-	6,164	9,742	125,824	430,054
1999	-	-	-	7,041	6,759	111,066	410,296
2000	-	-	-	5,630	7,731	120,719	443,287
2001	-	-	-	6,846	14,354	195,925	548,379
2002	10,693	151,645	45,626	10,248	12,749	186,370	541,713

Note: 1) Includes software industry for the year 1996-2000.

2) In FY2001, there were changes in the Industrial Classification for the Survey of Research and Development

3) As FY2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.

4) Technical trade means patents, expertise, technical guidance, etc.

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 11-3-2: Trends in the technology exports to imports ratio for Japan

(Export value/Import value of technological trade)

FY	Industrial chemicals & chemical fibers	Drugs and medicines	Iron and steel	General machinery	Electrical machinery, equipment & supplies	Miscellaneous electrical machinery and supplies	Communication & electronic equipment
1980	1.52	0.29	2.23	0.32	0.37	-	0.38
1981	1.27	0.75	1.65	0.17	0.40	-	0.43
1982	0.79	0.51	3.72	0.19	0.33	-	0.43
1983	0.98	0.80	2.28	0.38	0.42	-	0.37
1984	1.25	0.99	5.82	0.48	0.42	-	0.54
1985	1.46	1.00	5.58	0.48	0.74	-	0.69
1986	1.02	1.37	3.73	0.27	0.55	-	0.59
1987	1.27	1.18	1.25	0.41	0.62	-	0.53
1988	1.32	0.89	1.37	0.48	0.61	-	0.60
1989	1.27	0.88	4.52	0.40	0.99	-	0.64
1990	1.32	1.11	1.45	0.47	0.78	-	0.55
1991	0.99	0.98	1.77	0.46	1.02	-	0.57
1992	1.06	0.81	2.54	0.78	0.74	-	0.55
1993	1.19	0.90	3.91	0.72	1.91	-	0.60
1994	1.90	0.96	5.48	0.87	1.78	-	0.62
1995	1.61	1.00	4.04	1.05	2.36	-	0.88
1996	1.80	1.39	6.93	0.96	1.96	-	0.85
1997	1.88	1.66	2.94	1.36	2.26	-	0.92
1998	2.11	2.09	2.45	1.34	1.89	-	0.97
1999	2.24	2.80	4.77	1.02	2.06	-	0.77
2000	2.68	2.21	5.92	0.91	1.74	-	0.83
2001	3.63	1.70	4.28	1.64	2.00	-	0.86
2002	5.93	3.41	4.75	0.93	-	1.56	-

(Export value/Import value of technological trade)

FY	Electronic equipment & electric measuring instruments	Information & communication electronics equipment	Electronic parts and devices	motor vehicles	Precision instruments	Other industries	All industries
1980	-	-	-	0.81	0.30	0.72	0.67
1981	-	-	-	1.18	0.77	0.71	0.67
1982	-	-	-	0.96	0.69	0.71	0.65
1983	-	-	-	1.73	0.92	1.09	0.86
1984	-	-	-	2.64	0.41	1.10	0.99
1985	-	-	-	2.28	0.34	0.56	0.80
1986	-	-	-	3.56	0.45	0.72	0.86
1987	-	-	-	5.47	0.44	0.51	0.76
1988	-	-	-	8.26	0.63	0.47	0.79
1989	-	-	-	11.46	1.51	0.57	1.00
1990	-	-	-	11.76	0.38	0.65	0.91
1991	-	-	-	12.40	0.95	0.62	0.94
1992	-	-	-	6.60	0.23	0.65	0.91
1993	-	-	-	14.20	0.18	0.66	1.10
1994	-	-	-	18.41	0.53	0.64	1.25
1995	-	-	-	21.19	0.71	0.82	1.43
1996	-	-	-	23.09	0.81	1.06	1.56
1997	-	-	-	45.94	0.59	0.77	1.90
1998	-	-	-	69.89	0.86	0.64	2.13
1999	-	-	-	70.05	1.37	0.68	2.34
2000	-	-	-	103.46	1.00	0.72	2.39
2001	-	-	-	97.61	0.94	0.60	2.27
2002	0.89	0.90	1.34	74.96	0.87	0.64	2.56

Note: 1) Includes software industry for the year 1996-2000.

2) In FY2001, there were changes in the Industrial Classification for the Survey of Research and Development

3) As FY2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.

4) Technical trade means patents, expertise, technical guidance, etc.

5) Trade balance of technology: (Export value of technology) ÷ (Import value of technology)

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 11-3-3: Comparison of financial relationships in technology exports and imports by industry

(A) Export of technology

	Export value of technology (unit: million yen)	Parent-subsidiary companies' share (unit: million yen)	Capital ratio of parent and subsidiary (unit: %)
Drugs and medicines	142,212	40,530	28.5
Industrial chemicals and chemical fibers	48,233	21,536	44.6
Ceramics	14,079	11,816	83.9
Iron and steel	9,570	1,154	12.1
General machinery	45,946	30,802	67.0
Miscellaneous electrical machinery equipment and supplies	35,980	20,480	56.9
Electronic equipment and electric measuring instruments	9,468	6,445	68.1
Information and communication electronics equipment	135,954	71,111	52.3
Electronic parts and devices	61,157	32,309	52.8
Motor vehicles	768,236	666,251	86.7
Precision instruments	11,141	6,720	60.3
Software and infomation processing	2,646	2,109	79.7
Other industries	102,147	54,448	53.3
All industries	1,386,769	965,711	69.6

(B) Import of technology

	Import value of technology (unit: million yen)	Parent-subsidiary companies' share (unit: million yen)	Capital ratio of parent and subsidiary (unit: %)
Drugs and medicines	41,684	2,336	5.6
Industrial chemicals and chemical fibers	8,132	4,031	49.6
Ceramics	972	34	3.5
Iron and steel	2,013	215	10.7
General machinery	49,485	13,569	27.4
Miscellaneous electrical machinery equipment and supplies	23,068	1,089	4.7
Electronic equipment and electric measuring instruments	10,693	6,394	59.8
Information and communication electronics equipment	151,645	2,466	1.6
Electronic parts and devices	45,626	14,465	31.7
Motor vehicles	10,248	962	9.4
Precision instruments	12,749	939	7.4
Software and infomation processing	34,491	556	1.6
Other industries	150,907	44,655	29.6
All industries	541,713	91,711	16.9

Note: 1) Technical trade means patents, expertise, technical guidance, etc.
2) Parent-subsidiary company is a company which investment ratio exceeds 50%.
Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 11-3-4: Value of technology trade by region and by industry

(A) Export value of technology

(unit: million yen)

Industrial sector	North America		Europe		Asia	
	FY 1997	FY 2002	FY 1997	FY 2002	FY 1997	FY 2002
Drugs and medicines	42,103	92,436	18,804	46,815	249	2,904
Industrial chemicals & chemical fibers	10,454	7,708	7,820	13,299	17,851	23,853
General machinery	13,622	17,609	5,931	11,838	9,979	16,209
Electrical machinery,equipment supplies	18,507	-	5,447	-	49,113	-
Miscellaneous electrical machinery equipment and supplies	-	17,349	-	2,504	-	15,458
Communication & electronic equipment	37,305	-	28,292	-	102,799	-
Electronic equipment & electric measuring instruments	-	7,702	-	200	-	1,560
Information & communication electronics equipment	-	28,175	-	26,260	-	79,219
Electronic parts and devices	-	10,086	-	4,058	-	46,549
Motor vehicles	235,816	576,116	41,639	68,747	56,359	103,304
Precision instruments	3,265	2,712	2,692	2,196	2,904	6,232
Software	258	-	12	-	130	-
Software & infomation processing	-	1,706	-	359	-	561
Other industries	33,197	36,596	13,958	17,117	45,725	65,436
All industries	394,527	798,195	124,595	193,393	285,109	361,285

(unit: million yen)

Industrial sector	Other area		Total	
	FY 1997	FY 2002	FY 1997	FY 2002
Drugs and medicines	28	57	61,184	142,212
Industrial chemicals & chemical fibers	1,725	3,373	37,850	48,233
General machinery	195	290	29,727	45,946
Electrical machinery,equipment supplies	1,309	-	74,376	-
Miscellaneous electrical machinery equipment and supplies	-	669	-	35,980
Communication & electronic equipment	3,236	-	171,632	-
Electronic equipment & electric measuring instruments	-	6	-	9,468
Information & communication electronics equipment	-	2,300	-	135,954
Electronic parts and devices	-	464	-	61,157
Motor vehicles	12,373	20,069	346,187	768,236
Precision instruments	29	1	8,890	11,141
Software	0	-	400	-
Software & infomation processing	-	20	-	2,646
Other industries	8,437	6,647	101,317	125,796
All industries	27,332	33,896	831,563	1,386,769

(B) Import value of technology

(unit: million yen)

Industrial sector	North America		Europe		Other areas (including Asia)		Total	
	FY 1997	FY 2002	FY 1997	FY 2002	FY 1997	FY 2002	FY 1997	FY 2002
Drugs and medicines	18,462	11,462	18,028	30,027	X	196	36,828	41,684
Industrial chemicals & chemical fibers	11,736	5,779	8,361	2,349	15	5	20,113	8,132
General machinery	14,635	40,599	7,022	8,332	275	554	21,932	49,485
Electrical machinery,equipment supplies	26,204	-	6,537	-	241	-	32,982	-
Miscellaneous electrical machinery equipment and supplies	-	17,297	-	5,211	-	559	-	23,068
Communication & electronic equipment	154,962	-	30,781	-	216	-	185,960	-
Electronic equipment & electric measuring instruments	-	9,327	-	1,184	-	182	-	10,693
Information & communication electronics equipment	-	122,284	-	27,449	-	1,913	-	151,645
Electronic parts and devices	-	40,538	-	4,532	-	555	-	45,626
Motor vehicles	2,847	5,560	4,641	3,976	47	711	7,536	10,248
Precision instruments	12,516	11,103	1,730	952	839	695	15,085	12,749
Software	4,991	-	91	-	227	-	5,309	-
Software & infomation processing	-	33,322	-	819	-	351	-	34,491
Other industries	67,164	70,674	42,647	82,439	3,185	778	112,655	153,892
All industries	313,517	367,945	119,838	167,270	5,045	6,499	438,400	541,713

Note: 1) Japan Standard Industry Classification and Industrial Classification for the Survey of Research and Development for 1997 are different from that of 2002.

2) Technological trade means patents, expertise, technical guidance, etc.

3) x: When research unit is 2 or less, figures are hidden.

4) Countries in each area: <North America>U.S., Canada, Mexico, Panama, etc.

<Europe>U.K., Italy, Netherlands, Switzerland, Sweden, Spain, Russia, Denmark, Germany, Norway, France, Romania, etc.

<Asia (excluding West Asia)>India, Indonesia, Republic of Korea, Thailand, China (including Taiwan), Philippines, Malaysia, etc.

<Other areas>West Asia (Iraq, Iran, Saudi Arabia, Turkey, etc.), South America (Colombia, Argentina, Brazil, etc.), Africa (Egypt, Nigeria, South Africa, etc.), Oceania (Australia, New Zealand, etc.)

Source: <Japan>Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 11-3-5: Comparison of the statistics on the technology trade in Japan (FY2002)

(A) Trend in technological trade value in Japan (Statistics by Bank of Japan)

FY	Export value of technology: Foreign currency received (million dollars)	Export value of technology: Yen equivalent (100 million yen)	Import value of technology: Foreign currency paid (million dollars)	Import value of technology: Yen equivalent (100 million yen)	Balance ratio
1980	378	817	1,439	3,112	0.26
1981	537	1,229	1,711	3,917	0.31
1982	527	1,315	1,796	4,481	0.29
1983	624	1,475	2,079	4,913	0.30
1984	693	1,692	2,317	5,657	0.30
1985	746	1,649	2,522	5,576	0.30
1986	1,009	1,613	3,375	5,395	0.30
1987	1,385	1,916	4,177	5,777	0.33
1988	1,681	2,156	5,076	6,510	0.33
1989	2,189	3,127	5,455	7,793	0.40
1990	2,582	3,647	6,004	8,481	0.43
1991	-	3,976	-	8,619	0.46
1992	-	3,995	-	8,899	0.45
1993	-	4,351	-	7,906	0.55
1994	-	5,427	-	8,561	0.63
1995	-	6,182	-	9,445	0.65
1996	-	7,562	-	10,967	0.69
1997	-	9,297	-	11,557	0.80
1998	-	9,530	-	11,862	0.80
1999	-	9,667	-	11,019	0.88
2000	-	11,881	-	12,180	0.98
2001	-	12,366	-	13,703	0.90
2002	-	13,907	-	13,705	1.01

(B) Trend in technological trade value in Japan (Statistics by Ministry of Public Management, Home Affairs, Posts and Telecommunications)

FY	Export value of technology: Number of trade	Export value of technology: Yen currency received (100 million yen)	Import value of technology: Number of trade	Import value of technology: Yen currency paid (100 million yen)	Balance ratio
1980	4,103	1,596	7,248	2,395	0.67
1981	4,877	1,751	7,207	2,596	0.67
1982	4,738	1,849	6,936	2,826	0.65
1983	6,403	2,409	7,839	2,793	0.86
1984	5,426	2,775	7,316	2,815	0.99
1985	5,885	2,342	7,679	2,932	0.80
1986	5,469	2,241	7,494	2,606	0.86
1987	5,955	2,156	7,373	2,833	0.76
1988	6,352	2,463	8,356	3,122	0.79
1989	7,559	3,294	7,109	3,299	1.00
1990	7,163	3,394	8,249	3,719	0.91
1991	8,063	3,706	7,409	3,947	0.94
1992	8,201	3,777	8,126	4,139	0.91
1993	8,338	4,004	7,724	3,630	1.10
1994	9,099	4,621	7,618	3,707	1.25
1995	9,073	5,621	7,712	3,917	1.43
1996	13,194	7,030	7,659	4,512	1.56
1997	10,008	8,316	7,888	4,384	1.90
1998	9,517	9,161	6,687	4,301	2.13
1999	10,958	9,608	6,386	4,103	2.34
2000	15,067	10,579	6,445	4,433	2.39
2001	-	12,468	-	5,484	2.27
2002	-	13,868	-	5,417	2.56

Note: <Table A>1) Before 1990, dollar base amount in the 'Balance of payments statistics' is converted into yen at the interbank central rate, fiscal year-end month average.
2) After 1991, the yen amount in the 'Balance of payments statistics' was applied, revised in January, 1996.
3) Technological trade means patent royalties (patent rights, industrial property rights such as trade mark, mining rights, usage fees for copyright, and usage fees under license agreement).
<Table B>1) Includes software industry for the year 1996-2000.
2) In FY2001, there were changes of the classification and addition of the industrial sector in the Industrial Classification for the Survey of Research and Development.
3) In FY2002, there were changes in the Japan Standard Industry Classification and the Industrial Classification for the Survey of Research and Development.
4) Technological trade means patents, expertise, technical guidance, etc.
Source: <Table A>Bank of Japan, 'Balance of Payments Monthly'
Ministry of Public Management, Home Affairs, Posts and Telecommunications, 'Report on the Survey of Research and Development'

Table 12-1-1: Time-series change in the TFP indicator

Year	All industries	Manufacturing	Non-manufacturing
1970	1.000	1.000	1.000
1971	0.996	1.015	0.982
1972	0.993	1.025	0.968
1973	0.993	1.039	0.955
1974	0.934	1.024	0.912
1975	0.939	1.001	0.938
1976	0.945	1.025	0.921
1977	0.947	1.039	0.911
1978	0.951	1.045	0.908
1979	0.980	1.071	0.914
1980	0.991	1.082	0.915
1981	0.988	1.090	0.905
1982	0.971	1.092	0.888
1983	0.964	1.093	0.881
1984	0.963	1.100	0.874
1985	0.990	1.092	0.905
1986	0.964	1.096	0.878
1987	0.963	1.103	0.872
1988	0.985	1.120	0.878
1989	0.992	1.140	0.869
1990	1.007	1.155	0.870
1991	1.003	1.159	0.864
1992	0.996	1.147	0.867
1993	0.993	1.137	0.872
1994	1.003	1.133	0.883
1995	1.020	1.142	0.891
1996	1.049	1.158	0.904
1997	1.052	1.165	0.902
1998	1.020	1.146	0.889

Note: The figures in the table are recalculated by NISTEP based on JIP database shown in the “Economic Analysis No. 170” by Economic and Social Research Institute, Cabinet Office.

2) Manufacturing includes industries stated in JIP Code 11-45 shown in Table 1-7 of “Economic Analysis No. 170,” and non-manufacturing refers to the rest.

3) The current-term TFP index is defined as the value of the previous fiscal year TFP index x (1+current TFP growth rate). 1970 TFP index is made to be 1. The TFP growth rate of the overall economy each year is Domar’s weighted average efficiency of TFP growth rate of each industry of each year. The TFP index of each year/each industry is quoted from the Table 6-12 of “Economic Analysis No. 170.” Similarly, TFP of the manufacturing industry each year is Domar’s weighted average efficiency of the TFP growth rate of the manufacturing industry (JIP Code 11-45).

4) ‘Domar’s weight,’ which is a multiplier of the TFP growth rate of each industry in the current term, is defined as the quotient of output of each industry in the current term divided by added value of overall economy in the current term. The output of each industry in the current term is quoted from the Table 1-7 in the “Economic Analysis No. 170.” Also, the added value of each industry in the current term was calculated based on output reported in the previously shown Table 1-7 and the intermediate input total (Added value = output - intermediate input total). Output and intermediate input total of 1971 and 1972 are not reported in the “Economic Analysis No. 170.” Therefore, compiled data for these two years through linear imputation are as below. For the data of 1971, 1970 value x (2/3) + 1973 value x (1/3), and for the data of 1972, 1970 value x (1/3) + 1973 value x (2/3). With these figures, Domar’s weighted average efficiency for 1971 and 1972 was derived. This calculation method was used on the advice of Mr. Kwon Hyeog Ug of Hitotsubashi University.

Reference: “Measuring Productivity OECD Manual: Measurement of Aggregate and Industry level Productivity Growth” (2001)

Table 12-1-2: Time-series change in the TFP indicator (All industries)

Year	Base case	TFP with cosidering utilization rate	TFP without considering labor quality
1970	1.000	1.000	1.000
1971	0.996	1.001	1.004
1972	0.993	1.003	1.007
1973	0.993	1.011	1.015
1974	0.934	0.970	0.962
1975	0.939	0.959	0.974
1976	0.945	0.945	0.986
1977	0.947	0.950	0.995
1978	0.951	0.948	1.004
1979	0.980	0.977	1.041
1980	0.991	1.006	1.058
1981	0.988	1.012	1.061
1982	0.971	0.988	1.048
1983	0.964	0.973	1.046
1984	0.963	0.961	1.050
1985	0.990	0.986	1.084
1986	0.964	0.974	1.061
1987	0.963	0.980	1.066
1988	0.985	1.016	1.096
1989	0.992	1.021	1.109
1990	1.007	1.009	1.130
1991	1.003	1.000	1.128
1992	0.996	1.001	1.120
1993	0.993	1.006	1.118
1994	1.003	1.014	1.128
1995	1.020	1.027	1.147
1996	1.049	1.055	1.184
1997	1.052	1.057	1.192
1998	1.020	1.030	1.160

Note: 1) Figures in the table are recalculated by NISTEP based on JIP database described in the “Economic Analysis No. 170” by Economic and Social Research Institute, Cabinet Office.

2) Manufacturing includes industries stated in JIP Code 11-45 shown in the Table 1-7 of “Economic Analysis No. 170,” and non-manufacturing refers to the rest.

3) The current-term TFP index is defined as the value of the previous fiscal year TFP index x (1+current term TFP growth rate). 1970 TFP index is made to be 1. The TFP growth rate of the overall economy of each year is Domar’s weighted average efficiency of the TFP growth rate of each industry of each year. The TFP index of each year/each industry is quoted from the Table 6-12 (base case), Table 6-13 (case where quality of work is disregarded), and Table 6-14 (case where operating rate is considered) of “Economic Analysis No. 170.”

4) ‘Domar’s weight,’ which is a multiplier of the TFP growth rate of each industry in the current term, is defined as the quotient of output of each industry in the current term divided by the added value of the overall economy in the current term. The output of each industry in the current term is quoted from the Table 1-7 in the “Economic Analysis No. 170.” Also, the added value of each industry in the current term was calculated based on output reported in the previously shown Table 1-7 and the intermediate input total (Added value = output - intermediate input total). The output and intermediate input total of 1971 and 1972 are not reported in the “Economic Analysis No. 170.” Therefore, data for these two years through linear imputation are compiled as below. For the data of 1971, 1970 value x (2/3) + 1973 value x (1/3), and for the data of 1972, 1970 value x (1/3) + 1973 value x (2/3). With these figures, Domar’s weighted average efficiency for 1971 and 1972 was derived.

Reference: “Measuring Productivity OECD Manual: Measurement of Aggregate and Industry level Productivity Growth” (2001)

Table 12-1-3: Time-series change in the TFP indicator (Manufacturing industries)

Year	Base case	TFP with cosidering utilization rate	TFP without considering labor quality
1970	1.000	1.000	1.000
1971	1.015	1.015	1.017
1972	1.025	1.026	1.030
1973	1.039	1.040	1.046
1974	1.024	1.030	1.035
1975	1.001	1.012	1.013
1976	1.025	1.034	1.038
1977	1.039	1.048	1.054
1978	1.045	1.053	1.062
1979	1.071	1.077	1.089
1980	1.082	1.087	1.102
1981	1.090	1.098	1.112
1982	1.092	1.101	1.114
1983	1.093	1.101	1.116
1984	1.100	1.105	1.125
1985	1.092	1.097	1.118
1986	1.096	1.104	1.123
1987	1.103	1.111	1.131
1988	1.120	1.125	1.150
1989	1.140	1.145	1.172
1990	1.155	1.158	1.187
1991	1.159	1.163	1.192
1992	1.147	1.158	1.181
1993	1.137	1.152	1.172
1994	1.133	1.149	1.170
1995	1.142	1.156	1.180
1996	1.158	1.172	1.197
1997	1.165	1.177	1.206
1998	1.146	1.163	1.186

Note: 1) The figures in the table are recalculated by NISTEP based on JIP database described in the "Economic Analysis No. 170" by Economic and Social Research Institute, Cabinet Office.

2) Manufacturing includes industries stated in JIP Code 11-45 shown in the Table 1-7 of "Economic Analysis No. 170," and non-manufacturing refers to the rest.

3) The current-term TFP index is defined as the value of previous fiscal year TFP index x (1+current term TFP growth rate). 1970 TFP index is made to be 1. The TFP growth rate of each year is Domar's weighted average efficiency of the TFP growth rate of the manufacturing industry (JIP Code 11-45) of each year. The TFP index of each year/each industry is quoted from the Table 6-12 (base case), Table 6-13 (case where quality of work is disregarded), and Table 6-14 (case where operating rate is considered) of "Economic Analysis No. 170."

4) 'Domar's weight,' which is a multiplier of TFP growth rate of each industry in the current term, is defined as the quotient of output of each industry in the current term divided by the added value of the overall economy in the current term. The output of each industry in the current term is quoted from the Table 1-7 in the "Economic Analysis No. 170." Also, the added value of each industry in the current term was calculated based on the output reported in the previously shown Table 1-7 and the intermediate input total (Added value = output - intermediate input total). Output and intermediate input total of 1971 and 1972 are not reported in the "Economic Analysis No. 170." Therefore, data for these two years through linear imputation were compiled as below. For the data of 1971, 1970 value x (2/3) + 1973 value x (1/3), and for the data of 1972, 1970 value x (1/3) + 1973 value x (2/3). With these figures, Domar's weighted average efficiency for 1971 and 1972 was derived.

Reference: "Measuring Productivity OECD Manual: Measurement of Aggregate and Industry level Productivity Growth" (2001)

Table 12-1-4: Time-series change in the TFP indicator (Non-manufacturing industries)

Year	Base case	TFP with cosidering utilization rate	TFP without considering labor quality
1970	1.000	1.000	1.000
1971	0.982	0.986	0.987
1972	0.968	0.977	0.977
1973	0.955	0.972	0.969
1974	0.912	0.941	0.930
1975	0.938	0.947	0.961
1976	0.921	0.914	0.949
1977	0.911	0.906	0.943
1978	0.908	0.899	0.945
1979	0.914	0.906	0.955
1980	0.915	0.925	0.960
1981	0.905	0.921	0.954
1982	0.888	0.897	0.940
1983	0.881	0.883	0.936
1984	0.874	0.868	0.932
1985	0.905	0.898	0.968
1986	0.878	0.881	0.944
1987	0.872	0.880	0.941
1988	0.878	0.902	0.952
1989	0.869	0.891	0.945
1990	0.870	0.870	0.951
1991	0.864	0.859	0.945
1992	0.867	0.863	0.948
1993	0.872	0.872	0.953
1994	0.883	0.881	0.963
1995	0.891	0.887	0.971
1996	0.904	0.900	0.988
1997	0.902	0.897	0.988
1998	0.889	0.885	0.977

Note: 1) The figures in the table are recalculated by NISTEP based on JIP database described in the "Economic Analysis No. 170" by Economic and Social Research Institute, Cabinet Office.

2) Manufacturing includes industries stated in JIP Code 11-45 shown in the Table 1-7 of "Economic Analysis No. 170," and non-manufacturing refers to the rest.

3) The current-term TFP index is defined as the value of the previous fiscal year TFP index x (1+current term TFP growth rate). 1970 TFP index is made to be 1. The TFP growth rate of each year is Domar's weighted average efficiency of the TFP growth rate of the non-manufacturing industry of each year. The TFP index of each year/each industry is quoted from the Table 6-12 (base case), Table 6-13 (case where quality of work is disregarded), and Table 6-14 (case where operating rate is considered) of "Economic Analysis No. 170."

4) 'Domar's weight,' which is a multiplier of the TFP growth rate of each industry in the current term, is defined as the quotient of output of each industry in the current term divided by the added value of the overall economy in the current term. The output of each industry in the current term was quoted from the Table 1-7 in the "Economic Analysis No. 170." Also, the added value of each industry in the current term was calculated based on output reported in the previously shown Table 1-7 and the intermediate input total (Added value = output - intermediate input total). The output and intermediate input total of 1971 and 1972 are not reported in the "Economic Analysis No. 170." Therefore, data for these two years through linear imputation are compiled as below. For the data of 1971, 1970 value x (2/3) + 1973 value x (1/3), and for the data of 1972, 1970 value x (1/3) + 1973 value x (2/3). With these figures, Domar's weighted average efficiency for 1971 and 1972 was derived.

Reference: "Measuring Productivity OECD Manual: Measurement of Aggregate and Industry level Productivity Growth" (2001)

Table 12-2-1: Trends in the amount of JICFS registration data (by category)

Classification	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002(FY)
Foods	293,656	278,383	320,184	378,855	387,791	391,136	431,898	484,159	527,733	575,263
Daily-use goods	258,741	249,669	284,440	336,023	337,167	378,615	420,678	445,735	474,057	488,497
Entertainment-related and productivity-related goods	59,173	57,209	76,303	86,764	95,099	127,413	177,362	212,002	211,118	204,584
Durable consumer goods	32,529	105,476	75,699	52,185	125,927	163,080	194,004	211,042	215,488	148,836
Apparel, personal articles and accessories and sporting goods	58,822	50,165	53,066	54,193	49,201	59,259	71,843	89,757	99,916	130,503
Other products	339	439	194	308	339	378	705	1,007	1,379	2,732
Total (active data)	703,260	741,341	809,886	908,328	995,524	1,119,881	1,296,491	1,443,702	1,529,691	1,550,415

Source: JICFS (JAN Item Code File Service) data of Distribution Code Center, The Distribution Systems Research Institute.
The data are estimated by NISTEP from the JICFS data.

Table 12-2-2: Trends in the amount of JICFS registration data (by subcategory under 'foods' and 'daily-use goods')

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002(FY)
Processed foods	147,788	134,648	149,677	171,670	174,588	171,918	194,159	221,321	242,807	270,160
Sweets and snacks	72,217	68,711	86,157	100,700	96,660	90,068	100,876	114,191	124,001	129,715
Soft and alcoholic beverages	50,704	55,567	62,734	81,726	91,578	102,347	107,647	116,158	126,252	139,331
Other foods	22,947	19,457	21,616	24,759	24,965	26,803	29,217	32,489	34,673	36,057
Daily-use sundries	28,890	28,444	31,351	35,962	37,773	39,687	42,540	45,493	55,330	63,168
Pharmaceutical products	9,376	10,671	15,910	37,755	37,206	59,518	56,864	54,259	54,466	50,960
Cosmetics	55,476	60,581	68,348	77,980	77,035	74,119	80,050	87,520	87,757	91,516
Household goods	112,013	100,778	113,363	119,341	114,560	123,102	148,827	163,694	175,137	180,046
DIY products	32,568	31,486	35,877	42,178	46,028	52,795	59,157	62,859	70,724	72,054
Pet products	9,989	9,556	11,546	14,210	16,395	20,377	23,611	26,365	25,775	25,989
Other daily-use goods	10,429	8,153	8,045	8,597	8,170	9,017	9,629	5,545	4,868	4,764

Source: JICFS (JAN Item Code File Service) data of Distribution Code Center, The Distribution Systems Research Institute.
The data are estimated by NISTEP from the JICFS data.

Table 12-2-3: Trends in the amount of JICFS registration data (by category)

(unit: %)

Classification	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002(FY)
Processed foods	21.01	18.16	18.48	18.90	17.54	15.35	14.98	15.33	15.87	17.43
Sweets and snacks	10.27	9.27	10.64	11.09	9.71	8.04	7.78	7.91	8.11	8.37
Soft and alcoholic beverages	7.21	7.50	7.75	9.00	9.20	9.14	8.30	8.05	8.25	8.99
Other foods	3.26	2.62	2.67	2.73	2.51	2.39	2.25	2.25	2.27	0.02
Daily-use sundries	4.11	3.84	3.87	3.96	3.79	3.54	3.28	3.15	3.62	4.07
Pharmaceutical products	1.33	1.44	1.96	4.16	3.74	5.31	4.39	3.76	3.56	3.29
Cosmetics	7.89	8.17	8.44	8.59	7.74	6.62	6.17	6.06	5.74	5.90
Household goods	15.93	13.59	14.00	13.14	11.51	10.99	11.48	11.34	11.45	11.61
DIY products	4.63	4.25	4.43	4.64	4.62	4.71	4.56	4.35	4.62	4.65
Pet products	1.42	1.29	1.43	1.56	1.65	1.82	1.82	1.83	1.68	1.68
Other daily-use goods	1.48	1.10	0.99	0.95	0.82	0.81	0.74	0.38	0.32	0.31
Entertainment-related and productivity-related goods	8.41	7.72	9.42	9.55	9.55	11.38	13.68	14.68	13.80	13.20
Durable consumer goods	4.63	14.23	9.35	5.75	12.65	14.56	14.96	14.62	14.09	9.60
Apparel, personal articles and accessories and sporting goods	8.36	6.77	6.55	5.97	4.94	5.29	5.54	6.22	6.53	8.42
Other products	0.05	0.06	0.02	0.03	0.03	0.03	0.05	0.07	0.09	0.18
Total (active data)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: JICFS (JAN Item Code File Service) data of Distribution Code Center, The Distribution Systems Research Institute.
The data are estimated by NISTEP from the JICFS data.

Table 12-2-4: Trends in the number of new JICFS registration data

	1988	1989	1990	1991	1992	1993	1994
Foods	34,655	60,158	46,277	85,881	49,569	71,554	47,888
Daily-use goods	37,173	71,491	55,331	79,699	48,103	66,341	39,776
Entertainment-related and productivity-related goods	4,111	13,650	13,296	27,508	12,327	17,137	10,682
Durable consumer goods	962	5,578	9,995	17,482	6,737	9,999	79,541
Apparel, personal articles and accessories and sporting goods	8,471	11,614	20,707	24,356	13,083	23,300	7,553
Other products	5	20	3	26	-4	296	119
Total (number of newly registered)	85,377	162,511	145,609	234,952	129,815	188,626	185,559

	1995	1996	1997	1998	1999	2000	2001	2002(FY)
Foods	58,286	75,156	64,018	72,270	80,306	91,093	99,832	123,937
Daily-use goods	49,557	66,368	42,898	84,873	84,571	64,955	80,782	82,548
Entertainment-related and productivity-related goods	26,505	17,871	26,441	47,464	64,403	50,705	25,229	26,634
Durable consumer goods	1,532	7,795	79,574	42,356	42,347	28,981	39,200	14,343
Apparel, personal articles and accessories and sporting goods	10,127	8,354	14,015	20,224	21,163	27,698	24,399	44,027
Other products	-203	157	53	76	420	379	423	1,354
Total (number of newly registered)	145,804	175,701	226,999	267,263	293,211	263,812	269,853	292,803

Source: JICFS (JAN Item Code File Service) data of Distribution Code Center, The Distribution Systems Research Institute.

The data are estimated by NISTEP from the JICFS data.

The data of ‘other products’ is the sum total of the increase due to new registrations and decrease due to changes to other group.

Table 12-2-5: Trends in the amount of new JICFS registration data (under ' foods' and 'daily-use goods' categories)

Classification	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002 (FY)
Processed foods	15,181	29,563	22,869	46,405	23,769	36,607	20,109	23,326	30,289	28,047	31,775	38,699	43,838	46,359	60,371
Sweets and snacks	13,327	17,048	14,389	20,611	10,413	6,294	11,217	19,536	16,632	15,547	15,181	20,583	22,713	24,534	28,963
Soft and alcoholic beverages	3,645	8,498	5,433	11,026	9,676	21,150	12,843	11,544	23,370	16,025	19,012	15,909	18,501	22,276	26,668
Other foods	2,502	5,049	3,586	7,839	5,711	7,504	3,718	3,881	4,864	4,399	6,302	5,115	6,041	6,663	7,935
Daily-use sundries	4,425	5,287	4,140	5,206	5,448	9,256	3,515	4,565	6,270	5,064	6,799	6,473	6,846	15,289	13,337
Pharmaceutical products	1,680	4,682	2,053	1,895	1,272	1,607	2,149	5,555	22,161	1,962	24,848	3,856	2,155	4,277	3,280
Cosmetics	8,666	10,057	7,585	10,082	12,248	18,508	12,154	11,286	13,151	11,090	11,312	15,212	16,994	11,627	12,294
Household goods	18,799	43,357	27,428	44,175	18,687	13,023	13,094	18,103	11,496	14,296	24,353	38,724	27,749	31,643	35,092
DIY products	2,248	3,863	10,117	10,898	5,899	15,049	5,396	6,885	8,795	6,758	10,765	14,628	9,836	14,432	14,143
Pet products	860	2,162	1,897	1,980	2,690	4,502	1,488	2,316	2,990	2,964	5,268	4,308	4,646	3,155	3,709
Other daily-use goods	495	2,083	2,111	5,463	1,859	4,397	1,980	847	1,506	764	1,528	1,370	-3,270	360	693

Data: JICFS (JAN Item Code File Service) data of Distribution Code Center, The Distribution Systems Research Institute.

The data are estimated by NISTEP from the JICFS data.

Table 12-2-6: Average product life by category, based on new registration and withdrawals from JICFS

Classification	Average product life based on withdrawals	Average product life based on new registrations
Foods (total)	8.34	5.04
Processed foods	8.87	4.88
Sweets and snacks	7.06	4.83
Soft and alcoholic beverages	9.49	5.66
Other foods	6.78	5.00
Daily-use goods (total)	7.87	6.17
Daily-use sundries	9.82	4.62
Pharmaceutical products	9.14	16.44
Cosmetics	7.92	6.52
Household goods	7.44	5.49
DIY products	7.31	5.35
Pet products	7.65	6.79
Other daily-use goods	n.a	n.a
Entertainment-related and productivity-related goods	7.51	6.12
Durable consumer goods	4.22	6.97
Apparel, personal articles and accessories and sporting goods	7.58	3.33
Other products	32.61	2.37
Total (active data)	7.16	5.47

Data: JICFS (JAN Item Code File Service) data of Distribution Code Center, The Distribution Systems Research Institute.

The data are estimated by NISTEP from the JICFS data.

The data of ‘other daily-use goods’ are n.a. (not available) because most of the items in this category were re-classified to another one in October, 2000.

Table 12-2-7: JICFS classification table (Divisions, Major groups)

Divisions	Major groups	Note
Foods	Processed foods	
	Perishable foods	The items in this classification are included in the 'others' in this analysis because of the small volume
	Sweets and snacks	
	Soft and alcoholic beverages	
	Other foods	
Daily-use goods	Daily-use cundries	
	Pharmaceutical products	
	Cosmetics	
	Household goods	
	DIY products	
	Pet products	
	Other daily-use goods	
Entertainment-related and productivity-related goods	Stationery and office and information-related products	
	Toys	
	Books	The items classified in 'books' are very small in JICFS
	Musical instruments and sound software	
	Furniture	
	Automotive products and accessores	
Durable consumer goods	Furniture	
	Automotive products and accessories	
	Clocks and glasses	
	Optical and photograph-related goods	
	Household electrical appliances	
	Other durable consumer goods	
Apparel, personal articles and accessoried and sporting goods	Apparel and clothing	
	Bedclothes and bedding goods	
	Personal articles	
	Shoes and footwear	
	Sporting goods	
	Other apparel, personal articles and accessories and sporting goods	
Other products	Other products	The number of items may increase or decrease as some items may be re-classified into another category

Source: JICFS Classification Code Table, Distribution Code Center, The Distribution Systems Research Institute, May 2003.

Table 12-3-1-1: Birth and death rates of Japanese firms

Year	Number of corporation	Number of registrations of incorporation	Birth rate	Death rate	Rate of increase (%)
1971	967,726	96,507	-	-	-
1972	1,028,270	111,638	11.5	5.3	6.3
1973	1,085,470	118,102	11.5	5.9	5.6
1974	1,148,608	95,256	8.8	3.0	5.8
1975	1,211,000	95,100	8.3	2.8	5.4
1976	1,259,771	101,980	8.4	4.4	4.0
1977	1,312,224	99,848	7.9	3.8	4.2
1978	1,349,335	92,805	7.1	4.2	2.8
1979	1,402,060	102,981	7.6	3.7	3.9
1980	1,449,549	99,794	7.1	3.7	3.4
1981	1,498,888	94,801	6.5	3.1	3.4
1982	1,541,299	92,144	6.1	3.3	2.8
1983	1,578,452	95,879	6.2	3.8	2.4
1984	1,624,261	102,943	6.5	3.6	2.9
1985	1,660,010	104,683	6.4	4.2	2.2
1986	1,701,642	103,849	6.3	3.7	2.5
1987	1,783,434	116,073	6.8	2.0	4.8
1988	1,851,673	139,033	7.8	4.0	3.8
1989	1,962,026	163,945	8.9	2.9	6.0
1990	2,078,270	174,251	8.9	3.0	5.9
1991	2,216,880	169,545	8.2	1.5	6.7
1992	2,291,375	105,123	4.7	1.4	3.4
1993	2,344,131	95,137	4.2	1.8	2.3
1994	2,369,282	90,255	3.9	2.8	1.1
1995	2,404,027	90,322	3.8	2.3	1.5
1996	2,435,749	100,750	4.2	2.9	1.3
1997	2,465,347	92,610	3.8	2.6	1.2
1998	2,508,852	82,502	3.3	1.6	1.8
1999	2,527,224	88,036	3.5	2.8	0.7
2000	2,536,878	98,350	3.9	3.5	0.4

Note: 1) Number of registrations of incorporation: Total number of registrations of incorporation of general partnership/joint capital/private limited/joint-stock corporation reported in the "Minji, Shomu, Jinken Tokei Nenpou" by Ministry of Justice.

2) Number of corporation: National Tax Agency, "Report on the Results of the Corporation Sample Surveyt"

3) Birth rate: Number of registrations of incorporation in the year/total numbers of corporations in previous year x 100.

4) Death rate: Birth rate - Rate of increase

Source: Small and Medium Enterprise Agency, "White Paper on Small and Medium Enterprises," Ministry of Justice, "Minji, Shomu, Jinken Tokei Nenpou," and National Tax Agency, "Report on the Results of the Corporation Sample Survey t"

Table 12-3-1-2: Birth and death rates in the United States

(unit: 1,000 companies)

Year	Year-end total number of enterprises	Number of business successions	Newly established enterprises	New and business succession enterprises	Number of closing down	Birth rate (%)	Death rate (%)	Rate of increase (%)
1982	4,777	185	595	781	717	-	-	-
1983	4,837	171	633	804	728	13.3	12.0	1.3
1984	5,009	164	691	855	680	14.3	10.7	3.6
1985	5,142	166	715	881	748	14.3	11.6	2.7
1986	5,230	175	725	900	809	14.1	12.4	1.7
1987	5,420	163	748	911	724	14.3	10.7	3.6
1988	5,513	153	733	886	763	13.5	11.8	1.7
1989	5,568	153	745	898	830	13.5	12.5	1.0
1990	5,689	146	769	915	838	13.8	11.6	2.2
1991	5,740	140	726	866	820	12.8	11.9	0.9
1992	5,791	138	737	875	819	12.8	12.0	0.9
1993	5,900	136	758	894	803	13.1	11.2	1.9
1994	6,035	137	807	944	803	13.7	11.4	2.3
1995	6,105	164	819	983	864	13.6	12.4	1.2
1996	6,191	176	842	1,018	850	13.8	12.4	1.4
1997	6,330	168	885	1,053	857	14.3	12.0	2.2

Note: 1) Birth rate = Number of new enterprises of the year / Total enterprises in previous year-end x 100.

2) Death rate = Birth rate - Rate of increase

Source: Translation of "The State of Small Business: A Report of the President (The U.S. Small Business Administration)." by Japan Small Business Research Institute.

Table 12-3-1-3: GDP and average growth rate of GDP

Country	1995	1996	1997	1998	1999	2000	2001
Austria	172,287	175,736	178,536	185,537	190,617	197,352	198,674
Belgium	202,174	204,621	211,960	216,232	223,124	231,433	233,216
Denmark	1,009,756	1,035,188	1,065,929	1,092,236	1,117,464	1,151,248	1,162,201
Finland	94,953	98,760	104,974	110,574	115,057	122,085	122,932
France	1,181,849	1,194,884	1,217,640	1,259,055	1,299,510	1,348,655	1,373,397
Germany	1,801,300	1,815,100	1,840,400	1,876,400	1,914,800	1,969,500	1,980,800
Greece	79,927	81,812	84,788	87,640	90,762	94,606	98,473
Iceland	446,524	469,488	491,169	519,805	537,624	567,822	584,636
Ireland	52,641	56,891	63,106	68,684	76,338	83,937	88,710
Italy	923,052	933,142	952,050	969,130	984,567	1,012,802	1,030,782
Japan	497,739,400	515,009,988	524,282,327	518,516,462	521,986,724	534,311,798	531,218,251
The Netherlands	302,233	311,419	323,373	337,438	350,921	362,552	367,128
Norway	937,445	986,700	1,037,897	1,065,188	1,087,912	1,114,028	1,130,121
Portugal	80,827	83,692	86,997	90,955	94,100	97,429	99,041
Spain	437,787	448,457	466,513	486,785	507,220	528,439	542,569
Sweden	1,772,021	1,795,106	1,838,784	1,905,750	1,992,928	2,079,780	2,096,848
Switzerland	363,329	364,486	370,763	379,493	385,299	397,470	400,971
U.K.	719,176	738,046	763,459	785,777	804,713	829,517	845,820
U.S.	7,338,400	7,603,000	7,943,000	8,285,900	8,629,100	8,955,100	8,977,800

Country	Average growth rate of GDP (1)	Average growth rate of GDP (2)
Austria	2.8	2.1
Belgium	2.7	2.2
Denmark	2.7	2.0
Finland	5.2	3.4
France	2.7	2.8
Germany	2.3	1.7
Greece	3.2	4.2
Iceland	4.9	4.3
Ireland	9.8	7.8
Italy	1.9	2.3
Japan	1.4	0.9
The Netherlands	3.7	2.3
Norway	3.5	1.9
Portugal	4.0	2.6
Spain	4.2	3.4
Sweden	3.3	2.6
Switzerland	1.8	2.0
U.K.	2.8	2.5
U.S.	4.0	2.0

Note: 1) GDP of each country is in national currency on a 1995-base.
2) Average growth rate of GDP (1) is calculated as average growth rate of GDP(geometrical average) of 1995-2000. Growth rate for Denmark and Portugal are for the period of 1995-1998, Germany for 1997-2000, Greece/Ireland/U.K. for 1995-1999, Spain for 1996-2000, and U.S. for 1995-1997. This is to adjust to estimated period of average rate of establishing business of each country stated later inTable 12-3-1-4.
3) Average growth rate of GDP (2) is calculated as average growth rate of GDP (geometrical average) of 1999-2001.
Source: “OECD STAN Data Base”

Table 12-3-1-4: Birth rate, death rate and average growth rate of GDP

(unit: %)

	Birth rate	Death rate	Average growth rate of GDP	Remarks
Austria	7.4	4.9	2.8	
Belgium	8.4	8.2	2.7	
Denmark	6.5	n.a	2.7	1995–1998
Finland	12.3	10.6	5.2	
France	11.6	n.a	2.7	
Germany	15.7	12.6	2.3	1997–2000
Greece	11.0	7.8	3.2	1995–1999
Ireland	14.2	8.2	9.8	1995–1999
Italy	8.1	6.5	1.9	
Japan	3.8	2.6	1.4	
The Netherlands	10.2	5.5	3.7	
Portugal	13.2	9.1	4.0	1995–1998
Spain	13.3	11.4	4.2	1996–2000
Sweden	8.2	2.0	3.3	
Switzerland	7.5	5.1	1.8	
U.K.	10.9	10.3	2.8	1995–1999
U.S.	13.9	12.3	4.0	1995–1997

Note: 1) Average growth rate of GDP is geometrical average of 6 years between 1995 and 2000 (Average growth rate of GDP (1) ofTable 12-3-1-3).
2) As for the establishing/closing down rate, quoted from the birth rate and death rate of enterprises on P.15 of the "Observatory of European SMEs 2002/No. 5 Business demography in Europe" by European Commission. As for Japan and U.S., calculated based onTable 12-3-1-1, andTable 12-3-1-2.
Source: European Commission, "Observatory of European SMEs 2002/No. 5 Business demography in Europe"

Table 12-3-2: Birth rate and economic growth

Year	Number of listed enterprises (Japan)	Newly listed enterprises (Japan)	Newly listed enterprises (U.S.)	Enterprises funded by venture capital	Ratio (%)
1992	1,651	15	n.a	n.a	n.a
1993	1,667	22	n.a	n.a	n.a
1994	1,689	27	n.a	n.a	n.a
1995	1,714	32	n.a	n.a	n.a
1996	1,766	59	n.a	n.a	n.a
1997	1,805	50	519	136	26.2
1998	1,838	54	337	77	22.8
1999	1,892	75	508	257	50.6
2000	2,055	157	351	226	64.4
2001	2,103	92	110	37	33.6

Note: 1) The number of listed companies and newly listed enterprises in Japan is based on "Monthly Statistics Report May 2002 No, 547 (Tokyo Stock Exchange)."
2) Number of newly listed enterprises in U.S. is based on "2002 National Venture Capital Association Yearbook".
Source: Tokyo Stock Exchange, "Monthly Statistics Report No, 547" (May, 2002), National Venture Capital Association, "2002 National Venture Capital Association Yearbook"

Table 12-3-3-1: Investment by venture capital

(unit: 100 million yen, $1=¥130, EUR1=¥115)

Year	Amounts of investment (flow)			Amounts of investment (stock)		
	U.S.	EU	Japan	U.S.	EU	Japan
1995	7,410	6,378	1,511	51,220	28,874	8,258
1996	12,870	7,806	1,644	60,320	31,379	9,193
1997	18,200	11,103	2,427	80,210	37,703	8,391
1998	24,960	16,630	2,004	116,350	46,683	7,695
1999	62,400	28,883	1,157	174,850	67,103	7,757
2000	120,796	40,234	2,301	272,740	108,129	8,531

Source: Venture Enterprise Center, "Venture Capital Investments Survey' (2002)"

Table 12-3-3-2: Investment in high-tech industry by venture capital (Japan)

(unit: million yen)

Year	Agriculture, forestry and fisheries	Biotechnology	Business/ Services	Telecommunic ations	Computer-related	Construction	Consumer-related	Finance/ insurance/ real estate	Industry/ energy-related	Manufacturing
1983	0	0	0	0	0	50	0	0	0	50
1984	0	0	200	0	0	0	0	0	0	0
1985	0	0	52	0	0	0	0	0	0	40
1986	0	0	0	0	0	0	0	0	0	114
1987	0	0	10	0	0	0	0	0	0	0
1988	0	0	108	0	0	0	0	0	0	0
1989	0	42	30	0	0	30	0	0	0	0
1990	0	0	33	0	0	0	0	0	0	0
1991	0	0	28	0	0	65	0	180	0	0
1992	0	0	0	0	0	50	150	0	0	0
1993	0	0	28	0	0	78	30	0	0	0
1994	0	0	20	0	0	0	71	25	0	82
1995	0	30	0	0	10	0	65	0	0	45
1996	0	21	0	0	160	16	73	0	0	2
1997	0	0	84	18	20	64	240	0	34	162
1998	0	0	134	51	113	20	102	0	0	160
1999	0	101	678	49	965	0	711	24	0	96
2000	0	1,095	3,699	1,284	3,199	35	2,891	1,797	48	580
2001	0	74	146	282	504	44	336	122	42	170
High-tech industry		*		*	*					

(unit: million yen)

Year	Medical/heal thcare	Internet-related	Semiconductor and other electronic item	Transportation	Public sercvices	Others	Total investment	Investment in high-tech industry	Investment ratio in high-tech industry (%)
1983	0	0	299	0	0	46	445	299	67.2
1984	0	0	412	0	0	278	890	412	46.3
1985	0	0	716	0	0	387	1,195	716	59.9
1986	0	0	108	0	0	137	359	108	30.1
1987	0	0	20	0	0	70	100	20	20.0
1988	0	0	20	0	0	70	198	20	10.1
1989	0	0	0	0	0	76	178	42	23.6
1990	0	0	287	0	0	365	685	287	41.9
1991	0	0	108	0	0	452	833	108	13.0
1992	0	0	62	0	0	113	375	62	16.5
1993	0	0	19	0	0	0	155	19	12.3
1994	10	0	72	0	0	0	280	72	25.7
1995	0	0	71	0	0	91	312	111	35.6
1996	20	0	61	0	0	0	353	242	68.6
1997	94	2	6	0	0	64	788	46	5.8
1998	26	162	522	0	0	113	1,403	848	60.4
1999	91	756	520	0	0	256	4,247	2,391	56.3
2000	1,641	3,343	1,946	27	0	1,558	23,143	10,867	47.0
2001	641	1,802	457	50	0	488	5,158	3,119	60.5
High-tech industry		*	*						54.6

Note: 1) * shows high-tech industry. Here, high-tech industry mainly includes biotechnology, telecommunications hardware, computer hardware, Internet technology, semiconductors and other electronic parts industries. The definition of high-tech industry complies with the "2001 EVCA Yearbook" by European Private Equity & Venture Capital Association.

2) Investment ratio in high-tech industry = (Investment in high-tech industry / total investment) x 100.

Source: Venture Enterprise Center, "Venture Capital Fund Benchmark Survey' (2002)"

Table 12-3-3-3: Investmetn field of venture capital (4 countries in Europe)

(unit: %)

Industry	France	Germany	Italy	U.K.
Communications	13.8	8.2	38.0	14.0
Computer-related	8.7	15.0	6.0	12.8
Other electronics-related	5.0	1.4	0.8	1.9
Biotechnology	2.3	11.2	0.3	1.2
Medical-healthcare-related	6.2	5.4	0.6	8.6
Energy	4.1	1.2	8.9	2.5
Consumer-related	18.3	14.5	8.3	23.1
Industrial products and services	18.0	14.2	4.9	0.2
Chemical/materials	4.5	15.3	3.3	1.3
Industrial Automation	0.7	1.2	4.3	1.0
Other manufacturing	5.0	1.0	11.4	3.0
Transportation	1.0	0.6	0.2	5.9
Financial services	0.7	3.2	6.2	3.7
Other services	4.7	2.6	4.0	6.5
Agriculture	1.6	0.1	0.1	0.2
Construction	3.9	1.7	0.9	7.2
Others	1.6	3.1	1.6	7.0
Total	100	100	100	100

Note: Compiled by NISTEP based on “2002 EVCA Yearbook” by European Private Equity & Venture Capital Association.
2) ‘Consumer-related’ includes consumer products and services, leisure and recreational products, and retailing.

Table 12-3-3-4: Volume of venture capital in high-tech industry (EU)

(unit: 1,000 euro)

Country	1999			2000			2001			Average of 1999-2001
	Total investment	Investment in high-tech industry	Investment ratio in high-tech industry (%)	Total investment	Investment in high-tech industry	Investment ratio in high-tech industry (%)	Total investment	Investment in high-tech industry	Investment ratio in high-tech industry (%)	Investment ratio in high-tech industry (%)
Austria	89,289	26,698	30	163,136	82,710	51	147,270	63,840	43	41.3
Belgium	673,441	395,310	59	564,771	399,687	71	409,554	142,102	35	54.7
Denmark	862,553	283,780	33	2,039,625	1,251,211	61	2,470,195	1,018,862	41	45.1
Finland	248,527	116,062	47	384,240	208,238	54	256,813	131,688	51	50.7
France	2,816,735	808,403	29	5,304,090	2,408,057	45	3,286,795	743,267	23	32.2
Germany	3,132,931	n.a	n.a	4,766,595	2,362,168	50	4,434,890	1,706,760	39	44.1
Greece	23,195,770	463,915	2	65,647,851	39,026,931	59	103,850	15,945	15	25.6
Iceland	1,818,692	834,780	46	10,021,535	4,708,209	47	1,601,869	1,272,277	79	57.4
Ireland	104,976	52,593	50	223,368	188,302	84	144,545	116,408	81	71.6
Italy	1,778,934	324,972	18	2,968,515	672,383	23	2,184,566	1,011,554	46	29.1
The Netherla	1,850,248	425,557	23	1,916,486	511,195	27	1,887,241	129,835	7	18.9
Norway	2,202,250	554,967	25	2,402,356	1,204,984	50	2,241,610	925,277	41	38.9
Portugal	118,591	47,901	40	183,175	38,192	21	108,389	25,123	23	28.2
Spain	722,796	78,926	11	1,126,792	332,392	30	1,198,545	209,657	18	19.3
Sweden	11,248,622	2,812,156	25	19,420,183	4,158,077	21	18,903,473	2,268,085	12	19.5
Switzerland	703,761	421,553	60	975,600	173,627	18	367,671	136,620	37	38.3
U.K.	7,578,491	1,402,021	19	8,032,123	1,576,312	20	4,306,553	1,179,482	27	21.8

Note: 1) The definition of high-tech industry complies with "2001 EVCA Yearbook" by European Private Equity & Venture Capital Association. Here, high-tech industry mainly includes information-communications equipment, Internet technology, computer hardware/software/services, electronics, semiconductors, biotechnology, and the medical equipment industry.

2) Investment ratio in high-tech industry = Investment in high-tech industry / total investment x 100.

3) Total figures may not be consistent because of rounding-off.

Source: Cited from "2001 EVCA Yearbook" and "2002 EVCA Yearbook" by European Private Equity & Venture Capital Association.

Table 12-3-3-5: Investment in high-tech industry by venture capital (U.S.)

(unit: 1,000 dollar)

	1999	2000	2001	High-tech industry
Communications	12291.9	29317.6	12004.5	*
Computer software	9095.4	19558.9	8238.1	*
Wholesale and media	18266.7	28900.3	6511.2	
Computer hardware	5302.6	11873.2	3855.3	*
Biotechnology	2193.3	4203.6	3418.6	*
Healthcare-related	2158.2	3089.3	2323.4	
Semiconductor and electricity	1558.2	4054.6	2190	*
Industry/energy	1562.9	2178	1205.2	
Business/finance	2008.4	2734.3	872.3	
Total Investment	54437.6	105909.8	40618.6	
Investment in high-tech industry	30441.4	69007.9	29706.5	
Investment ratio in high-tech industry (%)	56	65	73	*65*

Note: 1) * shows high-tech industry. The definition of high-tech industry complies with "2001 EVCA Yearbook" by European Private Equity & Venture Capital Association. Here, high-tech industry mainly includes information-communications equipment, Internet technology, computer hardware/software/services, electronics, semiconductors, biotechnology, and the medical equipment industry.

2) Investment ratio in high-tech industry = Investment in high-tech industry / Total investment x 100

3) Italic letters refer to arithmetic average of investment ratio in high-tech industry (1999-2001)

Source: Cited from National Venture Capital Association, "2002 Yearbook"

Table 12-3-3-6: Average growth rate of GDP and investment ratio in high-tech industry

(unit: %)

Country	Investment ratio in high-tech industry	Average growth rate of GDP
Austria	41.3	2.1
Belgium	54.7	2.2
Denmark	45.1	2.0
Finland	50.7	3.4
France	32.2	2.8
Germany	44.1	1.7
Greece	25.6	4.2
Iceland	57.4	4.3
Ireland	71.6	7.8
Italy	29.1	2.3
The Netherlands	18.9	2.3
Norway	38.9	1.9
Portugal	28.2	2.6
Spain	19.3	3.4
Sweden	19.5	2.6
Switzerland	38.3	2.0
U.K.	21.8	2.5
Japan	54.6	0.9
U.S.	64.7	2.0

Note: 1) Investment ratio in high-tech industry: Quoted fromTable 12-3-3-2,Table 12-3-3-3, andTable 12-3-3-5.
2) Average growth rate of GDP is quoted fromTable 12-3-1-2, average growth rate of GDP (2)
3) Both average growth rate and investment ratio in high-tech industry is arithmetic average of 3 years from 1999 to 2001.

Table 12-4-1: Firm size and R&D expenditure

(unit: %)

Number of employees	Less than 100	From 100 to 499	From 500 to 999	1,000 and more	Remarks
Australia (1996)	26.8	23.7	13.9	35.5	
Belgium	19.0	17.3	12.3	51.4	
Canada	19.6	15.0	9.7	55.8	
Denmark	10.3	30.4	14.6	44.7	
Finland (1997)	14.3	15.0	14.5	56.2	
France	20.4	-	9.6	70.0	Note 3)
Germany	5.4	9.0	4.8	80.8	
Italy	4.3	15.5	15.1	65.1	
Japan (1997)	6.2	-	9.5	84.3	Note 4)
Republic of Korea (1997)	4.1	8.8	8.2	78.9	
The Netherlands (1996)	9.8	16.6	73.6	-	Note 5)
Norway	25.8	29.4	44.8	-	Note 6)
Spain	17.9	30.1	17.3	34.7	
Sweden (1997)	3.3	12.8	11.2	72.7	
Swizerland (1996)	10.1	20.3	11.3	58.3	
U.K. (1997)	5.9	23.0	12.5	58.6	
U.S. (1997)	15.3	-	3.2	81.6	Note 7)

Note: 1) Figures show share (%) of total R&D expenditure of enterprises of each size class to total R&D expenditure in whole industry.
2) 1996 values for Australia, Netherlands, and Switzerland. 1997 values for Finland, Japan, Korea, Sweden, U.K., and U.S. 1995 values for the rest.
3) 'From 100 to 499' is included in 'Less than 100.'
4) 'From 100 to 499' is included in 'Less than 100.'
5) '1,000 and more' is included in '500 and more.'
6) '1,000 and more' is included in '500 and more.'
7) 'From 100 to 499' is included in 'Less than 100.'
Source: OECD, "Small and Medium Enterprise Outlook 2000 Edition"

Table 12-4-2: The ratio of innovators classified by firm size

(unit: %)

Country	Small enterprises	Medium-sized enterprises	Large enterprises
Belgium	33	34	51
Denmark	64	76	91
Germany	63	70	85
Spain	21	43	76
France	34	48	75
Ireland	68	78	85
Italy	44	57	73
Luxembourg	21	52	85
The Netherlands	54	71	84
Austria	59	73	88
Portugal	22	30	52
Finland	26	40	77
Sweden	43	61	79
U.K.	54	59	81
Norway	39	56	77

Note: 1) The figures show ratio of innovators of each size of enterprise (figure of 1996). For example, small Belgian enterprises who answered they had made innovations in 1996 were 33% of all small enterprises in Belgium. Similarly, medium-sized Belgian enterprises who answered they had made innovations are 34% of all medium-sized enterprises in Belgium.

2) Definition of enterprise size is that an enterprise with from 20 to 49 employees is small, from 50 to 249 is medium-sized, and 250 and more is a large enterprise.

3) Innovation in this data means the introduction of new or improved products/services from technological aspects to the enterprise. These products/services are not necessarily new to the market.

Source: European Commission, "Statistics on Innovation in Europe Data 1996-1997" (2000 Edition)

Table 12-4-3: The ratio of 'novel' innovators classified by firm size

(unit: %)

Country	Small enterprises	Medium-sized enterprises	Large enterprises
Belgium	12	13	29
Denmark	22	32	42
Germany	19	22	46
Spain	7	17	38
France	14	22	42
Ireland	23	28	50
Italy	23	32	50
Luxembourg	9	28	41
The Netherlands	21	33	53
Austria	14	31	42
Portugal	4	11	17
Finland	12	17	45
Sweden	21	24	43
U.K.	15	19	37
Norway	8	17	36

Note: 1) Figures show ratio of novel innovators of each size of enterprise. For example, small Belgian enterprises who answered they had made novel innovations in 1996 were 12% of all small enterprises in Belgium. Similarly, medium-sized Belgian enterprises who answered they had made novel innovations are 13% of all medium-sized enterprises in Belgium.

2) Definition of enterprise size is that an enterprise with from 20 to 49 employeesis small, from 50 and to 249 is medium-sized, and 250 and more is a large enterprise.

3) Novel innovation in this data means the introduction of new or improved products/services from technological aspects not only to the enterprise, but also to the market.

Source: European Commission, "Statistics on Innovation in Europe Data 1996-1997" (2000 Edition)

Table 13-1-1: Trends in interest toward S&T (breakdown by age group)

Age	1976	1981	1986	1987	1990	1995	1998	2004 (unit: %)
20s	67.2	55.3	52.2	49.8	50.8	43.5	50.0	41.3
30s	64.1	52.9	51.9	54.2	56.3	53.1	51.6	52.0
40s	66.5	55.1	50.9	58.7	63.9	61.6	64.1	57.6
50s	60.4	49.9	46.9	56.2	58.8	64.1	64.1	58.6
60s	45.8	53.6	43.0	47.2	55.8	54.7	57.2	56.4
70 and over		31.1	26.8	39.5	38.9	49.7		44.1

Note: 1) Interest level is the total answers of 'very interested' and 'somewhat interested' obtained in the survey of 1976. For the survey of 1981, 1987, 1990, and 1995, there was a total of 'very interested' and 'interested to some extent.' For the survey of 1986, there was a total of 'very interested' and 'somewhat interested.' For the survey of 1998, there was a total of 'interested' and 'interested to some extent.'
2) In the survey of 1976 and 1998, people aged 60s included people aged 70 and over.
Source: Prime Minister's Office, Public Opinion Survey (1976, 1981, 1986, 1987, 1990, 1995, 1998)

Table 13-1-2: US-Japan comparison of interest in issues related to S&T

(index score)

Issue	Japan		U.S.	
	1991	2001	1992	2001
Scientific discoveries	51	44	61	70
Utilizaion of technological invention	54	48	64	67
Medical findings	67	61	82	81
Environment pollution	73	75	77	70

Note: Index scores were calculated by assigning a value of 100 for a 'very interested' (level of interest) or 'well informed' (sense of being well informed) response × 100 points, a value of 50 for a 'somewhat interested' or 'somewhat informed' response, and a value of 0 for a 'uninterested' / 'uninformed' or 'I don't know' resoponse.
Source: Ministry of Education, Culture, Sports, Science and Technology, "White Paper on Science and Technology (2003)"

Table 13-1-3: International Comparison of Understanding of Basic S&T Concepts (average accuracy of response to 11 questions)

(unit: %)

Country	Percentage of questions answered correctly
Sweden	73
The Netherlands	68
Finland	67
Denmark	67
U.S.	63
U.K.	62
France	61
Italy	61
Austria	60
Germany	59
Luxembourg	59
EU average	58
Belgium	56
Japan	54
Spain	53
Ireland	53
Greece	52
EU candidate average	52
Portugal	48

Note: The survey years are 2001 for U.S. and Japan, 2001 for EU, and 2002 for EU candidate (13 countries).
Source: Ministry of Education, Culture, Sports, Science and Technology, 'White Paper on Science and Technology (2003),' 'Candidate Countries Eurobarometer 2002.3RESEARCH November 2002'

Table 13-1-4: Japan's S&T level

(unit: %)

Answers	Response rate
Top class	42.1
Not top class	28.3
No opinion	28.7
No answer	0.8

Note: Survey was conducted with 1,800 people of age 16 and over (response rate 73.1%).
Source: NHK Broadcasting Culture Research Institute, 'Public Opinion Survey on Science and Technology/Life Ethics, 2002/01'

Table 13-1-5: Recognition of S&T terminology

(unit: %)

Engineering and scientific terms	Level of public knowledge
Clone	88.7
Fiber optics	89.0
Genetic engineering	88.1
Endocrine-disrupting chemicals	79.6
Deep-sea water	74.9
Hybrid cars	69.1
Next-generation cell phones	64.0
Nuclear fusion	56.4
H-2 rockets	48.7
Fuel cells	47.0
Artificial intelligence	43.5
Broadband Internet	44.3
Human genome	37.2
Plasma display	37.0
Prions	24.9

Note: Multiple answers allowed.
Source: Same asTable 13-1-4.

Table 13-1-6: Pros and cons of science and technology

(unit: %)

Opinions	Agree			Disagree			Don't know
	Strongly agree	Agree	sub-total	Disagree	Strongly disagree	sub-total	
We can enjoy a simple living without such advanced technology	8	49	57	27	2	29	14
Our life style is changing too fast because of science	8	54	62	24	1	25	13
Overdependence on science has resulted in the neglect of moral principles	7	47	54	26	2	28	18
We rely too much on science and ignore our beliefs Development of technology is destroying the earth	5	29	34	38	5	44	23
Development of technology makes human life artificial	5	46	50	31	2	33	17
New inventions cause a technology development hazards	4	47	51	28	2	30	19
Mechanizaion increases our workload	3	30	33	45	4	50	18
It is not important to know about science	2	23	25	57	11	68	8

Note: Survey was conducted with 3,000 people of age 18 and over (response rate 71.5%)
Source: NISTEP, 'Survey on Attitude toward Science and Technology' (2001)

Table 13-1-7: Research areas where greater future emphasis should be placed

(unit: %)

Field of research	Ratio
Improvement of environment pollution, recycling	76.9
Medical treatment for the elderly and for the disabled	67.5
Natural energy such as wind-power generation and solar energy generation	67.0
Prevention of natural disasters such as earthquake prediction and meteorological forecastir	64.2
State-of the art medicine such as new drug development and gene therapy	44.3
Automobiles, linear motorcars	35.5
Construction, roads, housing	30.6
Electronic engineering, computer equipment	29.6
Internet, broadcastitng	25.2
Computer software, artificial intelligence	24.0
Marine resources search, deep-water research	24.0
Development of new substances and materials	24.3
Rockets, space stations	19.4
Employment of atomic energy, such as nuclear power generation, nuclear fusion	11.3

Source: Same asTable 13-1-4.

Table 13-1-8: Opinions toward science education

(unit: %)

Answers	Ratio
Agree	2.9
Somewhat agree	9.9
No opinion	47.3
Somewhat disagree	26.0
Desagree	12.9
No answer	1.0

Note: Answers to the question ‘Do you think current science education at elementary, junior high and high schools is well-developed?’
Source: Same asTable 13-1-4.

Table 13-1-9: Expectations toward science education in the future

(unit: %)

Requests	Ratio
Increase science class hours	11.0
Increase experiment in science classes	35.7
Increase hands-on activities such as nature walks	64.9
Indroduce ability grouping system for science/math classes	19.4
Systematically train highly capable teachers who lead science classes	31.6
Sweepingly revise the curriculum to comply with the contents of modern science	26.1
Proactively teach even difficult subjects	6.4
Have front-line scientists and engineers teach	29.0
Increase facilities to provide more chances for different experiences such as visiting science centers and science museum	43.4
Others	3.6
Nothing is necessary	3.0
No response	1.1

Note: Answers to the question, ‘What do you think is necessary to raise the level of science education in Japan?’ (multiple answers allowed)
Source: Same asTable 13-1-4.

Table 13-2-1: Interest toward life science and technology developments

(unit: %)

Group		Interested			Not interested				No response
		Very interested	Somewhat interested	sub-total	No opinion	Not interested	Not at all interested	sub-total	
Total		16.1	40.0	56.1	19.6	19.8	2.8	22.6	1.6
Gender	Male	20.7	38.6	59.3	15.7	19.9	3.0	22.9	2.0
	Female	11.9	40.9	52.8	23.4	20.3	2.7	23.0	0.9

Note: Survey was conducted with 4,000 people of age 20 and over (response rate 27.1%)

Source: Cabinet Office, 'Attitude Survey on Human Embryo Research' (2002)

Table 13-2-2: Interest in present-day life science and technology (expectations and awareness of issues)

(unit: %)

Questionnaire item	Agree			Disagree			No opinion/ Don't know	No response
	Strongly agree	Somewhat agree	sub-total	Disagree	Strongly disagree	sub-total		
To scientifically clarify life phenomena has genuine value itself	28.7	36.1	64.8	18.4	3.8	22.2	6.1	6.9
It will solve the global food problems and environment issues	19.1	39.1	58.2	25.2	4.0	29.2	6.6	6.1
It will develop innovative medical technology	39.8	42.6	82.4	8.4	1.1	9.5	2.2	6.0
It will stimulate the growth of new industries	20.0	36.9	56.9	24.5	5.2	29.7	5.7	7.8
There are various ethical issues	56.3	30.4	86.7	4.7	0.6	5.3	2.3	5.6
There is a risk of life manipulation	61.1	25.9	87.0	4.4	1.0	5.4	2.3	5.4
Safety of technology is doubtful	39.3	39.3	78.6	9.1	0.9	10.0	5.1	6.3
The public is not given sufficient information	47.1	35.4	82.5	6.1	0.4	6.5	3.8	7.3
Need strict regulation of future plans	64.2	22.3	86.5	4.7	0.7	5.4	2.2	5.8
There is a risk of researchers breaking rules	62.5	25.8	88.3	3.2	0.1	3.3	2.6	5.8

Note: Questions were made of those who answered 'interested' or 'no opinion' to the questions whose results are shown inTable 13-2-1.

Source: Same asTable 13-2-1.

Table 13-2-3: Awareness of life science and technology terms

(unit: %)

Technical terms	Ihave thought about it	I know a little about the meaning of the term	I have heard the term but don't know its meaning	I heard the term for the first time in this survey	Others	No response
Human embryos	7.0	27.3	35.9	27.5	0.7	1.6
Regeneration medicine	11.3	21.7	31.9	33.1	0.4	1.7
Cloning technology	21.5	50.2	21.7	4.2	0.4	2.1
Research using cloned embryos	8.6	27.1	35.7	26.5	0.1	2.0

Source: Same asTable 13-2-1

Table 13-2-4: Interest in issues related to bioethics

(unit: %)

Questionnaire item	Ratio
Interested	32.9
Rather interested	37.0
No opinion	18.0
Rather not interested	7.1
Not interested	4.7
No response	0.2

Note: Answers to a question made those aged 18 and over, 'Along with advanced medical technology, life ethics issues such as brain death/organ transplants, surrogate motherhood, and gene therapy are attracting public attention recently. Are you interested in these issues?'
Source: Same asTable 13-1-4.

Table 13-2-5: Does brain death or heart death constitute human death?

(unit: %)

Group		Brain death (including somewhat agree)	No opinion	Heart death (including somewhat agree)
	Total	35	22	43
Gender	Male	43	19	38
	Female	28	24	48
Age	16-39 years old	36	26	38
	40-50 years old	38	20	42
	60 years old and over	32	18	50

Note: The figures for 'brain death' are the total of 'I agree that brain death is human death' and 'I somewhat agree that brain death is human death.'
Figures for 'Heart death' are also the total of 'I agree that heart death is human death' and 'I somewhat agree that heart death is human death.'
Source: Same asTable 13-1-4.

Table 13-2-6: Would you approve cloning a dead child?

(unit: %)

Questionnaire item	Ratio
Agree	2.7
Somewhat agree	5.6
No opinion	22.3
Somewhat disagree	19.6
Desagree	49.4
No response	0.4

Note: Answers to the question to those of 16 and over, 'What is your opinion on a person who has lost a child due to illness or accident trying to create a clone inheriting the dead child's genes obtained from the child's somatic nucleus?'
Source: Same asTable 13-1-4.

Table 13-2-7: Areas that should be considered to reflect public opinion in research promotion

(unit: %)

Questionnaire item	Ratio
Provide chances to learn through school and social education	54.6
Provide a wide range of information to the public through the Internet, etc.	50.1
Take appropriate amount of time to debate ethical issues	47.8
Attract public attention through the mass media	47.4
Provide people with more opporunities to speak out on national strategies	29.2
Provide people with more opportunities to participate in debate	29.0
Don't know	8.1
Others	2.6

Note: Answers to the question made to those aged 20 and over, 'Life science technology in the future will have to be promoted by reflecting wide public opinion. In this sense, what do you think must be enhanced?' (multiple answers allowed).
Source: Same asTable 13-2-1.

Table 13-3-1: Leading sources of information about S&T

(unit: %)

Source	Ratio
TV news	91
Newspaper articles	70
TV documentaries	53
Magazine articles	35
Information from family/friends	20
Magazine advertisements	15
TV commercials	13
Books and other publications	13
Internet	12
Newspaper advertisements	10
Exhibitions and museums	8
Video, CD-ROM, tapes, etc.	4
None in particular	4
Others	1

Note: Multiple-choice responses..
Source: NISTEP, Survey on Attitude toward Science and Technology (2001)

Table 13-3-2: Frequency of reading newspaper articles related to S&T

(unit: %)

		Medicine/ health	Environment	Science/ technology	Recycling	IT/Internet
	Total	32.0	14.1	10.9	9.2	6.7
Gender	Male	20.0	13.7	16.7	7.1	9.3
	Female	43.6	14.4	5.2	11.2	4.2

Note: Survey was conducted nationwide with people of age 15 and under 69 (3,618 respondents, multiple answers allowed)
Source: Japan Newspaper Publishers and Editors Association, '2001 Survey on National Media Contact/Evaluation' (October, 2001)

Table 13-3-3: Readers' interests by genre

(unit: %)

Genre	Ratio
Hobbies/sports	40
Japanese novels	26
Living/cooking/childcare	26
health/medicine/welfare	24
No response	22
Nonfiction	15
History/geography	13
Economcs/industry/money	13
Essays/poetry/*tanka* and *haiku* poem	10
Foreign novels	9
Religion/philosophy/ethics	9
Natural science/environment	8
Children's books/picture books	8
Social science	8
Politics	7
Photo collections	5
Others	5

Note: 1) Itemized answers to the question, 'What genre do you read most?' (multiple answers allowed)
2) Survey was conducted with 4,800 people of age 16 and over (response rate 64.1%)
Source: Mainichi Newspaper Co., Ltd., 'Public Opinion Survey on Reading 2003'

Table 13-3-4: Trends in the number of science museums and other comprehensive museums

Era/Year	Number of museums, facilities equivalent to museums, and kindred facilities			
	Science museums	General museums	Historical museums	Art museums
Meiji era	7	6	13	6
Taisho era	8	8	30	12
1st to 20th year of the Showa era	12	14	71	21
21st-25th	16	19	84	27
26th-30th	26	39	112	41
31st-35th	41	51	164	53
36th-40th	58	62	247	74
41st-45th	76	81	424	120
46th-50th	103	108	673	180
51st-55th	132	139	1,073	251
56th-60th	201	202	1,577	383
61st-2nd year of the Heisei era	289	246	2,051	561
3rd-7th	384	305	2,653	841
8th-10th	426	340	2,879	968
11th	426	340	2,916	968
14th	444	366	3,090	1,032

Note: 1) Cumulative number of total registered museums, facilities equivalent to museums, and facilities kindred to museums.
2) General museums are museums that have collections of both human science and natural science field.
Source: Ministry of Education, Culture, Sports, Science and Technology, 'Survey Report on Social Education 1999' and 'Interim Report on Social Education Survey 2002'

Table 13-3-5: Trends in the number of visitors to science museums, etc.

Year	Registered museums/Facilities equivalent to museums								
	Science museum	General museum	Historical museum	Art museum	Open air museum	Zoo	Botanical garden	Botanical and zoological	Aquarium
1989	24,786,384	11,023,632	62,366,475	45,341,708	7,077,406	46,089,747	12,653,966	12,438,864	23,202,099
1992	28,587,777	18,665,651	71,046,906	45,765,029	5,831,223	44,079,611	18,254,402	16,488,692	34,367,979
1995	33,468,773	17,965,350	73,072,740	53,439,422	5,984,706	39,387,155	18,864,613	12,536,814	31,281,478
1998	34,669,000	19,814,000	78,529,000	53,414,000	7,836,000	32,041,000	19,400,000	8,503,000	26,443,000
2001	33,215,000	15,215,000	77,972,000	50,426,000	6,257,000	34,887,000	17,365,000	7,234,000	26,152,000

Note: Zoo, Botanical garden, and aquarium are facilities equivalent to museums.

Source: Ministry of Education, Culture, Sports, Science and Technology, 'Survey Report on Social Education 1999' and 'Interim Report on Social Education Survey 2002'

Table 13-3-6: Trends in the number of Invention Club for Schoolchildren in Japan

Inauguration year	Number of invention clubs	Cumulatige total	Enrollment limit	Cumulative total
1974	2	2	1,750	1,750
1975	1	3	15	1,765
1976	1	4	20	1,785
1977	3	7	94	1,879
1978	2	9	50	1,929
1979	4	13	254	2,183
1980	4	17	134	2,317
1981	4	21	657	2,974
1982	14	35	650	3,624
1983	14	49	570	4,194
1984	17	66	627	4,821
1985	10	76	486	5,307
1986	7	83	355	5,662
1987	7	90	219	5,881
1988	9	99	331	6,212
1989	6	105	194	6,406
1990	3	108	100	6,506
1991	4	112	148	6,654
1992	7	119	240	6,894
1993	3	122	82	6,976
1994	4	126	143	7,119
1995	5	131	135	7,254
1996	3	134	90	7,344
1997	1	135	50	7,394
1998	1	136	60	7,454
1999	4	140	248	7,702
2000	2	142	63	7,765
2001	3	145	141	7,906
2002	3	148	170	8,076

Source: Japan Institute of Invention and Innovation, 'Outline of Invention club for shoolchildren'

Reference Data

"Correlation between the industry classification for the
Survey of Research and Development
and the Japan Standard Industry Classification"

Correspondence between the Industrial Classifiction used in the Surveyand the Standard Industrial Classification for Japan

Note: The bold text is the revised category of the Japan Standard Industry Classificatio
◎ shows newly added categories for the survey of R&D; x shows categories excluded from the survey.
The shaded column is addition or modification of the Industrial Classification for the Survey of R&I

FY 2002				FY 2003			
Industrial Classification used in the Survey			Standard Industrial Classification for Japan	Standard Industrial Classification for Japan	Industrial Classification used in the Survey		
Division	Major groups	Groups			Groups	Major groups	Division
1 All Industries			Industries other than the following divisions excluding the businesses indicated in the brackets: 1) Wholesale and retail trade, eating and drinking places [wholesale trade, general merchandise, wholesale trade, textile and apparel, wholesale trade, food and beverages, wholesale trade, building materials, minerals, and metals, wholesale trade, machinery and equipment and other wholesale trade] 2) Finance and insurance [financial, institutions for small-business, except government related financial institutions, financial institutions for agriculture, forestry and fisheries finances, except government related financial instutitions and government related financial institutions, except otherwise classified] 3) Real estates and services [broadcasting,software (computer programming and other software services), data processing and information services,professional services, N.E.C., other business services, and scientific research institutions]	Industries other than the following divisions excluding the businesses indicated in the brackets: 1) Wholesale and retail trade [wholesale trade, general merchandise, wholesale trade, textile and apparel, wholesale trade, food and beverages, wholesale trade, building materials, mineral, wholesale trade and metals, wholesale trade, machinery and equipment and other wholesale trade] 2) Finance and insurance [financial, institutions for cooperative organizations, institutions dealing with postal savings, government-related financial institutions] 3) Real estate 4) Eating and drinking places, accomodations 5) Medical, health care and welfare 6) Education, learning support 7) Compound services 8) Services, n.e.c. [professional services,n.e.c., scientific and development research institutes and except other business services]			1 All Industries
2 Agriculture, forestry and fisheries			011 Crop farms 012 Livestock farm 013 Sericulture fams 014 Agricultural services, except horticultural services 015 Horticultural services 021 Timber tracts 022 Logging 023 Special forest product production, except growing of mushrooms 024 Forestry services 029 Miscellaneous forestry 031 Marine fisheries 032 Wholesale trade 033 Inland water fisheries 041 Marine culture 042 Inland water culture	011 Crop farms 012 Livestock farm 013 Agricultural services, except horticultural services 014 Horticultural services 021 Timber tracts 022 Logging 023 Special forest product production, except growing of mushrooms 024 Forestry services 029 Miscellaneous forestry 031 Marine fisheries 032 Inland water fisheries 041 Marine culture 042 Inland water culture			2 Agriculture, forestry and fisheries
3 Mining			051 Precious metallic ore mining 052 Non-ferrous metallic ore mining 053 Ferrous metallic ore mining 059 Miscellaneous metal mining 061 Coal and lignite minig, except coal cleaning and grading 062 Coal cleaning and grading 071 Crude petroleum 072 Natural gas 081 Stone quarrying, sand and gravel pits 082 Ceramic mineral mining (minerals only for refractory, pottery and porcelaine, glass and cement materials) 083 Clay mining, except otherwise classified 089 Miscellaneous non-metallic mineral mining	051 Metal mining 052 Coal and lignite mining 053 Crude petroleum and natural gas production 054 Stone quarrying, sand and gravel pits 055 Ceramic mineral mining (minerals only for refractory, pottery and pocelain, glass and cement materials) 059 Miscellaneous non-metallic mineral minig			3 Mining
4 Construction			091 General civil engineering and building work 092 Civil engineering work, except paving and dredging work 093 Paving work 094 Dredging work 095 Buiding work, except wooden building work 096 Wooden building work 101 Carpentry work 102 Scaffolding work, earth work and concrete work 103 Steel-frame and steel reinforcement work 104 Stone, brick, tile and concrete block work 105 Plaster work 106 Roofing work, except metal roofing work 107 Sheet-metal work and hardware work 108 Painting work 109 Miscellaneous construction work by occupation 111 Electric work 112 Telecommunication work and signal system work	061 General civil engineering and building work 062 Civil engineering work, except paving work 063 Paving work 064 Buiding work, except wooden building work 065 Wooden building work 066 Building reform work 071 Carpentry work 072 Scaffolding work, earth work and concrete work 073 Steel-frame and steel reinforcement work 074 Stone, brick, tile and concrete block work 075 Plaster work 076 Sheet-metal work and hardware work 077 Painting work 078 Flooring and interior finish work 079 Miscellaneous construction work by occupation 081 Electric work 082 Telecommunication work and signal system work			4 Construction

Correspondence between the Industrial Classifiction used in the Surveyand the Standard Industrial Classification for Japan

Note: The bold text is the revised category of the Japan Standard Industry Classificatic
◎ shows newly added categories for the survey of R&D; x shows categories excluded from the survey.
The shaded column is addition or modification of the Industrial Classification for the Survey of R&I

FY 2002				FY 2003			
Industrial Classification used in the Survey			Standard Industrial Classification for Japan	Standard Industrial Classification for Japan	Industrial Classification used in the Survey		
Division	Major groups	Groups			Groups	Major groups	Division
4 Construction			113 Piping work, except water-well drilling work	083 Piping work, except water-well drilling work			4 Construction
				084 **Machine and equipment installation work**			
			114 **Water-well drilling work**				
			119 Miscellaneous equipment installation work	089 Miscellaneous equipment installation work			
5 Manufacturing	6 Food products		121 Livestock product	091 Livestock product		6 Food products	5 Manufactiring
			122 Seafood products	092 Seafood products			
			123 Canned and preserved fruit and vegetable products	093 Canned and preserved fruit and vegetable products			
			124 Seasonings	094 Seasonings			
			125 Sugar processing	095 Sugar processing			
			126 Flour and grain mill products	096 Flour and grain mill products			
			127 Bakery and confectionery products	097 Bakery and confectionery products			
			128 Animal and vegetable oils and fats	098 Animal and vegetable oils and fats			
			129 **Miscellaneous foods and related products**	099 **Miscellaneous foods and related products**			
			131 Soft drinks and carbonated water	101 Soft drinks and carbonated water			
			132 Alcoholic beverages	102 Alcoholic beverages			
			133 Tea and coffee	103 Tea and coffee			
			134 Manufactured ice	104 Manufactured ice			
				105 Tobacco manufactures			
			136 Prepared animal foods and organic fertilizers	106 **feetstuff/organic fertilizer**			
	7 Textile mill products		141 Silk reeling plants	111 Silk reeling plants		7 Textile mill products	
			142 Spinning mills	112 Spinning mills			
			143 Twisting and bulky yarns	113 Twisting and bulky yarns			
			144 Woven fabric mills	114 Woven fabric mills			
			145 Knit fabrics mills	115 Knit fabrics mills			
			146 Dyed and finished textiles	116 Dyed and finished textiles			
			147 Rope and netting	117 Rope and netting			
			148 Lace and other textile goods	118 Lace and other textile goods			
			149 Miscellaneous textile mill products	119 Miscellaneous textile mill products			
			151 Textile outer garments and shirts, including bonded fabrics and lace, except Japanese style	121 Textile outer garments and shirts, including bonded fabrics and lace, except Japanese style			
			152 Knitted garments and shirts	122 Knitted garments and shirts			
			153 Underwear	123 Underwear			
			154 **Fur apparel and apparel accessories**				
			155 Japanese style apparel and socks ("Tabi")	124 Japanese style apparel and socks ("Tabi")			
			156 Other textile apparel and accessories	125 Other textile apparel and accessories			
			159 Miscellaneous fabricated textile products	129 Miscellaneous fabricated textile products			
	8 Pulp and paper products		181 Pulp	151 Pulp		8 Pulps and paper products	
			182 Paper	152 Paper			
			183 Coated and glazed paper	153 Coated and glazed paper			
			184 Paper products	154 Paper products			
			185 **Paper containers**	155 **Paper containers**			
			189 Miscellaneous pulp, paper and paper worked products	159 Miscellaneous pulp, paper and paper worked products			
	9 Printing and publishing		191 **Newspaper industries**			**9 Printing**	
			192 **Publishing industries**				
			193 Printing, except mimeograph printing industries	161 Printing			
			194 Plate making for printing	162 Plate making for printing			
			195 Bookbinding and printed matter	163 Bookbinding and printed matter			
			199 Service industries related to printing trade	169 Service industries related to printing trade			
	10 Chemical products			176 Drugs and medicines		10 Drugs and medicines	
		11 Industrial chemical and chemical fibers	201 Chemical fertilizers	171 Chemical fertilizers	12 Industrial chemicals and chemical fibers	11 Chemical products	
			202 Industrial inorganic chemicals	172 Industrial inorganic chemicals			
			203 Industrial organic chemicals	173 Industrial organic chemicals			
			204 Chemical fibers	174 Chemical fibers			
		12 Oil and paints	205 Oil and fat products, soaps, synthetic detergents, surfaceactive agents and paints	175 Oil and fat products, soaps, synthetic detergents, surfaceactive agents and paints	13 Oil and paints		
		13 Drugs and medicines	206 Drugs and medicines				
		14 Other chemical products	207 Cosmetics, toothpaste and toilet preparations	177 Cosmetics, toothpaste and toilet preparations	14 Other chemical		
			209 Miscellaneous chemical and allied products	179 Miscellaneous chemical and allied products			

Correspondence between the Industrial Classifiction used in the Surveyand the Standard Industrial Classification for Japan

Note: The bold text is the revised category of the Japan Standard Industry Classificatic
◎ shows newly added categories for the survey of R&D; x shows categories excluded from the survey.
The shaded column is addition or modification of the Industrial Classification for the Survey of R&I

FY 2002				FY 2003			
Industrial Classification used in the Survey			Standard Industrial Classification for Japan	Standard Industrial Classification for Japan	Industrial Classification used in the Survey		
Division	Major groups	Groups			Groups	Major groups	Division
5 Manufacturing (continued)	15 Petroleum and coal products		211 Petroleum refining	181 Petroleum refining		15 Petroleum and coal products	5 Manufacturing (continued)
			212 Lubricating oils and greases (not made in petroleum refineries)	182 Lubricating oils and greases (not made in petroleum refineries)			
			213 Coke	183 Coke			
			214 **Briquettes and bruqiette balls**				
			215 Paiving materials	184 Paiving materials			
			219 Miscellaneous petroleum and coal products	189 Miscellaneous petroleum and coal products			
	16 Plastic products		221 Plastic plates, bars and rods, pipes and tubes, pipe fittings and profile extrusions	191 Plastic plates, bars and rods, pipes and tubes, pipe fittings and profile extrusions		16 Plastic products	
			222 Plastic films, sheets, floor coverings and synthetic leather	192 Plastic films, sheets, floor coverings and synthetic leather			
			223 Industrial plastic products	193 Industrial plastic products			
			224 Foamed and reinforced plastic products	194 Foamed and reinforced plastic products			
			225 Compounding plastic materials, including reclaimed plastcs	195 Compounding plastic materials, including reclaimed plastcs			
			229 Miscellaneous plastic products	199 Miscellaneous plastic products			
	17 Rubber products		231 Tires and inner tubes	201 Tires and inner tubes		17 Rubber products	
			232 Rubber and plastic footwear and its findings	202 Rubber and plastic footwear and its findings			
			233 Rubber belts and hoses and mechanical rubber goods products	203 Rubber belts and hoses and mechanical rubber goods products			
			239 Miscellaneous rubber products	209 Miscellaneous rubber products			
	18 Ceramics		251 Glass and its products	221 Glass and its products		18 Ceramics	
			252 Cement and its products	222 Cement and its products			
			253 Structural clay products, except those of potter	223 Structural clay products, except those of potter			
			254 Pottery and related products	224 Pottery and related products			
			255 Clay refractories	225 Clay refractories			
			256 Carbon and graphite products	226 Carbon and graphite products			
			257 Abrasive products	227 Abrasive products			
			258 Aggregate and stone products	228 Aggregate and stone products			
			259 Miscellaneous ceramic, stone and clay products	229 Miscellaneous ceramic, stone and clay products			
	19 Iron and steel		261 **Iron industries, with blast furnaces**	231 **Iron industries, with blast furnaces**		19 Iron and steel	
			262 **Iron smeliting, without blast furnaces**				
			263 Steel, with rolling facilities	232 Steel, with rolling facilities			
			264 Steel materials, except made by smelting furnaces and steel works with rolling facilities, exept coated steel	233 Steel materials, except made by smelting furnaces and steel works with rolling facilities, exept coated steel			
			265 Coated steel	234 Coated steel			
			266 Ferrous metal machine parts and tooling products	235 Ferrous metal machine parts and tooling products			
			269 Miscellaneous iron and steel	239 Miscellaneous iron and steel			
	20 Non-ferrous metals and products		271 Prmimary smelting and refining of non-ferrous metals	241 Prmimary smelting and refining of non-ferrous metals		20 Non-ferrous metals and products	
			272 Secondary smelting and refining of non-ferrous metals, including non-ferrous alloys	242 Secondary smelting and refining of non-ferrous metals, including non-ferrous alloys			
			273 Rolling of non-ferrous metals and alloys, including drawing and extruding	243 Rolling of non-ferrous metals and alloys, including drawing and extruding			
			274 Electric wire and cable	244 Electric wire and cable			
			275 Non-ferrous metal machine parts and tooling products	245 Non-ferrous metal machine parts and tooling products			
			279 Miscellaneous non-ferrous metal products	249 Miscellaneous non-ferrous metal products			
	21 Fabricated metal products		281 Tin cans and other plated sheet products	251 Tin cans and other plated sheet products		21 Fabricated metal products	
			282 Tableware (occedental type), cutlery, hand tools and hardware	252 Tableware (occedental type), cutlery, hand tools and hardware			
			283 Heating apparatus and plumbing supplies	253 Heating apparatus and plumbing supplies			
			284 Fabricated constructional and architectural metal products, including fabricated plate work and sheet metal work	254 Fabricated constructional and architectural metal products, including fabricated plate work and sheet metal work			
			285 Metal machine parts and tooling products	255 Metal machine parts and tooling products			
			286 Metal coating, engraving and heat reating, except enameled ironware	256 Metal coating, engraving and heat reating, except enameled ironware			
			287 Fabricated wire products	257 Fabricated wire products			
			288 Bolts, nuts, rivets, machine screws and wood screws	258 Bolts, nuts, rivets, machine screws and wood screws			
			289 Miscellaneous fabricated metal products	259 Miscellaneous fabricated metal products			
	22 General machinery		291 Boilers, engines and turbines	261 Boilers, engines and turbines		22 General machinery	
			292 Agricultural machinery and equipment	262 Agricultural machinery and equipment			
			293 **Machinery and equipment for construction and mining, including tractors for construction, agriculture and transportation of goods**	263 **Machinery and equipment for construction and mining**			
			294 Metal working machinery	264 Metal working machinery			
			295 Textile machinery	265 Textile machinery			
			296 Special industry machinery	266 Special industry machinery			
			297 **General industry machinery ane equipment**	267 **General industry machinery ane equipment**			
			298 **Office, service industry and household machines**	268 **Office, service industry and household machines**			
			299 Miscellaneous machinery and machine parts	269 Miscellaneous machinery and machine parts			

Correspondence between the Industrial Classifiction used in the Surveyand the Standard Industrial Classification for Japan

Note: The bold text is the revised category of the Japan Standard Industry Classificatic
◎ shows newly added categories for the survey of R&D; x shows categories excluded from the survey.
The shaded column is addition or modification of the Industrial Classification for the Survey of R&I

FY 2002				FY 2003			
Industrial Classification used in the Survey			Standard Industrial Classification for Japan	Standard Industrial Classification for Japan	Industrial Classification used in the Survey		
Division	Major groups	Groups			Groups	Major groups	Division
5 Manufacturing (continued)	22 General machinery		331 Small arms (rifles) 332 Artillery 333 Small arms ammunition (bullets) 334 Shells, except ammunition loading and assembling 335 Ammunition, except small arms and artillery ammunition, ammunition loading and assembling 336 Ammunition loading and assembling, except small arms ammunition 337 Special combat vehicles and parts (vehicles equipped with caterpillar treads with guns and other launchers) 339 Miscellaneous ordnance and accessories				5 Manufacturing (continued)
	23 Electrical machinery	24 Electrical machinery, equipment and supplies	301 Electrical generating, transmission, distribution and industrial apparatus 302 Household electric appliances 303 Electric bulbs and lighting fixtures 309 Miscellaneous electrical machinery qeuipment and supplies	274 Electronic equipment 275 Electric measuring instruments	24 Applied electronics/ lectrical measuring instrument industry	23 Electrical mahinery, equipment and supplies	
				271 Electrical generating, transmission, distribution and industrial apparatus 272 Household electric appliances 273 Electric bulbs and lighting fixtures 279 Miscellaneous electrical machinery qeuipment and supplies	25 Other electric machinery and apparatus industry		
		25 Communication and electronic equipment	304 Communication equipment and related products 305 Electronic data processing machines, digital and analog computer, equipment and accessories 306 Electronic equipment 307 Electric meauring instruments 308 Electronic parts and devices	281 Communication equipment and related products 282 Electronic data processing machines, digital and analog computer, equipment and accessories		26 Information and	
				291 Electronic parts and devices		27 Electronics parts and devices	
	26 Transportation equipment	27 Motor vehicles	311 Motor vehicles, parts and accessories	301 Motor vehicles, parts and accessories	29 Motor vehicles	28 Transportation equipment	
		28 Other transportation equipment	312 Railroad equipmetn and parts **313 Bicycles and parts** 314 Shipbuilding and reparing, and marine engines 315 Airecraft and parts **319 Miscellaneous transportation equipment**	302 Railroad equipmetn and parts 303 Shipbuilding and reparing, and marine engines 304 Airecraft and parts **305 Industrial trucks and parts and accessories** **309 Miscellaneous transportation equipment**	30 Other transportation equipment		
	29 Precision instruments		321 Measuring instruments, analytical instruments and testing machines 322 Surveying instruments 323 Medical instruments and apparatus 324 Physical and chemical instruments 325 Optical instruments and lenses 326 Ophthalmic goods, including frames 327 Watches, clocks, clockwork-operated devices and parts	311 Measuring instruments, analytical instruments and testing machines 312 Surveying instruments 313 Medical instruments and apparatus 314 Physical and chemical instruments 315 Optical instruments and lenses 316 Ophthalmic goods, including frames 317 Watches, clocks, clockwork-operated devices and parts		31 Precision instruments	
	30 Other manufacturing		135 Tabacco manufactures(*) 161 Sawing planning mills and wood products 162 Millwork, plywood and prefabricated structural wood products 163 Wooden, bamboo and rattan containers 169 Miscellaneous manufacture of wood products, including bamboo and rattan 171 Furniture 172 Furniture for religious purposes 173 Sliding doors and screens 179 Miscellaneous furniture and fixtures 241 Leather tanninng and finishing 242 Mechanical leather products, except gloves and mittens 243 Cut stock and findings for boots and shoes	131 Sawing planning mills and wood products 132 Millwork, plywood and prefabricated structural wood products 133 Wooden, bamboo and rattan containers 139 Miscellaneous manufacture of wood products, including bamboo and rattan 141 Furniture 142 Furniture for religious purposes 143 Sliding doors and screens 149 Miscellaneous furniture and fixtures 211 Leather tanninng and finishing 212 Mechanical leather products, except gloves and mittens 213 Cut stock and findings for boots and shoes		32 Other manufacturing	
			244 Leather footwear 245 Leather gloves and mittens 246 Luggage 247 Handbags and small leather cases 248 Fur skins 249 Miscellaneous leather products **341 Precious metal products, including jewel processing** 342 Musical instruments 343 Toys and sporting goods 344 Pens, lead pencils, painting materials and stationery	214 Leather footwear 215 Leather gloves and mittens 216 Luggage 217 Handbags and small leather cases 218 Fur skins 219 Miscellaneous leather products **321 Precious metal products, including jewel processing** 322 Musical instruments 323 Toys and sporting goods 324 Pens, lead pencils, painting materials and stationery			

Correspondence between the Industrial Classifiction used in the Surveyand the Standard Industrial Classification for Japan

Note: The bold text is the revised category of the Japan Standard Industry Classificatio
◎ shows newly added categories for the survey of R&D; x shows categories excluded from the survey.
The shaded column is addition or modification of the Industrial Classification for the Survey of R&I

FY 2002: Industrial Classification used in the Survey – Division	Major groups	Groups	FY 2002: Standard Industrial Classification for Japan	FY 2003: Standard Industrial Classification for Japan	FY 2003: Industrial Classification used in the Survey – Groups	Major groups	Division
5 Manufacturing (continued)			345 Costume jewellery, costume accessories, buttons and related products, except precious metals and jewell 346 Lacquer ware 347 Sundry goods and straw ("tatami") mats, umbrellas and other daily commodities **349 Manufacturing industries, N.E.C.**	325 Costume jewellery, costume accessories, buttons and related products, except precious metals and jewellery 326 Lacquer ware 327 Sundry goods and straw ("tatami") mats, umbrellas and other daily commodities 328 Ordnance and accessories **329 Manufacturing industries, N.E.C.**			5
31 Transport, communications and public utilities			351 Production, collection and distribution of electricity 361 Manufacturing of gas 371 Heat supply 381 Water for end-users, except industrial users 382 Water for industrial users 383 Sewerage	331 Production, collection and distribution of electricity 341 Manufacturing of gas 351 Heat supply 361 Water for end-users, except industrial users 362 Water for industrial users 363 Sewerage			33 Electricity, gas, heat supply and water
				◎391 Computer programming and other software services (moved from F: Manufacturing to H: Information-communications) **◎392 Data processing and information services (moved from F: Manufacturing to H: Information-communications)**		35 Software and information processing	34 Information and communications
			461 Postal services **×462 xContracted postal services** **471 Domestic telecommunications, except wire broadcast telephones** **472 International telecommunication** **473 Wire broadcast telephones** 474 Services incidental to telecommunications	**371 Transmission of correspondence** **372 Rixed telecommunications** **373 Mobile telecommunications** 374 Services incidental to telecommunications		36 Communications	
			811 Public broadcasting, except cablecasting 812 Private broadcasting, except cablecasting 813 Cablecasting	381 Public broadcasting, except cablecasting 382 Private-sector broadcasting, except cablecasting 383 Cablecasting		37 Broadcasting	
				◎413 Newspaper publishers (moved from F: Manufacturing to H: Information-communications) ◎414 Publishers, except newspapers (moved from F: Manufacturing to H: Information-communications) ◎401 Internet based services (moved from L: Services to H: Information-communications) ◎411 Video picture information production and distribution (moved from L: Services to H: Information-communications) ◎412 Sound information production (moved from L: Services to H: Information-communications) ◎415 Services incidenatal to video picture, sound information, character information production and distribution (moved from L: Services to H: Information-communications)		38 Newspaper, publishers and other data processing	
			391 Railway transport 401 Common omnibus operators 402 Common taxicab operators 403 Contracted omnibus operators **404 Motor passenger transport (particularly-contracted)** **409 Miscellaneous road pasenger transport** 411 Common motor trucking 412 Motor trucking (particularly-contracted) 413 Mini-sized vehicle freight transport 414 Collect-and-deliver freight transport 419 Miscellaneous road freight transport	421 Railway transport 431 Common omnibus operators 432 Common taxicab operators 433 Contracted omnibus operators **439 Miscellaneous road pasenger transport** 441 Common motor trucking 442 Motor trucking (particularly-contracted) 443 Mini-sized vehicle freight transport 444 Collect-and-deliver freight transport 449 Miscellaneous road freight transport			39 Transport
			421 Oceangoing transport 422 Coastwise transport 423 Inland water transport 424 Vessel and ship rental and leasing 431 Air transport 432 Aircraft service, except air transport **441 Ordinary warehousing** 442 Refrigerated warehousing **443 Floating-lumber storage**	451 Oceangoing transport 452 Coastwise transport 453 Inland water transport 454 Vessel and ship rental and leasing 461 Air transport 462 Aircraft service, except air transport **471 Ordinary warehousing** 472 Refrigerated warehousing			

Correspondence between the Industrial Classifiction used in the Surveyand the Standard Industrial Classification for Japan

Note: The bold text is the revised category of the Japan Standard Industry Classificatic
◎ shows newly added categories for the survey of R&D; x shows categories excluded from the survey.
The shaded column is addition or modification of the Industrial Classification for the Survey of R&I

FY 2002 Industrial Classification used in the Survey: Division	Major groups	Groups	FY 2002 Standard Industrial Classification for Japan	FY 2003 Standard Industrial Classification for Japan	FY 2003 Industrial Classification used in the Survey: Groups	Major groups	Division
31 Transport, communications and public utilities			×451 xTravel Agency 452 Port transport 453 Freight forwarding, except collect-and-deliver freight transport 454 Transport agencies **455 Booking of transport** 456 Packing and crating 457 Transport facilities services 459 Miscellaneous service incidental to transport	 481 Port transport 482 Freight forwarding, except collect-and-deliver freight transport 483 Transport agencies 484 Packing and crating 485 Transport facilities services 489 Miscellaneous service incidental to transport			
32 Wholesale trade			481 Wholesale trade, general merchandise 491 Textile products (except apparel, apparel accessories and notions) 492 Apparel, apparel accessories and notions 501 Agricultural, animal and poultry farm and acquatic products 502 Food and beverages 511 Building materials 512 Chemicals and related products 513 Minerals and metals 514 Recovered material 521 General machinery and equipment 522 Motor vehicles 523 Electrical machinery, equipment and supplies 529 Miscellaneous machinery and equipment 531 Furniture, fixtures and house furnishings 532 Drugs and toiletries **533 Agents and brokers** 539 Other products, N.E.C.	491 Wholesale trade, general merchandise 501 Textile products (except apparel, apparel accessories and notions) 502 Apparel, apparel accessories and notions 511 Agricultural, animal and poultry farm and acquatic products 512 Food and beverages 521 Building materials 522 Chemicals and related products 523 Minerals and metals 524 Recovered material 531 General machinery and equipment 532 Motor vehicles 533 Electrical machinery, equipment and supplies 539 Miscellaneous machinery and equipment 541 Furniture, fixtures and house furnishings 542 Drugs and toiletries 549 Other products, N.E.C.			40 Wholesale trade
33 Finance and insurance			621 Central banks 622 Banks 661 Credit card and installment finance institutions 662 Pawnbrokers 663 Credit card and installment finance institutions **664 Investment institutions** 669 Other non-deposit money corporations engaged in the provision of finance, credit and investment 671 Financial auxiliaries **681 Securities** 682 Brokers and dealers of other securities, and related business 683 Futures commodity transaction dealers and commodity investors **684 Exchanges and clearing houses** 691 Life insurance institutions 692 Nonlife insurance institutions 693 Mutual aid 694 Insurance agents and brokers 695 Insurance service institutions	611 Central banks 612 Banks, except central bank 641 Credit card and installment finance institutions 642 Pawnbrokers 643 Credit card and installment finance institutions 649 Other non-deposit money corporations engaged in the provision of finance, credit and investment **651 Securities** 652 Brokers and dealers of other securities, and related business 653 Futures commodity transaction dealers and commodity investors **661 Financial auxiliaries** 671 Life insurance institutions 672 Nonlife insurance institutions 673 Mutual aid 674 Insurance agents and brokers 675 Insurance service institutions			41 Finance and insurance
34 Sortware and information processing			**821 Computer programming and other software services** **822 Data processing and information services**				
35 Professional services			841 Lawyers and patent attorneys offices 842 Notaries public's and judicial scriveners offices 843 Certified public accountants and auditors offices 844 Veterinary services 845 Engineering and architectural services 846 Commercial and engineering design services 847 Authors and artists **×848 Individual instruction places** **849 Other specialized services**	801 Lawyers and patent attorneys offices 802 Notaries public's and judicial scriveners offices 803 Certified public accountants and auditors offices 804 Veterinary services 805 Engineering and architectural services 806 Design, mechanical services 807 Authors and artists **◎808 Photographic studios** **809 Other specialized services**		43 Professional services	42 Services

Correspondence between the Industrial Classifiction used in the Surveyand the Standard Industrial Classification for Japan

Note: The bold text is the revised category of the Japan Standard Industry Classificatic
◎ shows newly added categories for the survey of R&D; x shows categories excluded from the survey.
The shaded column is addition or modification of the Industrial Classification for the Survey of R&I

<table>
<tr><th colspan="4">FY 2002</th><th colspan="4">FY 2003</th></tr>
<tr><th colspan="3">Industrial Classification used in the Survey</th><th rowspan="2">Standard Industrial Classification for Japan</th><th rowspan="2">Standard Industrial Classification for Japan</th><th colspan="3">Industrial Classification used in the Survey</th></tr>
<tr><th>Division</th><th>Major groups</th><th>Groups</th><th>Groups</th><th>Major groups</th><th>Division</th></tr>
<tr><td rowspan="2">36 Other business services</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">861 Stenographic, copying and duplicating services
862 Commodity inspection services
863 Surveyor certification
864 Building maintenance services
865 Private employment services
866 Guard services
869 Business services, n.e.c.</td><td>811 Research institutes for natural sciences and engineering
812 Research institutions for social science and humanities</td><td></td><td>44 Scientific research</td><td rowspan="3">42 Services</td></tr>
<tr><td rowspan="2">901 Stenographic, copying and duplicating services
902 Commodity inspection services
903 Surveyor certification
904 Building maintenance services
905 Private employment services
906 Guard services
909 Business services, n.e.c.</td><td rowspan="2"></td><td rowspan="2">45 Other business services</td></tr>
<tr><td>37 Scientific research institutes</td><td></td><td></td><td>921 Research institutes for natural sciences and engineering
922 Research institutions for social science and humanities</td></tr>
</table>