

Statistics of Japan's Trade in Technology

- Quantitative Analysis Approach -

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January 1993

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Technology Policy (NISTEP)**

Science and Technology Agency



Translation from
Japanese Version

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Contents

1.	Introduction	1
2.	Statistics of Japan's Trade in Technology	3
2.1	"Balance of Payments of Japan" prepared by the Bank of Japan	3
2.2	"Report on the Survey of Research and Development" prepared by Management and Coordination Agency	4
2.3	"Annual Report" of the Fair Trade Commission	9
2.4	"Analysis of Trends in Technology Imports" prepared by NISTEP	10
3.	Qualitative Analysis	12
3.1	Classification of the Statistics	12
3.2	Comparison and Problems of "BJ and MCA Statistics" ...	12
4.	Quantitative Analysis	17
4.1	Factor 1: Exclusion of Wholesaling, Retailing and Services	17
4.2	Factor 2: Compensation for Know-how and Industrial Technical Guidance related with Plant Exports	20
4.3	Factor 3: Compensation for Transfer and Setting up of Rights for Using Trademarks	24
4.4	Factor 4: Compensation related with Software	31
4.5	Quantitative Analysis and Balance of Payments of Technology Trade	37
5.	Conclusion	42
6.	Bibliography	43
	Supplementary Remarks	44
	Attachment	45

1. Introduction

Technology trade means an international transaction in the form of the provision and acquirement of patents, utility models and technical know-how which comprise industrial property rights. The data on technology trade balances is a significant indicator of Japan's level of technology and R&D activities. This is because patents, utility models and know-how are results of R&D activities by firms and research institutes. They have the effect of developing the national and private firm's international competitiveness.

Japan has four main statistics related with technology trade. These are the "Balance of Payments of Japan" prepared by the Bank of Japan ("BJ statistics"), the "Report on the Survey of Research and Development" prepared by Management and Coordination Agency ("MCA statistics"), the "Annual Report" of Fair Trade Commission ("FTC statistics") and the "Analysis of trends in Technology Imports" prepared by National Institute of Science and Technology Policy, Science and Technology Agency ("NISTEP statistics").

These statistics vary with regard to the survey method used, subjects covered and the scope of technology trade. Statistics based on values have even produced findings which are completely contradictory. Hence, special care is required when using these statistics.

<Trends of values of technology trade and ratio of balance of payments>

Figure 1 shows a graph of the trends of the value of technology trade (by technology exports and imports) according to the "BJ statistics" and "MCA statistics". (US dollars have been converted into yen using inter-bank middle rates.)

The technology export and import values of these statistics have been increasing every year. In FY1991, the technology export value reached 2.984 billion dollars (around 397.4 billion yen) and the technology import value 6.493 billion dollars (around 864.7 billion yen) according to the "BJ statistics". The "MCA statistics" showed the technology export value of 370.6 billion yen and the import value of 394.7 billion yen.

As can be seen, there has emerged a great difference in the two's ratios of balance of payments (export value / import value)(see Figure 2). In FY1991 the ratio was 0.46 according to the "BJ statistics" and 0.94 according to the "MCA statistics".

This report will first outline the four statistics, and next qualitatively analyze the statistics of balance of payments and lastly attempt to quantitatively analyze the major differences.

Figure 1. Trends of Value of Technology Trade

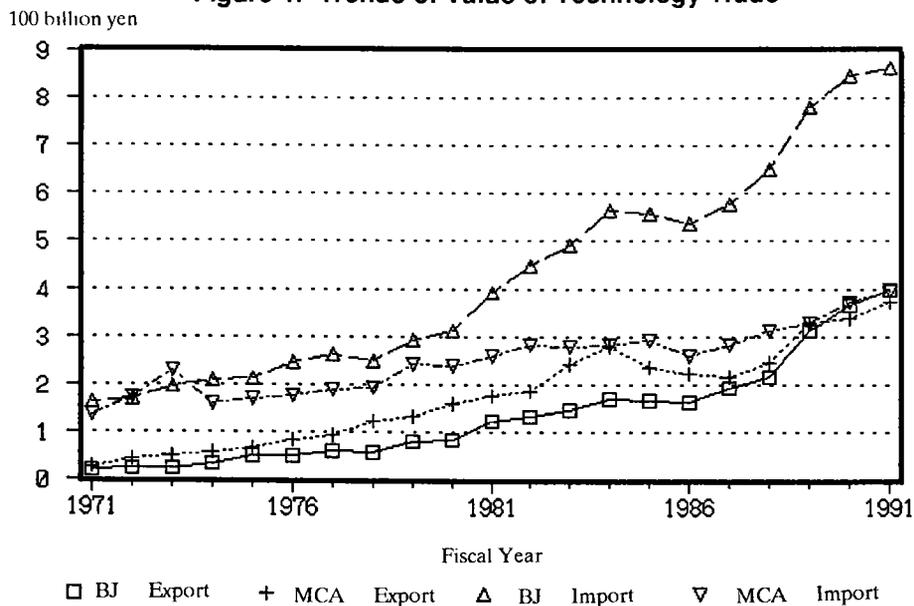
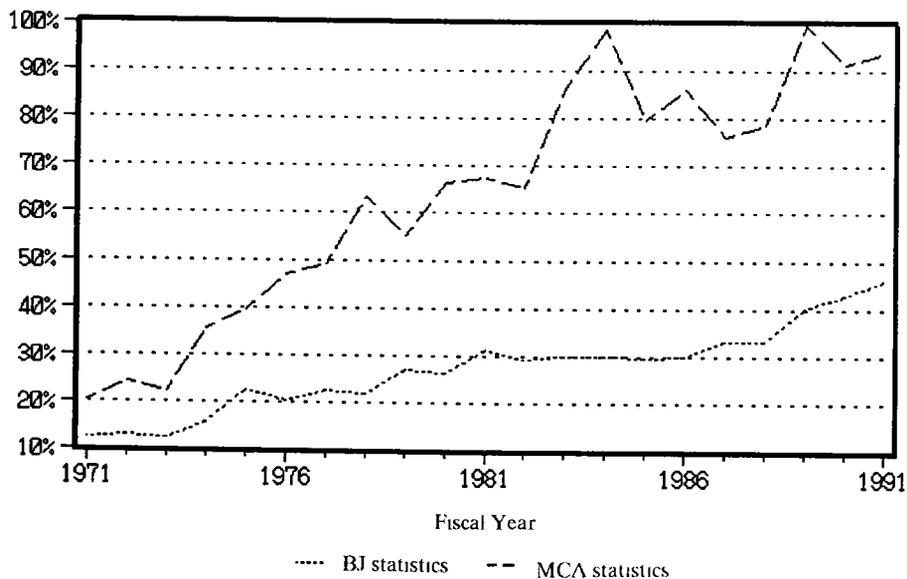


Figure 2. Trends of Ratio of Balance of Payments of Technology Trade (Value of technology exports/Value of Btechnology imports)



2. Statistics of Japan's trade in technology

2.1 "Balance of Payments of Japan" prepared by the Bank of Japan ("BJ Statistics")

2.1.1 Objectives

The "BJ statistics" is designed to grasp the actual condition of international transactions and the trends of balance of payments by systematically recording all of the external economic transactions of Japan during a fixed period (usually one year). It is thereby designed to promote the equilibrium of the balance of payments and stability of the currencies.

2.1.2 Survey method

The Bank of Japan totalizes the values written as "patent royalties" in the items of the "Report on Invisible Trade Receipts and Payments" submitted via authorized foreign exchange banks by residents who executed invisible trade transactions.

2.1.3 Contents and publication

The totalized values are categorized by month, fiscal year and calendar year and published every month as the "Monthly Statistics on Balance of Payments."

2.1.4 Subjects covered

The survey covers residents who executed transactions involving patents (including know-how) based on technical licensing contracts with values exceeding the equivalent of 3 million yen with non-residents.

The terms "residents" and "non-residents" here mean the following.

Residents:

Regardless of nationality, individuals living permanently in Japan and corporate bodies located here (juridical persons having their place of administration in Japan, including branches and agencies of foreign juridical persons). However, Japanese diplomatic establishments abroad and overseas travelers are also treated as residents.

Non-residents:

All individuals and corporate bodies other than residents.

2.1.5 Scope of technology trade

The survey covers patents (including know-how) based on technical licensing contracts. Specifically, these mean the following:

- 1) Transfer and setting up of rights for using patents, utility models, designs and trademarks
- 2) Transfer and setting up of rights for using know-how

- (such as specifications, knowledge, information and software)
- 3) Technical guidance related to factory and business management

However, the compensation for know-how and industrial technical guidance related with plant exports comprises a part of plant export values. It is hence included in the trade balance but is not covered by technology trade. On the other hand, the survey covers compensation related with trademarks and designs which cannot be said to comprise technology in the pure sense.

2.2 "Report on the Survey of Research and Development" prepared by Management and Coordination Agency ("MCA Statistics")

2.2.1 Objectives

The survey is designed to provide basic data pertaining to national research and development activities which is required for the development of science and technology.

2.2.2 Survey method

This survey is conducted by directly mailing questionnaires (see Table 1). The organizations are classified by presence of research activities based on past surveys, size of capital and industrial classification and populations are surveyed either in total or by sampling (see Table 2). The values and number of contracts written under the headings "technology imports" and "technology exports" on the recovered questionnaires are totalized as "international technology exchange."

In the case of a sampling survey, the population is estimated by multiplying the findings by the reciprocal of the sampling rate for each category.

Subjects covered by the total survey:

- Companies capitalized at over 1 billion yen
- Companies capitalized at over 5 million yen but under 1 billion yen which were carrying out R&D in the previous year's survey
- Semigovernmental corporations not specializing in research

Subjects covered by the sampling survey:

- Companies capitalized at over 5 million yen to under 1 billion yen (the sampling rate depends on the size of capital and industrial classification)

2.2.3 Contents and publication

The totalized values and number of contracts (new and con-

tinued) of technology exports and imports are classified by industry and country of the contract partner and published every year as "Report on the Survey of Research and Development."

2.2.4 Subjects covered

Irrespective of receipt and payment of monetary transactions, the survey covers the companies and semigovernmental corporations which signed technology exchange contracts with foreign corporate bodies or individuals.

The "companies" and "semigovernmental corporations" mean the following.

Companies:

Stock companies and limited responsibility companies engaged in "Agriculture", "Forestry", "Fisheries", "Mining", "Construction", "Manufacture", "Electricity/gas/heat supply and water", "Transport and Communication" and "Radio and television broadcasting" (defined in the "Statistical Industrial Classification for Japan")

Semigovernmental corporations:

"Profit-Oriented" semigovernmental corporations established in conformity to each special law. However, "Research-centered" semigovernmental corporation are excluded. Ex: the National Space Development Agency of Japan, the Power Reactor and Nuclear Fuel Development Corporation, the Japan Atomic Energy Research Institute and the Institute of Physical and Chemical Research.

Based on the above definition, the following entities are excluded:

- 1) Wholesaling, retailing, eating and drinking, finance and insurance, real estate and services other than radio and television broadcasting.
- 2) "Research-centered" semigovernmental corporations.
- 3) Research institutions established by central or local governments or by private organizations which perform R&D in the field of social sciences and humanities, or natural sciences and engineering.
- 4) Universities, junior colleges, technical colleges and research institutes attached to the universities.
- 5) Individuals

2.2.5 Scope of technology trade

- Provision and acquirement of technologies related with patents, utility models, know-how (including software) and technical guidance.
- Excludes those related with design and trademarks.

Table 1. Question about International Technology Exchange

[2] Yes or no for international exchange of technology (Circle 'yes' or 'no'. If you circle 'yes', answer the following questions.)

Yes



No

Enter the number of cases and the amount of technology exchange in the form of provision and acquirement of patentship, know-how and technical guidance by country or territory of destination or origin during the 1989 fiscal year.

In this case the number of cases is irrespective of monetary transaction of receipt and payment.

	Country or territory of destination or origin		New programs				Continued programs			
			Number of cases		Amount (10 thousand yen)		Number of cases		Amount (10 thousand yen)	
	code		code		code		code		code	
Technology exports	150	Total technology exports	151		152		153		154	
			151		152		153		154	
			151		152		153		154	
			151		152		153		154	
			151		152		153		154	
			151		152		153		154	
			151		152		153		154	
			151		152		153		154	

Technology imports	155	Total technology imports	156		157		158		159	
			156		157		158		159	
			156		157		158		159	
			156		157		158		159	
			156		157		158		159	
			156		157		158		159	
			156		157		158		159	
			156		157		158		159	

Table 2. Sampling of companies in the 1991 survey

	Stratum	Size of capital	Industry	Universe size	Sampling fraction	Number of samples
All companies	0	1000 million yen or more	All industries*	2,243	1/1	2,243
New companies	0	1000 million yen or more	All industries*	51	/	
Companies performing R & D in the latest survey	1	100 ~ 1000 million yen	All industries*	2,067	1/1	2,067
	2	30 ~ 100 million yen	All industries*	2,154	1/1	2,154
	3	10 ~ 30 million yen	All industries*	943	1/1	943
	4	5 ~ 10 million yen	All industries*	121	1/1	121
Companies not performing R & D in the latest survey or not covered in the latest survey	11	100 ~ 1000 million yen	Oils and paints manufacturing, Drugs and medicines manufacturing, Other chemical products manufacturing, Rubber products manufacturing, Fabricated metal products manufacturing, Communication and electronics equipment manufacturing, Other transportation equipment manufacturing	621	1/1	621
	12		Petroleum and coal products manufacturing, Non-ferrous metals and products manufacturing, Manufacturing of electrical machinery, equipment and supplies	186	1/2	93
	13		Food manufacturing, Pulp and paper manufacturing, Plastic products manufacturing	609	1/3	203
	14		Agriculture, forestry and fisheries, Mining, Printing and publishing manufacturing, General machinery manufacturing	625	1/4	156
	15		Textiles manufacturing, Industrial chemicals and chemical fibers manufacturing, Precision instruments manufacturing, Other manufacturing	559	1/6	93
	16		Construction, Ceramics manufacturing	1,249	1/12	104
	17		Iron and Steel manufacturing, Motor vehicles manufacturing	268	1/20	13
	18		Transport, communication and public utilities	1,294	1/100	12
	21	30 ~ 100 million yen	Drugs and medicines manufacturing, Ceramics manufacturing, Communication and electronics equipment manufacturing, Motor vehicles manufacturing	2,868	1/6	478
	22		Industrial chemicals and chemical fibers manufacturing, Oils and paints manufacturing, Other chemical products manufacturing, Petroleum and coal products manufacturing, Plastic products manufacturing, Rubber products manufacturing, Non-ferrous metals and products manufacturing, Fabricated metal products manufacturing, General machinery manufacturing, Manufacturing of electrical machinery, equipment and supplies, Precision instruments manufacturing	5,541	1/13	422
	23		Mining, Construction, Food manufacturing, Textiles manufacturing, Pulp and paper manufacturing, Iron and steel manufacturing, Other transportation equipment manufacturing, Other manufacturing	14,696	1/25	588
24	Agriculture, forestry and fisheries, Printing and publishing manufacturing		1,458	1/100	14	
25	Transport, communication and public utilities		3,797	1/400	10	

*"All industries" includes Agriculture, Forestry, Fisheries, Mining, Construction, Manufacturing, Electricity, gas, heat supply and water, Transport and communication, and Radio and television broadcasting.

	Stratum	Size of capital	Industry	Universe size	Sampling fraction	Number of samples	
Companies not performing R & D in the latest survey or not covered in the latest survey	31	10 ~ 30 million yen	Other chemical products manufacturing, Non-ferrous metals and products manufacturing, General machinery manufacturing, Communication and electronics equipment manufacturing, Motor vehicles manufacturing, Precision instruments manufacturing	9,854	1/13	756	
	32		Food manufacturing, Textiles manufacturing, Pulp and paper manufacturing, Industrial chemicals and chemical fibers manufacturing, Oils and paints manufacturing, Drugs and medicines manufacturing, Petroleum and coal products manufacturing, Plastic products manufacturing, Ceramics manufacturing, Iron and steel manufacturing, Fabricated metal products manufacturing, Manufacturing of electrical machinery, equipment and supplies, Other transportation equipment manufacturing	24,386	1/30	811	
	33		Agriculture, forestry and fisheries, Mining, Rubber products manufacturing, Other manufacturing	7,599	1/80	95	
	34		Construction, Printing and publishing manufacturing, Transport, communication and public utilities	50,633	1/400	127	
	41	5 ~ 10 million yen	Petroleum and coal products manufacturing	58	1/20	3	
	42		Industrial chemicals and chemical fibers manufacturing, Oils and paints manufacturing, Drugs and medicines manufacturing, Other chemical products manufacturing, Non-ferrous metals and products manufacturing, General machinery manufacturing, Manufacturing of electrical machinery, equipment and supplies, Communication and electronics equipment manufacturing, Precision instruments manufacturing	13,782	1/40	343	
	43		Mining, Pulp and paper manufacturing, Rubber products manufacturing, Fabricated metal products manufacturing, Other transportation equipment manufacturing	9,816	1/90	110	
	44		Agriculture, forestry and fisheries, Construction, Food manufacturing, Textiles manufacturing, Printing and publishing manufacturing, Plastic products manufacturing, Ceramics manufacturing, Iron and steel manufacturing, Motor vehicles manufacturing, Other manufacturing, Transport, communication and public utilities	86,114	1/300	287	
	New companies	61	100 ~ 1000 million yen	Oils and paints manufacturing, Drugs and medicines manufacturing, Other chemical products manufacturing, Rubber products manufacturing, Fabricated metal products manufacturing, Communication and electronics equipment manufacturing, Other transportation equipment manufacturing	6		
		62		Petroleum and coal products manufacturing, Non-ferrous metals and products manufacturing, Manufacturing of electrical machinery, equipment and supplies	1		
63		Food manufacturing, Pulp and paper manufacturing, Plastic products manufacturing		4			
64		Agriculture, forestry and fisheries, Mining, Printing and publishing manufacturing, General machinery manufacturing		16			
65		Textiles manufacturing, Industrial chemicals and chemical fibers manufacturing, Precision instruments manufacturing, Other manufacturing		5			
66		Construction, Ceramics manufacturing		8			
67		Iron and steel manufacturing, Motor vehicles manufacturing		2			
68		Transport, communication and public utilities		12			
Special corporations			All industries*	18	1/1	18	
Total				243,559		12,885	

2.3 "Annual Report" of the Fair Trade Commission ("FTC Statistics")

2.3.1 Objectives

These statistics are designed to prevent the signing of international contracts (agreements) between domestic and foreign businesses which comprise unreasonable restraint of trade or unfair trade practices and to oblige businesses which have signed international contracts to notify the government of such contracts thereby monitoring the execution of such contracts.

2.3.2 Survey method

The Fair Trade Commission totalizes the "Notification of Conclusion of International Miscellaneous Agreement(Contract)" submitted when businesses sign international contracts involving unreasonable restraint of trade or unfair trade practices.

2.3.3 Contents and publication

The totalized number of cases (introduction of technology, technical licensing, trademarks, copyrights, etc.) is published every year as "Annual Report" by classifying by industry and country of contract partner for each fiscal year.

2.3.4 Subjects covered

The survey covers businesses which signed international contracts of terms of over one year and involving unreasonable restraint of trade or unfair trade practices.

2.3.5 Scope of technology trade

- International contracts related with patents, utility models and designs.
- International contracts related with the copyright of computer programs (software).
- International contracts related with know-how associated with industrial technology.

[Reference]

Revision of FTC rules in March 1992

- 1) International contracts related with trademarks and copyrights need not be notified.
- 2) Only exclusive licensing contracts related with technology trade need to be notified.
- 3) Only businesses having market shares of over 10% or which are among the top three in the market for the commodity or service need to notify.

These revisions have substantially narrowed the scope of the technology trade which need to be notified.

2.4 "Analysis of Trends in Technology Imports" prepared by NISTEP ("NISTEP Statistics")

2.4.1 Objectives

This statistics is designed to contribute toward grasping the state of the science and technology activities in Japan by clarifying the actual condition of introduction of foreign technologies.

2.4.2 Survey method

NISTEP totalizes the number of contracts based on notifications submitted by residents and non-residents who sign (or modify) contracts to introduce technologies.

2.4.3 Contents and publication

The totalized number of cases of introduction of technologies is published every year as an "Analysis of Trends in Technology Imports" for each fiscal year by technical classification, country of contract partner and contract condition.

The number of cases of introduction of technologies by industrial classification has been added from FY1991.

2.4.4 Subjects covered

The survey covers residents and non-residents who sign, renew, or in other ways change the provisions of the contracts related with introduction of technologies.

2.4.5 Scope of technology trade

- Transfer of rights related with industrial property rights and other technologies.
- Setting up of rights for using industrial property rights and other technologies.
- Guidance on technologies related with factory management and that on technologies related with management of the following businesses: 1) agriculture, 2) forestry, 3) fisheries, 4) mining, 5) construction, 6) manufacturing, 7) transport and communications and 8) electricity and gas supply.

"Industrial property rights" mean patents, utility models, designs and trademarks. "Other technologies" mean the know-how, (including software).

[Reference]

Revision in January 1992 of Foreign Exchange and Foreign Trade Control Law and Cabinet Order concerning Direct Domestic Investments etc.

- 1) Introduction of the *ex post facto* notification system (within 15 days of signing of the contract).

However, contracts for introducing "designated technologies" whose value of compensation exceeds equivalents of 100 million yen must be notified in advance.

"Designated technologies": Technologies related with aircraft, weapons, explosives, atomic energy and space development.

- 2) Signing, renewal or modification in the provisions of the contract related with introduction of technology by non-residents need not be notified.

3. Qualitative analysis

This section first classifies the four statistics (BJ, MCA, FTC and NISTEP) into those on balance of payments and number of cases and qualitatively analyzes the "BJ statistics" and "MCA statistics" which are representative statistics on balance of payments.

3.1 Classification of the statistics

Table 3 categorizes the four statistics based on their contents.

Table 3. Types and Contents of Technology Trade Statistics

Type of statistics	Contents	Classification
BJ statistics	Export/import values	Only values
MCA statistics	Export/import values and cases	By industry, region and new/continued
FTC statistics	Export/import cases	By industry and country of contract partner
NISTEP statistics	Import cases only	By technology, country of contract partner and contract condition

Table 3 shows that the statistics can roughly be divided into those based on values and those on number of cases.

As for the statistics based on the number of cases, the "NISTEP statistics" only cover technology imports and on the other hand the "FTC statistics" scope of obligation to notify international contracts has substantially been narrowed from this year as mentioned in the Reference (section 2.3). Hence, the analysis will be conducted by focusing on the "BJ and MCA statistics" based on values.

3.2 Comparison and problems of "BJ and MCA statistics"

3.2.1 Survey method

The "BJ statistics" is designed to grasp the actual condition of international transactions and the trends of balance of payments by systematically recording all of the external economic transactions. It is based on a total survey totalizing the payments and receipts by all residents (individuals, corporate bodies and foreign affiliates etc.) which executed technology

trade exceeding equivalents of 3 million yen. They, however, only totalize the amounts written in the item "patent royalties." When the payments and receipts related with technology trade are carried out with trade in commodities and the resident reports such a transaction in the other item, such will not be reflected on the statistics at all.

On the other hand, the "MCA statistics" is designed to acquire the basic data necessary in promoting science and technology. They are strongly characterized as industrial statistics mainly covering the manufacturing industry. Also, they are based on a sampled questionnaire survey mailed to companies, etc. It is possible that some firms should misunderstand the survey's objectives or its items or fail to fill out the necessary items. The figures also comprise estimates obtained by multiplying the findings by the reciprocal of the sampling rate for each category set up based on size of capital and industrial classification.

The number of firms capitalized at over 1 billion yen which were covered by total survey in "MCA statistics" was 2,032 out of 3,175 in the data provided by "NISTEP statistics FY1991" which covered only new technology introduction. That means 64% of all number of cases in the "MCA statistics" was covered by total survey. The "MCA statistics" can hence be said as fully reliable as statistics for analyzing the trends of technology trade. However, the figures involve uncertainties peculiar to questionnaire surveys.

3.2.2 Subjects covered

The "BJ statistics" covers all the residents (individuals, corporate bodies and foreign affiliates etc.) which made foreign exchange remittance related with invisible trade transactions exceeding equivalents of 3 million yen.

The "MCA statistics" in contrast covers only manufacturing firms and semigovernmental corporations not specializing in research. It hence excludes wholesalers and retailers such as trading firms, department stores and software makers, eating and drinking businesses, finance and insurance, real estate, services other than radio and television broadcasting, semigovernmental corporations specializing in research, national, public and private research institutes, universities and individuals which are believed to be actually introducing technologies although they may not be developing or providing technologies. This is believed to be one of the reasons why the value of technology imports in the "MCA statistics" is smaller than that in the "BJ statistics."

3.2.3 Scope of technology trade

The following summarizes the scope of technology trade as per the two statistics.

Common items:

- Transfer and setting up of rights for using patents and utility models.
- Transfer and setting up of rights for using know-how (including software).
- Industrial technical guidance (quality control, operation, and maintenance etc.).

Differences:

Those only covered by the "BJ statistics":

- Transfer and setting up of rights for using trademarks and designs.
- Technical guidance on factory and business management.

Those only covered by the "MCA statistics":

- Know-how and industrial technical guidance related with plant exports.

These show that although both the "BJ and MCA statistics" deal with balance of payments, they differ in many respects when it comes to the scope of technology trade. While the "BJ statistics" includes compensation for trademarks and designs which cannot be said as technology in the pure sense and compensation for technical guidance related with business management, It does not include the compensation for know-how related with plant exports which is naturally considered as technology.

The former is believed one of the reasons to make the value of technology imports in the "BJ statistics" greater than that in the "MCA statistics," and the latter is believed one of the reasons to make the value of technology exports smaller.

3.2.4 Factors to affect the values of technology exports and imports

Examining Figure 1 again shows that while the value of technology exports in the "MCA statistics" slightly exceed that in the "BJ statistics", the value of technology imports in the "BJ statistics" greatly exceed that in the "MCA statistics".

The sections so far have qualitatively analyzed the two sets of statistics from three viewpoints. The following briefly summarizes the factors causing differences in the two statistics' values of technology exports and imports.

Values of technology exports: Why the figures in the "MCA statistics" are greater than those in the "BJ statistics"

- Treatment of the compensation for know-how and industrial technical guidance related with plant exports

Values of technology imports: Why the figures in the "MCA statistics" are smaller than those in the "BJ statistics"

- Exclusion of wholesaling, retailing and services

- Exclusion of compensation for transfer and setting up of rights for using trademarks and designs
- Exclusion of compensation for technical guidance on factory and business management

3.2.5 Other problems: cross-licensing

Cross-licensing means that a firm introduces technologies from other firms in exchange of its own technologies. With the development of Japanese technological capacities, cross-licensing has emerged due to the frequent execution of international technical tie-ups between firms in forms different from unilateral provision and introduction of technologies. There can also be cross-licensing not involving payment of compensation when firms mutually provide technologies.

The "BJ statistics" totalizes the amounts written in the "Report on Invisible Trade Receipts and Payments" submitted when companies remit or receive through foreign exchange. The "MCA statistics" totalizes the amounts paid or received in the form of compensation. Only when there is a difference in the compensation for the mutually supplied technology, this amount is reflected on these statistics.

Cross-licensing can be said as a form of technology trade. However, because the compensation for the supplied technology is mutually offset, considerable values related with cross-licensing will be excluded from the values of technology exports and imports.

3.2.6 Summary of the qualitative analysis

Table 4 summarizes the discussion so far.

Table 4. Qualitative Comparison of BJ and MCA Statistics

	BJ statistics	MCA statistics
Objectives	Grasping of the actual condition of international transactions and trends of balance of payments	Collection of basic data necessary in promoting science and technology
Survey method	Totalization of the values written as "patent royalties" in the "Report on Invisible Trade Receipts and Payments" submitted to the Bank of Japan	Survey by mailing questionnaires (1) Total survey: firms capitalized at over ¥1 billion and those capitalized at under ¥1 billion which were conducting R&D in the previous year's survey. (2) Sampling survey: firms capitalized at under ¥1 billion. Totalization of the value written in the questionnaire's items "technology export" and "technology import" (estimated by multiplying the values by the reciprocal of the sampling rate).
Subjects covered	Residents (individuals and corporate bodies in Japan) who executed invisible trade transactions of over ¥3 million with non-residents	Research institutes (national, public and private), Universities, "Research-Centered" semigovernmental corporations, firms capitalized at over ¥5 million and other than wholesaling, retailing and services.
Scope of Tech. trade	(1) Patents, utility models, designs and trademarks (2) Know-how (3) Industrial technical guidance. (4) Technical guidance on factory and business management. (5) Excludes those related with plant exports. (6) Excludes those related with cross-licensing.	(1) Patents and utility models. (2) Excludes designs. (3) Know-how (4) Industrial technical guidance. (5) Excludes technical guidance on factory and business management. (6) Excludes those related with cross-licensing.

4. Quantitative analysis

This section attempts quantitative analysis of how these differences affect the values of technology exports and imports, and if they are actually working as factors to explain the differences in values of technology exports and imports in the two statistics.

The quantitative analysis will be conducted using three factors namely 1) exclusion of wholesaling, retailing and services from the survey, 2) compensation for know-how and industrial technical guidance related with plant exports and 3) compensation for transfer and setting up of rights for using trademarks. These have been said as major factors to explain the differences in the values of technology trade.

4.1. Factor 1: Exclusion of wholesaling, retailing and services

As mentioned, the "MCA statistics" excludes wholesaling, retailing, eating and drinking, finance and insurance, services other than radio and television broadcasting, "Research-centered" semigovernmental corporations, national, public and private research institutes, universities and individuals. This is one of the factors to make the value of technology imports in the "MCA statistics" smaller than that in the "BJ statistics" which covers these subjects.

This factor's effect on the total value of compensation for technology introduction will quantitatively be analyzed using the number of cases of new introduction of technologies in the "NISTEP statistics" by industrial classification as data.

It is also believed meaningful to examine this factor's effect on the value of technology exports. However, the "NISTEP Statistics" here used only deals with cases of introduction of technologies. It hence cannot be used in analyzing the effect on the value of technology exports.

4.1.1 "NISTEP statistics": Number of new contracts related with introduction of technologies by firms not covered by the "MCA statistics"

Table 5 summarizes the number of contracts related with technologies (FY1991) as per "NISTEP statistics" by firms etc. not covered the "MCA statistics".

4.1.2 Quantitative analysis

According to Table 5, there were 1,117 cases of the introduction of technologies related with patents and know-how that were not covered by the "MCA statistics". The "NISTEP statistics" shows that the total number of cases of the introduction of technologies were 3,175 in FY1991. Hence, over a third or 35.2% were not covered by the "MCA statistics".

Table 5. Number of Cases of Introduction of Technologies by Firms Not Covered by MCA Statistics(FY 1991)

Unit:Case

Statistical Industrial Classification for Japan (major classification)	Total	Type of technology	
		Trademarks only	Patents and know-how
Wholesaling, retailing, eating and drinking	864	153	711
Trading firms, etc.	829	121	708
Other	35	32	3
Finance and insurance	36	1	35
Real estate	6	4	2
Services	412	45	367
Information service	159	0	159
Education	3	0	3
Academic research institutes	15	0	15
Foundations	1	0	1
Other	234	45	189
Public service	1	0	1
Unclassifiable	1	0	1
Total	1,320	203	1,117

Notes:

(1)The firms were classified by NISTEP based on "Statistical Industrial Classification for Japan."

(2)"Trading firms, etc.": Commodity wholesalers and wholesalers of clothes, foodstuffs, furniture, etc.

"Information service": Information services and research and advertisement businesses

"Education": Universities and other educational institutions

"Academic research institutes": Natural and cultural science research institutes

"Foundations, etc.": Political, economic and cultural organizations

"Other" of services excludes radio and television broadcasting

"Unclassifiable" includes individuals

Source: "Analysis of Trends in Technology Imports"(1991). NISTEP.

These findings are only based on the number of new contracts related with the introduction of technologies. Yet it can be inferred that the number of cases considerably affect the total value of the compensation for the introduction of technologies (value of technology imports).

At present it is difficult to directly obtain the value of technology imports. However, using the above ratio of 35.2%, the total number of cases of technology imports and the value paid in compensation in FY1991 according to the "MCA statistics" including wholesaling, retailing and services are estimated below.

- Total number of cases of technology imports: 7,409
- Total number of cases of technology imports including the excluded businesses : 11,434 [$7,409 \div (1 - 0.352)$]
- Total amount paid in compensation: 394.66 billion yen
- Total amount paid in compensation including the excluded businesses: 609.04 billion yen [$394.66 \div (1 - 0.352)$]

Since 370.55 billion is the total value received in compensation, the ratio of balance of payments of technology trade according to the "MCA statistics" is estimated as 0.608.

As a matter of course, there are problems with the adequacy of this estimation method. However, it is believed to serve as a yardstick to estimate the ratio of the balance of payments by taking account of the factor under question (only the value of technology imports).

4.2 Factor 2: Compensation for know-how and industrial technical guidance related with plant exports

As mentioned, the compensation for know-how and industrial technical guidance related with plant exports is considered one of the factors to make the value of technology exports in the "BJ statistics" smaller than that of the "MCA statistics".

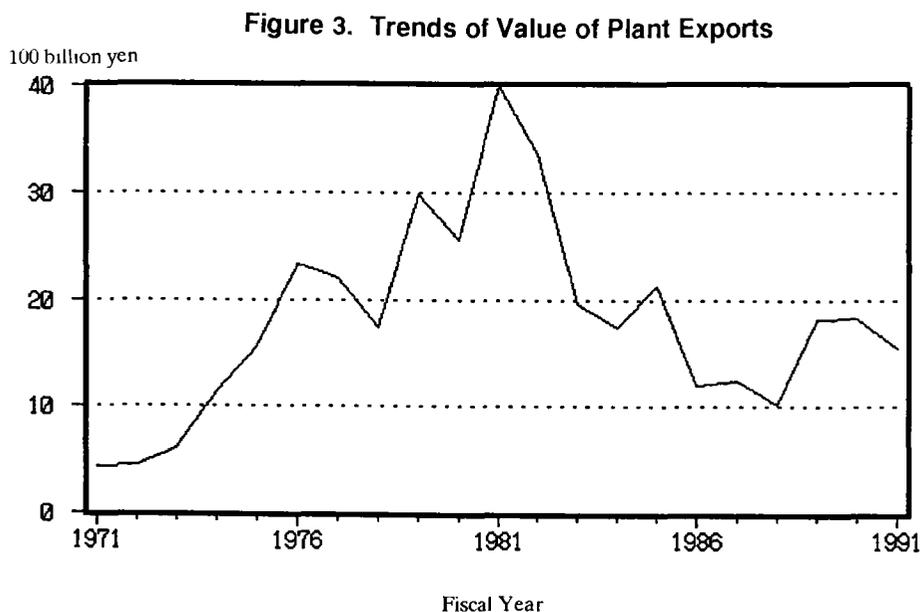
This section estimates the compensation for know-how and industrial technical guidance related with plant exports and adds this value to the "BJ statistics'" value of technology exports. It thereby attempts to quantitatively analyze the effect of this factor.

It is also believed meaningful to analyze the effect on the value of technology imports. However, since data which allows estimation of the compensation are not available, the effect cannot be analyzed at present.

4.2.1 Statistics on plant exports

Available as statistics on plant exports is "Plant Export year book" published every year by MITI's Machinery and Information Industry Bureau. In FY1991 the value of plant exports reached 2.48 billion dollars (around 300 billion yen) in terms of approved statistics, 9.13 billion dollars (around 1.2 trillion yen) in terms of non-approved statistics for a total of 11.61 billion dollars (around 1.5 trillion yen). This statistics shows the totalization of the value of contracted plant exports involving heavy machinery costing over 500,000 yen a case and excluding transport machinery such as ships, aircraft, railway vehicles and automobiles and single machinery.

Figure 3 shows the trends of the value of plant exports. (US dollars have been converted using inter-bank middle rates.)



4.2.2 Ratio of price of know-how and industrial technical guidance related with plant exports

Table 6 summarizes the average price structure of plants. It was estimated by MITI by interviewing businesses.

In Table 6, the expense item which is believed to include know-how and industrial technical guidance related with plant exports is "engineering" among the indirect expenses. Its average ratio to the overall price is 2.3%. This figure is hence used in the quantitative analysis to follow.

Table 6. Price Structure of Plants

Expense items	Scope (%)	Average (%)
Direct expenses		67.5
Machinery production expenses	30~45	37.5
Piping and material expenses	10~20	15.0
Instruments and other	10~20	15.0

Indirect expenses		17.5
Head office expenses		7.5
Engineering	1.5~6.0	2.3
Drafting and other	3.0~14.0	4.0
Commodity costs	1.0~3.0	1.2
Site expenses		10.0
Temporary constructions	3.0~8.0	5.5
Commodity costs	4.0~7.0	4.5

Cost of works		15.0
Concrete foundation	1.5~5.0	2.5
Piping and ducts	1.5~7.0	4.5
Structures	1.5~4.0	2.0
Instrumentation and other	5.0~8.0	6.0
Total	-----	100.0

Source: "1986 The perspectives and present situation of plant export"
Heavy and Chemical Industry News Agency

4.2.3 Quantitative analysis

Figure 4 shows the estimated compensation for know-how and industrial technical guidance related with plant exports by multiplying the ratio of 2.3% for engineering into the total value of plant exports (around 35.6 billion yen in FY1991).

Next, to examine whether this compensation comprises a factor to quantitatively explain the difference in the value of technology exports between the "BJ and MCA statistics", the value of compensation estimated in Figure 4 has been added to the value of technology exports in the "BJ statistics" by *giving a delay of three years*. Figure 5 shows the comparison of the results with the value of technology exports in the "MCA statistics".

Figure 4. Estimated Compensation for Know-How and Industrial Technical Guidance Related with Plant Exports

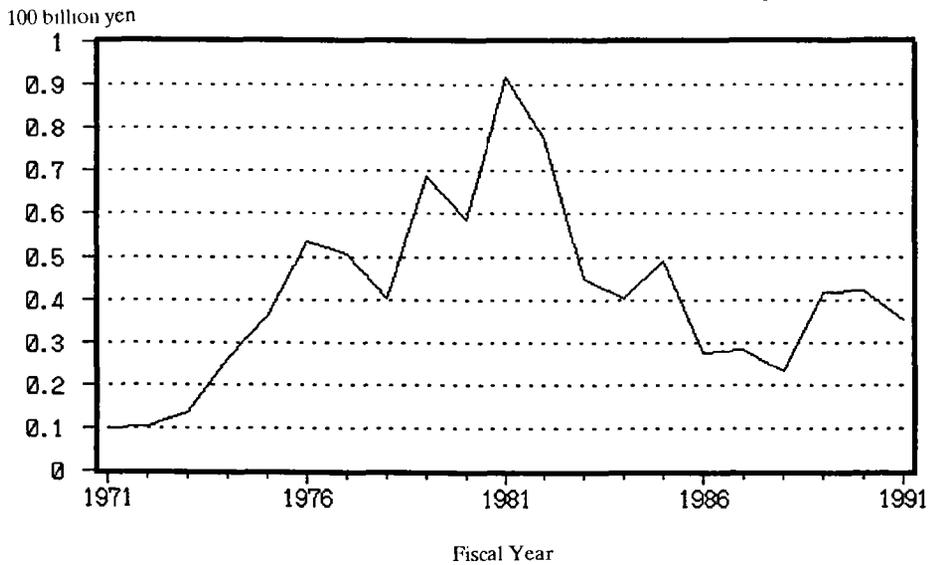


Figure 5. Comparison of Values of Technology Exports(including plant exports)

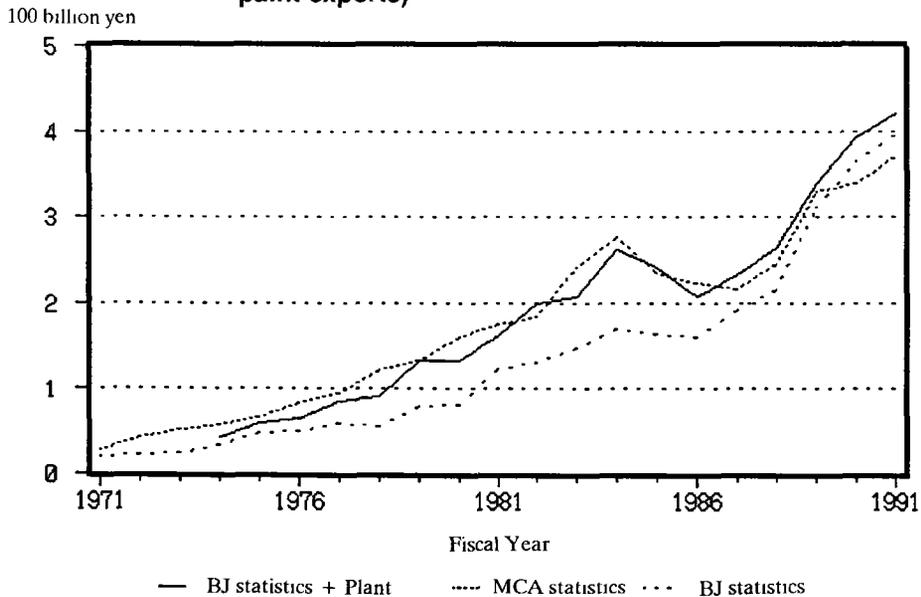


Figure 5 shows discrepancies in the trends of the values of technology exports. However, when consideration is given to the fact that the "MCA statistics" are based on a sampling questionnaire survey, it can be said that the two values of technology exports are more or less the same.

The foregoing quantitative analysis has made clear that the compensation for know-how and industrial technical guidance related with plant exports can quantitatively explain the difference in the two statistics' values of technology exports.

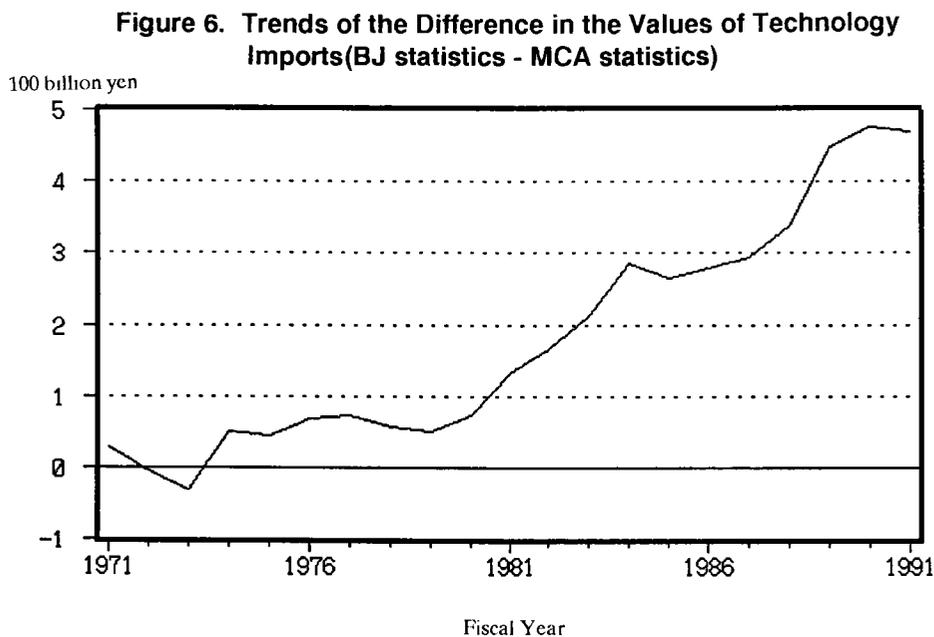
When the approximately 23.3 billion yen for FY1988 is added to the value of technology exports to reexamine the "BJ statistics'" ratio of balance of payments by taking account of this factor (only the value of technology exports), the value of technology exports in FY1991 reaches around 420.7 billion yen and that of technology imports around 864.7 billion yen for balance of payments ratio of 0.487 (yen-based).

4.3 Factor 3: Compensation for transfer and setting up of rights for using trademarks

As mentioned, the "BJ statistics" includes the compensation for trademarks which cannot be said as technology in the pure sense. This is considered a factor to make the value of technology imports in the "BJ statistics" much greater than that of the "MCA statistics" which does not include this item.

In quantitatively analyzing this factor, as in the case of Factor 1, this section analyzes the trends of trademarks based on the number and conditions of new contracts for introducing technologies according to the "NISTEP statistics" which only deals with the number of cases. It thus examines the effect of this factor on the value of technology imports.

This section especially examines the factor's effect by obtaining the difference in the value of technology imports between the "BJ and MCA statistics" (see Figure 6).

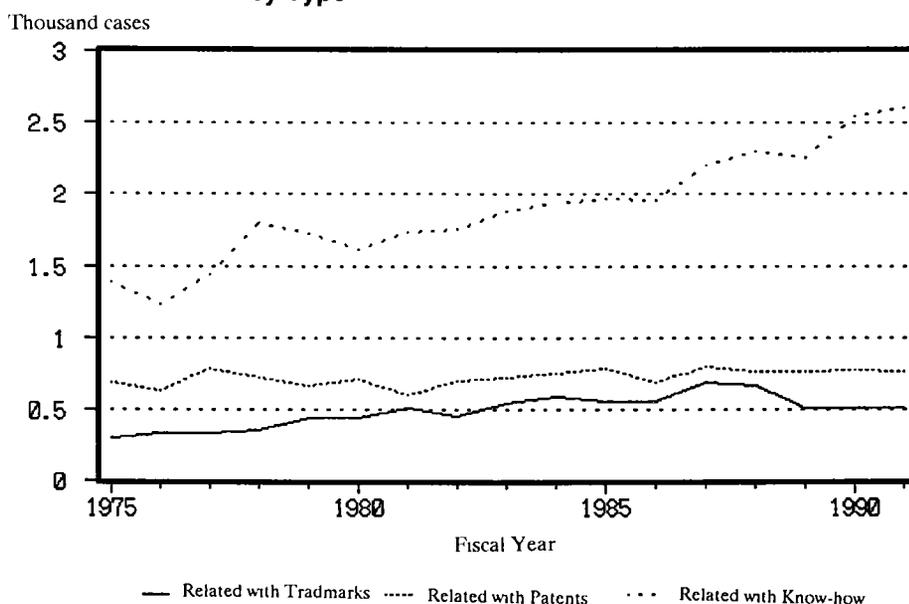


It is also believed meaningful to analyze the effect of this factor on the value of technology exports. However, the "NISTEP statistics" used in conducting the analysis only deals with the number of cases of technology introductions. It hence cannot be used in analyzing the effect on the value of technology exports.

4.3.1 "NISTEP statistics": Number of new contracts for introducing technologies related with trademarks

Figure 7 shows the graph of the trends of the number of new contracts for introducing technologies by type as per the "NISTEP statistics" (including overlaps).

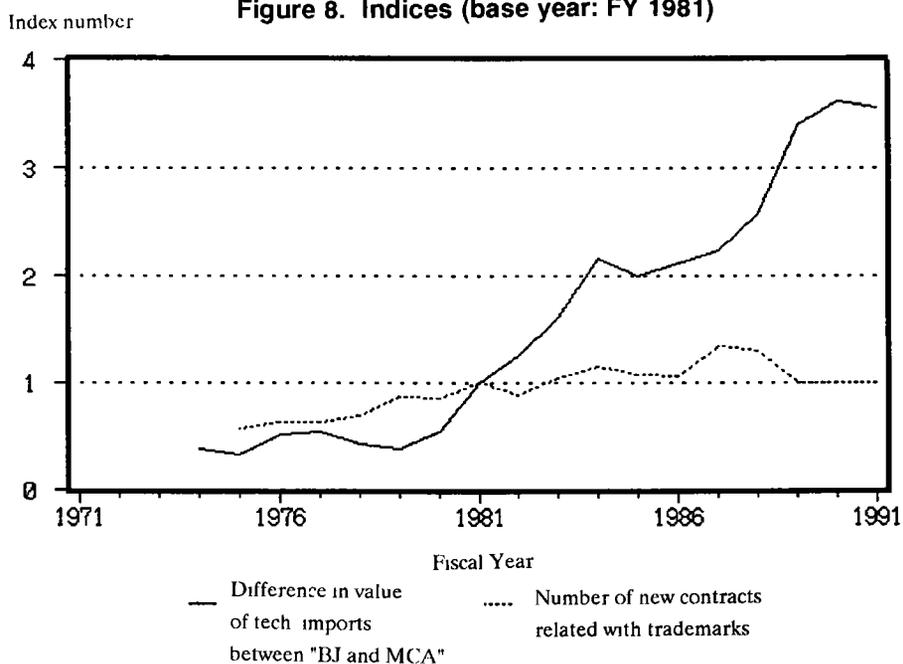
Figure 7. Trends of Number of Cases of Technology Introduction by Type



The figure shows no major changes in the number of contracts. On the other hand, the trends of the difference in the value of technology imports in Figure 6 show that the difference has increased greatly.

To clarify the difference in the two's trends (growth rates), Figure 8 has converted the figures into indices using FY1981 as the base year.

Figure 8. Indices (base year: FY 1981)



4.3.2 Three factors related with trademarks and their quantitative analysis

The increase and decrease of the compensation for transfer and setting up of rights for using trademarks is not explained just by the increase and decrease of the number of cases of introduction of technologies. It will be necessary to analyze the following three factors namely 1) conditions of payment of royalties, 2) the number of continued contracts and 3) trends of sales.

In conducting this analysis, Table 7 summarizes the trends of the conditions of new contracts related with trademarks in the recent six years as per the "NISTEP statistics."

(1) Number of continued contracts

As can be seen from "conditions of payment of compensation" in Table 7, the payment conditions consist of initial payment and running royalty of paying a fee of a fixed rate of the sales or proceeds. Around 80% of the cases of introduction related with trademarks involved running royalties. As a matter of course, the increase of the running royalty increases the compensation for setting up the right for using the trademark.

However, examining the trends of the running royalties does not show any overall tendencies for the royalties to rise.

Judging from this, the trends of the running royalties do not seem to comprise a factor to explain the drastic increase of the difference in the value of technology imports.

(2) Number of continued contracts

Most of the contracts related with trademarks involved running royalties. Hence, the length of the term of these contracts affects the total value of the compensation for setting up the right for using trademarks.

Examining the trends of "term of contract" in Table 7 shows that the component ratios of the terms of contract are more or less fixed, showing that there have been no major changes in the trends of "term of contract" in the last few years.

The trends of the number of continued contracts are fixed more or less as with the case of the number of new contracts. Hence, 1) the component ratios of the categories of the terms of contracts for each year is more or less the same, and 2) as seen in Figure 7 the number of new contracts for introducing technologies for each year is more or less the same. These mean that a fixed number of new contracts are increasing every year and a fixed number of expired contracts are decreasing every year. Hence, theoretically, the number of continued contracts will more or less be fixed every year. The trends of the number of continued contracts can be said as more or less the same as those of the graph in Figure 8 which has converted the number of new contracts related with trademarks into indices.

Table 7. Trends of Conditions of Contracts Related with Trademarks

Term of Contract

Fiscal Year	1986		1987		1988		1989		1990		1991	
	Cases	Ratio	Cases	Ratio	Cases	Ratio	Cases	Ratio	Cases	Ratio	Cases	Ratio
Under 1 year	5	3.1%	4	2.3%	13	4.1%	18	4.8%	27	6.6%	14	3.9%
1 year - under 5 years	84	52.2%	92	52.3%	174	55.2%	210	55.7%	242	59.5%	218	60.4%
5 years - under 10 years	13	8.1%	17	9.7%	45	14.3%	49	13.0%	58	14.3%	55	15.2%
10 years - under 15 years	6	3.7%	7	4.0%	6	1.9%	12	3.2%	4	1.0%	12	3.3%
15 years +	2	1.2%	2	1.1%	6	1.9%	2	0.5%	4	1.0%	3	0.8%
Term of patent	5	3.1%	10	5.7%	11	3.5%	14	3.7%	11	2.7%	26	7.2%
Other	46	28.6%	44	25.0%	60	19.0%	72	19.1%	61	15.0%	33	9.1%
Total	161	100.0%	176	100.1%	315	99.9%	377	100.0%	407	100.1%	361	99.9%

Notes:

1. The number of cases only covers contracts related with trademarks.

2. "Other". No term, permanent, term of other contracts, etc.

Condition of Payment of Compensation

Fiscal Year	1986		1987		1988		1989		1990		1991	
	Cases	Ratio										
Initial payment only	32	26.0%	28	20.1%	50	18.1%	68	20.1%	58	15.7%	55	16.4%
Initial + RR	14	11.4%	19	13.7%	18	6.5%	11	3.3%	17	4.6%	12	3.6%
RR only	17	13.8%	34	24.5%	49	17.7%	48	14.2%	67	18.1%	59	17.6%
RR + minimum	59	48.0%	53	38.1%	151	54.5%	199	58.9%	215	58.1%	183	54.5%
Initial + RR + minimum	1	0.8%	5	3.6%	9	3.2%	12	3.6%	13	3.5%	27	8.0%
Total	123	100.0%	139	100.0%	277	100.0%	338	100.1%	370	100.0%	336	100.1%

Note. "RR": running royalty.

Running Royalties

Fiscal Year	1986		1987		1988		1989		1990		1991	
	Cases	Ratio	Cases	Ratio	Cases	Ratio	Cases	Ratio	Cases	Ratio	Cases	Ratio
Under 2%	10	11.0%	13	11.7%	11	4.8%	9	3.3%	19	6.1%	13	4.6%
2% - under 5%	16	17.6%	21	18.9%	78	34.4%	87	32.2%	84	26.9%	64	22.8%
5% - under 8%	53	58.2%	50	45.0%	98	43.2%	124	45.9%	119	38.1%	143	50.9%
8% +	9	9.9%	11	9.9%	22	9.7%	33	12.2%	59	18.9%	32	11.4%
Other	3	3.3%	16	14.4%	18	7.9%	17	6.3%	31	9.9%	29	10.3%
Total	91	100.0%	111	99.9%	227	100.0%	270	99.9%	312	99.9%	281	100.0%

Note: "Other": Royalty not based on percentage but on unit price per piece.

Source: NISTEP

Judging from this, the trends of the number of continued contracts related with trademarks also do not seem to comprise a factor to explain the drastic increase of the difference in the value of technology imports.

(3) Trends of sales

Most of the contracts related with trademarks involve running royalties. If commodities or products which use the trademarks sell or are produced in large quantities, as a matter of course this will increase the total value of the compensation for setting up the right for using the trademark.

In terms of the technical classification, clothes and textile products comprised around 30% of the contracts related with trademarks in the "NISTEP statistics", here the trends of sales of clothing by department stores will be used as data (see Figure 9).

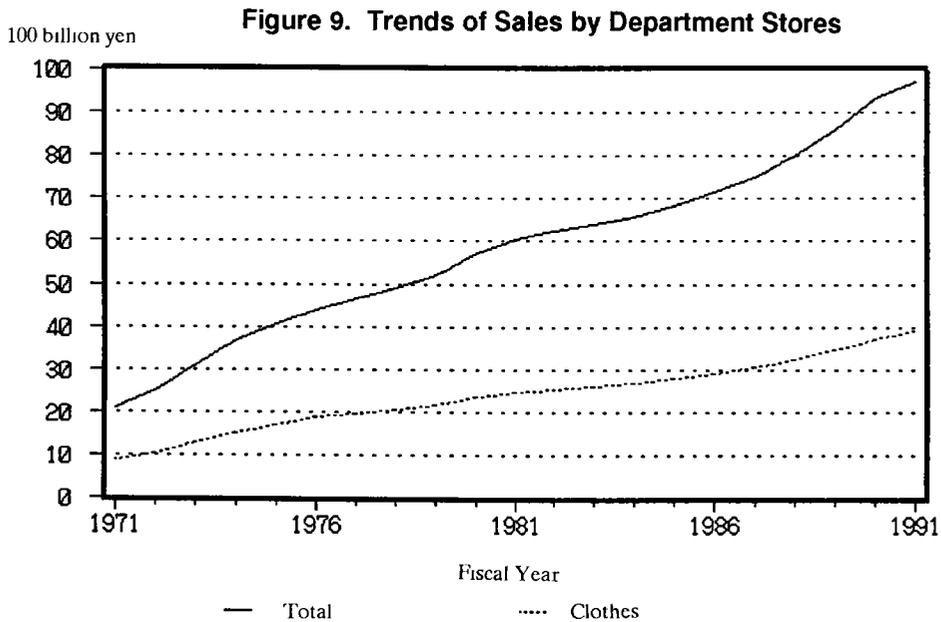
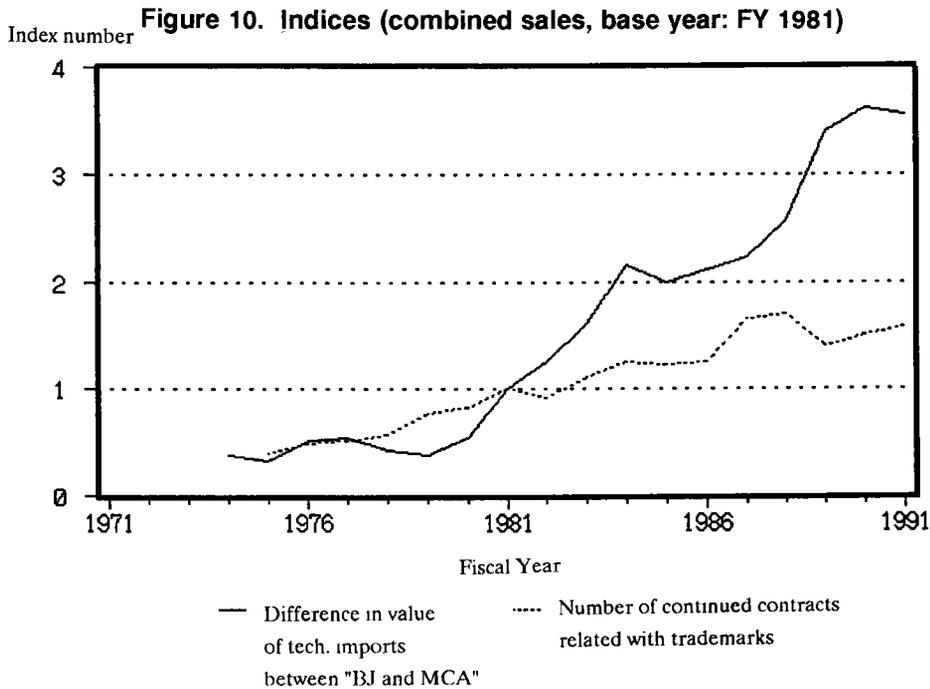


Figure 9 shows that the sales of clothing have been growing by an annual of around 8% in the last few years. To analyze the effect of this growth on the total value of the compensation for setting up the right for using trademarks, Figure 10 has multiplied the growth of sales by the indices in Figure 8 of the number of cases (as mentioned in (2), these also comprise indices of the number of cases of continued introduction of technologies related with trademarks). Figure 10 shows that the difference in the value of technology imports has been widening in the recent years.



Judging from this, the trends of sales do not seem to comprise a factor to explain all of the drastic increase in the difference in the value of technology imports.

4.3.3 Summary

The effects of these three factors on the difference in the value of technology imports are summarized below.

- (1) Condition of payment of royalties: Virtually no effect
- (2) Number of continued contrasts: Virtually no effect
- (3) Trends of sales: The effect is around 40% of the growth rate of the difference in the value of technology imports (FY1991)

Hence, while the compensation for transferring and setting up rights for using trademarks comprises a factor to explain the difference in the value of technology imports in the "BJ and MCA statistics", it can only explain around 40% of the growth rate from the base year of the difference in the value of technology imports (in FY1991). Though the growth rate of the number of cases does not immediately explain the trends of the value of technology imports, it will be necessary to look for other factors to explain the rest by taking account of Factor 1 which excludes such businesses as wholesaling, retailing and services.

4.3.4 Estimated compensation for transferring and setting up rights for using trademarks

This section estimates how this factor specifically affects the value of technology imports and the ratio of balance of payments. Yet since such is difficult using the available data, a questionnaire survey was conducted to obtain the average value paid in compensation per contract for transferring and setting up rights for using trademarks. This survey covered 17 major trading firms and department stores which were regularly transferring and setting up rights for using trademarks related with clothes and textile products. The period covered was the one year retrospective from the most recent settling day before April 1, 1992. The average value paid in compensation per contract was found to be 43 million yen.

Since there were 513 contracts in FY1991 for introducing technologies related with trademarks, the total compensation obtained by using this finding was 22.1 billion yen. Also, the average term of contract estimated using the weighted average based on the component ratio of "term of contract" for FY1991 in Table 9 was 4.9 years. The total number of contracts related with trademarks is estimated to be 4.9 times the number of new contracts. As a result, the total value of the compensation for transferring and setting up rights for using trademarks is estimated to be 108.3 billion yen.

Subtracting this value from the value of technology imports for FY1991 in the "BJ statistics" produced 756.4 billion yen. The ratio of the balance of payments of technology trade according to the "BJ statistics" by taking only this factor into account becomes 0.525. When the compensation for know-how and industrial technical guidance related with plant exports (Factor 2) is also taken into account, the ratio of balance of payments becomes 0.556.

This estimate however emphasizes trademarks related with clothes and textile products. Also, since the population covered is very small, the statistical significance of this finding is believed to be very low. However, as with the estimation related with Factor 1, this estimation is believed to serve as a yardstick in grasping this factor's effect on the value of technology imports and the ratio of balance of payments.

4.4 Factor 4: Compensation related with software

When the "NISTEP statistics" was examined for the technology showing marked growth in terms of the number of cases, found was software which comprises advanced technology. This section examines the effect of compensation related with software on the value of technology imports.

Both the "BJ and MCA statistics" include software in their definition of technology trade. It might be inappropriate to take up the compensation for software as a new factor. However, because the "MCA statistics" are based on a questionnaire survey, the compensation for software may not be reflected in its value of technology imports if the respondent for example saw the purchase of general analytical software simply as purchase of a commodity. Moreover, while not all of the number of cases of know-how in the "NISTEP statistics" concern software, nearly 90% (983 out of the 1,117 cases of introduction of technologies) comprised introduction only of know-how. On the other hand, the data by industrial classification in the "NISTEP statistics" comprise a new attempt so that it is difficult to explore past trends. Hence it is not believed entirely meaningless to analyze the effect of the compensation related with software.

In quantitatively analyzing this factor, just as in the case of compensation for transferring and setting up rights for using trademarks, the effect will be analyzed based on the number and conditions of contracts for introducing technologies related with software in the "NISTEP statistics."

It is also believed meaningful to analyze the effect of this factor on the value of technology exports. However, the "NISTEP statistics" used in the analysis only deals with the number of cases of technology imports. The available data cannot be used in analyzing the effects on the value of technology exports.

4.4.1 "NISTEP statistics": Trends of the number of new contracts for introducing technologies related with software

Figure 11 shows the graph of the trends of the number of new contracts for introducing technologies related with software in the "NISTEP statistics."

It shows that the number of new contracts had markedly increased. On the other hand, as mentioned, the difference in the value of technology imports (see Figure 6) has greatly been increasing.

To clarify the difference in the two's trends (growth rates), Figure 12 has converted the figures into indices by using FY1981 as the base year.

Figure 11. Trends of Number of Cases of Introduction of Software

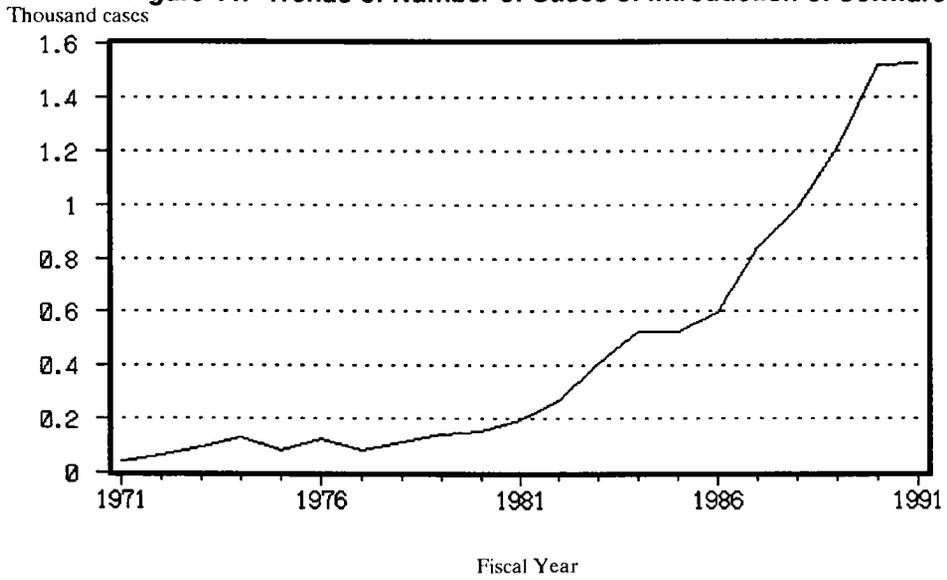
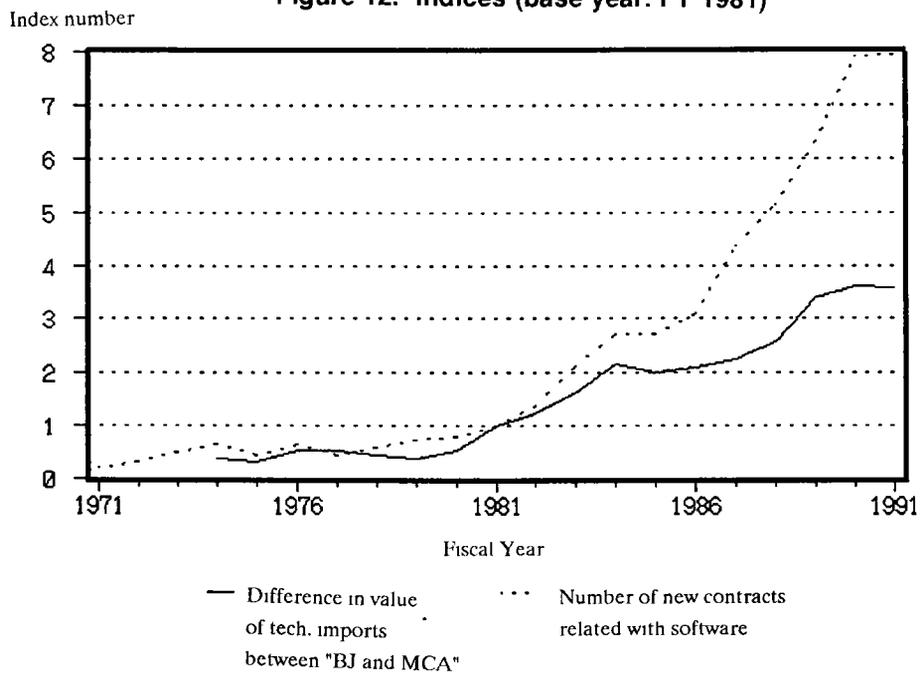


Figure 12. Indices (base year: FY 1981)



4.4.2 Three factors related with software and their quantitative analysis

The number of contracts for introducing technologies is not the only factor affecting the difference in the value of technology imports. As in the case of Factor 3, to analyze the effects of the three factors of 1) conditions of payment of royalties, 2) number of continued contracts and 3) trends of sales on the difference in the value of technology imports, Table 8 summarizes the trends of the conditions of contracts related with introduction of technologies related with software in the recent six years according to the "NISTEP statistics."

(1) Conditions of payment of royalties

Around 60% of the contracts involved only initial payments. Nearly 90% fell into the "other" category regarding running royalties. There were no major changes in the recent six years in the trends of their component ratio. Hence, affecting the value of technology imports are the trends of the value of initial payments. Because the royalties were mostly in the "other" category, it is not possible to read any tendencies from Table 8.

(2) Number of continued contracts

As mentioned in (1), around 60% of the contracts involved only initial payments. Hence, the effect of the number of continued contracts on the value of technology imports is believed to be small. Also, examining the trends of "term of contract" shows that around 60% of the contracts fell into the "other" category (this is because around 60% of the contracts involved only initial payments). There are no major changes in the trends of their component ratio in the recent six years. Hence, the trends of the number of continued contracts do not seem to comprise a factor to explain the drastic increase of the difference in the value of technology imports.

(3) Trends of sales

As mentioned in (1) and (2), since around 40% of the contracts involved running royalties as condition of payment of compensation, the increase of the manufacture or sales of the software products introduced from abroad increases the value of technology imports.

In analyzing these tendencies, the trends of sales by information service industry in Japan were used as data (see Figure 13).

Table 8. Trends of Conditions of Contracts Related with Software

Term of Contract

Fiscal Year	1986		1987		1988		1989		1990		1991	
	Cases	Ratio	Cases	Ratio	Cases	Ratio	Cases	Ratio	Cases	Ratio	Cases	Ratio
Under 1 year	14	2.3%	43	5.1%	48	4.9%	42	3.5%	48	3.2%	47	3.1%
1 year - under 5 years	154	25.8%	205	24.5%	258	26.2%	289	23.8%	336	22.1%	340	22.3%
5 years - under 10 years	39	6.5%	54	6.5%	49	5.0%	63	5.2%	103	6.8%	89	5.8%
10 years - under 15 years	33	5.5%	23	2.7%	40	4.1%	43	3.5%	26	1.7%	44	2.9%
15 years +	7	1.2%	9	1.1%	16	1.6%	19	1.6%	7	0.5%	13	0.9%
Term of patent	4	0.7%	5	0.6%	3	0.3%	3	0.2%	3	0.2%	3	0.2%
Other	345	57.9%	498	59.5%	571	58.0%	754	62.2%	996	65.6%	986	64.8%
Total	596	99.9%	837	100.0%	985	100.1%	1,213	100.0%	1,519	100.1%	1,522	100.0%

Notes:

1. The number of cases only covers contracts related with software.
2. "Other". No term, permanent, term of other contracts, etc.

Condition of Payment of Compensation

Fiscal Year	1986		1987		1988		1989		1990		1991	
	Cases	Ratio	Cases	Ratio	Cases	Ratio	Cases	Ratio	Cases	Ratio	Cases	Ratio
Initial payment only	358	61.6%	486	60.0%	605	62.8%	724	61.0%	857	59.1%	899	61.7%
Initial + RR	103	17.7%	154	19.0%	186	19.3%	210	17.7%	282	19.5%	282	19.4%
RR only	74	12.7%	133	16.4%	124	12.9%	191	16.1%	260	17.9%	218	15.0%
RR + minimum	33	5.7%	17	2.1%	22	2.3%	35	2.9%	26	1.8%	27	1.9%
Initial + RR + minimum	13	2.2%	20	2.5%	26	2.7%	27	2.3%	24	1.7%	31	2.1%
Total	581	99.9%	810	100.0%	963	100.0%	1,187	100.0%	1,449	100.0%	1,457	100.1%

Note "RR": running royalty.

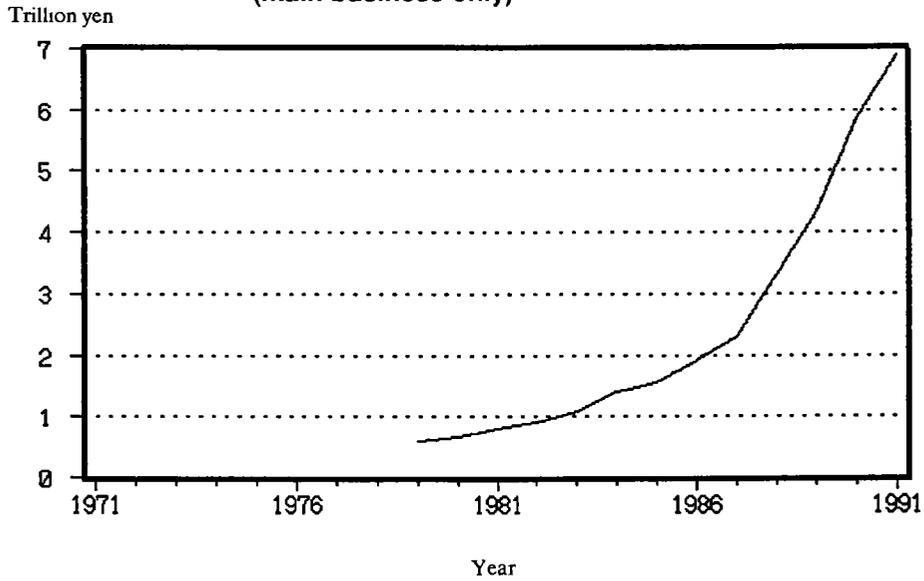
Running Royalties

Fiscal Year	1986		1987		1988		1989		1990		1991	
	Cases	Ratio										
Under 2%	2	0.9%	1	0.3%	1	0.3%	4	0.9%	2	0.3%	2	0.4%
2% - under 5%	3	1.3%	4	1.2%	5	1.4%	6	1.3%	12	2.0%	9	1.6%
5% - under 8%	10	4.5%	1	0.3%	11	3.1%	13	2.8%	4	0.7%	12	2.2%
8% +	39	17.5%	41	12.7%	37	10.3%	53	11.4%	53	9.0%	73	13.1%
Other	169	75.8%	277	85.5%	304	84.9%	387	83.6%	521	88.0%	462	82.8%
Total	223	100.0%	324	100.0%	358	100.0%	463	100.0%	592	100.0%	558	100.1%

Note "Other": Royalty not based on percentage but on unit price per piece.

Source: NISTEP

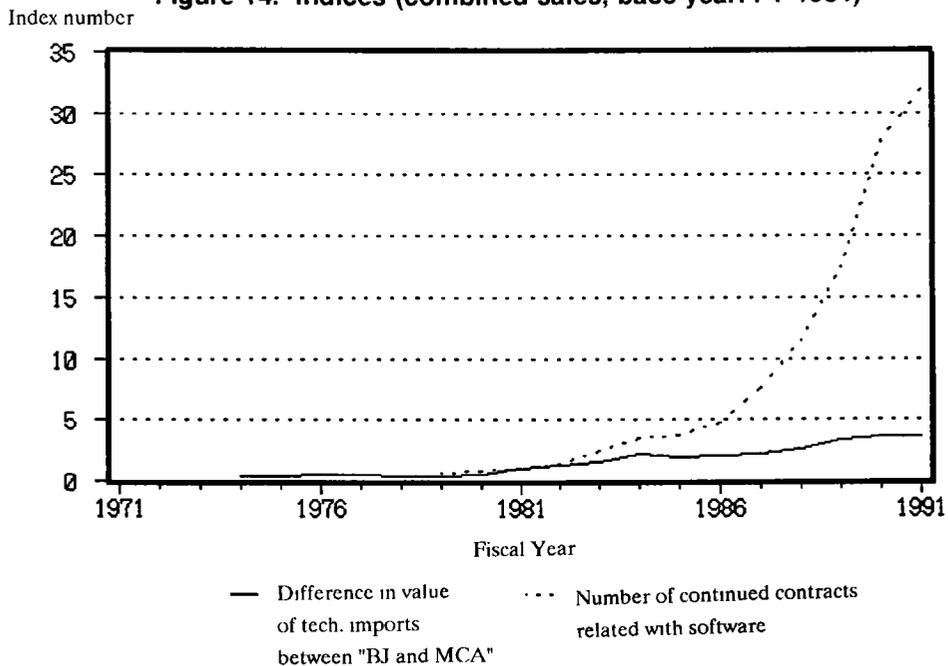
**Figure 13. Trends of Sales by Information Service Industry
(main business only)**



Next, to analyze the effect of the growth of this sales on the total value of the compensation related with software, Figure 14 has multiplied the growth of sales by 40% of the indices of the number of new contracts as shown in Figure 12 (as mentioned in (2)), these also comprise trends of the indices of the number of continued contracts for introducing technologies related with software) and added the remaining 60% as it is.

Figure 14 shows that the number of contracts for introducing technologies related with software grew very markedly.

Figure 14. Indices (combined sales, base year: FY 1981)



Judging from this, the trends of sales are believed to comprise a factor to explain the increase of the difference in the value of technology imports.

4.4.3 Summary

The following summarizes the effects on the difference in the value of technology imports of the three factors affecting the total value of the compensation related with software.

- (1) Conditions of payment of royalties: The effect is unclear.
- (2) Number of continued contracts: Virtually no effect.
- (3) Trends of sales: Considerable effect, explaining around 9 times of the growth rate of the difference in the value of technology imports
(FY1991, including growth of the number of contracts)

While this remains to be an inference, nearly 60% (983 out of 1,522) of the number of cases of new introduction of technologies related with software as per the "STA statistics" (in FY1991) are not covered by the "MCA statistics". Even if this 60% is subtracted from the growth rate of the compensation related with software, if by any chance a part of the compensation related with general analytical software was omitted in the "MCA statistics", such is believed to affect the difference in the value of technology imports. Also, the past growth rate of the number of cases of patents and know-how including many software not covered by the "MCA statistics" is inferred to be very high.

4.5 Quantitative analysis and balance of payments of technology trade

This section summarizes the effects of the quantitatively analyzed factors on the balance of payments of technology trade and the ratio of such balance.

4.5.1 The factors and the balance of payments of technology trade

Table 9 summarizes the estimated values of technology exports and imports attempted in analyzing the factors.

Table 9. Results of Estimation of Balance of Payments of Technology Trade for FY 1991

Unit: Billion yen

		Factor 2: Technology exports: plants	Factor 3 Technology exports trademarks	Estimated value of technology exports
BJ statistics	Value of technology exports:	397.4	23.3	420.7
	Value of technology imports:	864.7	108.3	756.4
		Technology imports: plants	Technology imports: trademarks	Estimated value of technology imports

		Factor 1: Technology exports not covered by the survey	Factor 4: Technology exports software	Estimated value of technology exports
MCA statistics	Value of technology exports.	370.6	370.6	370.6
	Value of technology imports:	394.7	214.4	609.1
		Technology imports not covered by the survey	Technology imports: software	Estimated value of technology imports

Notes:

1. The boxes surrounded by double lines are those believed to involve large values of technology trade in comparison to technology exports and imports related with the factors.
2. Factors 1 and 4 are connected with a broken line because parts of the value of technology exports and imports related with Factor 4 are believed to overlap with those related with Factor 1.

The estimation obtained the difference between the two statistics' values of technology trade to be around 50 billion yen (exports) and 150 billion yen (imports). Even if the estimation error is taken into account, the difference in the imports is too large. The following are believed to be the main factors to explain this difference.

•Compensation for software:

As discussed in Factor 4, the effect will be great if general analytical software, etc., were dropped from the "MCA statistics" for not being recognized as technology.

•Compensation for technology import by firms capitalized at under 5 million yen:

The "MCA statistics" excludes firms capitalized at under 5 million yen. It hence excludes the compensation for technology imports by these firms.

4.5.2 Factors affecting the ratio of balance of payments of technology trade

This section summarizes the results of estimation of the ratio of balance of payments attempted in analyzing the factors by capturing the factors affecting the "BJ and MCA statistics'" values of technology exports and imports as those also affecting the ratio of the balance of payments of technology trade.

Ratio of balance of payments in FY1991
(Value of technology exports / Value of technology imports)

"BJ statistics"

Factors to increase the ratio of balance of payments:

- Factor 2: Compensation for know-how and industrial technical guidance related with plant exports

*(the estimated ratio by taking only this factor into account:
0.487)*

- Factor 3: Compensation for transfer and setting up of rights for using trademarks

*(the estimated ratio by taking only this factor into account:
0.525)*

*(the estimated ratio of by combining this factor with Factor 2:
0.556)*

- Other Factor 1: Compensation for transfer and setting up of rights for using designs

Factors whose effect on the ratio of balance of payments is unclear:

- Other Factor 2: Compensation for technical guidance on factory and business management

"MCA statistics"

Factors to reduce the ratio of balance of payments:

- Factor 1: Exclusion of wholesaling, retailing and services
(the estimated ratio by taking only this factor into account:
0.608)
- Factor 4: Compensation related with software

4.5.3 Examination of the ratio of balance of payments of technology trade

This section first clarifies the concept of the statistics on technology trade (subjects covered and scope of such trade) as an indicator of the level of technology and R&D activities. Next, it evaluates the ratio of balance of payments of technology trade.

Concept of statistics on technology trade

Subjects covered

- All industries including wholesaling and retailing, eating and drinking, finance and insurance, real estate and services other than radio and television broadcasting

Scope of technology trade

- Transfer and setting up of rights for using patents and utility models
- Transfer and setting up of rights for using know-how (including software)
- Know-how and industrial technical guidance related with plant exports
Industrial technical guidance (quality control, operation, maintenance and management, etc.)

Excluded:

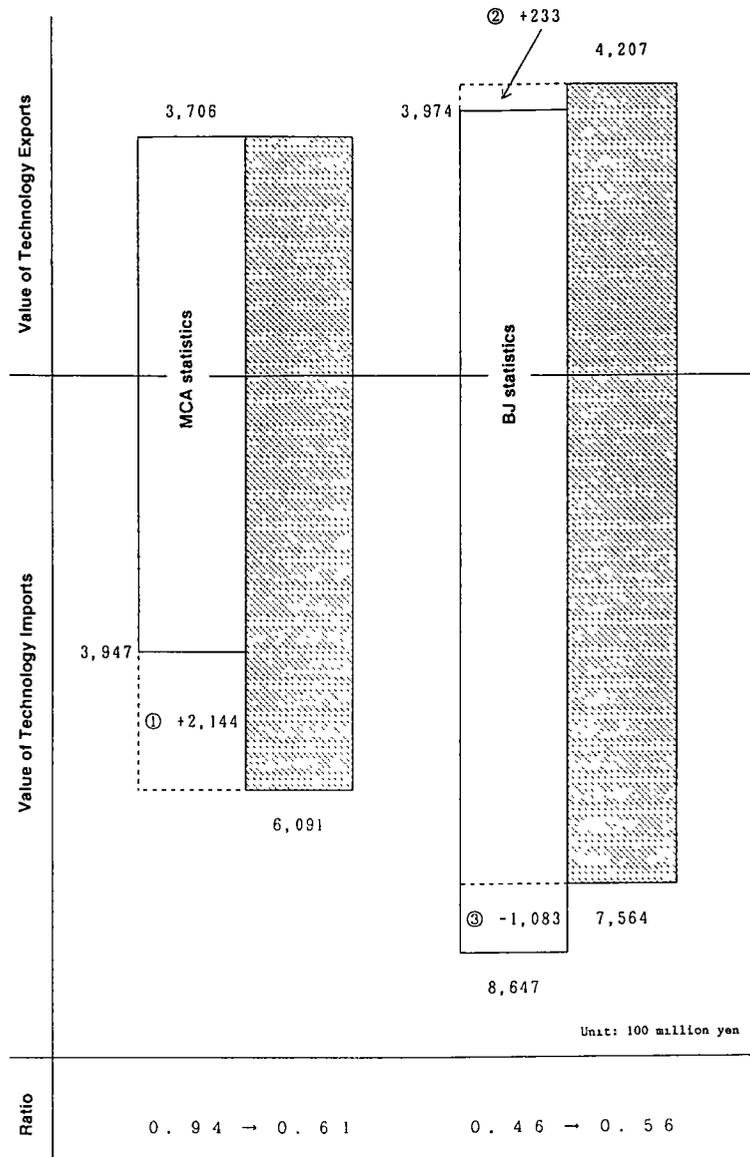
- Transfer and setting up of rights for using trademarks and designs
- Technical guidance on factory and business management

When the ratio of the balance of payments of technology trade is evaluated based on these assumptions, it should become something considerably higher than 0.46 based on the "BJ statistics" (when consideration is given to the base of estimation, something slightly over 0.556). Based on the "MCA statistics", it should be something much lower than 0.939 (when consideration is given to the base of estimation, something slightly lower than 0.608).

As can be seen in Table 9, this examination of the ratio of the balance of payments only covers factors whose value of either

technology exports or imports is believed to be markedly great. Yet at present it is difficult to estimate the effect of the factors which are not covered, and their relevant values of technology trade is believed to be small. Hence, while this will be a rather vague statement, in the final analysis, the ratio of the balance of payments of technology trade for FY1991 is believed to be somewhere around 0.6 (see Figure 15).

**Figure 15. Summary of Quantitative Analysis
(Values and Ratio of Technology Trade)**



- ① Factor 1: Exclusion of Wholesaling, Retailing and Services
- ② Factor 2: Compensation for Know-how and Industrial Technical Guidance related with Plant Exports
- ③ Factor 3: Compensation for Transfer and Setting up of Rights for Using Trademarks

5. Conclusion

This study has focused on Japan's technology trade statistics particularly those on the balance of payments (the "BJ and MCA statistics"). After outlining the four major statistics, and following a qualitative analysis pointing out the differences between them, it attempted quantitative analysis of the said differences.

As regards the qualitative analysis, the study has been able to clarify and substantiate the differences which had been identified earlier. As regards the quantitative analysis however, there were virtually no data directly indicating the compensation related with the various factors so that the study had to analyze the factors' effect on the value of technology trade using such things as the number and conditions of contracts for introducing technologies in the "NISTEP statistics".

As a result, the study was not able to obtain the actual ratio of balance of payments of technology trade and may have ended as something quite removed from the quantitative analysis it set out to do. However, it is believed to have been able to attempt an approach for evaluating the said ratio.

There is no doubt that in the future, a more specific evaluation of the said ratio will be produced by gathering data indicating the compensation related with the various factors. The only way to resolve the problems is believed to be to select one of the three methods: 1) for the Science and Technology Agency to prepare its own statistics, 2) expand the scope covered by the "MCA statistics" or 3) collect new data indicating the compensation related with the factors treated in this study. Although each of these methods is believed to involve many difficulties, it is desirable that these difficulties should be overcome quickly.

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Supplementary Remarks

This study was conducted by Researcher Takuzo Yoshimi under the guidance by Deputy Director-General Kiichiro Takagi. In conducting the research, the researcher obtained the cooperation of Director-General Fujio Sakauchi, the members of the Third Policy-Oriented Research Group and many other people within the Institute. Mention must also be made of the assistance and support from the following people.

Akiya Nagata,
Researcher, 1st Theory-Oriented Research Group, NISTEP
Masataka Ota,
Information System Division, NISTEP

Lastly, the researcher would like to thank the people of the related government offices, foundations and incorporated associations who cooperated in conducting this study and the people of the companies who cooperated with the questionnaire survey.

Attachment

- 1: Trends of Yen/Dollar Exchange Rate
- 2: Trends of Value of Technology Trade (BJ statistics)
- 3: Trends of Value of Technology Trade (MCA statistics)

ATTACHMENT 1: Trends of Yen/Dollar Exchange Rate

Fiscal Year	Average exchange rate
1971	332.78
1972	296.24
1973	273.30
1974	293.66
1975	299.55
1976	291.51
1977	255.02
1978	200.16
1979	231.69
1980	216.23
1981	228.92
1982	249.48
1983	236.32
1984	244.17
1985	221.08
1986	159.85
1987	138.31
1988	128.25
1989	142.85
1990	141.26
1991	133.18

Note: The monthly average of the final inter-bank middle rate.
Source: "Economic Statistics Monthly"
The Bank of Japan

**ATTACHMENT 2: Trends of Value of Technology Trade
(BJ statistics)**

Fiscal Year	Technology exports		Technology imports		Ratio
	FC received (\$ million)	Yen (100 million)	FC paid (\$ million)	Yen (100 million)	
1971	60	199.7	488	1,624.0	12.30%
1972	74	219.2	572	1,694.5	12.94%
1973	88	240.5	715	1,954.1	12.31%
1974	113	331.8	718	2,108.5	15.74%
1975	161	482.3	712	2,132.8	22.61%
1976	173	504.3	846	2,466.2	20.45%
1977	233	594.2	1,027	2,619.1	22.69%
1978	274	548.4	1,241	2,484.0	22.08%
1979	342	792.4	1,260	2,919.3	27.14%
1980	378	817.3	1,439	3,111.5	26.27%
1981	537	1,229.3	1,711	3,916.8	31.39%
1982	527	1,314.8	1,796	4,480.7	29.34%
1983	624	1,474.6	2,079	4,913.1	30.01%
1984	693	1,692.1	2,317	5,657.4	29.91%
1985	746	1,649.3	2,522	5,575.6	29.58%
1986	1,009	1,612.9	3,375	5,394.9	29.90%
1987	1,385	1,915.6	4,177	5,777.2	33.16%
1988	1,681	2,155.9	5,076	6,510.0	33.12%
1989	2,189	3,127.0	5,455	7,792.5	40.13%
1990	2,582	3,647.3	6,004	8,481.3	43.00%
1991	2,984	3,974.1	6,493	8,647.4	45.96%

Source: "Balance of Payments of Japan"
The Bank of Japan

**ATTACHMENT 3: Trends of Value of Technology Trade
(MCA statistics)**

Fiscal Year	Technology exports		Technology imports		Ratio
	Number of cases	Yen (100 million)	Number of cases	Yen (100 million)	
1971	2,556	271.9	4,446	1,345.4	20.21%
1972	2,836	421.7	5,983	1,739.2	24.25%
1973	2,033	508.5	5,513	2,277.9	22.32%
1974	2,208	571.0	5,830	1,598.3	35.73%
1975	2,811	665.9	6,766	1,691.3	39.37%
1976	2,767	834.0	6,050	1,773.0	47.04%
1977	2,881	933.3	6,659	1,900.7	49.10%
1978	3,157	1,220.5	6,573	1,920.6	63.55%
1979	3,667	1,331.5	7,012	2,409.8	55.25%
1980	4,103	1,596.1	7,248	2,395.3	66.63%
1981	4,877	1,751.1	7,207	2,596.3	67.45%
1982	4,738	1,849.2	6,936	2,826.1	65.43%
1983	6,403	2,408.9	7,839	2,792.8	86.25%
1984	5,426	2,775.1	7,316	2,814.5	98.60%
1985	5,885	2,342.2	7,679	2,931.7	79.89%
1986	5,469	2,240.8	7,494	2,605.8	85.99%
1987	5,955	2,155.8	7,373	2,832.5	76.11%
1988	6,352	2,462.6	8,356	3,122.0	78.88%
1989	7,559	3,293.5	7,109	3,299.3	99.82%
1990	7,163	3,393.5	8,249	3,719.1	91.25%
1991	8,063	3,705.5	7,409	3,946.6	93.89%

Source: "Report on the Survey of Research and Development"
Management and Coordination Agency

