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Digest of Japanese Science and Technology

Indicators 2023

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Center for S&T Foresight and Indicators
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Japanese Science and Technology Indicators 2023 (ABSTRACT)

"Science and Technology Indicators" is a fundamental resource for understanding Japanese science and technology activities based on objective and quantitative data. It classifies science and technology activities into five categories such as R&D Expenditure; R&D Personnel; Higher Education and S&T personnel; Output of R&D; and Science, Technology, and Innovation, and shows the state of Japanese science and technology activities with approximately 170 indicators. The report is published annually and offers the latest results of the analyses of scientific publications and patent applications conducted by the NISTEP.

This edition of "Science and Technology Indicators 2023" includes new indicators such as "Comparison of female researchers by industry classification in Japan and Germany," "Patent family analysis using 35 technology classifications," "Trade volume and import partner countries/regions in Japan," "Employed doctoral scientists and engineers by primary work activity in the U.S.," and "Progress and disparities in digitalization."

Overviewing the latest Japan's situation from "Science and Technology Indicators 2023," the R&D expenditure and the number of researchers in Japan are the third-largest in major countries (Japan, U.S., Germany, France, U.K., China, and Korea). The rank of Japan in the number of scientific publications (fractional counting method) is the 5th in the world. The rank of Japan in the number of top 10% and top 1% highly cited publications is 13th and 12th. Japan is the world's first place in the patent family (patent applications to more than two countries). Japan also maintains the number one position among major countries in terms of the trade balance ratio in medium-high R&D intensive industries. The number of joint research projects and the amount of research funds received by Japanese universities with private firms have been increasing over time. The ratio of indirect costs to direct costs is also growing.

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1. Japan's trends in key indicators

Trends in key indicators for Japan are as follows. Japan's ranking is generally the same as in the previous edition of the report, except for drops in the rankings for the number of researchers for "universities and colleges" and "public organizations" and the number of highly cited scientific papers. Although Japan ranks third or fourth behind the U.S., China, the UK, and Germany in many of the indicators listed, Japan's growth in many of them are smaller than other selected countries. The data of R&D expenditures and R&D human resources have been revised for the U.K. and are being updated for China. Therefore, R&D expenditures of "business enterprises" and "universities and colleges" have increased for the U.K., while recent data have been withheld from publication by the OECD and not reflected to this report for China. In addition, the number of researchers at "universities and colleges" and "public organizations" in the U.S. was published by the OECD after nearly 20 years of unavailability, which caused the change in the ranking of the number of researchers in Japan.

[Summary Chart 1] Japan's trends in key indicators

Indicators	Changes in Japan's ranking	Japan's figures	Note
R&D expenditure	No. 3→No. 3	18.1T yen	No. 1: U.S., No. 2: China
Business enterprises	No. 3→No. 3	14.2T yen	No. 1: U.S., No. 2: China
Universities and colleges	No. 4→No. 4	2.1T yen	No. 1: U.S., No. 2: China, No. 3: Germany
Public organizations	No. 4→No. 4	1.5T yen	No. 1: China, No. 2: U.S., No. 3: Germany
Number of Researchers	No. 3→No. 3	705K	No. 1: China, No. 2: U.S.
Business enterprises	No. 3→No. 3	529K	No. 1: China, No. 2: U.S.
Universities and colleges	No. 3→No. 4	137K	No. 1: China, No. 2: U.S, No. 3: U.K.
Public organizations	No. 3→No. 4	30K	No. 1: China, No. 2: Germany, No. 3: U.S
Number of scientific papers (fractional counting)	No. 5→No. 5	71K	No. 1: China, No. 2: U.S., No. 3: India, No. 4: Germany
Number of adjusted top 10% scientific papers (fractional counting)	No. 12→No. 13	3.8K	No. 1: China, No. 2: U.S., No. 3: U.K., No. 4: Germany, No. 5: Italy, No. 6: India, No. 7: Australia, No. 8: Canada, No. 9: France, No. 10: Korea, No. 11: Spain, No 12: Iran
Number of adjusted top 1% scientific papers (fractional counting)	No. 10→No. 12	0.32K	No. 1: China, No. 2: U.S., No. 3: U.K., No. 4: Germany, No. 5: Australia, No. 6: Italy, No. 7: Canada, No. 8: India, No. 9: France, No. 10: Spain, No. 11: Korea
Number of patent families	No. 1→No. 1	66K	
The trade balance ratios for high R&D intensive industries	No. 6→No. 6	0.7	No. 1: Korea, No. 2: China, No. 3: Germany, No. 4: France, No. 5: U.K.
The trade balance ratios for medium-high R&D intensive industries	No. 1→No. 1	2.6	
Number of cross-border trademark applications (Number of classes)	No.5→No.6	121K	No. 1: China, No. 2: U.S., No. 3: Germany, No. 4: U.K., No. 5: France

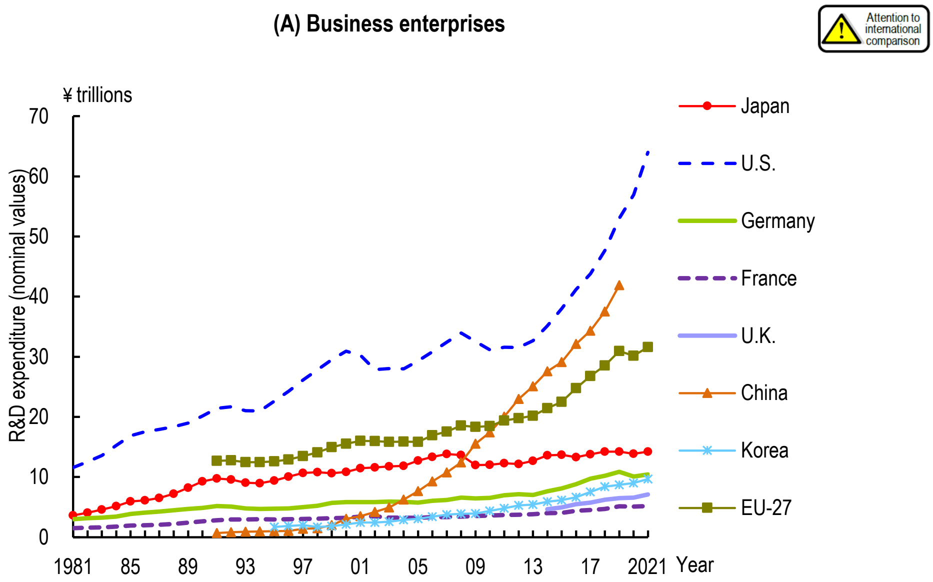
Note:
*: R&D expenditure is the cost of performing research and development work at a given institution, and is different from the science and technology budget.
1) The "Changes in Japan's rankings" compares the latest year and the previous year. The "Japan's figures" is for the latest year.
2) Except for the number of papers and adjusted top 10% papers and the number of patent families, the rankings are within the following selected countries: Japan, the U.S., Germany, France, the U.K., China, and Korea.

(1) The growth of R&D expenditure in Japan's "business enterprises" and "universities and colleges" sectors is smaller compared to the other selected countries.

The U.S. has the largest R&D expenditures in the sectors of "business enterprises" and "universities and colleges" among the selected countries. Both sectors have seen strong growth since the 2010s. China is also increasing its R&D expenditures. Japan ranks third among the selected countries in the "business enterprises" sector, but its growth has been moderate over the same period. In the sector of "universities and colleges", Japan's R&D expenditure has remained almost flat since the 2000s, surpassed by China and Germany, which have grown rapidly since the 2010s.

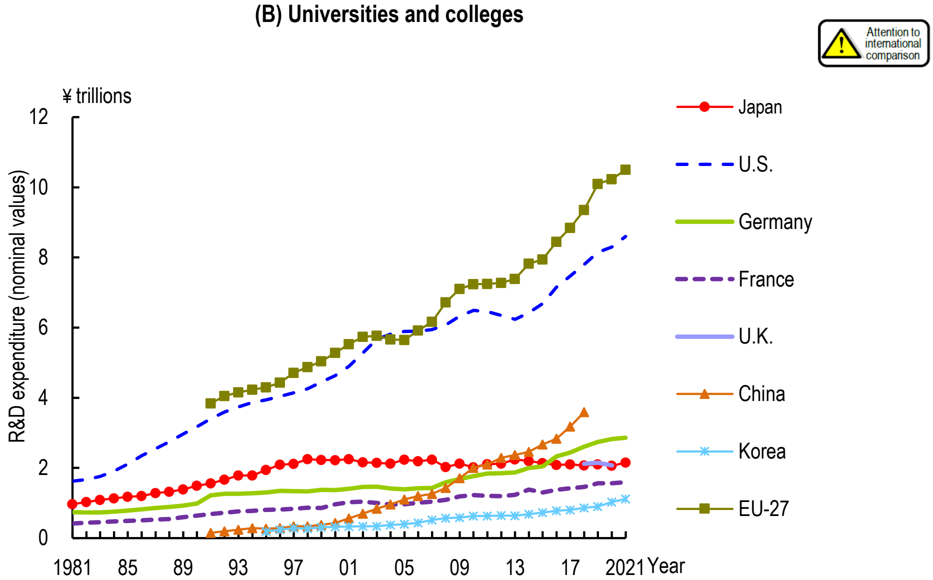
[Summary Chart 2] Nominal values of R&D expenditure by "business enterprises" and "universities and colleges" (based on OECD purchase power parities data)

(A) Business enterprises



Reference: Chart 1-3-3(A), Japanese Science and Technology Indicators 2023 (in Japanese)

(B) Universities and colleges

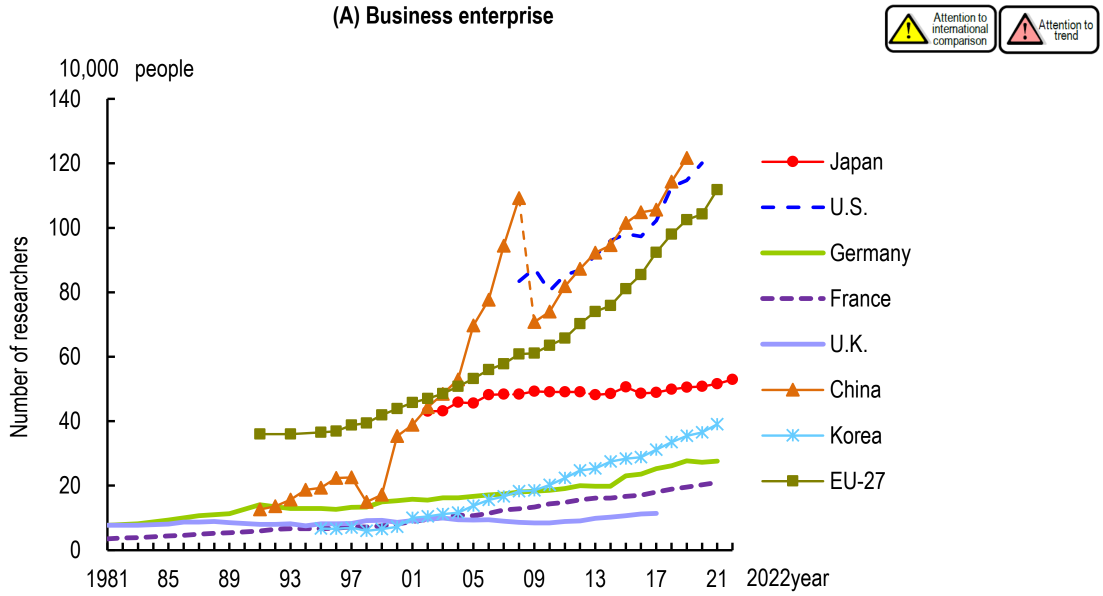


Reference: Chart 1-3-13(A), Japanese Science and Technology Indicators 2023 (in Japanese)

China has the largest number of researchers in the “business enterprises” and “universities and colleges” sectors among the selected countries. In the “business enterprises” sector, the U.S. and China are closely matched, with both countries showing rapid growth. The number of researchers in the “business enterprises” sector in Japan remained almost flat from the late 2000s, but has increased slightly since 2017. The number of Korean researchers in the “business enterprises” sector has also been increasing over a long time. In the “universities and colleges” sector, Germany has seen an increase since the mid-2000s. Japan's growth has been moderate and has recently leveled off.

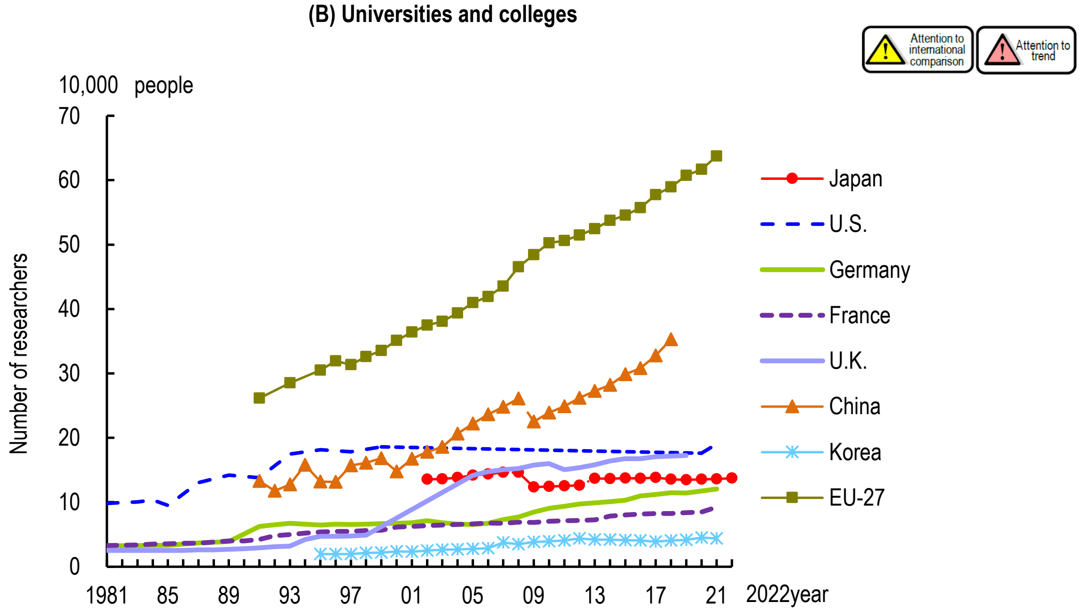
[Summary Chart 3] Trends in the number of researchers in “business enterprise” and “universities and colleges”

(A) Business enterprise



Reference: Chart 2-2-4, Japanese Science and Technology Indicators 2023 (in Japanese)

(B) Universities and colleges

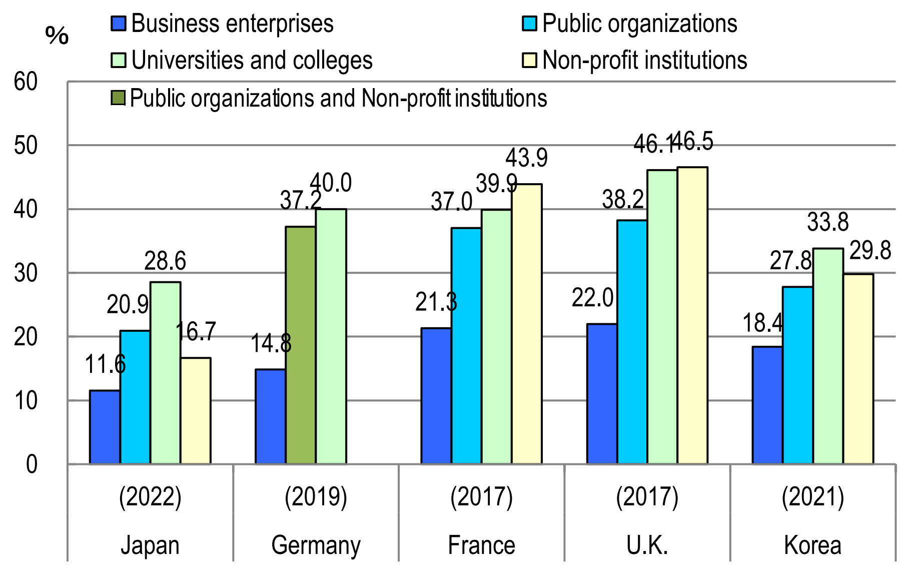


Reference: Chart 2-2-11, Japanese Science and Technology Indicators 2023 (in Japanese)

(2) Although the percentage of female researchers in Japan is lower than that in other selected countries, the percentage of women among newly hired researchers has been increasing.

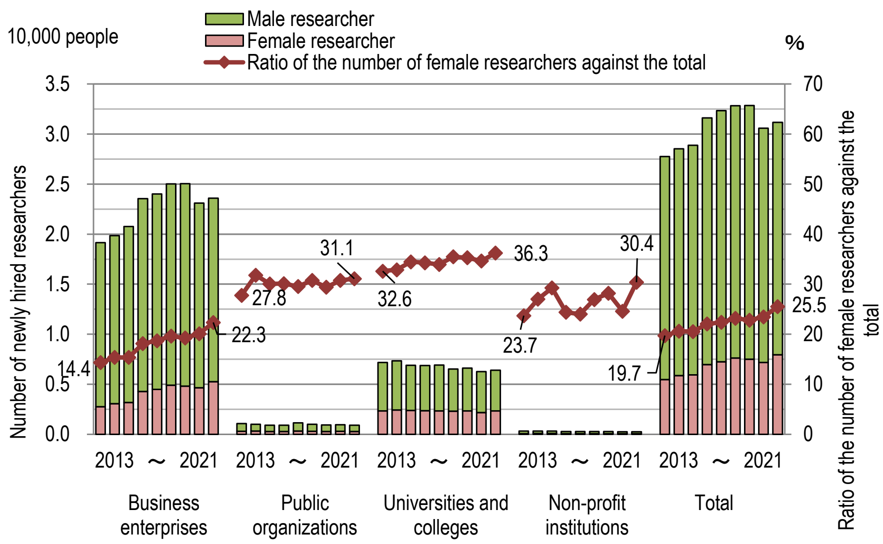
The percentage of women among all researchers is the lowest in “business enterprises” in all the selected countries. The percentage of female researchers in Japan is the lowest in each sector compared to the other countries. In Japan, the percentage of newly hired female researchers tends to be higher than the percentage of women among all researchers regardless of the sector.

[Summary Chart 4] Shares of female researchers of the selected countries by sector



Reference: Chart 2-1-11, Japanese Science and Technology Indicators 2023 (in Japanese)

[Summary Chart 5] Newly hired researchers by gender in Japan

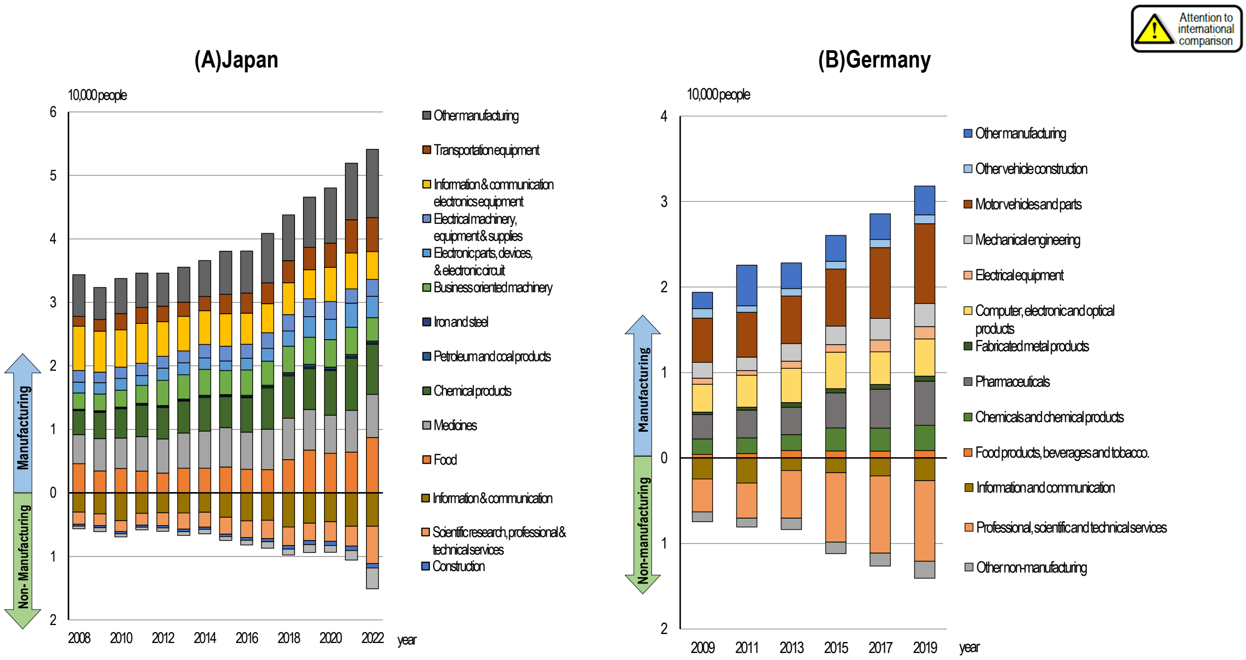


Reference: Chart 2-1-17(A), Japanese Science and Technology Indicators 2023 (in Japanese)

(3) Regarding the number of female researchers in business enterprises in the latest year, Japan and Germany have the highest number in the “food” and “professional, scientific and technical services” sectors, respectively.

In terms of the number of female researchers in business enterprises, in Japan in 2022 there were 54,000 in the manufacturing industries and 15,000 in the non-manufacturing industries, both continuously increasing; a breakdown for 2022 shows that in the manufacturing industries the largest number of female researchers was in the “food manufacturing industry,” followed by “chemical products.” In Germany, the number of female researchers was 32,000 in the manufacturing industries and 14,000 in the non-manufacturing industries in 2019, both of which continued to increase; the 2019 breakdown shows the largest number was found in the “motor vehicles and parts” sector for the manufacturing industries and in the “professional, scientific and technical services” sector for the non-manufacturing industries.

[Summary Chart 6] Comparison of female researchers by industry classification in Japan and Germany



Note:
The charts show actual head counts of researchers. The Japan chart shows the number of researchers as of March 31 of the given year.
Reference: Chart 2-2-10, Japanese Science and Technology Indicators 2023 (in Japanese)

2. Students and graduate students: situations in Japan and selected countries

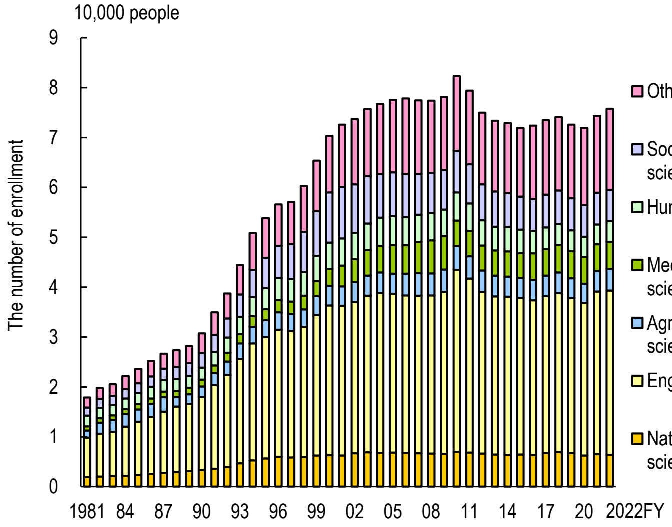
(1) Enrollment in Japanese graduate school doctoral programs peaked in FY2003 and has been on a long-term declining trend.

The enrollment in Japanese graduate school master's programs peaked in FY2010 and began to decline, with a temporary increase. Then the number started to rise again after FY2020. In FY2022, there was a 1.9% increase compared to the previous fiscal year, with a total of 76,000 students. Additionally, the number of recurrent students enrolled in master's programs, which had been around 10% of the total, started to slightly decrease from FY2019 onwards.

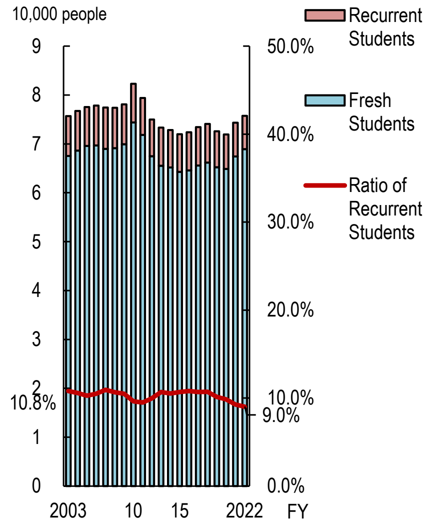
The enrollment in graduate school doctoral programs has been on a long-term downtrend since its peak in FY2003, totaling 14,000 in FY2022. Among them, the number of recurrent students enrolled in doctoral programs increased for a long time, but has been decreasing since FY2018. This number accounted for 41.7% of the total in FY2022. Looking at the composition by major, there has been a long-term increase in the number of students enrolled in “Others” in both the master's and doctoral programs.

[Summary Chart 7] The number of new enrollments in graduate schools (master's programs)

(A) Changes in the number of new enrollments in graduate schools by major subject (master's programs)



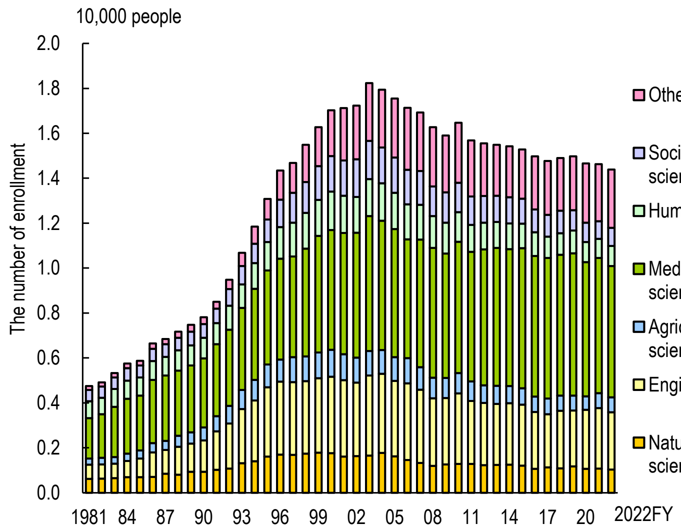
(B) Changes in the number of recurrent students newly enrolled in graduate schools (master's programs)



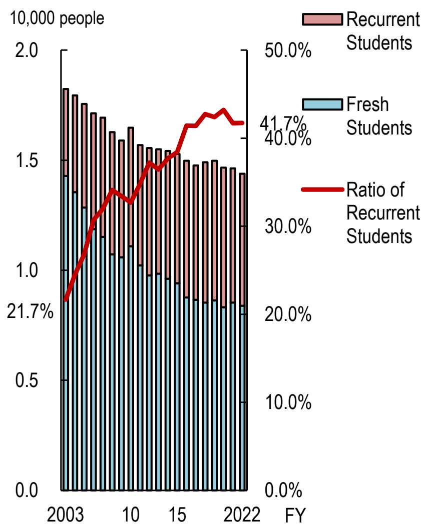
Reference: Chart 3-2-2, Japanese Science and Technology Indicators 2023 (in Japanese)

[Summary Chart 8] The number of new enrollments in graduate schools (doctoral programs)

(A) Changes in the number of new enrollments in graduate schools by major subject (doctoral programs)



(B) Changes in the number of recurrent students newly enrolled in graduate schools (doctoral programs)



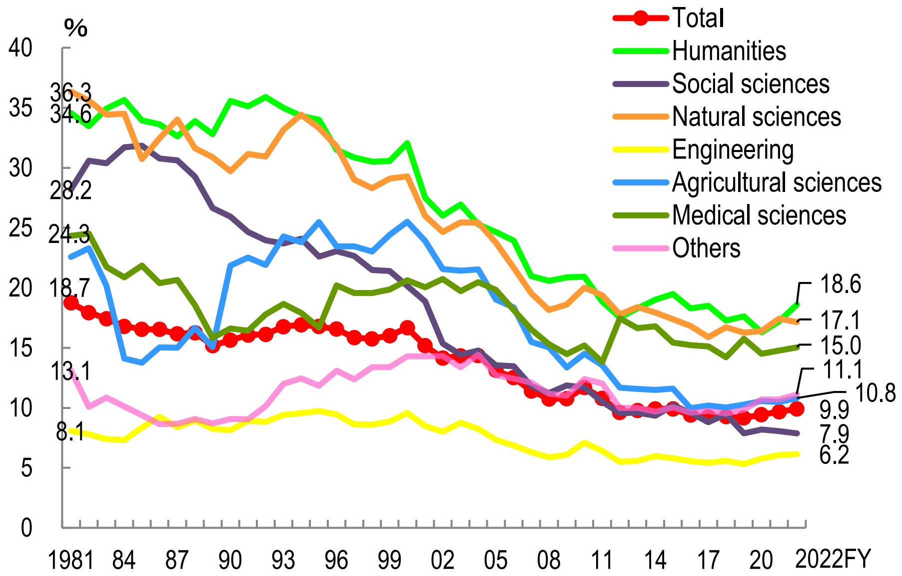
Reference: Chart 3-2-3, Japanese Science and Technology Indicators 2023 (in Japanese)

Note.
"Others" in chart (A) are "Education," "Arts," "Merchant Marine," and "Domestic Science," as well as "Others," which indicates "Others" in the "Departmental Classification Table" of the "Report on School Basic Survey" Actual major study fields' names included in this category often use words such as "Environment," "Human," "Information," "International," and so on.

(2) The further education rate for graduates of master's programs continued to decline, but has turned to slightly increase after FY2019, and is 9.9% in FY2022.

Looking at the further education rate of those who completed master's programs (all fields), the rate was 18.7% in FY1981, and although it was on a long-term downward trend thereafter, it has been slightly increasing since FY2019, and is 9.9% in FY2022. By field, many fields show long-term declines, but in the late 2010s, some fields began to level off or even slightly increase. The field that has been on a continuous downward trend is “social sciences.”

[Summary Chart 9] Further education rate of master's program graduates

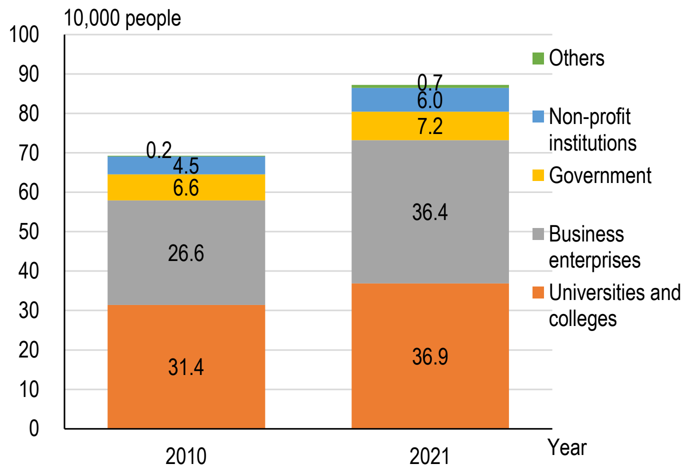


Note:
Further education rate of master's program graduates refers to the proportion of individuals who have completed a master's program as of March each year and have gone on to pursue advanced studies at graduate schools or equivalent institutions. This calculation excludes those who entered vocational schools, foreign schools, etc.
Reference: Chart 3-2-4, Japanese Science and Technology Indicators 2023 (in Japanese)

(3) The number of PhD holders in U.S. business enterprises has increased 1.4 times in the past decade. Many are engaged primarily in "any R&D," while some are engaged in "management, sales, or administration" or "professional services" as well.

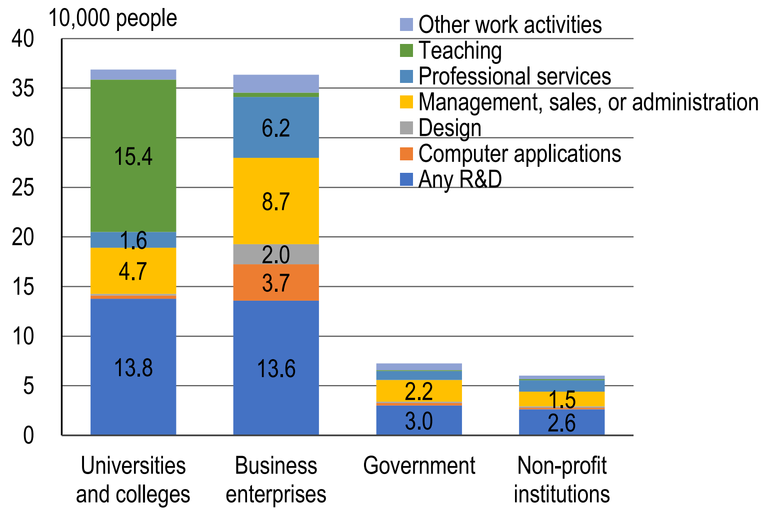
In the U.S., the number of PhD holders who are affiliated with "universities and colleges" and "business enterprises" are nearly the same. The number of PhD holders in business enterprises has increased by 1.4 times over the past 10 years. In business enterprises, government, and non-profit institutions, the number of PhD holders is the largest in those who are engaged in "any R&D" as their primary work activity. In universities and colleges, it is "teaching", followed by "any R&D." In business enterprises, PhD holders whose primary work activity is "management, sales, or administration" or "professional services" are also common.

[Summary Chart 10] Number of PhD holders in the U.S. by employment sector: 2010 and 2021



Reference: Chart 3-6-1, Japanese Science and Technology Indicators 2023 (in Japanese)

[Summary Chart 11] Number of PhD holders in the U.S. by employment sector and by primary work activity: 2021



Reference: Chart 3-6-3, Japanese Science and Technology Indicators 2023 (in Japanese)

Notes:
1) PhD holders here refers to those who obtained a Science, Engineering, and Health (SEH) research doctorate from a U.S. academic institution, reside in the U.S., and are employed.
2) "Primary work activity" refers to the job that accounts for the largest portion of an individual's working hours during a typical week, constituting at least 10% of their total work time.
3) "Any R&D" encompasses basic research (focused on acquiring scientific knowledge for its intrinsic value), applied research (geared towards obtaining scientific knowledge to address identified needs), and development (the application of knowledge obtained from research to manufacture materials and devices, and so on). "Computer applications" is computer programming, system or application development. "Professional services" are, for example, healthcare, counseling, financial services, and legal services.

3. R&D outputs and status of science, technology and innovation in the selected countries

(1) In terms of the number of papers (fractional counting method), Japan ranks 5th in the world. When focusing on highly cited papers, Japan ranks 13th and 12th in the number of adjusted top 10% and top 1% papers. China ranks first in the world in all categories of paper production.

Japan is ranked 5th after China, the U.S., India, and Germany in terms of the number of papers (the average of 2019-2021) counted by the fractional counting method that measures the degree of contribution to paper production. Focusing on highly cited papers, Japan ranks 13th in the number of adjusted top 10% papers, slightly lower the 12th (by 3 papers). For adjusted top 1% papers, Japan ranks 12th. China holds the world top position in the number of papers, as well as in the adjusted top 10% and top 1% paper counts.

[Summary Chart 12] Top countries/regions in the number of papers and in the numbers of adjusted top 10% and 1% papers in citation counts (in natural sciences, based on the fractional counting method)

All fields	2019 — 2021 (PY) (Average)		
	The number of papers		
Country/Region	Fractional counting		
	Papers	Share	World rank
China	464,077	24.6	1
U.S.	302,466	16.1	2
India	75,825	4.0	3
Germany	73,371	3.9	4
Japan	70,775	3.8	5
U.K.	67,905	3.6	6
Italy	57,579	3.1	7
Korea	57,070	3.0	8
France	46,588	2.5	9
Canada	45,350	2.4	10
Brazil	44,983	2.4	11
Spain	44,625	2.4	12
Australia	41,886	2.2	13
Iran	37,777	2.0	14
Russia	33,026	1.8	15
Türkiye	30,117	1.6	16
Poland	26,720	1.4	17
Netherlands	22,848	1.2	18
Taiwan	21,937	1.2	19
Switzerland	16,458	0.9	20
Sweden	15,301	0.8	21
Mexico	13,676	0.7	22
Saudi Arabia	12,648	0.7	23
Egypt	12,310	0.7	24
Pakistan	11,887	0.6	25

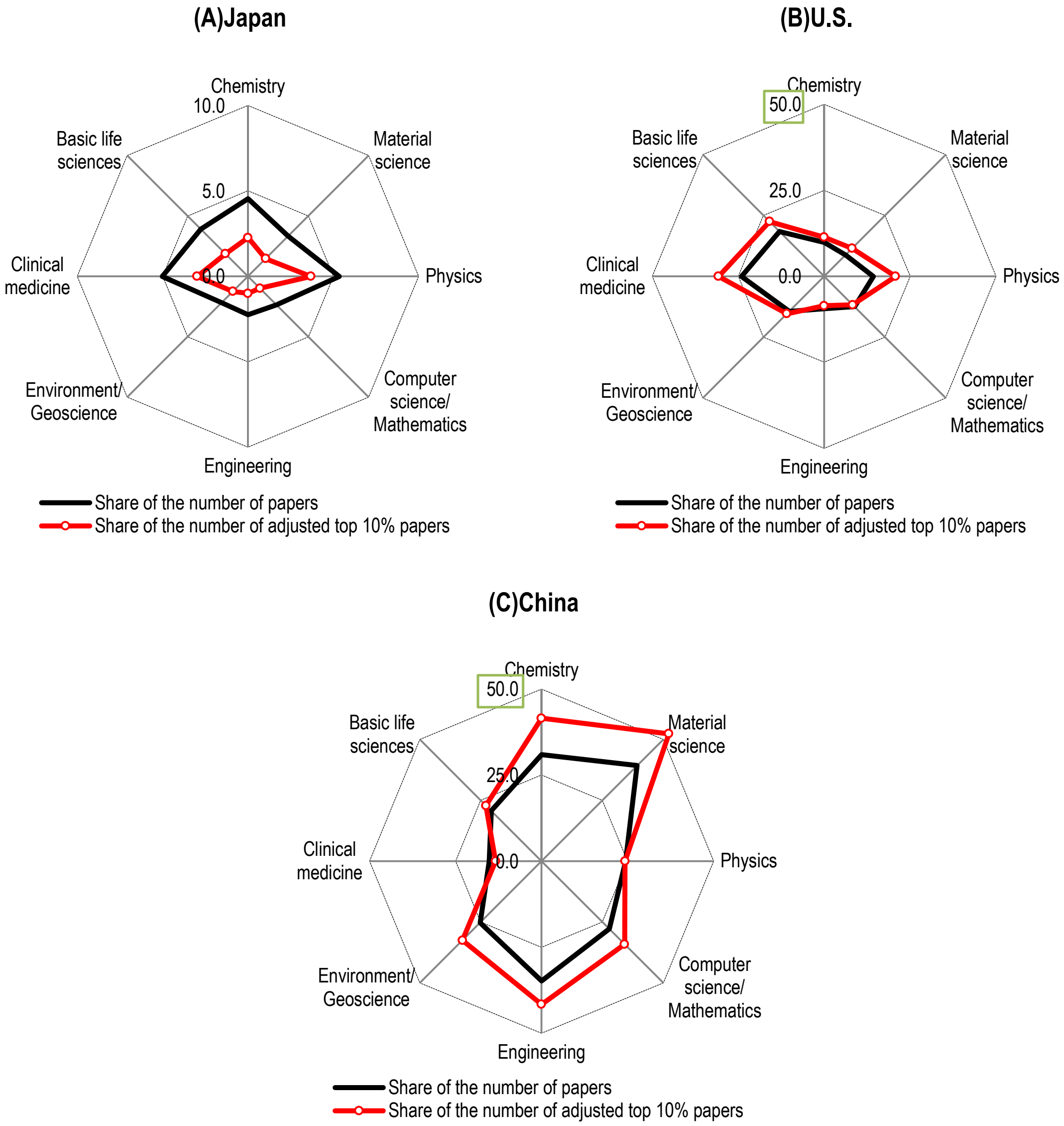
All fields	2019 — 2021 (PY) (Average)		
	The number of adjusted top 10% papers		
Country/Region	Fractional counting		
	Papers	Share	World rank
China	54,405	28.9	1
U.S.	36,208	19.2	2
U.K.	8,878	4.7	3
Germany	7,234	3.8	4
Italy	6,723	3.6	5
India	6,031	3.2	6
Australia	5,186	2.8	7
Canada	4,632	2.5	8
France	4,210	2.2	9
Korea	4,100	2.2	10
Spain	3,987	2.1	11
Iran	3,770	2.0	12
Japan	3,767	2.0	13
Netherlands	2,866	1.5	14
Brazil	2,177	1.2	15
Switzerland	2,125	1.1	16
Türkiye	1,726	0.9	17
Saudi Arabia	1,672	0.9	18
Sweden	1,560	0.8	19
Singapore	1,495	0.8	20
Egypt	1,454	0.8	21
Pakistan	1,425	0.8	22
Taiwan	1,413	0.7	23
Poland	1,360	0.7	24
Belgium	1,351	0.7	25

All fields	2019 — 2021 (PY) (Average)		
	The number of adjusted top 1% papers		
Country/Region	Fractional counting		
	Papers	Share	World rank
China	5,516	29.3	1
U.S.	4,265	22.6	2
U.K.	1,033	5.5	3
Germany	715	3.8	4
Australia	564	3.0	5
Italy	540	2.9	6
Canada	481	2.6	7
India	464	2.5	8
France	399	2.1	9
Spain	341	1.8	10
Korea	331	1.8	11
Japan	319	1.7	12
Netherlands	296	1.6	13
Iran	277	1.5	14
Switzerland	229	1.2	15
Singapore	211	1.1	16
Saudi Arabia	157	0.8	17
Türkiye	152	0.8	18
Brazil	148	0.8	19
Sweden	147	0.8	20
Pakistan	133	0.7	21
Belgium	131	0.7	22
Denmark	120	0.6	23
Taiwan	115	0.6	24
Egypt	104	0.6	25

Note:
The number of Articles and reviews was counted. Publication year (PY) was used for the year tally. The number of citations is the value at the end of 2022.
Reference: Chart 4-1-6(B), Japanese Science and Technology Indicators 2023 (in Japanese)

Comparing the shares of the number of adjusted top 10% papers by field, the shares of "Physics," "Clinical medicine," and "Chemistry" are higher in Japan than those of other fields. In the U.S., the shares of "Clinical medicine," "Basic life sciences," and "Physics" are high. In China, the shares of "Material science" and "Chemistry" are high.

[Summary Chart 13] A comparison of the share of papers and adjusted top 10% papers in Japan, the U.S. and China by field (%, 2019–2021, fractional counting method)



Note:
The number of Articles and reviews was counted. Publication year (PY) was used for the year tally. The number of citations is the value at the end of 2022.
Reference: Chart 4-1-10, Japanese Science and Technology Indicators 2023 (in Japanese)

(2) Japan has maintained the 1st position in the world in the number of patent families (patents filed in two or more countries/regions). Among 35 technology classifications, Japan has high shares in sectors such as "textile and paper machines" and "optics." For highly cited patent families, the U.S. maintains the world's leading position in most of technology classifications, followed by Japan.

This section examines the status of patent applications by analyzing the number of patent families, which is the number of inventions created in each countries/region measured in an internationally comparable manner.

Between 1996 and 1998, the United States was ranked the first and Japan the second. Between 2006 and 2008 and between 2016 and 2018, Japan was ranked the first and the United States the second.

Note that Japan's global share has been declining since the mid-2000s. And that China is in the fourth place in 2016-2018, steadily increasing the number of patent families.

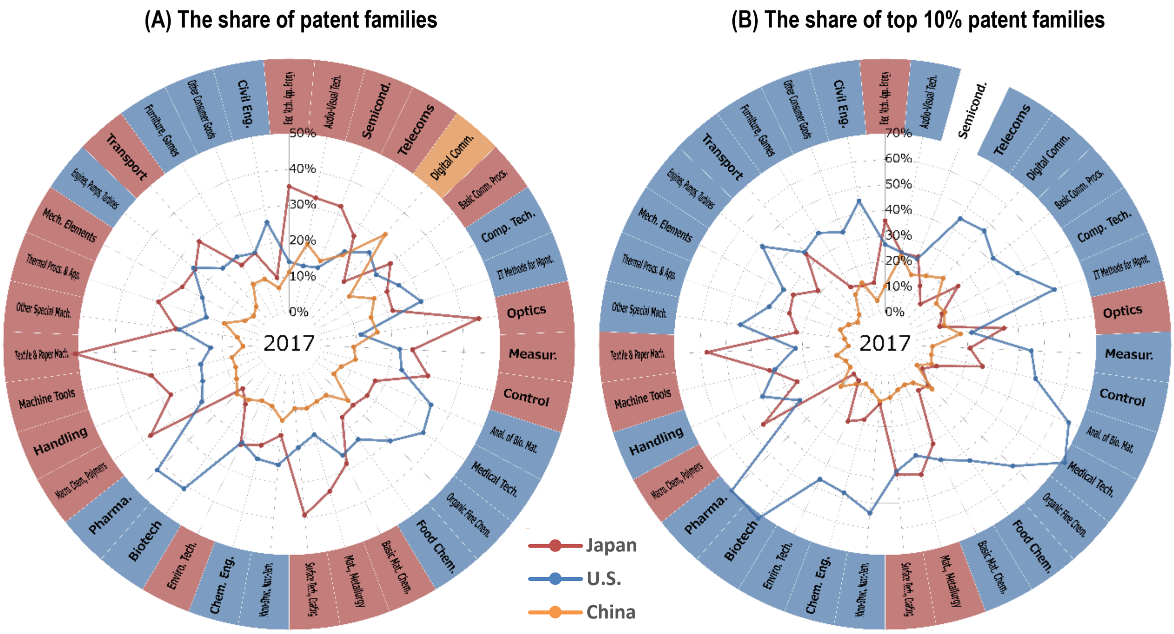
Regarding patent families across 35 technology classifications, Japan has high shares in sectors like "textile and paper machines," "optics," and "surface technology, coating." Regarding highly cited patent families, the U.S. leads in terms of share in most of technology classifications, followed by Japan.

[Summary Chart 14] The number of patent families by selected countries/region: top 10 countries/regions

1996 - 1998(Average)				2006 - 2008(Average)				2016 - 2018(Average)			
Country/Region	Number of patent families (Whole counting)			Country/Region	Number of patent families (Whole counting)			Country/Region	Number of patent families (Whole counting)		
	Patent Families	Share	World rank		Patent Families	Share	World rank		Patent Families	Share	World rank
U.S.	32,777	27.9	1	Japan	60,902	29.8	1	Japan	65,870	26.0	1
Japan	31,954	27.2	2	U.S.	46,456	22.7	2	U.S.	55,730	22.0	2
Germany	20,427	17.4	3	Germany	28,150	13.8	3	China	30,942	12.2	3
France	7,378	6.3	4	Korea	18,152	8.9	4	Germany	28,196	11.1	4
U.K.	6,319	5.4	5	France	10,582	5.2	5	Korea	22,005	8.7	5
Korea	4,937	4.2	6	Taiwan	9,523	4.7	6	France	11,094	4.4	6
Italy	3,342	2.8	7	China	9,219	4.5	7	Taiwan	10,597	4.2	7
Netherlands	2,776	2.4	8	U.K.	8,425	4.1	8	U.K.	8,561	3.4	8
Switzerland	2,666	2.3	9	Canada	5,300	2.6	9	Italy	5,628	2.2	9
Canada	2,602	2.2	10	Italy	5,206	2.5	10	Canada	5,187	2.0	10

Note:
Reference: Chart 4-2-5(B), Japanese Science and Technology Indicators 2023 (in Japanese)

[Summary Chart 15] Patent family analysis using 35 technology classifications：2017 (2016-2018 年平均)



Note:

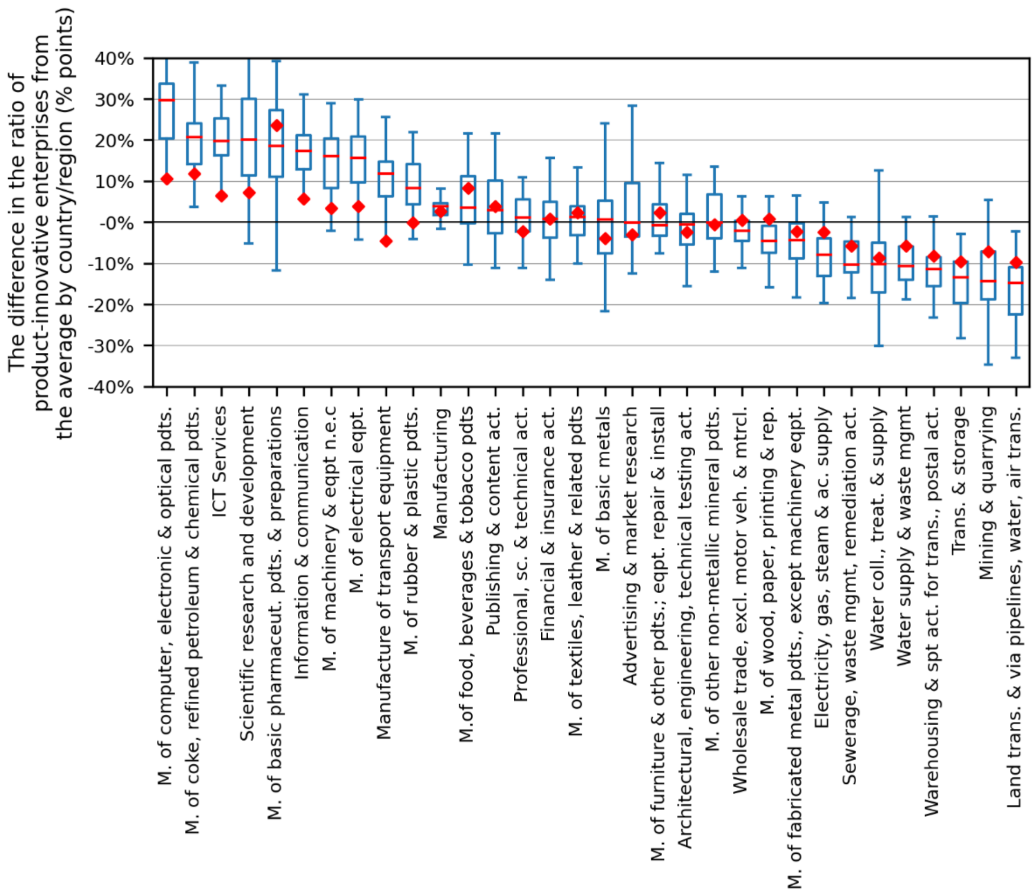
"Top 10% patent families" refers to high-profile patent families receiving top 10% number of citations from other patent families.

Reference: Chart 4-2-14, Japanese Science and Technology Indicators 2023 (in Japanese)

(3) The ratio of product-innovative enterprises varies by industry classification. Japan exhibits smaller differences by industry classification compared to other countries.

The ratio of product-innovative enterprises by industry classification (deviation from the national average) is high in certain industries like "manufacturing of computer, electronic, and optical products" and "manufacturing of coke, refined petroleum, and chemical products" exceeding the national average by 20-30 percentage points in the 40 countries mostly from OECD member countries. In these industries, the introduction of new products and services is relatively high. For Japan, differences by industry classification tends to be smaller than in other countries.

[Summary Chart 16] Ratio of product-innovative enterprises by industry classification

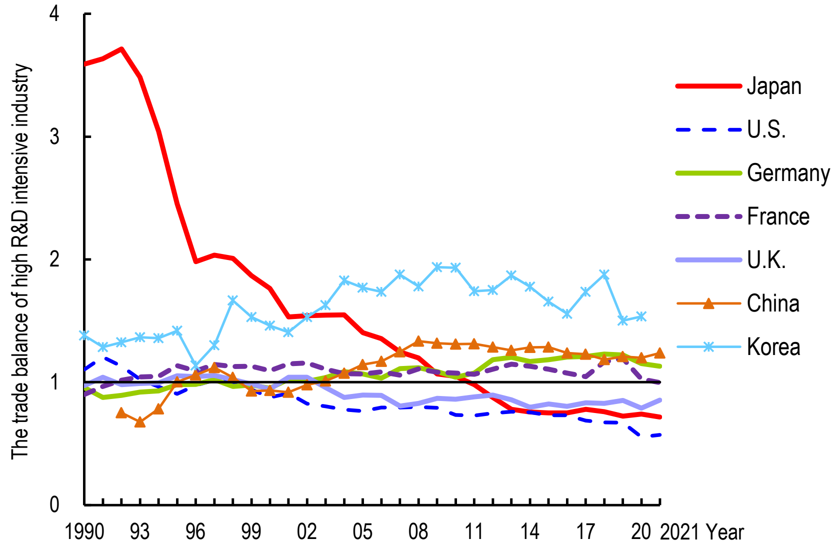


Note:
The boxplot illustrates the distribution of the ratio of product-innovative enterprises by industry classification (deviation from the national average) for a group of 40 countries mostly from OECD member countries. The bottom and top of the box indicate the first and third quartiles, the red line indicates the median, the top and bottom of the whiskers indicate the maximum and minimum values (excluding outliers), and the red marker indicates the value for Japan.
Reference: Chart 5-4-7, Japanese Science and Technology Indicators 2023 (in Japanese)

(4) Japan's trade balance ratio for high R&D intensive industries is low among the selected countries. However, in medium high R&D intensive industries, Japan maintains highest position among the selected countries.

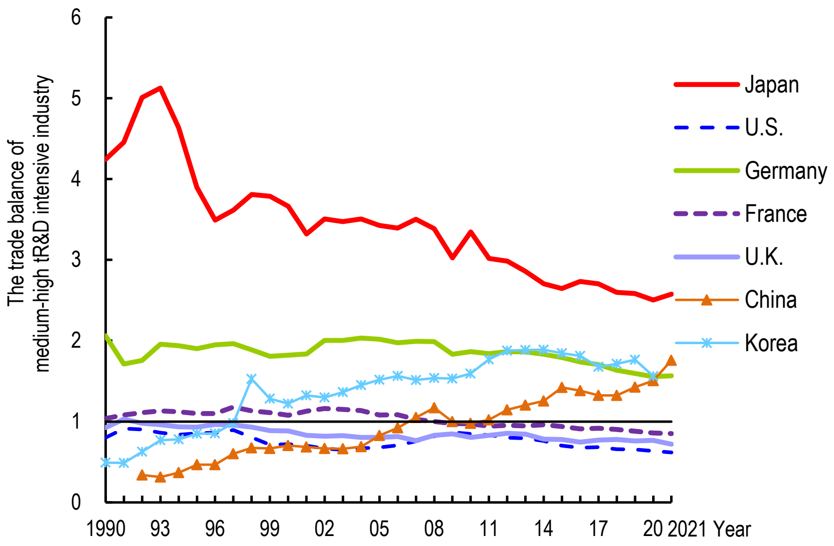
Japan's trade balance ratio for high R&D intensive industries is 0.72 (indicating a trade deficit) in the latest year. For the trade balance ratio for medium-high R&D intensive industries, Japan posts 2.58 (indicating a trade surplus) in the latest year, ranking first among the selected countries. The figure for China continues to increase, reaching 1.76 in the latest year, second only to Japan.

[Summary Chart 17] Changes in the trade balance ratios for High R&D intensive industries in the selected countries



Note:
1) High-technology industries refer to “pharmaceutical,” “computer, electronic and optical, ” and “aerospace.”
2) Trade balance ratio = export value / import value
Reference: Chart 5-2-4, Japanese Science and Technology Indicators 2023 (in Japanese)

[Summary Chart 18] Changes in the trade balance ratios for Medium-high R&D intensive industries in the selected countries

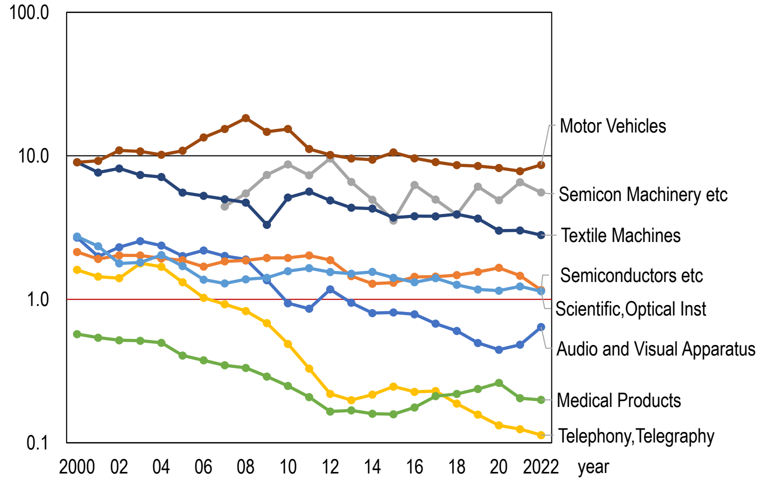


Note:
1) Medium high-technology industries refer to “chemicals and chemical products,” “electrical equipment,” "machinery and equipment n.e.c.,” “motor vehicles, trailers and semi-trailers,” “railroad equipment and transport equipment n.e.c.,” and “other.”
2) Trade balance ratio = export value / import value
Reference: Chart 5-2-6, Japanese Science and Technology Indicators 2023 (in Japanese)

(5) In Japan's trade, the industry of “motor vehicles” is notably strong in its export performance compared to other principal commodities.

Japan’s trade in principal commodities like “motor vehicles,” “semicon machinery etc,” and “textile machines” has maintain robust exports based on the trade statics of Japan’s Ministry of Finance. In particular, the “motor vehicles” has consistently upheld a significant trade surplus throughout the entire period. While principal commodities such as “audio and visual apparatus” and “telephony, telegraphy” have witnessed declining exports, resulting in trade deficits. Additionally, the “medical products” industry has maintained a trade deficit throughout the entire period.

[Summary Chart 19] Trade balance ratios by principal commodities

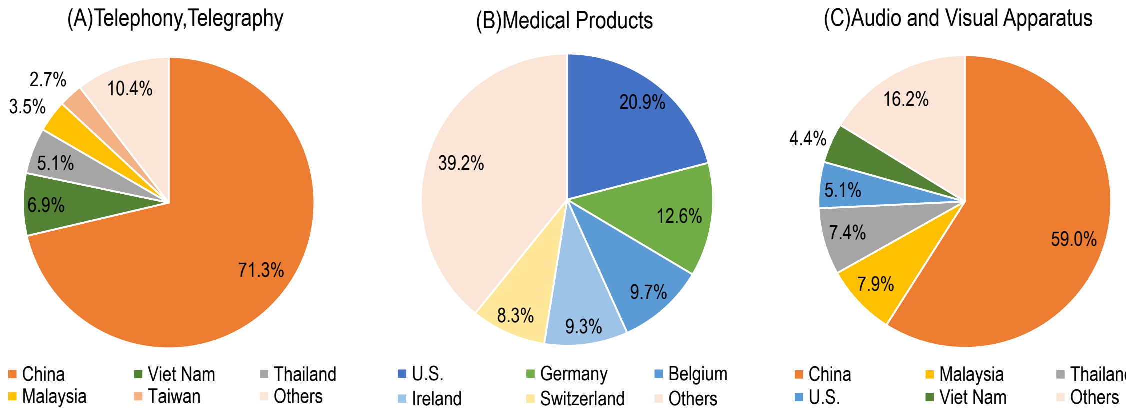


Note:
The term "principal commodity" indicates a general name given to a group of statistical items in the trade statistics of Japan’s Ministry of Finance.
Reference: Chart 5-2-8, Japanese Science and Technology Indicators 2023 (in Japanese)

(6) In Japan's trade, “telephony, telegraphy” and “audio and visual apparatus” are highly dependent on China.

Among the principal commodities that show trade deficits in 2022, “telephony, telegraphy” and “audio and visual apparatus” are highly dependent on China. Although the trends are related to the production systems of global companies, it is inferred that the improvement in China's technological capabilities also has an impact on the trends as China is also increasing its share in the number of top 10% patent families in “audio-visual technology,” “telecommunications,” and “digital communication” (see Figure 4-2-14(B) in the Main Section).

[Summary Chart 20] Import partner countries/regions



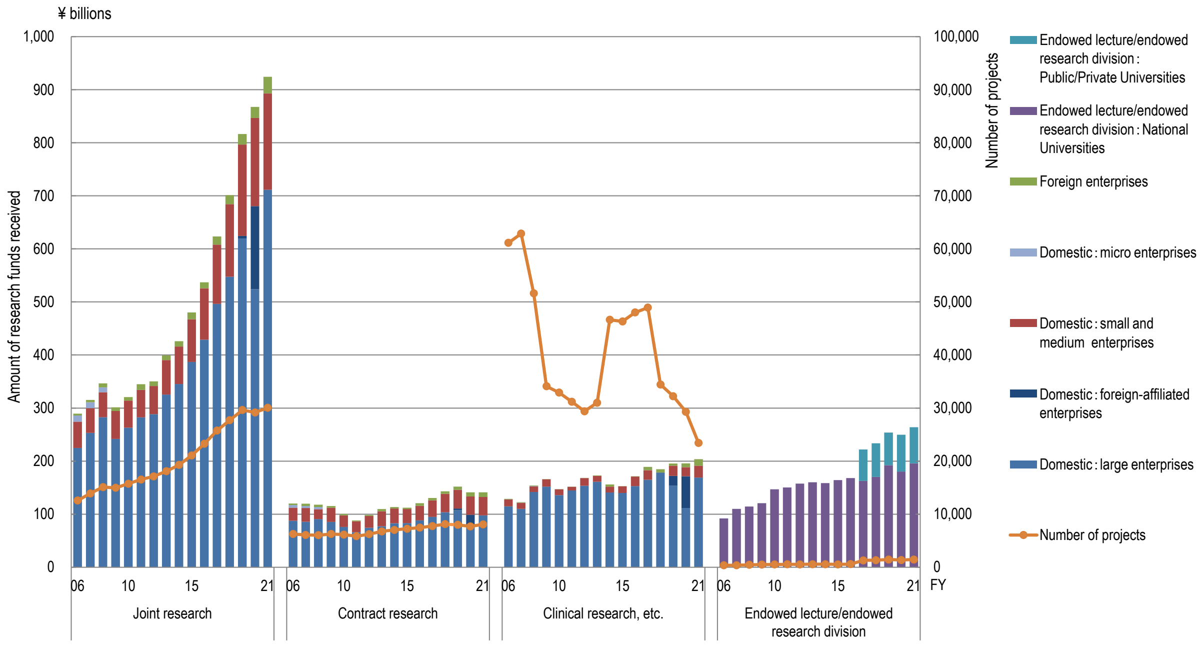
Note:
Import figures are averaged over the three-year period 2020-2022.
Reference: Chart 5-2-9, Japanese Science and Technology Indicators 2023 (in Japanese)

(7) The number of joint research projects conducted by Japanese universities and private companies and the amount of research funds received by Japanese universities have been increasing over the long term.

Among the changes in the funds received (breakdown) and number of projects implemented for joint research, etc. with private business enterprises, “joint research” is the largest in the amount 92.4 billion yen, and the number 30,000 projects, respectively in FY2021. Joint research projects are largely funded by large enterprises, amounting to 71.1 billion yen in the same fiscal year. Concerning “joint research” and “contract research,” the “ratio of indirect expenses to direct expenses” has been steadily increasing. Comparing FY2006 and FY2021, joint research increased significantly from 8.5% to 22.8% (17.2 billion yen), and contract research from 10.1% to 19.1% (2.3 billion yen).

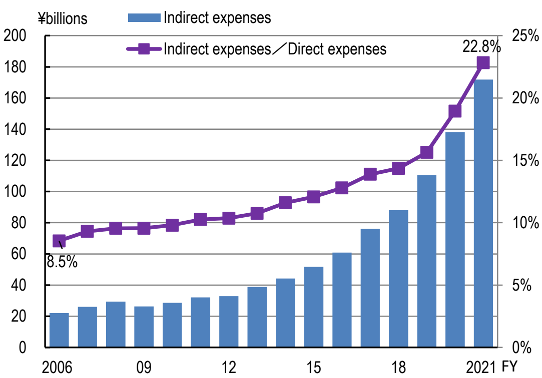
[Summary Chart 21] Changes in the funds received (breakdown) and number of projects implemented for joint research, etc., by Japanese universities and private businesses, etc.

(A) Changes in the amount of funds received (breakdown) and number of projects implemented

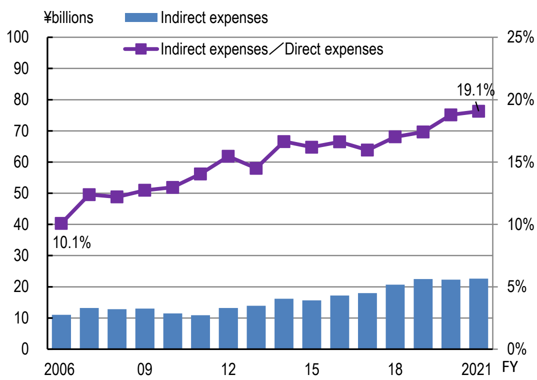


(B) Status of indirect expenses

(a)Joint research



(b)Contract research



Note:
1) Joint research: Joint research and development by institutions and private business, etc., in which the other party bears the expenses. Until FY2008, the amount of funding and the number of projects were classified according to the size of the enterprises - small and medium, micro and large enterprises.
2) Contract research: R&D conducted primarily by universities, etc., under a commission from private enterprises, etc., the costs of which are paid for by the private enterprises, etc.

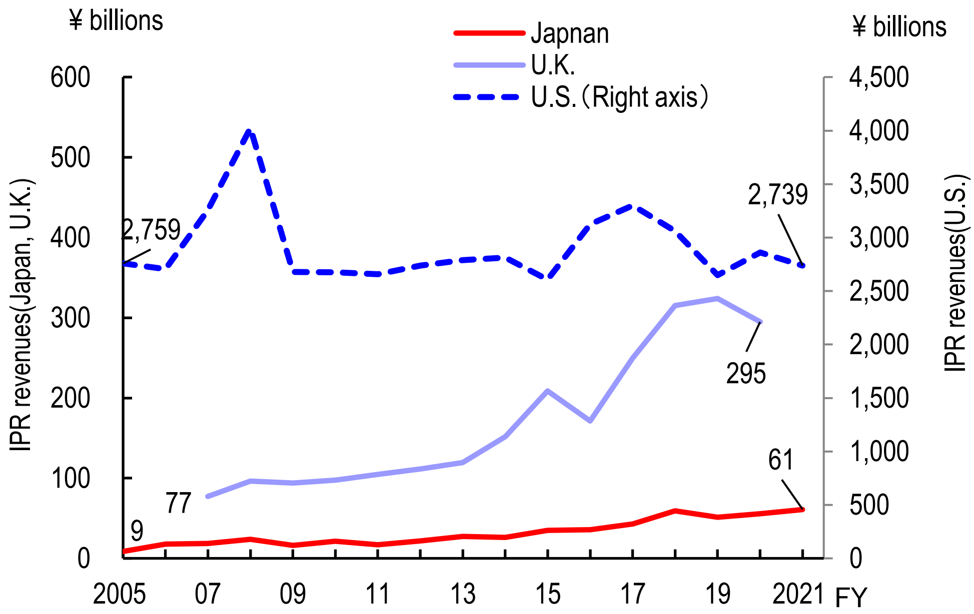
3) Clinical research, etc.: Clinical research on pharmaceuticals and medical equipment, etc., conducted primarily and independently by universities, etc., based on a contract with outside parties, the costs of which are paid for by the consignee. Clinical research includes histopathological examination outside the range of clinical research as well as similar tests and surveys.
4) Endowed lecture/endowed research division: Values shown are only for national universities.
5) Regarding the breakdown of domestic enterprises, data have been available for large enterprises, small and medium enterprises, and micro enterprises from 2006. However, data of micro enterprises was provided only up to FY2008, and data of foreign-affiliated enterprises only in FY2019 and FY2020.
6) Direct expenses are those expenses that are directly required for the joint research, and indirect expenses are those expenses for promoting industry-academia collaboration, expenses other than direct expenses, and administrative expenses.

Reference: Chart 5-4-9(A)(B), Japanese Science and Technology Indicators 2023 (in Japanese)

(8) The revenue from intellectual property rights at Japanese universities and colleges has been on an increasing trend over the long term, having increased approximately seven-fold in the past 15 years.

The revenue from intellectual property rights (IPR) at Japanese universities and colleges has been on an increasing trend over the long term, reaching 6.1 billion yen in FY2021, about seven times as much as in FY2005. The IPR revenue in the U.K. had been on an increasing trend over the long term, but decreased in the latest year, amounting to 29.5 billion yen. The U.S. stands in a league of its own compared to Japan and the U.K., with 273.9 billion yen in FY2021. In the long term, except for a surge in FY2008, the amount has remained around 300 billion yen.

[Summary Chart 22] Trends in IPR revenues in Japan, the U.S., and the U.K.



Notes:
1) Intellectual property rights in Japan include patent rights, utility model rights, design rights, trademark rights, copyrights, other intellectual property (breeder's rights, layout design exploitation rights, etc.), know-how, etc., and tangible objects (materials, etc.).
2) Intellectual property rights in the U.S. include running royalties, license income, license issuance fees, option-based payments, end-user licenses for software and biological substances (over $1 million), etc.
3) Intellectual property rights in the U.K. include patent rights, copyrights, designs, trademarks, etc.

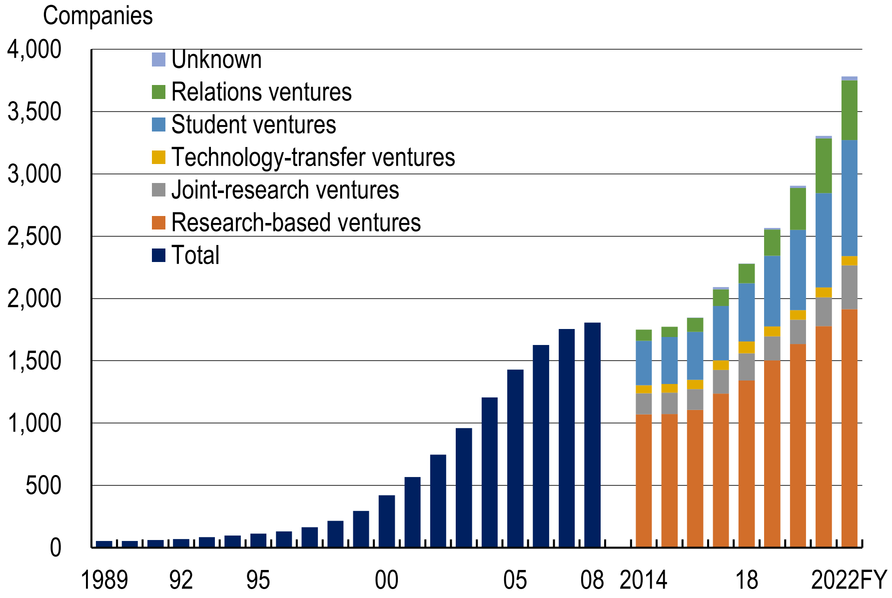
Reference: Chart5-4-11, Japanese Science and Technology Indicators 2023 (in Japanese)

(4) PhD holders account for a large percentage of employees in Japan's university-launched venture companies.

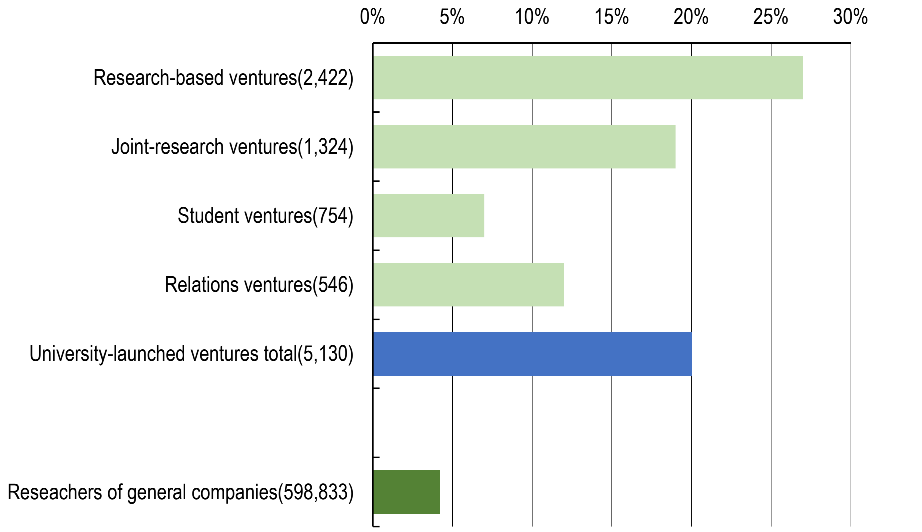
The number of university-launched venture companies in Japan has been steadily increasing, standing at 3,782 in FY2022. By venture category, “research-based ventures” accounted for 50.6% of the total. PhD holders account for 20% of the total number of employees in university-launched venture companies, which is substantial compared to the percentage of PhD holders among researchers in general companies (4%).

[Summary Chart 22] The status of university-launched venture companies

(A) Changes in the number of companies



(B) Percentage of PhD holders in the number of employees by venture category (FY2022 survey)



Note:
Summary Chart 14(B) is sourced from the Survey on University-Developed Venture Businesses (2023), showing the results of the survey of university-launched venture companies identified in the “Survey on the Establishment of University-Developed Venture Businesses (2023),” of which contact information was available (569/3,779 cases were collected, for a response rate of 15.1%).
Figures in parentheses ( ) are the number of employees, and the number of researchers for the figure of “researchers of general companies.” Technology-transfer ventures are not listed due to the small number of employees.
Reference: Chart5-4-12(A),14(A), Japanese Science and Technology Indicators 2023 (in Japanese)

Characteristics of the Japanese Science and Technology Indicators

“The Japanese Science and Technology Indicators” is published annually to present the most recent statistics/indicators at the time of publication. The statistics/indicators are selected considering the following two conditions: 1) the indicators should allow either of the time-series comparison or the comparison among the selected countries and 2) the indicators should be possible to update annually in principle.

NISTEP conducted analysis of paper and patent databases

Paper data were aggregated and analyzed by NISTEP using Web of Science provided by Clarivate Analytics. Patents family data were aggregated and analyzed by NISTEP using PATSTAT (the patent database of the European Patent Office).

Use of “reminder marks” for international comparisons and time-series comparisons

The reminder marks “attention to international comparison” 

and “attention to trend” 

have been attached to graphs where they are required. Generally, the data for each country are collected in line with the OECD’s manuals. However, differences in methods or scope of collecting data exist, and therefore attention is necessary when making comparisons in some cases. Such cases are marked “attention to international comparison.” Likewise, for some time series data, data could not be continuously collected under the same conditions due to changes in statistical standards. Cases where special attention is required when reading chronological trends are marked “attention to trend.” Specifics for such points requiring attention are provided in the notes of individual charts.

To download the collection of statistics (numerical data for the graphs in this report)

The numerical data for the graphs in this report can be downloaded from the following URL or QR code.

https://www.nistep.go.jp/research/indicators

The references shown below the summary charts in this report indicate the table numbers in the collection of statistics.

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