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Digest of Japanese Science and Technology

Indicators 2025

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Center for S&T Foresight and Indicators
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Japanese Science and Technology Indicators 2025 (ABSTRACT)

"The Science and Technology Indicators" is a fundamental resource for systematically understanding Japan's science and technology activities based on objective and quantitative data. These activities are categorized into five areas: "Research and Development Expenditure," "Research and Development Personnel," "Higher Education and Science and Technology Personnel," "Research and Development Output," and "Science, Technology, and Innovation." Approximately 160 indicators represent the status of these activities in Japan and other selected countries. This report is published annually to present indicators that reflect trends in science, technology, and innovation policy. In addition, the report includes timely analyses reflecting social trends and experimental indicators. It offers the latest results of the analyses of scientific publications and patent applications conducted by NISTEP.

Overviewing the latest Japan's situation from "Science and Technology Indicators 2025," the R&D expenditure and the number of researchers in Japan were the third-largest among selected countries (Japan, U.S., Germany, France, U.K., China, and Korea). Japan ranked fifth in the world in the number of scientific publications (fractional counting method) and first in the number of patent families. Among selected countries, Japan ranked sixth in the trade balance of high R&D intensive industries and first in that of medium-high R&D intensive industries. These rankings remain unchanged from the previous edition ("Science and Technology Indicators 2024"). The report also introduces six columns in total, including "R&D expenditure as a percentage of corporate sales: Japan-U.S. comparison," "Price increases in research supplies: an analysis using trade statistics," and "Analysis of high-technology industry trade with a focus on Japan-U.S.-China relations."

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Summary

"The Science and Technology Indicators" is a fundamental resource for systematically understanding Japan's science and technology activities based on objective and quantitative data. These activities are categorized into five areas: "Research and Development Expenditure," "Research and Development Personnel," "Higher Education and Science and Technology Personnel," "Research and Development Output," and "Science, Technology, and Innovation." Approximately 160 indicators clarify the status of these activities in Japan and other selected countries. (See Summary Chart 1)

The indicators are designed to help readers understand the latest trends in Japan and other selected countries by referring to the latest data from Japan, other countries, and international organizations such as the Organization for Economic Co-operation and Development (OECD). Reminder marks clearly indicate points that should be noted when making international or time-series comparisons.

The indicators are reviewed regularly so that they reflect current trends in science, technology, and innovation policies. Additionally, the report includes columns that provide timely analyses reflecting social trends, as well as preliminary experimental indicators that will be incorporated into the main report in the future. "Science and Technology Indicators 2025" includes an analysis of higher costs for research supplies in light of rising prices, as well as an analysis of imports and exports in high R&D intensive industries, with a focus on the relationship between Japan, the U.S., and China.

This summary presents notable indicators from "Science and Technology Indicators 2025". However, the indicators discussed here only constitute part of the whole picture. Science, technology and innovation are complex activities involving a variety of different stakeholders. To understand the current status of science, technology, and innovation in Japan, it is important not only to look at specific indicators, but also to take a comprehensive, bird's-eye view of the indicators as a whole.

[Summary Chart 1] Science and Technology Indicators 2025 at a glance

Chapter 1：R&D expenditure（39）
- 1.1 International comparison of each country's R&D expenditure (6)
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- 5.3 Trademark applications (4)
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Column
- 1: R&D expenditure as a percentage of corporate sales: Japan-U.S. comparison
- 2: Price increases in research supplies: an analysis using trade statistics
- 3: Fields of study of ASEAN students at Japanese graduate schools
- 4: Names of graduate programs and departments: changes in the "other" category in lists of academic disciplines
- 5: Trading partner countries/regions for high R&D intensive industries
- 6: Experts' views and current status of the relationship between the future of science and technology and society

Note: Numbers in parentheses indicate the number of indicators in each section.

1. Japan's trends in key indicators

The trends in key indicators for Japan are as follows: Two new indicators were have been introduced to "Science and Technology Indicators 2025." Doctorate holders play a crucial role in generating new knowledge and bringing innovation to society. Therefore, "Doctorate holders per million population" was introduced to provide an internationally comparable measure of progress in developing highly skilled professionals. The ability to apply scientific knowledge to technology is also important in reflecting technological trends, such as artificial intelligence, quantum computing, and genome editing. In light of this, "usage of scientific knowledge (papers) in technology (patents)" was added as an indicator of the connection between science and technology.

Trends in Japan show that the rankings for all indicators are the same as in "Science and Technology Indicators 2024." Compared to other selected countries, Japan ranked sixth for "Doctorate holders per million population," and seventh for the "usage of scientific knowledge (papers) in technology (patents)."

[Summary Chart 2] Japan's trends in key indicators

Indicators	Changes in Japan's ranking	Japan's figures	Note
R&D expenditure*	No. 3→No. 3	20.4T yen	No. 1: U.S., No. 2: China
Business enterprises	No. 3→No. 3	16.1T yen	No. 1: U.S., No. 2: China
Universities and colleges	No. 5→No. 5	2.3T yen	No. 1: U.S., No. 2: China, No. 3: Germany, No. 4: U.K.
Public organizations	No. 4→No. 4	1.8T yen	No. 1: China, No. 2: U.S., No. 3: Germany
Researchers	No. 3→No. 3	701K	No. 1: China, No. 2: U.S.
Business enterprises	No. 3→No. 3	524K	No. 1: China, No. 2: U.S.
Universities and colleges	No. 4→No. 4	139K	No. 1: China, No. 2: U.S., No. 3: U.K.
Public organizations	No. 5→No. 5	30K	No. 1: China, No. 2:U.S., No. 3: Germany, No. 4: France
Doctorate holders per million population	No. 6→No. 6	123	No.1: U.K., No.2: Korea, No.3: Germany, No.4: U.S., No.5: France
Scientific papers (fractional counting)	No. 5→No. 5	70K	No. 1: China, No. 2: U.S., No. 3: India, No. 4: Germany
Adjusted top 10% scientific papers (fractional counting)	No. 13→No. 13	3.4K	No. 1: China, No. 2: U.S., No. 3: U.K., No. 4: India, No. 5: Germany, No. 6: Italy, No. 7: Australia, No. 8: Canada, No. 9: Korea, No. 10: Spain, No. 11: France, No. 12: Iran
Adjusted top 1% scientific papers (fractional counting)	No. 12→No. 12	0.29K	No. 1: China, No. 2: U.S., No. 3: U.K., No. 4: Germany, No. 5: India, No. 6: Australia, No. 7: Italy, No. 8: Canada, No. 9: Korea, No. 10: France, No. 11: Spain
Patent families	No. 1→No. 1	65K	
Usage of scientific knowledge (papers) in technology (patents)	No. 7→No. 7	6.9%	No. 1: U.S., No. 2: U.K., No. 3: France, No. 4: Germany, No. 5: China, No. 6: Korea
Trade balance ratios for high R&D intensive industries	No. 6→No. 6	0.8	No. 1: China, No. 2: Korea, No. 3: Germany, No. 4: France, No. 5: U.K.
Trade balance ratios for medium-high R&D intensive industries	No. 1→No. 1	2.5	
Cross-border trademark applications (Number of classes)	No.6→No.6	93K	No. 1: China, No. 2: U.S., No. 3: Germany, No. 4: U.K., No. 5: France

Notes:
*: 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 ranking" compares the latest year and the previous year. The "Japan's figures" is for the latest year.
2) Except for the number of scientific papers and adjusted top 10%/top 1% 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.
3) "Usage of scientific knowledge (papers) in technology (patents)" is defined as the percentage of patent families that cite papers among all patent families in each country for the period 2013–2020.

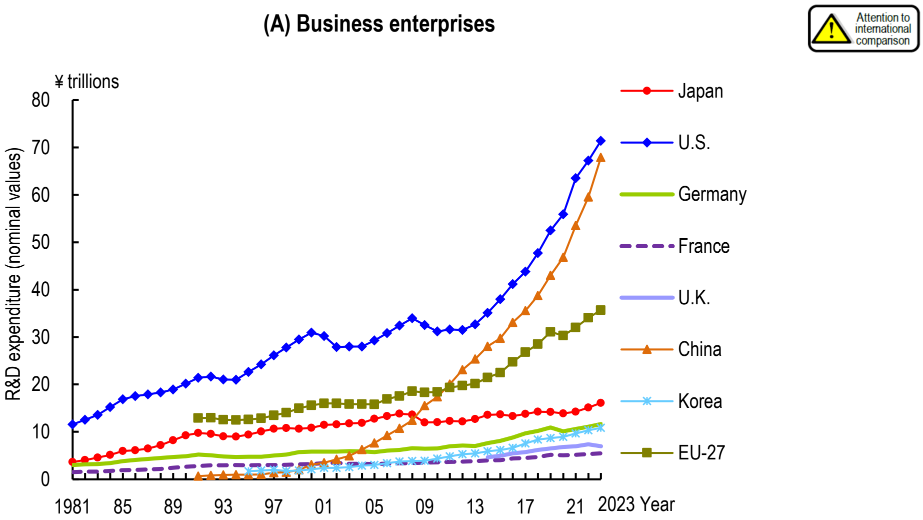
2. R&D expenditure in Japan and selected other countries

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

Among the selected countries, the U.S. had the largest R&D expenditure in both the “business enterprises” and “universities and colleges” sectors. Both sectors have experienced significant growth since the mid-2010s. In China, R&D expenditure has increased sharply in both sectors since the 2000s and mid-2010s, respectively. Growth in R&D expenditure in Japan's “business enterprises” sector has been slow, but it increased by 1.9 trillion yen between 2021 and 2023. R&D expenditure contributed by the government sector increased by 156.4 billion yen over the same period, accounting for 8% of the overall increase in R&D expenditure in the “business enterprises” sector. This indicates that the government sector also contributed to the overall increase in R&D expenditure. Japan's R&D expenditure in the “universities and colleges” sector remained almost flat from the beginning of the 2000s, but has increased slightly since 2021.

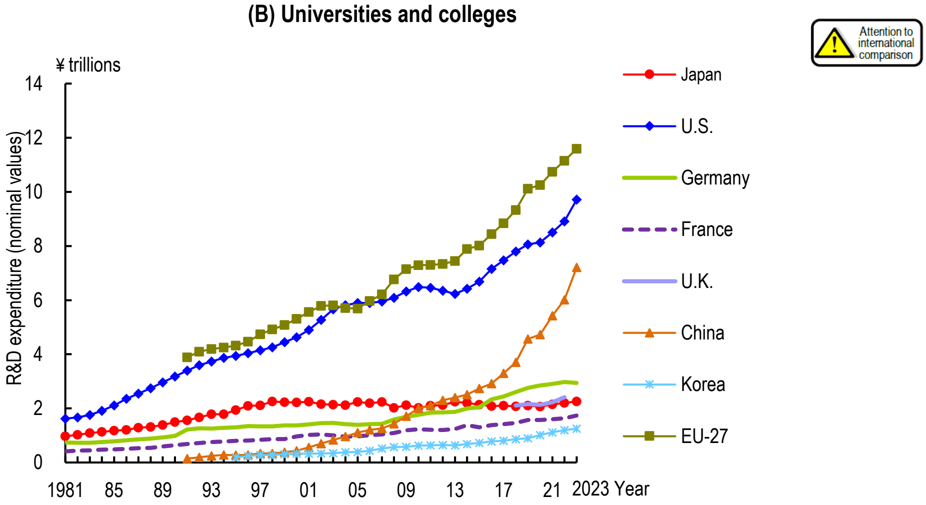
[Summary Chart 3] Nominal values of R&D expenditure by “business enterprises” and “universities and colleges” (based on OECD purchase power parities data)

(A) Business enterprises



Reference: Chart 1-3-3(A), Japanese Science and Technology Indicators 2025 (in Japanese)

(B) Universities and colleges

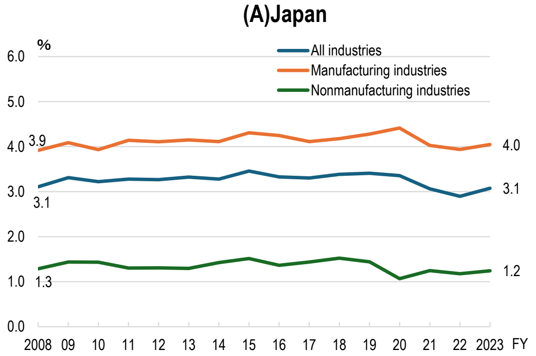


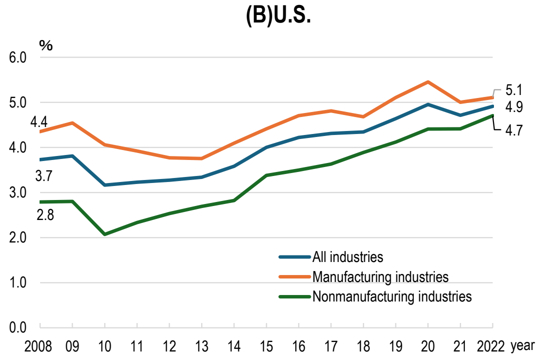
Reference: Chart 1-3-13(A), Japanese Science and Technology Indicators 2025 (in Japanese)

(2) Compared to Japanese companies, U.S. companies focus more on R&D. This difference is particularly evident in non-manufacturing sectors.

A comparison of R&D expenditure as a percentage of corporate sales in Japan and the U.S. shows that, over the past 15 years or so, the figures for Japan have remained stable in both the manufacturing and non-manufacturing sectors. In contrast, figures for the U.S. have increased in both sectors, particularly in the non-manufacturing sector.

[Summary Chart 4] R&D expenditure as a percentage of corporate sales





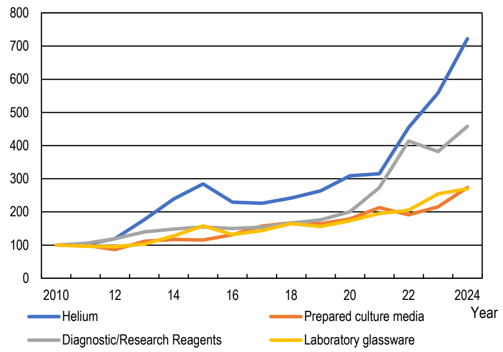
Note：
1） The graphs cover companies that conduct research and development.
2） The U.S. industry classification is based on the North American Industry Classification System (NAICS). The 2002 NAICS is used for 2008, the 2007 NAICS for 2009-2013, the 2012 NAICS for 2014-2019, and the 2017 NAICS for 2020 and later. Data up to 2016 does not include companies with fewer than five domestic employees. Data for 2017 through the latest year does not include companies with fewer than ten domestic employees.
Reference: Column Chart 1-2, Japanese Science and Technology Indicators 2025 (in Japanese)

(3) The unit prices of research supplies have increased significantly compared to 2010.

A comparison of the unit prices (price per kilogram) of four types of research supplies in 2010 with those in more recent years reveals a significant increase in the prices of helium and diagnostic/research reagents. Comparing unit prices in 2010 and 2024, the price is 7.2 times higher for helium and 4.6 times higher for diagnostic/research reagents.

Examining the import value of diagnostic/research reagents by country/region reveals that the U.S. accounted for the largest share of total global imports, at 44%. Although China accounted for only 8% of the import value, the import volume was almost the same as that of the U.S. due to the low unit price of 8,000 yen/kg.

[Summary Chart 5] Time-series change in unit prices of research supplies (vs. 2010, per kg)



Note：Change from 2010 prices (2010 = 100).
Reference: Column Chart 2-2, Japanese Science and Technology Indicators 2025 (in Japanese)

[Summary Chart 6] Import value, import volume, and unit price of research supplies (diagnostic/research reagents) by top 5 importing countries/regions (for 2024)

Country/Region	Import Value (100 million yen)	Import Volume (tons)	Unit Price (thousand yen/kg)
U.S.	963	2,589	37
China	181	2,237	8
Germany	172	331	52
Ireland	164	932	18
U.K.	148	281	53
Total	2,199	7,642	29

Reference: Column Chart 2-3, Japanese Science and Technology Indicators 2025 (in Japanese)

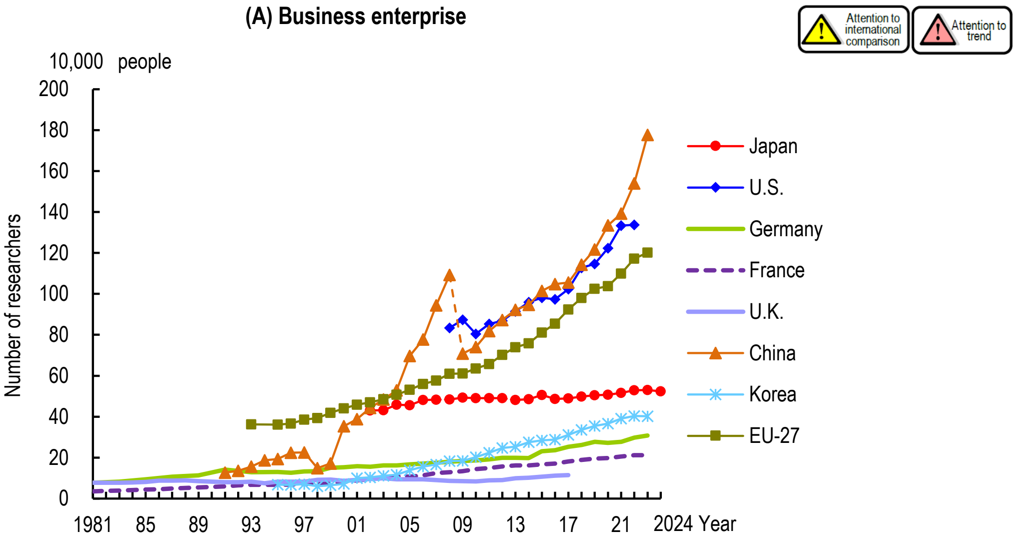
3. R&D personnel in Japan and the selected countries

(1) The growth of researchers in Japan's "business enterprises" and "universities and colleges" sectors is smaller compared to that in other selected countries.

China had the largest number of researchers in the "business enterprises" and "universities and colleges" sectors among the selected countries. While the number of researchers in the "business enterprises" sector was growing at a similar rate in the U.S. and China, it has increased sharply in China since 2021. The number of researchers in Japan remained relatively stable from the late 2000s, growing slightly in 2017 and onward, before declining by 1.3% year-on-year in 2024, resulting in a total of 524,000. China also has seen a significant increase in the number of researchers in the "universities and colleges" sector. Germany has seen a rise in the number of researchers since the mid-2000s and is closing in on Japan. Japan's growth has been moderate and has recently leveled off.

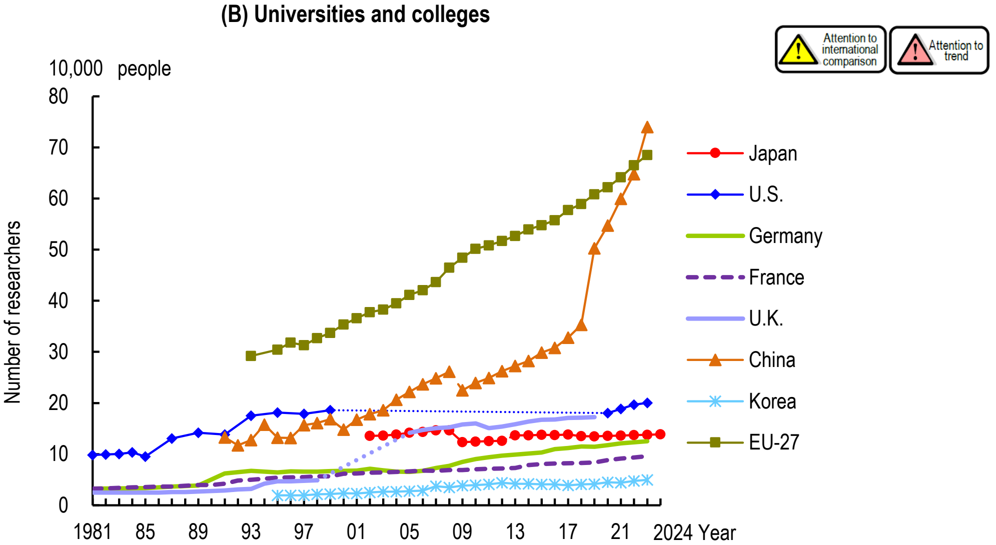
[Summary Chart 7] Trends in the number of researchers in "business enterprise" and "universities and colleges"

(A) Business enterprise



Reference: Chart 2-2-4, Japanese Science and Technology Indicators 2025 (in Japanese)

(B) Universities and colleges



Note: In the chart, periods for which no data is available are indicated by dotted lines.
Reference: Chart 2-2-11, Japanese Science and Technology Indicators 2025 (in Japanese)

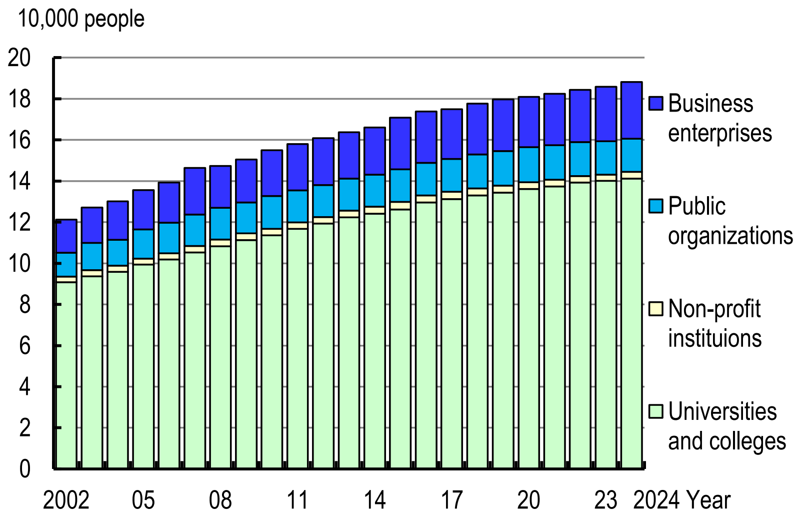
(2) The number of researchers with doctorate degrees in Japan was 188,000 in 2024, accounting for 21.5% of all researchers (excluding those enrolled in graduate doctoral programs).

In 2024, the "universities and colleges" sector had the largest number of doctorate holders (141,000). The number for the "business enterprises" sector was 28,000 in the same year, which is low compared to the "universities and colleges", but 1.7 times higher than in 2002.

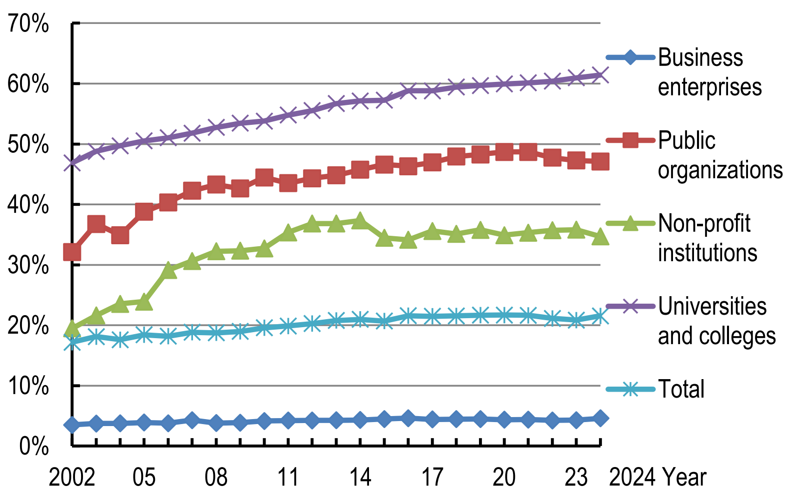
The percentage of doctorate holders among researchers (excluding those enrolled in graduate doctoral programs) is high in the "universities and colleges" sector, which was 61.4% in 2024. The percentage was the lowest for "business enterprises" at 4.6% in the same year.

[Summary Chart 8] Situation of researchers with doctorate degrees in each sector (HC)

(A) Changes in the number of researchers with doctorate degrees



(B) Percentages of researchers with doctorate degrees among all researchers



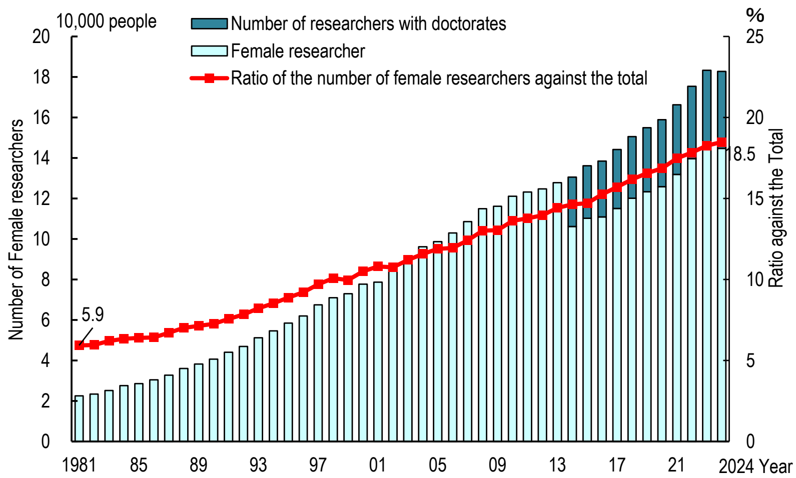
Note:
1) Values are on a head count basis.
2) The number of researchers in "universities and colleges" shown in Summary Chart 8 (B) includes faculty members and medical staff/other researchers but excludes those enrolled in graduate doctoral programs. The number of doctorate holders refers to the number of researchers with doctorate degrees. Those who are concurrently employed by another university/college are excluded.
3) The number of researchers as of March 31 of the relevant year was counted.
Reference: Chart 2-1-8, Japanese Science and Technology Indicators 2025 (in Japanese)

(3) **The number of female researchers decreased by 0.3% compared to the previous year, while the number of female researchers holding doctorate degrees increased by 2.7%. The percentage of non-permanent researchers in "universities and colleges" is larger for women than for men.**

In 2024, the number of female researchers in Japan was 183,000, accounting for 18.5% of the total. Of these, 38,000 are doctorate holders, and the figure is steadily increasing.

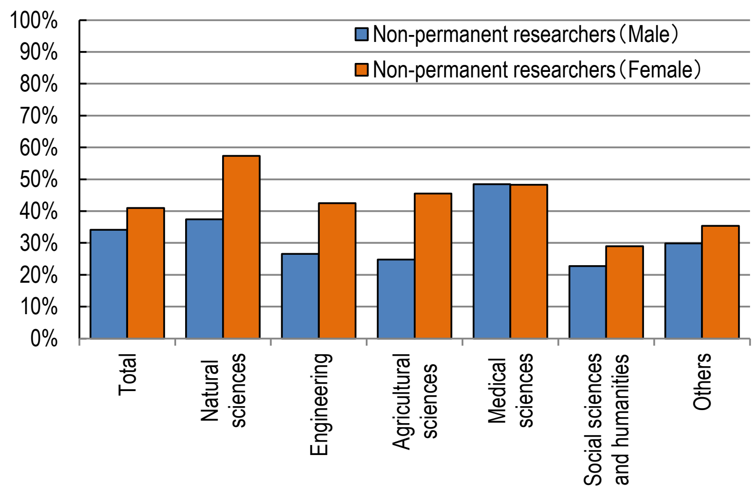
In terms of the percentage of non-permanent researchers in "universities and colleges," there is no gender difference in the field of "medical sciences," while there is a significant gender difference in the fields of "natural sciences," "engineering," and "agricultural sciences."

[Summary Chart 9] The number of female researchers and their ratio against the total number of researchers (HC)



Note :
1) The numbers of researchers until 2001 were regular researchers. The numbers of researchers since 2002 were head count basis.
2) Values for 2001 and earlier are based on the number of researchers as of April 1 of the relevant year; values for 2002 and later are based on the number of researchers as of March 31 of the relevant year.
Reference: Chart 2-2-12, Japanese Science and Technology Indicators 2025 (in Japanese)

[Summary Chart 10] The situation of non-permanent researchers in universities and colleges (2024)



Note :
1) The survey covers teaching and other research staff. Values are on a head count basis.
2) Permanent researchers here refer to teaching and other research staff with no prescribed term of employment contract (including terms that last until the retirement age). Non-permanent researchers refer to all researchers other than permanent researchers.
3) The number of researchers as of March 31 of the relevant year was counted.
Reference: Chart 2-2-15, Japanese Science and Technology Indicators 2025 (in Japanese)

4. Status of Higher Education and Science and Technology Personnel

(1) Enrollment growth in Japanese graduate schools had been sluggish; however, enrollment in master's programs began to increase after FY2020, and enrollment in doctoral programs began to increase after FY2022. In FY2024, the number of students enrolled in doctoral programs increased by 4.9% compared with the previous year.

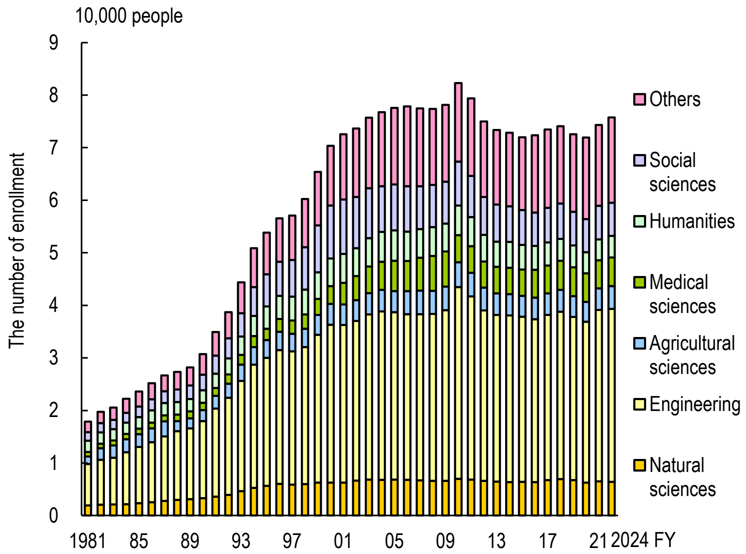
The number of enrollments in Japan's graduate school master's programs peaked in FY2010 and began to decline, but increased after FY2020. The number of enrollments increased by 2.8% over the previous year, reaching 79,000 in FY2024, with recurrent students accounting for 8.8% of the total.

After peaking in FY2003, the number of enrollments in graduate doctoral programs began a long decline that finally ended with an increase in FY2023, reaching 16,000 in FY2024, a 4.9% increase from the previous year. The percentage of recurrent students, which was 39.8% in FY2024, declined after FY2020[1]. Examining the number by major subject, there was an increase in all fields shown here from FY2022 to FY2024. "Others" increased by 16.8%, "Engineering" increased by 15.1%, and "Social sciences" increased by 12.9%.

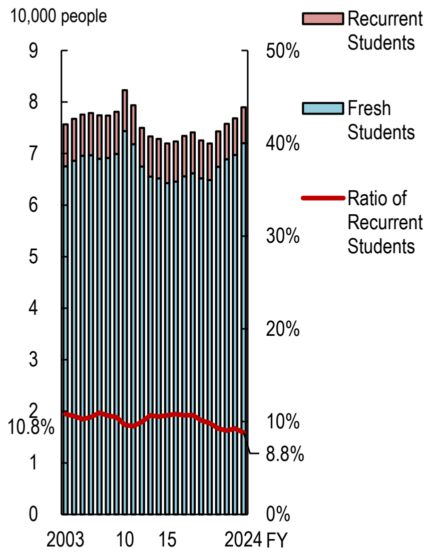
[1] Among students enrolled in doctoral programs, the number of international students was 3,000 in FY2024, down 3.7% from the previous year.

[Summary Chart 11] The number of enrollments in graduate schools (master's programs)

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



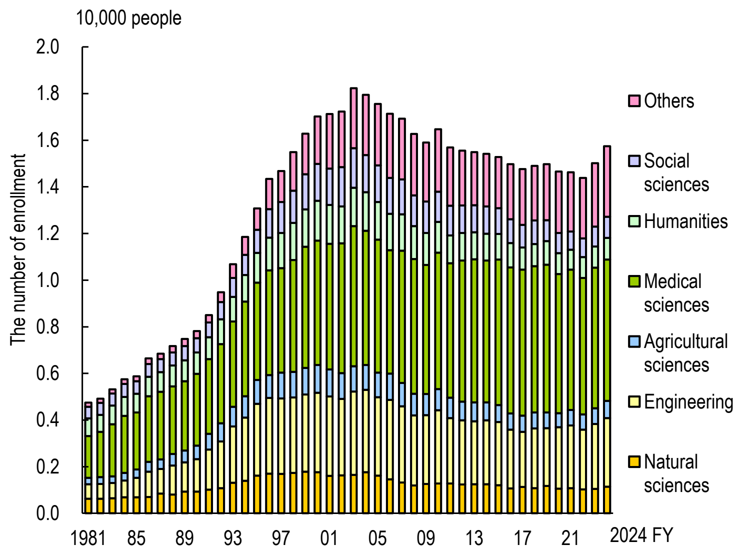
(B) Changes in the number of recurrent students newly enrolled in graduate schools (master's programs)



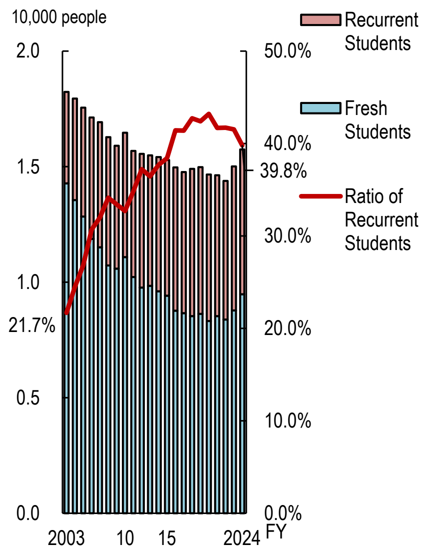
Reference: Chart 3-2-2, Japanese Science and Technology Indicators 2025 (in Japanese)

[Summary Chart 12] The number of enrollments in graduate schools (doctoral programs)

(A) Changes in the number of 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 2025 (in Japanese)

Note:
"Others" in the 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." The names of major study fields included in this category often use words such as "Environment," "Human," "Information," "International," and so on.

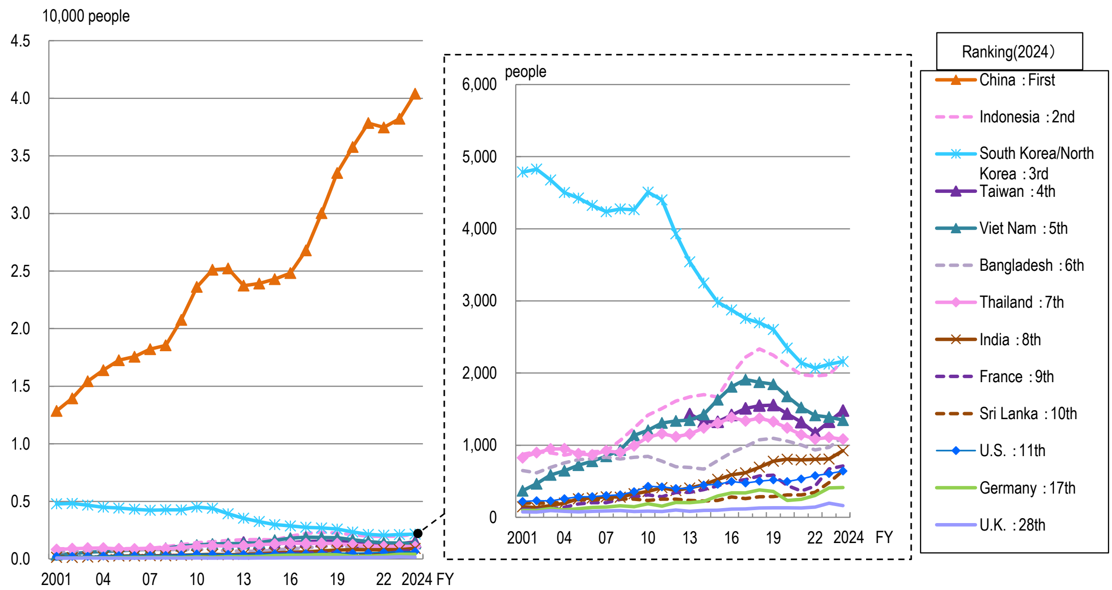
(4) Both Japan and the U.S. have a large number of graduate students from Asia, but the proportion by place of origin is changing.

The number of Chinese students was the largest among international graduate students in Japan, at approximately 40,000 in FY2024. Students from Indonesia and South Korea/North Korea follow, with about 2,200 students from each country, indicating that many Asian countries/regions are in the top 10.

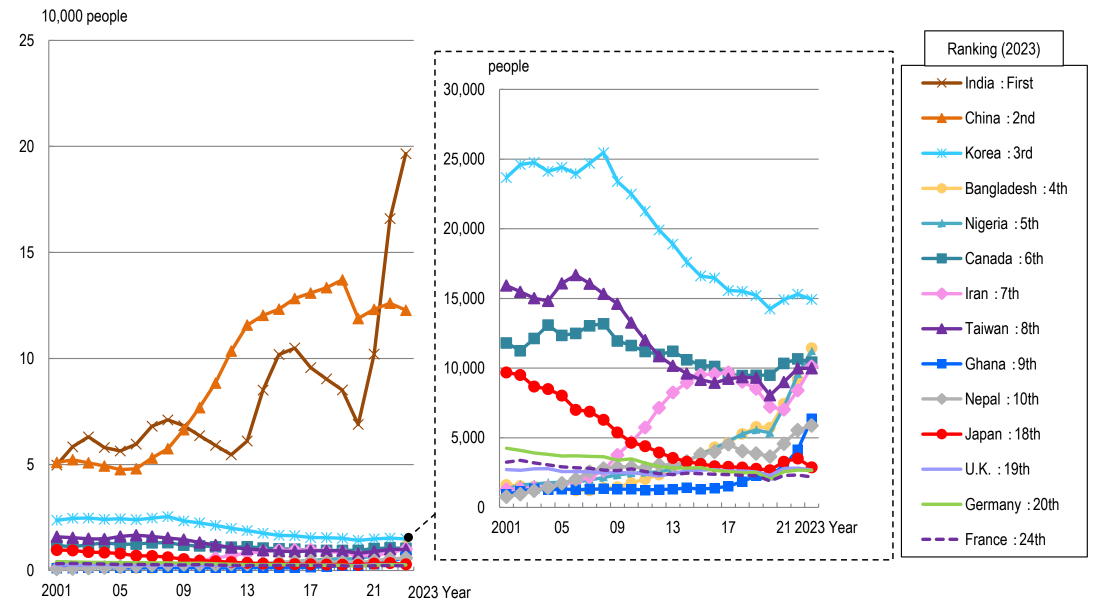
The number of Indian and Chinese students was growing in close competition in the U.S. Although the number for both countries declined in 2020, Indian students saw a significant rise, reaching 197,000 in 2023. Meanwhile, growth in the number of Chinese students was small, totaling 123,000 in the same year.

[Summary Chart 13] International graduate students in Japan and the U.S.

(A) Japan



(B) U.S.



Note: International students in Japan refer to students who do not have Japanese nationality. Due to the implementation of a new residency management system in July 2012, Chinese and Taiwanese students are counted separately. Figures include non-degree-seeking students, auditors, and research students. International students in the U.S. refer to students with a temporary non-immigrant visa that makes them eligible for enrollment in a course of study, and who are currently enrolled in a course of study in the U.S.
Reference: Chart 3-5-1, Japanese Science and Technology Indicators 2025 (in Japanese)

5. Status of Research and Development Outputs

(1) Japan ranked 5th in the world in terms of the number of scientific papers (fractional counting method). Focusing on highly cited papers, Japan ranked 13th and 12th in the adjusted top 10% and top 1% papers, respectively. China ranked first in the world in all categories of papers.

Japan ranked 5th after China, the U.S., India, and Germany in terms of the number of scientific papers (the average from 2021 to 2023) counted by the fractional counting method, which measures the degree of contribution to paper production. Focusing on highly cited papers, Japan ranked 13th in the number of adjusted top 10% papers. For adjusted top 1% papers, Japan ranked 12th. China ranked first in the world in all categories of papers.

When comparing the shares of the number of adjusted top 10% papers by field, the shares of “Physics,” and “Clinical medicine” are higher in Japan than in 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,” “Engineering,” and “Chemistry” are high.

[Summary Chart 14] Top countries/regions in the number of scientific papers and in the numbers of adjusted top 10% and 1% papers in citation counts (in natural sciences, based on the fractional counting method)

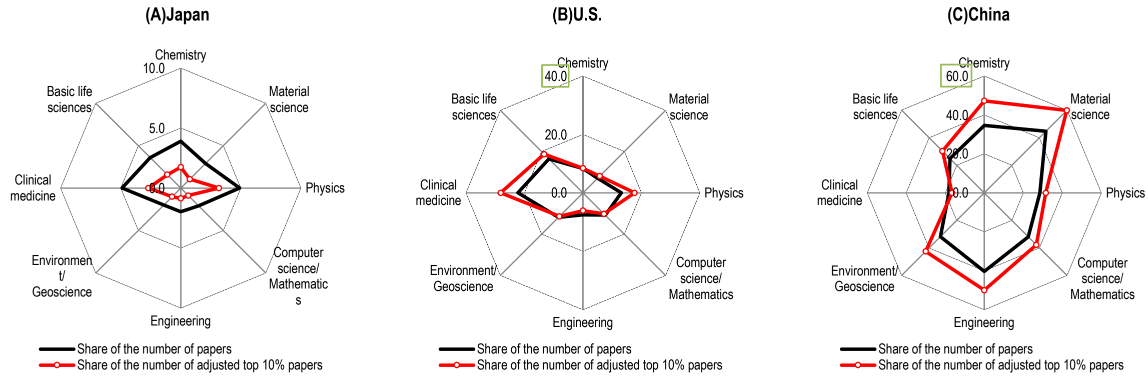
All fields	2021 — 2023 (PY) (Average)		
	The number of papers		
Country/Region	Fractional counting		
	Papers	Share	World rank
China	599,435	29.1	1
U.S.	289,791	14.1	2
India	91,997	4.5	3
Germany	72,762	3.5	4
Japan	70,225	3.4	5
U.K.	65,203	3.2	6
Italy	60,712	3.0	7
Korea	58,382	2.8	8
France	44,976	2.2	9
Spain	44,789	2.2	10
Canada	44,487	2.2	11
Brazil	43,083	2.1	12
Australia	41,064	2.0	13
Iran	37,760	1.8	14
Türkiye	35,256	1.7	15
Russia	33,592	1.6	16
Poland	27,047	1.3	17
Taiwan	23,558	1.1	18
Netherlands	22,639	1.1	19
Saudi Arabia	18,845	0.9	20

All fields	2021 — 2023 (PY) (Average)		
	The number of adjusted top 10% papers		
Country/Region	Fractional counting		
	Papers	Share	World rank
China	73,315	35.6	1
U.S.	32,781	15.9	2
U.K.	8,396	4.1	3
India	7,697	3.7	4
Germany	6,845	3.3	5
Italy	6,428	3.1	6
Australia	4,971	2.4	7
Canada	4,469	2.2	8
Korea	4,380	2.1	9
Spain	3,767	1.8	10
France	3,730	1.8	11
Iran	3,619	1.8	12
Japan	3,447	1.7	13
Netherlands	2,802	1.4	14
Saudi Arabia	2,334	1.1	15
Türkiye	2,076	1.0	16
Switzerland	2,029	1.0	17
Egypt	1,951	0.9	18
Brazil	1,901	0.9	19
Pakistan	1,740	0.8	20

All fields	2021 — 2023 (PY) (Average)		
	The number of adjusted top 1% papers		
Country/Region	Fractional counting		
	Papers	Share	World rank
China	7,458	36.2	1
U.S.	3,910	19.0	2
U.K.	1,000	4.9	3
Germany	718	3.5	4
India	614	3.0	5
Australia	550	2.7	6
Italy	484	2.4	7
Canada	458	2.2	8
Korea	360	1.8	9
France	342	1.7	10
Spain	330	1.6	11
Japan	293	1.4	12
Netherlands	286	1.4	13
Iran	248	1.2	14
Switzerland	227	1.1	15
Saudi Arabia	207	1.0	16
Singapore	199	1.0	17
Türkiye	164	0.8	18
Pakistan	157	0.8	19
Sweden	152	0.7	20

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 2024.
Reference: Chart 4-1-6(B), Japanese Science and Technology Indicators 2025 (in Japanese)

[Summary Chart 15] A comparison of the share of the papers and adjusted top 10% papers in Japan, the U.S. and China by field (%, 2021–2023, fractional counting method)



Notes: Same as Summary Chart 14.
Reference: Chart 4-1-10, Japanese Science and Technology Indicators 2025 (in Japanese)

(2) Japan has maintained the number one position in the world in terms of the number of patent families (patents filed in two or more countries) for about 20 years. However, its global share has been declining since the mid-2000s.

A close look at patent applications reveals that, in terms of the number of patent families, which is measured by the number of inventions created in each country/region in an internationally comparable manner, Japan was ranked first in the world, followed by the U.S., during three periods: 1998-2000, 2008-2010, and 2018-2020. However, Japan's global share has been declining since the mid-2000s. China ranked third in 2018-2020, rapidly gaining in terms of the number of patent families and global share.

In terms of technological fields, Japan has high shares in "General machinery" and "Electrical engineering"; the U.S. has high shares in "Biotechnology/pharmaceuticals" and "Biomedical devices;" and China has high shares in "Information and communications technology" and "Electrical engineering." Compared to 10 years ago, China's shares have expanded while Japan's shares in "Electrical engineering," "Information and communications technology," and "General machinery" have decreased.

[Summary Chart 16] The number of patent families by selected countries/region: top 20 countries/regions

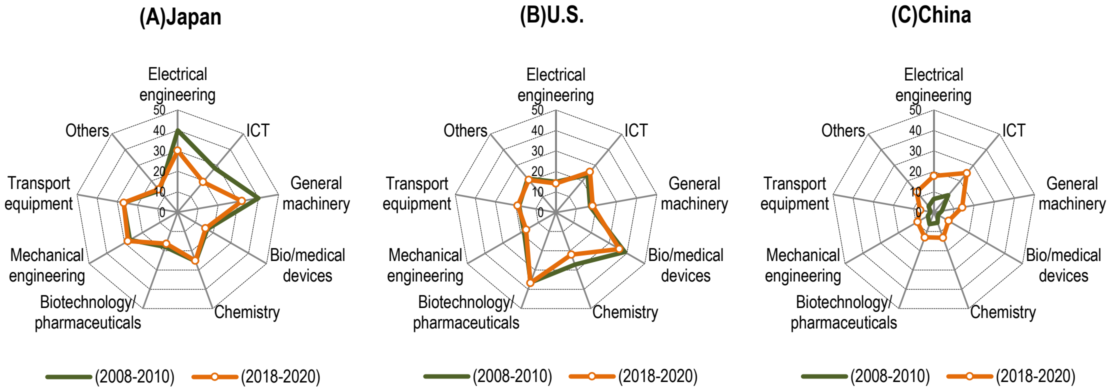
1998 - 2000(Average)			
Country/Region	Number of patent families (Whole counting)		
	Patent Families	Share	World rank
Japan	38,317	27.9	1
U.S.	37,185	27.1	2
Germany	24,124	17.6	3
France	8,493	6.2	4
U.K.	7,553	5.5	5
Korea	4,923	3.6	6
Italy	3,857	2.8	7
Netherlands	3,399	2.5	8
Canada	3,184	2.3	9
Switzerland	3,034	2.2	10
Sweden	2,769	2.0	11
Taiwan	1,782	1.3	12
Finland	1,637	1.2	13
Austria	1,455	1.1	14
Belgium	1,419	1.0	15
China	1,158	0.8	16
Australia	1,101	0.8	17
Israel	1,061	0.8	18
Denmark	855	0.6	19
Spain	824	0.6	20

2008 - 2010(Average)			
Country/Region	Number of patent families (Whole counting)		
	Patent Families	Share	World rank
Japan	58,228	29.0	1
U.S.	44,112	22.0	2
Germany	27,369	13.6	3
Korea	17,176	8.5	4
China	11,685	5.8	5
France	10,552	5.3	6
Taiwan	10,173	5.1	7
U.K.	8,039	4.0	8
Canada	5,371	2.7	9
Italy	5,111	2.5	10
Netherlands	4,105	2.0	11
Switzerland	3,745	1.9	12
Sweden	3,149	1.6	13
India	3,081	1.5	14
Austria	2,286	1.1	15
Belgium	1,909	1.0	16
Spain	1,751	0.9	17
Israel	1,698	0.8	18
Finland	1,669	0.8	19
Australia	1,555	0.8	20

2018 - 2020(Average)			
Country/Region	Number of patent families (Whole counting)		
	Patent Families	Share	World rank
Japan	65,450	24.3	1
U.S.	58,594	21.7	2
China	41,475	15.4	3
Germany	27,668	10.3	4
Korea	25,329	9.4	5
Taiwan	11,746	4.4	6
France	10,959	4.1	7
U.K.	8,761	3.3	8
Canada	5,669	2.1	9
Italy	5,538	2.1	10
India	4,557	1.7	11
Netherlands	4,335	1.6	12
Switzerland	4,274	1.6	13
Sweden	3,796	1.4	14
Austria	2,647	1.0	15
Israel	2,635	1.0	16
Belgium	2,287	0.8	17
Spain	1,985	0.7	18
Finland	1,799	0.7	19
Denmark	1,700	0.6	20

Note: patent family is a group of patents filed in two or more countries, directly or indirectly related to each other by priority rights. In many cases, the same patents filed in multiple countries belong to the same patent family.
Reference: Chart 4-2-5(B), Japanese Science and Technology Indicators 2025 (in Japanese)

[Summary Chart 17]　Comparison of the shares of patent families by technological fields in Japan, the U.S. and China (%, 2008-2010 and 2018-2020, whole counting)



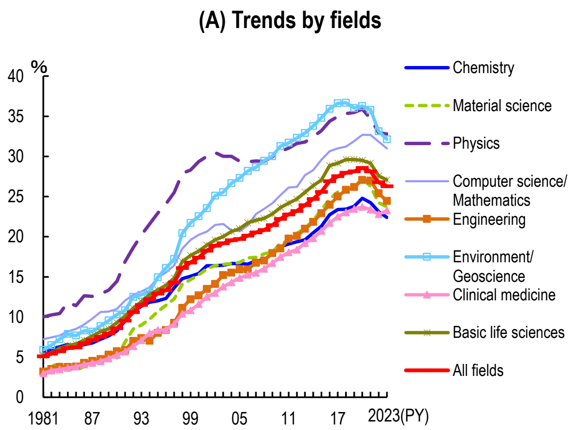
Note: Same as Summary Chart 16. The items "ICT" in Summary Chart 17 stand for "Information and communication technology."
Reference: Chart 4-2-12, Japanese Science and Technology Indicators 2025 (in Japanese)

(3) The percentage of internationally co-authored papers had been on an upward trend, but has been declining in all fields since around 2020. Among selected countries, the decline in China is significant.

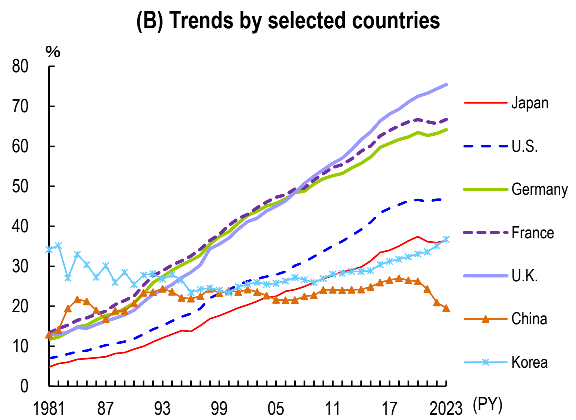
Looking at the percentages of internationally co-authored papers as of 2023 for each field, "Physics" and "Environment/Geosciences" had higher percentages than other fields, at 32.8% and 32.1%, respectively. The percentage of internationally co-authored papers was the lowest in "Clinical Medicine" at 22.4%. The percentage of internationally co-authored papers has been decreasing in all fields since around 2020.

Examining the percentages of internationally co-authored papers in selected countries, the U.K. and Korea are rising, while Japan, the U.S., Germany, and France have remained relatively stable since around 2020. China's decline continued after 2018, with a 7.4 percentage point drop in 2023 compared to 2018.

[Summary Chart 18] Percentage of internationally co-authored papers



Reference: Chart 4-1-4(A), Japanese Science and Technology Indicators 2025 (in Japanese)



Reference: Chart 4-1-3, Japanese Science and Technology Indicators 2025 (in Japanese)

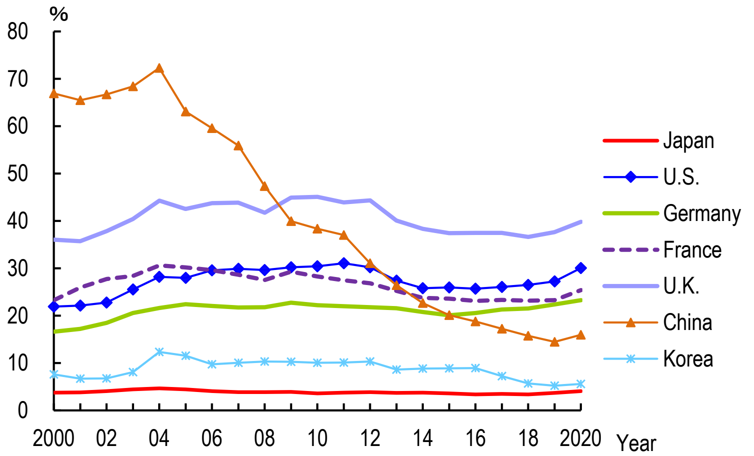
Note: The number of articles and reviews was counted. Publication year (PY) was used for the year tally.

(4) The percentage of international collaboration (with two or more countries) in patent families tends to be higher in Europe and the U.S. and lower in Asia.

In terms of the percentage of international collaboration (with two or more countries) in patent families, the U.K. had the highest percentage in 2020 at 39.8%, followed by the U.S. at 30.0%, France at 25.4%, and Germany at 23.3%. China and Korea came in at 16.0% and 5.6%, respectively, while Japan was the lowest at 4.1%.

Examining the trends, a significant decline has been observed in the percentage of international collaboration in China; however, no similar change has been noted in other selected countries.

[Summary Chart 19] Percentage of international collaboration in selected countries' patent families



Note: International collaboration refers to a joint application between two or more countries.
Reference: Chart 4-2-8, Japanese Science and Technology Indicators 2025 (in Japanese)

(5) Japan's technology (patent families) cites scientific achievements (scientific papers) at a lower rate compared to other countries. The proportion of Japanese scientific papers cited by global technology is about the global average.

To examine the linkage between science and technology, information on scientific papers cited by patent families was analyzed for the period 2013–2020. Japan ranked second in the world for the number of patent families that cite papers. However, the number of Japanese patent families that cite papers accounted for only 6.9% of this total.

During the 2013–2020 period, the number of Japanese papers cited by patent families was the fifth highest in the world. The ratio of Japanese papers cited in patent families to the total number of papers was 3.1%, which was close to the average for the countries/regions shown here.

[Summary Chart 20] The number of patent families that are citing papers: top 10 countries/regions

Whole counting		2013–2020 (Total)			
		(A) Patent families citing papers		(B) Total number of patent families	
No.	Country / Region	No. of patent families	Global share of (A)	No. of patent families	Percentage of patent families citing papers (A) / (B)
1	U.S.	110,589	31.4	450,624	24.5
2	Japan	35,439	10.1	511,763	6.9
3	Germany	28,561	8.1	221,297	12.9
4	China	24,678	7.0	246,470	10.0
5	France	18,383	5.2	88,880	20.7
6	Korea	17,522	5.0	191,270	9.2
7	U.K.	17,035	4.8	69,922	24.4
8	Canada	9,920	2.8	43,334	22.9
9	Netherlands	9,356	2.7	35,212	26.6
10	Switzerland	8,489	2.4	32,345	26.2

Reference: Chart 4-3-2, Japanese Science and Technology Indicators 2025 (in Japanese)

[Summary Chart 21] The number of papers that are cited by patent families: top 10 countries/regions

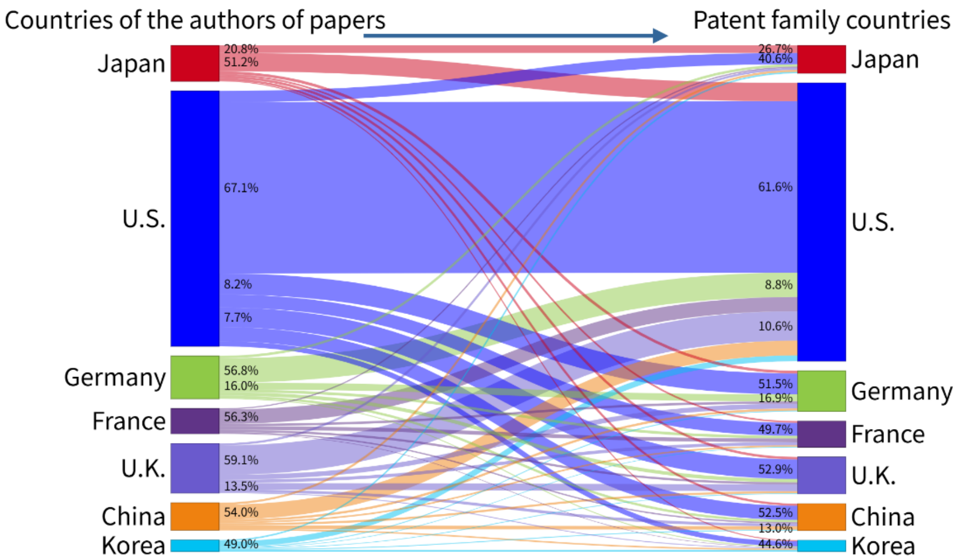
Whole counting		1981-2020 (Total)			
		(C) Papers cited by patent families		(D) Total number of papers	
No.	Country / Region	No. of papers	Global share of (C)	No. of papers	Percentage of papers cited by patent families (C) / (D)
1	U.S.	456,259	33.1	10,066,570	4.5
2	U.K.	94,959	6.9	2,697,754	3.5
3	Germany	92,179	6.7	2,677,276	3.4
4	China	86,628	6.3	4,151,956	2.1
5	Japan	77,696	5.6	2,473,383	3.1
6	France	59,259	4.3	1,927,322	3.1
7	Canada	51,301	3.7	1,528,535	3.4
8	Italy	43,358	3.1	1,456,411	3.0
9	Netherlands	36,019	2.6	834,816	4.3
10	Korea	32,222	2.3	909,663	3.5

Reference: Chart 4-3-3, Japanese Science and Technology Indicators 2025 (in Japanese)

(6) It is the U.S. papers that are most frequently cited by the patent families of from any of the selected countries.

Japanese papers accounted for 26.7% of all the papers cited by patent families originating from Japan. However, the largest percentage of papers cited by Japanese patent families was from the U.S. (40.6%). The U.S. papers were the most cited by the patent families from any of the selected countries. In the U.S., papers from the U.K. were the second-most cited (10.6%), after those from the U.S. itself. The percentage of patent families citing papers from their own country was lower in China than in the other selected countries (13.0%).

[Summary Chart 22] Linkage between science and technology among the selected countries



Reference: Chart 4-3-4, Japanese Science and Technology Indicators 2025 (in Japanese)

6. Status of Science, Technology and Innovation

(1) 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.

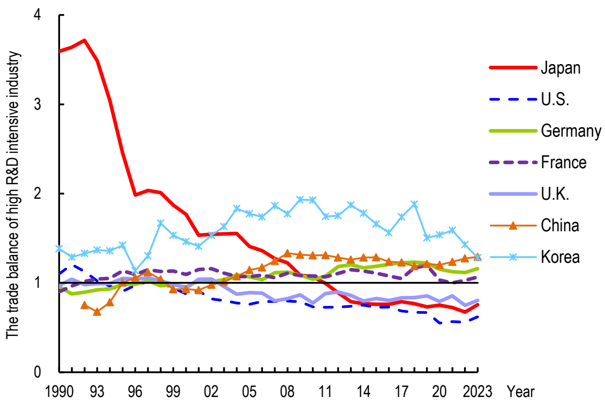
Japan's trade balance ratio for high R&D intensive industries was 0.76 (indicating a trade deficit) in the latest year. Looking at other countries, China and Korea had higher trade balance ratios, at 1.29 and 1.28, respectively.

For the trade balance ratio for medium-high R&D intensive industries, Japan had a ratio of 2.45 (indicating a trade surplus) in the latest year, ranking first among the selected countries. While Japan's trade balance ratio has been on a downward trend, China has seen an increase over the long term. Its trade balance ratio for the latest year was 2.32, coming close to Japan.

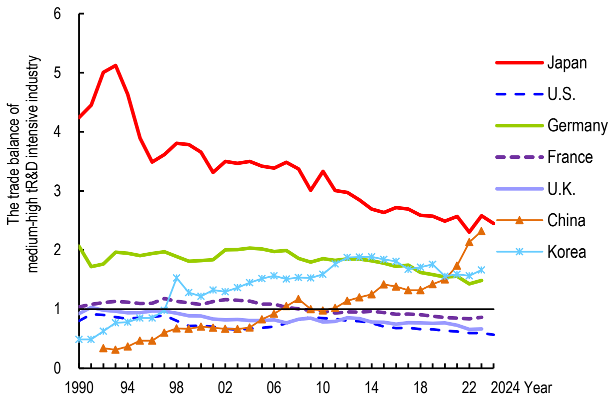
Examining the trading partner countries/regions for high R&D intensive industries, most of the selected countries experienced a decrease in imports from and exports to China in 2023 compared to 2021. However, the high R&D intensive industries in Japan and the U.S. still import a considerable amount from China, leading to a large trade deficit. The U.S. trade balance ratio indicates that the country continues to have a trade deficit with China. In the latest year, it was 0.2, the lowest among its partner countries/regions shown here. The U.S. trade balance ratio with Japan was 0.8 in 2023, compared to 0.4 in 1990.

[Summary Chart 23] Trends in the value of industrial trade in the selected countries

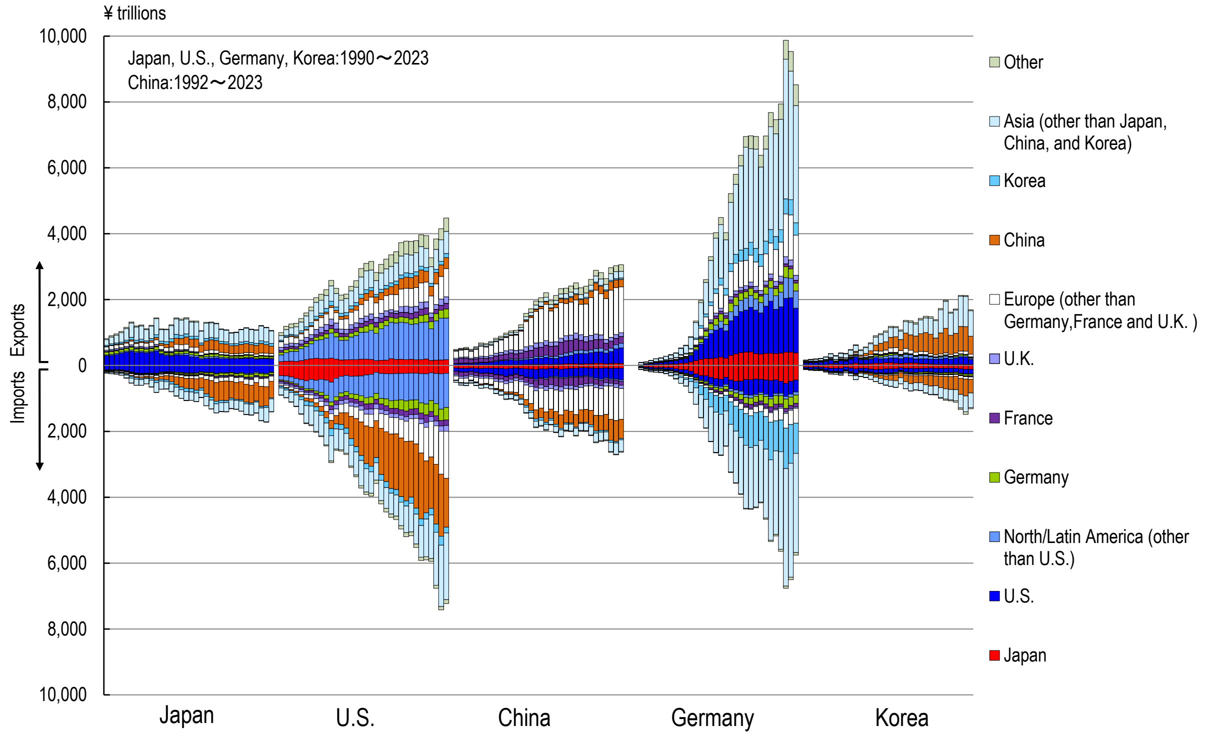
(A) Trade balance ratios for High R&D intensive industries



(B) Trade balance ratios for Medium-high R&D intensive industries



(C) Trading partner countries/regions for the high R&D intensive industries



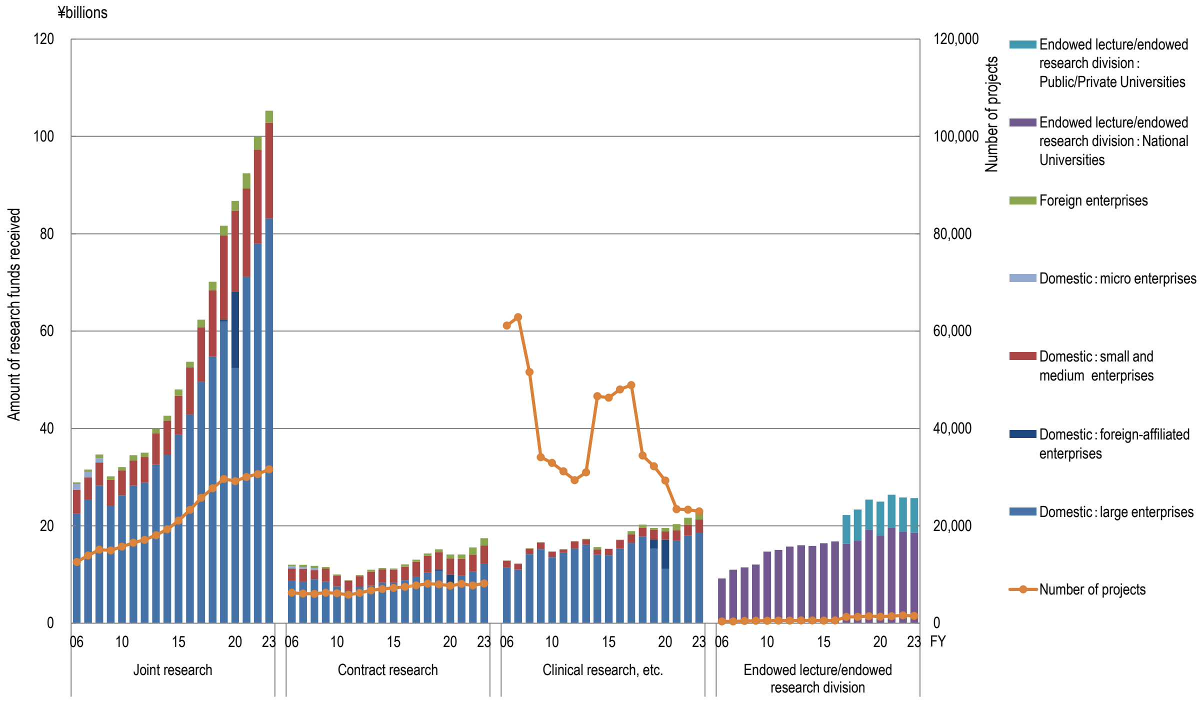
Note :
1) High R&D intensive industries refer to “pharmaceutical,” “computer, electronic and optical, ” and “aerospace.”
2) Medium high R&D intensive industries refer to “chemicals and chemical products,” “electrical equipment,” "machinery and equipment n.e.c.,” “motor vehicles, trailers and semi-trailers,” “railroad equipment and transport equipment n.e.c.,” and “other.”
3) Trade balance ratio = export value / import value
Reference: Chart 5-2-4,6, Column Chart 5 Japanese Science and Technology Indicators 2025 (in Japanese)

(2) The amount of "joint research" between Japanese universities and private business enterprises has continuously increased, reaching 105.3 billion yen in FY2023.

Among the changes in the funds received and the number of projects with private business enterprises, "joint research" was the largest in terms of both amount (105.3 billion yen) and number (32,000) of projects, respectively, in FY2023. Joint research projects were funded mainly by large enterprises, amounting to 83.2 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 FY2023, joint research increased significantly from 8.5% to 26.2% (indirect expenses: 21.9 billion yen), and contract research from 10.1% to 21.4% (indirect expenses: 3.1 billion yen).

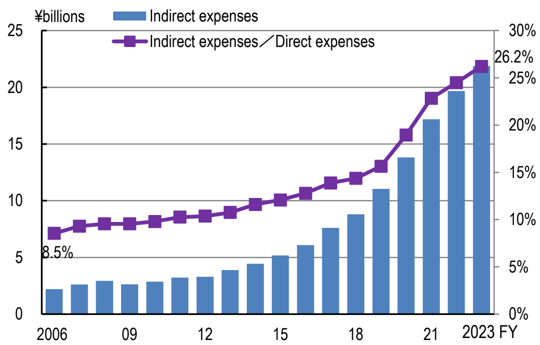
[Summary Chart 24] Changes in the funds received (breakdown) and number of projects implemented for joint research, etc., by Japanese universities and private business enterprises, etc.

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

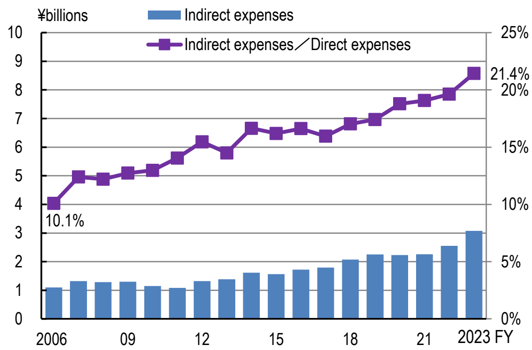


(B) Status of indirect expenses

(a)Joint research



(b)Contract research



Notes:
1) Joint research: Joint research and development by institutions and private business enterprises, 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 business enterprises, etc., the costs of which are paid for by the private business 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.

Reference: Chart 5-4-5, Japanese Science and Technology Indicators 2025 (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 selected countries and 2) the indicators should be able to be updated 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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