# Indicators Related to Regional Science, Technology, and Innovation

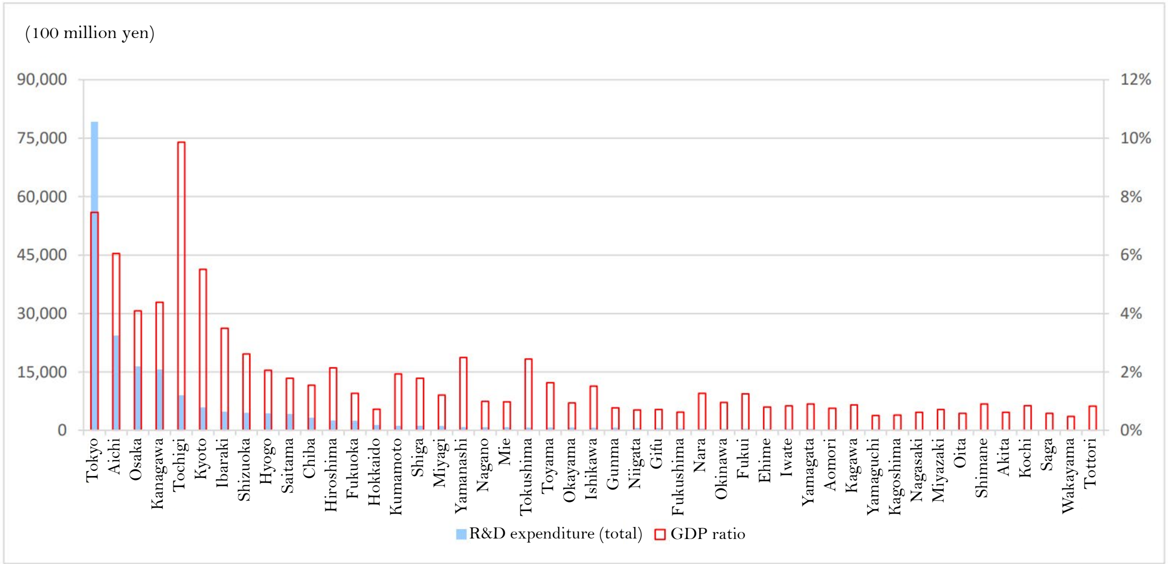
While Part 1 introduced initiatives in each region, Section 1 of this document will take a comprehensive look at various indicators related to each prefecture's science, technology, and innovation.

In addition, Section 2 will take a comprehensive look at indicators for Japan as a whole and show comparisons with other major countries.

## Section 1 Indicators Related to Regional Science, Technology, and Innovation

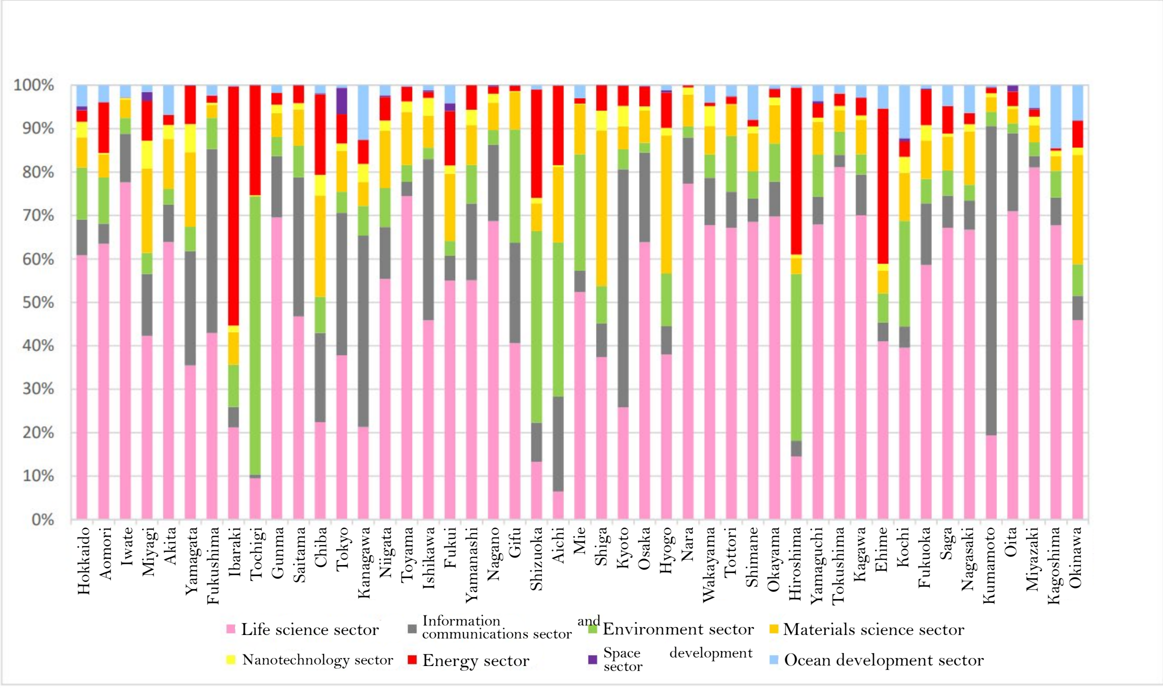
### Item 1: R&D Expenditure

■Figure D1-1/R&D expenditure and its ratio to gross prefectural product by prefecture (total, 2018)



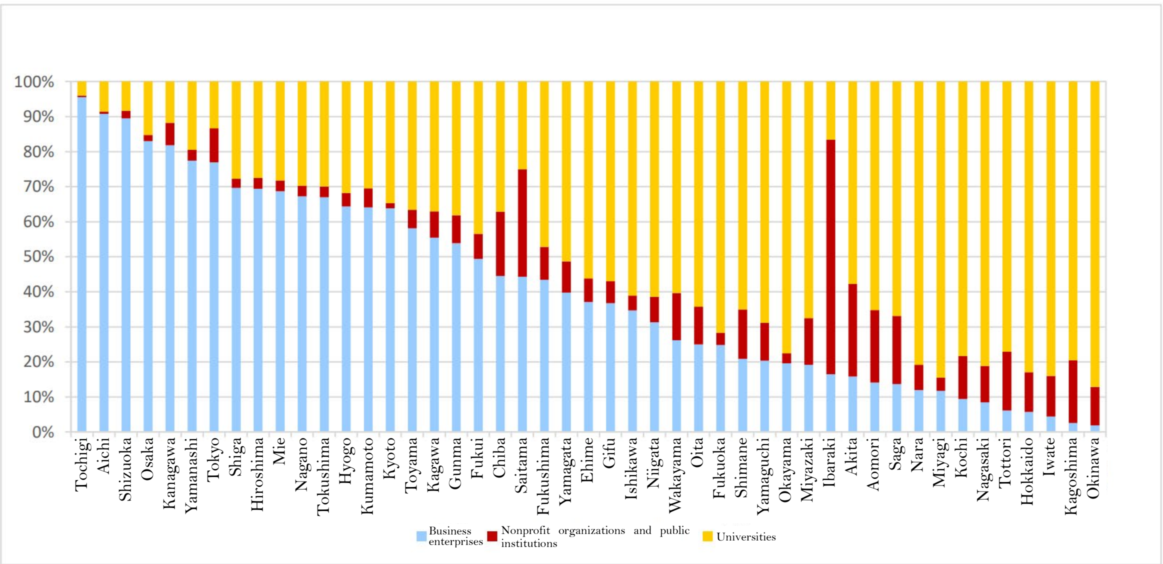

Note: R&D expenditure figures for enterprises are estimates.
Note: Gross prefectural product uses 2017 nominal figures.
Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

## ■Figure D1-2/Breakdown of R&D expenditure across eight specialized fields by prefecture (2018)



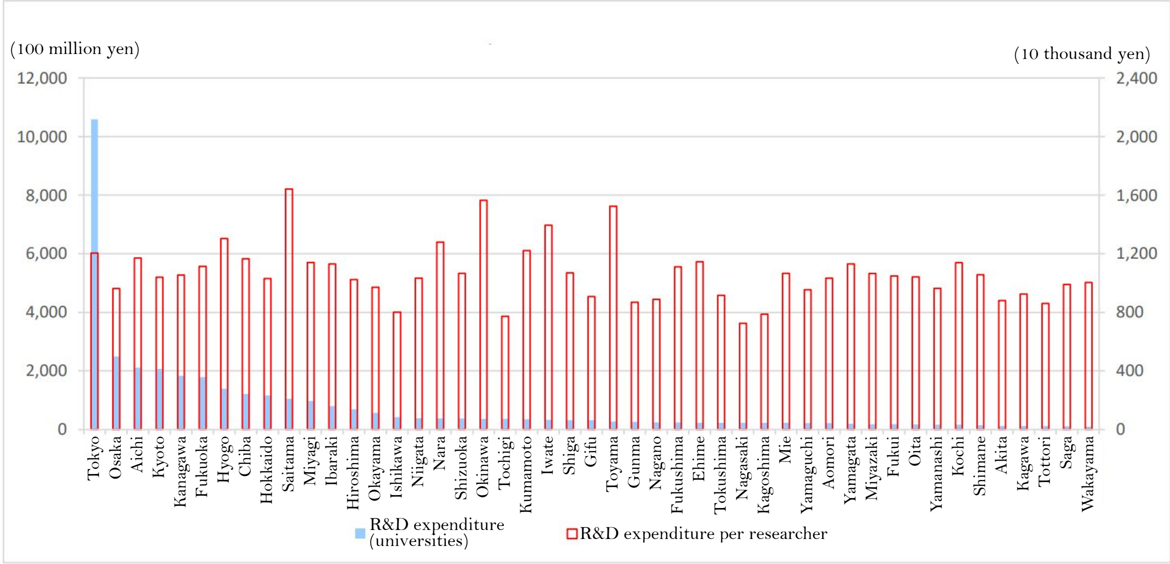

Note: R&D figures for enterprises are estimates.
Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

## ■Figure D1-3/Breakdown of organization-specific R&D expenditure by prefecture (2018)




Note: R&D figures for enterprises are estimates.
Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

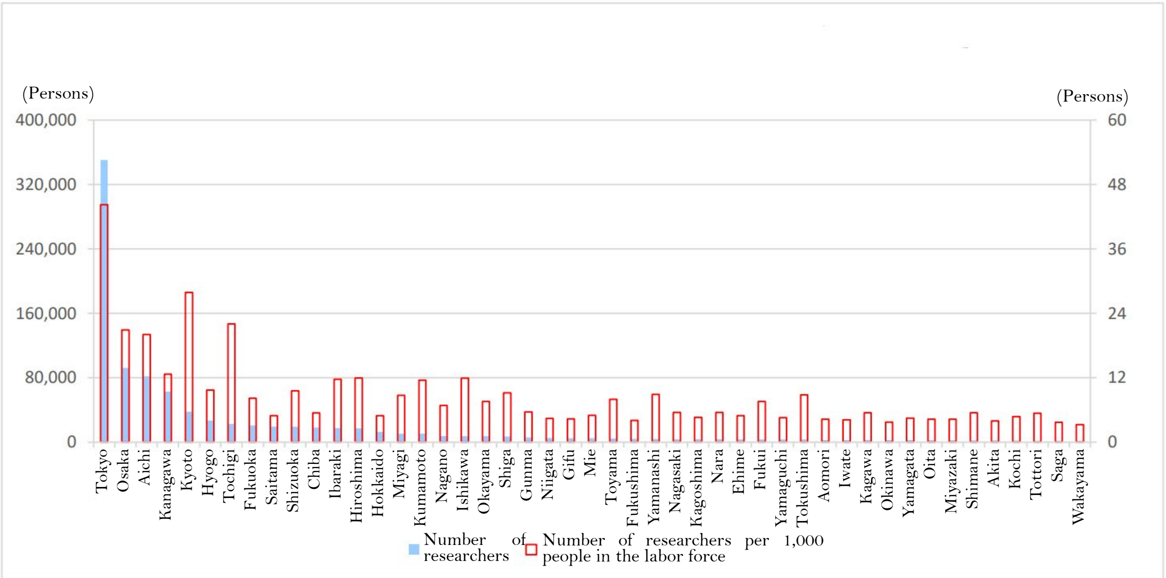
■Figure D1-4/Amount of R&D expenditure by prefecture (universities, 2018)




Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

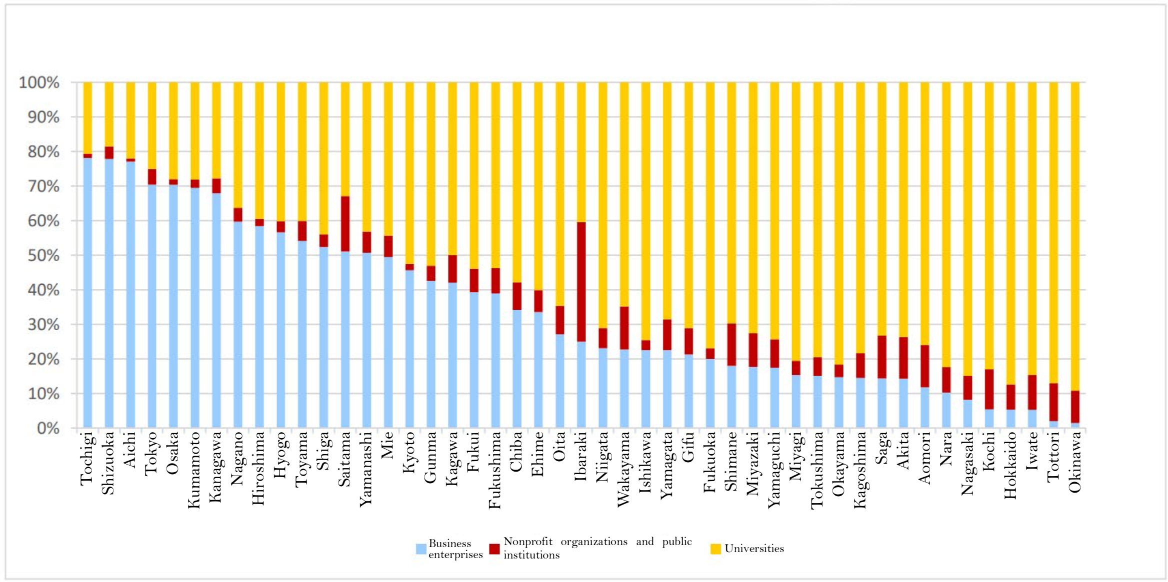
## Item 2: R&D Personnel

■Figure D1-5/Number of researchers and number of researchers per 1,000 people in the labor force by prefecture (total, 2018)



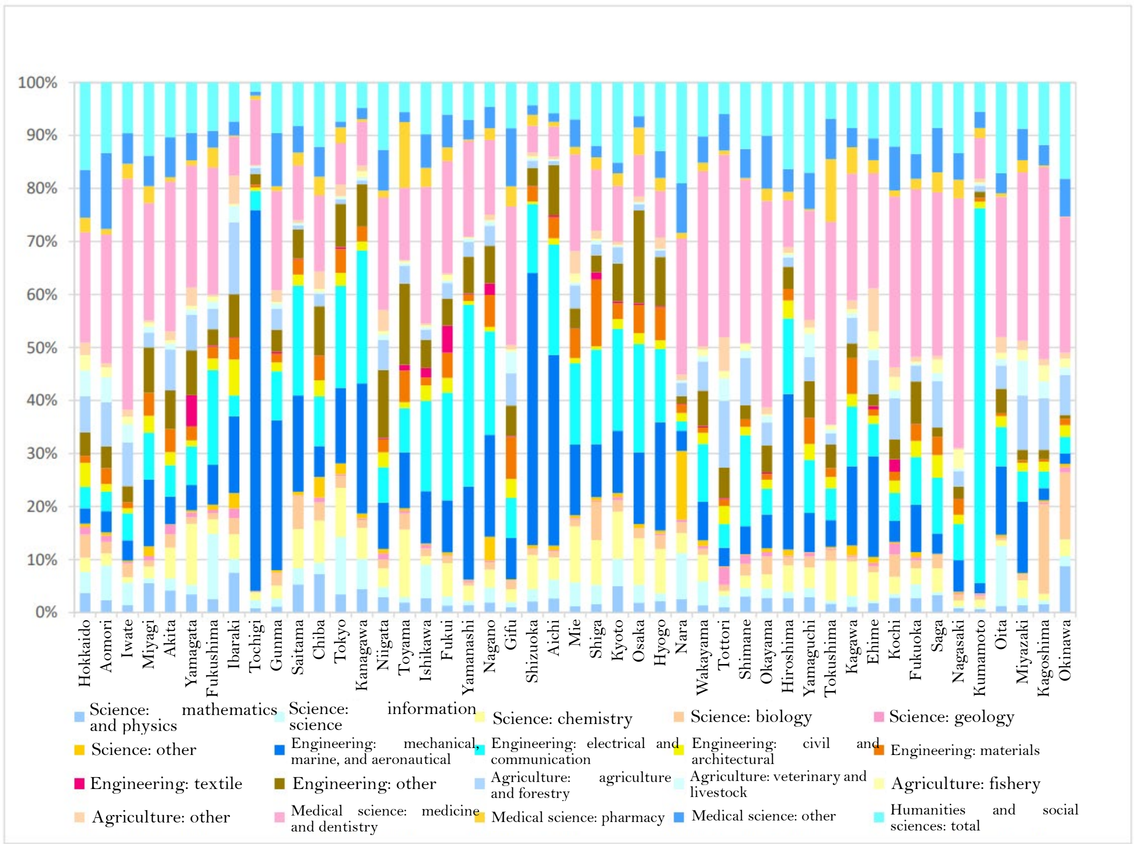

Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

## ■Figure D1-6/Breakdown of organization-specific numbers of researchers by prefecture (2018)



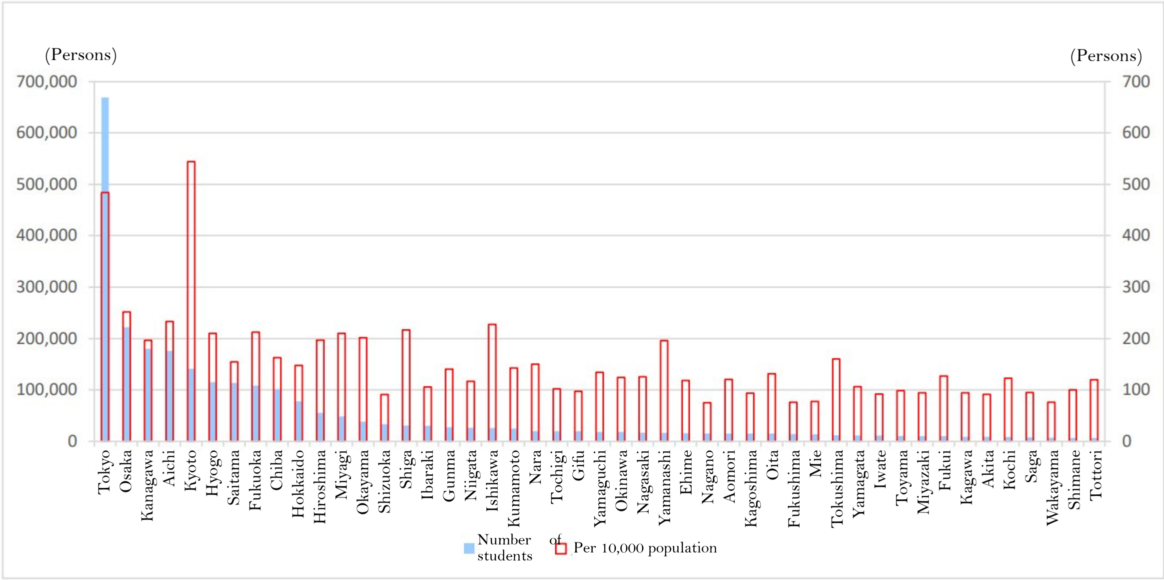

Note: R&D figures for enterprises are estimates.
Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

## ■Figure D1-7/Breakdown of specialized field-specific numbers of researchers (2018)




Note: R&D figures for enterprises are estimates.
Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

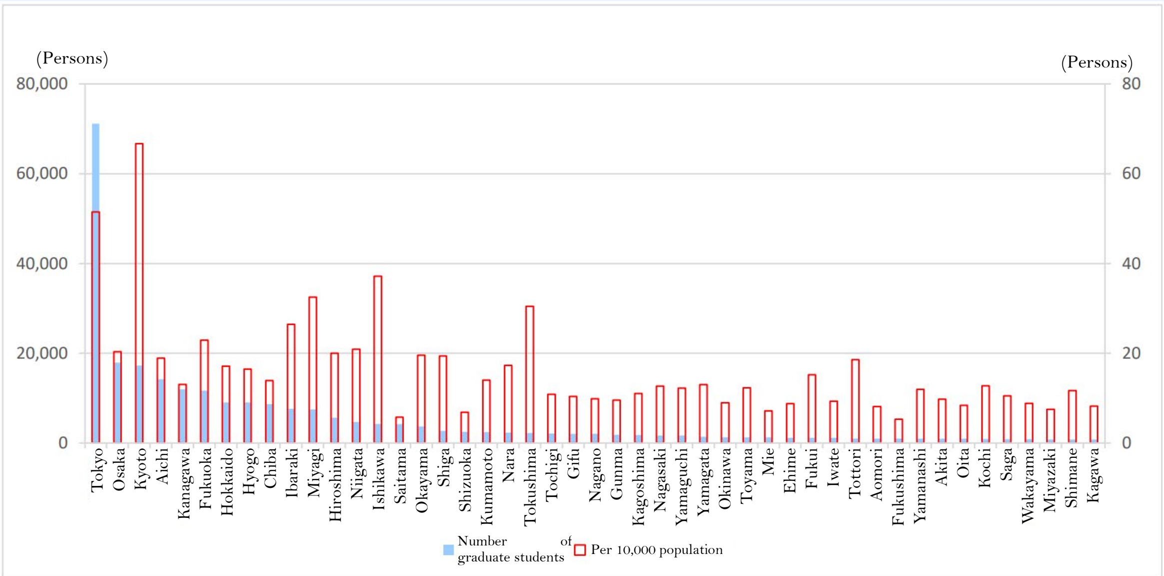
■Figure D1-8/Number of university students and number of university students per 10,000 population by prefecture (2018)




Note: Population is based on figures in 2018's "Population Estimates" by MIC.

Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

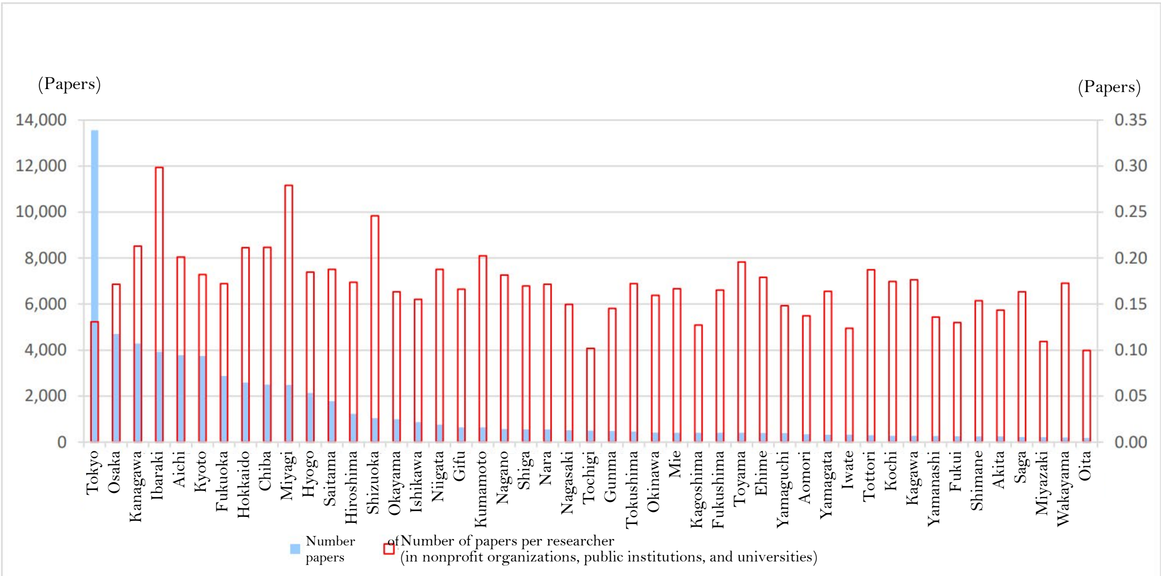
■Figure D1-9/Number of graduate students and number of graduate students per 10,000 population by prefecture (2018)




Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

## Item 3: Paper Index

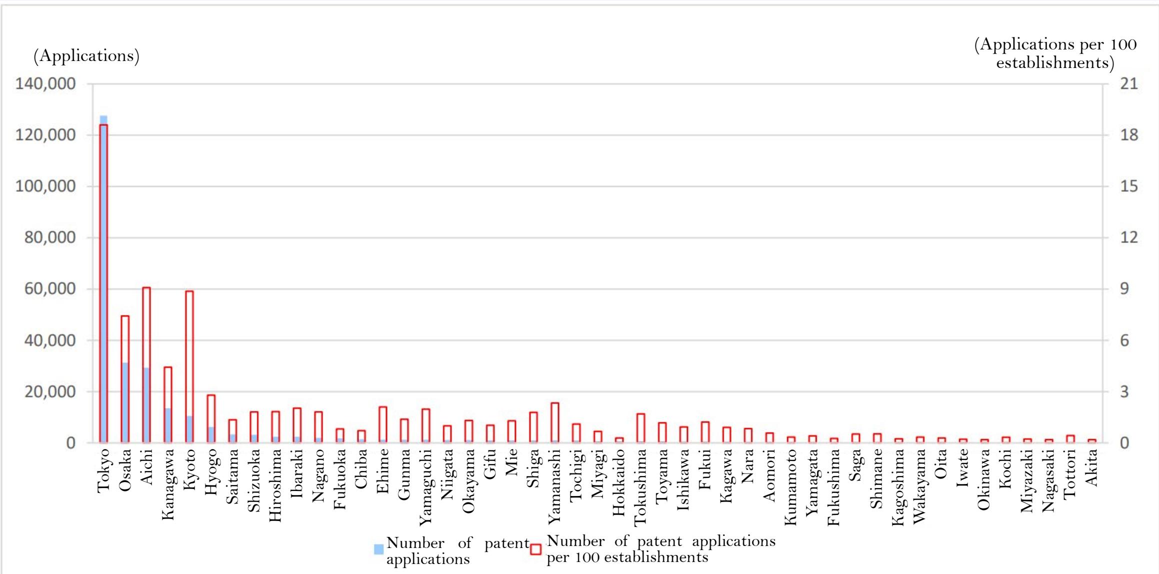
■Figure D1-10/Number of papers and number of papers per researcher (in nonprofit organizations, public institutions, and universities) by prefecture (2017 average)




Note: The 2017 average data are average figures for the 3-year period including the preceding and following years of 2016 and 2018, respectively.
Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

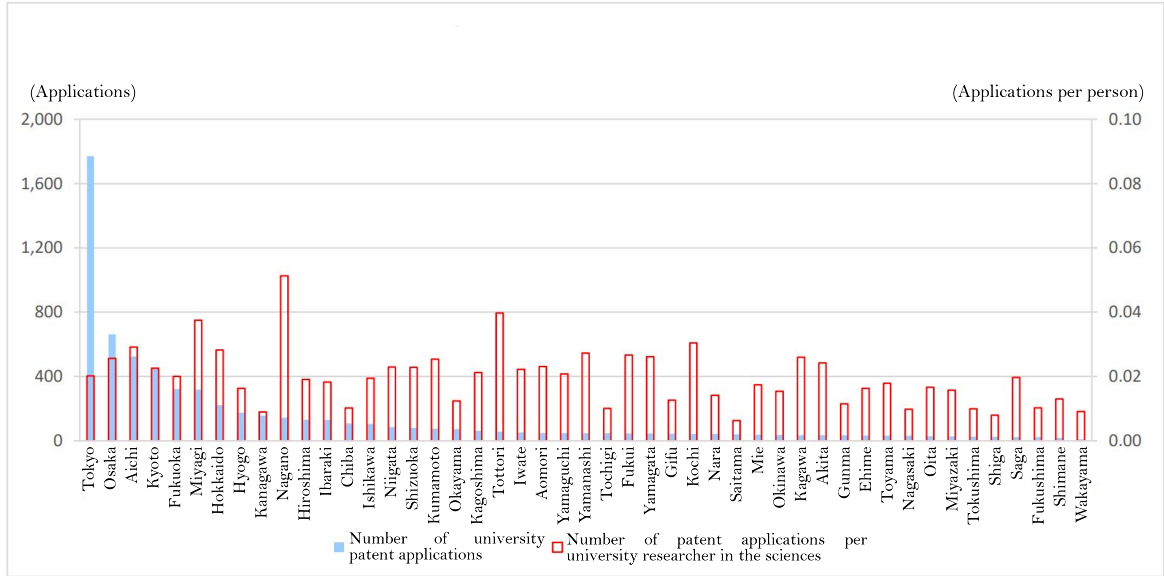
## Item 4: Patents and Industry-University Collaboration

■Figure D1-11/Number of patent applications and number of patent applications per 100 establishments by prefecture (2018)



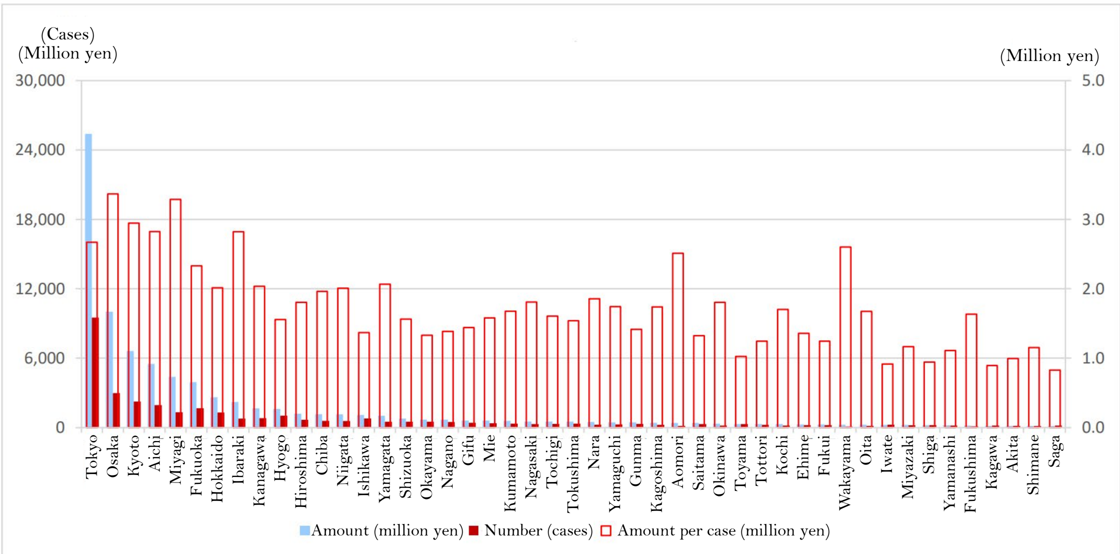

Note: The number of establishments is based on figures in the "2016 Economic Census for Business Activity" by MIC and METI.
Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

■Figure D1-12/Number of university patent applications and number of patent applications per university researcher in the sciences by prefecture (2018)



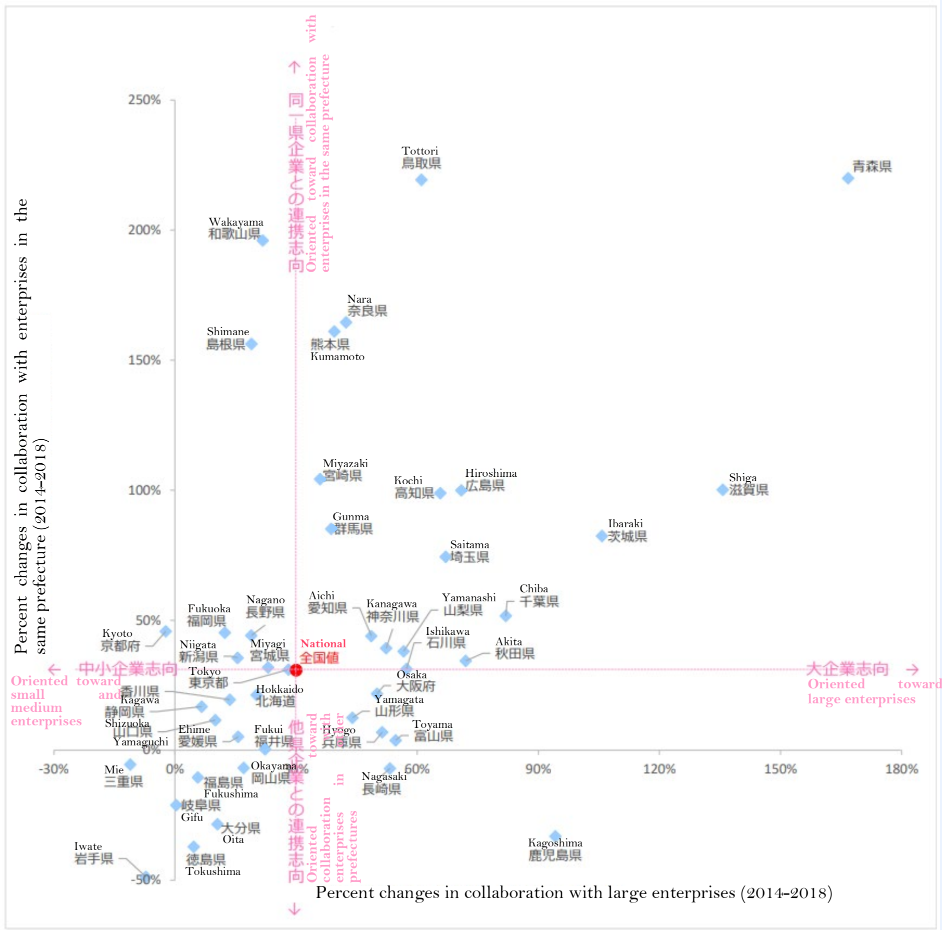

Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

■Figure D1-13/Amount of university research funds, etc., received from private enterprises and number of such cases by prefecture (2018)




Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

■Figure D1-14/Changes in the ratios of private enterprise collaboration with large enterprises and with enterprises in the same prefecture (amount, 2014-2018)

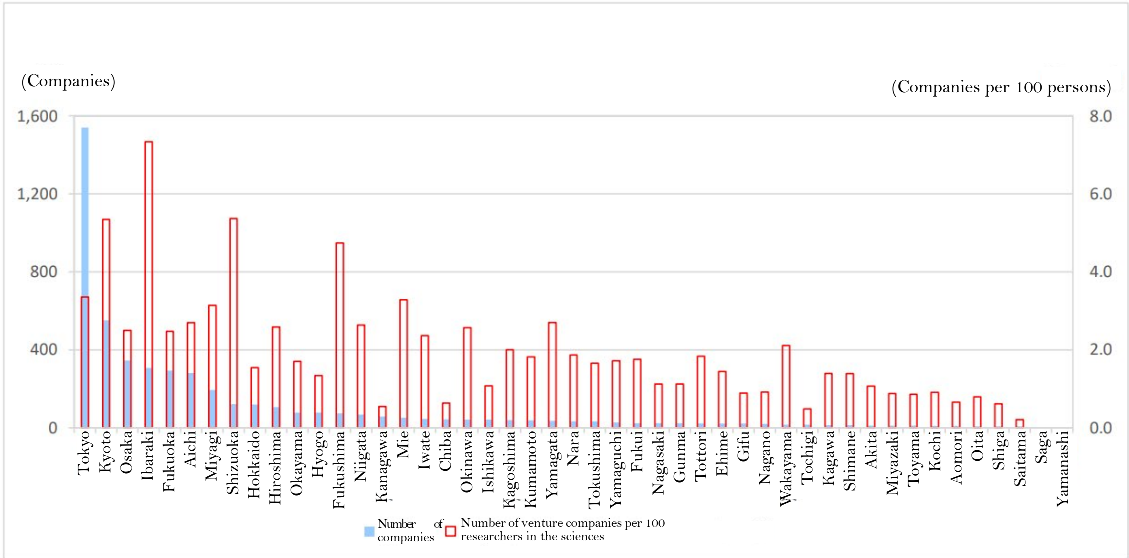



Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

■Figure D1-15/Relationship between the ratios of collaboration with large enterprises and with enterprises in the same prefecture (number of cases, 2018)


Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

■Figure D1-16/Number of university-launched venture companies and number of university-launched venture companies per 100 university researchers in the sciences (2018)



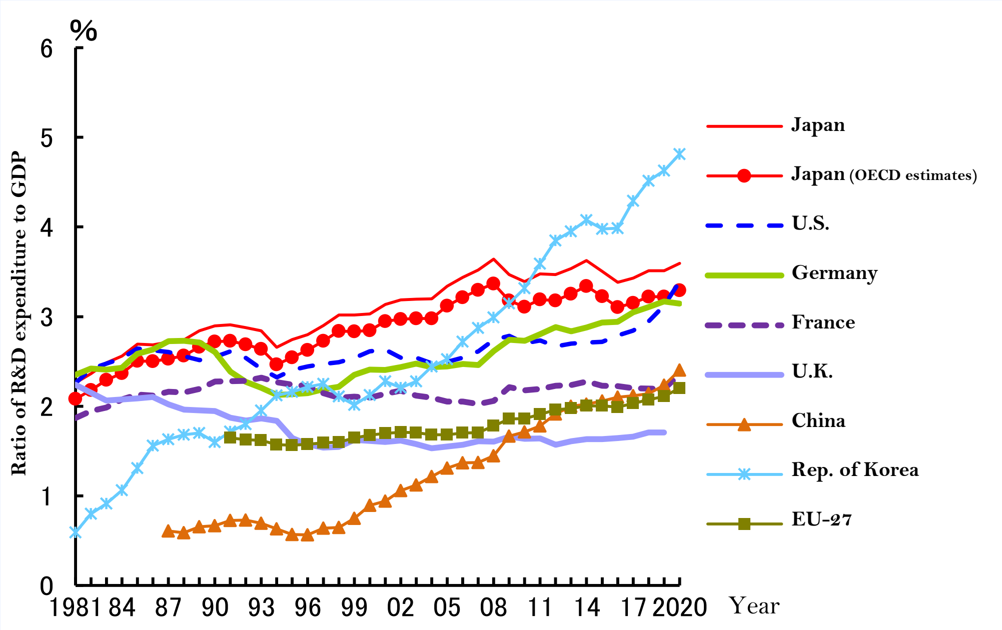

Source: "Regional Science and Technology Indicators 2020," NISTEP, MEXT

Section 2 | Indicators Related to Japanese Science, Technology, and Innovation

## Item 1: R&D Expenditure

### 1. Changes in the Ratio of Total R&D Expenditure to GDP

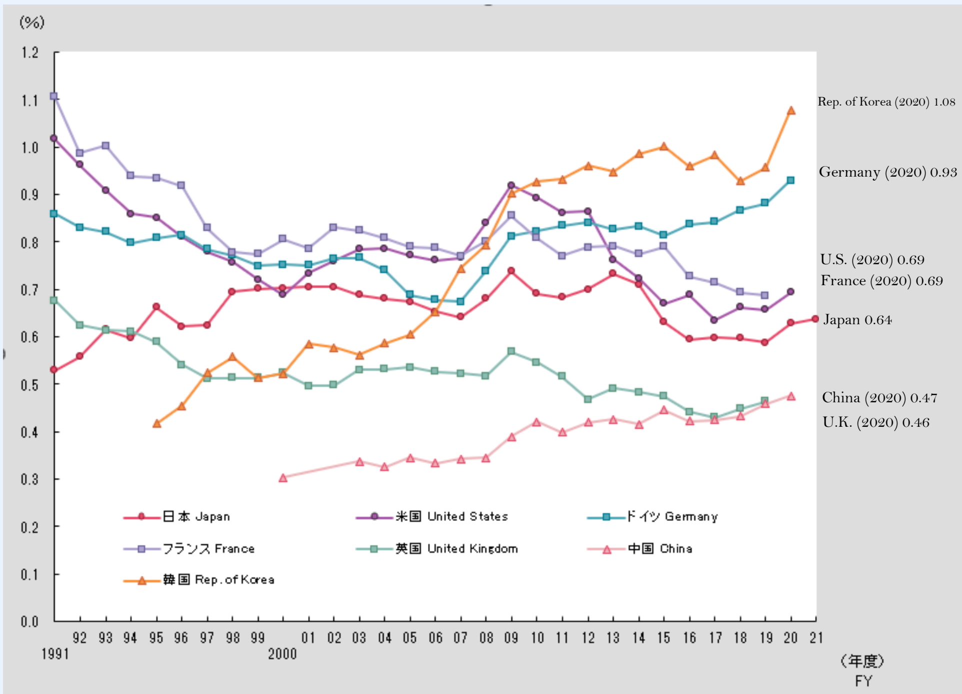
■Figure D1-17/Changes in the ratio of total R&D expenditure to GDP in major countries




Source: "Japanese Science and Technology Indicators 2022," NISTEP, MEXT

## 2. Changes in the Ratio of Government-Funded Research Expenditure to GDP in Major Countries

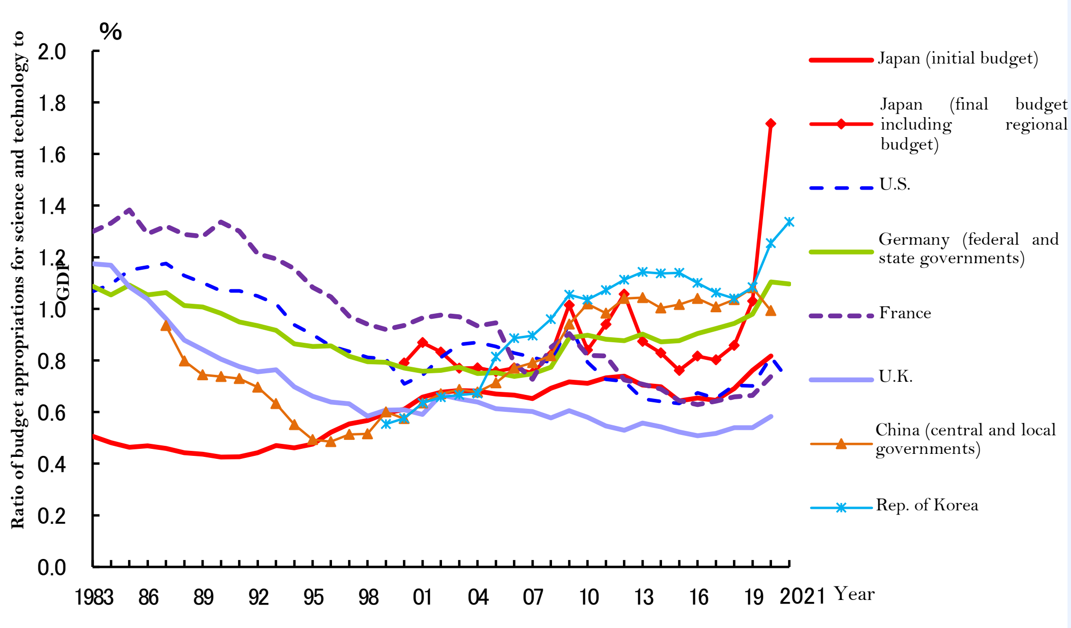
■Figure D1-18/Changes in the ratio of government-funded research expenditure to GDP in major countries, etc.




Source: Prepared by MEXT based on the "Indicators of Science and Technology 2022" by MEXT

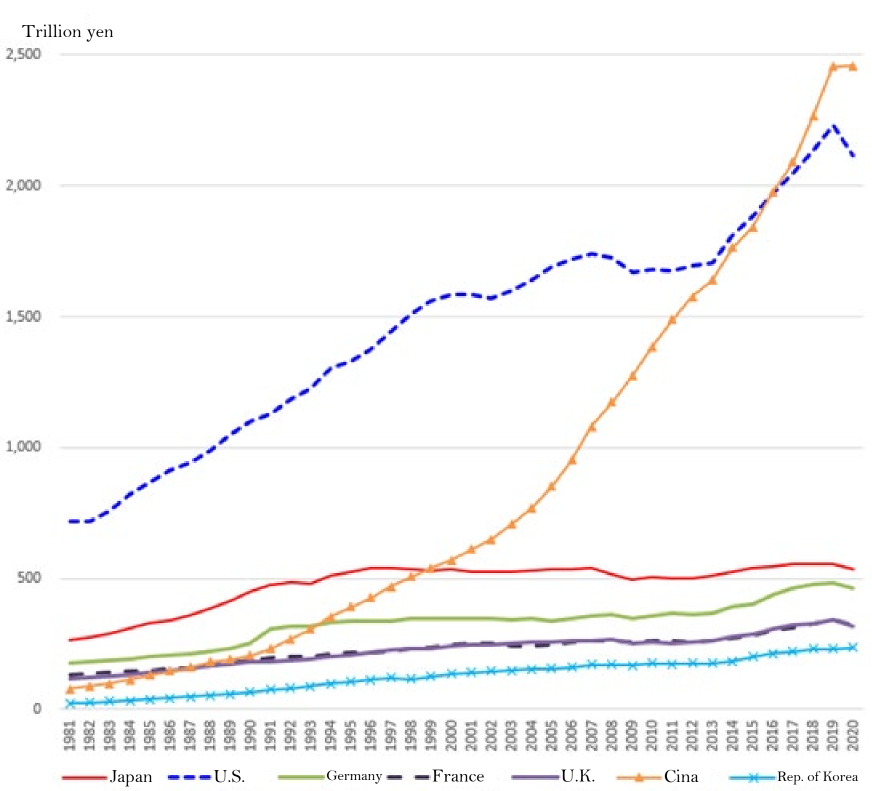
## 3. Changes in the Ratio of Government Budget Appropriations for Science and Technology to GDP in Major Countries

■Figure D1-19/Changes in the ratio of government budget appropriations for science and technology to GDP in major countries




Source: "Japanese Science and Technology Indicators 2022," NISTEP, MEXT

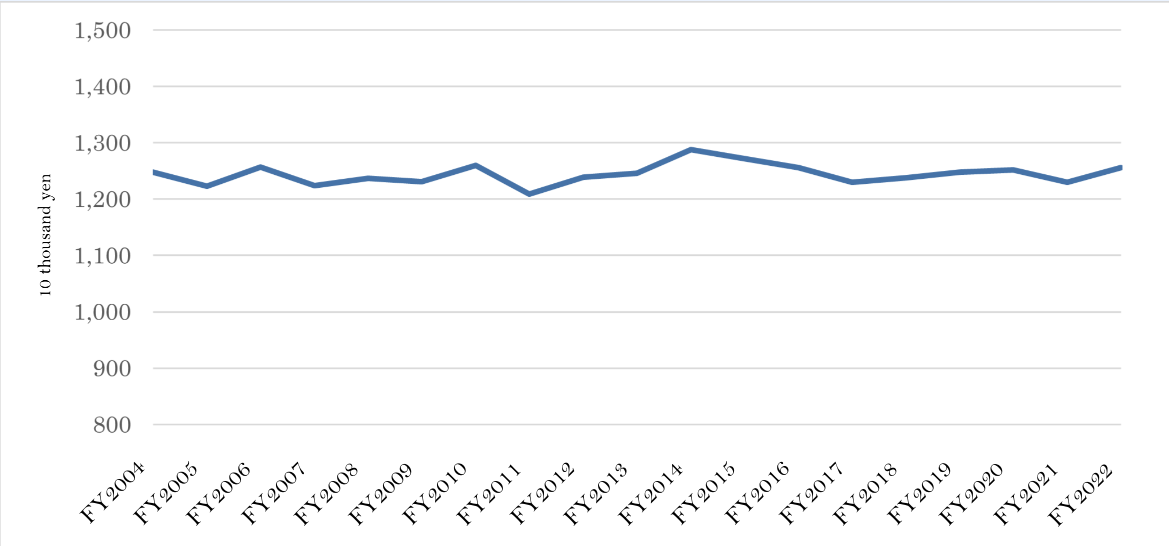
■Figure D1-20/Changes in the gross domestic product (GDP) of major countries (OECD purchasing power parity equivalent)




Source: Prepared by MEXT based on the NISTEP "Japanese Science and Technology Indicators 2022"

## 4. Research Expenditure per Full-time Researcher in the University Sector

■Figure D1-21/Changes in research expenditure per full-time researcher

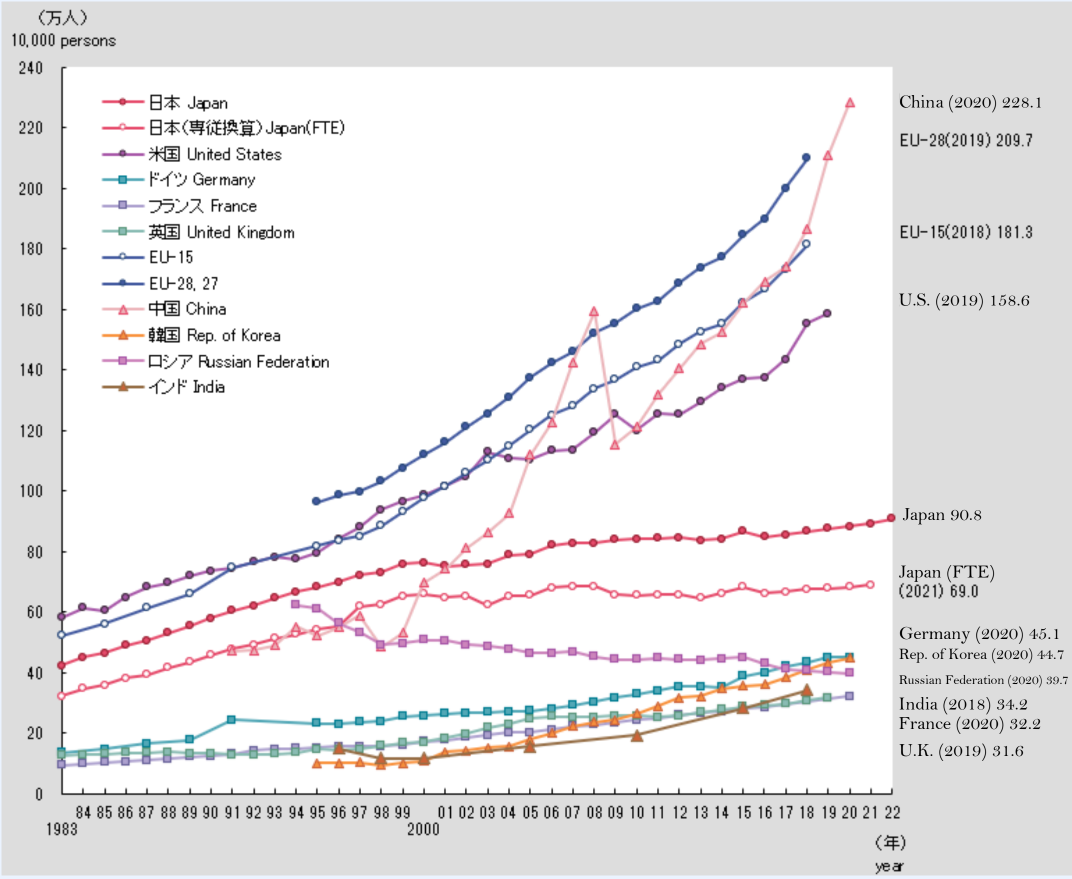



Source: Prepared by MEXT based on the "Report on the Survey of Research and Development" by MIC

## Item 2: Research Personnel

### 1. Number of Researchers Taking into Account the Ratio of Time Spent on Research

**■Figure D1-22/Changes in the number of researchers in major countries, etc.**



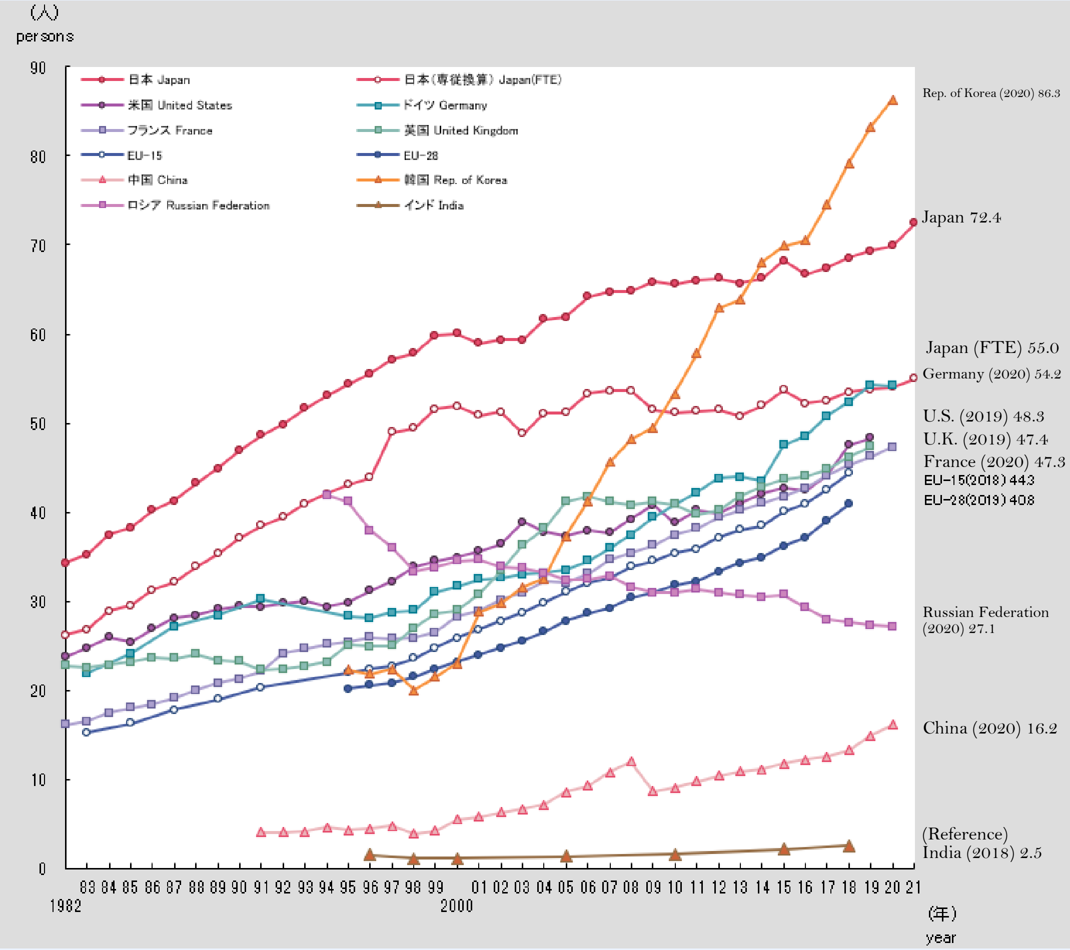

Source: “Indicators of Science and Technology 2022” by MEXT

Note: 1. Researchers in humanities and social sciences are included for each country. However, they were not included until 2006 for the Rep. of Korea.

2. The figures for Japan are as of April 1 for 2001 and earlier, and as of March 31 for 2002 and later.
3. Japan’s full-time equivalent figures are OECD estimates until 1995.
4. The number of researchers in China does not comply with the Frascati Manual of the OECD until 2008.
5. The figures for the U.S. for 2000 and later are OECD estimates.
6. The figures for Germany for 1996, 1998, 2000, 2002, 2008, and 2010 are estimates.
7. The figures for France for 2012 and 2013 are estimates, while those for 2020 are estimates and provisional figures.
8. The figures for the U.K. until 1983 show the total number of employees in industry (scientists and engineers) and national research institutions (degree-holding researchers and above) and do not include universities and private research institutions.
   The figures for 1999-2010, 2012, 2014, 2016, and 2018 are estimates.
9. The figures for the EU are OECD estimates.

Source: Japan / (Number of researchers) “Report on the Survey of Research and Development” by MIC’s Statistics Bureau
Japan / (Full-time equivalent figures) Vol. 2023/2 of the “Main Science and Technology Indicators” by the OECD
India / UNESCO Institute for Statistics S&T database
Other countries / Vol. 2023/2 of the “Main Science and Technology Indicators” by the OECD

■Figure D1-23/Changes in the number of researchers per 10,000 population in major countries, etc.




Source: "Indicators of Science and Technology 2022" by MEXT

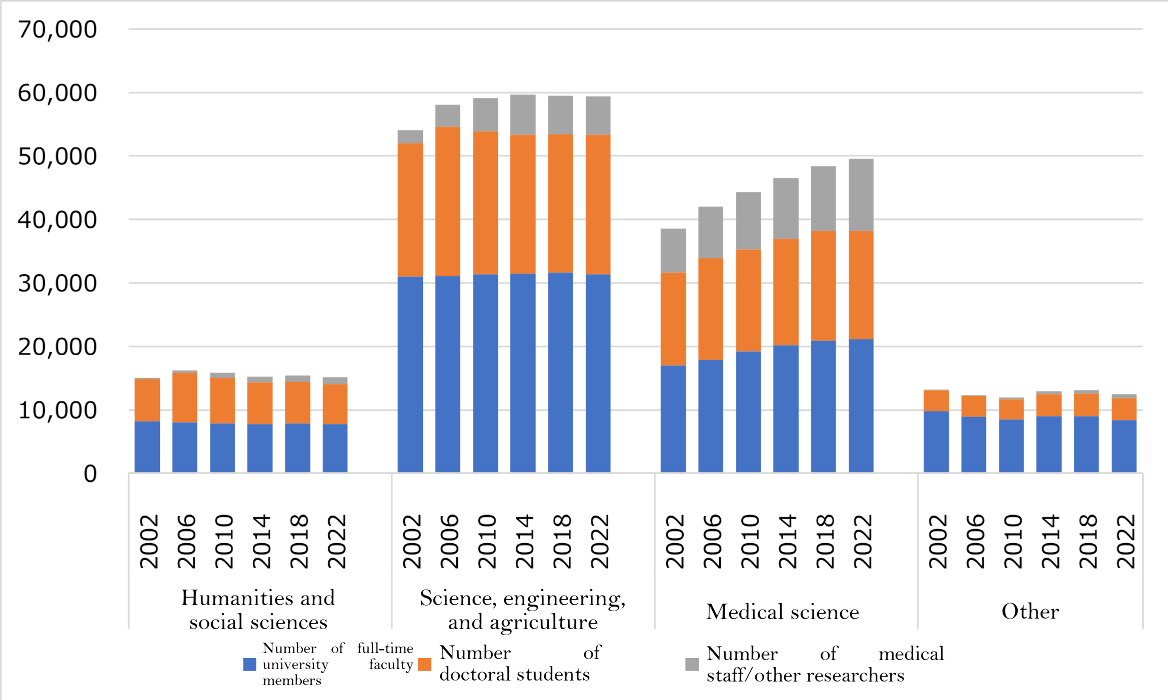
Note: 1. Researchers in humanities and social sciences are included for each country. However, they were not included until 2006 for the Rep. of Korea.

2. The number of researchers per 10,000 population is estimated by MEXT based on the population and number of researchers.
3. The number of researchers in Japan is as of April 1 for 2001 and earlier, and as of March 31 for 2002 and later.
4. The full-time equivalent figures for Japan are OECD estimates until 1995.
5. The number of researchers in the U.S. for 2000 and later is an OECD estimate.
6. The number of researchers in the EU is an OECD estimate.
7. The figures for Germany for 1996, 1998, 2000, and 2010 are estimates.
8. The figures for France for 2012, 2013, and 2019 are estimates, while those for 2017 and 2018 are provisional figures.
9. The number of researchers in the U.K. until 1983 shows the total number of employees in industry (scientists and engineers) and national research institutions (degree-holding researchers and above) and does not include universities and private research institutions. The figures for 1999-2010, 2012, 2014, and 2016-18 are OECD estimates, while those for 2019 are provisional figures.
10. The number of researchers in China does not comply with the Frascati Manual of the OECD until 2008.
11. The number of researchers in India is per 10,000 residents.

Source: Japan / (Number of researchers) "Report on the Survey of Research and Development" by MIC's Statistics Bureau
(Full-time equivalent figures) Vol. 2022/1 of the "Main Science and Technology Indicators" by the OECD
(Population) "Population Estimates Series" by MIC's Statistics Bureau (as of October 1 of each year)
India / UNESCO Institute for Statistics S&T database
Other countries / Vol. 2022/1 of the "Main Science and Technology Indicators" by the OECD

2. Number of Researchers by Field at National Universities, etc.

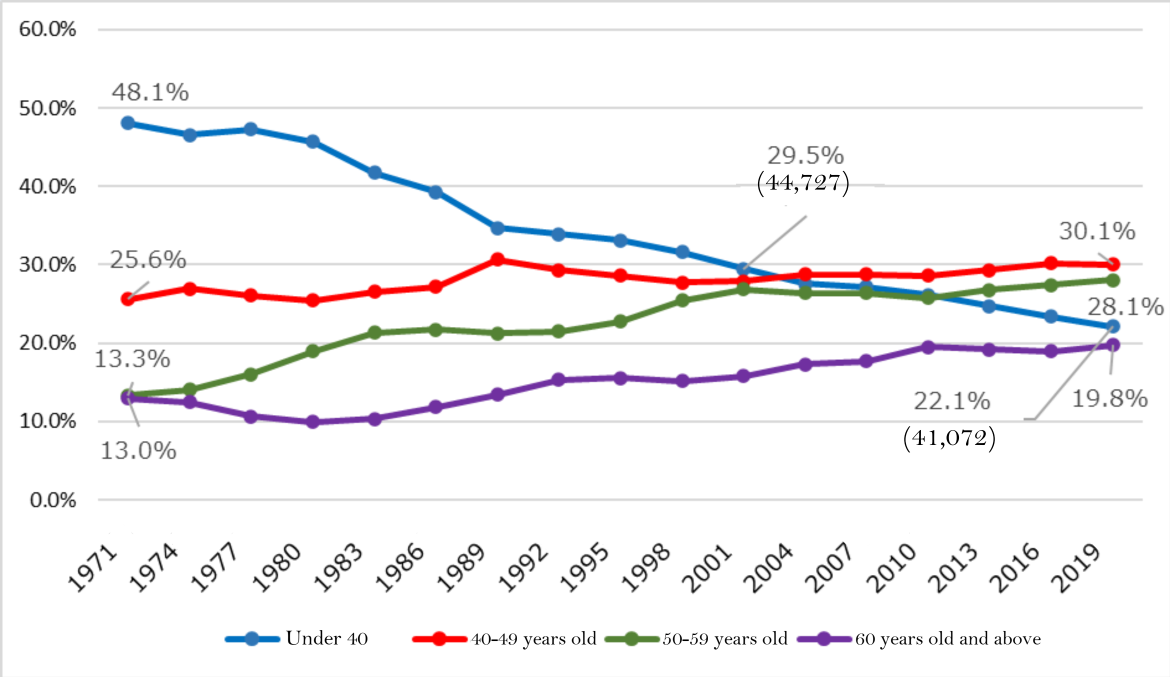
■ Figure D1-24/Changes in the number of researchers by field at national universities, etc.




Source: Prepared by MEXT based on the "Report on the Survey of Research and Development" by MIC

### 3. Percentage of Full-time University Faculty Members by Age Group

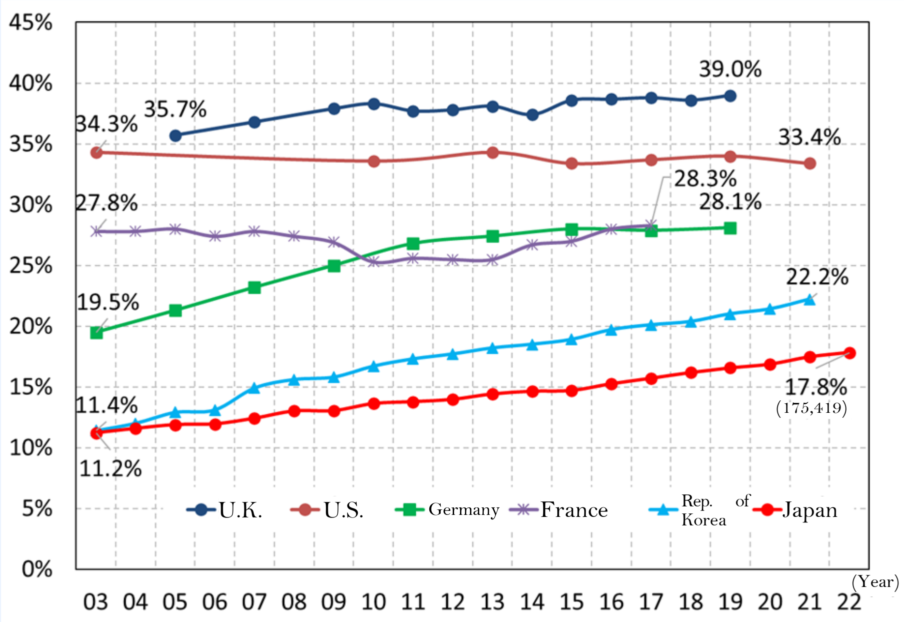
■Figure D1-25/Changes in the percentage of full-time university faculty members by age group




Source: Prepared by MEXT based on the "School Teachers Survey" by MEXT

## 4. Percentage of Female Researchers

■Figure D1-26/Percentage of female researchers in various foreign countries




Note: 1. Data for the U.S. are the percentages of women who, of scientific and engineering occupations (S&E occupations), are scientists and who are employed with a bachelor's degree or higher (Scientific occupations include biologists and life scientists, computer and information scientists, mathematical scientists, physical chemists, psychologists, and social scientists. Engineering occupations include aerospace engineers, chemical engineers, civil engineers, electrical engineers, industrial engineers, mechanical engineers, other engineers, and educators in higher education.)

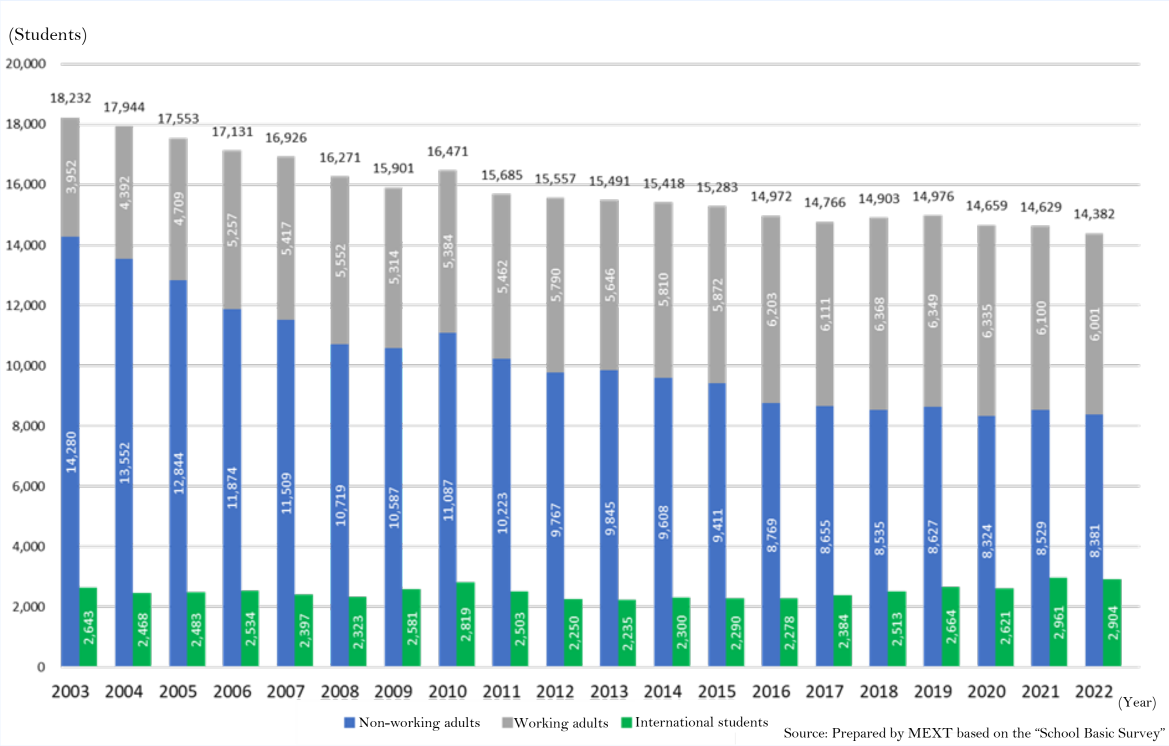
Note: 2. A "researcher" in Japan refers to persons who have completed a course in a university (excluding junior college) or who have specialized knowledge equivalent to or superior to such courses and are conducting research on a specific theme. In addition to universities, researchers from public institutions and business enterprises, etc., have also been included in the survey.

Note: 3. When surveying and counting researchers in Japanese universities, in addition to university faculty members (professors, associate professors, lecturers, and assistant professors), medical staff, those enrolled in graduate school doctoral programs, etc., have been included.

Source: Japan / "Report on the Survey of Research and Development" by MIC
U.S. / "Science and Engineering Indicator" by the NSF
Other countries / Prepared by MEXT based on the "Main Science and Technology Indicators" by the OECD

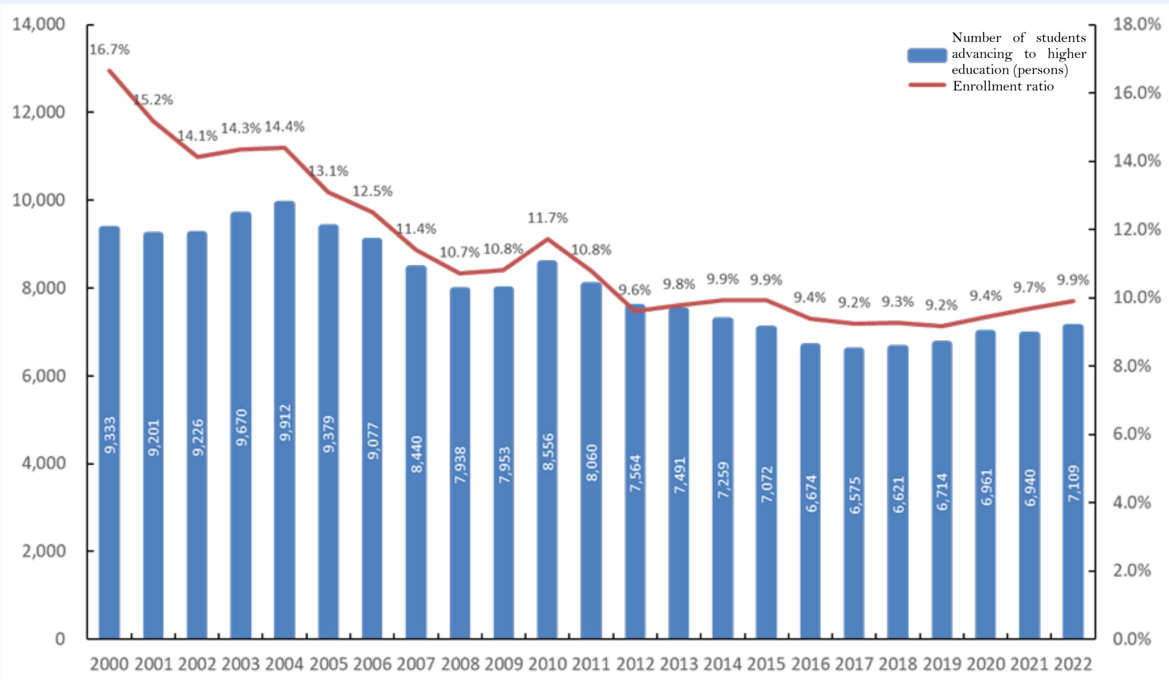
## 5. Number of Students Enrolled in Doctoral Courses

### ■Figure D1-27/Changes in the number of students enrolled in doctoral courses




Source: Prepared by MEXT based on the "School Basic Statistics" by MEXT

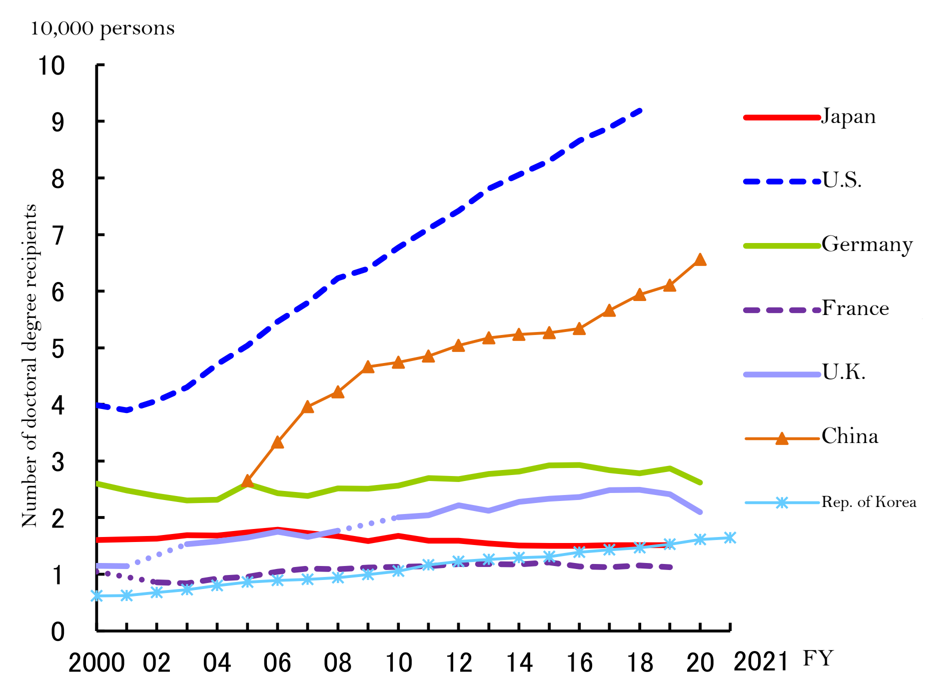
### ■Figure D1-28/Changes in the number and percentage of students advancing from master's courses to doctoral courses, etc.




Source: Prepared by MEXT based on the "School Basic Statistics" by MEXT

## 6. Number of Doctoral Degree Recipients per Population

■Figure D1-29/International comparison of doctoral degree recipients per million population

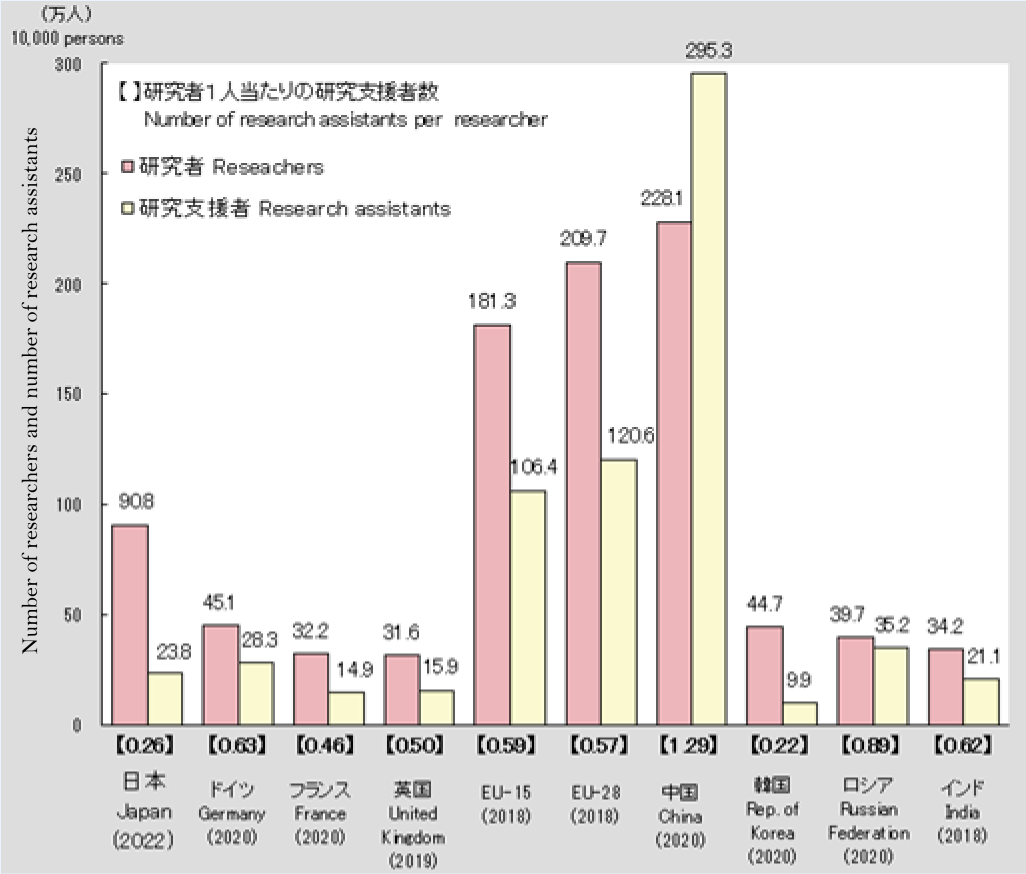



Note: The number of doctoral degree recipients in the U.S. is the value calculated by subtracting all the figures for "professional fields" (formerly referred to as first-professional degrees) from the figures for "doctor's degrees" stated in the "Digest of Education Statistics."

Source: "Japanese Science and Technology Indicators 2022," NISTEP, MEXT

## 7. Number of Research Assistants

■Figure D1-30/Number of research assistants per researcher in major countries, etc.




Source: "Indicators of Science and Technology 2022" by MEXT

Note: 1. The number of research assistants per researcher is estimated by MEXT based on the number of researchers and research assistants.
2. Research assistants in humanities and social sciences are included for each country.
3. Research assistants refer to people who assist researchers, people who provide technical services that add value to research, and people employed in research administration, who in Japan are referred to as assistant research workers, technicians, and clerical and other supporting personnel.
4. The figures for France are estimates.
5. The figures for the U.K. are estimates, and they underestimate the number of research assistants.
6. The figures for the EU are OECD estimates.

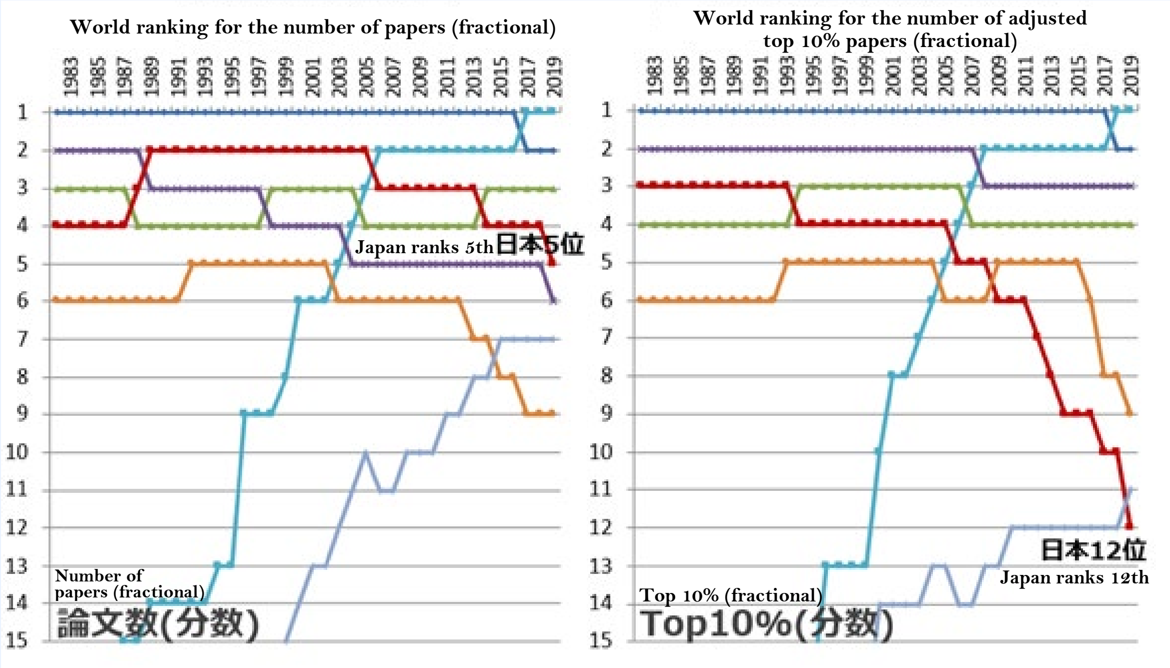
Source: "Report on the Survey of Research and Development" by MIC's Statistics Bureau
India / UNESCO Institute for Statistics S&T database
Other countries / Vol. 2023/2 of the "Main Science and Technology Indicators" by the OECD

## Item 3: Paper Index[1]

### 1. World Ranking in Number of Papers

■D1-31/Changes in the world ranking of major countries for the number of papers and number of adjusted top 10% papers

Comparison with the year 2000: (Number of papers) 2nd → 5th; (Number of adjusted top 10% papers) 4th → 12th




Note: 1. Articles and Reviews are included in the analysis and analyzed using the fractional counting method. Moving average over 3 years is shown; the 2019 world ranking is the average for 2018-2020.

Note: 2. The number of top 10% papers is the number of papers in the top 10% of each field (22 fields) for each year in terms of the number of citations of papers (2021 year-end figures). The number of adjusted top 10% papers is obtained by adjusting the top 10% papers so that they total to one-tenth of all papers.

Source: Aggregated by NISTEP based on Clarivate Web of Science XML (SCIE, 2021 Year-end version)

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[1] The number of papers referred to in this item includes only the papers in the field of natural sciences.

■Table D1-32/Number of papers and number of adjusted top 10% papers by country: top countries (natural sciences, fractional counting)

| All fields | 2018-2020 (PY) (average) | | |
|---|---|---|---|
| | Number of papers | | |
| Country/ region name | Fractional counting | | |
| | Number of papers | Share | Ranking |
| China | 407,181 | 23.4 | 1 |
| U.S. | 293,434 | 16.8 | 2 |
| Germany | 69,766 | 4.0 | 3 |
| India | 69,067 | 4.0 | 4 |
| Japan | 67,688 | 3.9 | 5 |
| U.K. | 65,464 | 3.8 | 6 |
| Rep. of Korea | 53,310 | 3.1 | 7 |
| Italy | 52,110 | 3.0 | 8 |
| France | 45,364 | 2.6 | 9 |
| Canada | 43,560 | 2.5 | 10 |

| All fields | 2018-2020 (PY) (average) | | |
|---|---|---|---|
| | Number of adjusted top 10% papers | | |
| Country/ region name | Fractional counting | | |
| | Number of papers | Share | Ranking |
| China | 46,352 | 26.6 | 1 |
| U.S. | 36,680 | 21.1 | 2 |
| U.K. | 8,772 | 5.0 | 3 |
| Germany | 7,246 | 4.2 | 4 |
| Italy | 6,073 | 3.5 | 5 |
| Australia | 5,099 | 2.9 | 6 |
| India | 4,926 | 2.8 | 7 |
| Canada | 4,509 | 2.6 | 8 |
| ⋮ | ⋮ | ⋮ | ⋮ |
| Japan | 3,780 | 2.2 | 12 |

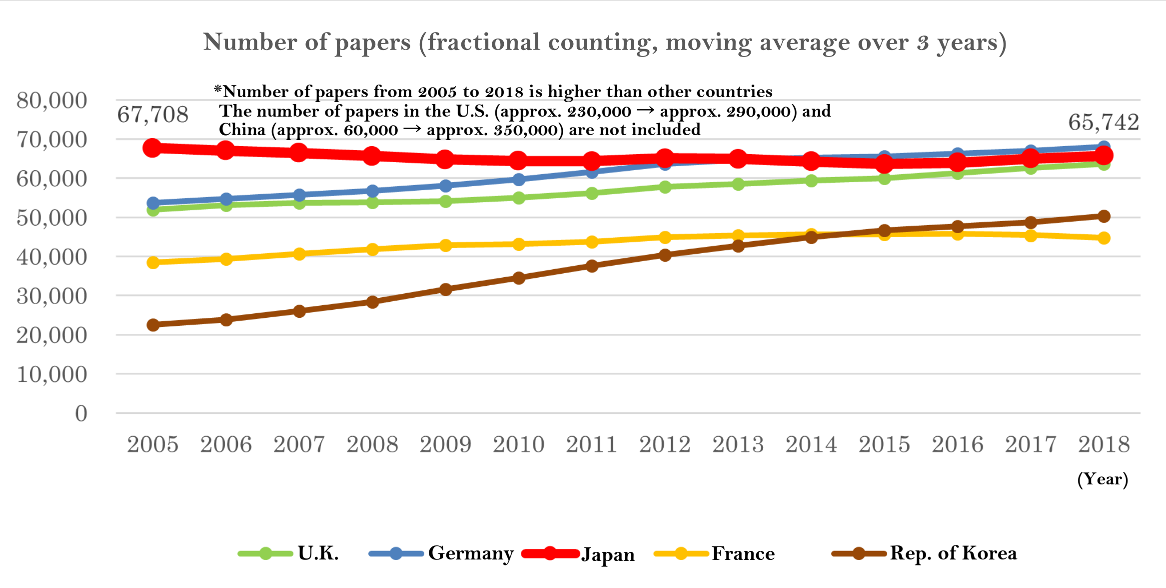
Source: Prepared by MEXT based on the NISTEP "Japanese Science and Technology Indicators 2022"

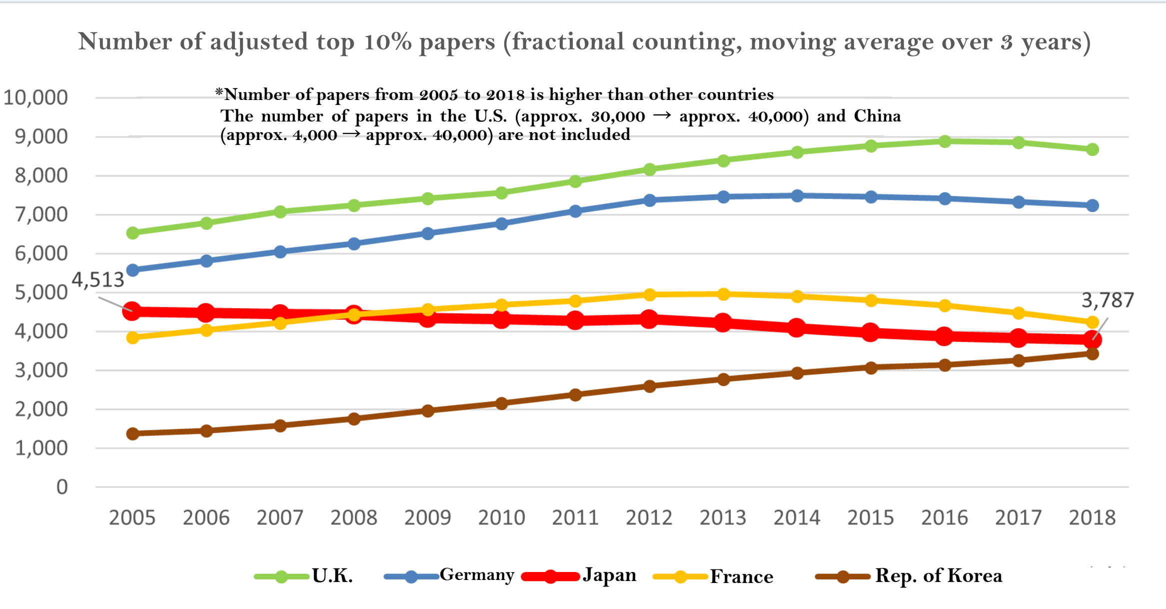
## What are Whole Counting and Fractional Counting?

Whole counting and fractional counting are methods for counting papers. Whole counting is an aggregation by country based on the presence or absence of involvement. For example, in the case of a paper co-authored by University A in Japan, University B in Japan, and University C in the U.S., one paper is counted for each of Japan and the U.S. Thus, this method is used to measure "the degree of participation in the production of papers in the world (amount of participation in the process of producing papers)." On the other hand, fractional counting is an aggregation by country weighted at the institutional level. For example, if a paper is co-authored by University A in Japan, University B in Japan, and University C in the U.S., each institution is given a weight of one-third. The national totals would be two-thirds for Japan and one-third for the U.S. Thus, this method is used to measure "the degree of contribution to the production of papers in the world (how much contribution was made for one paper)."

## 2. Changes in the Number of Papers and Number of Adjusted Top 10% Papers

■Figure D1-33/Changes in the number of papers and number of adjusted top 10% papers of major countries (moving average over 3 years, fractional counting)

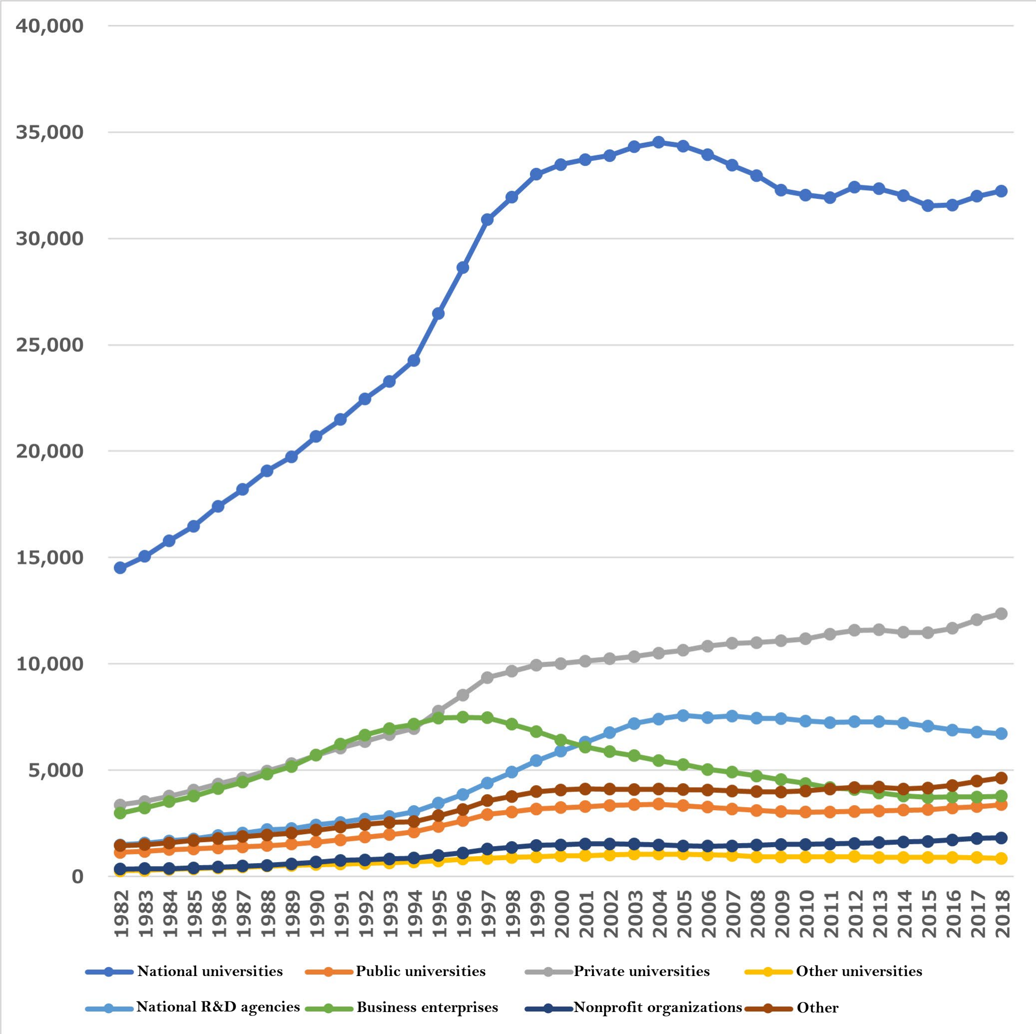



Source: Prepared by MEXT based on the NISTEP "Benchmarking Scientific Research 2021"

## 3. Changes in the Number of Papers by Type of Organization

■Figure D1-34/Changes in Japan's number of papers by type of organization (moving average over 3 years, fractional counting)



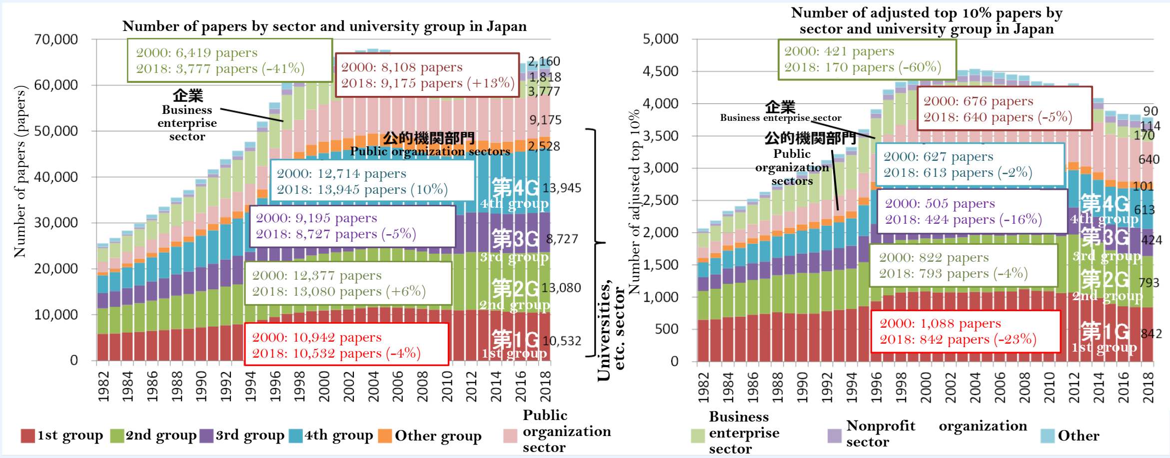

Source: Prepared by MEXT based on the NISTEP "Benchmarking Scientific Research 2021"

## 4. Number of Papers and Number of Adjusted Top 10% Papers by Sector and University Group

**Figure D1-35/Number of papers and number of adjusted top 10% papers by sector and university group in Japan**

Share of the number of papers: Universities, etc. sector / 74%; Public institution sector / 14%; Business enterprise sector / 6%

Share of the number of adjusted top 10% papers: Universities, etc. sector / 73%; Public institution sector / 17%; Business enterprise sector / 4%




| University group | Share of papers | Number of universities | Name of university |
|---|---|---|---|
| 1st group | 1% or more (top 4 universities) | 4 | Osaka University, Kyoto University, The University of Tokyo, Tohoku University |
| 2nd group | 1% or more (excluding top 4 universities) | 14 | Okayama University, Kanazawa University, Kyushu University, Kobe University, Chiba University, University of Tsukuba, Tokyo Medical and Dental University, Tokyo Institute of Technology, Nagoya University, Hiroshima University, Hokkaido University, Keio University, Nihon University, Waseda University |
| 3rd group | 0.5% or more - less than 1% | 26 | Ehime University, Kagoshima University, Gifu University, Kumamoto University, Gunma University, Shizuoka University, Shinshu University, Tokyo University of Agriculture and Technology, Tokushima University, Tottori University, University of Toyama, Nagasaki University, Niigata University, Mie University, Yamagata University, Yamaguchi University, Osaka City University, Osaka Prefecture University, Tokyo Metropolitan University, Yokohama City University, Kitasato University, Kindai University, Juntendo University, Tokai University, Tokyo Women's Medical University, Tokyo University of Science |
| 4th group | 0.05% or more - less than 0.5% | 137 | 37 national universities, 18 public universities, 82 private universities |

Note: 1. Articles and Reviews are included in the analysis and analyzed using the fractional counting method. Shows the 3-year moving average.

Note: 2. The "public institution sector" includes national government agencies, national R&D agencies, organizations of local governments. This is aggregated by NISTEP based on Clarivate Web of Science XML (SCIE, 2020 Year-end version).

Source: Prepared by MEXT based on the materials presented by NISTEP at the Subdivision on Science, Council for Science and Technology (84th meeting) (September 2, 2021)

## Item 4: Patents and Industry-University Collaboration[1]

### 1. Number of Patent Families

■Figure D1-36/Number of patent families in major countries/regions (top 10 countries/regions)

| 1995-1997 (PY) (average) | | | |
|---|---|---|---|
| Country/ region name | Number of patent families (whole counting) | | |
| | Count | Share | Ranking |
| U.S. | 30,227 | 28.0 | 1 |
| Japan | 29,728 | 27.5 | 2 |
| Germany | 18,239 | 16.9 | 3 |
| France | 6,722 | 6.2 | 4 |
| U.K. | 5,747 | 5.3 | 5 |
| Rep. of Korea | 4,774 | 4.4 | 6 |
| Italy | 3,094 | 2.9 | 7 |
| Switzerland | 2,482 | 2.3 | 8 |
| Netherlands | 2,469 | 2.3 | 9 |
| Canada | 2,294 | 2.1 | 10 |

| 2005-2007 (PY) (average) | | | |
|---|---|---|---|
| Country/ region name | Number of patent families (whole counting) | | |
| | Count | Share | Ranking |
| Japan | 61,922 | 29.9 | 1 |
| U.S. | 48,732 | 23.5 | 2 |
| Germany | 28,504 | 13.8 | 3 |
| Rep. of Korea | 18,919 | 9.1 | 4 |
| France | 10,583 | 5.1 | 5 |
| Taiwan | 8,874 | 4.3 | 6 |
| U.K. | 8,595 | 4.2 | 7 |
| China | 8,537 | 4.1 | 8 |
| Canada | 5,262 | 2.5 | 9 |
| Italy | 5,242 | 2.5 | 10 |

| 2015-2017 (PY) (average) | | | |
|---|---|---|---|
| Country/ region name | Number of patent families (whole counting) | | |
| | Count | Share | Ranking |
| Japan | 63,627 | 26.0 | 1 |
| U.S. | 55,018 | 22.4 | 2 |
| Germany | 27,709 | 11.3 | 3 |
| China | 26,793 | 10.9 | 4 |
| Rep. of Korea | 22,298 | 9.1 | 5 |
| France | 11,075 | 4.5 | 6 |
| Taiwan | 10,162 | 4.1 | 7 |
| U.K. | 8,624 | 3.5 | 8 |
| Italy | 5,815 | 2.4 | 9 |
| Canada | 5,160 | 2.1 | 10 |

Source: "Japanese Science and Technology Indicators 2022," NISTEP, MEXT

### 2. Number of Papers Cited in Patent Families

■Figure D1-37/Number of papers cited in patent families: Top 25 countries/regions

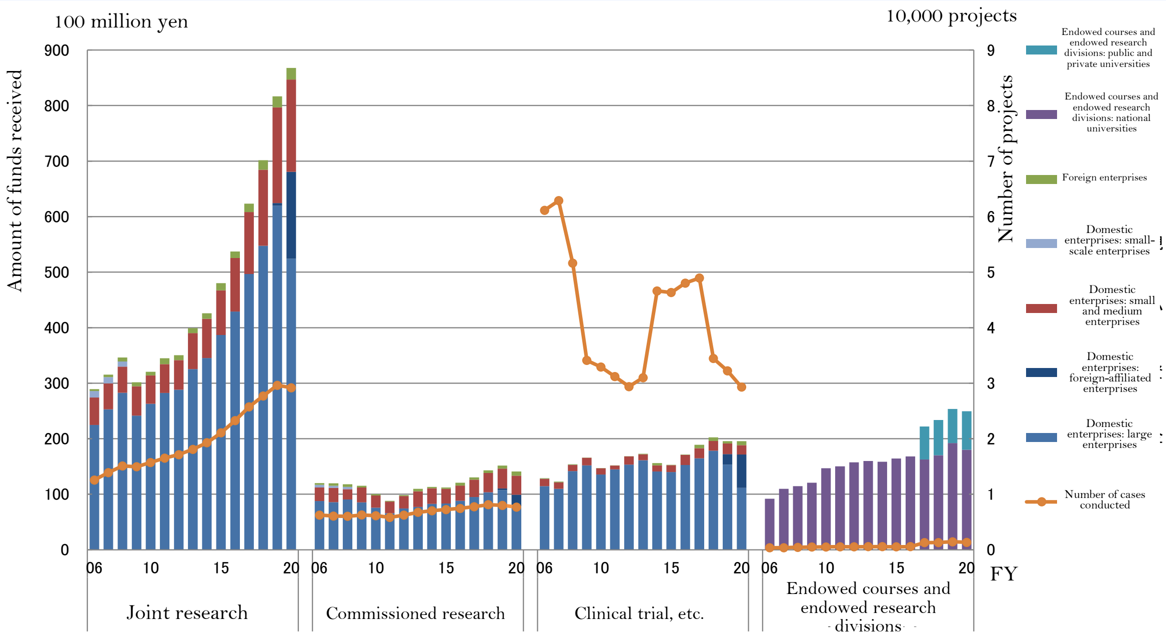
| 1981-2017 (total number) | | | | | |
|---|---|---|---|---|---|
| Country/ region name | (C) Number of papers cited in patent families | | | (D) Percentage of (C) in the number of papers | Ranking based on (D) |
| | Whole counting | | | | |
| | Count | Share | Ranking | | |
| U.S. | 405,008 | 34.6 | 1 | 4.6 | 2 |
| U.K. | 81,145 | 6.9 | 2 | 3.5 | 11 |
| Germany | 79,869 | 6.8 | 3 | 3.4 | 12 |
| Japan | 74,794 | 6.4 | 4 | 3.4 | 13 |
| China | 56,504 | 4.8 | 5 | 2.0 | 21 |
| France | 52,055 | 4.5 | 6 | 3.1 | 16 |
| Canada | 43,952 | 3.8 | 7 | 3.3 | 14 |
| Italy | 36,462 | 3.1 | 8 | 3.0 | 17 |
| Netherlands | 30,563 | 2.6 | 9 | 4.3 | 4 |
| Rep. of Korea | 25,638 | 2.2 | 10 | 3.6 | 10 |
| Australia | 24,952 | 2.1 | 11 | 2.9 | 19 |
| Switzerland | 24,784 | 2.1 | 12 | 4.5 | 3 |
| Spain | 23,358 | 2.0 | 13 | 2.6 | 20 |
| Sweden | 20,442 | 1.7 | 14 | 3.8 | 8 |
| Belgium | 15,917 | 1.4 | 15 | 4.1 | 5 |
| India | 13,958 | 1.2 | 16 | 1.5 | 22 |
| Taiwan | 12,582 | 1.1 | 17 | 3.0 | 18 |
| Israel | 12,358 | 1.1 | 18 | 4.0 | 6 |
| Denmark | 11,842 | 1.0 | 19 | 3.9 | 7 |
| Austria | 9,942 | 0.9 | 20 | 3.7 | 9 |
| Finland | 8,178 | 0.7 | 21 | 3.3 | 15 |
| Brazil | 7,991 | 0.7 | 22 | 1.4 | 24 |
| Singapore | 7,786 | 0.7 | 23 | 4.7 | 1 |
| Poland | 6,464 | 0.6 | 24 | 1.4 | 23 |
| Russian Federation | 6,402 | 0.5 | 25 | 0.6 | 25 |

Source: "Japanese Science and Technology Indicators 2022," NISTEP, MEXT

1 The number of papers referred to in this item includes only the papers in the field of natural sciences.

## 3. Joint Research Projects between Universities, Private Enterprises, etc.

■Figure D1-38/Changes in the amount received (breakdown) and the number of joint research projects between Japanese universities and private enterprises




Source: "Japanese Science and Technology Indicators 2022," NISTEP, MEXT