Highlights of
Science and Technology Indicators 2017

Research Unit for Science and Technology Analysis and Indicators
National Institute of Science and Technology Policy (NISTEP)

This material indicates the main points of the following reports released on August 9, 2017.

Science and Technology Indicators 2017, NISTEP Research Material-261

NISTEP
NATIONAL INSTITUTE OF SCIENCE AND TECHNOLOGY POLICY

Introduction

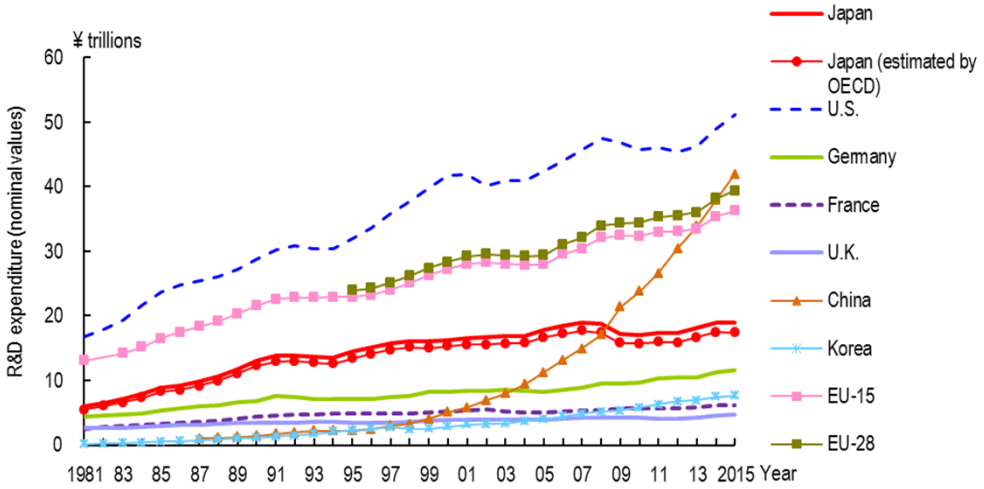
Science and Technology Indicators (from 1991, released annually since 2005)

- S&T activities are classified into five categories: “R&D expenditure,” “R&D personnel,” “higher education,” “output of R&D,” and “science, technology and innovation.”
- Approximately 150 indicators are used to understand the situation of Japan and those of the selected countries.
- Long-term (since the 1980s) S&T activities of Japan and the selected countries are shown if time-series data are available.
- In relation to twenty-five indicators, this edition introduces twenty new indicators and five indicators with improved visualization.
- In this material, New means a newly introduced indicator.

The main circumstances of S&T activities in Japan and the selected countries derived from "Science and Technology Indicators 2017" are as shown on the following slides.

- **Japan's total R&D expenditure was 18.9 trillion yen in 2015 (OECD-estimate Japan: 17.4 trillion yen), the world's third largest after the United States and China.**

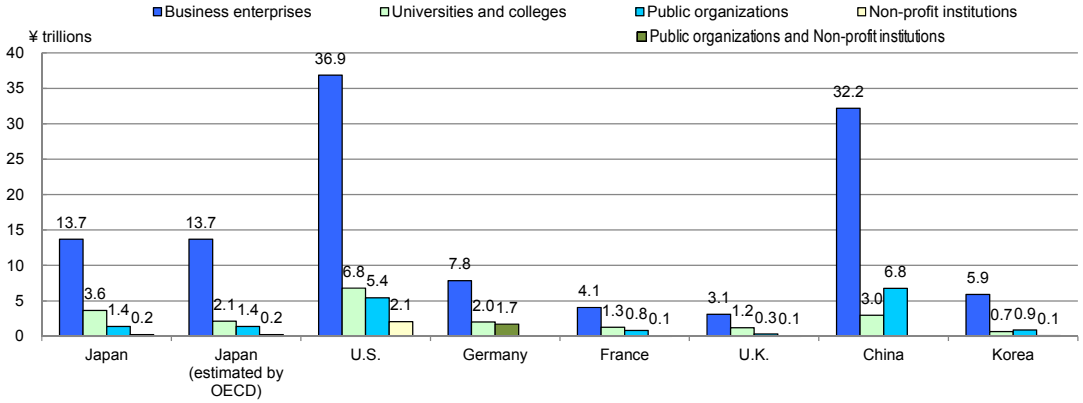
[Changes in total R&D expenditure in the selected countries: nominal values (converted using OECD purchase power parities data)]



Attention to international comparison

- The United States' total R&D expenditure was 51.2 trillion yen in 2015, maintaining the world's largest scale, followed by China with 41.9 trillion yen.

[R&D expenditure by sector in the selected countries (2015): nominal values (converted using OECD purchase power parities data)]



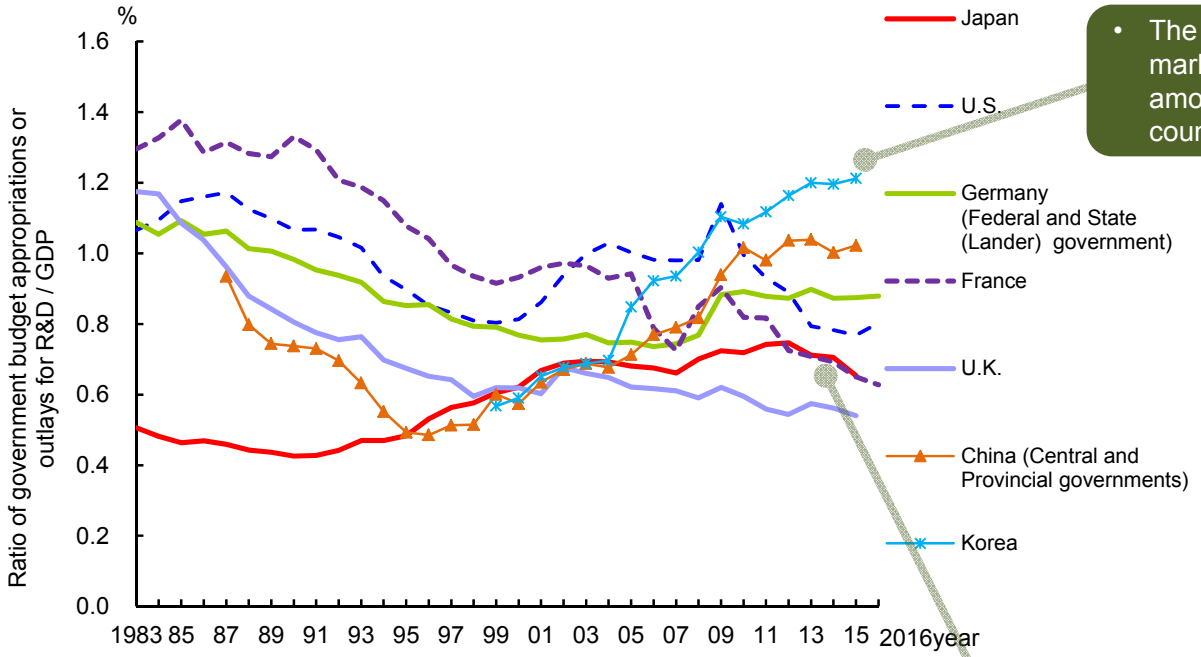
- The business enterprises sector accounted for the largest percentage of R&D expenditure in all of the selected countries. This tendency is particularly notable in Japan, China and Korea.

- Differences between the business enterprises sector and other sectors are relatively small in major European countries.

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

- **Japan's science and technology budget as a percentage of GDP is 0.65% (2015), ranked fifth after Korea, China, Germany, and the United States, among the selected countries.**

[Changes in government budgets for science and technology as percentages of GDP in the selected countries]



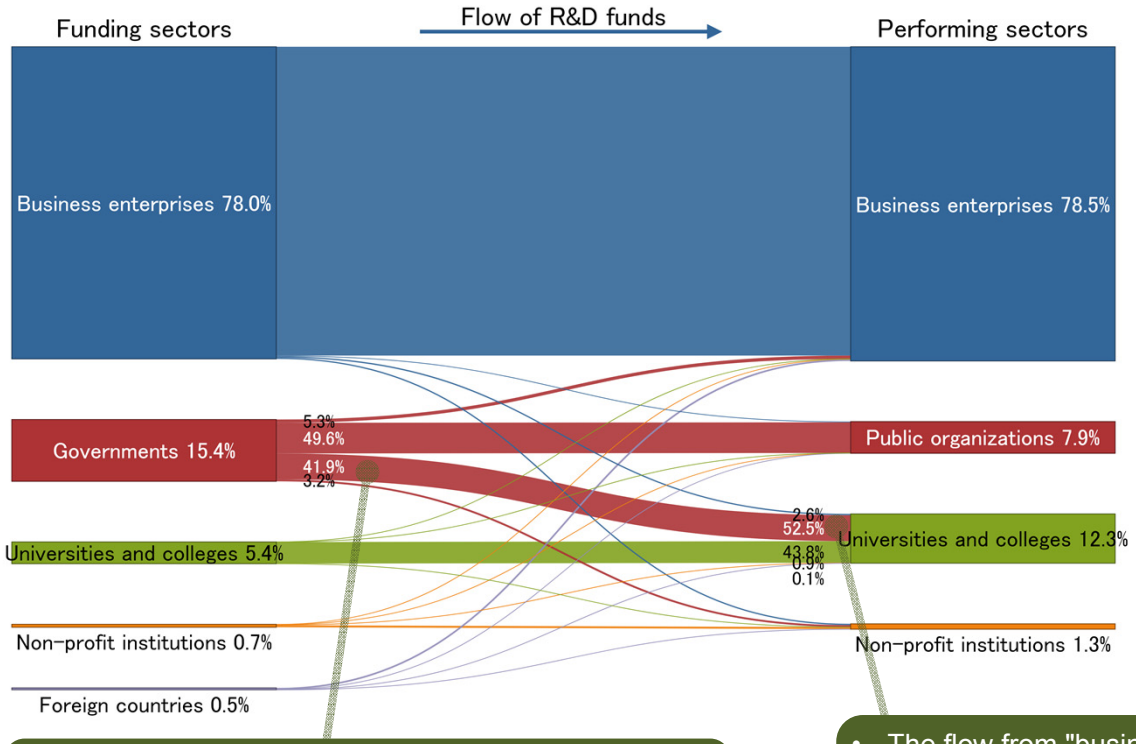
- The percentage of Korea marks 1.21%, ranked top among the selected countries.

- Second place is China with 1.02%, followed by Germany with 0.88%, the U.S. with 0.80%, Japan with 0.65%, France with 0.63%, and the United Kingdom with 0.54%.

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

- **Proportion of the funds, and most of the funds flow to "business enterprises." The flow from "business enterprises" to "universities and colleges" is small, accounting only for 2.6% of the entire amount used out of R&D funds.**

[Flow of R&D funds from funding sectors to performing sectors in Japan (estimated by the OECD) (2015)]



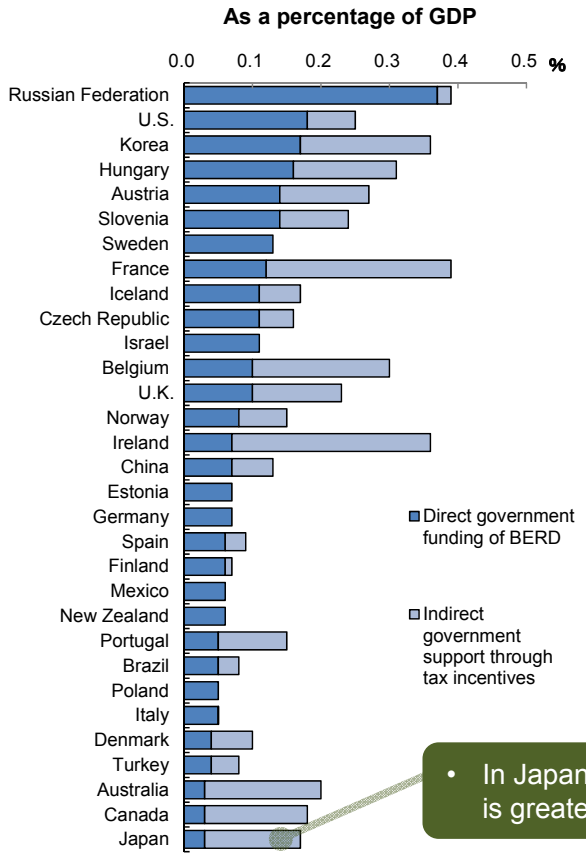
- The flow from "governments" to "public organizations" is largest with 49.6%, followed by "universities and colleges" with 41.9%.
- The flow from "business enterprises" to "universities and colleges" is small, accounting only for 2.6% of the entire amount used out of R&D funds.

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

- **Compared with other countries, Japan's direct government funding to business enterprises is lowest.**
- **The direct government funding of Japan and the United States is concentrated on large-scale enterprises.**

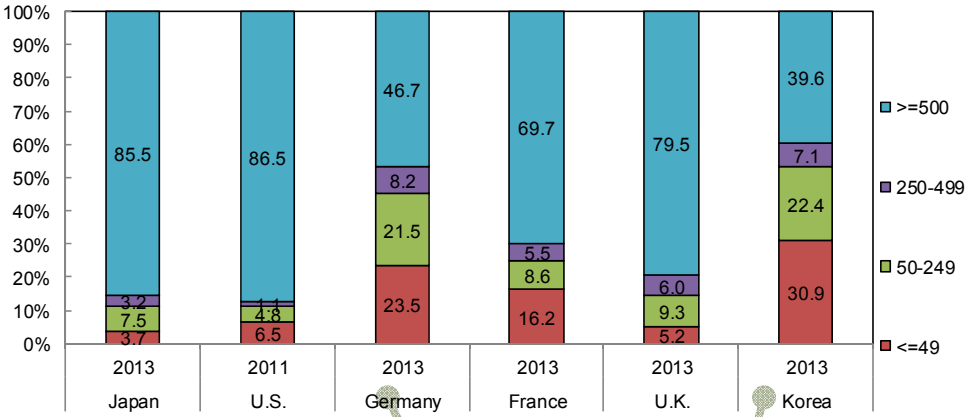
[Direct government funding and indirect government support to help business enterprises with R&D]

(A) Country comparison (2014)



- In Japan, indirect government support is greater.

New **(B) Comparison of major countries in terms of direct government funding (Government contributions to R&D expenditure according to the number of employees)**



Government contribution to business enterprises' R&D expenditure	0.1 trillions ¥	3.4 trillions ¥	0.2 trillions ¥	0.3 trillions ¥	0.2 trillions ¥	0.3 trillions ¥

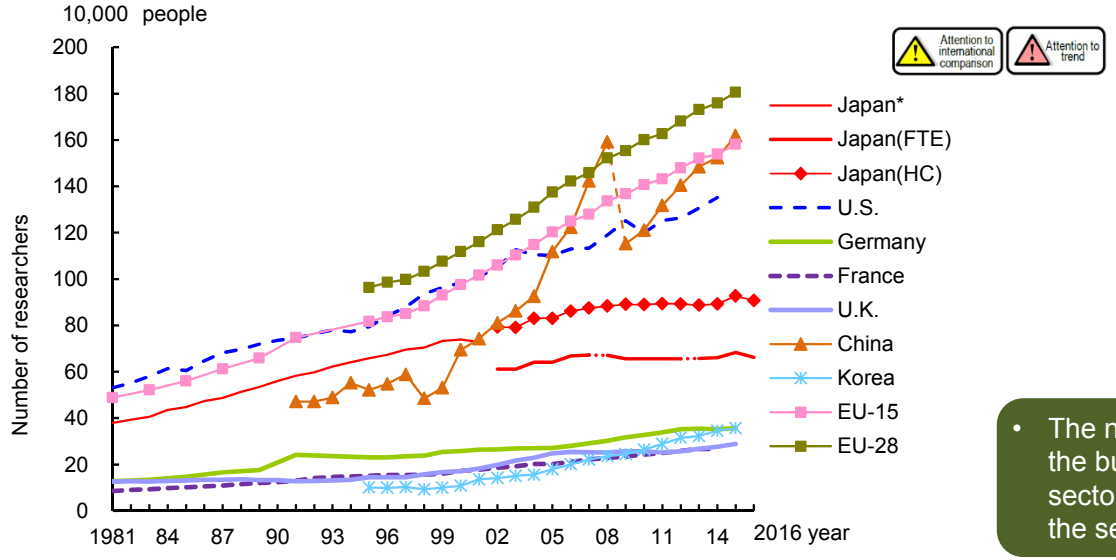
- Support for small- and medium-scale enterprises also carries a certain weight in Germany and Korea.

(Note) Direct government funding is the amount funded by the government to support business enterprises' R&D expenditure, which is expressed as a percentage of GDP. Indirect government support is the amount of deducted corporate tax through R&D tax incentives, which is expressed as a percentage of GDP.

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

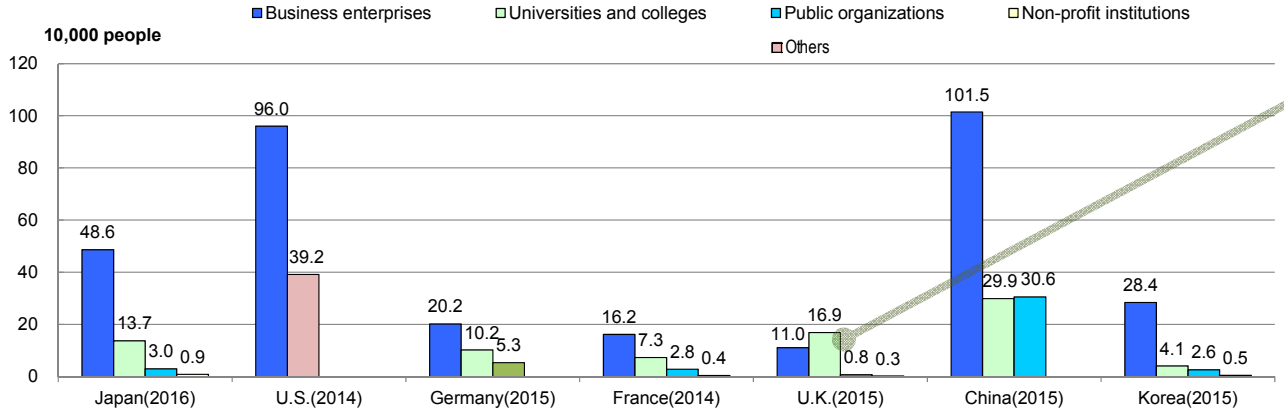
- **The number of researchers (FTE) in Japan was 662,000 in 2016, the third largest scale in the world after China and the United States.**

[Changes in the number of researchers in the selected countries]



- The number of researchers in the business enterprises sector is the highest in most of the selected countries.

[The number of researchers (FTE) by sector in the selected countries]



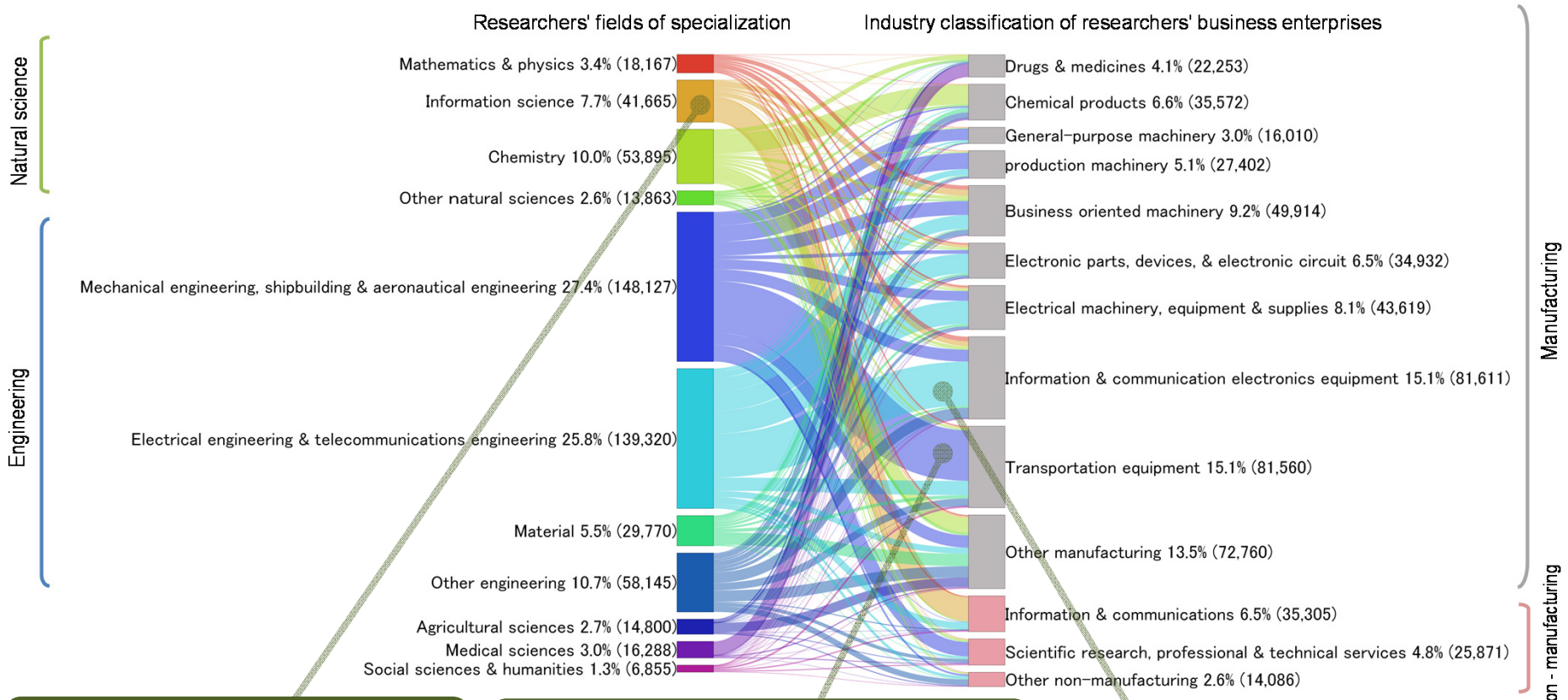
- For the United Kingdom, the largest number of researchers is found in the university and college sector.

(Notes)
(1) HC means the head count of researchers. FTE means the net number of researchers when the degree of involvement in research is taken into consideration.
(2) Data on the U.S. are values estimated by the OECD Secretariat.
(3China's definition of a researcher up to 2008 was not fully compatible with the OECD's definition, and consequently its method of measurement was changed in 2009. For that reason, there is a break between the years leading up to 2008 and 2009 onward.

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

- **In the manufacturing industry of Japan, researchers with engineering-related specialized knowledge account for a large proportion of the total number of researchers.**

New **[Fields of specialization of researchers belonging to business enterprises in Japan (2016)]**



- The number of researchers specializing in the field of "information science" is large in the "information & communication industry."
- In the "transportation equipment manufacturing industry," a large number of researchers specialize in the field of "mechanical engineering, shipbuilding & aeronautical engineering."
- The number of researchers specializing in the "electrical engineering & telecommunications engineering" field is large in the "information & communication electronics equipment manufacturing industry.

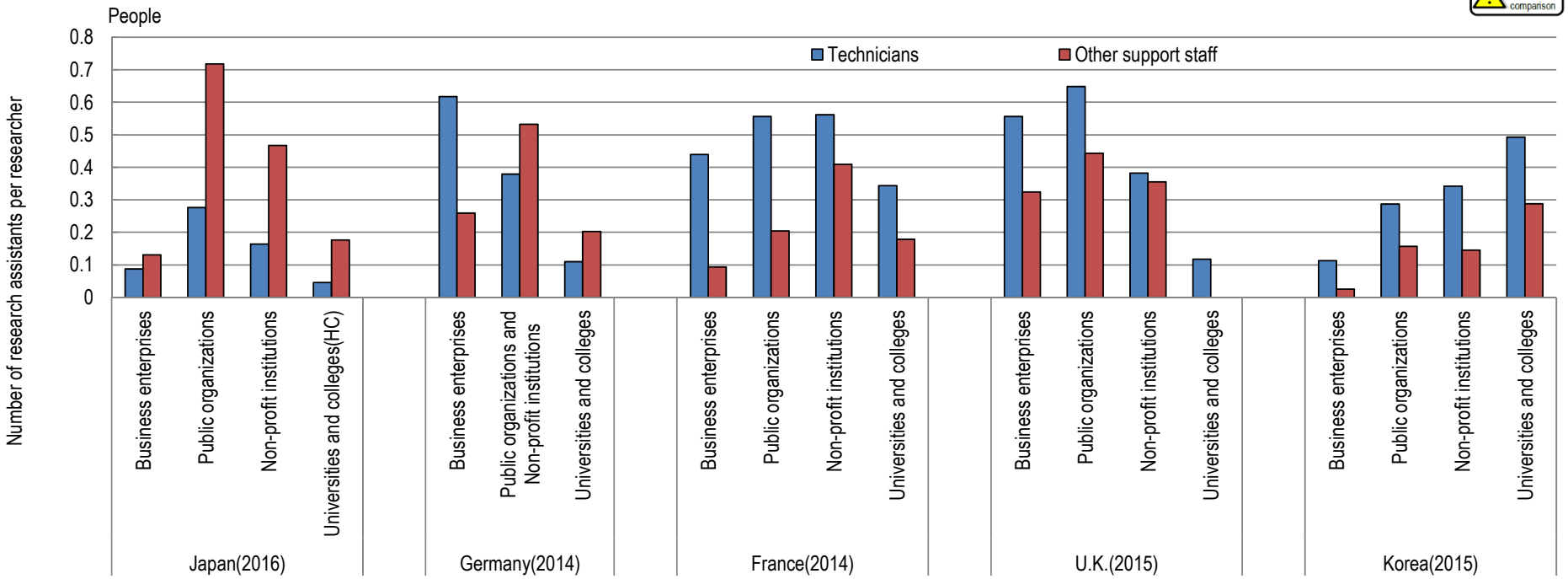
(Note) Researchers' fields of specialization are classified according to the contents of their current research (operations).
(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

- **In an international comparison of research assistants according to their operations, the number of "other support staff" is higher than that of "technicians" in Japan, whereas the number of "technicians" tends to be higher in other countries.**

New

[Operation-specific number of research assistants for each researcher by sector in the selected countries]

Attention to international comparison

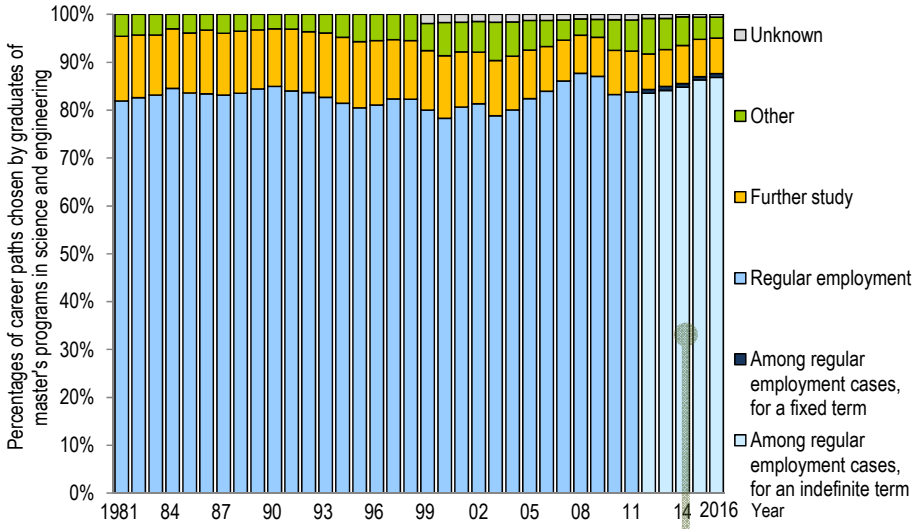


(Note)(1)Technicians (skilled workers and staff equivalent thereto) mean those whose primary tasks require technical knowledge and experience in one or more of the fields of engineering, physics, life sciences, social sciences, and/or humanities. Normally, technicians are those who participate in R&D by engaging in scientific/technical tasks associated with the application of concepts or actual methods, or with the use of research devices, under the instructions of researchers.
(2)Other support staff are operating, administrative, secretarial and office work staff who are skilled or unskilled and participate in a R&D project or are directly involved in a similar project.
(3)Numerical values pertaining to "other support staff" at UK universities and colleges are not specified in the relevant reference material ("R&D Statistics" by the OECD), which is used as the source of the above-shown values.

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

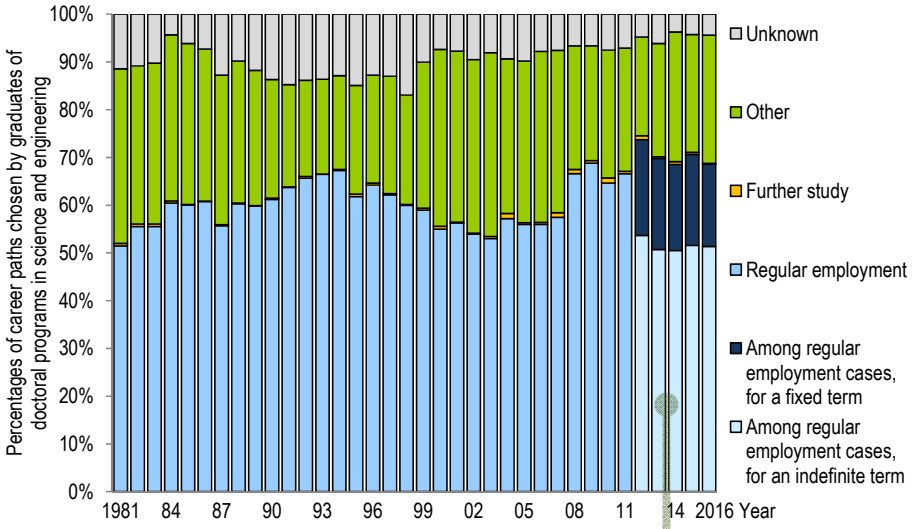
- **Approximately 90% of graduates of master's programs in "science and engineering" find "regular employment," and most of such graduates are employed for "indefinite terms."**
- **Approximately 70% of graduates of doctoral programs in "science and engineering" find "regular employment," and only roughly 50% of such graduates are employed for "indefinite terms."**

[Career paths of graduates of master's programs in science and engineering]



- With regard to career paths chosen by graduates of master's programs in "science and engineering" in 2016 (37,128 graduates), the percentage of those who found "regular employment" was 87.6%. The percentage of those who found "regular employment" for "indefinite terms" was 86.8% of the total graduates concerned, and those employed for "fixed terms" accounted for 0.8% of the total.

[Career paths of graduates of doctoral programs in science and engineering]



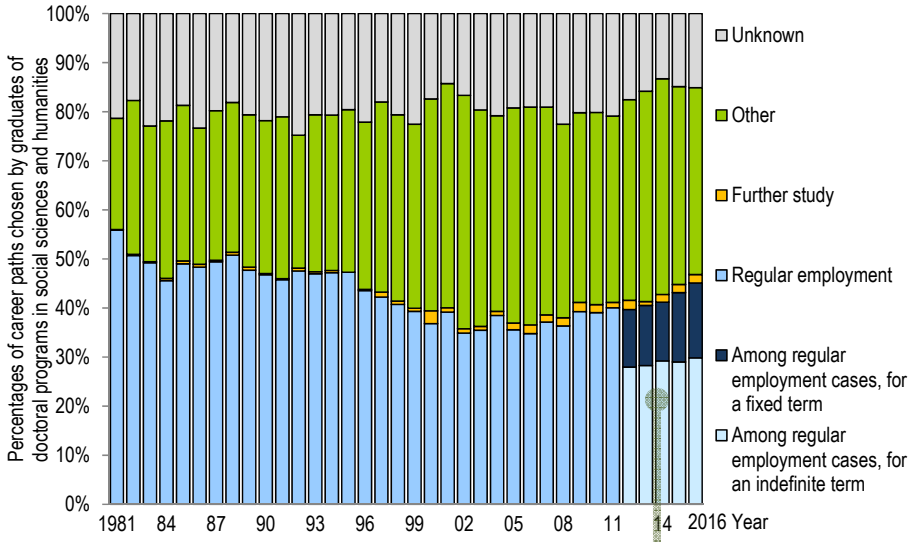
- With regard to career paths chosen by graduates of doctoral programs in "science and engineering" in 2016 (4,809 graduates), the percentage of those who found "regular employment" was 68.6%. The percentage of those who found "regular employment" for "indefinite terms" was 51.4% of the total graduates concerned, and those employed for "fixed terms" accounted for 17.2% of the total.

(Note)(1)Graduates employed for indefinite terms mean those who are employed without a specific term of employment. Graduates employed for fixed terms mean those whose terms of employment are stipulated as at least one year, and also whose prescribed weekly working hours are around 30 to 40 hours.
(2) "Other" means the total of "graduates newly enrolling in advanced vocational schools, overseas schools, etc.," "graduates who are in temporary employment," etc.

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

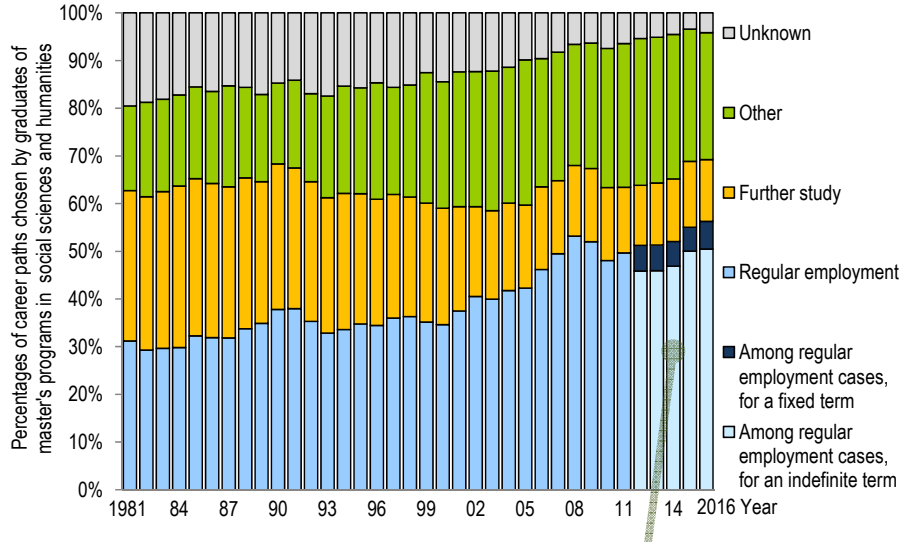
- **The percentage of graduates of master's programs in "humanities and social sciences" who find "regular employment" has increased, and approximately 60% of the total graduates concerned are employed. With respect to graduates of doctoral programs in "humanities and social sciences," although approximately 50% of the total graduates find employment, only roughly 30% of the total are employed for "indefinite terms."**

New **[Career paths of graduates of master's programs in humanities and social sciences]**



- During the 1980s, the percentages of those who found "regular employment" and those who went on to "further study" were both approximately 30%. Later, the percentage of those who found "regular employment" increased, reaching 56.3% among graduates of master's programs in "humanities and social sciences" (11,458 graduates) in 2016. Among these graduates, the percentage of those employed for "indefinite terms" was 50.5% of the total.

New **[Career paths of graduates of doctoral programs in humanities and social sciences]**



- With regard to Career paths chosen by graduates of doctoral programs in "humanities and social sciences" in 2016 (2,135 graduates), the percentage of those who found "regular employment" was 45.1%. However, only 29.8% of the total doctoral graduates were employed for "indefinite terms," and 15.3% were employed for "fixed terms."

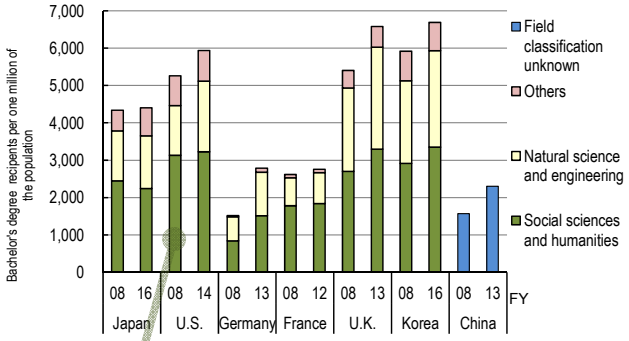
(Note) (1)Graduates employed for indefinite terms mean those who are employed without a specific term of employment. Graduates employed for fixed terms mean those whose terms of employment are stipulated as at least one year, and also whose prescribed weekly working hours are around 30 to 40 hours.
(2) "Other" means the total of "graduates newly enrolling in advanced vocational schools, overseas schools, etc.," "graduates who are in temporary employment," etc.

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

- **In Japan, the number of graduates in "natural sciences" tends to be high as the academic stage advances, specifically among master's degree resipients and doctoral degree resipients. In the selected countries other than Japan, the number of graduates in "humanities and social sciences" is largest even among master's degree resipients, and the number of graduates in "natural sciences" tends to be largest among doctoral degree resipients.**

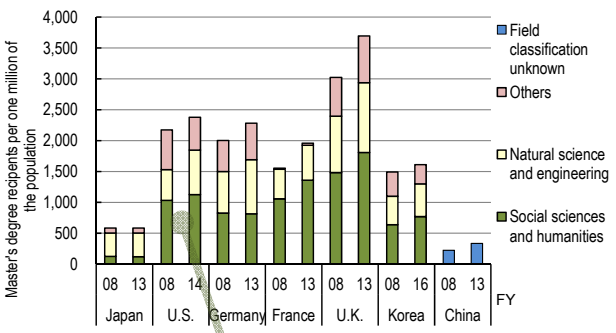
[International comparison of academic degree resipients per one million of population]

(A) New bachelor's degree recipients



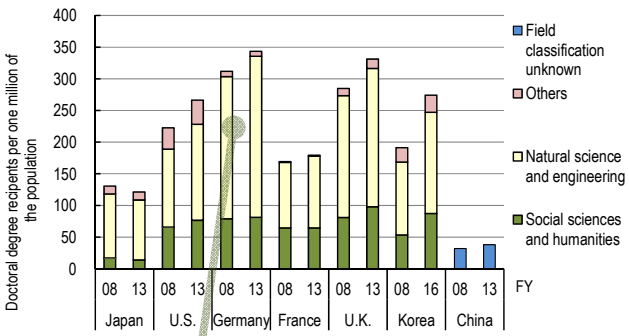
- With regard to bachelor's degree resipients, the number of those in "humanities and social sciences" is large in many of the countries concerned.

(B) New master's degree recipients



- Among master's degree resipients, the number of those in "humanities and social sciences" is largest in the selected countries other than Japan.
- In comparison with 2008, the number in Japan has remained flat, while those of the other countries have increased.

(C) New doctoral degree recipients



- The number of doctoral degree resipients in "natural sciences" is highest in all the selected countries.
- In comparison with 2008, the number in Japan has lowered, while those of the other countries have increased.

(Note)
(1) The numbers of doctoral degree resipients in the United States are the figures calculated by subtracting the figures for "law and economics," "medicine, dentistry, pharmacy, and health care," and "other" among the figures for first-professional degrees (such as the bachelor of medicine and the bachelor of law) from the figures for the "doctor's degrees" noted in the "Digest of Education Statistics."
(2) With regard to China, the figures for individual fields are not known.
(3) Each field classification includes the following.
Humanities and social sciences: humanities, art, law, economics, etc.; Natural sciences: science, engineering, agriculture, medicine, dentistry, pharmacy, and health care; and Others: education, teacher training, domestic economy, etc.

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

- **Compared with ten years ago, the number of Japanese papers has slightly declined (counted by the fractional counting method). With other countries expanding their shares, the position of Japan in the world rankings has moved down. The decline of Japan's ranking is remarkable in relation to highly cited papers (the number of adjusted top 10% papers and adjusted top 1% papers).**

[Top 10 countries/regions in terms of the number of papers and the number of hot papers (top 10% and top 1%) (based on the fractional counting method)]

PY (Publication Year) 2003–2005

All fields	2003— 2005 (PY) (Average)		
	The number of papers		
Country/Region	Fractional counting		
	Papers	Share	World rank
U.S.	221,367	26.1	1
Japan	67,888	8.0	2
Germany	52,315	6.2	3
China	51,930	6.1	4
U.K.	50,862	6.0	5
France	37,392	4.4	6
Italy	30,358	3.6	7
Canada	27,847	3.3	8
Spain	21,527	2.5	9
India	20,319	2.4	10

All fields	2003— 2005 (PY) (Average)		
	The number of adjusted top 10% papers		
Country/Region	Fractional counting		
	Papers	Share	World rank
U.S.	33,242	39.4	1
U.K.	6,288	7.5	2
Germany	5,458	6.5	3
Japan	4,601	5.5	4
France	3,696	4.4	5
China	3,599	4.3	6
Canada	3,155	3.7	7
Italy	2,588	3.1	8
Netherlands	2,056	2.4	9
Australia	1,903	2.3	10

All fields	2003— 2005 (PY) (Average)		
	The number of adjusted top 1% papers		
Country/Region	Fractional counting		
	Papers	Share	World rank
U.S.	3,983	47.2	1
U.K.	673	8.0	2
Germany	503	6.0	3
Japan	365	4.3	4
France	311	3.7	5
Canada	295	3.5	6
China	283	3.4	7
Netherlands	211	2.5	8
Italy	200	2.4	9
Switzerland	178	2.1	10

PY (Publication Year) 2013–2015

All fields	2013 — 2015 (PY) (Average)		
	The number of papers		
Country/Region	Fractional counting		
	Papers	Share	World rank
U.S.	272,233	19.9	1
China	219,608	16.0	2
Germany	64,747	4.7	3
Japan	64,013	4.7	4
U.K.	59,097	4.3	5
India	49,976	3.7	6
France	45,315	3.3	7
korea	44,822	3.3	8
Italy	43,804	3.2	9
Canada	39,473	2.9	10

All fields	2013 — 2015 (PY) (Average)		
	The number of adjusted top 10% papers		
Country/Region	Fractional counting		
	Papers	Share	World rank
U.S.	39,011	28.5	1
China	21,016	15.4	2
U.K.	8,426	6.2	3
Germany	7,857	5.7	4
France	4,941	3.6	5
Italy	4,739	3.5	6
Canada	4,442	3.2	7
Australia	4,249	3.1	8
Japan	4,242	3.1	9
Spain	3,634	2.7	10

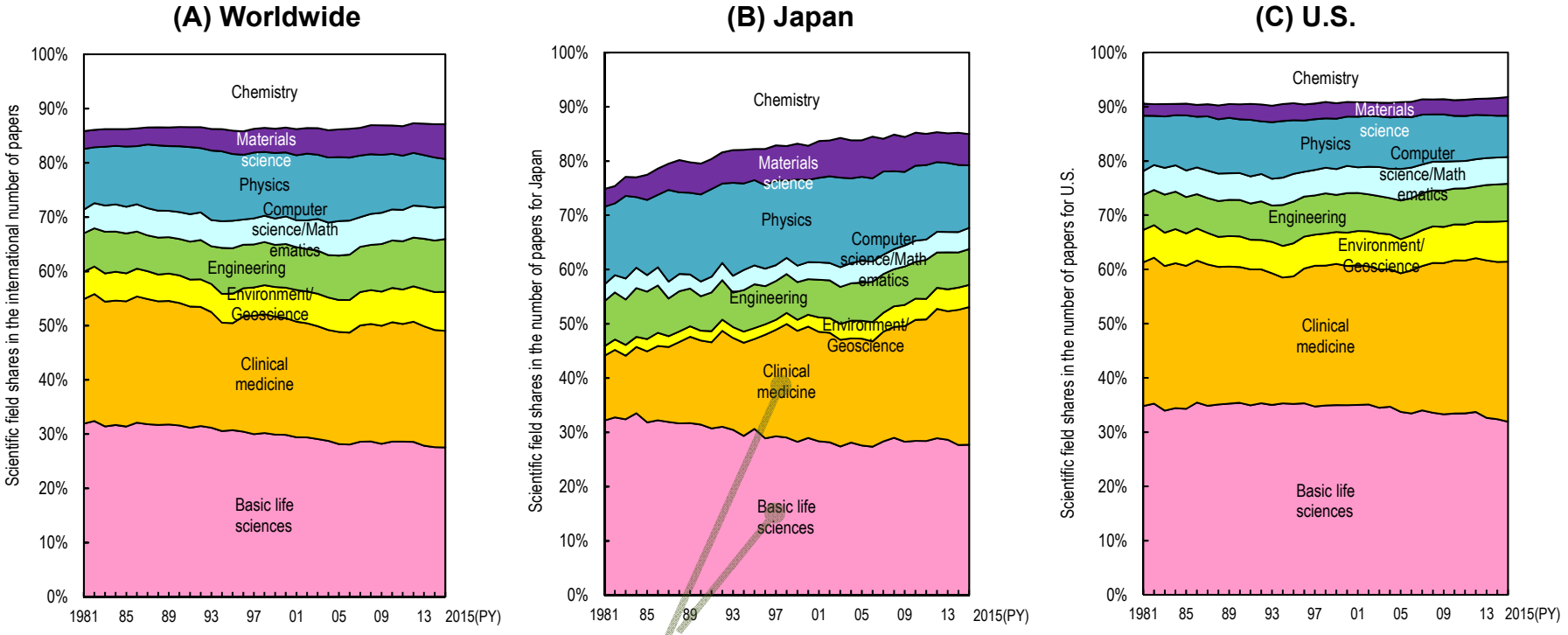
All fields	2013 — 2015 (PY) (Average)		
	The number of adjusted top 1% papers		
Country/Region	Fractional counting		
	Papers	Share	World rank
U.S.	4,700	34.3	1
China	1,954	14.3	2
U.K.	961	7.0	3
Germany	763	5.6	4
France	476	3.5	5
Australia	433	3.2	6
Canada	419	3.1	7
Italy	384	2.8	8
Japan	335	2.4	9
Spain	299	2.2	10

[Methods of counting papers]
(Fractional counting method) In the case where one paper is co-authored by Japanese Organization A and US Organization B, this method counts Japan as 1/2 and the U.S. as 1/2. This indicates the degree of contribution to the production of papers.
(Whole counting method) In the case where one paper is co-authored by Japanese Organization A and US Organization B, this method counts Japan as 1 and the U.S. as 1. This indicates the degree of participation in the production of papers.
For counting, both the methods are based on the countries of the organizations with which the authors are affiliated.

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

- **With regard to scientific field shares in the number of Japanese papers, the shares of "basic life sciences," "chemistry," and "physics" were large in the first half of the 1980s. Over time, "basic life sciences" and "chemistry" have lowered, while "clinical medicine" has risen.**

[Changes in scientific field shares in the worldwide number of papers and the selected countries' numbers of papers (fractional counting)]



- In comparison between life sciences ("clinical medicine" and "basic life sciences") and other fields in Japan, the share of life sciences has increased by nearly 10 points in Japan.

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

- **Japan has maintained its position as highest in the world in terms of the number of patent families for the last ten years. In relation to technological fields, Japan's shares of "electrical engineering" and "general machinery" are high, compared with the corresponding worldwide shares.**

[The number of patent families by selected country/region]
(Top 10 countries/regions)

2000 - 2002(Average) Whole counting			
Country/Region	Patent Families	Share	World rank
Japan	46,332	30.2	1
U.S.	43,501	28.3	2
Germany	26,933	17.5	3
France	9,153	6.0	4
U.K.	8,633	5.6	5
Korea	7,326	4.8	6
Italy	4,592	3.0	7
Canada	4,376	2.9	8
Netherlands	4,283	2.8	9
Switzerland	3,521	2.3	10

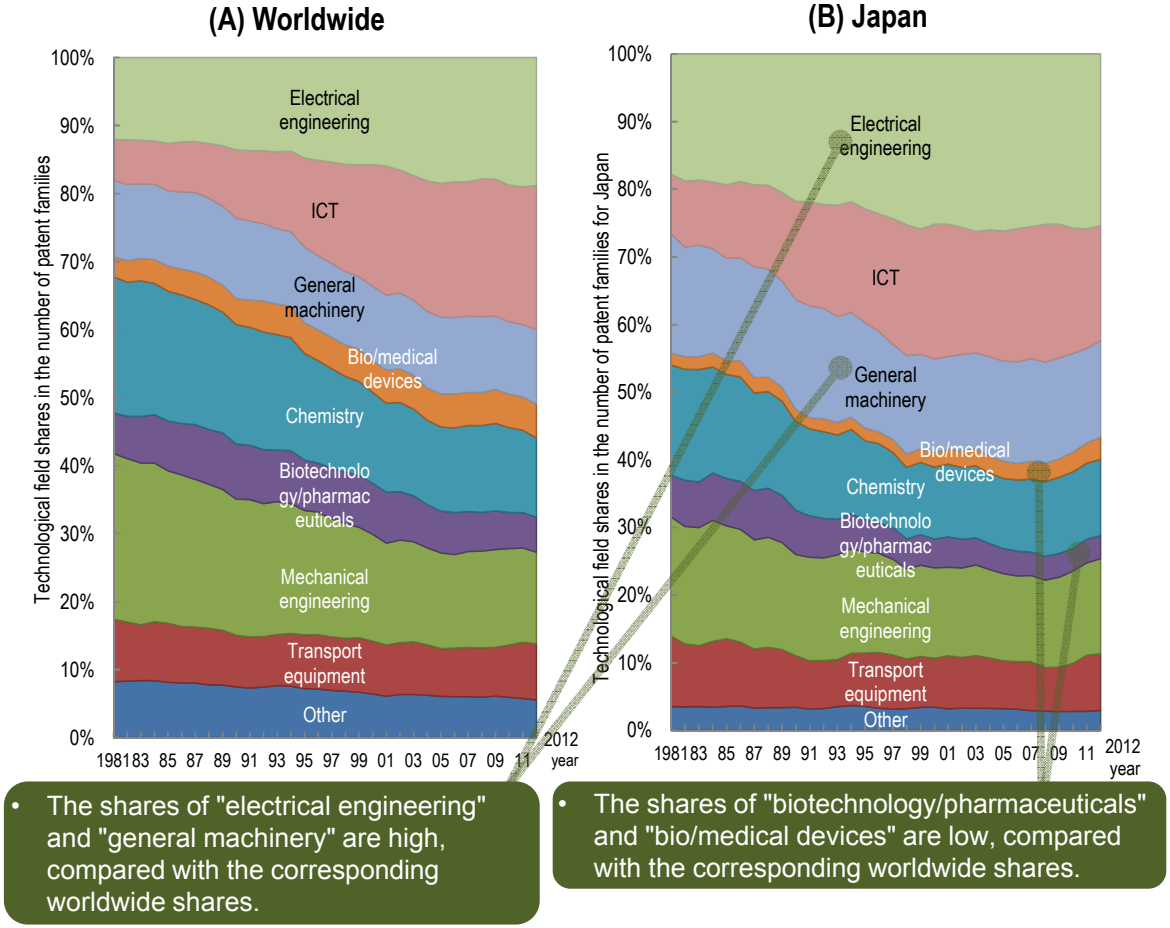
2010 - 2012(Average) Whole counting			
Country/Region	Patent Families	Share	World rank
Japan	64,273	29.8	1
U.S.	48,847	22.6	2
Germany	30,097	13.9	3
Korea	20,094	9.3	4
China	16,144	7.5	5
Taiwan	11,932	5.5	6
France	11,393	5.3	7
U.K.	8,647	4.0	8
Canada	5,990	2.8	9
Italy	5,557	2.6	10

2000-2002

Japan remains in first place

2010-2012

[Changes in technological field shares in the number of patent families]



- The shares of "electrical engineering" and "general machinery" are high, compared with the corresponding worldwide shares.
- The shares of "biotechnology/pharmaceuticals" and "bio/medical devices" are low, compared with the corresponding worldwide shares.

(Note) A 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.
(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

- **With regard to the linkage between science and technology (science linkage), although the number of Japanese patent families citing papers is the world's second largest, these patent families account for only a small proportion of the total patent families of Japan.**
- **A large number of Japanese papers are cited by patent families around the world.**

New **[The number of patent families citing papers: top 10 countries/regions]**

Whole counting		2005–2012 (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.	100,720	27.1	383,812	26.2
2	Japan	46,790	12.6	494,925	9.5
3	Germany	41,606	11.2	242,606	17.1
4	France	22,506	6.0	89,106	25.3
5	U.K.	19,453	5.2	69,304	28.1
6	China	17,026	4.6	96,432	17.7
7	Korea	12,571	3.4	151,249	8.3
8	Canada	11,918	3.2	45,748	26.1
9	Netherlands	10,659	2.9	36,434	29.3
10	India	8,922	2.4	26,194	34.1

- The number of patent families citing papers → Second in the world
- Of the total patent families of Japan, the number of patent families citing papers accounts for a small proportion.

New **[The number of papers cited by patent families: top 10 countries/regions]**

Whole counting		1981–2012 (Total)			
		(A) Papers cited by patent families		(B) Total number of papers	
No.	Country / Region	No. of papers	Global share of (A)	No. of papers	Percentage of papers cited by patent families (A) / (B)
1	U.S.	354,699	36.2	7,079,917	5.0
2	Japan	78,187	8.0	1,821,236	4.3
3	Germany	69,747	7.1	1,826,813	3.8
4	U.K.	69,129	7.1	1,824,576	3.8
5	France	46,177	4.7	1,333,730	3.5
6	Canada	36,687	3.7	1,006,284	3.6
7	China	30,766	3.1	1,353,245	2.3
8	Italy	30,330	3.1	898,805	3.4
9	Netherlands	23,388	2.4	531,922	4.4
10	Switzerland	20,599	2.1	401,594	5.1

- The number of papers cited by patent families → Second in the world

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

- **In the technological fields of "electrical engineering" and "general machinery," which account for a large part of the composition of technological fields in Japan compared with the worldwide levels of these fields, Japan's share of patent families citing papers tends to be low, in comparison with the corresponding shares of the United States and European countries.**

New **[Technological field shares in the selected countries' numbers of patent families citing papers]**
(Relative value to "biotechnology/pharmaceuticals" in each country)

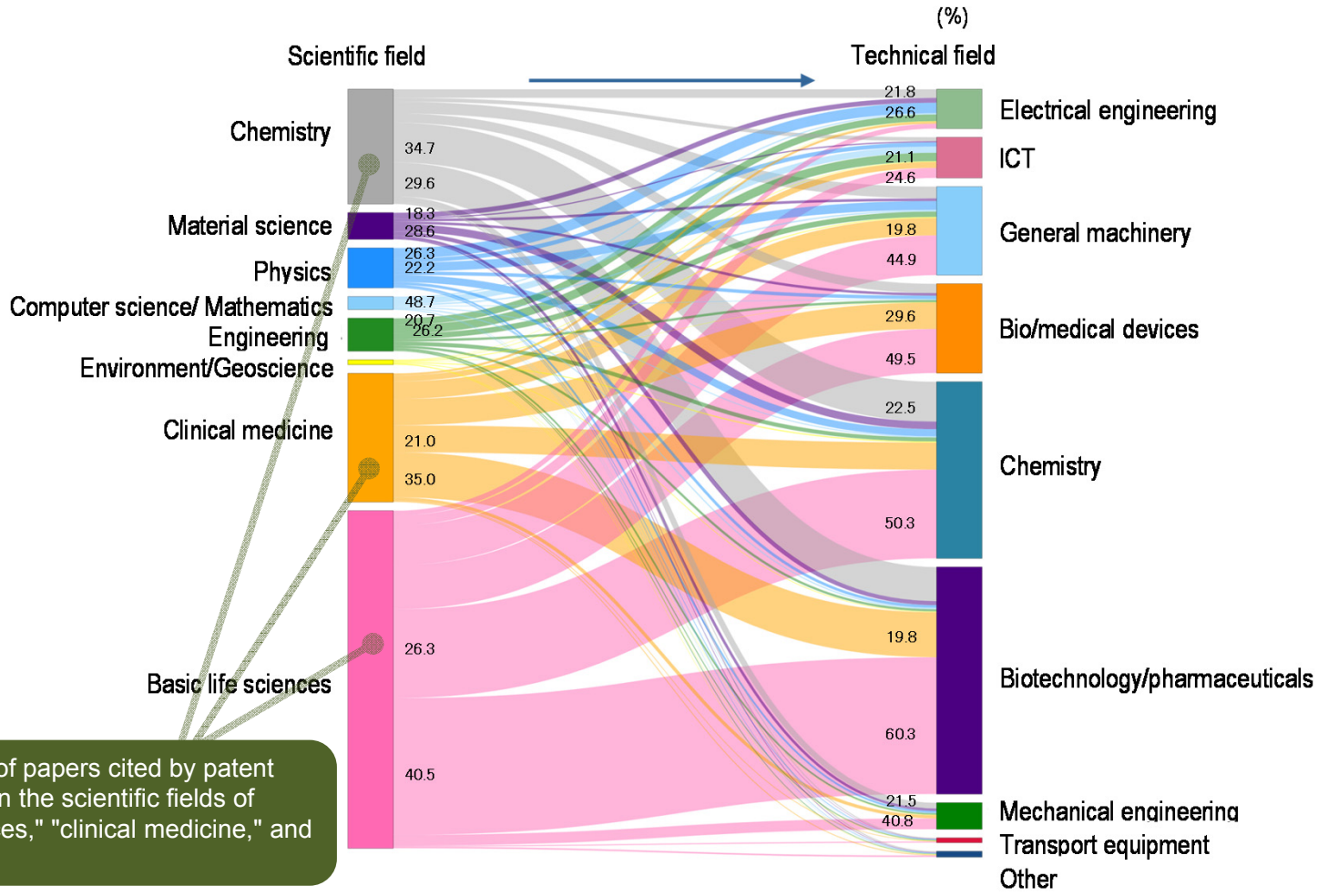
Technical field	Japan	U.S.	Germany	France	U.K.	China	Korea
Biotechnology/pharmaceuticals	1	1	1	1	1	1	1
Chemistry	0.48	0.58	0.50	0.59	0.60	0.61	0.45
Bio/medical devices	0.37	0.43	0.38	0.41	0.41	0.38	0.33
ICT	0.22	0.36	0.41	0.41	0.36	0.27	0.18
General machinery	0.18	0.40	0.32	0.41	0.43	0.19	0.13
Electrical engineering	0.16	0.29	0.22	0.31	0.32	0.18	0.12
Mechanical engineering	0.09	0.15	0.09	0.11	0.13	0.12	0.08
Other	0.08	0.12	0.05	0.06	0.09	0.06	0.05
Transport equipment	0.07	0.08	0.06	0.07	0.08	0.08	0.04

- "Biotechnology/pharmaceuticals" is high for all the selected countries.
- "Mechanical engineering" and "transport equipment" are low for all the selected countries.
- Japan tends to be low in these two fields, compared with Western countries.

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

- **The linkage between scientific fields and technological fields in the world shows that a large number of papers cited by patent families fall within the scientific fields of "basic life sciences," "clinical medicine," and "chemistry."**

New **[Linkage between scientific fields and technological fields in the world]**



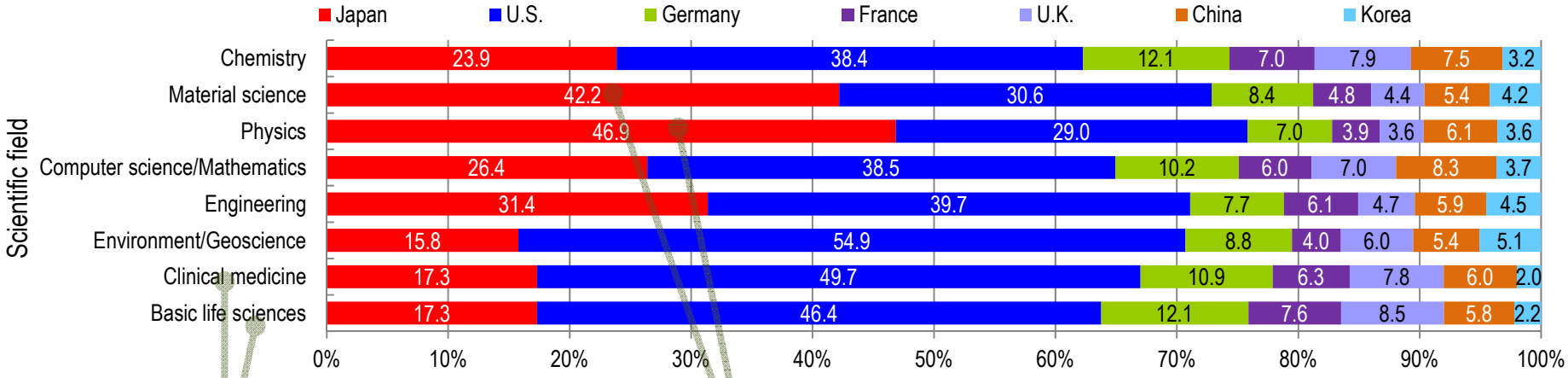
- A large number of papers cited by patent families fall within the scientific fields of "basic life sciences," "clinical medicine," and "chemistry."

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

- **With regard to which countries' patent families cite Japanese papers in each scientific field, a large number of papers in "physics" and "materials science" are cited by Japan's own patent families. On the other hand, Japan's papers in "clinical medicine" and "basic life sciences" account for a relatively small proportion of papers cited by Japan's own patent families; such papers are instead cited by countries other than Japan.**

New

[Countries whose patent families cite Japanese papers]



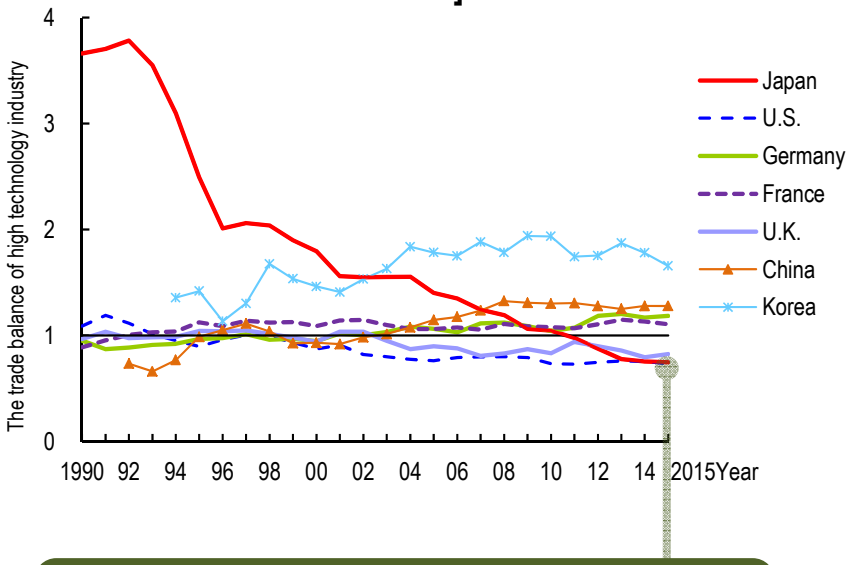
- A large number of Japanese papers in "clinical medicine" and "basic life sciences" are cited for the use of other countries' technologies.

- A large number of Japanese papers in "physics" and "materials science" are cited for the use of Japan's own technologies.

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

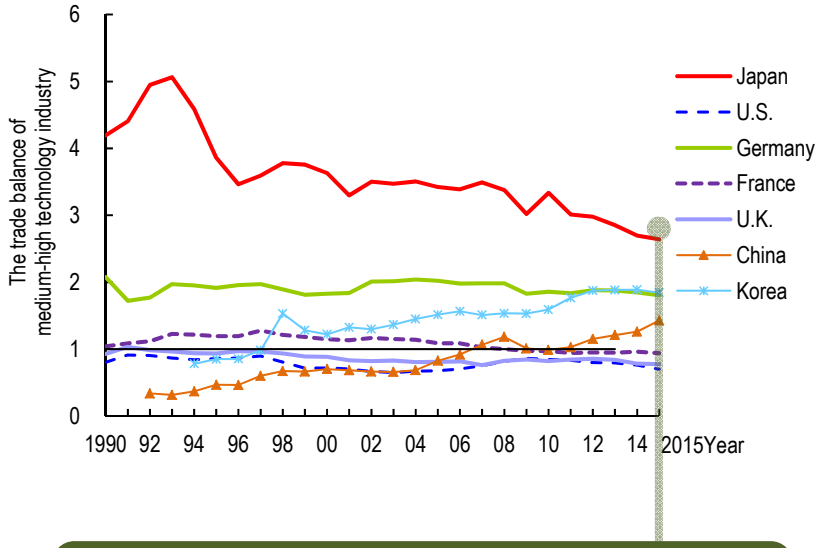
- **Japan's trade balance ratio for high - technology industries is the lowest among the selected countries. However, in medium high - technology industries, Japan maintains its position as the highest among the selected countries.**

[Changes in the trade balance ratios for high - technology industries in the selected countries]



- Japan has hit below 1 and has run import surpluses since 2011. The trade balance ratio of Japan in 2015 was 0.75.

[Changes in the trade balance ratios for medium high - technology industries in the selected countries]



- Japan's trade balance ratio drastically dropped during the middle of the 1990s, and has since kept declining gradually, reaching 2.64 in 2015.

(Note)
(1) High-technology industries refer to "pharmaceutical," "computer, electronic and optical," and "aerospace."
(2) Note: 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."
(3) Trade balance ratio = export value / import value

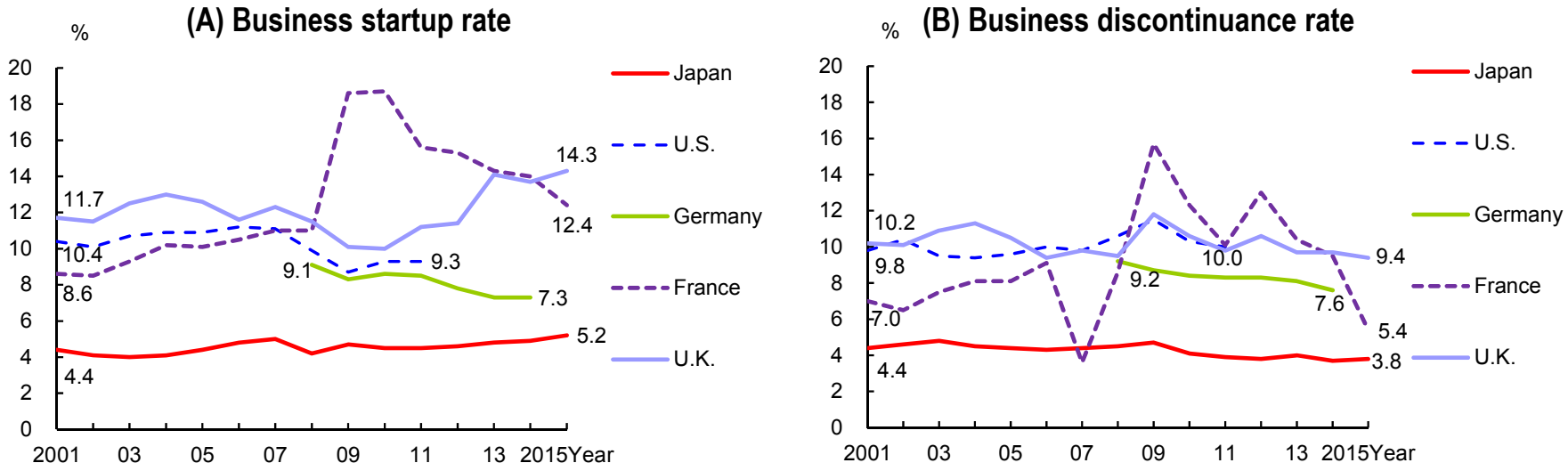
(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

- **In Japan, the business startup rate is higher than its business discontinuance rate. However, both of these rates remain at low levels, compared with those rates of the other selected countries, and have not changed much over time.**

New

[Changes in the business startup rates and business discontinuance rates of the selected countries]

Attention to international comparison



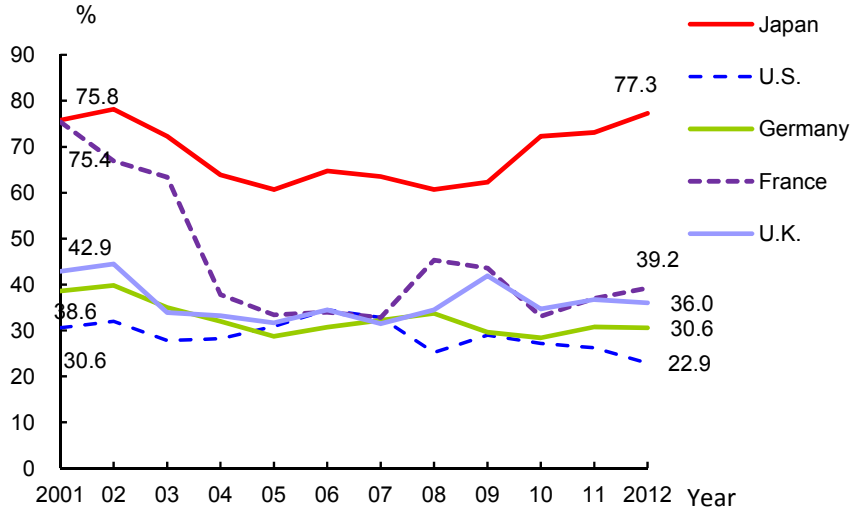
(Note) It is necessary to pay attention to international comparisons in this regard since the method of calculating a business startup rate and a business discontinuance rate differs from country to country.
<Japan> The business startup and discontinuance rates are calculated on the basis of the formation and extinguishing of business establishments in respect of which necessary insurance relations have been established (applicable places of business). Specifically, the business startup rate is calculated by dividing the number of business establishments that newly establish employment relationships during the year concerned by the number of applicable places of business at the end of the previous year. The business discontinuance rate is calculated by dividing the number of business establishments whose employment relationships extinguish during the year concerned by the number of applicable places of business at the end of the previous year. Applicable places of business mean the number of business establishments that have established labor insurance relations pertaining to employment insurance.
<U.S.>The business startup and discontinuance rates are calculated on the basis of the generation and extinguishing of employers.
<U.K.>The business startup and discontinuance rates are calculated on the basis of the number of business enterprises registered for VAT (value-added tax) and PAYE (withholding income tax).
<Germany>The business startup and discontinuance rates are calculated on the basis of the number of business enterprises that have submitted the notifications of business commencement/discontinuance.
<France>The business startup rate is calculated on the basis of the number of business startup cases registered with/deleted from the SIRENRE database (the list of business enterprises and offices).

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

- **Regarding to changes in the selected countries' percentages of people without entrepreneurial motivation, Japan's percentage in the most recent year is 77.3%, the highest level among the countries concerned. The difference between Japan and the other selected countries in this regard is as big as approximately 40 points.**
- **The business survival rate in Japan is relatively high, compared with the other selected countries. Even after five years, 81.7% of business enterprises in Japan continue their businesses.**

New

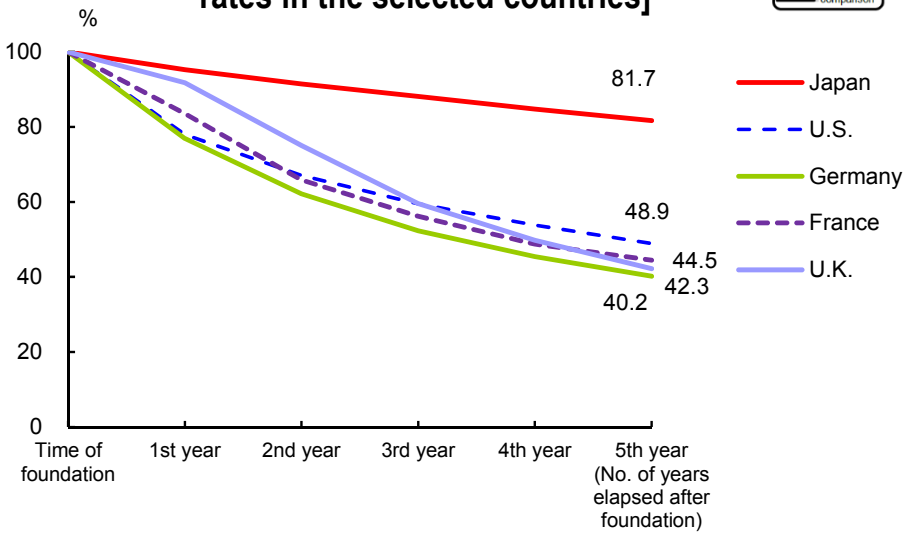
[Changes in the percentages of people without entrepreneurial motivation in the selected countries]



New

[Changes in the post-startup business survival rates in the selected countries]

Attention to international comparison



(Note) (1) Using research results produced by Global Entrepreneurship Monitor ("GEM"), the percentage of "people without entrepreneurial motivation" is a percentage calculated by counting people to whom none of the three indicators, "the indicator of entrepreneurial activity penetration," "the indicator of business opportunity perception" and "the indicator of knowledge, ability and experience," applies.

(2) The business survival rate in Japan is calculated only on the basis of business enterprises whose company information is recorded on the database "COSMOS2 (corporate profile database)" of Teikoku Databank, Ltd. In addition, since it takes a certain period of time until information is recorded on the database, the calculated rate may be higher than the actual survival rate.

(3) The business survival rate in each of the U.S., the U.K., Germany, and France is acquired from its average of the number of business enterprises that newly started business during the period from 2007 to 2013.

(Source) Science and Technology Indicators 2017, NISTEP Research Material-261, released on August 9, 2017

Summary

- The R&D expenditure and the number of researchers in Japan is the third largest in major countries (Japan, the United States, Germany, France, the United Kingdom, China and Korea), but the number of new doctoral degree recipients per 1 million population is the sixth place in the major countries.

- With regard to R&D funds in Japan, direct government funding to business enterprises is lowest among the other countries, and is concentrated on large-scale business enterprises.

- Among graduates of doctoral programs in "science and engineering" in Japan, the percentage of those who are employed for "indefinite terms" is approximately 50%. In contrast, the same percentage for graduates of doctoral programs in “Social sciences and humanities" is approximately 30%.

- The number of scientific publications in Japan (fraction counting method) is the fourth in the world and the number of scientific publications with high citations is the ninth, the ranking of Japan in the latter has been declining in quicker pace. On the other hand, Japan continues to be the world first place in the patent family (patent applications to more than two countries).

Summary

- A large number of Japanese papers are cited by patent families (technologies) around the world. In comparison with other countries, the proportion of Japan's technologies citing papers (scientific outputs) is low. In particular, it is possible that the scientific outputs of "clinical medicine" and "basic life sciences" are not utilized for Japanese technologies.

- Japan's high technology industry trade balance ratio has been declining since the 1990s. After 2011, it experiences a foreign trade deficit and it is the sixth position in the major countries. Meanwhile, the medium high technology industry trade balance ratio is at an exports surplus, keeping the first place among the major countries.

- The business startup rate and business discontinuance rate in Japan remain low, compared with those of the United States and European countries. However, once businesses are established, such businesses tend to continue for a long term.