Japanese Science and Technology Indicators 2009

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Research Unit for Science and
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National Institute of Science and Technology Policy
(NISTEP)
Ministry of Education, Culture, Sports,
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Introduction

The National Institute of Science and Technology Policy (NISTEP) published the first edition of *Science and Technology Indicators* in 1991, in which Japan's science and technology activities were analyzed systematically based on objective and quantitative data. Since then, revised reports of the indicators have been reported every 3 years, and the 5th edition was published in 2004.

Since 2005, we have published the reports by updating based on the 5th edition, adding to the brief explanation by picking up newly released statistics and related figures. However, since the reports were written from a diversity of perspectives, there were some duplicated figures and the report itself tended to be voluminous.

In the "*Science and Technology Indicators 2009*", the composition of the report was reviewed and simplified. We selected the data which was updated annually in principle and was possible to make time-series and international comparison. It was elaborated by gathering related charts and data from different parts. Moreover, the following improvements were made to heighten consistency and to make the data more understandable.

(1) Clarification of attention points of international comparisons and time-series comparisons

Reminder marks, "Attention to international comparison" or "Attention to time-series" were attached where they were required. Basically, the data for each country conformed to the manual of the OECD; however, there were some cases where attention to comparisons is needed due to differences in the ways of collecting data or the range of objects. For such cases, "Attention to international comparison" was marked. And regarding time series data, continuous data could not be collected under the same conditions due to changes in statistical standards. Therefore, "Attention to time-series" was marked in cases where attention is required in reading the trends of increases and decreases. Other specific attention points are described in the notes of charts..

(2) Metadata in data collections was tabulated

The metadata is arranged in tables to show clearly how the statistical data of each country is collected and what differences exist as far as is possible with the publicly-available information.

(3) An integration of the database applied

For example, regarding the data about scientific papers, they are integrated with the data of *Web of Science*, and the increase in international co-authorship papers is analyzed. About patents, patent applications to Japan/U.S./Europe are analyzed and heighten international comparisons.

(4) Color-coded charts

Charts are color-coded and a certain country corresponds to a certain color.

We are seeking to publish a more improved *Science and Technology Indicators* through such rearrangements and revisions. We hope that *Indicators* is used not only by people who engage in science and technology activities but also by people from across the social spectrum. We would appreciate your opinions to help us improve and enhance future *Science and Technology Indicators*.

August 2009

Terutaka KUWAHARA
Deputy Director General
National Institute of Science and Technology Policy (NISTEP)

Summary

1． R&D expenditure

(1)International comparison of each country's R&D expenditure

- The total Japan's R&D expenditure was approximately 18.9 trillion yen in fiscal 2007. This amount is the equivalent of approximately 17.3 trillion yen on a full time equivalent (FTE) basis, the highest ever ratio against GDP.
- Out of all the performing sectors, the business enterprise sector accounted for the highest ratio of the total R&D expenditure in each country. The proportions of R&D expenditure by the business enterprise sector in Japan, the U.S. and Germany were approximately 70%; however, those in France and the U.K. were approximately 60%.
- The proportion of R&D expenditure by the university and college sector in the U.K. is increasing while that in Japan and Germany remains flat.

(2)Government budgets

- With regard to the GBAORD, the growth rate in the U.S., the U.K. and Germany was higher during the 2000s compared to the 1990s. The growth rates in Japan or France, however, started slowing down in the 2000s.
- Japan's government budget appropriation or outlays (the government budget appropriation for S&T) in fiscal 2009, including the supplementary budget, was approximately 5 trillion yen, and recorded the highest amount ever.

(3)R&D expenditure in the business enterprise sector

- The ratio of R&D expenditure against GDP in the business enterprise sector was 2.68% in Japan followed by 2.49% in Korea, and each value was an all time high in the corresponding country. The ratio was 1.92% in the U.S., and has recently been gradually increasing.
- With regard to direct fund distribution (direct aid) and R&D tax incentives (indirect aid) to the business enterprise sector by the government in each country, the former accounts for a large proportion in the U.S., France, the U.K., etc., and the latter accounts for a large proportion in the in Japan, Canada, etc., respectively.

(4)R&D expenditure in the university and college sector

- The R&D expenditure in the university and college sector was 3,423.7 billion yen, which is the equivalent of 2,192.7 billion yen if the labor cost is multiplied by FTE factor.
- With regard to the annual average growth rate of R&D expenditure by real value (2000 base, national currency), the U.S., Germany, the U.K. and China showed a higher rise in the 1990s than in the 2000s.
- By observing the R&D expenditure in the university and college sector in Japan by field, it was found that national universities used approximately 50% of the total R&D expenditure in the field of natural science and engineering, while private universities used approximately 70% of the total R&D expenditure in the field of social sciences and humanities.

(5)R&D expenditure by character of work

- Among the countries studied, in France, the proportion of R&D expenditure for basic research in the latest available year was 23.7%, and 67% of this amount was used by the university and college sector. In contrast, the proportion of R&D expenditure for the basic research was smallest in China at 5.2%. In Japan and the U.S., the values were 13.8% and 17.5% respectively.
- With regard to R&D expenditure by character of work in the business and enterprise sector, the R&D expenditure for development and for applied research account for 70% or more in Japan, the U.S. and Korea, and for approximately 40% in France and the U.K.

(1)International comparison of the number of researchers in each country

- The definition and measurement of researchers in each country are conducted in line with the Frascati Manual. However, the actual methods used for the investigations are often different in each country. In particular, the university and college sector are excluded from the coverage of R&D statistical surveys in some countries. Also some countries set special conditions regarding the scope of the range of the surveys. Also there are countries which apply the full-time equivalent (FTE) method in surveying the number of re-searchers. And there are other countries which apply actual head counting for this purpose. Therefore, it could be said that there are many contributing factors which reduce the performance of the international comparability. In addition, in the U.S. and in the U.K., the number of researchers belonging to some sectors is not reported to the OECD. This forces the OECD to utilize estimated figures as a substitute. For the reasons given above, it is necessary to be careful in making international comparisons and trend comparisons of the number of researchers.
- In 2008, the number of researchers in Japan was a total of about 670,000, if the number of researchers working at universities and colleges is calculated by using the FTE method. The number is about 880,000 in the head count method. In recent years, the number of researchers in China has greatly increased. But the number of researchers per capita still lags behind compared to the other selected countries.

(2)Researchers by sector

- The numbers of researchers in the business enterprise sector recently has had a tendency to increase for both Japan and the U.S., while that for Germany and the U.K. have been flat. With regard to the proportion of the number of researchers by industry, the ratio of those in the manufacturing industry to the non-manufacturing industry in Japan was approximately 90% to 10%, and in the U.S. was approximately 60% to 40%. The trends of both countries are different in this way.
- The number of researchers in the university and college sector in Japan in accordance with the statistics by the OECD was extremely large compared to other countries (180,000 people (2006) in Japan, while 190,000 people (1999) in the U.S.). But if the number of researchers in the university and college sector is measured using the statistics for education, the value is not necessarily extremely large (250,000 people in Japan compared to 740,000 people in the U.S. (both in 2006)).

(3)Research assistants

- With regard to the number of research assistants per researcher by sector, the value is large in the public organization sector and small in the university and college sector in almost all the countries. Especially in Japan, the number of research assistants is so small that the value is approximately a half of that in Ger-many and France.
- Out of the number of research assistants in the university and college sector in Japan, the number of “assistant research workers” has been flat while that of “clerical and other supporting human resources” is in-creasing in number.

3. Higher Education

(1)The status of students in Higher Education institutions

- The number of newly enrolled undergraduates in Japan has been roughly unchanged since about 2000, and that for the year 2008 is about 614,000. The numbers newly enrolled in private universities and colleges is high, and constitutes about 80% of the total. When classified by field, the students who major in “Natural science and engineering” are about 30% of the total. Of these, the students who study in national universities and colleges are about 30%, and those in private universities and colleges are about 60%.
- The numbers newly enrolled in master’s programs has been roughly unchanged since about 2005 and that for the year 2008 is about 77,000. The numbers newly enrolled in national universities and colleges constitutes about 60% of the total. When classified by field, the students who major in “Natural science and engineering” are about 70% of the total. Of these, the students who study in national universities and colleges are about 70%, and those in private universities and colleges are about 30%.
- The numbers newly enrolled in doctoral programs has been decreasing since 2003 and was about 16,000 for the year 2008. The numbers newly enrolled in national universities and colleges is high and constitutes about 70% of the total. When classified by field, the students who major in “Natural science and engineering” are about 70% of the total. Of these, about 70% of the students study in national universities and colleges, and the students who study in private universities and colleges are about 20%.

(2)Career options for students in Natural sciences and Engineering

- Looking at career options for undergraduate students in “Natural sciences and engineering” after graduation, students who enter employment are about 60% and those who proceed to higher education are about 30%. When it comes to master’s students, those who enter employment are about 90% and those who go on to the next stage of education are about 10%. The percentage of students who head into the workforce has increased during recent years.
- Looking at those who enter employment among the graduates of “Natural sciences and engineering” by industrial classification, in case of undergraduates, the “Manufacturing industry”, “Service type industries” and “Others” comprise one-third each. And in the case of master’s students, the percentage of students who enter employment in the “Manufacturing industry” is about 60%, and the percentage of students who find employment in “Service type industries” is about 20%.

(3)The number of degree-awarded

- Looking at the number of persons who have degrees per one million of the population, bachelor’s degree awarded in Japan are about 4,400. This is less than the U.S. and U.K., however, it greatly surpasses Germany and France. Meanwhile, the number of doctoral degree awarded is about 100, which is half as many as that in the U.K. and Germany and falls below that of the U.S. and France.
- When the rate of increase of the number of doctoral degree awarded per one million of the population is compared with the rate of increase during the 10 years from 1995, the U.K. has been enlarged 1.71 times,

which has reached approximately the same level as Germany. During these years, Japan has enlarged 1.25 times, which is a higher increase than the U.S. and Germany.

4. The output of R&D

(1)Papers

- The quantity of papers, which are the output of the world's research activities, has consistently shown an upward trend.
- Research activities themselves have changed from the activities of a single country into joint activities that are conducted by multiple countries. Now international co-authorship papers have increased, and a difference has emerged between the "degree of participation in papers in the world" and the "degree of contribution to the production of papers in the world".
- Regarding the numbers of papers produced in Japan (the average from 2005 – 2007), in terms of the "degree of participation in papers in the world (number counts)" Japan is ranked third in the world, after U.S. and China, and is at the same level as U.K. and Germany. Meanwhile, although in terms of the "degree of contribution to the production of papers in the world (fractional counts)" Japan is third ranked as well, it has more than 1% more than U.K. and Germany in the world share.
- China has increased both in terms of the "degree of participation in papers in the world" and the "degree of contribution to the production of papers in the world" since the late 1990s, and has gone up to second place.
- Looking at the balance of the fields in Japan, the share of Chemistry has decreased and that of Clinical medicine has increased.
- On the other hand, looking at the field portfolios in main countries by world share, Japan has more weight on Chemistry, Material science and Physics, and less weight on Computer science/Mathematics, Environment/Geoscience, Basic biology and Clinical medicine. In U.S. and U.K., there is much weight placed on Basic biology and Clinical medicine.
- The percentage of international co-authorship for 2007 was 48% for Germany, 46% for U.K. and 50% for France, while U.S. was 30% and Japan was 24%.

(2)Patents

- The numbers of patent applications had been increasing with an annual average growth rate of about 5% since the mid 1990s, and reached 1.76 Million for the year 2006.
- The numbers of patent applications to the Japan Patent Office (hereinafter "JPO") have been about 400,000 over these past several years. The numbers of patent applications to U.S. Patent and Trademark Office (hereinafter "USPTO") have been rapidly increasing, and it was more than that to JPO in the year 2006. The applications to JPO from Non-Residents have been increased, and accounted for over 15% of all in the year 2006. However, this ratio is small compared with that of USPTO, about a half of whose applications are from Non-Residents.
- All main countries including Japan have steadily increased their numbers of patent applications. Of these, the growth of Korea and China is especially large. Many applications from China are still to State Intellectual Property Office of the P.R.C. (hereinafter SIPO), and its presence in the world is still small. Korea has been applying for patents from patent offices in every country and has strengthened

its world presence.

- Looking at the numbers of patent applications for JPO, USPTO and The European Patent Office (herein-after EPO), Japan has shown a big presence since 10 years ago. Looking at the applications by technical field, Japan has a big share in Nanotechnology and Information and communication technology.
- The relation between patents and scientific papers has been getting stronger. The Science Linkage, which indicates the degree to which patent literature cites scientific literature, has been increasing. From 1996-1998 to 2004-2006, the values in all fields increased from 1.86 to 2.42. The value of Medical and chemical manufacturing is highest. Science Linkage has recently increased in Petroleum/Coal product manufacturing.

5. The outcome of R&D

(1)Technology trade

- Looking at technology trade balance, Japan was 3.49 in 2007, and its export surplus has been continuing since 1993. Looking at the technology trade excluding transactions with affiliates overseas, which is with so-called parent companies and subsidiaries, its technology trade balance was 1.1 in 2007 and it has been flat since 2001.
- The technology trade balance of U.S. has a trend of decline in the long run, and it has been lower than that of Japan since 2001. In 2006, the export surplus marked 2.12. However, regarding the technology trade balance, excluding transactions among affiliates, which are considered more appropriate as indicators for technology strength, U.S. is substantially higher than Japan (Japan has 1.1 for other companies excluding parent companies and subsidiaries. U.S. has 3.7 for other companies excluding associated companies.)
- Looking at the amount of technology exports of Japan, "Transportation equipment manufacturing" accounts for about 50% of all industries, and it is followed by "Pharmaceutical manufacturing", which accounts for about 10% of all industries. Regarding "Transportation equipment manufacturing", the ratio of parent companies and subsidiaries is approximately 90%. However, that of "Pharmaceutical manufacturing" remains at approximately 40%. "Pharmaceutical manufacturing" can be said to be an industry involving more international technology transfer for technology exports in Japan, many of which transactions are made among parent companies and subsidiaries.
- Although a lot of transactions for technology imports in Japan are made in companies excluding parent companies and subsidiaries, in "Electric equipment manufacturing" those among parent companies and subsidiaries comprise more than 50%.
- Looking at the partners of technology exports from Japan, U.S. accounts for about 40% of them all, which is first, and China follows it at about 10%. U.K. accounts for less than 10%, which is third place. On the other hand, regarding technology imports, U.S. accounts for 70% of the total, and Germany, France and U.K. follow it with about 5% each.

(2)The High Technology Industry Trade

- The high technology industry trade of the entire world increased by about double in recent 5 years. Especially, the "Radio, Television and Communication Equipment" industry was the largest, which accounted for about 40% of the total.
- Looking by country, the trade scale of U.S. was large and is tending to expand. However, China has increased its trade amount rapidly during recent years and it is getting near to U.S. level. The trade amount of Germany has also rapidly expanded. Japan has followed it, and is in fourth place.
- The trade balance of Japan's high technology industry had an export surplus of over 3 in the early 1990s. After that, the trade balance tended to decrease and it was an export surplus of over 1.3 in 2006. Europe and China have moved around 1 since 1990s, and U.S. has shifted to less than 1 since 2000, which means it now has an import surplus.

- Looking at it by field, the “Radio, Television and Communication Equipment” industry showed a large ratio, and particularly the amount of the imports and the exports of China have been larger than those of U.S. in recent years.
- The “Radio, Television and Communication Equipment” industry and the “Medical, Precision and Optical Instruments” industry of Japan have an export surplus. The “Aircraft and Spacecraft” industry of U.S. has an export surplus, and the “Pharmaceuticals” and “Medical, Precision and Optical Instruments” industries of Germany have an export surplus.

(3)Total Factor Productivity (TFP)

- Looking at the change in TFP which has had the contribution of labor and capital is excluded from economic growth, Japan’s TFP has gradually been increasing since the early 1990s and throughout the later 1990s and into the early 2000s.
- The TFP contribution for the early 2000s is about the same level among Japan, Germany, France and U.K. The TFP contribution of U.S. is higher than that of these countries.

Main parts

Chapter 1 : R&D expenditure

In this chapter, the status of R&D expenditure in Japan and other selected countries, which is a type of input data for R&D activities, is reviewed. R&D expenditure is the total expenditure used for conducting R&D operations in an organization. Expenditure which is internally used for R&D at an organization is called intramural R&D expenditure, and expenditure for outsourcing or commissioning R&D is called extramural R&D expenditure. Because this chapter deals with only intramural R&D expenditure, the simpler expression of R&D expenditure is used to refer to intramural R&D expenditure. The contents of this chapter also include mention of a part of the government budget appropriations or outlays for R&D (hereinafter referred to as GBAORD).

1.1 International comparison of each country's R&D expenditure

Key points

○The total Japan's R&D expenditure was approximately 18.9 trillion yen in fiscal 2007. This amount is the equivalent of approximately 17.3 trillion yen on a full time equivalent (FTE) basis, the highest ever ratio against GDP.

○Out of all the performing sectors, the business enterprise sector accounted for the highest ratio of the total R&D expenditure in each country. The proportions of R&D expenditure by the business enterprise sector in Japan, the U.S. and Germany were approximately 70%; however, those in France and the U.K. were approximately 60%.

○The proportion of R&D expenditure by the university and college sector in the U.K. is increasing while that in Japan and Germany remains flat.

1.1.1 Trend of R&D expenditure in each country

First of all, the total R&D expenditure in selected countries is examined in order to provide an overview of their sizes and trends. A precise comparison of R&D expenditures among different countries is difficult because surveying methods for R&D expenditures differ by country; however, the comparison of the data in each country over time is considered to represent the trend of the country.

For a comparison of R&D expenditures in each country, currency conversion is necessary. But, because of the conversion, the comparison inevitably falls under the influence of each country's economic conditions. Therefore, converted values are used for the international comparison of each country's R&D expenditure, and the value of each national currency is used for examining the change of R&D expenditure over time in the corresponding country.

Japan's R&D expenditures are shown with two types of values. One of such values was obtained from the Survey of Research and Development conducted and published by the Ministry of Public Management, Home Affairs, Posts and Telecommunications. And the other values were obtained from materials published by the OECD. The difference between both the values is how to obtain labor costs in the university and college sector. In the Survey of Research and Development, the expenditures in the university and college sector were measured on the basis of a head count (HC) of researchers, due to the background that the strict separation of expenditure for research and that for education in the university and college sector is difficult. Accordingly, the number of researchers in the university and college sector represents the total cost of labor including duties other than research carried out by universities' teaching staffs. As for the OECD[(1)], the total R&D expenditure in Japan's university and college sector is provided on the FTE basis (for more details, refer to Section 1.3.3, the R&D expenditure in the university and college sector). In this chapter, the status of R&D investment in each country is studied using the data estimated by the OECD (referred to as "Japan (estimated by the OECD)") and others.

The total amounts of R&D expenditure in each country are shown in Chart 1-1-1. (A) is nominal values (of R&D expenditure representing each year's nominal price,) and (B) is real values (of R&D expenditure on the basis of the standard price values in 2000). (C) and (D) are the nominal values and real values (on 2000 base) represented by the national currencies of each country respectively.

Japan's total R&D expenditure was approximately 18,943.8 billion yen in 2007[(2)]. Because R&D expenditure is greatly influenced by the size of the country's economy, the U.S. is in the dominant position followed by Japan, China, and Germany. France, the U.K. and Korea are at approximately same level.

All the selected countries apparently experienced a trend of slowdown or a decline in the first half of the 1990s. But in the latter half of the 1990s, the trend in the U.S. and Japan took an upturn followed by Germany, the U.K. and France little later. Recently, the figures leveled off in Germany, France and the U.K. China showed a significant rise both in nominal and real values.

Next, the investment status of each country was examined by comparing the annual average growth rate of R&D expenditure in the 1990s (1991 to 2000) and the 2000s (2000 to the latest available year) on the basis of each national currency.

According to the comparison of the annual average growth rate of R&D expenditure (nominal values) between the 1900s and the 2000s, the growth rate increased more in the 1990s in the U.S., Germany and Korea, while it increased more in the 2000s in the other selected countries. Out of the latter, the country in which the growth rate increased the most rapidly in the 2000s was China (22.3 %). In Japan, although the growth rate also increased more in the 2000s compared to that in the 1990s, the value was only 2.18% (Chart 1-1-1 (C)).

In the U.S. and Germany, the annual average growth rate of R&D expenditure (real values) which was on a 2000 base to reduce the influence of conditions related to price also increased more in the 1990s. Among the countries in which the growth rate increased more in the 2000s, China and Korea are outstanding in their growth surge. Japan also showed large growth at 3.42% (Chart 1-1-1(D)).

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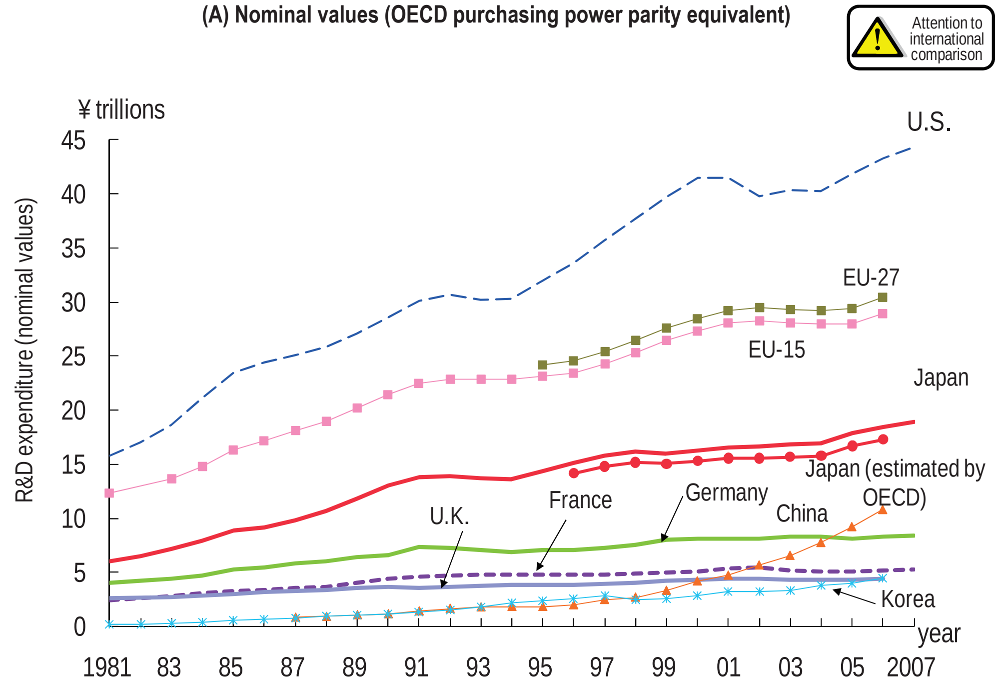
(1) The Organization for Economic Cooperation and Development (OECD) is the organization in which countries supporting democracy and market economy engage in activities for the purpose of ① economic development, ② aid to developing countries and ③ expansion of multilateral free trading. OECD is currently composed of 30 member countries, and gathers statistics, economic and social data which can be internationally compared, and also conducts prediction and analysis.

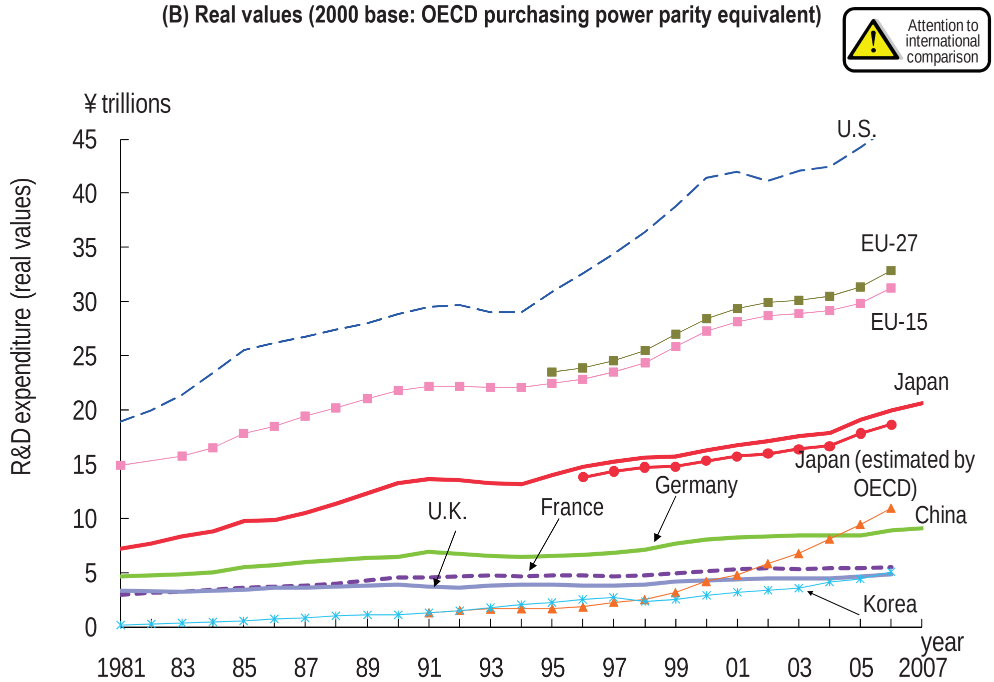
(2) Since the period covered to collect yearly total domestic R&D expenditure data differs depending on the country, this report in principle uses the calendar year for international comparison. However, fiscal years may sometimes be used for certain types of data for convenience.

Chart 1-1-1: Trend in total R&D expenditure in selected countries

(A) Nominal values (OECD purchasing power parity equivalent)



(B) Real values (2000 base: OECD purchasing power parity equivalent)



(C) Nominal values (national currency)

National currency	1991	2000	Latest year with available data	Annual average growth rate '91→'00	Annual average growth rate '00→Latest year
Japan (¥ trillions)	13.8	16.3	18.9 (2007)	1.88%	2.18%
Japan (estimated by OECD) (¥ trillions)	14.2 (1996)	15.3	17.3 (2006)	1.18% ('96→'00)	2.04%
U.S. ($ billions)	161	268	368 (2007)	5.82%	4.66%
Germany (€ billions)	37.8	50.6	61.2 (2007)	3.28%	2.76%
France (€ billions)	24.9	31.0	39.4 (2007)	2.46%	3.50%
U.K. (£ billions)	12.0	17.7	23.2 (2006)	4.41%	4.58%
China (¥ billions)	15.9	89.6	300 (2006)	21.1%	22.3%
Korea (₩ trillions)	4.16	13.8	27.3 (2006)	14.3%	12.0%

(D) Real values (2000 base; national currency)

National currency	1991	2000	Latest year with available data	Annual average growth rate '91→'00	Annual average growth rate '00→Latest year
Japan (¥ trillions)	13.6	16.3	20.6 (2007)	2.03%	3.42%
Japan (estimated by OECD) (¥ trillions)	14.0 (1996)	15.3	18.7 (2006)	1.01% ('96→'00)	3.35%
U.S. ($ billions)	190	268	307 (2007)	3.85%	1.99%
Germany (€ billions)	43.4	50.6	56.7 (2007)	1.72%	1.62%
France (€ billions)	27.8	31.0	34.0 (2007)	1.19%	1.35%
U.K. (£ billions)	15.2	17.7	19.8 (2006)	1.75%	1.88%
China (¥ billions)	28.3	89.6	234 (2006)	13.7%	17.4%
Korea (₩ trillions)	6.45	13.8	24.5 (2006)	8.85%	10.0%

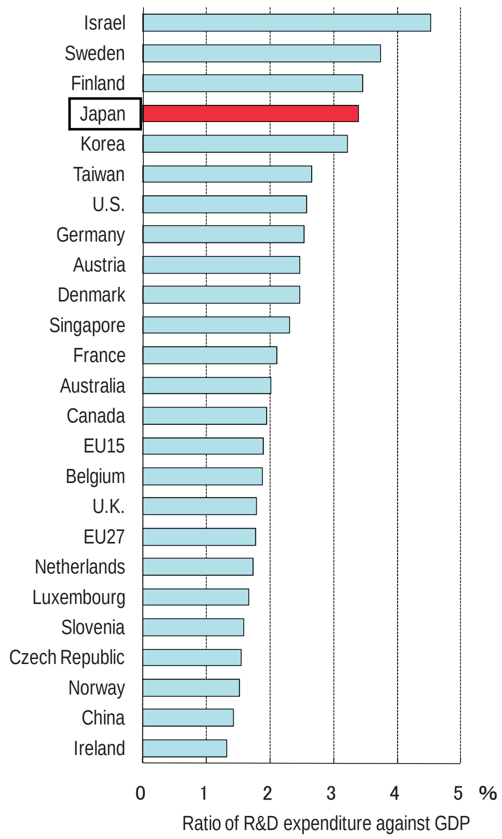
Note: 1) The total R&D expenditure is the sum of each sector's expenditure, and the definition of each sector occasionally differs depending on the country. Therefore it is necessary to be careful when making international comparisons. Refer to Chart 1-1-4 for the definition of sectors in each selected country.
2) R&D expenditure includes the expenditure in the field of social sciences and humanities (except for the case of Korea).
3) The former West Germany until 1990, and the unified Germany since 1991, respectively.
4) Reference statistics E were used for the conversion to obtain purchase power parity equivalent.
5) Real values were obtained by calculations with a deflator (reference statistics D were used).
6) Value for Japan (estimated by the OECD) represents the total R&D expenditure in which the labor cost comprising a part of R&D expenditure in the university and college sector was converted to FTE. The value was corrected and estimated by the OECD.

Sources: <Japan> Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"
<U.S.> NSF, "National Patterns of R&D Resources 2007 Date Update"
<Germany> Bundesministerium fur Bildung und Forschung, "Bundesbericht Forschung 2004, 2006", "Bundesbericht Forschung und Innovation 2008"; OECD, "Main Science and Technology Indicators 2008/2" for information since 2006
<Japan (estimated by the OECD), France and EU> OECD, "Main Science and Technology Indicators 2008/2"
<U.K> National Statistics website: www.statistics.gov.uk
<China> Ministry of Science and Technology of the People's Republic of China, S&T Statistics Data Book 2007 (website)
<Korea> KISTEP, Statistical DB (website)

Next, the “Ratio of R&D expenditure against GDP (gross domestic product)” is shown below for the comparison of R&D expenditures considering the influence by the size of economy (Chart 1-1-2).

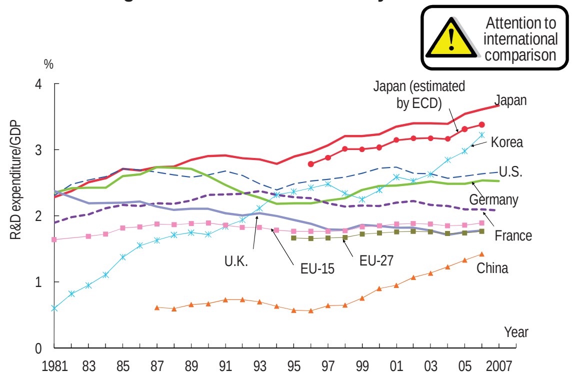
The ratio of R&D expenditure against GDP in Japan was fourth among the listed countries and regions, and stands at a high level.

Chart 1-1-2: Ratio of the total R&D expenditure against GDP in each country (2006)



Note: 1) Defense expenditure in Israel was excluded.
2) The values for Israel, France, Canada, Belgium and Netherlands were preliminary.
3) The value for Korea is only for the field of natural sciences and engineering.
4) Capital expenditure in Taiwan was almost excluded.
5) Secretariat estimate or projection based on national sources was used with regard to EU15 and 27.
Source: OECD, “Main Science and Technology Indicators 2008/2”

Chart 1-1-3: Trend in the ratio of the total R&D expenditure against GDP for each country



Note: Refer to the note on international comparisons and the details of the R&D expenditures in Chart 1-1-1. GDP is the same as that for reference statistics C.
Source: The details of the R&D values are the same as those given in the notes to Chart 1-1-1. GDP is the same as for reference statistics C.

Also, trend of R&D expenditure in selected countries was shown in another chart, by examining the change in the ratio of R&D expenditure against GDP (Chart 1-1-3).

In Japan, the ratio against GDP exceeded 3% in 1997, continued increasing, and reached a record high 3.7% in fiscal 2007. In accordance with the estimate by OECD, the ratio in Japan went beyond 3% in 1998, and has been increasing since then.

The value in Korea went beyond 3% in 2006 for the first time.

For almost every year in the 1980s, R&D expenditure against GDP in Japan, the U.S., Germany, France and U.K. was higher than 2%. But from the latter half of the 1980s to the first half of 1990s, R&D expenditure slowed down or reduced in every country.

In the U.K., the ratio reached 2% in 1994, and has been under 2% since then.

In China, which has recently been experiencing rapid industrial development, the ratio has been increasing since the upturn in 1996. The ratio gap between China and other selected countries is still wide, but is being narrowed.

1.1.2 Trend of R&D expenditure by sector in each country

In this section, R&D expenditure is classified to four performing sectors, and the change and proportion of R&D expenditure over time for each sector are examined. The classification into four sectors is in accordance with "Frascati Manual(3)" by the OECD, and for the naming of sectors, the naming used in the "Report on the Survey of Research and Development" by the Ministry of Internal Affairs and Communications is adopted.

What is problematic in the classification by sector and the international comparison is the discrepancy among the national R&D systems, the methods of survey, or the target organizations of each country. Accordingly, the comparison should be made in accordance with a correct understanding of the differences among each country. Chart 1-1-4 shows a rough summary of each country's specific breakdown of the sectors. Expressions used in the chart are the same as those which are used in each country's R&D statistics.

Chart 1-1-4: The definition of the performing sector in R&D expenditure in selected countries

Country	Business enterprises	Universities and colleges	Public organizations	Non-profit Instititions
Japan	・Companies ・Special corporations or independent administrative corporations (for-profit)	・University faculties (including advanced research cources at graduate schools) ・Junior colleges ・University research institutes ・Others	・National research institutes ・Special corporations or independent administrative corporations (non-profit) ・Public research institutes	・Non-profit institutions
U.S.	・Companies and others	・University & Colleges (organizations which each conduct R&D equivalent to $150,000 or more)	・Federal government ・FFRDCs **＊Local governments are not included**	・Other non-profit institutions
Germany	・Enterprises ・Public research institutes (IfG)	・Universities ・Comprehensive universities ・Colleges of education ・Colleges of theology ・Colleges of art ・Universities of applied sciences ・Colleges of public administration	・Federal government ・Non-profit institutions (institutions which each obtain public funds of €160,000 or more) ・Legally independent university research institutes ・Local government research institutes	
France	・Enterprises ・Government investment institution	・National Science and Research Center (CNRS) ・Grandes ecoles (not administered by Ministère de l'éducation nationale (MEN)) ・Higher education institutions (administered by Ministère de l'éducation nationale (MEN))	・Scientific and technical research public establishment "Etablissement public a caractere scientifique et technologique" (other than CNRS) ・Commercial and industrial research public establishment "Etablissement public a caractere industriel et commercial" ・Administrative research public establishment "Etablissement public a caractere administratif" (other than higher education institutions) ・Departments and agencies belonging to ministries **＊Local governments are not included**	・Non-profit institutions
U.K.	・Enterprises	・Universities	・Central government (U.K) ・Decentralized governments (Scotland, etc.) ・Research councils **＊Local governments are not included**	・Non-profit institutions
China	・Enterprises	・Universities	・Government research institutes **＊Local governments are not included**	・Other non-profit institutions
Korea	・Enterprises ・Government investment institution	・Universities and colleges offering majors in the field of natural sciences and engineering (including extention campuses and local campuses) ・University research institutes ・University hospitals (only if a school of medicine and its accounting are integrated)	・National ・or public research institutes ・Government suported research institutes ・National ・public hospitals **＊Local governments are not included**	・Private hospitals ・Other non-profit institutions

(3) The Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development): International standards with regard to the method of surveying R&D statistics are stated in this manual. In 1963, experts from member countries of the OECD attended a meeting on surveying research and experimental development (R&D) in Frascati, Italy. The summary of the result is the proposed standard practice for surveying research and experimental development. The latest publication was the sixth version (2002). Most surveys of R&D statistics in each country are mainly conducted following this manual.

Note 1): Detailed information by sector for the U.K. and China was not obtained.
2) Information of EU was not given here because the data of EU were given only as the total of each member country's data.
<U.S.>FFRDCs: Federally funded research and development centers
<Germany>IfG: Institutions for co-operative industrial research and experimental development.
<EU>No breakdown of sectors was given.
Source: NISTEP,"Metadata of R&D-related statistics in selected countries: Comparative study on the measurement methodology"
Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"
BMBF,"Bundesbericht Forschung und Innovation 2008

In Chart 1-1-5, each selected country's total R&D expenditure was classified by sector, and the proportion of each sector was shown. In every selected country, the business enterprise sector accounted for the largest proportion of the total R&D expenditure: 70% in Japan, the U.S. and Germany, and 60% in France and the U.K. On the other hand, the proportion used by the business enterprise sector is increasing in China and Korea, and recently reached 70%.

In Japan, the proportion used by the public organization sector is gradually decreasing while that by the business enterprise sector tends to be increasing in the long run. The significant decrease in the non-profit institution sector in 2001 was due to a change in classification method for statistics.

In the U.S., the proportion for the public organization sector is on the decrease and for the non-profit institution sector is on the increase, respectively, from a long run perspective. The proportion of the university and college sector has tended to decrease, but recently remains flat.

In Germany, the data of public organization sector and the non-profit institution sector are integrated because these have not been classified.

The proportion of these sectors has not fluctuated remarkably over time, and the entire status is considered to be influenced by the status of the business enterprise section.

In France, the proportion of the public organization sector is always relatively large. This proportion has been decreasing in the long term and has recently leveled off.

In the U.K., the proportion of the public organization sector has decreased and that of the university and college sector has increased, respectively since the 1990s.

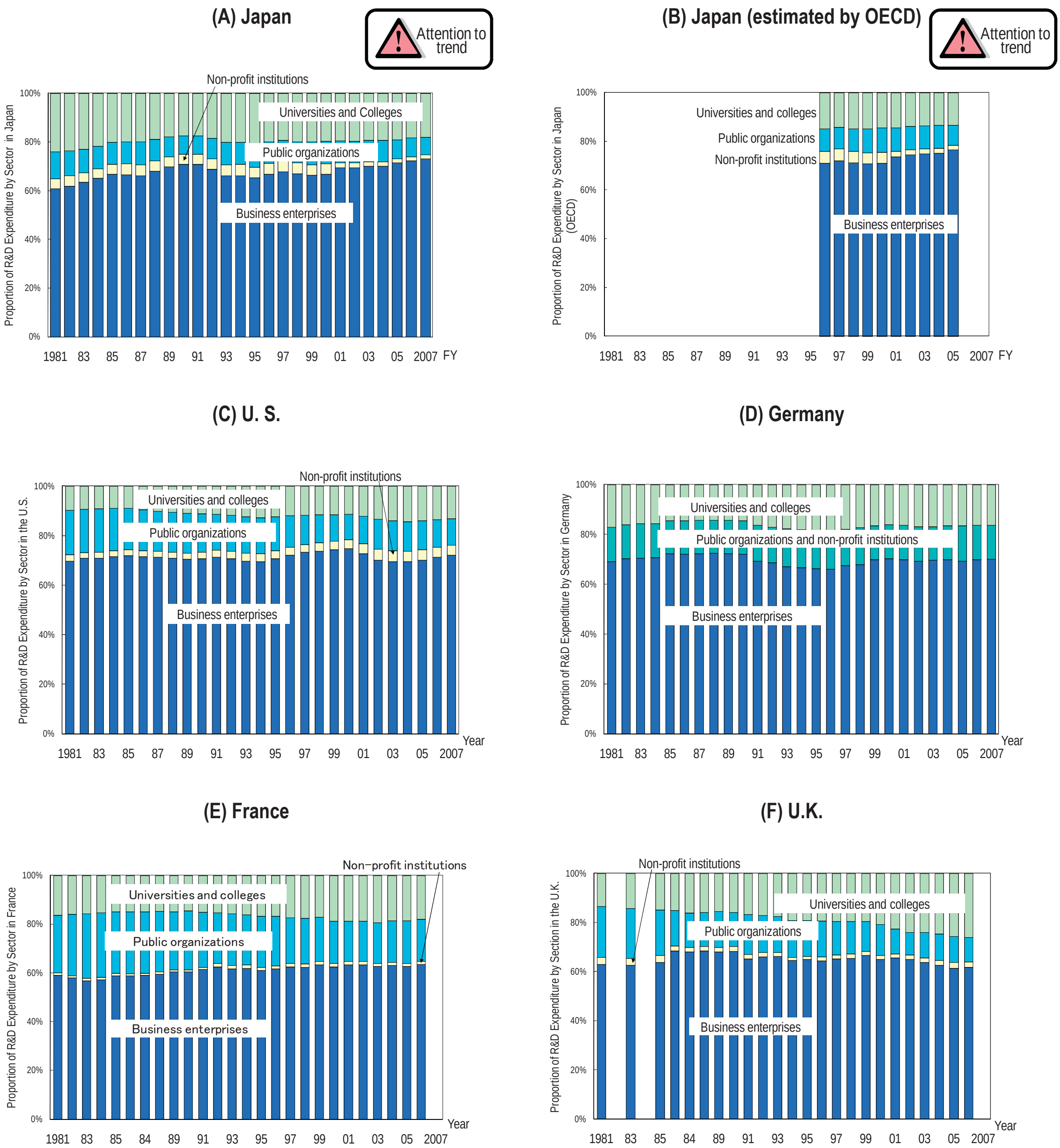
In China, the proportion of the public organization sector is large compared to other countries; however it has been decreasing since 1999. On the other hand, the proportion of the business enterprise sector is rising over time instead.

In Korea, the proportion of the public organization sector has been large, but is recently on the decrease.

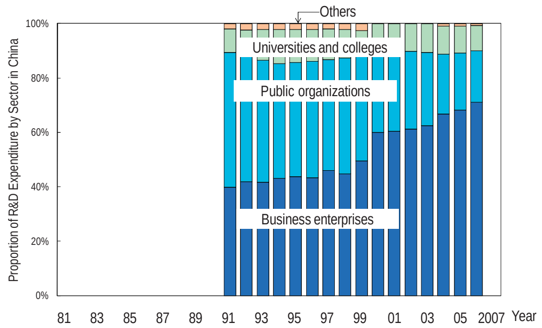
EU-15 and 27 show the same characteristics as the U.K. and France. That is to say, the proportion of the public organization sector has tended to decrease in the long run and that of the university and college sectors has tended to increase, respectively.

Chart 1-1-5: Trends in the proportion of R&D expenditure by performing sector in selected countries

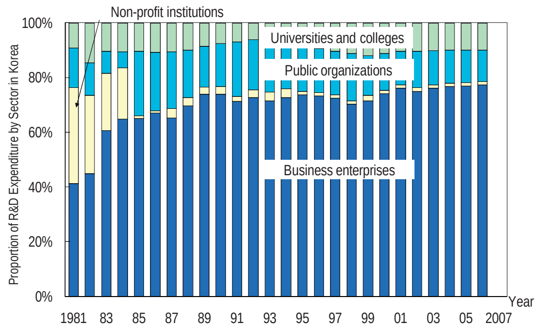
Attention to international comparison



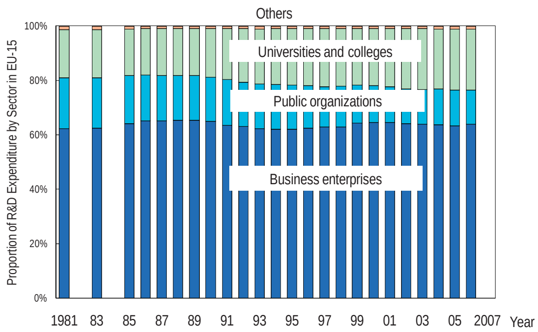
(G) China



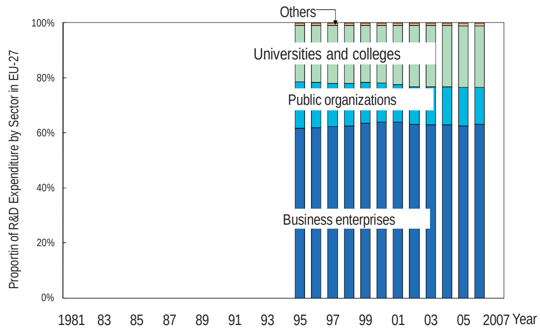
(H) Korea



(I) EU-15



(J) EU-27



Note : The total R&D expenditure is the sum of each sector's expenditure, and the definition of each sector occasionally differs depending on the country. Therefore it is necessary to be careful when making international comparisons. Refer to Chart 1-1-4 for the definition of sectors in each selected country.

<Japan, Japan (estimated by the OECD)> In 2001, a part of non-profit institutions moved into the business enterprise sector.

<Japan (estimated by the OECD)> The total R&D expenditure in which labor cost consisting a part of R&D expenditure in the university and college sector was converted to FTE. The value was corrected and estimated by the OECD.

<Germany>Former West Germany until 1990, and the unified Germany since 1991, respectively.

<Korea>R&D expenditure does not include expenditure in the field of social sciences and humanities.

<EU> Expression "others" represents the total expenditure subtracted by the expenditure for the industrial sector, university and college sector and government research institute sector.

Source: <Japan>Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development; OECD, "Research & Development Statistics 2007/1"

<U.S.>NSF, "National Patterns of R&D Resources 2007 Data Update"

<Germany>Bundesministerium für Bildung und Forschung,"Bundesbericht Forschung 2004,2006"; "Bundesbericht Forschungund Innovation 2008"; OECD, "Main Science and Technology Indicators 2008/2" for 2006 or later

<France>OECD, "Research & Development Statistics 2007/1"

<U.K.>National Statistics website: www.statistics.gov.uk

<China>OECD, "Main Science and Technology Indicators 2008/2"; Ministry of Science and Technology of the People's Republic of China, "S&T Statistics Data Book 2007" (Web site) for 2004 or later

<Korea>KISTEP, Statistical DB (web site); OECD, "Research & Development Statistics 2007/1" for 1995 or later

<EU>OECD, "Main Science and Technology Indicators 2008/2"

1.2 Government budgets

Key points

○With regard to the GBAORD, the growth rate in the U.S. the U.K. and Germany was higher during the 2000s compared to the 1990s. The growth rates in Japan or France, however, started slowing down in the 2000s.

○Japan's government budget appropriation or outlays (the government budget appropriation for S&T) in fiscal 2009, including the supplementary budget, was approximately 5 trillion yen, and recorded the highest amount ever.

In this chapter, each country's GBAORD included in the government budget are examined.

In this report, Japan's "government budget appropriations for Science & Technology (S&T)" are treated as the GBAORD. The government appropriations for S&T are composed of (1) funds for promoting science and technology (a part of the general account, with the main purpose of appropriation in the promotion of science and technology) (2) other research expenditure included in the general account, and (3) the government budget appropriation for S&T included in the special account.

1.2.1 GBAORD in each country

Chart 1-2-1(A), "Total GBAORD (OECD purchasing power parity equivalent) in selected countries," shows that Japan's amount of appropriations or outlays is approximately a fifth of the U.S.'s amount (2007). With regard to change over time, Japan's GBAORD have had a tendency to increase, but recently became flat. In the case of the U.S., the budget has significantly risen since 2001, but recently is rising only slightly.

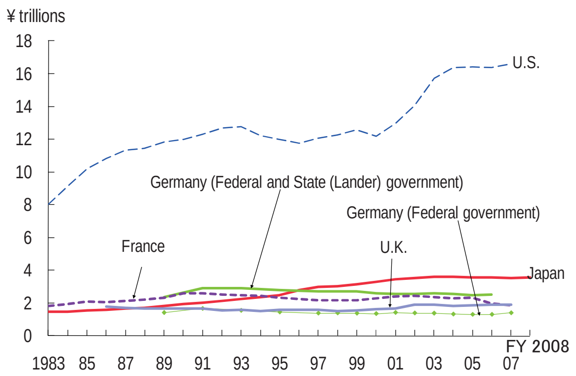
In international comparisons of GBAORD, defense-related expenses are frequently removed. In many cases, it is appropriate to remove such expenses, especially when comparing Japan and other countries, because the expenses for the purpose of defense and others are different in character. Chart 1-2-1(B) shows the amount obtained by subtracting defense-related expenses from the GBAORD (non-defense GBAORD).

The ratios of the non-defense GBAORD against the GBAORD in Japan and the U.S. accounted for 96.3% (2008) and only 41.0% (2007) respectively. As a result of the comparison of the non-defense GBAORD, Japan's amount of appropriations or outlays jumps up to a half of the U.S.'s amount. From the perspective of change over time, in the 1990s (1991 to 2000), Japan's annual average growth rate of the total GBAORD using national currency was 5.54%, the highest of all. On the other hand, the growth rates in Germany (unified Germany) and France were negative. In the 2000s (2000 to the latest available year of each country), an annual average growth rate of the total GBAORD in Japan was only 0.95% while that in the U.S. was high at 8.37%. The U.K. also demonstrated a higher growth rate in the 2000s than in the 1990s (Chart 1-2-1(C)).

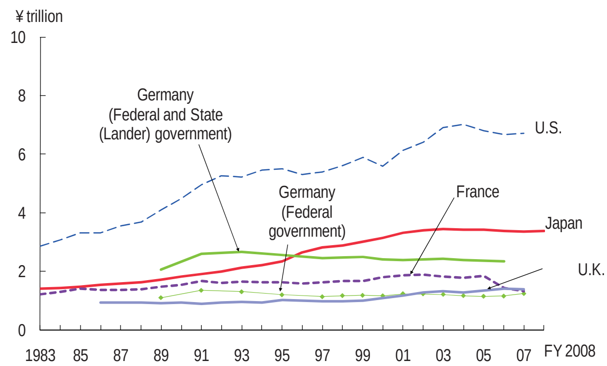
Furthermore, the change in real values, which reduces the influence of conditions related to price, shows that the growth rate was lower in the 2000s than in the 1990s only in Japan and France. In the other countries, the growth rate was higher in the 2000s. Out of the countries in which the total GBAORD was higher in the 2000s, the U.S. demonstrated a high growth rate in its defense-related budget and Germany and the U.K. demonstrated a high growth rate in their non-defense budget, respectively(Chart 1-2-1(D)).

Chart 1-2-1: Trend in the GBAORD in selected countries

(A)Total GBAORD (OECD purchasing power parity equivalent)



(B) Non-defense GBAORD (OECD purchasing power parity equivalent)



(C) Nominal values (national currency)

National Currencies	Government Budget Appropriations or Outlays for R&D	1991	2000	2007	Annual Average Growth Rate '91→'00	Annual Average Growth Rate '00→'07
Japan (¥trillions)	Total	2.02	3.29	3.51	5.54%	0.95%
	Non-defense	1.91	3.15	3.35	5.73%	0.90%
	Defense	0.12	0.14	0.16	1.88%	2.09%
U.S. ($ billions)	Total	65.9	78.7	138	1.99%	8.37%
	Non-defense	26.6	36.1	55.8	3.46%	6.43%
	Defense	39.3	42.6	82.3	0.89%	9.87%
Germany (Federal and State (Lander) Governments) (€ billions)	Total	15.1	16.3	17.8 ('06)	0.85%	1.15%(→'06)
	Non-defense	13.4	15.0	16.7 ('06)	1.25%	1.34%(→'06)
	Defense	1.65	1.27	1.14 ('06)	-2.92%	-1.30%(→'06)
Germany (Federal Government) (€ billions)	Total	8.62	8.48	10.3	-0.18%	2.81%
	Non-defense	6.99	7.29	9.13	0.47%	3.27%
	Defense	1.63	1.19	1.17	-3.43%	-0.29%
France (€ billions)	Total	14.2	13.8	14.1	-0.28%	0.27%
	Non-defense	9.08	10.9	10.0	2.04%	-1.14%
	Defense	5.12	2.96	4.06	-5.90%	4.62%
U.K. (£ billions)	Total	5.58	6.69	10.4	2.04%	6.55%
	Non-defense	3.02	4.45	7.73	4.40%	8.20%
	Defense	2.56	2.24	2.70	-1.46%	2.71%

(D) Real values (2000 base, National currency)

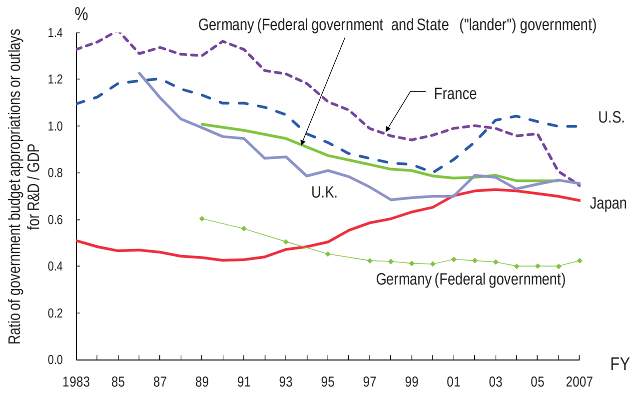
National Currencies	Government Budget Appropriations or Outlays for R&D	1991	2000	2007	Annual Average Growth Rate '91→'00	Annual Average Growth Rate '00→'07
Japan (¥ trillions)	Total	2.00	3.29	3.82	5.69%	2.18%
	Non-defense	1.88	3.15	3.65	5.88%	2.12%
	Defense	0.11	0.14	0.17	2.03%	3.33%
U.S. ($ billions)	Total	78.0	78.7	115	0.09%	5.61%
	Non-defense	31.5	36.1	46.6	1.54%	3.71%
	Defense	46.6	42.6	68.7	-0.99%	7.06%
Germany (Federal and State (Lander) Governments) (€ billions)	Total	17.3	16.3	16.8 ('06)	-0.67%	0.40% (→'06)
	Non-defense	15.4	15.0	15.7 ('06)	-0.29%	0.59% (→'06)
	Defense	1.90	1.27	1.07 ('06)	-4.39%	-2.03% (→'06)
Germany (Federal Government) (€ billions)	Total	9.89	8.48	10.5	-1.69%	1.68%
	Non-defense	8.02	7.29	9.34	-1.05%	2.13%
	Defense	1.87	1.19	1.17	-4.90%	-1.39%
France (€ billions)	Total	15.9	13.8	13	-1.52%	-1.81%
	Non-defense	10.2	10.9	9.36	0.77%	-3.18%
	Defense	5.73	2.96	3.6	-7.07%	2.46%
U.K. (£ billions)	Total	7.04	6.69	8.48	-0.55%	3.77%
	Non-defense	3.81	4.45	6.25	1.75%	5.38%
	Defense	3.22	2.24	2.22	-3.97%	0.03%

Note: <Japan>Data for all the fiscal years are of initial budget amounts.
<U.S.>The value for 2008 is a preliminary budget amount.
<Germany>Estimation for the value of the federal government and local governments ("lander governemnts") in 2006, and for the federal government in 2007 and 2008.
<France>Data for 1984, 1986, 1992, 1997 breaks in series with previous year for which data is available. Data for 2008 are estimates.
<U.K.>Data for fiscal 2006 are estimates. Data for fiscal 2007 and 2008 are planned values by cross cutting review.
Reference statistics E was used for the conversion to obtain purchasing power parity equivalent.
Source: <Japan>MEXT, "Indicators of Science and Technology"
<U.S.>NSF, "Federal R&D Funding by Budget Function Fiscal Years 2007-2009"
<Germany>Bundesministerium für Bildung und Forschung,"Faktenbericht Forschung 2002", "Bundesbericht Forschung 2004,2006", "Research and Innovation in Germany 2005,2007", "Bundesbericht Forschungund Innovation 2008"
<France>OECD," Main Science and Technology Indicators 2008/2"
<U.K.>OST,"SET Statistics"

Next, each country's ratio of GBAORD against GDP is shown for comparison to reduce the effect of the scale of the country's economy (Chart 1-2-2). The value for Japan started increasing in the 1990s; however, the ratio is still lower among the five selected countries, and in addition, recently the ratio has tended gradually to decrease. Since the 2000s, the ratio of each country has remained flat except for that of France, which has continued decreasing.

The ratios for the latest available year were 0.68% in Japan, 1.00% in the U.S., 0.77% or 0.43% in Germany with or without including the local governments ("Lander governments") respectively, 0.75% in France and 0.76% in the U.K.

Chart 1-2-2: Trends of the ratio of Government budget appropriations or outlays for R&D against GDP in selected countries



Note: <GBAORD>Same as Chart 1-2-1
<GDP>Same as Reference statistics C
Source: <GBAORD> Same as Chart 1-2-1
<GDP>Same as the reference statistics C

1.2.2 Ratio of R&D expenditure funded by the government in each country

The following are two types of methods for surveying government funded R&D expenditure:

(1) Sum up the results of the investigation conducted by each performing sector to obtain its government funded R&D expenditure

(2) Obtain R&D related expenditure (the GBAORD) out of the government expenditure.

Of the above mentioned two, method (1) which is conducted by the side of performing sectors can provide the total R&D expenditure, even if the flow of the expenditure is complicated, under the condition that the targets of the investigations cover the entire country. However, the sources of the R&D expenditure are not always precisely identifiable. On the other hand, it is difficult for method (2) which is conducted from the side of expenditure source (the GBAORD) to obtain accurate R&D expenditure because it is unknown whether or not the entire amount was used for the purpose of R&D in actuality.

In this section, method (1) by the side of performing sectors is used to show the status of each government's R&D expenditure. With this method, the ratio of the R&D expenditure which was funded by the government for each sector against the total R&D expenditure in each country is examined. The expression "the government" here mainly represents the central government, but what is represented depends on the country. Chart 1-2-3 shows a simple definition of "the government" for each country.

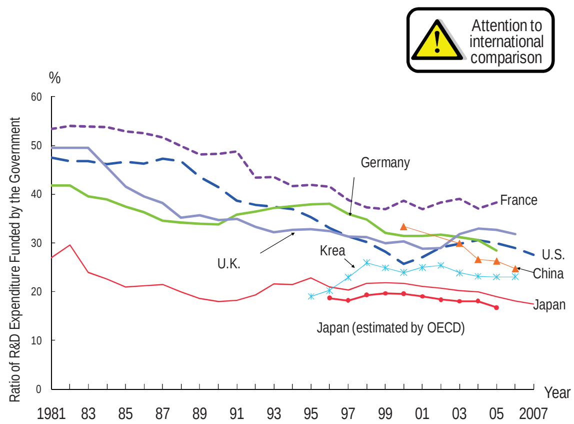
According to Chart 1-2-4, the ratios for the U.S. and major European countries are on the decrease in the long term, although that for France remains flat. The ratio in Japan is the lowest among the seven countries. In 2007, the ratio of government expenditure in Japan recorded an all time low of 17.4%. The continued decrease in government expenditure is not because the government of each country has reduced its R&D spending, but because the R&D spending in the business enterprise sector has risen as shown in Chart 1-2-1, which shows the trend in the ratio of R&D expenditure funded by the government in selected countries.

Chart 1-2-3: Definition of "the government" as a source of expenditure in selected countries

Country	Government
Japan	①National government, local public governments ②National research institutes, public research institutes, and the institutes run by special corporations or independent administrative corporations (non-profit) ③National and public universities (including junior colleges and university research institutes, etc.)
Japan (OECD)	①National governement, local public government ②National research institutes, public research institutes and the institutes run by special corporations or independent administrative corporations (non-profit)
U.S.	Federal government
Germany	Federal government and local ("lander") government
France	Government
U.K.	①Central government (including decentralized governments such as the Scottish government and the Welsh government) ②Research councils ③Higher education funding councils
China	Government
Korea	①Government ②Government supported research institute

Source: NISTEP,"Metadata of R&D-related statistics in selected countries: Comparative study on the measurement methodology"; Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"

Chart 1-2-4: Trend in the ratio of R&D expenditure funded by the government in selected countries



Note: 1) When an international comparison is conducted, it should be noted that the R&D expenditure which is investigated by the side of performing sectors may be funded exclusively by the central government, or by both central and local governments, depending on the country. The definition of each country's "government" is referred to in Chart 1-2-3.
2) R&D expenditure is the sum of the expenditure in the field of natural sciences and engineering, and of social sciences and humanities. (only in the field of natural sciences and engineering in Korea)
<Japan>The government refers to the national government, local public governments, national research institutes, public research institutes, research institutes run by special corporations, national and public universities (including junior colleges etc.).
<Japan（estimated by OECD)>The government refers to national government, local public governments, national research institutes, public research institutes and institutes run by special corporations.
<U.S.>R&D expenditure in 2007 is a preliminary budget amount . The government refers to the the federal government.
<Germany>West Germany and unified Germany until 1990 and since 1991 respectively. The government refers to the federal government and local (lander) governments.
<France>The government refers to public research institutes.
<U.K.>The government refers to the central government (including decentralized governments) , research conferences, and higher education funding councils.
<Korea>The government refers to government research institutes and government supported research institutes
Source: <Japan>Ministry of Internal Affairs and Communications, “Report on the Survey of Research and Development”
<U.S.>NSF, “National Patterns of R&D Resources 2007 Date Update”
<Germany>Bundesministerium fur Bildung und Forschung,“Bundesbericht Forschung 2004,2006”; “Bundesbericht Forschungund Innovation 2008”
<France, Korea>OECD, “Research & Development Statistics 2007/1”
<U.K.>National Statistics website: www.statistics.gov.uk
<China>Ministry of Science and Technology of the People's Republic of China, "China Science and Technology Indicators"; S&T Statistics Data Book 2007 (website)

Next, difference in national policy on R&D expenditure for each country is examined by means of observing the breakdown of R&D expenditure (funded by the government) by performing sector, in other words, by understanding what proportion of government funds was used in each performing sector (Chart 1-2-5).

In the case of Japan, no significant change in each sector occurred, and the university and college sector and the public organization sector accounted for the major proportion of the R&D expenditure through the period of the chart. Limited spending on the business enterprise sector as compared to other countries is one of the characteristics of Japan.

The government of the U.S. previously funded the business enterprise sector to a high proportion. In the 1980s, the proportion remained at around 40%. But since the latter half of the 1980s, the proportion for the business enterprise sector has been reduced significantly, while the proportion for the university and college sector has been on the rise. In the same period, the proportion for the non-profit institution sector has increased although the ratio against the total is still small.

In Germany, the proportion for the business enterprise sector decreased, while that for the university and college sector, the public organization sector and the non-profit institution sector increased from the 1980s to the middle of the 1990s.

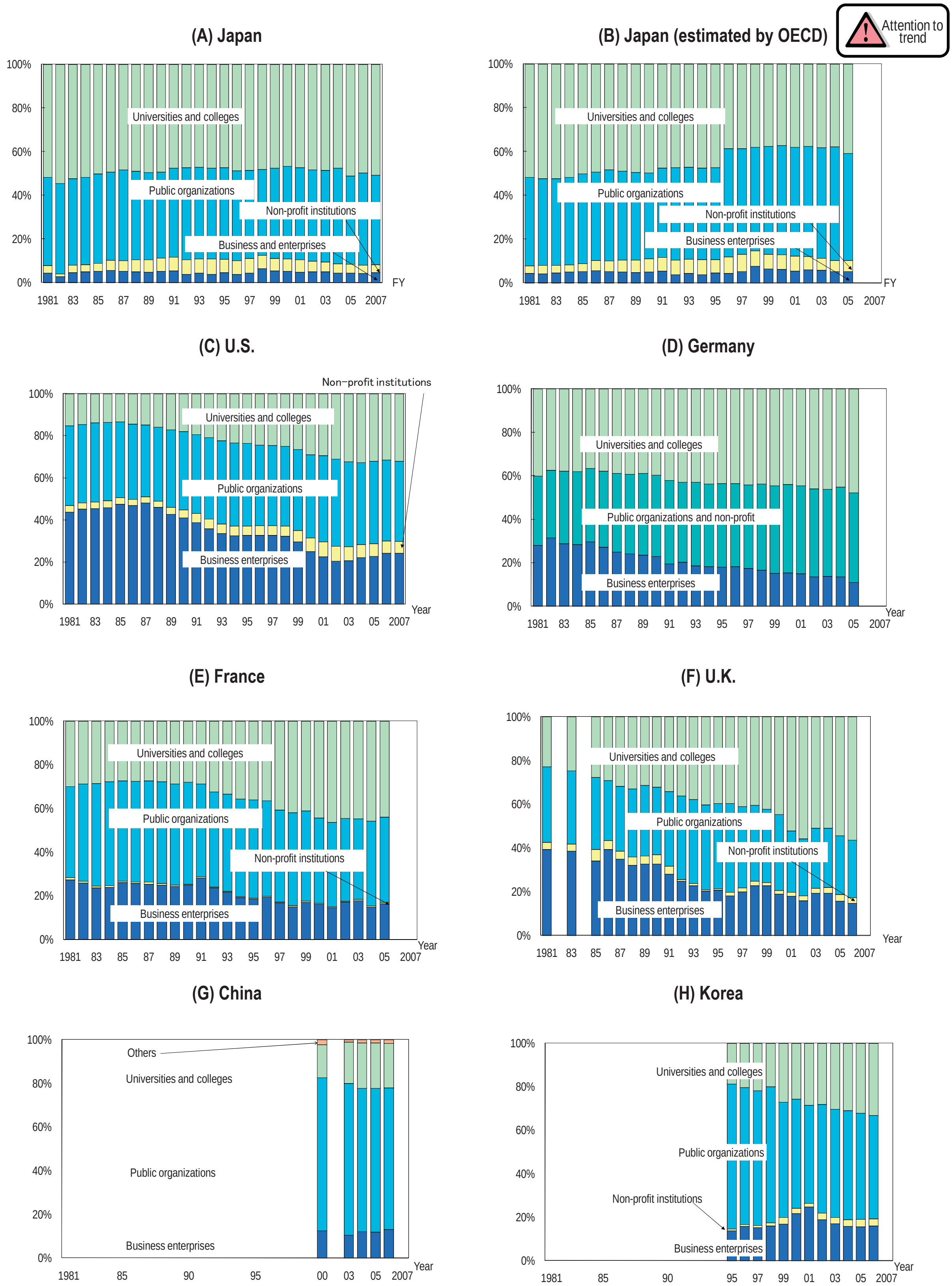
In France, previously the proportion for the public organization sector was large, and that for the university and college sector was relatively small. But starting in the 1990s, the proportion for the university and college sector has increased while that for the public organization sector and the business enterprise sector has decreased.

In the U.K., spending for the university and college sector is sharply on the rise. Spending for the business enterprise sector tended to decrease from 1981 to 1996, and was followed by continuous fluctuation. The proportion for the business enterprise sector has gradually been declining since the latter half of the 1990s.

In summary, in each country, the spending of R&D expenditure by the public organization sector for the business enterprise sector is in a declining trend, while that for the university and college sector is in a rising trend.

Chart 1-2-5: Trend of the proportion of R&D expenditure funded by the government by sector in selected countries

Attention to international comparison



Note:1) Attention is required for international comparison as in Chart 1-2-4

2) R&D expenditure is the sum of expenditure in the field of natural sciences and engineering, and of social sciences and humanities (only the field of natural science and engineering in Korea)

<Japan> The government refers to the national government, local public governments, national research institutes, public research institutes, research institutes run by special corporations and independent administrative corporations, national and public universities (including junior colleges etc.).
<Japan (estimated by OECD)>1)Attention is required for observing the change in a time series because the value which OECD adjusted and estimated (by converting the labor costs of the university and college sector in R&D expenditure with FTE) has been used since 1996.
2) The government refers to national government, local public government, national research institutes, public research institutes and research institutes run by special corporations and independent administrative corporations.
<U.S.>The R&D expenditure in 2007 is preliminary budget amount. The government refers to the federal government.
<Germany>Former West Germany and unified Germany until 1990 and since 1991 respectively. The government refers to the federal government and local governments.
<France> The government refers to public research institutes.
<U.K.> The government refers to the central government (including decentralized governments), research councils and the higher education funding council.
<Korea>The government refers to government research institutes and government supported research institutes.
Source: <Japan> Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"
<U.S.>NSF, "National Patterns of R&D Resources 2007 Date Update"
<Germany>Bundesministerium fur Bildung und Forschung,"Bundesbericht Forschung 2004,2006"; "Bundesbericht Forschungund Innovation 2008"
<France, Korea>OECD, "Research & Development Statistics 2007/1"
<U.K.>OECD, "Research & Development Statistics 2007/1"; National Statistics website: www.statistics.gov.uk since 1992
<China>Ministry of Science and Technology of the People's Republic of China, S&T Statistics Data Book 2007 (website); "Science and technology index of the People's Republic of China"

1.2.3 GBAORD (the government budget appropriations for S&T) in Japan

In Japan, the Cabinet decided on the "Science and Technology Basic Plan" in July 1996 (hereinafter referred to as the "First Science and Technology Basic Plan"). This First Science and Technology Basic Plan explicitly stated that "with regard to short-term doubling of government R&D investments, the ratio of such funds against GDP is intended to be raised to the level of the U.S. and major European countries at the beginning of the 21st Century. In this connection, it has been strongly required to double the amount within the period of the plan. If this is the case, the size of the total government budget appropriations for S&T from fiscal 1996 to fiscal 2000 needs to be approximately 17 trillion yen."

Approximately 17 trillion yen, the target stated in the Basic Plan, was achieved when the total of the government budget appropriation for S&T during the five years from fiscal 1996 to fiscal 2000 of the First Science and Technology Basic Plan became approximately 17.6 trillion yen in actuality. Looking at the trend over the five years, the amount in fiscal 1998 was substantial. This was largely due to a supplementary budget which was compiled as a measure for boosting the economy.

After that, the Cabinet decided on the "Second Science and Technology Basic Plan" for the five years from fiscal 2001 to fiscal 2005 (hereinafter referred to as the "Second Science and Technology Basic Plan"). The Second Science and Technology Basic Plan clearly stated that "in order to continuously make efforts to promote science and technology under the First Science and Technology Basic Plan, it is required to continue to maintain the level of government R&D investment against GDP at least to the same level as the U.S. and major selected European countries during the period of the Second Science and Technology Basic Plan too." In this case, the size of the total government R&D investment during fiscal 2001 to fiscal 2005 would have needed to be approximately 24 trillion yen. The actual sum of the budgets during the corresponding period was approximately 21.1 trillion yen in total, which was composed of approximately 18.8 trillion yen of the budget of the central government and approximately 2.3 trillion yen (for fiscal 2005, an initial budget was allocated) of the budget of the local governments.

Also, in the "Third Science and Technology Basic Plan" (hereinafter referred to as the "Third Science and Technology Basic Plan"), the size of the total budget for five years from fiscal 2006 to fiscal 2010 is considered to be approximately 25 trillion yen (under the condition that the ratio of government investigation for R&D against GDP during the period of the Third Science and Technology Basic Plan is 1%, and the average nominal growth rate of GDP during the same period is 3.1%).

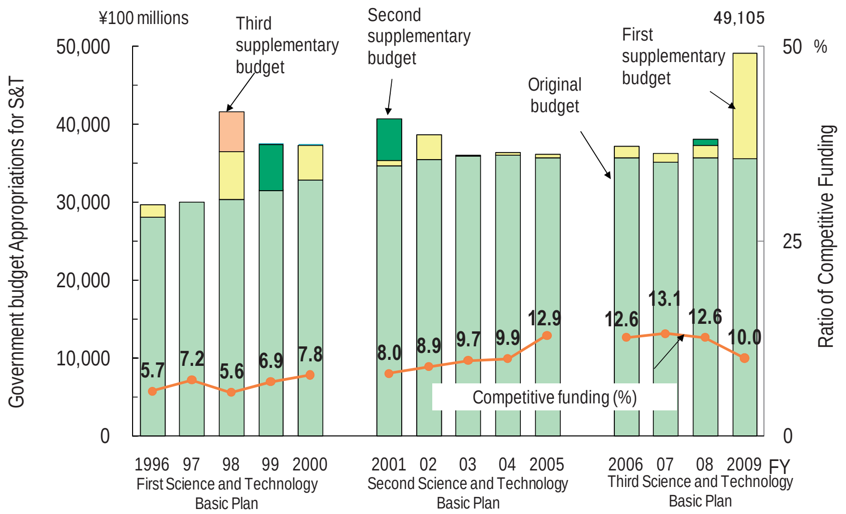
The initial budget of government budget appropriation for S&T for fiscal 2009 was approximately 3.6 trillion yen, but it was adjusted to the substantial amount of approximately 5 trillion yen by the first supplementary budget of approximately 1.3 trillion yen (Chart 1-2-6).

Next, some basic indexes associated with the government budget appropriations for S&T by the Japanese government are shown.

The ratios of the government budget appropriations for S&T in fiscal 2001 and 2009 against those of corresponding previous fiscal years were sharply increased. This is due to the influence of the supplementary budgets (Chart 1-2-7).

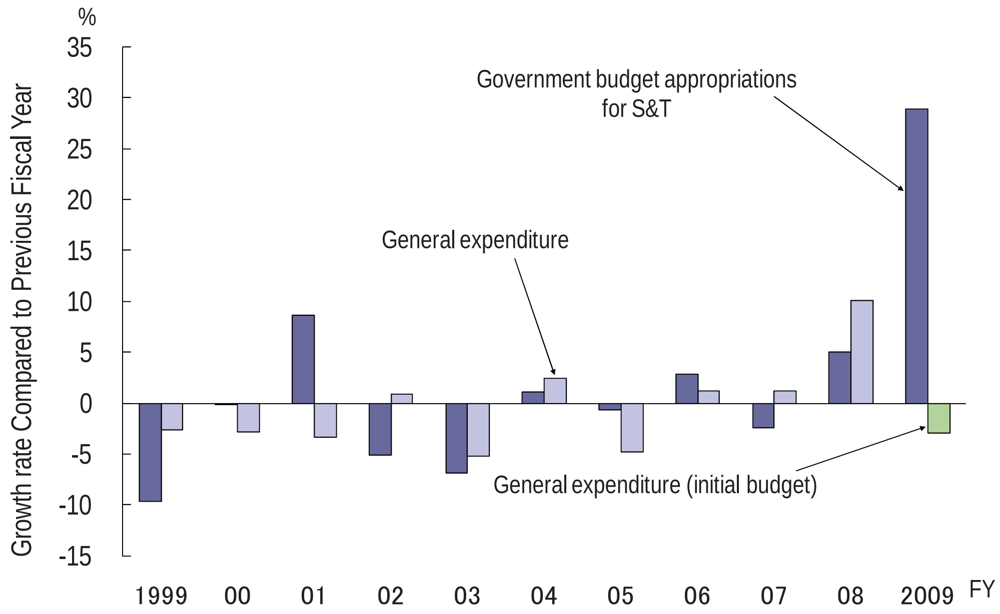
With regard to the government budget appropriations for S&T, the ratio of the general account to the special accounts is 7 to 1 (Chart 1-2-8). The general account is composed of the cost for national universities and public research institutes, "Funds for promoting science and technology" which consists of several grants and other research related costs, etc. In contrast, of the special accounts, the accounts for supply and demand of energy (special accounts for the measures for structural improvement of petroleum and energy supply and demand) and the accounts for promotion of power development (special accounts for electric power development promotion measures) account for a large proportion.

Chart 1-2-6: Trend of the government budget appropriation for S&T under the Science and Technology Basic Plans



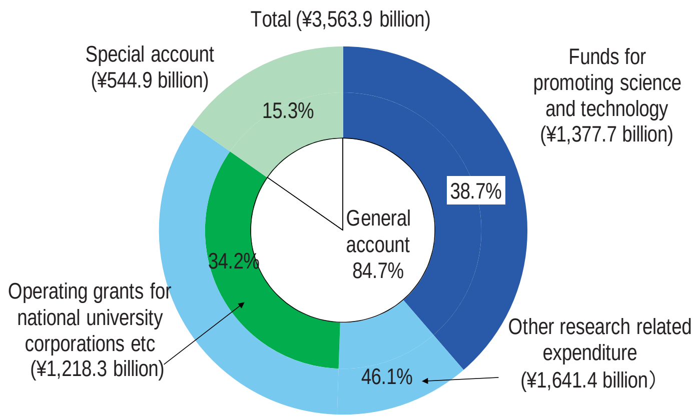
Note: 1) The supplementary budgets were composed of only additional amounts.
2) In accordance with the formulation of the science and technology basic plans (from the first to the third) , the range of targeted costs were reviewed in fiscal 1996, 2001 and 2006.
Source: Data from the Ministry of Education, Culture, Sports, Science and Technology.

Chart 1-2-7: Trend of the growth rate of the total government budget appropriations for S&T and the general expenditure, both compared to previous fiscal years in Japan



Note: 1) In accordance with the formulation of the science and technology basic plans (the first and the second), the range of targeted costs were reviewed in fiscal 1996 and 2001.
2) With regard to the amount for national university corporations out of the general account, until 2006, the budget appropriation was calculated in accordance with the sum of operating grants, and self income (by hospital income, tuition fees and commission projects, etc.) . (This amount was the equivalent of the government budget appropriation for S&T in special account for national institutions prior to the time when national universities, etc. were turned to corporations.) The calculation method was changed not to include self incomes since fiscal 2006.
Source: Data from the Ministry of Education, Culture, Sports, Science and Technology; the Ministry of Finance; the Ministry of Finance: web, "Monthly finance review"

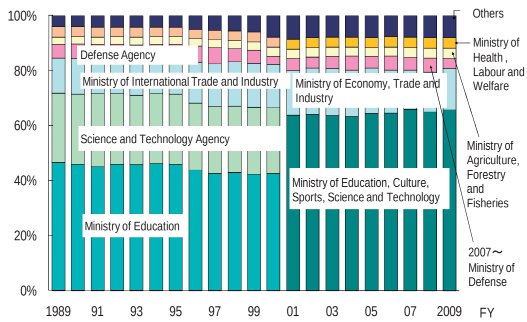
Chart 1-2-8: Breakdown of government budget appropriations for S&T (FY 2009)



Note: With regard to national university corporations, until fiscal 2006, the budget appropriation was calculated in accordance with the sum of operating grants, subsidies for capital expenditure and self income (by hospital income, tuition fees and commission projects, etc.). This amount is the equivalent of the government budget appropriation for S&T in the national school special account system prior to the time when national universities, etc. were turned into corporations. The calculation method was changed not to include self incomes since fiscal 2006.
Source: Data from the Ministry of Education, Culture, Sports, Science and Technology

With regard to the breakdown of the government appropriations for S&T by ministry and agency, the proportion has not significantly varied, except for the case of fiscal 1996, when the scope of the costs which is entitled to the government budget appropriation for S&T was reviewed, and the case of fiscal 2001, when ministries and agencies were reorganized. Out of all the ministries and agencies, the proportion of the Ministry of Education, Culture, Sports, Science and Technology (having been separated into the Ministry of Education, Science and Culture and the Science and Technology Agency in and before fiscal 2000) accounted for the highest, 65.9%, in fiscal 2009, followed by the Ministry of Economy, Trade and Industry (15.0%), the Ministry of Defense (3.7%), the Ministry of Agriculture, Forestry and Fisheries and the Ministry of Health, Labour and Welfare (3.8% each) (Chart 1-2-9).

Chart 1-2-9: Trend in the breakdown of the government budget appropriation by ministry and agency



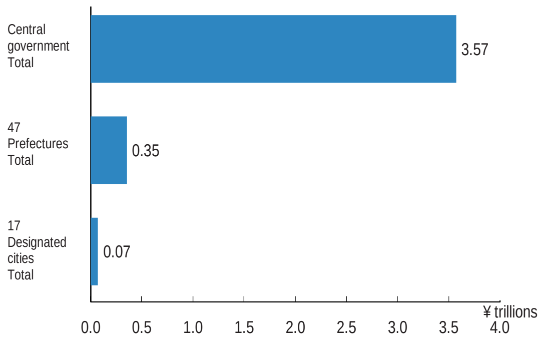
Note: 1) Data for each fiscal year is for initial budgets.
2) In accordance with the formulation of the science and technology basic plans (from the first to the third) , the range of targeted costs were reviewed in fiscal 1996, 2001 and 2006.
3) Until fiscal 2000, the expenditure on the Japan Key Technology Center (established on Oct.1985 and dissolved in Apr.1, 2003) was earmarked by both the Ministry of International Trade and Industry and the Ministry of Post and Telecommunications . (But the total was not doubly counted)
4) The government budget appropriations for S&T were compiled by the Ministry of Education, Culture, Sports, Science and Technology in accordance with materials submitted by each ministry.
5) The expenditure, etc. for each special corporation from the government budget appropriations for S&T which is included in the special account for Industrial investment under the jurisdiction of the Ministry of Finance is earmarked to the ministries etc. which have jurisdiction over the special corporations. But with regard to the National Agriculture and Bio-oriented Research Organization under the jurisdiction of the Ministry of Finance and the Ministry of Agriculture, Forestry and Fisheries, the expenditure is earmarked to only the latter.
6) The Defense Agency was upgraded to the Ministry of Defense on Jan. 9, 2007.

Source: MEXT, “Indicators of Science and Technology ”; Data from the Ministry of Education, Culture, Sports, Science and Technology

For an international comparison of government budget appropriations for S&T, it is necessary to include not only that of the central government, but also that of the local governments.

The original government budget appropriation for S&T allocated by 47 prefectures and 17 designated cities was approximately 421.9 billion yen in fiscal 2008. This amount was the equivalent of 11.8% out of the original government budget appropriation for S&T allocated by the national government (approximately 3,570.8 billion yen) in the same fiscal year(Chart 1-2-10).

Chart 1-2-10: Government budget appropriations for S&T by the central government and by local governments(FY2008)



Note: 1) The amount is the initial budget.
2) The national treasury disbursements were not included in the budget for local governments.

Source: MEXT, "Government budget appropriation for S&T in the fiscal 2008 budget"; Data from the Ministry of Education, Culture, Sports, Science and Technology

1.3 R&D expenditure by sector

1.3.1 R&D expenditure in the public organization sector

Key points

○The growth rate of Japan's R&D expenditure (real values) in the public organization sector in the 1990s was high at 4.32% but reduced to minus 0.12% in the 2000s.

○With regard to the status of each country, R&D expenditure by the public organization sector is on the rise for the U.S., Germany, China and Korea, while in decline for the U.K.

(1) R&D expenditure in the public organization sector for each country

In this section, the public organization sector as a performing sector of R&D expenditure is explained.

The public organizations of each country analyzed here include the research institutes as follows: In Japan, "National" research institutes (national experimental and research institutes, etc.), "Public" research institutes (public experimental and researching institutes, etc.), and research institutes run by "Special and independent administrative corporations" (non-profit) are included.

In the U.S., research institutes (NIH etc.) run by the federal government, and those which belong to FFRDCs (the sum of the amount of research institutes in industrial, university and non-profit institution sectors) are included.

In Germany, public research facilities run by the federal government; local governments and others; non-profit institutions (granted public funding of 160,000 Euros or more); and research institutes other than higher education institutions (research institutes belonging to legally independent universities) are included.

In France, research institutes run by certain types of foundation such as scientific and technical research public establishment ("Etablissement Public a Caractere Scientifique et Technologique" (EPST)) (other than CNRS) and commercial and industrial research public establishment ("Etablissement Public a Caractere Industriel et Commerce") (EPIC), etc are included.

In the U.K., research institutes run by the central government, decentralized governments and research councils are included.

In China, research institutes run by the central government are included.

In Korea, national and public research institutes, government supported research institutes and national and public hospitals (refer to Chart 1-1-4 on Page 18) are included.

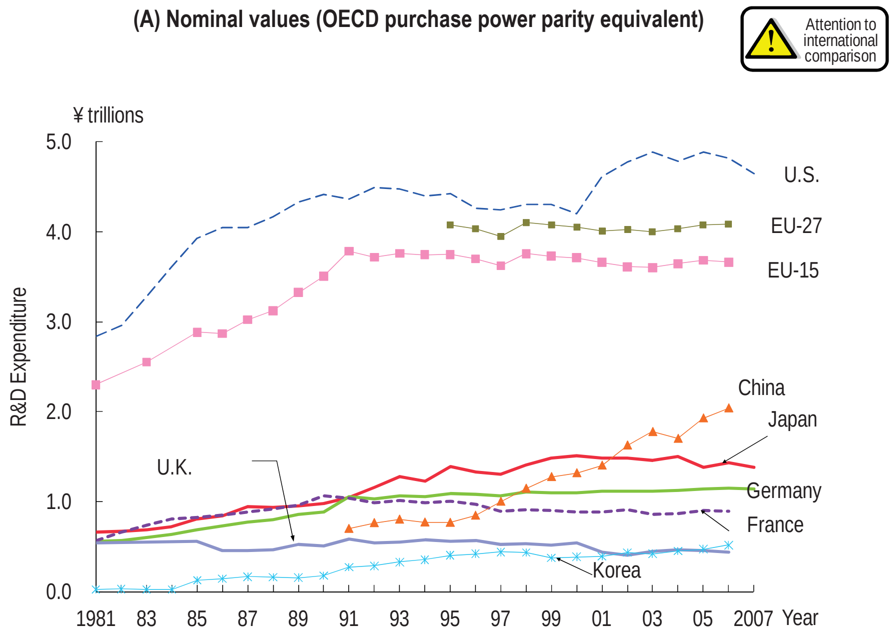
Chart 1-3-1(A) shows the trend of R&D expenditure (by OECD purchase power parity equivalent) in the public organization sector for selected countries. The R&D expenditure in the public organization sector in Japan was approximately 1.38 trillion yen in fiscal 2007. This amount is 0.9 times that of fiscal 2000 showing a downward trend. Although R&D expenditure has remained flat in many countries since the 1990s, China started rapidly increasing its R&D expenditure during the middle of the 1990s. Its growth rate rose beyond that of Japan in 2002, and is currently in second position, following the U.S.

Chart 1-3-1(B) shows the annual average growth rate of R&D expenditure (nominal values) in each country on a national currency basis. In the comparison between the annual average growth rate in the 1990s (1991 to 2000) and that in the 2000s (2000 to the latest available year in each country), the countries which showed more growth in the 2000s were the U.S. (5.19%) and France (3.38%). The growth rate in Japan was negative in the 2000s.

Furthermore, from a comparison of real values which are adjusted to remove the influence of high prices on a national currency basis, countries in which the growth rate increased in the 1990s were Japan, Germany, China and Korea. The other countries showed negative growth in the 1990s. Countries in which the growth rate was more increased in the 1990s than in the 2000s were the U.S. and France. Countries which showed negative growth at the beginning of the 2000s were Japan and the U.K. (Chart 1-3-1(C)).

Chart 1-3-1: Trend of R&D expenditure in the public organization sector for selected countries

(A) Nominal values (OECD purchase power parity equivalent)



(B) Nominal values (national currency)

National Currency	1991	2000	Latest year with available data	Annual average growth rate	
				'91→'00	'00→Latest year
Japan (¥ trillions)	1.05	1.51	1.38 (2007)	4.18%	-1.32%
U.S. ($ billions)	23.3	27.1	38.6 (2007)	1.68%	5.19%
Germany (€ billions)	5.46	6.87	8.40 (2007)	2.60%	2.91%
France (€ billions)	5.63	5.36	6.55 (2006)	-0.55%	3.38%
U.K. (£ billions)	1.95	2.24	2.32 (2006)	1.58%	0.57%
China (¥ billions)	7.90	28.2	56.7 (2006)	15.2%	12.4%
Korea (₩ trillions)	0.83	1.86	3.16 (2006)	9.45%	9.19%

(C) Real values (2000 base, national currency)

National Currency	1991	2000	Latest year with available data	Annual average growth rate	
				'91→'00	'00→Latest year
Japan (¥ trillions)	1.03	1.51	1.50 (2007)	4.32%	-0.12%
U.S. ($ billions)	27.6	27.1	32.3 (2007)	-0.21%	2.50%
Germany (€ billions)	6.26	6.87	7.77 (2007)	1.04%	1.77%
France (€ billions)	6.30	5.36	5.79 (2006)	-1.78%	1.30%
U.K. (£ billions)	2.45	2.24	1.98 (2006)	-1.01%	-2.03%
China (¥ billions)	14.0	28.2	44.2 (2006)	8.09%	7.79%
Korea (₩ trillions)	1.28	1.86	2.83 (2006)	4.23%	7.22%

Note 1) The definition of the public organization sector differs depending on the country. Therefore it is necessary to be careful when making international comparisons. Refer to Chart 1-1-4 for the definition of sectors in each selected country.
2) R&D expenditure includes the expenditure in the field of social sciences and humanities (only consists of the field of natural sciences and engineering in Korea)
3) "Germany " represents former West Germany until 1990 and unified Germany since 1991, respectively.
4) Japan's values are obtained on fiscal year unit base.
5) Purchase power parity equivalent is the same as the values in Reference statistics E .

Source: <Japan>Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"
<U.S.>NSF, "National Patterns of R&D Resources 2007 Date Update"
<Germany>Bundesministerium für Bildung und Forschung,"Bundesbericht Forschung 2004,2006", "Bundesbericht Forschungund Innovation 2008; OECD, "Main Science and Technology Indicators 2008/2" since 2006
<France>OECD, "Research & Development Statistics 2007/1"
<U.K.>National Statistics website: www.statistics.gov.uk
<China>Ministry of Science and Technology of the People's Republic of China, S&T Statistics Data Book 2007 (website)
<Korea>KISTEP, "Report on the survey of Research & Development in science and technology"
<EU>OECD, "Main Science and Technology Indicators 2008/2"

(2) R&D expenditure in Japan's public organization sector

Chart 1-3-2(A) shows the trend of R&D expenditure in Japan's public organization sector by type of organization. R&D expenditure in all the research institutes had been increasing until fiscal 2000 in spite of some slight fluctuations. Out of all sectors, the amount in that of special corporations (the proportion shown by "Special corporations and independent administrative corporations" until fiscal 2000 in the chart) is the highest. Another matter which should be mentioned is the discontinuity between the data for "National" research institutes and that for "Special corporations and independent administrative corporations" due to the fact that former national research institutes and special corporations turned into independent administrative corporations in 2001.

Chart 1-3-2(B) shows the trend in R&D expenditure for each of two types of institutes which compose the entire public organization sector, with the values on a 2000 base, which was adjusted considering the influence caused by price. One type of public institutes is run only by local governments, and the other is run by the other organizations.

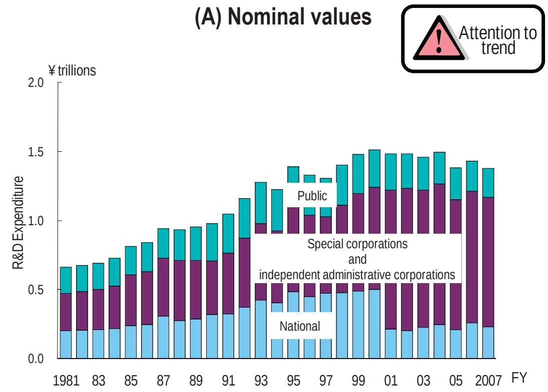
From 1991 to 2000, the annual average growth rate of R&D expenditure in public institutes run by local governments showed a decrease of -0.25%, while that in the other public organizations showed an increase of 5.67%.

From 2000 to 2007, the annual average growth rate of R&D expenditure in public institutes run by local governments was -2.44%, showing further dwindling, while that in the other public organizations was 0.35%, showing a shrinking rise.

As a result of the examination of the trend of R&D expenditure between 1996, the starting year of the First Science and Technology Basic Plan, and 2007, R&D expenditure in public institutes run by local governments was reduced by approximately 20%, and that in other public organizations was increased by approximately 20%. For the rise in the latter case, the increase of R&D expenditure from the middle to the latter half of the 1990s contributed greatly.

Chart 1-3-2: Trend of R&D expenditure used by public organization sector in Japan

(A) Nominal values



(B) Real values (2000 base)

¥trillions	1991	2000	2007	Annual average growth rate 91→'00	00→07
Public institutes (run by local government)	0.28	0.27	0.23	-0.25%	-2.44%
Public organizations other than public institutes	0.76	1.24	1.27	5.67%	0.35%
Total public organizations	1.03	1.51	1.50	4.32%	-0.12%

Note: 1) Part of the national research institutes were turned into independent administrative corporations in fiscal 2001, so care is needed when examining changes in time series.
2) The values for "Special corporations and independent administrative corporations" represent the values for only "Special corporations" until 2000.
3) Reference statistics D were used as a deflator.
Source: Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"

1.3.2 R&D expenditure in the business enterprise sector

Key points

- ○The ratio of R&D expenditure against GDP in the business enterprise sector was 2.68% in Japan followed by 2.49% in Korea, and each value was an all time high in the corresponding country. The ratio was 1.92% in the U.S., and has recently been gradually increasing.
- ○With regard to direct fund distribution (direct aid) and R&D tax incentives (indirect aid) to the business enterprise sector by the government in each country, the former accounts for a large proportion in the U.S. France, the U.K., etc., and the latter accounts for a large proportion in the in Japan, Canada, etc., respectively.

(1) R&D expenditure in the business enterprise sector for each country

R&D expenditure in the business enterprise sector accounts for the dominant proportion of the total R&D expenditure of each country. Accordingly, fluctuations in the amount in the business enterprise sector have a significant influence on a country's R&D expenditure.

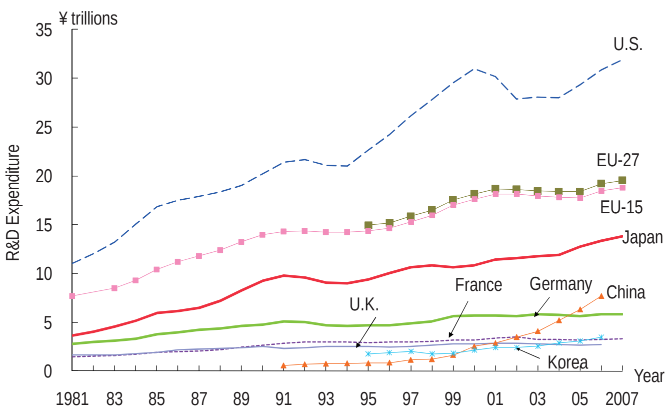
By examining the R&D expenditure in the business enterprise sector for selected countries with OECD purchase power parity equivalents, it is found that the expenditure is increasing in every country in the long term. In addition, the growth in China has been remarkable from around 2000, while the U.S. and major European countries have not shown any significant change (Chart 1-3-3(A)).

In accordance with the annual average growth rate with each country's national currency (nominal values), the R&D expenditure increased at a relatively high rate in every country in the 1990s (1991 to 2000) while Japan's growth rate was low at 1.21%. Only Japan and France experienced higher growth rates in the 2000s (2000 to the latest available year) compared to the growth rate in the 1990s (Chart 1-3-3(B)).

Also the annual average growth rate of the real values (2000 base, national currency), which are adjusted considering the commodity price trend in each country, show that the growth rate is higher in the 2000s than in the 1990s for Japan, China, Korea and France. Of these, Japan demonstrated an especially sharp rise, from 1.35% to 4.77% (Chart 1-3-3(C)).

Chart 1-3-3: R&D expenditure in the business enterprise sector for selected countries

(A) Nominal values (OECD purchase power parity equivalent)



(B) Nominal values (national currency)

National Currency	1991	2000	Latest year with available data	Annual average growth rate	
				'91→'00	'00→Latest year
Japan (¥ trillions)	9.74	10.9	13.8 (2007)	1.21%	3.51%
U.S. ($ billions)	115	200	265 (2007)	6.37%	4.12%
Germany (€ billions)	26.2	35.6	42.8 (2007)	3.45%	2.68%
France (€ billions)	15.3	19.3	24.9 (2007)	2.65%	3.65%
U.K. (₤ billions)	7.84	11.5	14.3 (2006)	4.36%	3.69%
China (¥ billions)	6.35	53.7	213 (2006)	26.8%	25.9%
Korea (₩ trillions)	2.97	10.3	21.1 (2006)	14.8%	12.8%

(C) Real values (2000 base, national currency)

National Currency	1991	2000	Latest year with available data	Annual average growth rate	
				'91→'00	'00→Latest year
Japan (¥ trillions)	9.62	10.9	15.0 (2007)	1.35%	4.77%
U.S. ($ billions)	136	200	221 (2007)	4.39%	1.46%
Germany (€ billions)	30.1	35.6	39.6 (2007)	1.88%	1.55%
France (€ billions)	17.1	19.3	21.5 (2007)	1.38%	1.50%
U.K. (₤ billions)	9.89	11.5	12.2 (2006)	1.70%	1.01%
China (¥ billions)	11.3	53.7	166 (2006)	19.0%	20.7%
Korea (₩ trillions)	4.60	10.3	18.9 (2006)	9.31%	10.8%

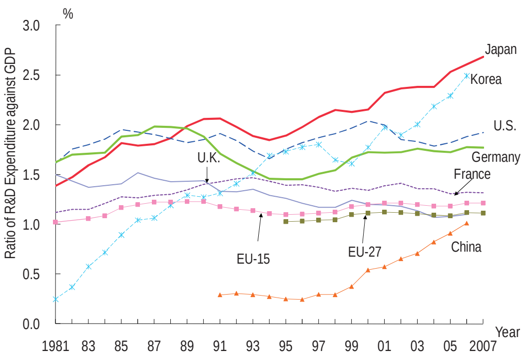
Note: 1) Refer to Chart 1-1-4 for the definition of the business enterprise sector in each country.
2) Purchase power parity equivalent is the same as Reference Statistics E.
<Japan>Fiscal year is used as a year scale.
<Germany> Data for former West Germany until 1990 and unified Germany since 1991.

Source: <Japan>Ministry of Internal Affairs and Communications, “Report on the Survey of Research and Development”
<U.S.>NSF, “National Patterns of R&D Resources 2007 Data Update”
<Germany>Bundesministerium für Bildung und Forschung, “Bundesbericht Forschung 2004, 2006”, “Bundesbericht Forschungund Innovation 2008”; OECD, “Main Science and Technology Indicators 2008/2” since 2006
<France, EU>OECD, “Main Science and Technology Indicators 2008/2”
<U.K.>National Statistics website: www.statistics.gov.uk
<China >Ministry of Science and Technology of the People’s Republic of China, S&T Statistics Data Book 2007 (website)
<Korea>KISTEP, "Report on the survey of Research and Development in science and technology"

Chart 1-3-4 shows the "Ratio of R&D expenditure against GDP" for an international comparison considering the difference in the economy size of each country.

The trend of the ratio of R&D expenditure (nominal values) against GDP in the business enterprise sector suggests that the difference in data among selected countries is small. The latest available ratio for Japan was 2.68%. Japan has kept the top spot since 1990. Korea has stayed in second position since 2002, and its ratio was extremely close to that of Japan in 2006. China's ratio against GDP is low, however, it is gradually reaching the level of other countries recently.

Chart 1-3-4: Trend in the Ratio of R&D expenditure in the business enterprise sector against GDP for selected countries

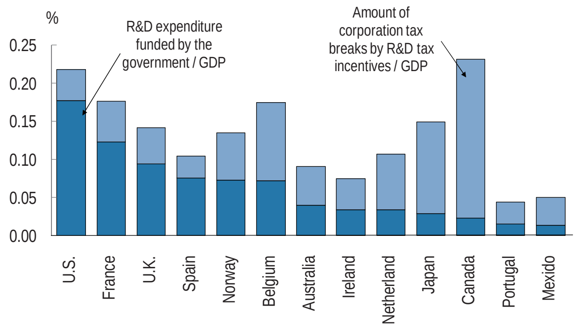


Note: 1) GDP is the same as Reference Statistics C.
2) Same as in Chart 1-3-3.
Source: Same as in Chart 1-3-3.

Next, the amount of R&D expenditure in the business enterprise sector which was funded by the government (direct funded distribution) against GDP, and the amount of corporation tax deduction by R&D tax incentives against GDP are examined (Chart 1-3-5).

The results show that the amount of direct aid by the government to the business enterprise sector accounts for a large proportion in the U.S., France, the U.K. etc, while the amount of indirect aid accounts for a large proportion in Japan, Canada etc.

Chart 1-3-5: Direct fund distribution and R&D tax incentives by the government for R&D in the business enterprise sector

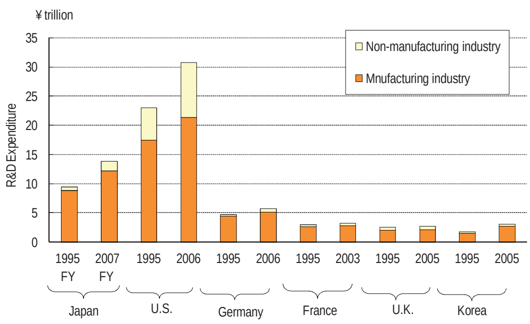


Note: Values estimated by each country (in accordance with the survey for R&D tax incentives by NESTI). Preliminary budget values are also included.
Source: OECD, "STI Outlook 2008"

Further, R&D expenditure in manufacturing and non-manufacturing industries, which comprise the business enterprise sector, for 1995 and in the latest year are compared. Due to the fact that industrial classifications are different by country, the comparison among countries was made only between the manufacturing and non-manufacturing industries.

The ratio of R&D expenditure in the manufacturing industry against the total accounts for 80 to 90% in almost all the countries. However, this ratio in the U.S. was only 70%, and means that the proportion of R&D expenditure in the non-manufacturing industry is relatively large in the U.S. compared to that in other countries. Also the ratio of R&D expenditure in non-manufacturing industry in the latest year was higher compared to that for 1995 in every country (Chart 1-3-6).

Chart 1-3-6: Comparison between R&D expenditure in the manufacturing industry and in all industries in selected countries (OECD purchase power parity equivalent)



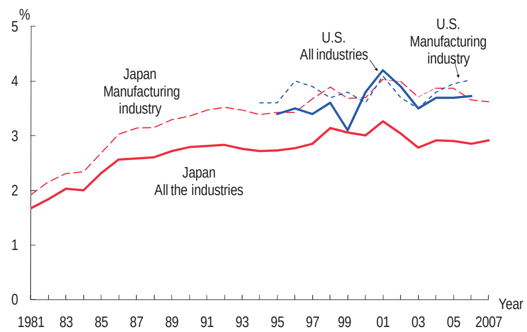
Note: 1) Refer to Chart 1-1-4 for the definition of the business enterprise sector in each country.
2) Purchase power parity is the same as in Reference statistics E.
<Japan> 1) The industrial classification was made in accordance with the classification in the survey of research and development based on the Japan standard industry classification. The data of fiscal 1995 was based on the "Japan standard industry classification" revised in 1993 (the 10th edition), and the data of fiscal 2007 was based on that revised in 2007 (the 12th edition).
2) Fiscal year was used as a year scale.
<U.S.> For the data of 1995, FFRDCs were not included , and SIC was adopted as an industrial classification. But for the data of 2006, NAICS was adopted as an industrial classification.
<Germany> For the data for 1995 and for the data of 2005, German industrial classification, "Classification of Economic Activities", revised in 1993 and in 2003 was used respectively.
<France> For the classification of the data of 1995 and 2005, France activity classification table, "Nomenclature d'activités française (NAF), revised in 1993, and revised in 2003 was used respectively.
Source: <Japan> Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"
<U.S.>NSF, "R&D in Industry"
<Germany> BMBF, "Research & Innovation in Germany 2007", "Bundesbericht Forschung und Innovation 2008 "
<France>OECD,"STAN Database "
<U.K.>OST,"SET Statistics"
<Korea>Science and technology indicators in fiscal 2007

(2) R&D expenditure per turnover amount in the business enterprise sector

Chart 1-3-7 shows the trend of the ratio of the R&D expenditure against turnover in Japan and the U.S. The ratios are shown for both all industries together and for the manufacturing industry.

As far as Japan is concerned, the ratio in the manufacturing industry was higher than the ratio in all industries, showing Japan's stronger R&D intensity in the manufacturing industry compared to that in the non-manufacturing industry. On the other hand, in the U.S., the ratios for all industries and that for the manufacturing industry varied together at almost the same level of values.

Chart 1-3-7: R&D per turnover in the business enterprise sector



Note: Refer to Chart 1-1-4 for the definition of the business enterprise sector of each country.
<Japan>1) The contents and timing of the survey in "Report on the Survey of Research and Development" by the Ministry of Internal Affairs and Communications were revised since the time of survey in 2002 (fiscal 2001 was the target) .
2) R&D expenditure in all the industries per sales amount represents such values in "all the industries other than finance and insurance industries" since fiscal 2001.
3) The industrial classification was made in accordance with the classification in the survey of research and development based on the Japan standard industry classification.
4) Following the revision in industrial classification, the classification in the survey of research and development was changed in the edition of 1996, 2002 and 2008.
<U.S.>1) As an industrial classification, SIC and NAICS were used until 1998 and since 1999 respectively.
2) FFRDCs have been excluded since 2001.
Source: <Japan> Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"
<U.S.> NSF,"R&D Industry 2003,2004","InfoBrief (NSF 07-335)(NSF 08-313) "

1.3.3 R&D expenditure in the university and college sector

Key points

○The R&D expenditure in the university and college sector was 3,423.7 billion yen, which is the equivalent of 2,192.7 billion yen if the labor cost is multiplied by FTE factor.

○With regard to the annual average growth rate of R&D expenditure by real value (2000 base, national currency), the U.S. , Germany, the U.K. and China showed a higher rise in the 1990s than in the 2000s.

○By observing the R&D expenditure in the university and college sector in Japan by field, it was found that national universities used approximately 50% of the total R&D expenditure in the field of natural science and engineering, While private universities used approximately 70% of the total R&D expenditure in the field of social sciences and humanities.

(1) R&D expenditure in the university and college sector in each country

Higher education institutions such as universities, which have a function as R&D institutions, play an important role in R&D systems in every country. As stated in Section1-1-2, R&D expenditure used in higher education institutions in each selected country accounts for approximately 10% to 30% of the total.

The scope of higher education institutions depends on the country, but in every country the main institutions are universities. The institutions under survey also depend on the country. The summary of targeted institutions is as follows: For Japan, universities (including graduate schools), junior colleges, technical colleges, university research institutes and other institutions were targeted[(4) (5)]. For the U.S., universities & colleges (institutions which perform R&D which is the equivalent of 150,000 dollars or more; FFRDCs are excluded) were targeted. For Germany, universities, comprehensive universities, and colleges of theology, etc. were targeted. For France, CNRS (including their facilities), and higher education institutions including universities and Grandes Ecoles not under the jurisdiction of the Ministry of National Education "Ministere de I'Educationale") (MEN) were targeted. In the countries above, not only the field of natural science and engineering but also the field of social sciences and humanities were covered by the statistics. But in Korea, only the field of natural sciences and engineering was included in the scope of the survey on R&D expenditure statistics. Therefore, the target of statistics on universities was also limited to the field of natural sciences and engineering (refer to Chart 1-1-4 on Page 18).

In order to obtain R&D expenditure in the university and college sector, it was necessary to calculate the costs after separating R&D activities from educational activities; however, this separation is generally difficult.

The figures for R&D expenditure in Japan's university and college sector are those according to the "Survey of research and development" compiled by the Ministry of Internal Affairs and Communications. In these surveys, the breakdown of the R&D expenditure includes labor cost. However, the total labor cost is composed of elements including "duties other than research (such as education)".

Statistics for R&D expenditure in the university

(4) According to "Report on School Basic Survey (fiscal 2007)" by MEXT in fiscal 2007, 756 universities (87 national, 89 public and 580 private universities), 434 junior colleges (2 national, 34 public and 398 private junior colleges) and 64 technical colleges are covered.

(5) In "Report on the Survey of Research and Development" compiled by the Ministry of Internal Affairs and Communications, which was used as the materials for the statistics of Japan's university and college sector in this chapter, universities are surveyed by faculty (by course in the case of graduate schools), and the total number is 2.122 as of March 31, 2007. "Other institutions" include Inter University Research Institutes Corporation, the National Institution for Academic Degrees and University Evaluation, the Center for National University Finance and Management, National Institute of Multimedia Education, and the museum, center and facility at universities.

and college sector in Japan do not adopt a full-time equivalent, and almost all teachers are measured as researchers. However, it not true that the duties of all teachers are exclusively limited to research. Therefore, it is natural to consider that the situation in which the labor cost of all the teachers is measured as R&D expenditure is an over-estimation with regard to R&D expenditure.

The OECD understands the actual situation, and multiplied 0.53 and 0.465 to the labor costs of Japan's R&D expenditure in 1996 to 2001 and since 2002 respectively in the OECD statistics. Adjustment factor 0.465 for the data since 2002 is the Full Time Equivalent coefficient obtained from the "Survey on the Data for full-time equivalents in universities and colleges" compiled by the Ministry of Education, Culture, Sports, Science and Technology. Hereinafter, both these values provided by the OECD (clearly referred to as "Japan (estimated by OECD)") and the values provided by the "Report on the Survey of Research and Development" compiled by the Ministry of Internal Affairs and Communications (referred to as "Japan") are given.

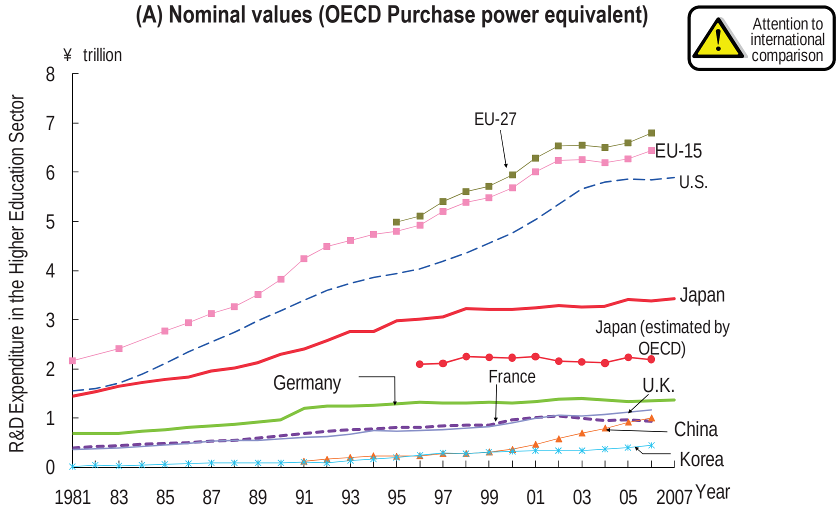
Chart 1-3-8(A) shows the nominal values of R&D expenditure in the university and college sector. The values of R&D expenditure in the university and college sector for "Japan" and "Japan (estimated by OECD)" both in fiscal 2007 were 3,423.7 billion yen and 2,192.7 billion yen, respectively. Japan's values have been slightly increasing since 1996. With regard to other countries, the rise in the U.S. and the U.K. is remarkable. Out of the EU countries, in Germany and France, where R&D expenditure is large, the amount is gradually increasing in the long term although the size of the change is not significant. In China, R&D expenditure is steadily increasing and recently the level has reached the same as that of France.

Next the annual average growth rate (of the nominal values) of R&D expenditure by country with each country's national currency shows that the growth rate was lower in the 2000s (2000 to the latest valuable year in each country) compared to that in the 1990s (1991 to 2000) in Japan, Germany, France and Korea (Chart 1-3-8(B)).

When the growth rates are compared with the real values which are adjusted considering the influence of price, it is found that the growth rate was lower in the 2000s compared to that in the 1990s in Japan, France and Korea. China is remarkable in leading all the countries where the growth rate is higher in the 2000s (Chart 1-3-8(C)).

Chart 1-3-8: Trend of R&D expenditure in the university and college sector for selected countries

(A) Nominal values (OECD Purchase power equivalent)



(B) Nominal values (national currency of each country)

National currency	1991	2000	Latest year with available data	Annual average growth rate '91→'00	Annual average growth rate '00→Latest year
Japan (¥ trillions)	2.41	3.21	3.42 (2007)	3.24%	0.93%
Japan (estimated by OECD) (¥ trillions)	2.09 (1996)	2.22	2.19 (2006)	1.26% ('96→'00)	-0.23%
U.S. ($ billions)	18.2	30.7	48.9 (2007)	5.98%	6.88%
Germany (€ billions)	6.15	8.15	10.0 (2007)	3.18%	2.97%
France (€ billions)	3.75	5.80	6.88 (2007)	4.97%	2.86%
U.K. (£ billions)	2.02	3.69	6.06 (2006)	6.93%	8.62%
China (¥ billions)	1.37	7.67	27.7 (2006)	21.1%	23.8%
Korea (₩ trillions)	0.29	1.56	2.72 (2006)	20.6%	9.70%

(C)Real values (2000 base; national currency of each country)

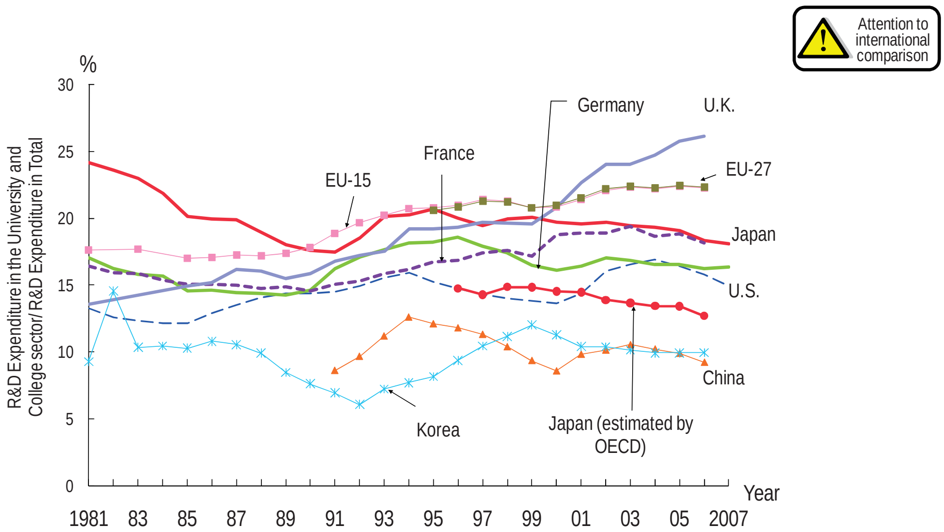
National currency	1991	2000	Latest year with available data	Annual average growth rate '91→'00	Annual average growth rate '00→Latest year
Japan (¥ trillions)	2.38	3.21	3.73 (2007)	3.38%	2.16%
Japan (estimated by OECD) (¥ trillions)	2.06 (1996)	2.22	2.37 (2006)	1.75% ('96'→'00)	1.05%
U.S. ($ billions)	21.6	30.7	40.8 (2007)	4.01%	4.16%
Germany (€ billions)	7.05	8.15	9.25 (2007)	1.62%	1.84%
France (€ billions)	4.20	5.80	6.08 (2007)	3.67%	0.79%
U.K. (£ billions)	2.55	3.69	5.18 (2006)	4.21%	5.81%
China (¥ billions)	2.43	7.67	21.6 (2006)	13.6%	18.8%
Korea (₩ trillions)	0.45	1.56	2.44 (2006)	14.9%	7.72%

Note:1) The definition of the university and college sector is different depending on the country. Therefore, it is necessary to be careful when making international comparisons. Refer to Chart 1-1-4 for the definitions of the university and college sector.
2) The purchase power parity used here is the same as that in Reference statistics E.
3) R&D expenditure includes the fields of social sciences and humanities (only the field of natural sciences and engineering is included in Korea)
<Japan (estimated by OECD)>These values were adjusted and estimated by the OECD (Labor cost included in the R&D expenditure for the university and college sector was converted to FTE to obtain the total R&D expenditure).
<Germany>Former West Germany until 1990 and unified Germany since 1991, respectively.
Source: Same as for Table 1-1-5

The trend of the ratio of R&D expenditure in the university and college sector against the total R&D expenditure for each country is shown in Chart 1-3-9.

In Japan, the ratio has tended to decrease recently. On the other hand, in the U.K., the ratio has tended to increase, and the growth has been especially remarkable since 2000. The increase is considered to be influenced by the rise in R&D expenditure in the university and college sector and the fall in that in the business enterprise sector. In the U.S. and Germany, the ratio has repeated ups and downs in the long term, and has recently remained flat.

Chart 1-3-9: Trend of the ratio of R&D expenditure in the university and college sector against the total for selected countries



Note: Same as for Chart 1-1-1 and Chart 1-1-5.
Source: Same as for Chart 1-1-1 and Chart 1-1-5.

(2) R&D expenditure in the university and college sector in Japan

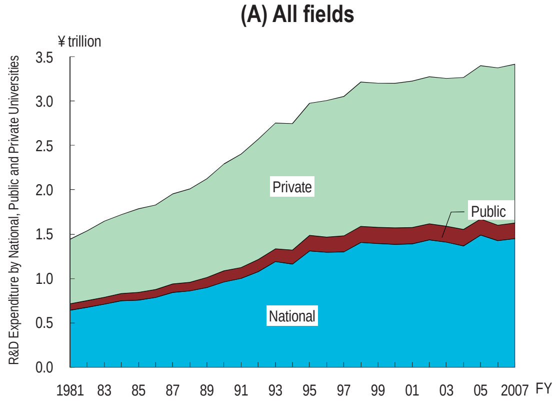
As stated above, it is necessary to be careful about the fact that the labor cost, which comprises a part of the R&D expenditure in the university and college sector in Japan, includes the cost for duties other than research. However, in this section, the R&D expenditure in the university and college sector by type, national, public or private, is examined in accordance with the data associated with R&D expenditure in universities and colleges. Published in the "Report on the Survey of Research and Development" (Chart 1-3-10).

R&D expenditure for the entire university and college sector in Japan in fiscal 2007 was approximately 3,423.7 billion yen, which was composed of approximately 2,156 billion yen for the field of natural sciences and engineering and approximately 936.1 billion yen for the field of social sciences and humanities, respectively. The proportion of R&D expenditure by type of universities against that total was, 42.4% for national, 5.2% for public or 52.4% for private universities. The proportion of R&D expenditure by type of universities against the total expenditure only in the field of natural sciences and engineering was 54.5% for national, 5.8% for public and 39.8% for private universities. In the case of the field of social sciences and humanities, the proportion for each was 21.6% in national, 4.3% in public and 74.1% in private universities.

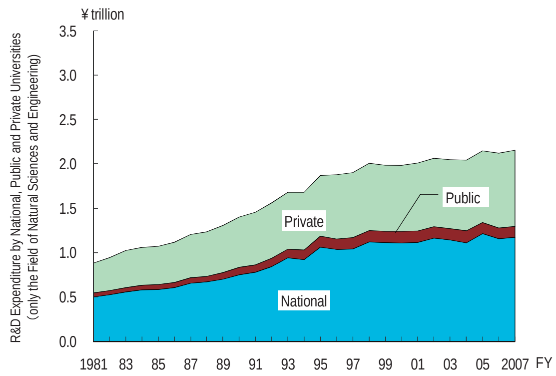
In summary, it was found that national universities accounted for large proportion of R&D expenditure in the field of natural sciences and engineering (natural sciences, engineering, agricultural sciences, medical sciences etc). On the other hand, private universities accounted for large proportion of R&D expenditure in the field of social sciences and humanities.

Chart 1-3-10: R&D expenditure by national, public and private universities

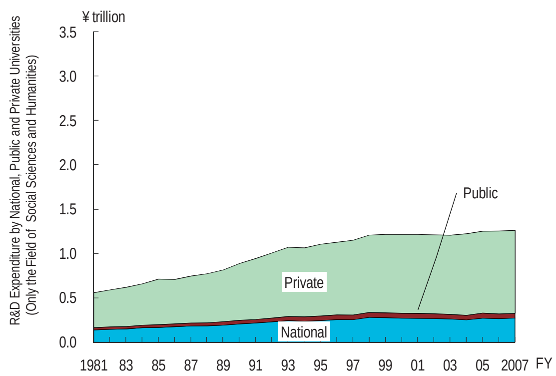
(A) All fields



(B) Field of natural sciences and engineering



(C) Field of social sciences and humanities

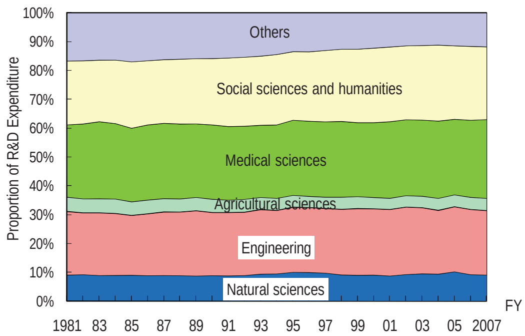


Source: Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"

Subsequently, the trend in the proportion of R&D expenditure in each field of study in the university and college sector is examined. The field of study represents the activities of education and research conducted in faculties and research facilities. In a case where more than one field of study is included in an organization, the field which is considered to be central is used to represent the field of study of research.

Chart 1-3-11 shows that R&D expenditure of each field changes only slightly. It is difficult to understand actually what kinds of R&D are performed from this chart because the fields of study shown are classified only in accordance with the kinds of faculties, as mentioned above.

Chart 1-3-11: Trend of the proportion of R&D expenditure by field of study in universities and colleges



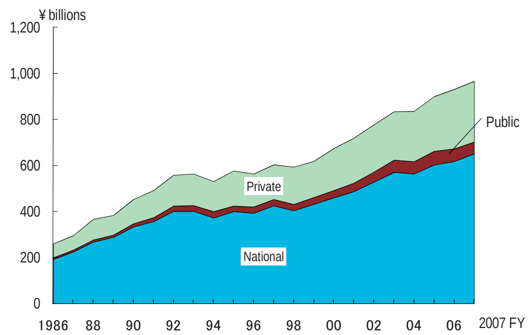
Note: Classification into the field of study represents a classification into the element of the organization, such as the faculty.
Source: Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"

In recent years, approaches trying to utilize the potential of universities are being enhanced in each country all over the world. It is true that universities are irreplaceable organizations for creating knowledge which is a source of innovation; however, transferring the knowledge generated by universities is not easy. The time is ripe to strongly enhance the cooperation between industry and academia, given the background mentioned above.

As an index to indicate the status of the cooperation between industry and academia, R&D expenditure which the university and college sector received from the business enterprise sector is examined (Chart 1-3-12). The trend of R&D expenditure which universities and colleges receive from the business enterprise sector has shown an extreme rise since fiscal 1999. But the amount of that in fiscal 2007 (96.7 billion yen) was only 2.8% of the total intramural R&D expenditure of universities in the same fiscal year (approximately 3,423.7 billion yen).

Among national, public and private universities, the proportion of R&D expenditure provided by the business enterprise sector in national universities was the highest at 70%, and this proportion has remained nearly unchanged.

Chart 1-3-12: Trend of the ratio of R&D expenditure from the business enterprise sector against the total intramural R&D expenditure in universities and colleges



Note: Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"

(3) R&D expenditure by item of expense in the university and college sector for Japan

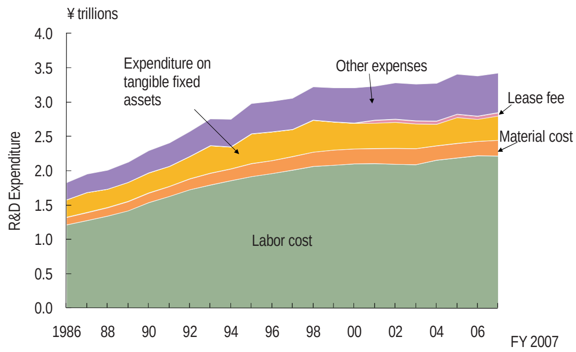
With regard to the breakdown of intramural R&D expenditure in universities and colleges by item of expense, the proportion of "labor cost" is large. The "labor cost" in fiscal 2007 was approximately 2,219.7 billion yen at 64.8% of the total (Chart 1-3-13).

According to the comparison between the case of national universities and the case of private universities, in national universities, the proportion of "labor cost" against the total was almost 60%, and that of "other expenses" was on the rise.

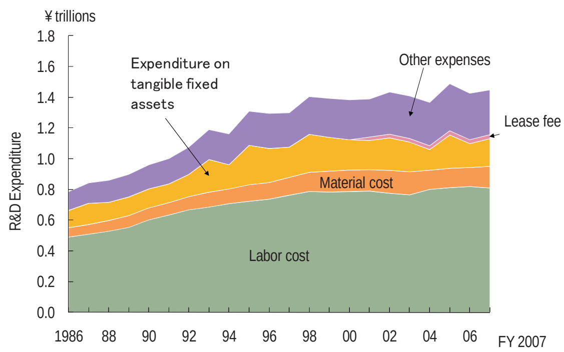
The "labor cost" in private universities was large at nearly 80%. But in private universities the field of social sciences and humanities comprises the main part. If only the field of natural sciences and engineering is focused upon, the total R&D expenditure is reduced to a half, and the "labor cost" against the reduced total expenditure is approximately 60%. On the other hand, the "labor cost" of the field of natural science and engineering alone in national universities is approximately 60% which is almost the same as in the case that the entire R&D expenditure is targeted.

Chart 1-3-13: R&D expenditure by item of expense in universities and colleges

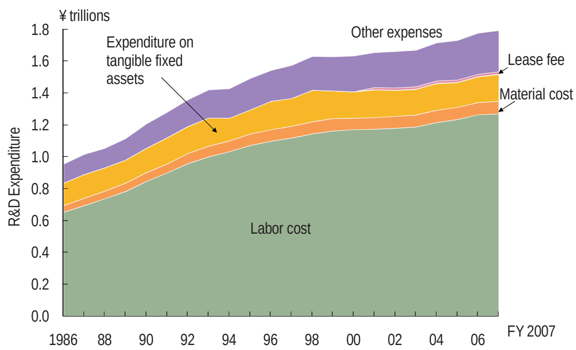
(A) Total



(B) National universities



(C) Private universities



Note: "Lease fee" was added to items for survey since FY 2001.
Source: Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"

1.4 R&D expenditure by character of work

Key points

○The expression R&D expenditure by character of work is a classification of R&D expenditure into that for basic research, applied research, and development. In Japan and Korea, however, this classification has been made only for the field of natural sciences and engineering.

○Out of R&D expenditure in fiscal 2007 for Japan, the proportion of that for basic research was 13.8%, and a large proportion, or 48.5%, of the total was used in the university and college sector. And in recent years, the proportion of the R&D expenditure for basic research in the business and enterprise sector is also increasing.

○Among the countries studied, in France, the proportion of R&D expenditure for basic research in the latest available year was 23.7%, and 67% of this amount was used by the university and college sector. In contrast, the proportion of R&D expenditure for the basic research was smallest in China at 5.2%. In Japan and the U.S., the values were 13.8% and 17.5% respectively.

1.4.1 R&D expenditure by character of work

The expression R&D expenditure by character of work represents the intramural R&D expenditure roughly classified into that for basic research, applied research and development. This classification is in accordance with the definition in the "Frascati Manual" by the OECD which each country has adopted. Therefore, the influence caused by responders' subjective estimates should be taken into account. The summary of the definition of characters of work in the "Frascati Manual" is as follows.

Basic research is exploratory and theoretical work mainly in order to obtain new knowledge on the causes behind phenomena and observable facts without considering any specific application or use.

Applied research is also a creative exploration in order to obtain new knowledge. It is, however, mainly for certain actual purposes or objectives.

(Experimental) development is systematic work in which existing knowledge obtained by research or actual experiments is applied, for the purpose of producing new materials, products and devices, introducing new procedures, systems and services, or practically revising what has already been produced or introduced.

Each country seems to measure the data in accordance with the definition above, but the expressions used are somewhat different depending on country. For example, "experimental development" is expressed as "development" in the U.S. but as "development experimental" in France, explicitly including experimental work.

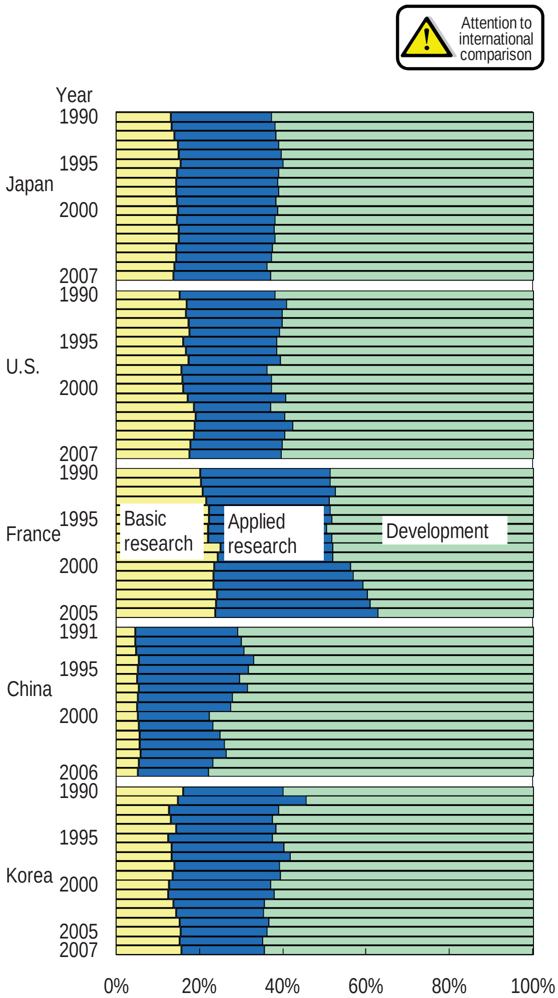
Germany has not publicly announced precise data for R&D expenditure by character of work, and does not have any such data for the university and college sector. But measured data for R&D expenditure by character of work in the business and enterprise sector has been published since 2001 (through the data of OECD). Also, the U.K. does not have data for R&D expenditure by character of work in the university and college sector. Therefore, it is impossible to measure the total R&D expenditure by character of work.

In Japan (and also in Korea), only the field of natural science and engineering is covered by the measurement of R&D expenditure by character of work(6). Therefore the nominal total of the R&D expenditure by character of work is different from the actual total.

Chart 1-4-1 shows the proportion of R&D expenditure by character of work. In Japan, although no significant change was observed in the long term, R&D expenditure for development is gradually tending to increase.

The proportion of R&D expenditure for basic research was largest in France and smallest in China. In France, that for applied research also accounts for a large proportion and is increasing. The proportion for development is large in every country, but the size was especially remarkable in China. China, together with Korea, is on the rise in R&D expenditure for development in the long term.

Chart 1-4-1: Trend of the proportion of R&D expenditure by character of work in selected countries



Note: 1) In Japan and Korea, R&D expenditure covers only the field of natural sciences and engineering. But R&D expenditure in other countries is the total of that for the field of natural sciences and engineering and for social sciences and humanities. Therefore it is necessary to be careful when an international comparison is being made.
2) With regard to R&D expenditure, refer to Chart 1-1-4.
3) Purchase power parity equivalent is the same as that for Reference statistics E.
<Japan> Fiscal year is used as a year scale.
<U.S.> Values in 2007 is of preliminary.

Source: <Japan>The Ministry of Internal affairs and communications, "Report on the Survey of Research and Development".
<U.S.>NSF, "National Patterns of R&D Resources 2007 Data Update"
<France, China>OECD, "Research & Development Statistics 2007/1"
<Korea>Korea National Statistical Office,Statistical DB(web site)

(6) The definition of R&D expenditure by character of work in Japan's survey of R&D expenditure, the "Survey of Research and Development" is as follows, and only the field of science and engineering is covered.
Basic research: theoretical or experimental research in order to create hypotheses and theories or to obtain new knowledge on phenomena or observable facts, without considering a certain application or use.
Applied research: research to determine the potential of the practical use of knowledge which was discovered by basic research in order to achieve certain objectives; research to explore additional application methods with regard to methods which are already in practical use.
Development: research to introduce new materials, devices, products, systems, procedures, etc. and to revise those which already exist, by using basic research, applied research and knowledge obtained by actual experience.

(1) Basic research in each country

Next, we examine which sector is in charge of basic research in each country.

According to the trend of the proportion of basic research expenditure by performing sector (Chart 1-4-2), the university and college sector accounts for a large proportion in almost all the selected countries. Especially in France, approximately 70% of the total is used by the university and college sector.

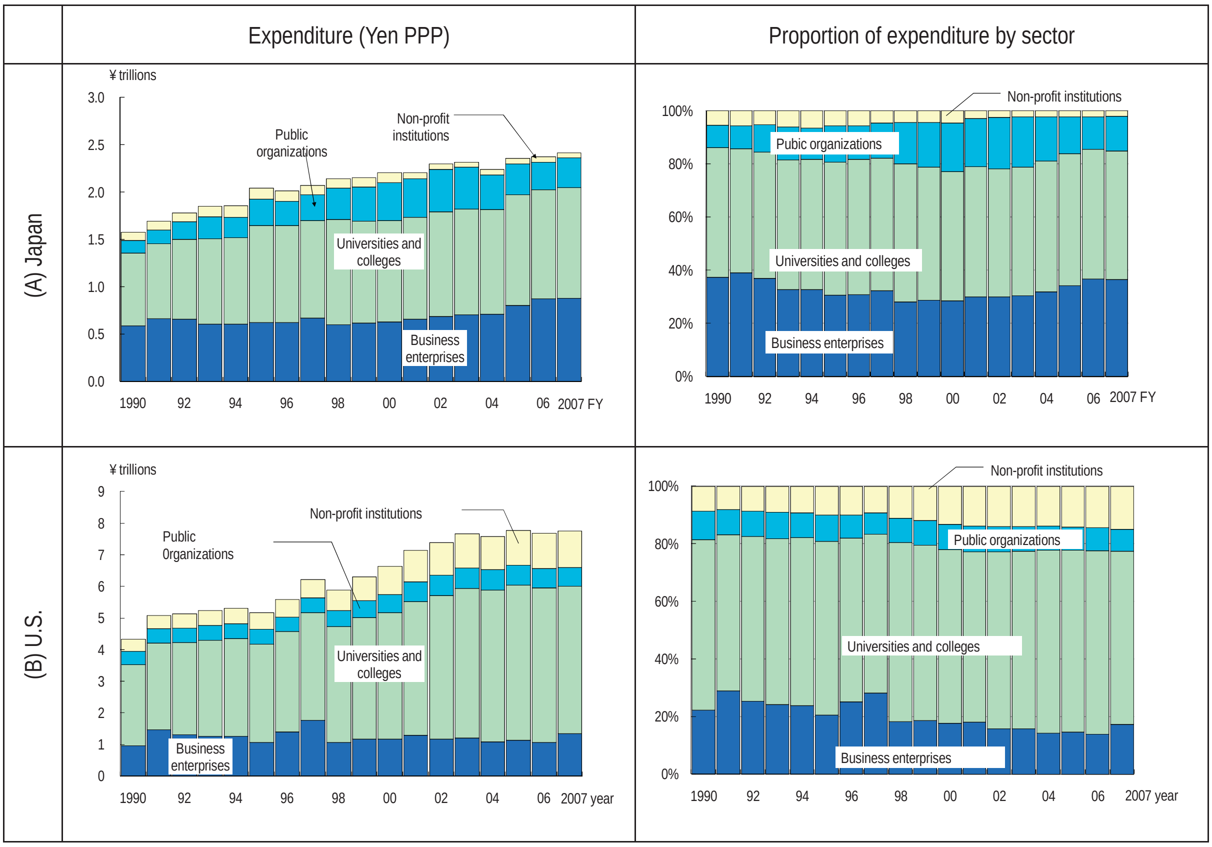
In Japan, the business and enterprise sector accounts for a relatively large proportion of basic research expenditure. This proportion is even higher in Korea, where the business and enterprise sector has rapidly grown to become the center of basic research since 2000.

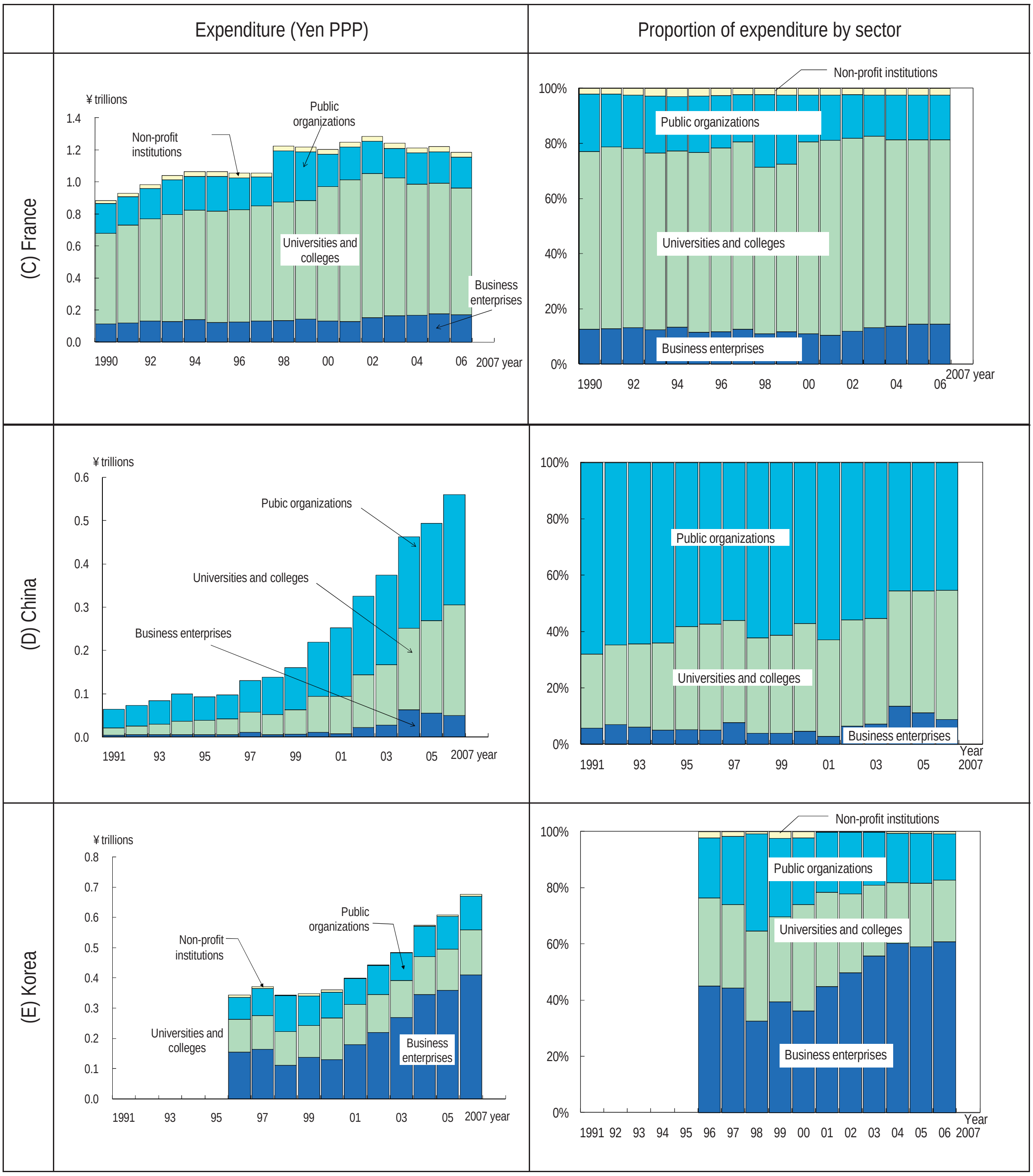
The country in which the public organization sector accounts for the largest proportion of basic research expenditure is China. This proportion in France and Korea is also large compared to other countries. With regard to France, discrepancies were found in the data of the public organization sector in 1998 and 1999. This was caused by a change in the method for estimating and a change in survey response slips, and so it is better to consider that the continuity of data during this period was interrupted.

In the U.S., the proportion of R&D expenditure in the business enterprise sector against the total basic research expenditure has been reducing in recent years, while that in the university and college sector is on the rise instead. Compared to other countries, the amount in the non-profit institution sector is also increasing.

Chart 1-4-2: Basic research expenditure by sector in selected countries

Attention to international comparison





Note: 1) In Japan and Korea, R&D expenditure covers only the field of natural sciences and engineering. But R&D expenditure in other countries is the total of the field of natural sciences and engineering and of social sciences and humanities. Therefore it is necessary to be careful when international comparisons are made.
2) With regard to R&D expenditure, refer to Chart 1-1-4.
3) Purchase power parity equivalent is the same as for Reference statistics E.
<U.S.> Values in 2007 are preliminary .
Source: <Japan> The Ministry of Internal Affairs and Communications. "Report on the Survey of Research and Development"
<U.S.>NSF, "National Patterns of R&D Resources 2007 Data Update"
<France, China and Korea>OECD, "Research & Development Statistics 2007/1"

1.4.2 R&D expenditure by character of work in each sector for each country

Key points

○With regard to R&D expenditure by character of work in the public organization sector, the R&D expenditure for development and for applied research account for big proportion in Japan, the U.S. and China, and in France and the U.K., respectively.

○With regard to R&D expenditure by character of work in the business and enterprise sector, the R&D expenditure for development and for applied research account for 70% or more in Japan, the U.S. and Korea, and for approximately 40% in France and the U.K.

(1) R&D expenditure by character of work in the public organization sector

Among R&D expenditure by character of work in the public organization sector (Chart 1-4-3), the proportion of R&D expenditure for basic research has been on the rise in every country, but in recent years, the trend has become flat or begun to decline. However, in the U.K. the tendency to rise is continuing. The proportion of R&D expenditure for development is large in Japan, the U.S. and China compared to other countries.

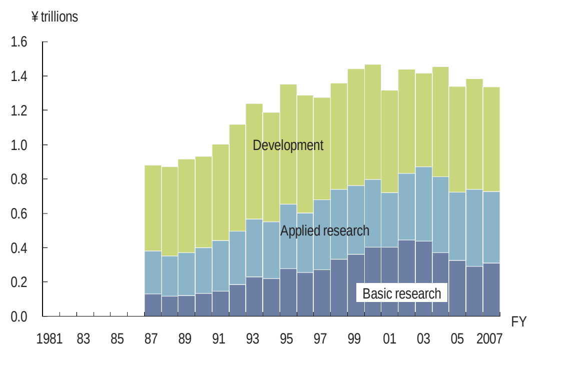
In France and the U.K., R&D expenditure for applied research accounts for a large proportion of the total. Germany seems not to have surveyed R&D expenditure by character of work on its own. Because Germany has not published data on R&D expenditure by character of work, the OECD statistics were used in this section, although the values are limited to those until 1999.

Chart 1-4-3: R&D expenditure by character of work in the public organization sector for selected countries

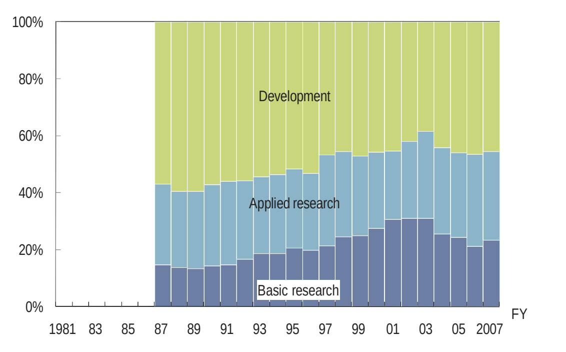
Attention to international comparison

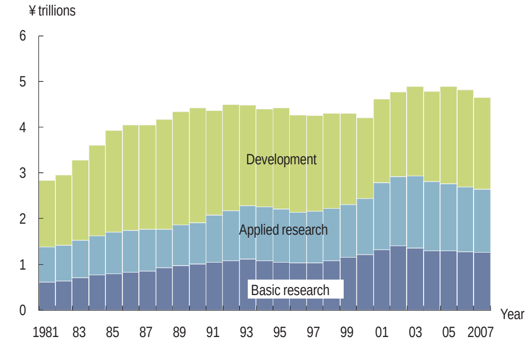
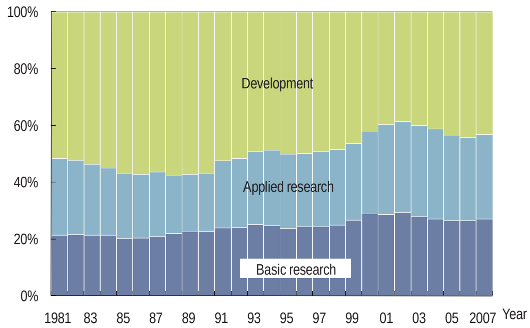
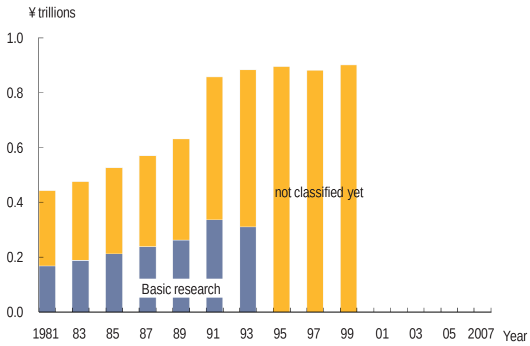
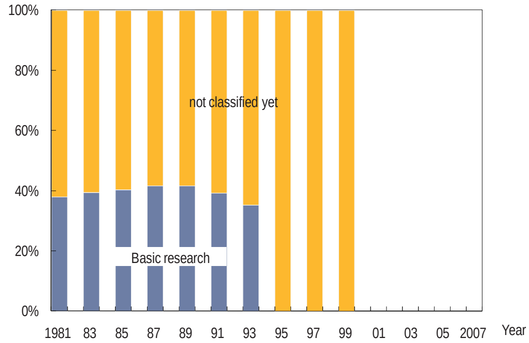
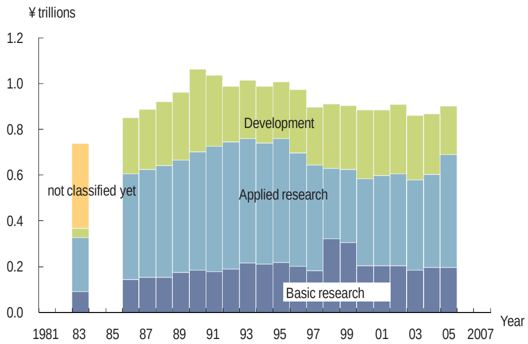
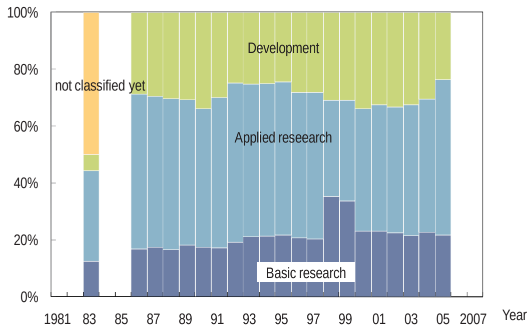
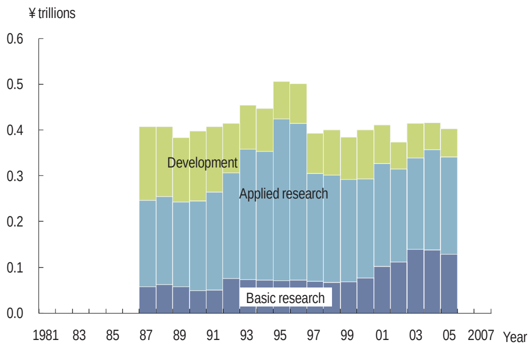
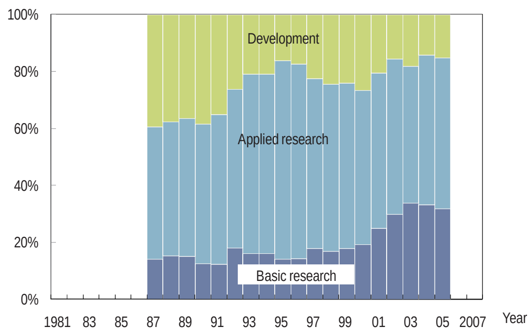
(A) Japan

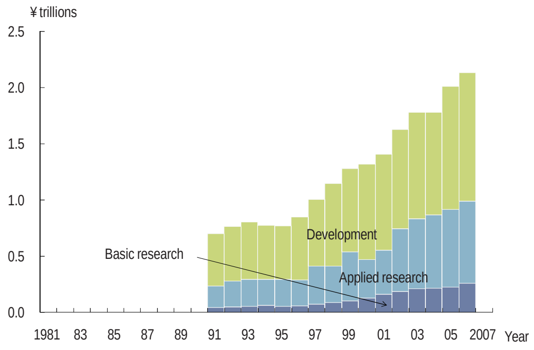
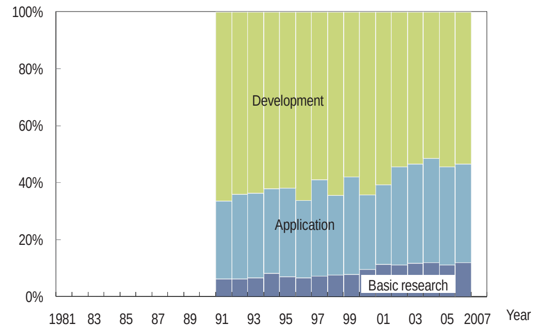
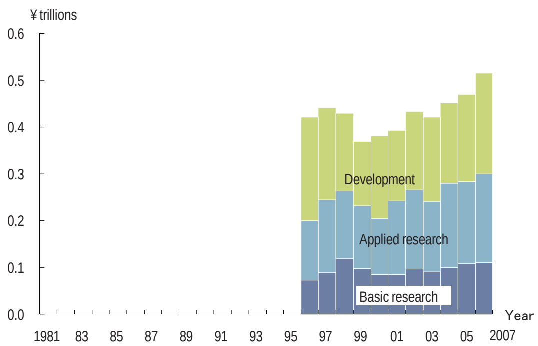
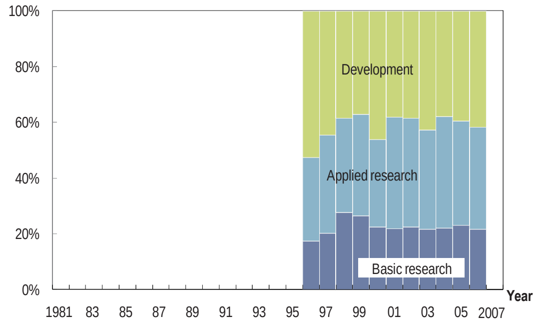
Expenditure (Yen PPP)



Proportion of expenditure by sector



	Expenditure (Yen PPP)	Proportion of expenditure by sector
(B) U.S.		
(C) Germany		
(D) France		
(E) U.K.		

	Expenditure (Yen PPP)	Proportion of expenditure by sector
(F) China		
(G) Korea		

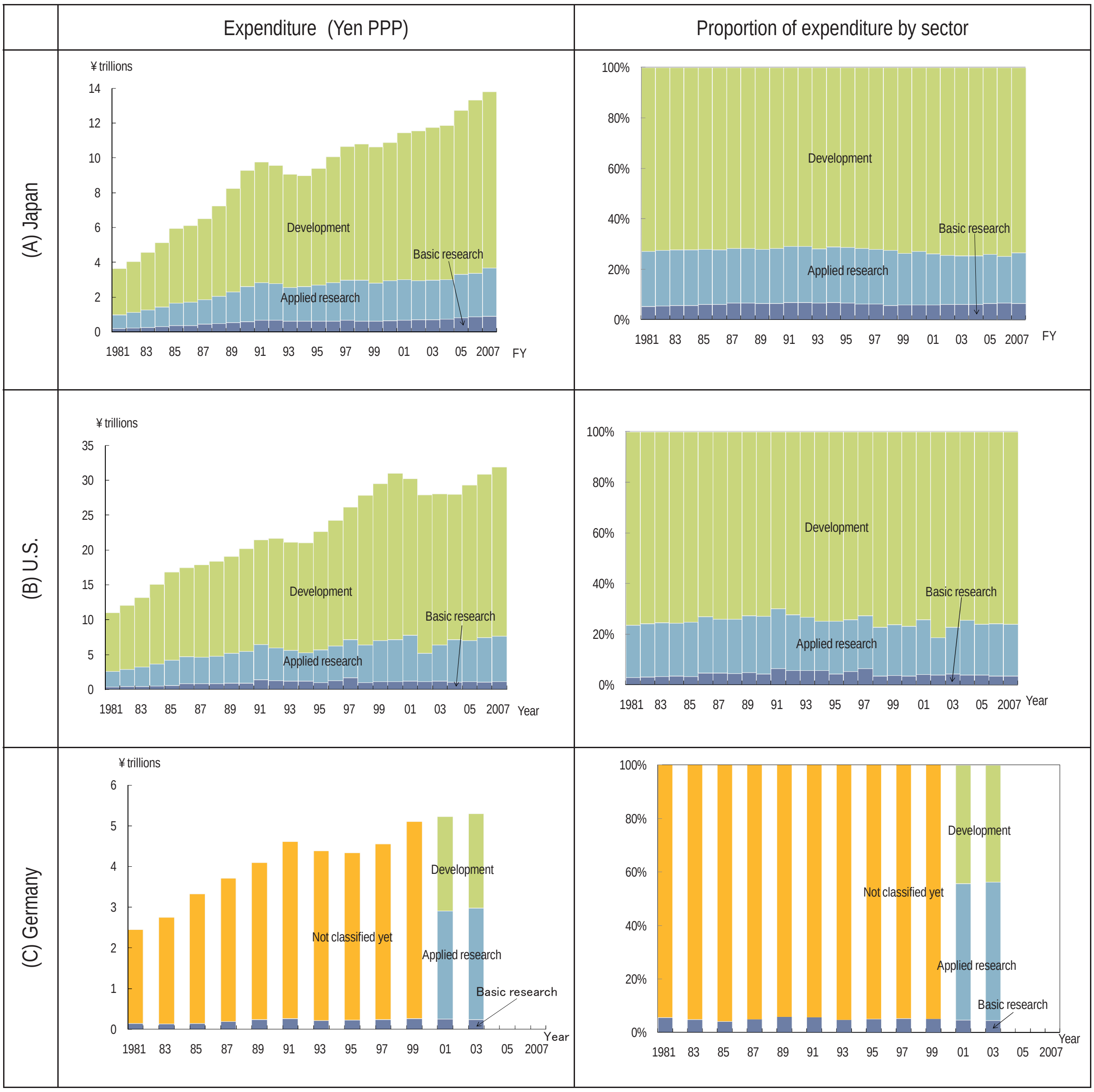
Note: 1) In Japan and Korea, R&D expenditure covers only the field of natural sciences and engineering. But R&D expenditure in other countries is the total of that for the field of natural sciences and engineering and of social sciences and humanities. Therefore it is necessary to be careful when international comparisons are being made.
2) With regard to R&D expenditure, refer to Chart 1-1-4.
3) Purchase power parity equivalent is the same as of Reference statistics E.
<U.S.>Values in 2007 are of preliminary budget amounts.
<Germany>1) West Germany until 1990 and unified Germany since 1991 respectively
2) Germany's data have not been included in materials published by the OECD since 2000.
<France>1) Change in the classification of the target for survey was made in 1991 (France Télécom and GIAT Industries were moved from the public organization sector to the business enterprise sector).
2) Method of statistics was changed in 1998 (method to estimate R&D expenditure in the field of defense).
Source: <Japan>The Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development".
<U.S.>NSF, "National Patterns of R&D Resources 2007 Data Update"
<Germany, France, U.K., Korea>OECD, "Research & Development Statistics 2007/1"

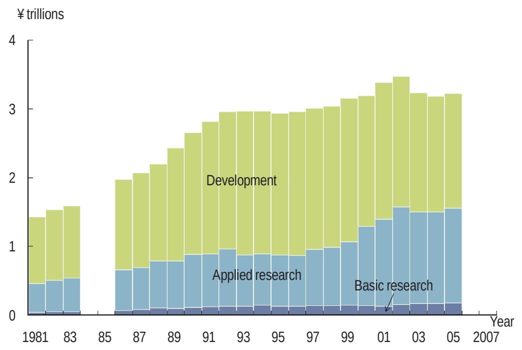
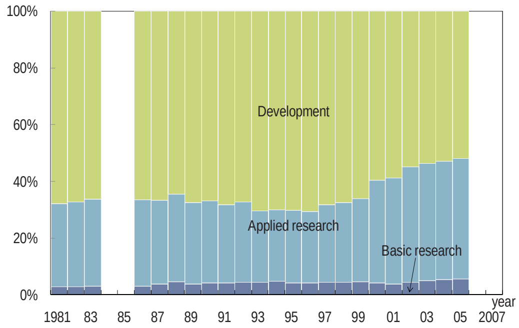
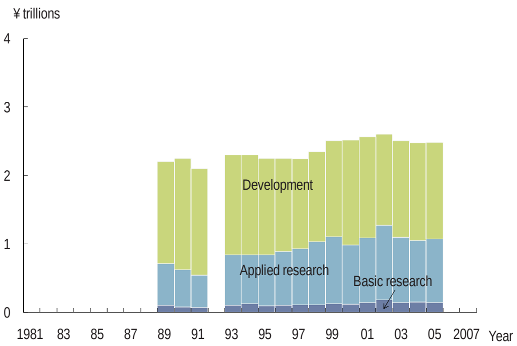
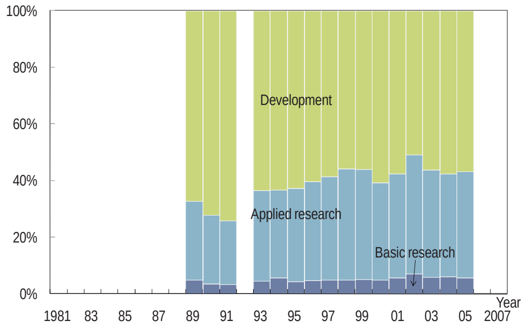
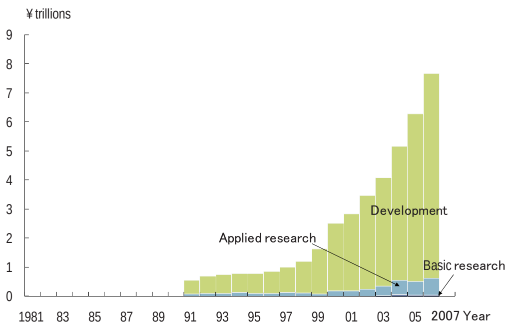
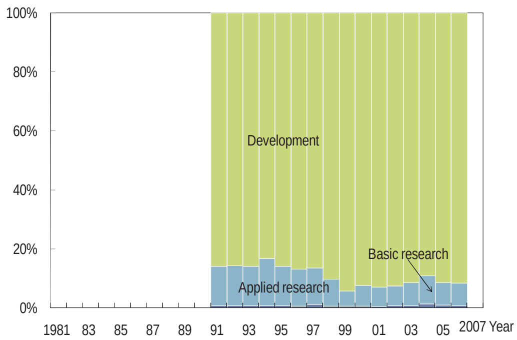
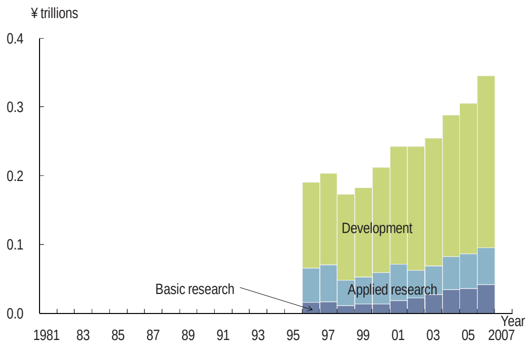
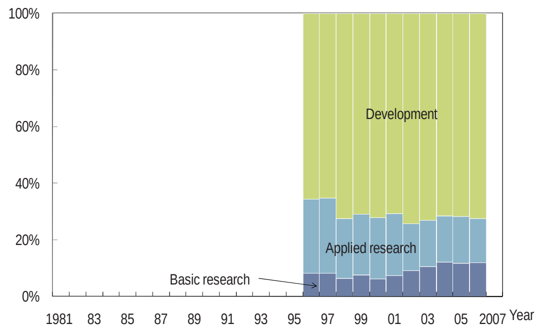
(2) R&D expenditure by character of work in the business enterprise sector

With regard to R&D expenditure by character of work in the business enterprise sector for each country (Chart 1-4-4), the proportion for development was large in almost all the selected countries. Among all, the proportion was the highest in China at approximately 90%, followed by Japan, the U.S. and Korea at 70%. These proportions have not shown significant change in the long term.

The proportion for applied research has continued to increase in Germany and France in recent years. And in all countries, the R&D expenditure for basic research accounts for an extremely small proportion of the total.

Chart 1-4-4: R&D expenditure by character of work in the business enterprise sector for selected countries (for all industries)



	Expenditure (Yen PPP)	Proportion of expenditure by sector
(D) France		
(E) U.K.		
(F) China		
(G) Korea		

Note: Purchase power parity equivalent is the same as for Reference statistics E.
<U.S.>Values in 2007 is of preliminary.
<Germany>West Germany until 1990 and unified Germany since 1991, respectively.
<France>1) Change in the classification of the target for survey was made in 1991 (France Télécom and GIAT Industries was moved from the public organization sector to the business enterprise sector).
2) Method of statistics was changed in 1998 (method to estimate R&D expenditure, method to evaluate the field of defense, method to evaluate R&D activities in large companies).

Source: <Japan>The Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"
<U.S.>NSF, "National Patterns of R&D Resources 2007 Data Update"
<Germany, France, U.K., Korea>OECD, "Research & Development Statistics 2007/1"

(3) R&D expenditure by character of work in the university and college sector

With regard to R&D expenditure by character of work in the university and college sector, basic research accounts for a large proportion of the total (Chart 1-4-5) .

In Japan, no difference in trend was shown in the proportion of R&D expenditure for basic research, applied research and development. In other words, Japan's university and college sector is consistent in the direction of its research.

In the U.S., both the amount and the proportion of R&D expenditure for basic research is on the rise, while that for applied research and development is gradually reducing

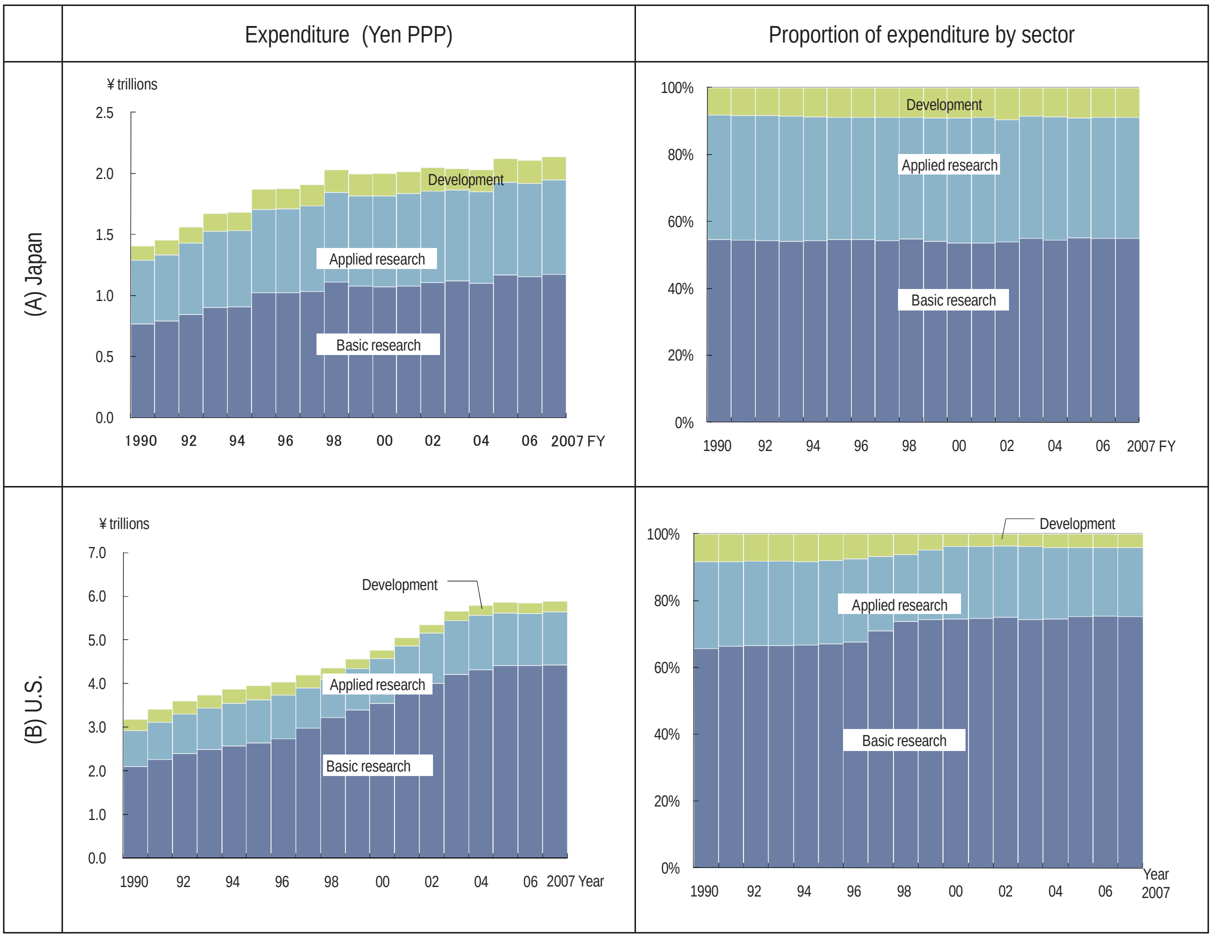
In France, R&D expenditure for basic research accounts for an overwhelmingly large proportion of the total, while that for development accounts for a very small proportion of the total, respectively.

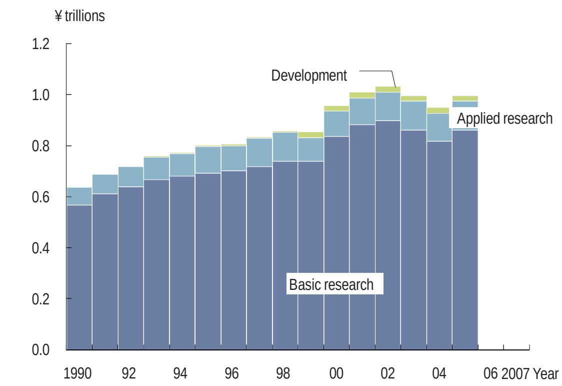
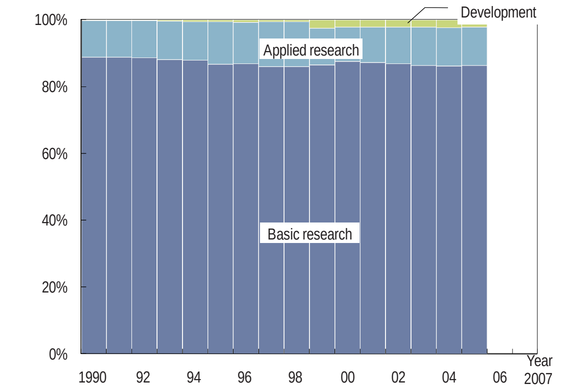
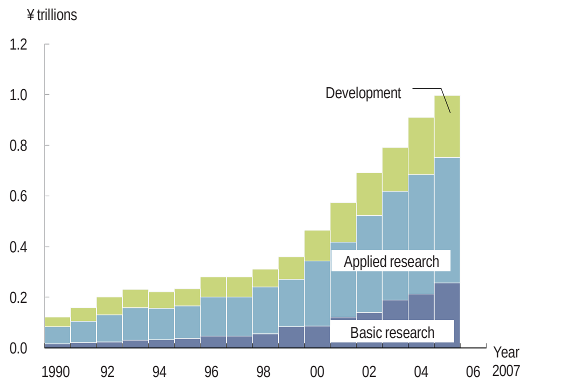
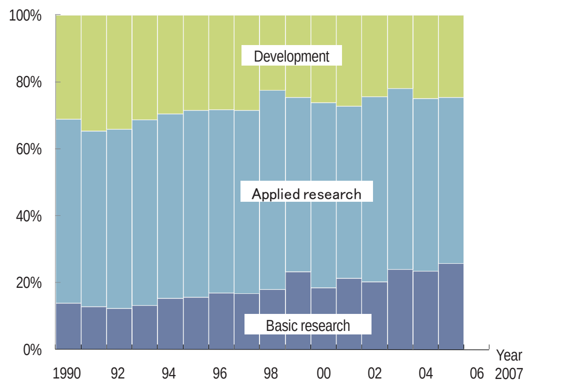
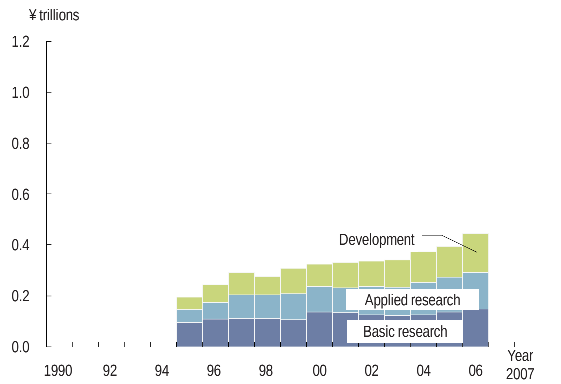
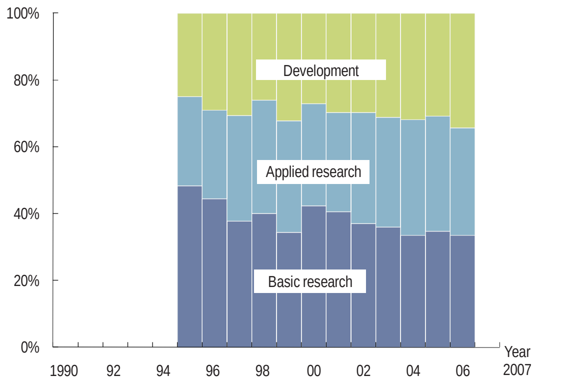
In China, the proportion of R&D expenditure for basic research is small, while that for applied research is large; however, the former is on the rise in the long-term.

In Korea, recently the proportion of each of the three types of research work are approximately the same each other. The proportion of R&D expenditure for basic research has been reducing.

Chart 1-4-5: R&D expenditure by character of work in the university and college sector in selected countries

Attention to international comparison



	Expenditure (Yen PPP)	Proportion of expenditure by sector
(C) France		
(D) China		
(E) Korea		

Note: 1) In Japan and Korea, R&D expenditure covers only the field of natural sciences and engineering. But R&D expenditure in other countries is the total of that for the field of natural sciences and engineering and of social sciences and humanities. Therefore it is necessary to be careful when international comparison is being made.
2) Refer to Chart 1-1-4 for R&D expenditure.
3) Purchase power parity equivalent is the same as for Reference Statistics E.
<U.S.> Values in 2007 is of preliminary.
Source: <Japan>The Ministry of Internal affairs and Communications, "Report on the survey of Research and Development".
<U.S.>NSF, "National Patterns of R&D Resources 2007 Data Update"
<France, U.K., Korea>OECD, "Research & Development Statistics 2007/1"

Chapter 2 : R&D personnel

Human resources, which are the basis for supporting scientific and technological activities, will be discussed here. In this chapter, R&D personnel, and more specifically, the status of researchers and research assistants in Japan and in selected countries will be explained. Concerning the present available data on the number of researchers, there are differences in definition of a researcher, and the methods of measurement applied are not unified across each country. Therefore, it could be said that this data is not suitable for strict international comparison. But even so, this data can be used to understand the condition of R&D personnel in each country if it is born in mind that there are differences in the scopes and levels of researchers in each country.

2.1 International comparison of the number of researchers in each country

Key points

○The definition and measurement of researchers in each country are conducted in line with the Frascati Manual. However, the actual methods used for the investigations are often different in each country. In particular, the university and college sector are excluded from the coverage of R&D statistical surveys in some countries. Also some countries set special conditions regarding the scope of the range of the surveys. Also there are countries which apply the full-time equivalent (FTE) method in surveying the number of researchers. And there are other countries which apply actual head counting for this purpose. Therefore, it could be said that there are many contributing factors which reduce the performance of the international comparability. In addition, in the U.S. and in the U.K., the number of researchers belonging to some sectors is not reported to the OECD. This forces the OECD to utilize estimated figures as a substitute. For the reasons given above, it is necessary to be careful in making international comparisons and trend comparisons of the number of researchers.

○In 2008, the number of researchers in Japan was a total of about 670,000, if the number of researchers working at universities and colleges is calculated by using the FTE method. The number is about 880,000 in the head count method. In recent years, the number of researchers in China has greatly increased. But the number of researchers per capita still lags behind compared to the other selected countries.

○If comparing the number of researchers by sector, in every country, the business enterprise sector has the largest proportion. On the other hand, when studying the number of female researchers by sector, the percentage hired by the business enterprise sector is small in every country.

2.1.1 Methods for measuring the number of researchers in each country

According to the Frascati Manual issued by the OECD, "researchers" are defined as "professionals engaged in the conception or creation of new knowledge, products, processes, methods, and systems and engaged also in the management of the projects concerned [(1)]."

To measure the number of researchers, similar to the method adapted to measure R&D expenditure, a questionnaire survey is used in general, but for some sectors in some countries data obtained from other survey is used.

In addition, there are two kinds of methods used to measure the number of researchers. One method is to measure the research work by converting it into "full-time equivalents" (FTE)[(2)]. In this case, R&D activities are separated from other activities and the number of hours engaged in actual R&D activity is used as the basis for measuring the number of researchers. This method is widely accepted internationally, in which by giving consideration to the activities of the researchers, the measurement of the number of researchers is performed by deducting the time consumed for other activities besides R&D activity[(3)].

The other method is to classify all activities as R&D activities, even when the research content of work is combined with other activities, and to measure the number of researchers according to the actual number found by head counting (HC).

Chart 2-1-1 shows the definition and measurement method of researchers for 4 sectors which are the same as the performing sectors of R&D expenditure in each country (The data for each country was measured by FTE conversion. And indication is given in the exceptional cases where the HC value was utilized.). All the countries conduct their measurements of researchers according to the questionnaire survey as indicated in the Frascati Manual issued by the OECD and based on its definition of researchers. But in some sectors, questionnaire surveys were not performed or the FTE value measurements were not carried out, which caused the differences by country and by sector. In particular, differences can be clearly seen according to the country regarding the measurements of researchers working in the university and college sector.

(1) In Japan the definition of a "researcher" is based on the terms written on the "Report on the Survey of Research and Development" issued by the Ministry of Internal Affairs and Communications.   In the statistics of this Ministry, the field of "research" is classified into "basic research", "applied research", and "development" and the "regular researchers" conducting such research are considered to be quite close to the "R&D scientists and engineers" mentioned in the Frascati Manual.

(2) For example, for researchers working at higher educational institutes such as universities and colleges, there are many cases when they are engaged in education together with their research work.   The way to measure the manpower of the portion of activities engaged in actual research work rather than treating above mentioned kinds of researchers (called "part-time researchers") as the same level as "full-time researchers" is called the "full-time equivalent". Specifically, for example, if a researcher dedicates 60% of his/her working time to R&D activities on annual basis, the value for this person as a researcher would be "0.6 people".

(3) In 1975, the OECD issued a recommendation that the full-time equivalent method should be applied to measure the manpower of researchers who are hired. The majority of OECD member countries have adopted the FTE method. The necessity of the FTE method and its principles are provided in the Frascati Manual issued by the OECD, which also provides international standards on the surveying methods for R&D statistics.

Chart 2-1-1: Definition and measurement method of researchers by sector in each country

Country	Business Enterprise Sector	University and College Sector	Public Organization Sector	Non-profit Institution Sector
Japan	People who completed any undergraduate course (except for junior college cources)	① Teachers (HC) ② Doctoral course students (HC) ③ Medical staff and others (HC)	People who completed any undergraduate course (except for junior college courses)	
	People who meet the above mentioned conditions or possess the equivalent or higher specialized knowledge, and conducting research on a special theme			
U.S.	Scientists and engineers mainly engaged in research	∗ Measured by independent surveys (HC) ① Scientists and engineers with doctoral degree. ②50% of Doctoral course students who are given economic assistance	∗ Measured in accordance with existing personnel data（HC） Scientists and engineers who are mainly engaged in research.	Scientists and engineers possessing doctoral degrees（HC）.
Germany	Staff who conceptualize or create new knowledge, products, manufacturing procedures, methods and systems. Persons in charge of the department of administration are included. Generally equivalent to scientists and engineers who graduated any university (comprehensive universities, technical universities and technical colleges)	∗ Measured in accordance with the statistics of education（HC） ① Teachers×FTE coefficient of field of study× FTE coefficient of research time ② Doctoral course students receiving economic assistance	Researchers	
France	① Researchers ② Research technologists ③ Recipients of scholarship for preparing any doctoral thesis who are given reward for the work of research			
U.K.	Researchers	∗ Measured in accordance with existing personnel data	Researchers	Researchers
China	Scientists and enginees who are mainly engaged in research.			
Korea	Recipients of at least a doctoral degree who are engaged in R&D activities.	① Teachers with the position of full time lecturer or higher ② doctoral course students ③ Recipients of at least a doctoral degree who are conducting surveys at any university research	Recipients of at least a doctoral degree who are engaged in R&D activities.	
	People engaged in reseach activities who meet above mentioned conditions or possess the equivalent or higher specialized knowledge as those.			

Notes: 1) The data is in accordance with statistical surveys of R&D except for data marked with ∗ which is obtained from a source other than statistical surveys of R&D.
2) Measurements are conducted on the basis of FTE in statistical surveys of R&D in each country. The cases in any sector in which FTE is not adopted are marked (HC).
3) ②Expression "doctoral course student" in the university and college sector in Japan represents those in the later term (the 3rd to 5th year).
4) With regard to the university and college sector in the U.S., the FTE of researchers is obtained by adding ①50% of doctoral course students who are financially
5) In Germany, the public organization sector and the non-profit institution sector are combined. With regard to the university and college sector, the FTE of obtained by multiplying the HC of teachers by FTE coefficients.
6) Expression solely used "researchers" represents that any definition and measurement method of researchers was not obtained in the sector.
Source: NISTEP, "Metadata of R&D-related statistics in selected countries: Comparative study on the measurement methodology";
Ministry of Internal Affairs and Communications, “Report on the Survey of Research and Development”

In Japan, the number of researchers has been measured in R&D statistics (Survey of Research and Development) by the Ministry of internal affairs and communications. But it was not until 2002 that the FTE method was introduced to measure researchers.

Chart 2-1-2(A) shows the measurement method used until 2001, which was neither FTE nor HC, but a method of measuring the people in the column of researchers only if the corresponding cell of Column ① was checked.

The measurement methods since 2002 are shown in Chart 2-1-2(B). The number of researchers is obtained by measuring the people in the column for researchers by means of FTE if the corresponding cell in Column ② is checked and by HC if the corresponding cell in Column ③ is checked, respectively.

As mentioned above, more than one method of measuring researchers is used in Japan. Therefore, figures found by these 3 types of methods will be given as the number of researchers (Chart 2-1-2).

Chart 2-1-2: Methods for measuring researchers in Japan

(A) Until 2001

Sector	Researchers	①
Companies etc	Researchers (regular)	○
	Researchers (external non-regular)	
Research Institutes (National and Public Institutes, Institutes run by Special corporations and by independent adminstrative corporations)	Researchers (regular)	○
	Researchers (external non-regular)	
Research Institutes (Private)	Researchers (regular)	○
	Researchers (external non-regular)	
Universities and Colleges	Researchers: ① Teachers ② Doctor's course students in graduate schools ③ Medical staff and others	○
	Researchers (external non-regular)	

(B) Since 2002

Sector	Researchers		②(FTE)	③(HC)
Business Enterprises	Mainly engated in research (number of people)		○	○
	Engaged in research under non-regular conditions	Number of people		○
		Number of people obtained by multiplying the ratio of research related work against the total work.	○	
Public Organizations (Natinonal and Public Organizations, Special coporations and Independent Administrative Corporations)	Mainly engated in research (number of people)		○	○
	Engaged in research under non-regular conditions	Number of people		○
		Number of people obtained by multiplying the ratio of research related work against the total work.	○	
Non-profit Institutions	Mainly engated in research (number of people)		○	○
	Engaged in research under non-regular conditions	Number of people		○
		Number of people obtained by multiplying the ratio of research related work against the total work.	○	
Universities and colleges	Teachers	Number of people		○
		Number of people obtained by multiplying the ratio of research related work against the total work.	○(0.465)	
	Doctor's course students	Number of people		○
		Number of people obtained by multiplying the ratio of research related work against the total work.	○(0.709)	
	Medical staff and others	Number of people		○
		Number of people obtained by multiplying the ratio of research related work against the total work.	○(0.465)	
	Engaged in research under external and non-regular conditions	Number of people		○

Notes: 1) ① "People mainly engaged in research" not converted on R&D basis until 2001. ② "People mainly engaged in research" and "people who are engaged in research under external and non-regular conditions and converted to FTE (FTE)" since 2002. ③ "People mainly engaged in research" and "people engaged in research under external and non-regular conditions (HC)" since 2002.

2) Values for the university and college sector are FTE coefficients. An FTE is obtained by multiplying the corresponding number of people by a FTE coefficient. As FTE coefficient, the result of MEXT, "Survey on the data for full-time equivalents in universities and colleges" conducted by the Ministry of education, culture, sports, science and technology in 2002. For "medical staff and others", the FTE coefficient same as for "teachers" is used.

Source: Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"

2.1.2 Trends in the numbers of researchers in each country

The number of Japan's researchers in 2008 was 670,000 (people) and its HC value was 880,000 (people) respectively. Both of them have been increasing in a linear manner, and the growth was mainly influenced by the rise in the number of researchers in the business enterprise sector.

The number of researchers in the U.S. was publicly announced only up to 1999 for the university and college sector, and up to 2002 for the public organization sector and the non-profit institution sector. Therefore, the values estimated by the OECD have been used for the total number of researchers since 2000.

In Germany, statistical surveys for R&D are conducted in the business enterprise sector, the public organization sector and the non-profit institution sector. With regard to the university and college sector, however, the measurement is in accordance with the statistics on education, and the FTE value of researchers is estimated using full time equivalent coefficients by academic field of study. There is no significant change except for an increase in the number of researchers in 1991 because of the unification of East and West Germany in 1990.

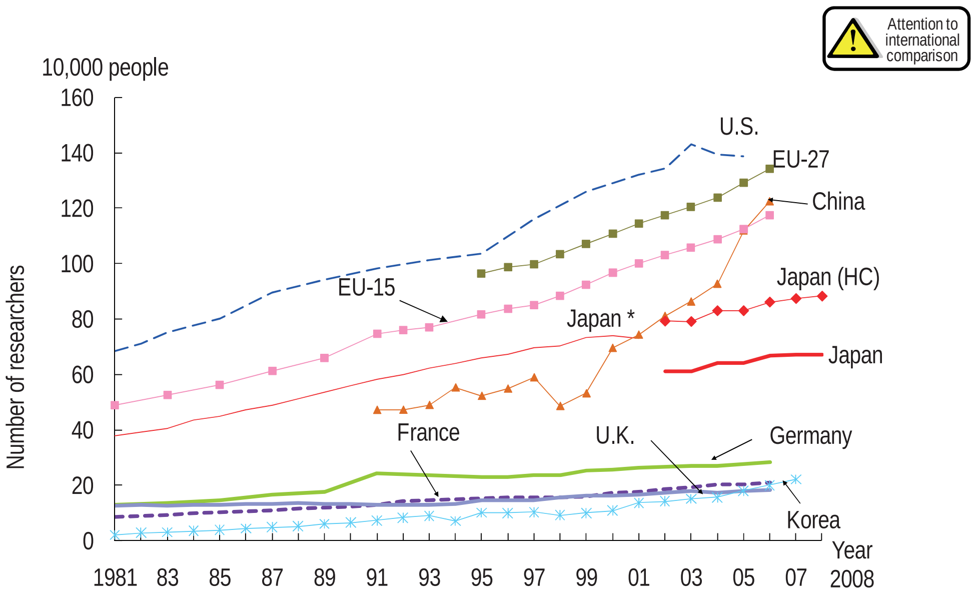
In France, the number of researchers is measured in accordance with statistical surveys for R&D which are conducted in all the sectors.

In the U.K., because no statistical survey for R&D is conducted in the university and college sector, the total number of researchers since 1999 has been calculated using the estimates by the OECD.

China is thought to be conducting statistical surveys for R&D, but the details are unknown. The number of researchers has surged since 1998 because of the rise in the number of researchers in the business enterprise sector, which surpassed that of Japan in 2002 and has remained more than that of Japan since then.

Korea is conducting statistical surveys for R&D by sector; however, the target is limited to the "field of sciences and engineering". Therefore this condition should be born in mind. Recently, the number of researchers is almost at the same level with that of France and the U.K. in spite of such conditions.

Chart 2-1-3: Trends in the number of researchers in selected countries



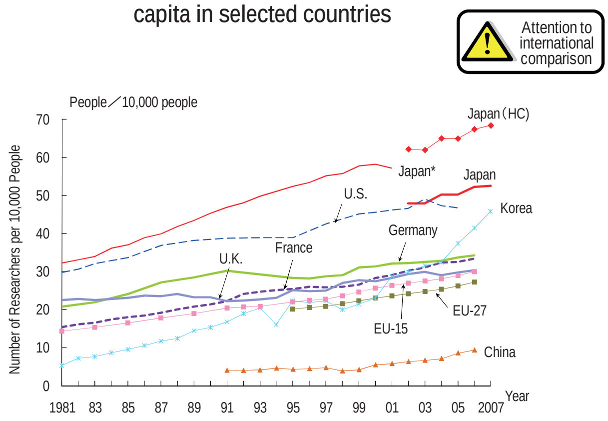
Notes: 1) The number of researchers in a country represents the total value of researchers in every sector, and the definition and measurement method for researchers in each sector is occasionally different depending on the country. Therefore it is necessary to be careful when international comparisons are being made.
2) FTE values are used.

3) The values represent the total of the number of researchers in the field of natural sciences and engineering and the field of social sciences and humanities (only that of the field of natural science and engineering for Korea).
<Japan>①Values until 2001 represent the numbers of researchers measured on Apr.1 and since 2002 represent the numbers of researchers measured on Mar.31 in the corresponding year, respectively.
②"Japan＊"represents the values in Chart 2-1-2(A)①.
(The number of "people mainly engaged in research" without being converted on FTE basis. External non-regular researchers are not measured.)
③"Japan (HC)" represents the values in Chart2-1-2(B)②.
(The total of "people mainly engaged in research" and "people engaged in research under non-regular conditions". The number of researchers in the university and college sector includes the above mentioned "external non-regular researchers").
④The FTE values of "Japan" represent the values in Chart2-1-2(B).
(The measurement for the university and college sector is made with the conversion in accordance with the results of the “Survey on the data for full-time equivalents in universities and colleges” in 2002. With regard to the business enterprise sector, the public organization sector and the non-profit institution sector, "people mainly engaged in research" and "people engaged in research under non-regular condition whose values are converted on FTE basis" are measured.)
<U.S.>OECD secretariat estimate or projection based on national sources has been used since 2000.
<Germany>Former West Germany until 1990 and unified Germany since 1991 respectively.
<U.K.> OECD secretariat estimate or projection based on national sources has been used since 1999.
<Korea> Only the field of natural sciences and engineering is included.
Source : <Japan>Ministry of Internal Affairs and Communications, “Report on the Survey of Research and Development ”;
MEXT, “Survey on the data for full-time equivalents in universities and colleges” (Nov. 2003)
<U.S.>NSF, “National Patterns of R&D Resources 1992,1996,2002 Data Update”; OECD, “Main Science and Technology Indicators 2008/2” for the data since 2000
<Germany>Bundesministerium für Forschung und Technologie, “Bundesbericht Forschung” 1996,2000,2004, “Research and Innovation in Germany 2007”,“Bundesbericht Forschung und Innovation 2008” ; OECD, “Main Science and Technology Indicators 2008/2” for the data since 2006
<France, U.K., China, EU> OECD, “Main Science and Technology Indicators 2008/2”
<Korea>KISTEP、Statistical DB (website)

Next, an international comparison is conducted in which the influence of the size of each country is reduced by using the relative value of the number of researchers, in other words, the number of researchers per capita (Chart 2-1-4). As far as the period since 2002 is concerned, Japan’s values have been higher than those of the U.S., and approximately 2 times those in European countries. The growth rate has been highest in Korea among all and especially remarkable since 2004. European countries show a gradual increase in the long term.

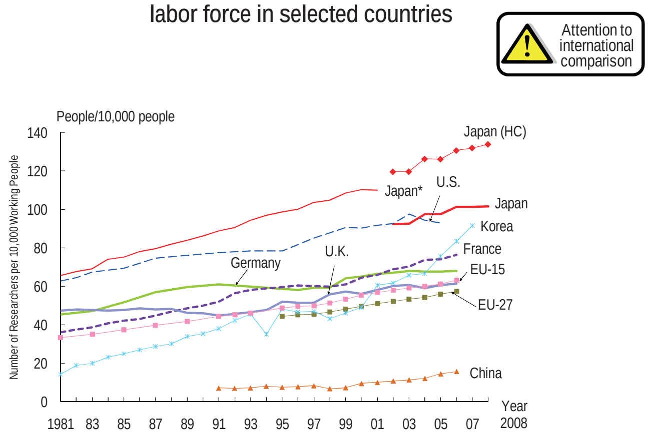
Also Japan’s values are high in terms of the number of researchers per labor force (Chart 2-1-5). The trend shows only a limited difference between the cases of the number of researchers per labor force and per capita, but in France the growth in the former case is on the rise recently.

Chart 2-1-4: Trends in the number of researchers per capita in selected countries



Notes: Refer to Chart 2-1-3 for the note on making international comparisons and the number of researchers. The population is the same as for Reference statistics A.
Source: Refer to Chart 2-1-3 for the note on making international comparisons and the number of researchers. The population is the same as for Reference statistics A.

Chart 2-1-5: Trends in the number of researchers per labor force in selected countries



Notes: Refer to Chart 2-1-3 for the note on making international comparisons and the number of researchers. The labor force is the same as for Reference statistics B.
Source : Refer to Chart 2-1-3 for the note on making international comparisons and the number of researchers. The labor force is the same as for Reference statistics B

2.1.3 Trends in the proportion of the number of researchers by sector in each selected country

The situation and trend over time with regard to the number of researchers are examined by sector, which are same as those in the classification of R&D expenditure, the "business enterprise sector", the "university and college sector", the "public organization sector" and the "non-profit institution sector".

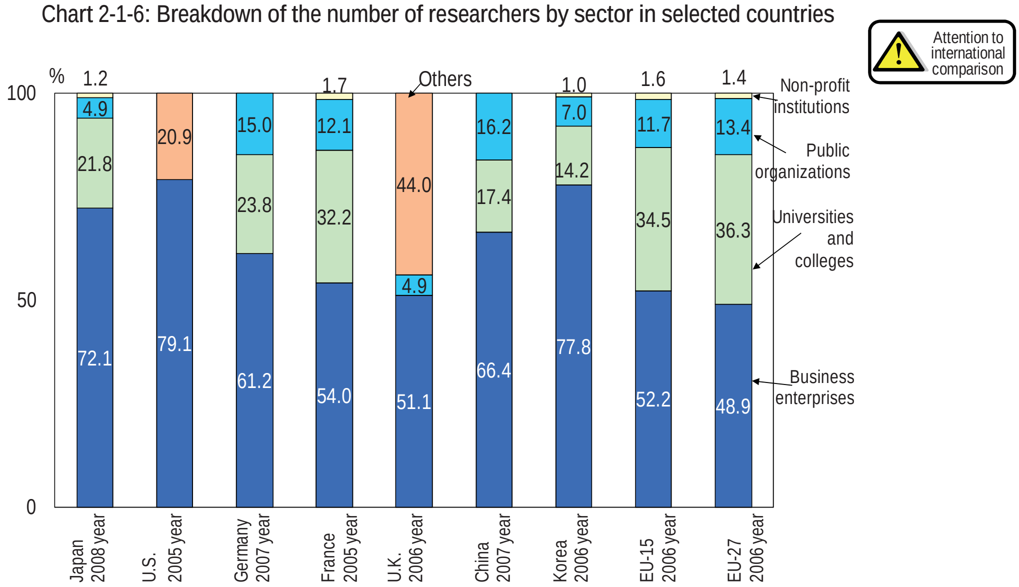
Although an international comparison of the number of researchers faces difficulties as mentioned in 2.1.1, in this section each country's characteristics are examined using the data which is available at the present time.

In each country, the number of researchers in the business enterprise sector accounts for the largest proportion of the total, followed by that in the university and college sector, the public organization sector and the non-profit institution sector. This order is the same for every country.

The proportion in the university and college sector is large in European countries and relatively small in Korea and China (Chart 2-1-6).

In classifying the number of researchers by sector in order to find the cause of the rise in the number of researchers, it is found that the number of researchers in the business enterprise sector accounts for large proportion in each country. In other words, the increase in the number of researchers is due to the influence of that in the business enterprise sector. The rise in the number of researchers in the business and enterprise sector is especially outstanding in newly developing industrial countries such as China and Korea. On the other hand, in the U.K., the increase in the business enterprise sector is not significant when compared to other countries. In addition, the number of researchers in the public organization sector is also reducing, which seems to be due to the transfer of a part of the public organization sector into the business enterprise sector (Chart 2-1-7).

Chart 2-1-6: Breakdown of the number of researchers by sector in selected countries

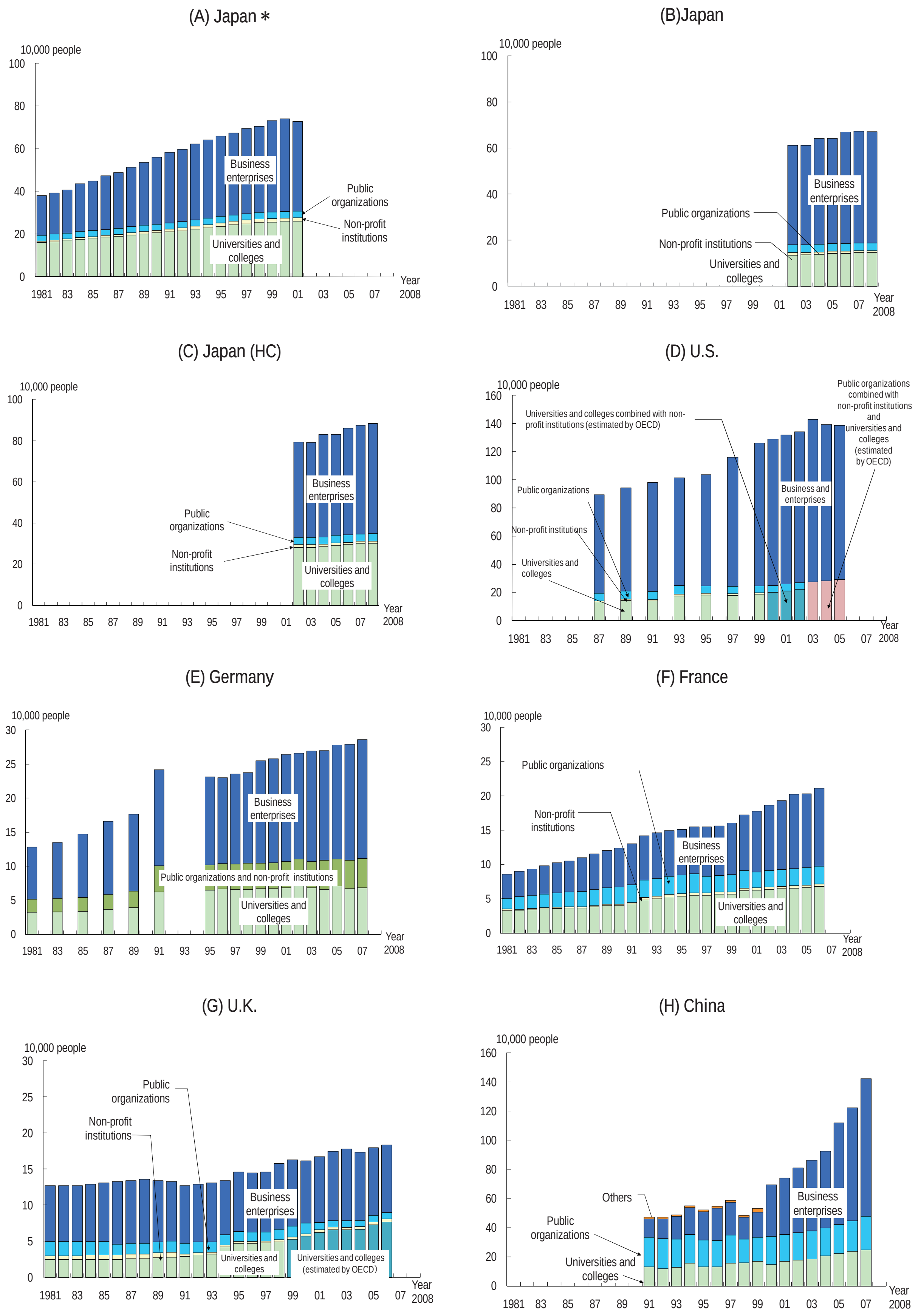


Notes: 1) Refer to Chart 2-1-3 for the note on making international comparisons
2) FTE values were used.
3) Data of the field of social sciences and humanities were also included (only data of the field of natural sciences and engineering are included in Korea).
4) Refer to Chart 2-1-3 with regard to the number of researchers in Japan.
5) In Germany, national estimate or projection adjusted, if necessary, by the OECD Secretariat to meet OECD norms was used.
6) Values for China were not completely consistent with the definition by the OECD.
7) Values for the EU were estimate or projection based on national sources by the OECD Secretariat. The value in the non-profit institution sector was obtained by subtracting the number of researchers in the business enterprise sector, the university and college sector and the public organization factor from the total.

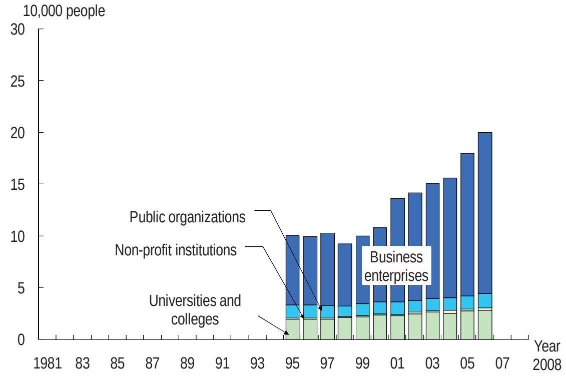
Source: <Japan> Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"
<U.S., Germany, France, U.K., China, Korea>OECD,"R&D Statistics(last updated 2009.2)"
<EU>OECD, "Main Science and Technology Indicators 2008/2"

Chart 2-1-7: Trends in the number of researchers by sector

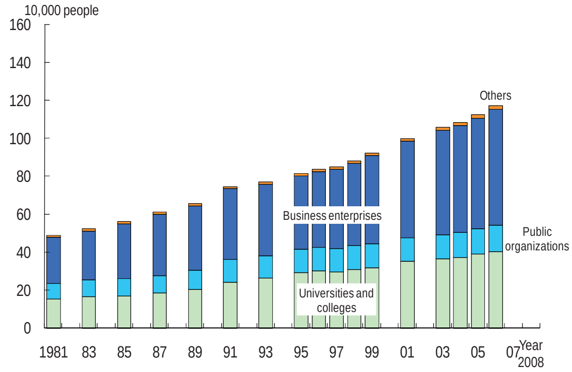
Attention to international comparison



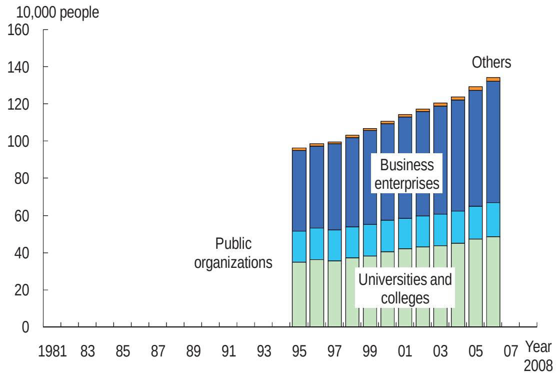
(I) Korea



(J) EU-15



(K) EU-27



Notes: 1) Refer to Chart 2-1-3 for the note on making international comparisons
2) FTE values were used.
3) Data for the field of social sciences and humanities were also included (only the data for the field of natural sciences and engineering are included in Korea)
4) Refer to Chart 2-1-3 for the number of researchers in Japan.
5) The number of researchers in the university and college sector combined with the non-profit institution sector in the U.S. since 2000 was obtained by subtracting the number of researchers in both the business enterprise sector and the public organization sector from the total.
6) Germany represents the former West Germany until 1990 and unified Germany since 1991 respectively.
7) The number of researchers in the university and college sector in the U.K. since 1999 was obtained by subtracting the number of researchers in the business enterprise sector; public organization sector and the non-profit institution sector form the total.
8) Others of China represents the number of researchers was obtained by subtracting the number of researchers in the business enterprise sector, the university and college sector, the public organization factor and the non-profit institution factor from the total.
9) Others of EU represents the number of researchers was obtained by subtracting the number of researchers in the business enterprise sector, the university and college sector and the public organization sector from the total.

Source: <Japan> Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"
<U.S.> NSF, "National Patterns of R&D Resources: 2002 Data Update" until 1999; OECD, "R&D Statistics(last updated 2009.2)" since 2000.
<Germany>Bundesministerium für Forschung und Technologie, "Bundesbericht Forschung" 1996,2000,2004; "Research and Innovation in Germany 2007", "Bundesbericht Forschung und Innovation 2008"; OECD,"R&D Statistics(last updated 2009.2)" since 2006.
<France, U.K., China, Korea>OECD,"R&D Statistics(last updated 2009.2)"
<EU>OECD, "Main Science and Technology Indicators 2008/2"

2.1.4 Female researchers in each country

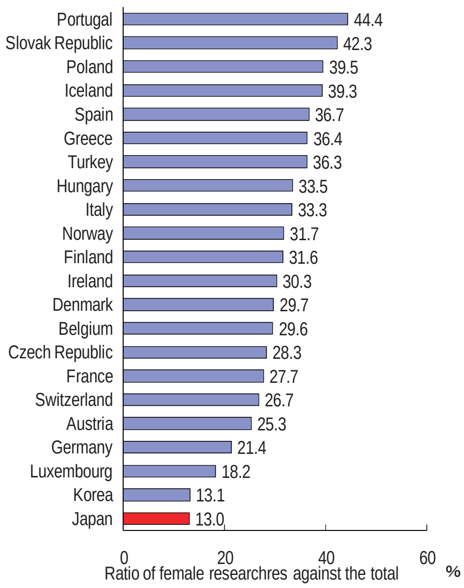
In this section, the ratio of female researchers in each country is examined. The active role of female researchers is expected from the viewpoint of the diversity of researchers. Furthermore, the enhancement of the activities by female researchers is one of basic principles of the Third Science and Technology Basic Plan.

The ratio of the number of female researchers against the total was measured using HC values. Because no precise information about female researchers exists for the U.S. and China, and no public announcement was made for some sectors in the U.K., unavoidably no data exists to obtain the ratio of female researchers against the total for these countries.

The ratio of the number of female researchers against the total in Japan was 13.0% in 2008, the smallest among the surveyed countries (Chart 2-1-8).

The advancement of female researchers in Japan has lagged behind European countries, and it is assumed that the abilities of Japan's women have not been positively used.

Chart 2-1-8: Ratio of the number of female researchers against the total (comparison in HC values)



Notes: 1) Data are for 2008 in Japan; for 2007 in Slovak Republic and Czech Republic; for 2006 in Poland, Spain, Turkey, Hungary, Italy, Finland, France, Austria and Korea; for 2005 in Portugal, Iceland, Greece, Norway, Ireland, Denmark, Belgium and Germany; for 2004 in Switzerland.
2) Values are on a head count basis.
3) Data of the U.S., the U.K. were not included in materials below.
Source: <Japan> Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"
<Others>OECD, "Main Science and Technology Indicators 2008/2"

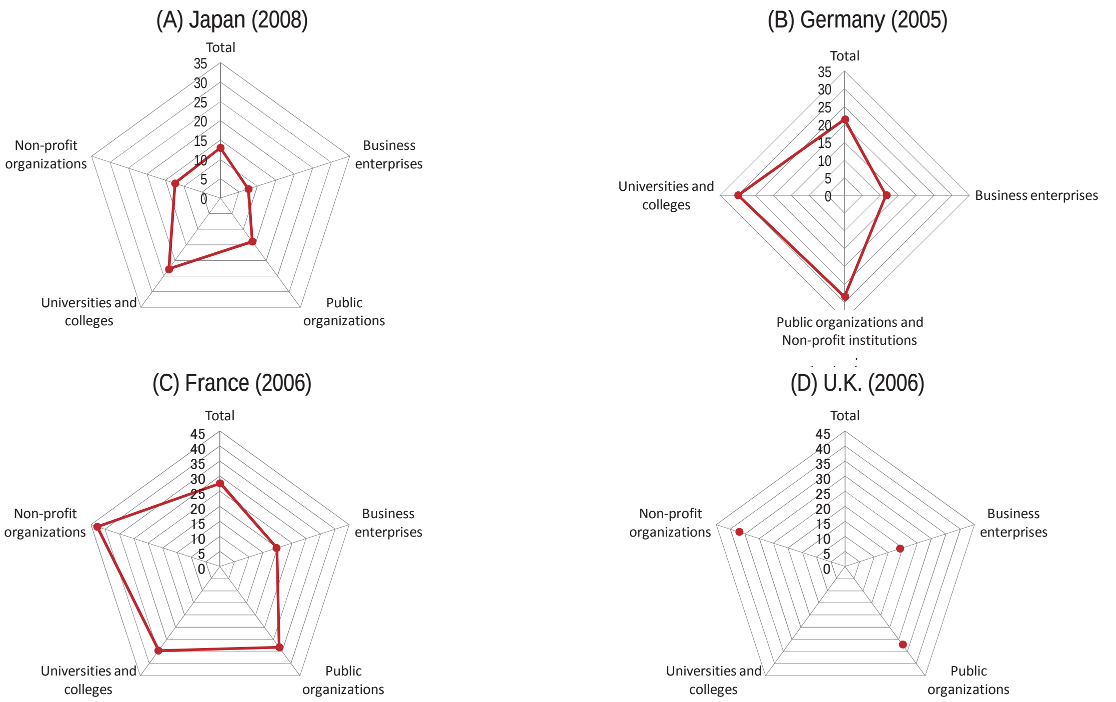
What exactly is the difference in the proportion of the number of female researchers by sector in each country? The female ratio against the total by sector was examined for selected countries where the data was available (Chart 2-1-9).

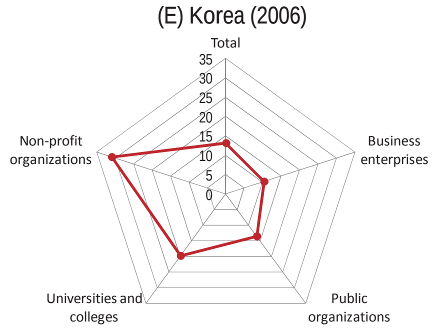
The U.K. did not have data for female researchers in the university and college sector, so it was impossible to measure the total number for all sectors. The values for other sectors, however, were available and are shown below. In Germany, the data of the public organization sector and that of the non-profit institution sector were combined.

In the business enterprise sector, the ratio of the number of female researchers was small in each country. On the other hand, the ratio in the university and college sector was relatively large, and that in the non-profit institution sector was remarkably large in size.

In Japan, the number of female researchers in the university and college sector accounted for 22.7% of the total in 2008. This value was larger than that in Korea (19.8%) as far as only the university and college sector is concerned. In contrast, the number of female researchers the business enterprise sector accounted for 7.5% of the total. This proportion was extremely small compared to other countries. In this connection, positive activities by female researchers in the business enterprise sector are required in the future.

Chart 2-1-9: The ratio of the number of female researchers by sector for selected countries

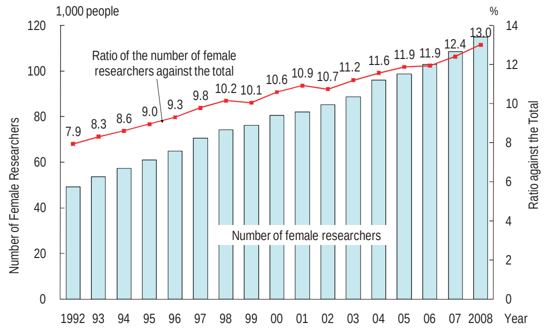




Notes: No data are available for the university and college sector of the U.K. Therefore the total value is unknown.
Source: <Japan>Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"
<Other countries>OECD, "R&D Statistics"

Next, the number of female researchers and the ratio of those against the total was examined and the result in 2008 was 114,942 people and 13.0% respectively (Chart 2-1-10). Past trend shows the tendency of the number and the ratio of female researchers to rise. It is true that the values are not high compared to other countries; however, it can be predicted that the role of female researchers will advance with the development of knowledge-based society.

Chart 2-1-10: The number of female researchers and the ratio of those against the total number of researchers



Notes: The ratios of the number of female researchers published in the "Report on the Survey of Research and Development" by the Ministry of Internal Affairs and Communications were used. The numbers of researchers until 2001 in this chart were obtained by measuring only regular researchers in the business enterprise sector and the non-profit institution sector, and those including external non-regular researchers in the university and college sector. The numbers of researchers by gender since 2002 were surveyed on head count basis.
Source: Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"

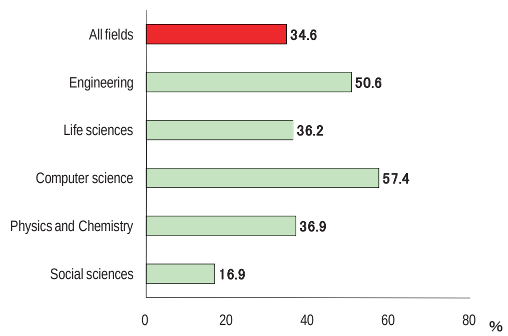
2.1.5 Doctoral degree holders

The migration of knowledge workers brings about most advanced knowledge and technical skills into the workplaces of countries which accept them, and inevitably becomes one of factors to enhance a country's power. In this section, the country of origin and the specialized field of knowledge workers, each of whom possesses a doctoral degree in the field of sciences or engineering, in Japan and the U.S. are examined. Because no data corresponding to the data in the U.S. is available in Japan, the data on the employment status of post doctoral fellows in Japan is used as a substitute.

Out of the total doctoral degree holders in the U.S., 34.6% of them or 300,000 people were born in foreign countries (Chart 2-1-1). And the breakdown of them shows that people who possess a doctoral degree in the field of computer science account for 57.4%, more than half of the total.

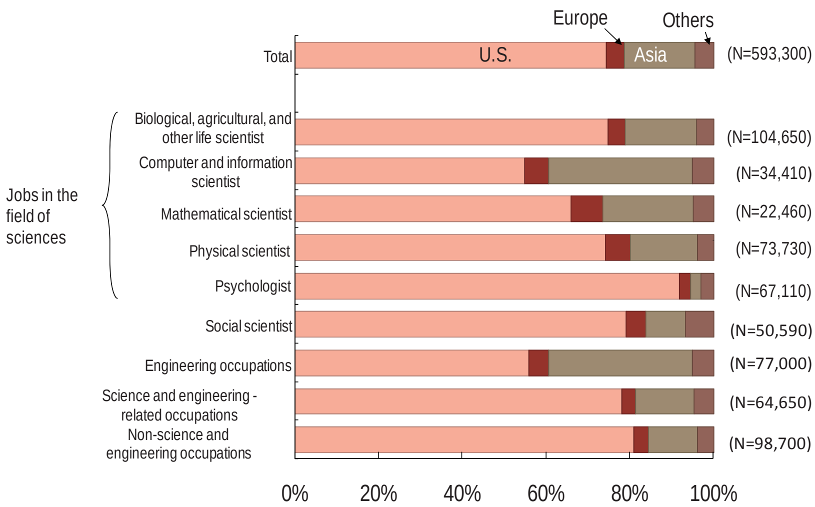
Next, which country and region doctoral degree holders came from and which specialized occupational fields they were employed in is examined. Understandably, U.S. born researchers account for more than half the proportion of each total in almost every specialized occupational field, and account for 74.6% of the entire total of all the fields. By examining the proportion of doctoral degree holders from the Asian region by specialized occupational field, it was found that the proportion of people employed in the fields of computer science and information science was large at 34.3% followed by those in the field of engineering at 34.2% (Chart 2-1-12).

Chart 2-1-11: Ratio of the doctoral degree holders from foreign countries against the total by specialized field of study in the U.S. (2003)



Notes: "Physics and Chemistry" represents Chemistry, Geosciences, Physics and astronomy.
Source: NSF, "Science and Engineering Indicators 2006"

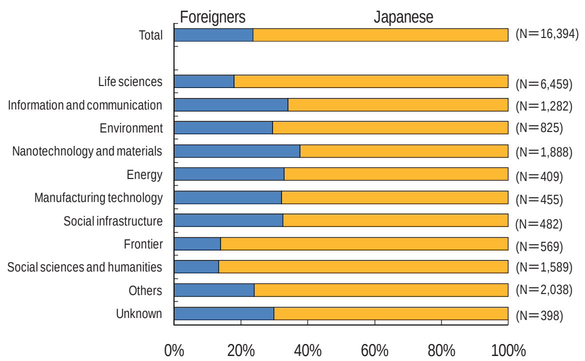
Chart 2-1-12: Status of employment for doctoral degree holders by country or region of origin in each occupational field



Source: NSF, "Characteristics of Doctoral Scientists and Engineers in the United States: 2003"

Chart 2-1-13 shows the ratio of the number of foreign employees against the total number of positions for post doctoral fellows in the university and college sector combined with the public organization sector in Japan. 23.7% of the total of such positions were held by foreigners. Examined by occupational field, the ratio in the field of nanotechnology combined with the field of materials was highest at 37.7%, followed by the ratio in the field of information and telecommunication at 34.0%.

Chart 2-1-13: Employment status for post doctoral fellows in the university and college sector and public organization by the field of research in Japan (2006)



Notes: Positions for post doctoral fellows are for the employees under a fixed term contract, and composed of ① employees engaged in research at university institutes, but not at the position of professor , assistant professor, nor assistant, and ②employees regularly engaged in research at research institutes run by independent administrative corporations etc, but not at the position of the leader of a research group nor senior research fellow, etc (including retired professors).
Source: NISTEP "Survey on Postdoctoral Fellows and Research Assistants (FY2006)"

2.1.6 Mobility of researchers

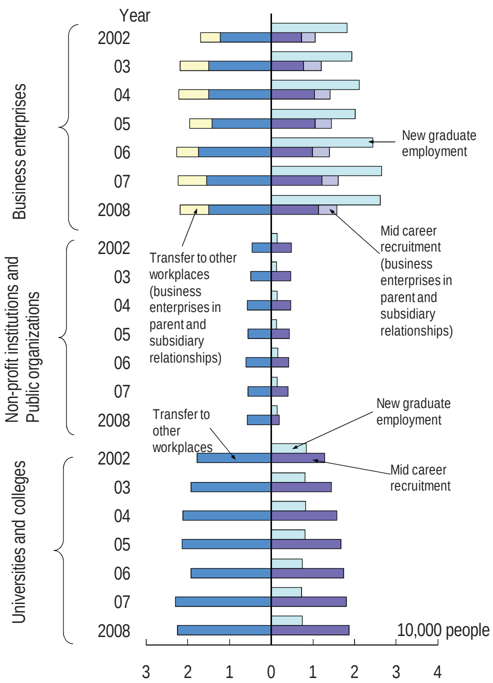
Enhancing the mobility of researchers is considered to advance the use of the abilities of researchers, who are in charge of knowledge production, and simultaneously to develop a research environment with vitality in each workplace.

The status of new graduate employment[(4)] and transfer, both to[(5)] and from the latest work place, of the researchers by sector in Japan was examined below (Chart 2-1-14). The number of researchers employed across the nation in 2008 was 73,752 people. Of these, the number of new graduates employed was 35,299 and the number of mid career recruits was 38,453, respectively. The former was 1.3 times and the latter was 1.4 times the figures for 2002.

According to a comparison by sector, in the business enterprise sector, the numbers for new graduate employment has been higher than that for mid career recruits, and the former has increased by 1.4 times during the period from 2002 to the latest available year. In the university and college sector, the numbers for mid career recruits has been higher than that for new graduate employment, and the former has increased by 1.5 times in the same period. In the non-profit institution sector combined with the public organization sector, the number of mid career recruits has been higher than that of new graduates employed, but the growth rate of the number of mid career recruits from 2002 to 2008 was 0.8 and shows reduction. In the business enterprise sector and the university and college sector, the number of new graduates employed and mid career recruits was higher than the number transferring to other sectors. On the other hand, in the non-profit institution sector, the number of new graduates employed and midterm recruits has gradually reduced and was exceeded by the number of transfers to other sectors in 2008.

(4) The new graduate employment represents so called new university graduates. Casual and part time workers as well as temporary workers at universities or research institutes are included.
(5) People transferred from the latest workplace include retired people.

Chart 2-1-14: Numbers of new graduates employed and midterm recruits/transfers with regard to researchers



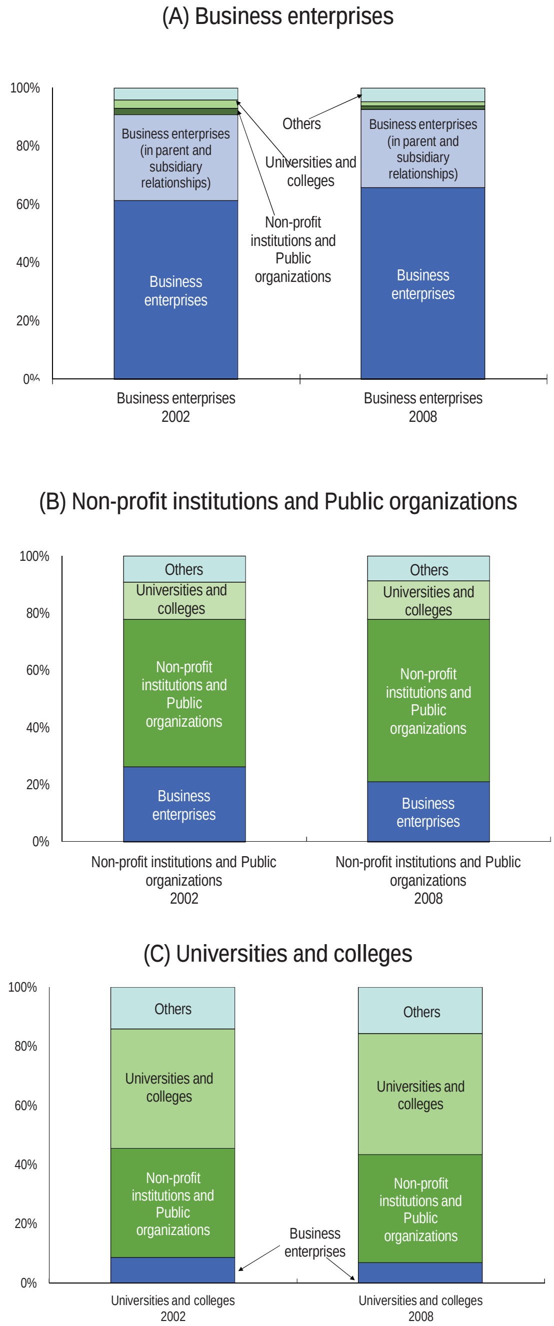
Source: Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"

In this connection, the sectors of the people who were employed as mid career recruits are examined by former affiliated sector by comparing the data from 2002 and that for the latest year for each sector where they were affiliated in 2008 (Chart 2-1-15).

In 2008, the number of researchers transferred from the business enterprise sector accounted for a significantly large proportion, 92.6%, of the total number of researchers transferred to the same sector.

Also in the non-profit organization sector combined with the public organization sector, the number of transferred researchers from the same sector accounted for the largest proportion, 56.7%, of the total number of the transferred researchers. In the university and college sector, the proportion was 41.0%. In either case, the ratio of the number of transferred researchers from the same sector in 2008 accounted for a large proportion, and has increased since 2002. With regard to transfers from other sectors, the proportion of the number of researchers from the non-profit institution sector and from the public organization sector accounted for the largest in the university and college sector. And those from the business enterprise sector were the largest in the non-profit institution sector combined with the public organization sector.

Chart 2-1-15: Breakdown of transferred researchers from other sectors by their former affiliated sector



Source: Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"

2.2 Researchers by sector

Key points

- ○The number of researchers in the public organization sector can significantly change due to the privatization of public organizations and depending on the scope of the statistics for R&D.
- ○The number of researchers in the public organization sector per 10,000-person population in the latest available year was 5.23 in Germany, which was the highest value, followed by 4.06 in France. Japan's value was 2.63. However, the number of researchers in local governments (state governments, etc.) in Japan and Germany was included in the data above, while that for France was not included. The value for the U.S., whose data did not include the number of researchers in local governments, was 1.66.
- ○The numbers of researchers in the business enterprise sector recently have had a tendency to increase for both Japan and the U.S., while that for Germany and the U.K. has been flat. With regard to the proportion of the number of researchers by industry, the ratio of those in the manufacturing industry to the non-manufacturing industry in Japan was approximately 90% to 10%, and in the U.S. was approximately 60% to 40%. The trends of both countries are different in this way.
- ○The number of researchers in the university and college sector in Japan in accordance with the statistics by the OECD was extremely large compared to other countries (180,000 people (2006) in Japan, while 190,000 people (1999) in the U.S.). But if the number of researchers in the university and college sector is measured using the statistics for education, the value is not necessarily extremely large (250,000 people in Japan compared to 740,000 people in the U.S. (both in 2006)).

2.2.1 Researchers in the public organization sector

(1) Researchers in public organizations in each country

Below is a summary of what "public organizations" in this section represent. Bearing in mind the differences for each country, the number of researchers in public organizations by country is examined.

In Japan, "national" institutes (such as national testing and research institutes), "public" institutes (such as public testing and research institutes), and special and public administrative corporations (non-profit) are included.

In the U.S., research institutes run by the federal government are included.

In Germany, research institutes run by the federal government and local governments and other public research institutes, non-profit institutions (receiving 160,000 Euros or more as public funds) and the research institutes except for higher education institutions are included.

In France, types of research institutes such as scientific and technical research public establishment "Etablissement public a caractere scientifique et technologique" (EPST) (except for CNRS) and commercial and industrial research public establishment "Etablissement Public a Caractere Industriel et Commercial" (EPIC) are included.

In the U.K., research institutes run by the central government and decentralized governments and research councils are included.

In China, research institutes run by the central government are included.

And in Korea, national and public research institutes, government supported research institutes and national and public hospitals are included.

With regard to the trends in the number of researchers, Japan did not show a significant change in the public organization sector in the long term. The

U.S., Germany, France and the U.K., however, have shown remarkable fluctuation. The main reasons are considered to be the transfer of some public organizations into the business enterprise sector, the change in surveying methods for measuring the number of researchers, etc. For example, in Germany, the above mentioned "research institutes other than higher education institutions (legally independent university research institutes)" were not covered as a target of the measurement until 1991. As another example, in the U.K., the "UK Atomic Energy Authority" which belonged to the public organization sector in 1985 was transferred to the business enterprise sector in 2000 as DERA(6) stopped operating.

The number of researchers in the public organization sector in China is extremely large compared to that in other countries; however, the ratio of the former per 10,000-person population is not so remarkable ((1.6) see chart 2-2-1(B))

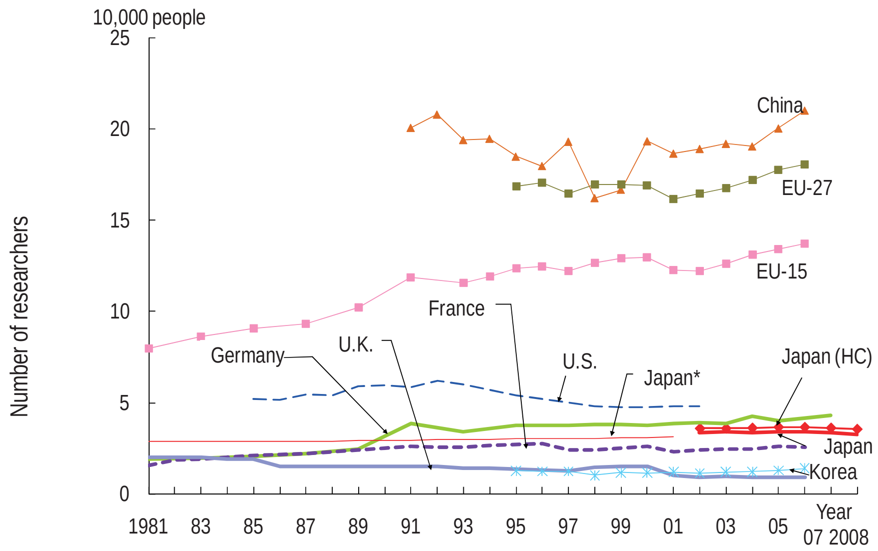
In the U.K., both the number of researchers and the ratio of the number of researchers per 10,000-person population are small (Chart 2-2-1 (A, B)).

(6) The Defense Evaluation and Research Agency (DERA).

Chart 2-2-1: Researchers in the public organization sector in selected countries

(A) Trends in the number of researchers in the public organization sector

Attention to international comparison



(B) Number of researchers in the public organization sector per 10,000-person population

(Unit: people)

Country (Year)	
Japan (2007)	2.63
U.S. (2002)	1.66
Germany (2007)	5.23
France (2006)	4.06
U.K. (2006)	1.48
China (2006)	1.60
Korea (2006)	2.91

Notes: 1) The definition and measurement method of researchers in the public organization sector is different depending on country. Therefore it is necessary to be careful when international comparisons are being made. Refer to Chart 2-1-1 for the definition of researchers in each country.
2) FTE values were used.
3) Values represent the total number of researchers in the field of natural sciences and engineering and the field of social sciences and humanities (only that in the field of natural sciences and engineering in Korea).
<Japan>1) National and public research institutes, special corporations and independent administrative corporations.
2) Refer to Chart 2-1-3 for researchers.
<U.S. >1) The federal government only.
2) Out of "federal scientists and engineers", only researchers who are mainly in charge of "research" and "development" as their work have been measured since1998.
3) A part of the Department of Defense has been excluded since 2003.
<Germany>1) The federal government, non-profit institutions (organizations which receives 160,000 Euros or more as public funds), legally independent university research institutes and research institutes run by local governments (Equivalent of local governments).
2) Former West Germany and unified Germany until 1990 and since 1991 respectively.
<France>Scientific and technical research establishment "Etablissement public a caractere scientifique et technologique" (other than CNRS), commercial and industrial research public establishment "Etablissement public a caractere industriel et commercial", administrative research public establishment "Etablissement public a caractere administratif" (other than higher education institutions) and departments and agencies belonging to ministries.
<U.K. >The central government (U.K), decentralized governments (Scotland etc.) and research councils.
<China>Research institutes run by the government.
<Korea>National and public research institutes, government supported research institutes and national and public hospitals.

Source: <Japan>Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"
<U.S.>NSF, "National Patterns of R&D Resources 1996" for 1985,86; NSF, "National Patterns of R&D Resources 2002 data update" for 1987~1997; NSF, "Federal Scientists and Engineers: 1998–2002" for 1998~2002; NSF, "Federal Scientists and Engineers:2003-05" for 2003~2005
<Germany>Bundesministerium für Forschung und Technologie, "Bundesbericht Forschung" 1996,2000,2004, "Research and Innovation in Germany 2007", "Bundesbericht Forschung und Innovation 2008"; OECD,"Main Science and Technology Indicators 2008/2" since 2006
<France, U.K., China, Korea, EU> OECD,"Main Science and Technology Indicators 2008/2"

(2) Researchers in the public organization sector in Japan

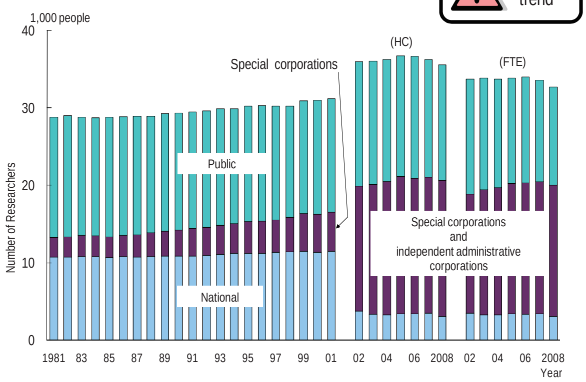
It should be noted that in Japan's public organization sector, part of the "national" research institutes turned into independent administrative corporations in 2001 (furthermore, part of the "special" corporations also turned into independent administrative corporations in 2003). As a result, data since 2002 has had no continuity with the previous data. Given this background, the number of Japan's researchers in the public organization sector was 32,705 people in total in 2008. When examined by type of organization, the number of researchers in "special and independent administrative corporations" accounts for half of the total or 16,993 people, while that in "public" research institutes accounts for approximately 40% of the total or 12,645 people, and that in "national" research institutes accounts for slightly less than 10% of the total or 3,067 people (Chart 2-2-2).

Next the number of researchers by specialty is examined. Specialty here represents a classification by specialized knowledge of individual researchers.

The number of researchers having specialized knowledge in "agriculture" has made up a large proportion consistently, although it is gradually decreasing. Among the types of organization to which they belong, "public research institutes" is at the top in terms of the number of researchers. The number of researchers in the field of "engineering" makes up the second largest proportion. For researchers in the field of "engineering" and "natural sciences", research institutes run by "special and independent administrative corporations" are the main workplaces. Many researchers in the field of "medical sciences" belong to "public" research institutes as well as "national" research institutes (Chart 2-2-3).

Chart 2-2-2: Trend in the number of researchers in the public organization sector in Japan

Attention to trend

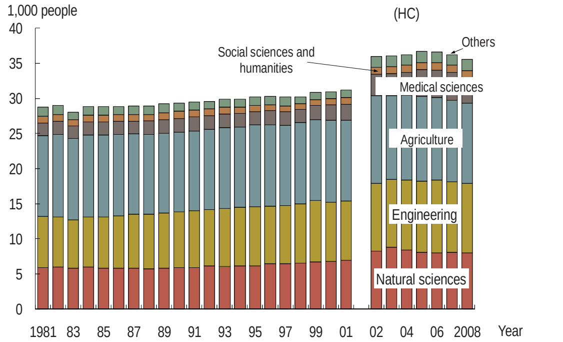


Notes: 1) A part of national research institutes turned into independent administrative corporations in 2001. Therefore it is necessary to be careful when trends in time series are being examined.
2) Values for "special corporations and independent administrative corporations" until 2000 represent values for only "special corporations".
3) Because of the change in the contents and time of surveys, the numbers of regular researchers on Apr. 1 until 2000 and the numbers of researchers on Mar.31, since 2001 were used.
4) Because of the change in measurement methods in 2002, data are interrupted. Refer to Chart 2-1-2 about researchers and measurement methods.

Source: Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"

Chart 2-2-3: Breakdown of researchers in the public organization sector by specialty in Japan

(A) Trend in the number of researchers



(B) Affiliations of researchers by specialty (2008)

(Unit: People)

Field of research	Public Organizations			
	Total	National	Public	Special Corporations and Independent Administrative Corporations
Natural Sciences	7,973	492	1,883	5,598
Engineering	9,924	732	2,629	6,563
Agriculture	11,476	221	7,484	3,771
Medical Sciences	3,490	1,265	1,460	765
Social Sciences and Humanities	1,093	282	261	550
Others	1,662	101	1,257	304
Grand Total	35,618	3,093	14,974	17,551

Notes: Same as for Chart 2-2-2. HC values have been used since 2002.
Source: Same as for Chart 2-2-2.

2.2.2 Researchers in the business enterprise sector

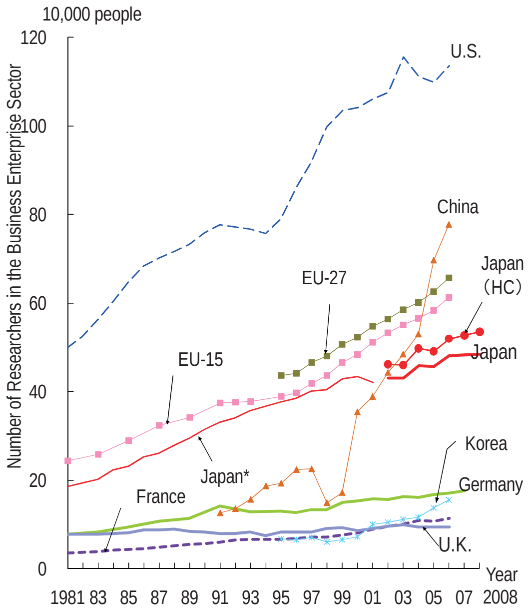
(1) Researchers in the business enterprise sector in each country

The number of researchers in the business enterprise sector is measured by statistical survey on R&D in every selected country. Therefore, the data for this sector is considered to be more suitable for international comparison compared to that for other sectors. The same data, however, can show fluctuation over time. The fluctuation is influenced by the fact that, in each country, the methods and scopes of surveys change when they are adjusted to structural change in industries due to the sophistication of economic activities, and due to the revision of the standard classifications of industries.

The drastic change in the number of researchers in this sector in the U.S. is considered to be caused by a revision in the scope of statistical surveys in 1995, when wider range of enterprises started being included than previously, and researchers in service industries started being measured.

In France and the U.K., part of public organizations were privatized and transferred into the business enterprise sector. Accordingly, the number of researchers in the previous affiliations was added to that in the business enterprise sector although this change is not that noticeable due to the fact that the initial number of researchers in the business enterprise sector already accounts for large proportion (Chart 2-2-4).

Chart 2-2-4: Trends in the number of researchers in the business enterprise sector in selected countries



Notes: FTE values were used.
<Japan>1) Values until 2001 represent the numbers of researchers measured on Apr.1and since 2002 represent the numbers of researchers measured on Mar.31 in corresponding year respectively.
2) Refer to Chart 2-1-3 for what the researchers represent.
3) The industrial classification adopted in the Survey of Research and Development was used based on Japan standard industry classification.
4) As industrial classification was revised, the classification adopted in the Survey of Research and Development was changed in its 1996, 2002 and 2008 versions.
<U.S.>1) SIC were used until 1998 and NAICS has been used since 1999 as the industrial classification.
2) FFRDCs have been excluded since 2001.
<Germany>1) West Germany until 1990 and unified Germany since 1991, respectively.
2) German Industrial classification, "Classification of Economic Activities", was revised in 1993 and 2003.
〈France>1) Classification under the scope of surveys was changed in 1991 and 1992 (France Télécom and GIAT Industries was moved from the government sector to the Business Enterprise sector).
2) The survey method on research personnel in the administration sector was changed in 1997.
3) French industrial classification, "Nomenclature d'activités française ", was revised in 2001 and 2005.
<U.K.>1) Classification under the scope of surveys was changed during 1985 and 1986, and in 2000 ("United Kingdom Atomic Energy Authority" was transferred from the government sector to the business enterprise sector during 1985 and 1986).
2) The Defence Evaluation and Research Agency (DERA) stopped operating in 2000. Three-quarters of it was turned into limited private companies and were transferred to the business enterprise sector.
3) Classification of research institutes was re-classified during 1991 and 1992.
4) British industrial classification, "UK Standard Industrial Classification of Economic Activities", was revised in 1980, 1992, 1997, 2003 and 2007.

Source: <Japan>Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"
<U.S., France, U.K., EU, China, Korea>
OECD, "Main Science and Technology Indicators 2008/2"
<Germany>Bundesministerium für Forschung und Technologie, "Bundesbericht Forschung" 1996,2000,2004, "Research and Innovation in Germany 2007", "Bundesbericht Forschung und Innovation 2008"; OECD, "Main Science and Technology Indicators 2008/2" for the data since 2006

(2) Researchers by industry in each country

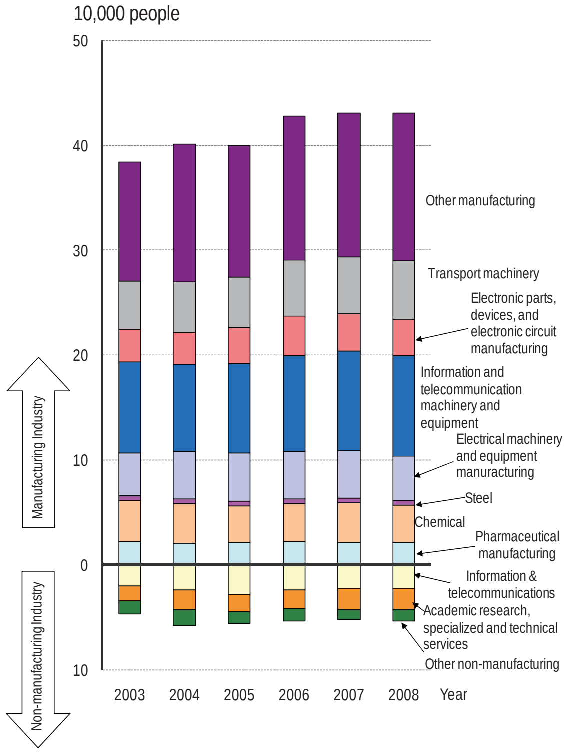
Industrial classification in this section represents what each country established for the statistical survey of R&D in the business and enterprise sector referring to standard industrial classifications. Standard industrial classifications in each country are mostly established consistent with ISIC (International Standard Industry Classifications); however some discrepancies inevitably exist depending on the country. Therefore, with regard to the credibility for international comparison, the level of data using this classification is considered to be low.

Given the background mentioned above, by examining the number of researchers by industry in Japan, the U.S., and Germany, it was found that the number of researchers in the manufacturing industry accounted for a considerably large ratio in Japan. This means that the increase in the number of total researchers was greatly influenced by the manufacturing industry. In the non-manufacturing industry, no significant change was shown. In the U.S., the number of researchers in non-manufacturing industry is remarkably large compared to that in Japan and Germany. In Germany, values are growing both in the manufacturing and non-manufacturing industries.

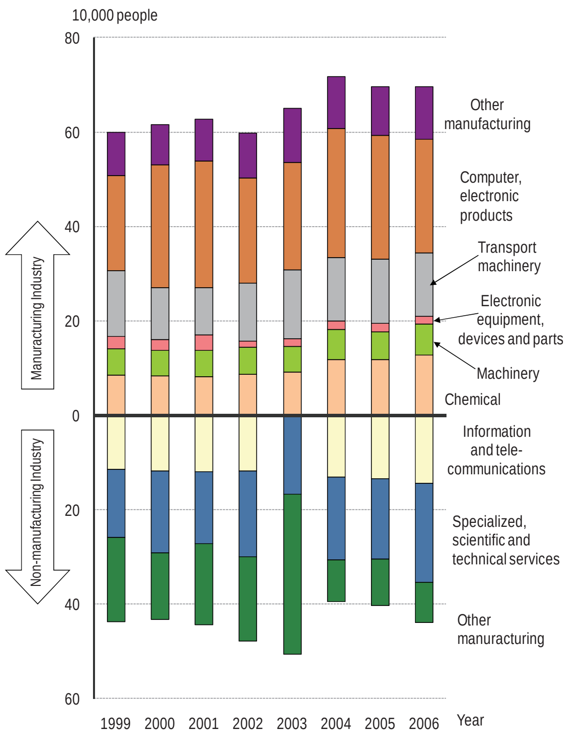
It should be noted that in Germany, the “software industry” and “R&D”, etc. are classified into “real estate, lease and business activities”. Variations in standard industrial classifications like this example should be taken in to account (Chart 2-2-5).

Chart 2-2-5: Number of researchers by industry in each country

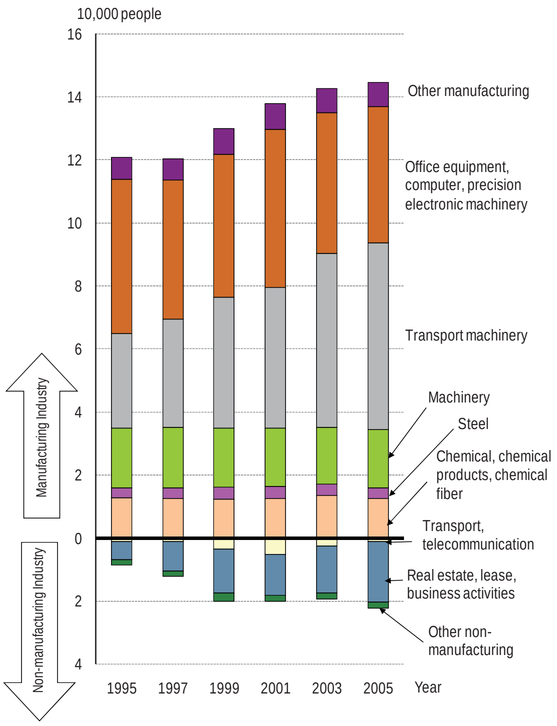
(A) Japan



(B) U.S.



(C) Germany



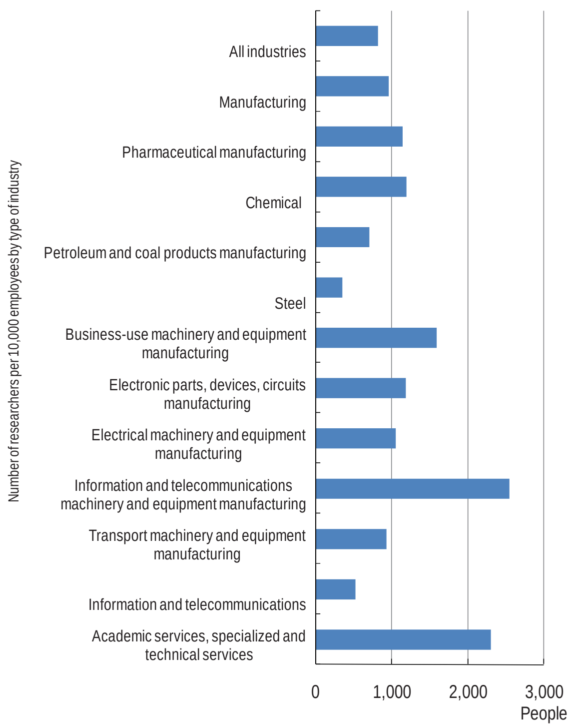
Notes: Same as for Chart 2-2-4.
Source: <Japan>Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"
<U.S.>NSF, "Industrial R&D for each year"
<Germany>BMBF, "Research and Innovation in Germany 2007", "Bundesbericht Forschung und Innovation 2008"

(3) Density of the number of researchers against the total number of employees by industry for Japan

The number of researchers per 10,000 employees (whether or not researchers) was examined in some types of industries picked up in order to understand which types of industries and enterprises employ researchers in Japan. The top position was for the industry of "information and telecommunication machinery and equipment" which has 2,546 researchers followed by the industry of "academic research, specialized and technical service" which has 2,299 researchers (Chart 2-2-6).

The manufacturing industry of "information and telecommunication machinery and equipment" includes the manufacturing industries of telecommunication machinery and equipment, audio and video equipment, electronic computer, etc. The industry of "academic research, specialized and technical services" includes academic institutions such as natural science research institutes.

Chart 2-2-6: Number of researchers per 10,000 employees by type of industry in Japan



Source: Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"

2.2.3 Researchers in the university and college sector

(1) Researchers in the university and college sector in each country

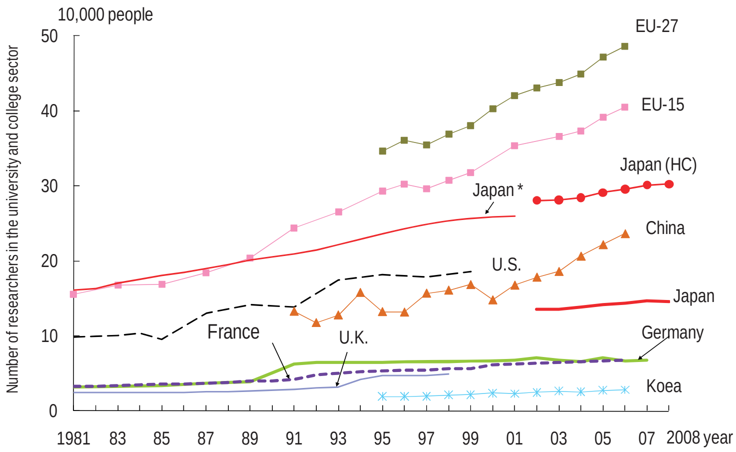
With regard to the number of researchers in university and college sector in each country, international comparison is difficult. The details were described in 2.1.1., and the main points which should be noted are restated below.

① Differences in the method of survey: Some countries use existing data such as statistics on education (statistics measuring teaching staff and students) and on the status of occupations and academic degrees without conducting statistical surveys on R&D. ② Differences in measurement methods: In cases where statistical surveys on R&D are conducted, it is possible to measure the number of researchers on an FTE basis based on questionnaires. However, in cases where the FTE values are measured in accordance with statistics on education etc., the values need to be obtained by multiplying full time equivalent coefficients. Japan is special because it conducts statistical surveys on R&D but does not obtain FTE values in these surveys. ③ Differences in the coverage of surveys: Doctoral degree holders included in researchers in the university and college sector are treated differently in surveys depending on country. For instance, whether or not they receive financial assistance and whether or not full time equivalent coefficients are multiplied depends on each country.

Given the above, next the trend over time by country is examined. In Japan, the number of researchers in the university and college sector was approximately 146,000 people in 2008, and the values have been almost the same since 2000. In Germany, the data since 1991 is influenced by the reunification of East and West Germany. In the U.K., the number of researchers surged during 1993 and 1994. This is considered to be the result of a change in the coverage of surveys due to reform in higher education institutions (the integration of former universities and former polytechnics). In France, the number of researchers has been consistently on the rise. In China, the number of researchers has rapidly increased since 2000. The influence of the policy on science and technology (Project No. 985) is considered to be substantial to this increase. In Korea, the number of researchers is on the rise although the values themselves are small (Chart 2-2-7).

Chart 2-2-7: Trends in the number of researchers in the university and college sector for selected countries

Attention to international comparison



Notes: 1) The definition and measurement method of researchers in the university and college sector is different depending on the country. Therefore it is necessary to be careful when international comparisons are being made. Refer to Chart 2-1-1 for the differences in researchers in each country.
2) FTE values were used.
3) Values are the total of that in the field of the natural sciences and engineering and the field of social sciences and humanities (only that in the field of natural sciences and engineering is included in Korea).
<Japan >1) Faculties in universities (including graduate school courses), junior colleges, university research institutes. etc.
2) Refer to Chart 2-1-3 for researchers.
<U.S. >University & Colleges
<Germany>1) Universities ,Comprehensive universities, Colleges of education, Colleges of theology, Colleges of art, Universities of applied sciences, Colleges of public administration
2) Former West Germany until 1990 and united Germany since 1991. respectively.
<France>French National Centre for Scientific Research (CNRS), Grandes Ecoles (other than those under the jurisdiction of the Ministry of National Education (MEN)), higher education institutions.
<Korea>Universities and colleges offering majors the field of natural sciences and engineering (extension campuses and local campuses are included), university research institutes, university hospitals (only for the case that a medical university and its accounting department are integrated).

Source: <Japan>Ministry of Internal Affairs and Communications, " Report on the Survey of Research and Development"; MEXT , “Survey on the data for full-time equivalents in universities and colleges”
<U.S.>NSF, “National Patterns of R&D Resources 2002” for the data during 1985 and 1995; OECD, “Main Science and Technology Statistics 2008/2” for the data in the other period.
<Germany>Bundesministerium für Forschung und Technologie, “Bundesbericht Forschung” 1996,2000,2004, “Research and Innovation in Germany 2007”, “Bundesbericht Forschung und Innovation 2008; OECD, “Main Science and Technology Indicators 2008/2” for the data since 2006
<France, U.K., China, Korea, EU>OECD, “Main Science and Technology Indicators 2008/2”

(2) International comparison of the number of researchers in the university and college sector for each country

It is true that an international comparison of researchers in the university and college sector is difficult as mentioned above, and inconsistency exists among the figures announced by each country.

The National Institute of Science and Technology Policy examined ways of improving international comparisons in "Comparative Analysis of R&D Inputs and Outputs between Japan and major countries", one of its projects for "Follow-up Studies for Third Science and Technology Basic Plan" in 2008. From this material, part of the data on researchers in the university and college sector is shown below.

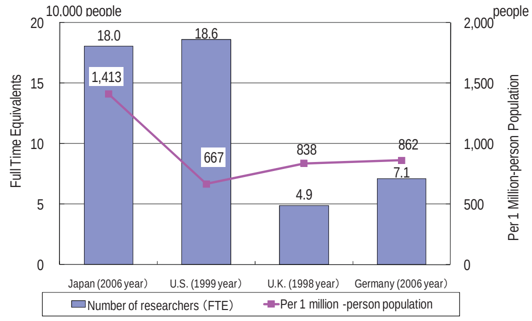
Chart 2-2-8 (A) shows the number of researchers in the university and college sector (FTE) (left axis) and that per 1 million-person population (right axis) publicly announced by the OECD. According to the data, although some inconsistencies among the year of survey exist, the number of researchers in Japan was extremely large and the ratio to population was almost twice larger than the ratio in the U.S.

Next, Chart 2-2-8(B) shows the number of researchers in the university and college sector estimated in accordance with each country's statistics on education. The values in this figure are the result of estimates in accordance with Japan's measurement method of the number of researchers in the university and college sector; in other words, the values were obtained after extracting the data for the breakdown of "regular researchers" which appeared in the "Survey of Research and Development" ("teachers", "doctoral course students in graduate schools", and "medical staff and others") from the statistics on education for each country(7).

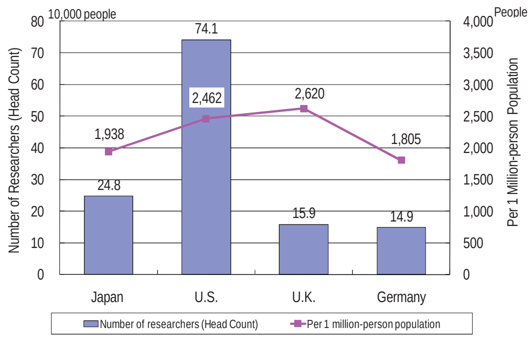
The latter Chart shows that the number of researchers in Japan is approximately one third of that in the U.S. Also, the number of researchers per 1 million-person population is approximately 2,000 to 2,500 people in each country. It is apparent that Japan does not have an especially large number of researchers compared to other countries.

Chart 2-2-8: Number of researchers in the university and college sector

(A) The number of researchers based on the data by OECD (FTE)



(B) The results of the estimate of the number of researchers in accordance with the statistics on education (2006)



Source: NISTEP, "Comparative analysis of R&D inputs and outputs

(7) The following materials were used as statistics on education for each country.
Japan: MEXT , "Report on School Basic Survey"
U.S.: The Integrated Postsecondary Education Data System (IPEDS),
U.K.: The Higher Education Statistics Agency (HESA)
Germany: The Federal Statistical Office (Personal an Hochschulen)

(3) Researchers in the university and college sector in Japan

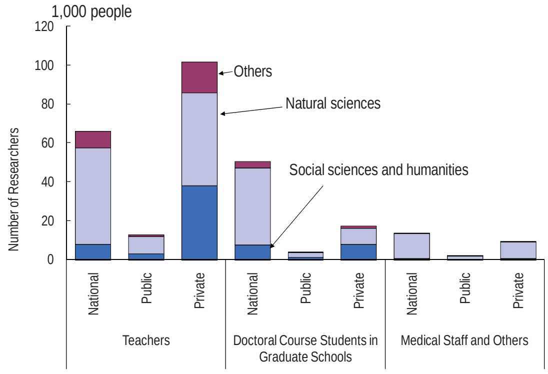
Chart 2-2-9 shows the number of researchers in the university and college sector in Japan by type of researcher, by type of organization, and by academic field of study in Japan. The number of researchers in the university and college sector in this section represents the number of "regular researchers" as stated in the "Report on the Survey of Research and Development", which does not cover external non-regular researchers.

The value of the total was 276,829 people on March 31, 2008, and 65.2% of those or 180,397 people are teachers. The number of researchers in the university and college sector includes "doctoral course students in graduate schools (71,503 people)" and "medical staff and others (24,929 people)". In these statistics, almost all the teachers in universities are measured as researchers(8).

The number of researchers in "private universities" accounts for a large proportion of those categorized as "teachers" and the number of researchers in "national universities" accounts for a large proportion of those categorized as "doctoral course students in graduate schools". More detailed examination shows that the number of researchers of the field of "natural sciences" accounts for the great majority of those in "national universities" and also of "doctoral course students in graduate schools". On the other hand, the number of researchers in the field of "social sciences and humanities" accounts for great proportion of that in the "private universities", and the huge number of researchers in "private universities" was due to the large number of researchers in these fields.

(8) According to the statistics on universities and colleges (MEXT, "Report on School Basic Survey" 2008 version), as of May 1, 2008, the number of regular teachers in faculties of universities combined with graduate schools was 169,914 and in junior colleges was 10,521, respectively.

Chart 2-2-9: Breakdown of the number of researchers in the university and college sector in Japan (2008)



Notes: Values are for universities and graduate schools
Source: Ministry of Internal Affairs and Communications "Report on the Survey of Research and Development"

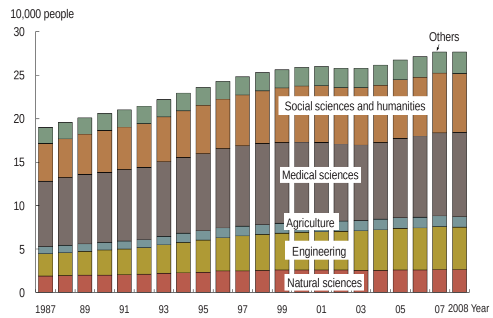
Next, the trend in the number of researchers by specialized field of study was shown (Chart 2-2-10(A)).

The expression "by specialized field of study" here represents "by personal specialized knowledge" and fields which are associated with each researcher's current work are prioritized.

The total number of researchers is increasing, and researchers in the field of "medical sciences" and the field of "social sciences and humanities" account for the main elements of the entire structure. But as far as the proportion of the number of researchers against the total is concerned, the increase in the field of engineering is larger than that in these two kinds of fields.

Chart 2-2-10: Researchers in the university and college sector in Japan

(A) Trend in the number of researchers by specialized field of study



Furthermore, the proportion of researchers by type of university in each specialized field is examined.

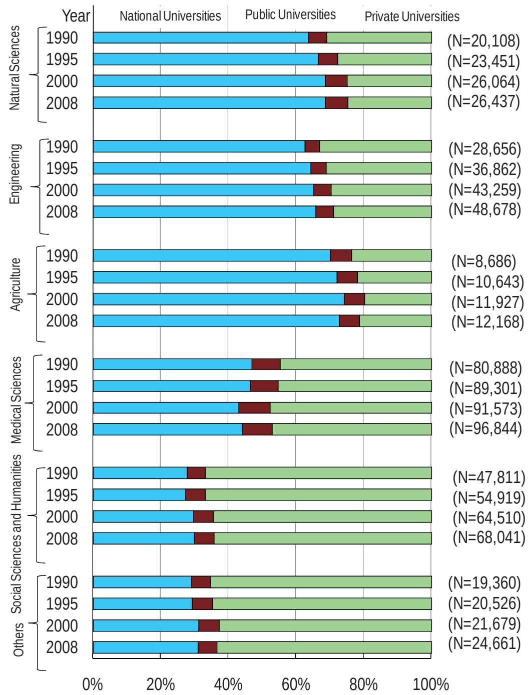
Chart 2-2-10(B) shows the proportion of the number of researchers by type of university, in other words, national, public and private universities, after classifying them by the field of their personal specialized knowledge.

The number of researchers in “national universities” accounts for large proportion or 70 to 80% of the number of researchers with knowledge in the field of “natural sciences”, “engineering” and “agriculture”. With regard to the field of “natural sciences” and “engineering”, the proportion is increasing. On the other hand, the number of researchers in “private universities” accounts for a large proportion of the number of researchers with knowledge in the field of “medical sciences”, “social sciences and humanities” and “others”.

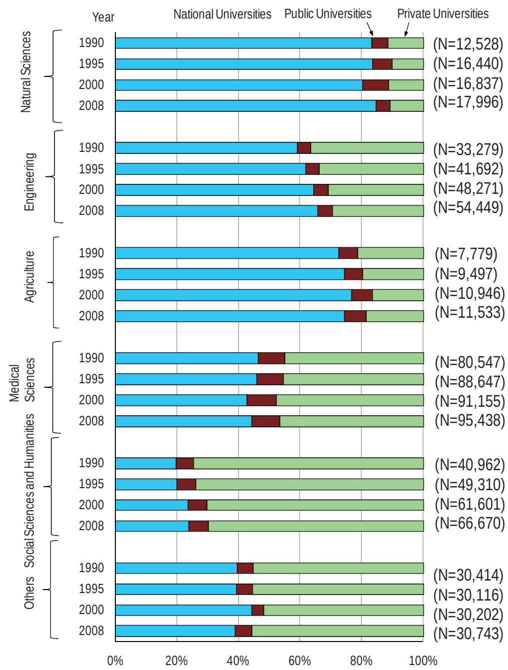
Next, the proportion of researchers by type of university in each field of affiliation (academic field) is examined (Chart 2-2-10(C)). This proportion is almost the same as in the case for each specialized field of study (Chart 2-2-10(B)). But the number of researchers in “national universities” accounts for a substantial 80% or more of those whose affiliation is in the field of “natural sciences”, while the proportion in “private universities” accounts for only approximately 10% of the same.

The fact of the matter is that the number of researchers in “private universities” accounts for 20% to 30% of the number of researchers whose personal specialized field is “natural sciences”. But only approximately 10% of researchers in “private universities” have affiliations related to “natural sciences”. This means that researchers who have specialized knowledge in “natural sciences” in “private universities” do not necessarily have affiliations related to “natural sciences”.

(B) Proportion of researchers by type of university (national, public and private) in each personal specialized field of study



(C) Proportion of the number of researchers by type of university (national, public and private) in each academic field of affiliation



Source: Ministry of Internal Affairs and Communications, “Report on the Survey of Research and Development”

(4) Greater diversity in alma maters of university teachers

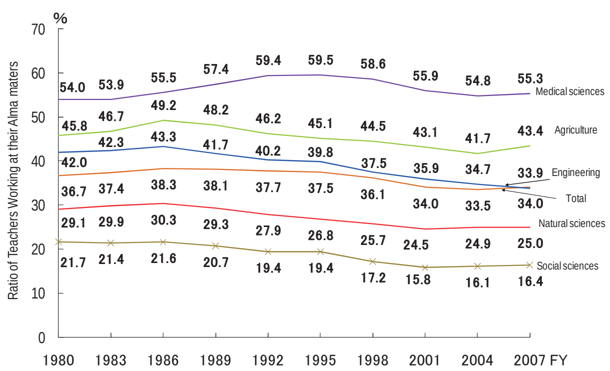
In Japan, traditionally many teachers currently working for a university graduated from the same university. Therefore the diversification of teachers' alma maters is a policy objective.

The average ratio of university teachers working at their alma mater in 2007 was 34.0% against the total, but is decreasing in the long term. Examined by field of study, the number of teachers working at their alma mater accounts for a large proportion or approximately 50% in the field of "medical sciences", and the trend is flat. The proportion has recently decreased in the field of "engineering", and remains flat or increasing in other fields (Chart 2-2-11(A)).

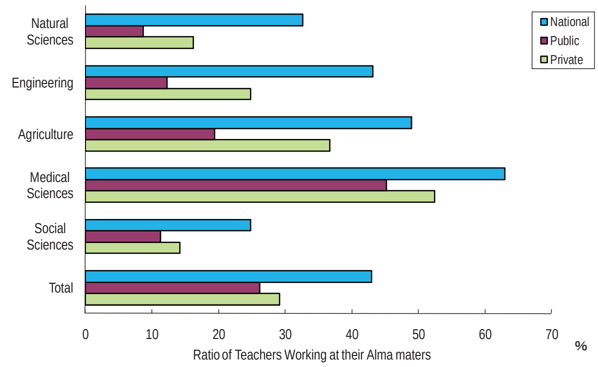
Examined by type of university, the ratio of university teachers working at their alma maters against the total was large in national universities and small in public universities in every specialized field of study. And when examined by field of study, the number of university teachers working at their alma maters accounts for especially large proportion in "medical sciences" in all types of, or national, public and private universities. But in "natural sciences" the number of teachers working at their alma maters was approximately a half in private universities and a quarter in public universities, respectively (Chart 2-2-11(B)).

Chart 2-2-11: Ratio of university teachers working at their alma maters

(A) Trend of ratio by specialized field of affiliated university



(B) Ratios by type of university (FY 2007)



Resource: MEXT, "Statistical Survey on School Teachers"

2.3 Research assistants

Key Points

○With regard to the number of research assistants per researcher by sector, the value is large in the public organization sector and small in the university and college sector in almost all the countries. Especially in Japan, the number of research assistants is so small that the value is approximately a half of that in Germany and France.

○Out of the number of research assistants in the university and college sector in Japan, the number of “assistant research workers” has been flat while that of “clerical and other supporting human resources” is increasing in number.

○Among national, public and private universities in Japan, the number of research assistants per researcher is largest in “national universities”. With regard to the trend by field of study, the number has tended to increase since 2000 in the field of “natural sciences” and “agriculture”.

2.3.1 Status of research assistants in each country

Research assistants tend to be recognized as being peripheral despite the fact that they are important participants in R&D. But both researchers and research assistants are important actors in modern R&D which is being complicated and large-scale and the differences between them should be recognized as a classification simply based on the characteristics of duties.

Each country has its own statistics on the number of research-related human resources including research assistants, but each of the statistics is different, as in the case of the number of researchers. But, “Technical and equivalent staff(9)” and “Other supporting staff(10)” according to the definition of “Frascati Manual” compiled by the OECD correspond to so called research assistants.

Chart 2-3-1 shows the names of elements which comprise “research assistants”. For Japan, France and Korea, the terms found in the questionnaire for the statistical survey of R&D was used. For Germany, the terms in R&D documents were used. For the U.K. and China, the terms in documents compiled by the OECD were used. There was no data for research assistants in the U.S.

Chart 2-3-2 shows the number of research assistants per researcher by sector. In each country, the value is declining in the business enterprise sector. In the public organization sector and the non-profit institution sector, year-on-year fluctuation is significant. Almost no change is shown in the university and college sector.

(9) Technical staff and their equivalent are people who are required to have technical knowledge and experience in one or more fields of study from among engineering, physics and life sciences, social sciences and humanities. They participate in R&D by accomplishing scientific and technical duties related to the application of concepts and practical methods usually under the guidance of researchers. The equivalent staffs accomplish duties related to R&D under the guidance for research in the field of social sciences and humanities.

(10) Other supporting staffs include skilled and unskilled craftsmen, secretaries and clerical staff who participate in R&D projects or are related to those projects.

Chart 2-3-1: Research assistants by sector in each country

Country	Business Enterprises	Universities and Colleges	Public Organizations	Non-profit Institutions
Japan	①Assistant research workers ②Technicians ③Clerical and other supporting personnel	①Assistant research workers (HC) ②Technicians (HC) ③Clerical and other supporting personnel (HC)	①Assistant research workers ②Technicians ③Clerical and other supporting personnel	①Assistant research workers ②Technicians ③Clerical and other supporting personnel
U.S.	NA			
Germany	①technisches personal : Technicians ②Sonstige : Others (specialized labor, assistant labor, clerical staff, etc. directly related to R&D fields)			
France	①Techniciens : Technicians ②Ouvriers : labor ③Administratifs : Clerical staff	Classification by EPST/EPA/other organizations ①Ingénieur d'étude, assistant ingénieur, technicien : Design engineers, assistant engineers, technicians ②Autre personnel : Other personnel Classification by EPIC ①Personnel de soutien technique : Technical assistant personnel ②Personnel de soutien administratif et de service : Clerical and service personnel		
U.K.	①Technicians : Technicians ②Other support staff : other supporting staff			
China	①Technicians : Technicians ②Other support staff : Other supporting staff			
Korea	Assistant research workers ①Research assistant personnel and technical personnel ②Research administration personnel and other assistant personnel	Assistant research workers ①Master's degree students participating in research ②Other assistant personnel (Research management and clerical assistance)	Assistant research workers ①Research assistant personnel and technical personnel ②Research administration personel and other assistant personnel	Assistant research workers ①Research assistant personnel and technical personnel ②Research administration personnel and other assistant personnel

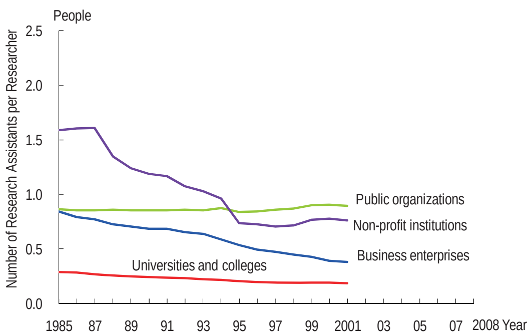
Notes: 1) FTE values were used although values mentioned as (HC) are actual numbers without conversion.
2) No data on the U.S. is available.
3) With regard to the U.K. and China, nomenclature on materials compiled by the OECD was used.

Source: NISTEP, "Metadata of R&D-related statistics in selected countries: Comparative study on the measurement methodology"; Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"; OECD, "R&D Statistics (last updated 2009.2)

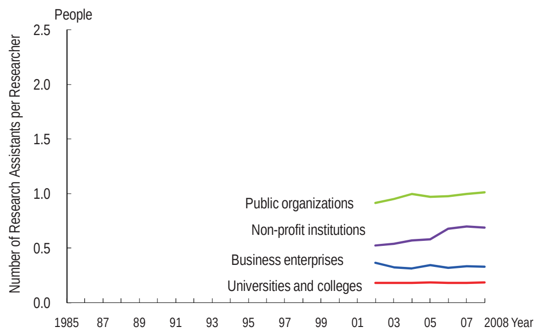
Chart 2-3-2: Trends in the number of research assistants per researcher by sector for selected countries

Attention to international comparison

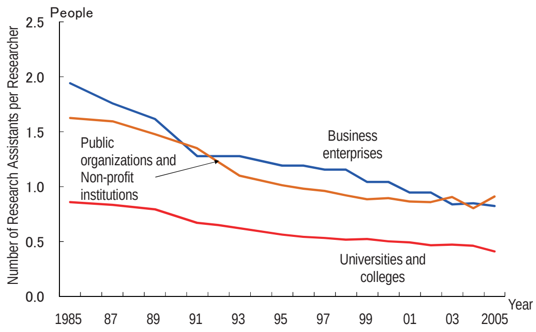
(A) Japan *



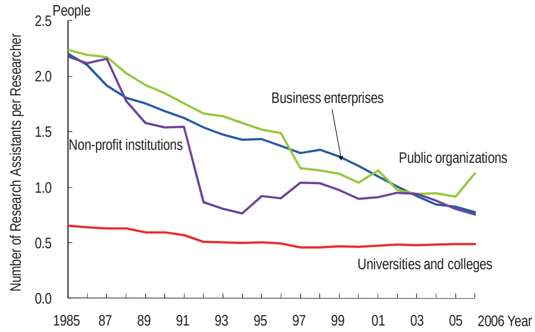
(B) Japan (HC)



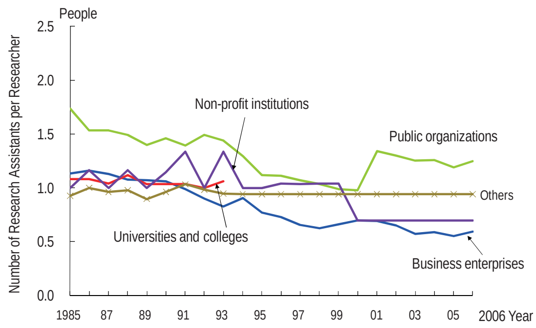
(C) Germany



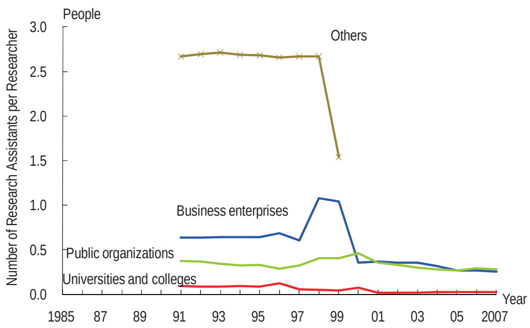
(D) France



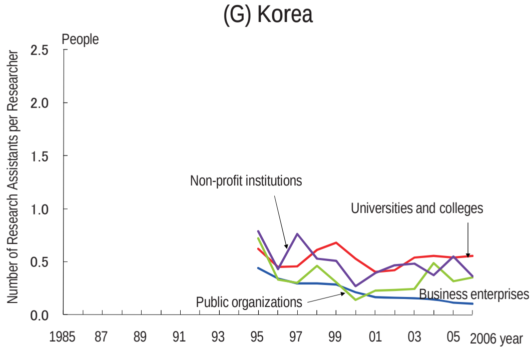
(E) U.K.



(F) China



(G) Korea



Notes:1) The definition and measurement methods of research assistants are different depending on the country or sector. Therefore it is necessary to be careful when international comparisons are being made. Refer to Chart 2-3-1 for the differences in research assistants.
2) The note for researchers is the same as for Chart 2-1-1.
3) FTE values were used in each country. But a part of Japan's data was HC values.
4) "Japan＊" used the values in accordance with Chart 2-1-2(A) (Values represent the number of researchers mainly engaged in research, and were not measured on FTE basis. External non-regular researchers were not covered.)
5) "Japan (HC)" used values in accordance with Chart 2-1-2 (A)③ (the total number of researchers "mainly engaged in research" and "engaged in research under non-regular conditions". The number of researchers in university and college sector includes the number of above mentioned "external non-regular researchers").

Source: <Japan>Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development",
<Germany>Bundesministerium für Forschung und Technologie, "Bundesbericht Forschung" 1996, 2000, 2004, "Research and Innovation in Germany 2007", "Bundesbericht Forschung und Innovation 2008"
<Other countries>OECD,"R&D Statistics(last updated 2009.2)"

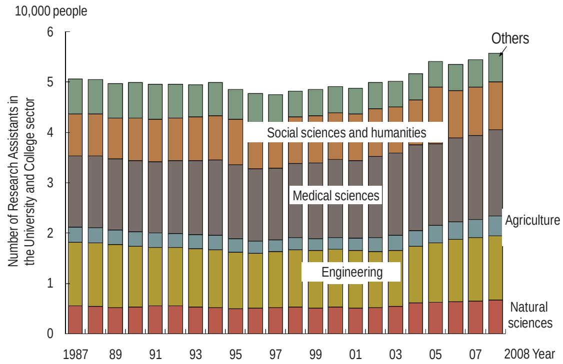
2.3.2 Status of research assistants in the university and college sector in Japan

(1) Breakdown of research assistants

As mentioned in Section 2.3.1., Japan's research assistants consist of "technicians", "assistant research workers" and "clerical and other supporting staff". In this section, details on research assistants in the university and college sector in Japan are examined.

Chart 2-3-3 shows the number of research assistants by the academic field of their affiliation. Their numbers have tended to be on the rise mainly in the field of natural sciences and the field of agriculture since around 2000, and the total for all fields was slightly less than 60,000 people in 2008.

Chart 2-3-3: Numbers of research assistants by academic field of study in the university and college sector



Source: Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"

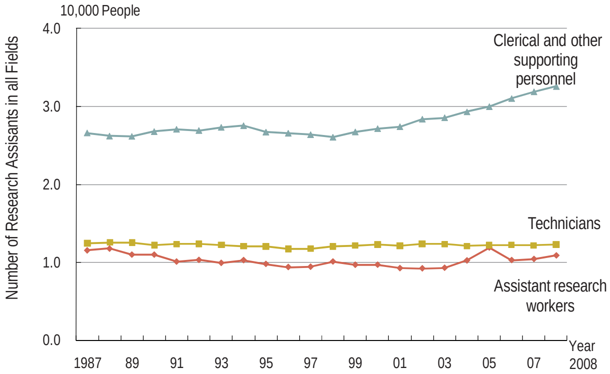
Next, looking at the breakdown of the number of research assistants, the number of "clerical and other supporting personnel", which account for the largest proportion of the total, has been increasing since 2000, and exceeded 30,000 people in 2008 (Chart 2-3-4(A)).

Above mentioned increase seems to have been caused by the revision of a cabinet order on the Act for Securing the Proper Operation of Worker Dispatching Undertakings and Improved Working Conditions for Dispatched Workers in fiscal 1997, which added "research tasks related to sciences" to the list of temporary tasks permitted and as a result enabled temporary researchers to be employed. Another likely cause is a decision in fiscal 2001 to enable research institutes to employ research assistants who are necessary for the accomplishment of the research of science and technology covered by grants in aid.

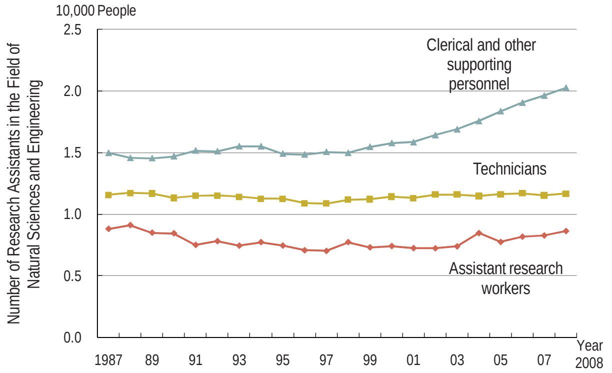
The breakdown of the number of research assistants by the academic field of their affiliation shows that the number of "clerical and other supporting personnel" is highest both in the field of "natural sciences" and the field of "social sciences and humanities" as it was in the breakdown of the total. But the number of "technicians" and "assistant research workers" is substantially larger in the field of "natural sciences" compared to that in the field of "social sciences and humanities" (Chart 2-3-4(B), (C)).

Chart 2-3-4: Breakdown of research assistants by academic field of study in the university and college sector

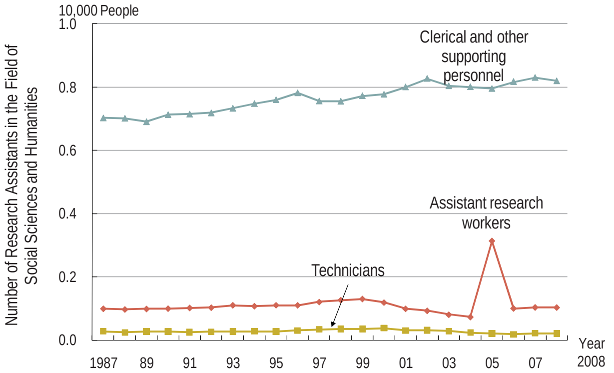
(A) Breakdown of the total



(B) Breakdown of the field of natural sciences and engineering



(C) Breakdown of the field of social sciences and humanities



Notes: 1) Expression "assistant research workers" represent s the people who assist "researchers" and work under the researchers' guidance.
2) Expression "technicians" represents the people who are not categorized as "researchers" nor "assistant research workers" and conduct research related auxiliary technical services under the guidance and supervision of "researchers" and "assistant research workers".
3) Expression "clerical and other supporting personnel" represents the people who are not categorized as "assistant research workers" nor "technicians", and work in general affairs, accounting and miscellaneous affairs.

Source: Ministry of Internal Affairs and Communications, “Report on the Survey of Research and Development”

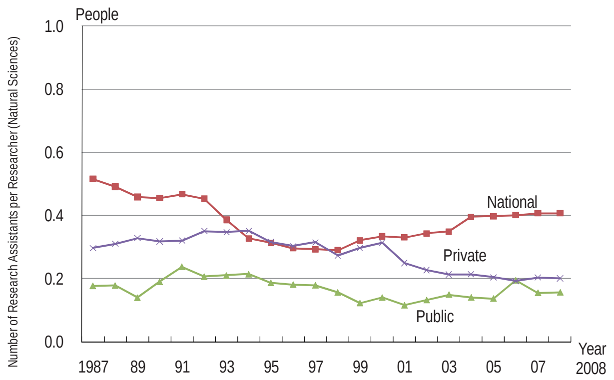
(2) Research assistants per researcher

In this section, the ratio of the number of research assistants per researcher (regular researchers: other than external non-regular researchers) by field of their affiliation is examined in order to determine whether or not the values differ depending on the type of university (national, public and private).

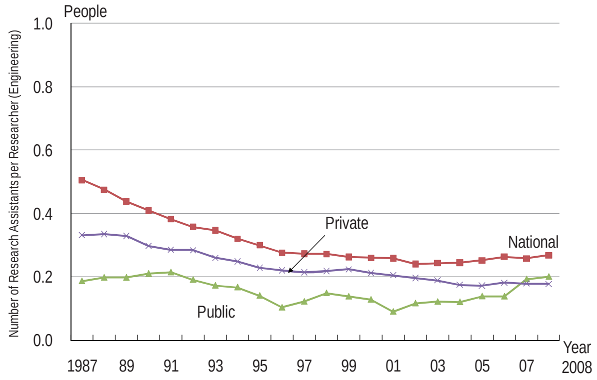
The ratio of the number of research assistants per researcher is large in national universities in every field. In the field of “engineering”, the ratio is decreasing in the long term both in national and private universities. In the field of “medical sciences”, the ratio per researcher is small, and the difference with the ratio per teacher in Chart 2-3-6 is significant. This difference, however, is due to the huge number of “medical staff and others” in this field compared to the other fields. In other words, the large number of researchers or the large denominator, rather than the small number of research assistants, influenced the result (Chart 2-3-5).

Chart 2-3-5: Trends in the number of research assistants per researcher by type of university in each academic field

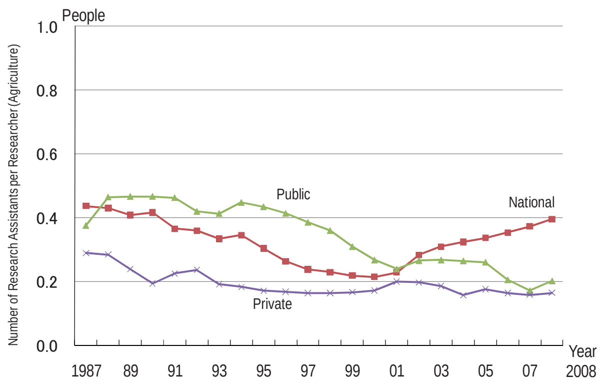
(A) Natural sciences



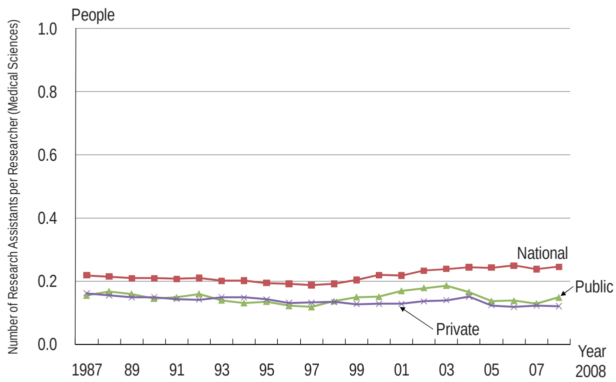
(B) Engineering



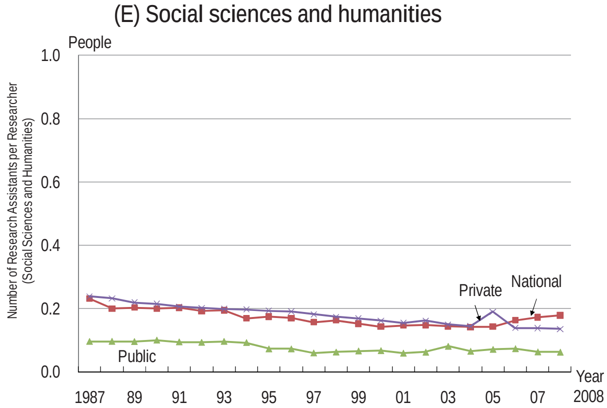
(C) Agriculture



(D) Medical sciences



(E) Social sciences and humanities



Source: Ministry of Internal Affairs and Communications, “Report on the Survey of Research and Development”

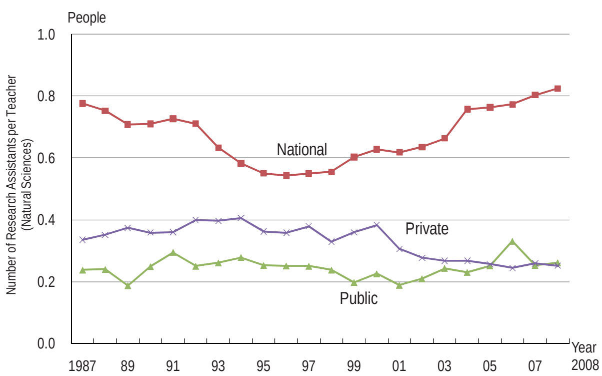
(3) Research assistants per teacher

Regular researchers are composed of ① teachers, ② doctoral course students and ③ medical staff and others, and the proportion of ② and ③ differs depending on the field. Therefore, in this section, ② and ③ were excluded from the coverage on the purpose of removing their influence. And the ratio of the number of research assistants per teacher by field of their affiliation is examined in order to determine whether or not the values differ depending on the type of university (national, public and private).

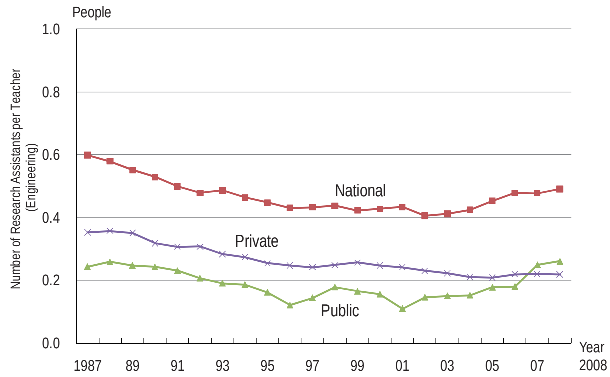
In every field, the number of research assistants is large in "national universities". In addition, the ratio of the number of research assistants in the field of "natural sciences" and "agriculture" of "national universities" have a similar tendency of a decreasing trend until the 1990s which begins to rise in 2000 (Chart 2-3-6).

Chart 2-3-6: Trends in the number of research assistants per teacher by type of university in each academic field

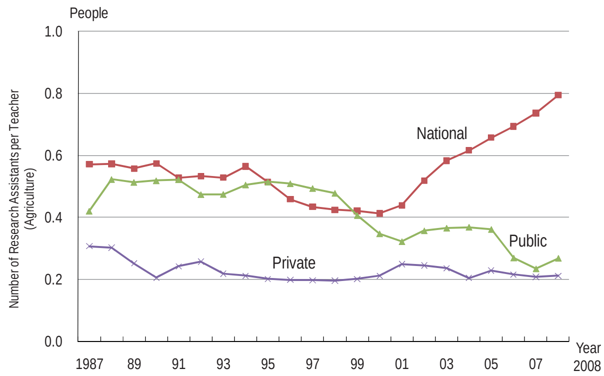
(A) Natural sciences



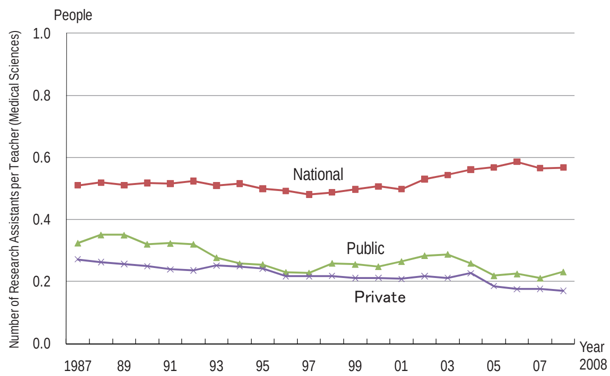
(B) Engineering



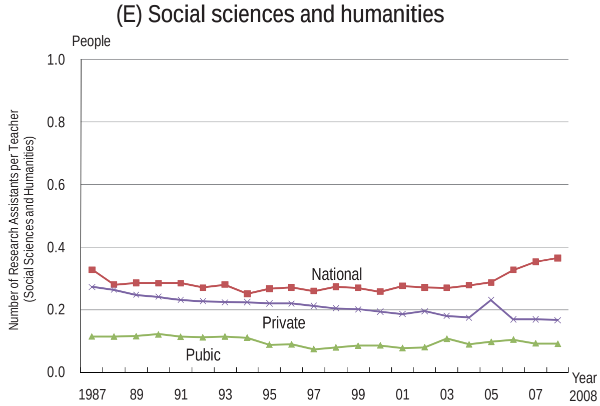
(C) Agriculture



(D) Medical sciences



(E) Social sciences and humanities



Source: Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"

Chapter 3 : Higher Education

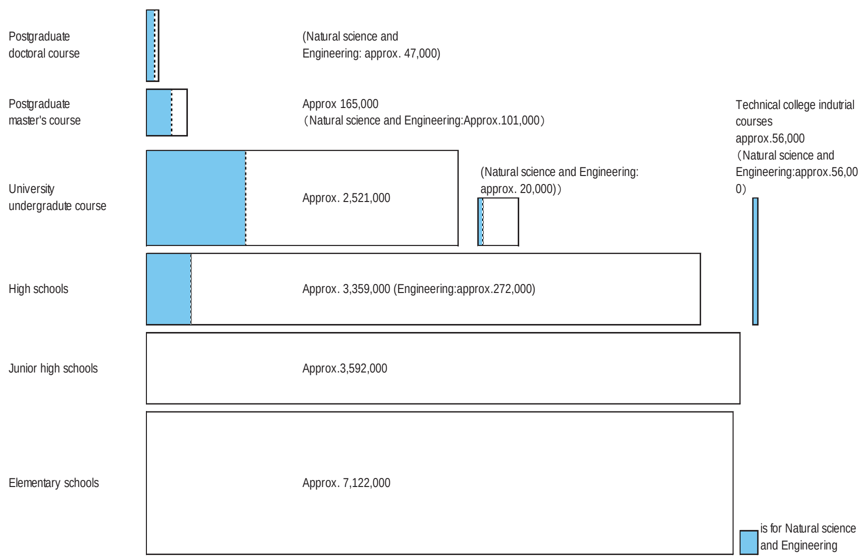
The cultivation of human resources relevant to science and technology is one of the most important basic infrastructures for promoting science and technology. This chapter describes the cultivation of human resources for science and technology in school education, mainly looking at universities and colleges as higher education institutions. Here, an international comparison of the enrollment status at each phase of higher education, career options after graduation or leaving school, the present situation of adult education, and of degree awarded is attempted.

3.1 The status of the number of students in Japan's education institutions

Chart 3-1 shows the total numbers of students and pupils in school education for the year 2008, in order to gain an overall impression of the education system in Japan. The height of each bar in the graph represents the length of time in terms of course terms in each educational institution and the area of each bar of the graph indicates the number of the students and the pupils enrolled there.

The number of children in elementary schools is about 7,122,000, that of pupils in junior high schools are about 3,592,000, and that of high school students are about 3,359,000 (including only the regular courses). The number of undergraduate students is about 2,521,000 (including approx 794,000 in the field of "Natural science and engineering"), and that of college students is about 166,000 (including approx 20,000 in the field of "Natural science and engineering"). The number of master's program students in graduate schools is about 165,000 (including approx 101,000 in the field of "Natural science and engineering") and that of doctoral program students is about 74,000 (including approx 47,000 in the field of "Natural science and engineering").

Chart 3-1: The present status of the number of students and pupils in school education (for the year 2008)



Note: 1) Indicates the breakdown of the number of students and pupils enrolling in the regular courses of each education institution and, of these, the number of students and pupils enrolled in Natural sciences and Engineering (the shaded regions).
2) "Natural sciences and engineering" for universities and colleges or graduate schools is the total of Natural sciences, Engineering, Agricultural sciences, Medical science, and Dentistry and Pharmaceutical science.
3) "Natural sciences and Engineering" in junior colleges means the "Industrial department".
4) The height of each bar in the graph represents the length of time in terms of course terms for each educational institution and the area of each bar of the graph indicates the number of the students and the pupils enrolled.
5) The number of students in the postgraduate master's course and postgraduate doctoral course excludes the students in professional graduate school program.
Source: MEXT, "Report on School Basic Survey"

3.2 The status of students in Higher Education institutions

Key Points

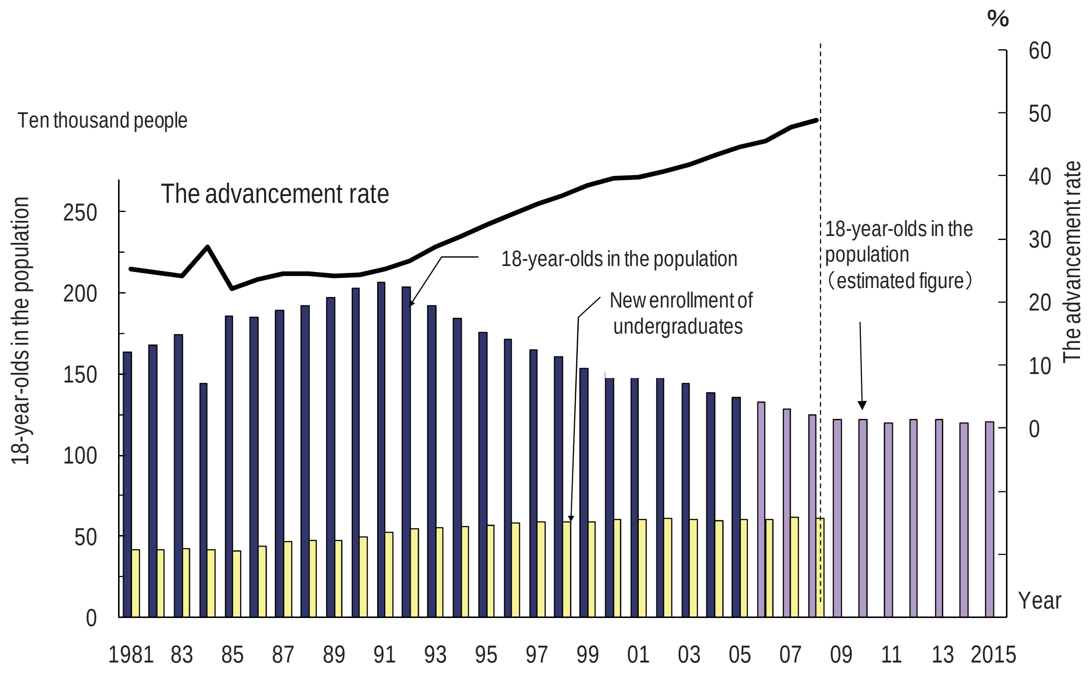
- ○The number of newly enrolled undergraduates in Japan has been roughly unchanged since about 2000, and that for the year 2008 is about 614,000. The numbers newly enrolled in private universities and colleges is high, and constitutes about 80% of the total. When classified by field, the students who major in "Natural science and engineering" are about 30% of the total. Of these, the students who study in national universities and colleges are about 30%, and those in private universities and colleges are about 60%.
- ○The numbers newly enrolled in master's programs has been roughly unchanged since about 2005 and that for the year 2008 is about 77,000. The numbers newly enrolled in national universities and colleges constitutes about 60% of the total. When classified by field, the students who major in "Natural science and engineering" are about 70% of the total. Of these, the students who study in national universities and colleges are about 70%, and those in private universities and colleges are about 30%.
- ○The numbers newly enrolled in doctoral programs has been decreasing since 2003 and was about 16,000 for the year 2008. The numbers newly enrolled in national universities and colleges is high and constitutes about 70% of the total. When classified by field, the students who major in "Natural science and engineering" are about 70% of the total. Of these, about 70% of the students study in national universities and colleges, and the students who study in private universities and colleges are about 20%.

3.2.1 New enrollment of undergraduates

The number of 18-year-olds in the population has been decreasing from about 2,068,000 in 1991, which marked the peak. It is expected that this trend of decreasing will continue and estimated that the numbers will decline to about 1,202,000 in 2015, which 58% of the peak (see Chart 3-2-1).

Under circumstances of young people increasingly wanting to proceed to higher education and an increase in the number of student places, the numbers newly enrolled for undergraduate studies has increased from about 413,000 for the year 1981 to about 607,000 for the year 2008, which represents a growth of 1.5 times. As a result, the advancement rate for the year 2008 (the ratio of the number newly enrolled to the total of 18-year-olds) is 48.8%, which is the highest rate ever.

Chart 3-2-1: 18-year-olds in the population and the transition of the numbers newly enrolled for undergraduate studies



Note: 1) 18-year-olds in the population is by medium estimation.
2) The numbers newly enrolled for undergraduate studies is the number of the students that enroll in universities and colleges in the above mentioned year, and are on the register as of 1st of May in the following year.
3) The advancement rate is the ratio of the numbers newly enrolled for undergraduate studies against 18-year-olds in the population.

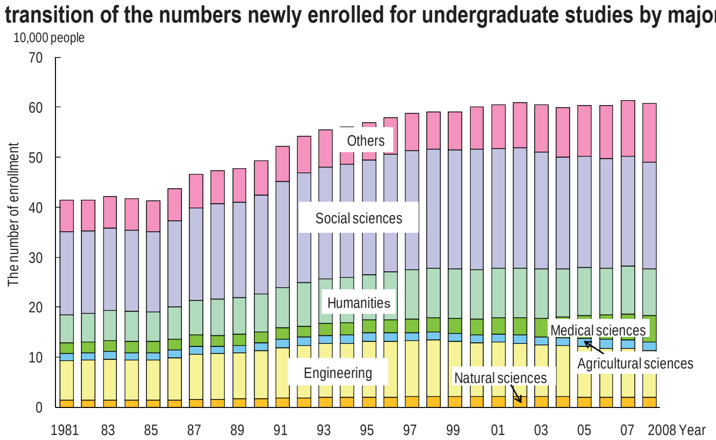
Source: 1) 18-year-olds in the population: <until 2007>Ministry of International Affairs and Communications, Statistics Bureau, "Population Estimates" (as of October in every year).
<After 2008>National Institute of Population and Social Security research, "Population Projections for Japan: 2006-2055, December 2006"
2) The numbers newly enrolled for undergraduate studies: MEXT, "Report on School Basic Survey"

Chart 3-2-2 (A) shows changes in new enrollment of undergraduates by major fields. The new enrollment of undergraduates in Japan has been largely unchanged since the year 2000 and it was about 614,000 in 2008. The breakdown of the new enrollment was followed closely by the field of "Social sciences" (approx 214,000); the field of "Humanities" (approx 93,000); the field of "Engineering" (approx 94,000); the field of "Medical sciences" (approx 53,000), the field of "Natural sciences" (approx 19,000); Others (approx 117,000) and especially the number newly enrolled in The field of "Medical sciences" is 2.4 times compared with that for the year 1981 and also that of "Others" became 1.9 times by comparison.

When the number newly enrolled is sorted by national, public and private universities and colleges (Chart 3-2-2(B)), the new enrollment in private universities and colleges constitutes 80% of the total. The increase in the new enrollment in private universities and colleges has had a profound effect to increase the new enrollment as a whole. And the large number of the new enrollment in private universities and colleges is in the "Social sciences". However, the composition ratio looking at private universities and colleges as a whole shows the trend that "Social sciences" has been decreasing. Meanwhile, the large number of the new enrollment in national universities and colleges is in "Engineering". The increase in "Others" is largely a result of the increase in the new enrollment in "private universities and colleges".

Chart 3-2-2: The numbers newly enrolled for undergraduate studies

(A) The transition of the numbers newly enrolled for undergraduate studies by major fields



(B) The transition of the number newly enrolled is sorted by national, public and private universities and colleges

(Unit: person)

Year	Universities and colleges	Total	Social science and Humanities	Social science	Natural sciences	Engineering	Agricultural sciences	Medical sciences	Mercantile marine	Home economics	Education	Art	Others
1990	Total	492,340	76,115	196,659	16,940	95,401	16,527	21,651	222	9,218	34,946	12,230	12,431
	National	100,991	6,360	15,757	6,419	29,117	7,549	6,047	222	306	22,137	600	6,477
	Public	14,182	2,842	5,346	709	1,739	422	1,233	-	746	342	633	170
	Private	377,167	66,913	175,556	9,812	64,545	8,556	14,371	-	8,166	12,467	10,997	5,784
2000	Total	599,655	98,407	241,275	20,795	107,566	16,147	31,573	174	11,473	32,086	17,395	22,764
	National	103,054	6,969	16,760	7,414	31,792	6,987	8,403	174	292	17,569	600	6,094
	Public	23,578	4,033	7,921	1,004	3,639	685	3,874	-	561	273	812	776
	Private	473,023	87,405	216,594	12,377	72,135	8,475	19,296	-	10,620	14,244	15,983	15,894
2008	Total	607,159	92,925	213,984	19,039	93,594	17,703	52,992	-	16,676	39,703	18,017	42,526
	National	102,345	6,696	15,690	7,270	30,859	7,134	10,382	-	280	16,382	845	6,807
	Public	27,461	4,729	7,826	670	3,429	1,028	5,459	-	638	331	976	2,375
	Private	477,353	81,500	190,468	11,099	59,306	9,541	37,151	-	15,758	22,990	16,196	33,344

Note: The "Others" in (A) are "Mercantile marine", "Home economics", "Education", "Art" and "Others"
Source: MEXT, "Report on School Basic Survey"

3.2.2 New enrollment in master's programs in graduate schools

The number of new enrollments in graduate school master's program for the year 2008 was about 77,000 in all. The breakdown of the major subjects was followed closely by "Engineering" (approx 32,000 (41.0%)); "Social sciences" (approx 8,000 (10.3%)); "Natural sciences" (approx 7,000 (8.6%)); "Medical sciences" (approx 7,000 (8.6%)).

Since there has been greater of focus on graduate schools since the year 1990, the number of new enrollments in master's programs in graduate schools greatly increased between the year 1990 and the year 2000. The rate of the increase was 2.3 times. Looking at this by major subject, the growth of the "Social sciences" was 3.4 times and that of "Medical sciences" was 2.5 times. And regarding from the year 2000 to the year 2008, the ratio of each major subject has stayed at the same level, however, "Medical sciences" increased to 1.9 times. "Others" also increased (Chart 3-2-3 (A)).

Looking at the trend of the number of new enrollments in master's programs by national, public and private universities and colleges, the trend was different from that for undergraduates. National universities and colleges accounted for about 60% of the total. By major subjects, there was a large number of "Natural science and engineering" in national Universities and Colleges, and private universities and colleges have more "social sciences and "Humanities". However, regarding "Medical sciences", the composition of national universities and colleges was 50% of the total, and that of private universities and colleges was also 40% of the total (Chart 3-2-3 (B)).

Chart 3-2-3: The number of new enrollments in graduate school (master's program)

(A) The transition of the number of new enrollments in graduate school (master's program) by major subjects

(B) The transition of new enrollments in graduate school (master's program) is sorted by national, public and private universities and colleges

(Unit：people)

Year	Universities and colleges	Total	Humanities	Social sciences	Natural sciences	Engineering	Agricultural sciences	Medical sciences	Mercantile marine	Home economics	Education	Art	Others
1990	Total	30,733	2,400	2,927	3,291	14,697	2,104	1,376	55	206	2,684	713	280
	National	19,894	829	877	2,359	10,267	1,805	644	55	44	2,420	326	268
	Public	1,190	75	127	142	482	66	130	−	29	5	134	−
	Private	9,649	1,496	1,923	790	3,948	233	602	−	133	259	253	12
2000	Total	70,336	5,251	10,039	6,285	30,031	3,938	3,424	15	486	5,212	1,437	4,218
	National	41,278	1,814	2,929	4,464	19,336	3,297	1,661	15	114	4,564	366	2,718
	Public	3,307	233	389	391	1,178	185	326	−	126	17	246	216
	Private	25,751	3,204	6,721	1,430	9,517	456	1,437	−	246	631	825	1,284
2008	Total	77,396	5,503	8,000	6,628	31,730	4,403	6,626	23	504	4,903	2,039	7,037
	National	44,364	1,633	2,041	4,514	20,492	3,715	3,154	23	74	4,172	514	4,032
	Public	4,597	218	525	514	1,364	126	844	−	121	13	299	573
	Private	28,435	3,652	5,434	1,600	9,874	562	2,628	−	309	718	1,226	2,432

Note: The "Others" in (A) are "Mercantile marine", "Home economics", "Education", "Art" and "Others"
Source: MEXT, "Report on School Basic Survey"

3.2.3 New enrollment in doctoral programs in graduate schools

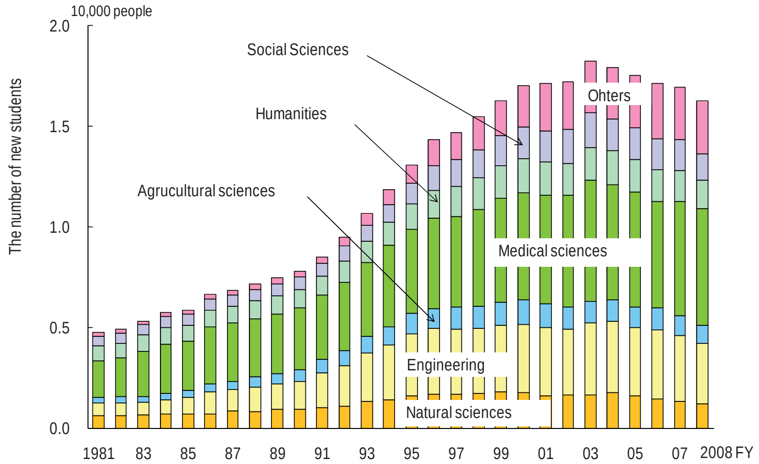
Looking at the number of new enrollments in graduate school doctoral programs, this was 16,000 in all for the year 2008. When compared with 18,000 for the year 2003 which was the highest ever, there has been a 10.8% decrease. The breakdown of the major subjects was followed closely by “Medical sciences” (approx 6,000 (35.5%)); “Engineering” (approx 3,000 (18.4%)); “Natural sciences” (approx 1,000 (7.4%)); “Humanities” (approx 1,000 (8.7%)); “Social sciences” (approx 1,000 (8.1%)).

The number of new enrollments in graduate school doctoral programs has largely increased since the beginning of the 1990s. This resembles the increase in the number of new enrollments in graduate school master’s programs. The number of new enrollments in master’s programs remains unchanged; however, that for doctoral programs has been decreasing since the year 2003 (Chart 3-2-4 (A)).

Looking at major fields by national, public and private universities and colleges, it is national universities and colleges that account for 80% - 90% in “Natural sciences”, “Engineering” and “Agricultural sciences”, and for 60% in “Medical sciences”. It can be said that the ratio of the students who major in “Natural science and engineering” is high in national universities and colleges (Chart 3-2-4(B)).

Chart 3-2-4: The numbers of new enrollments in graduate school (doctoral program)

(A) The transition of the numbers of new enrollments in graduate school (doctoral program) by major subjects



(B) The transition of new enrollments in graduate school (doctoral program) is sorted by national, public and private Universities and Colleges

(Unit: People)

FY	Universities and colleges	Total	Humanities	Social sciences	Natural sciences	Engineering	Agricultural sciences	Medical sciences	Marcantile marine	Home economics	Education	Art	Others
1990	Total	7,813	917	606	929	1,399	580	3,076	-	21	165	24	96
	National	5,170	368	244	776	1,182	522	1,830	-	12	116	24	96
	Public	417	53	31	36	31	16	239	-	6	5	-	-
	Private	2,226	496	331	117	186	42	1,007	-	3	44	-	-
2000	Total	17,023	1,710	1,581	1,764	3,402	1,192	5,339	-	61	373	117	1,484
	National	11,931	761	638	1,461	2,732	1,070	3,710	-	0	246	47	1,266
	Public	941	71	95	126	172	36	364	-	23	9	17	28
	Private	4,151	878	848	177	498	86	1,265	-	38	118	53	190
2008	Total	16,271	1,413	1,325	1,199	3,001	925	5,776	-	85	447	219	1,881
	National	10,846	606	561	1,022	2,399	812	3,649	-	9	329	107	1,352
	Public	1,022	65	78	63	111	23	475	-	33	0	26	148
	Private	4,403	742	686	114	491	90	1,652	-	43	118	86	381

Note: The “Others” in (A) are “Mercantile marine”, “Home economics”, “Education”, “Art” and “Others”
Source: MEXT, “Report on School Basic Survey”

3.2.4 The ratio of female students

New enrollment of female students for undergraduate studies in the year 2008 was 258,000, which accounted for 40.3% of the total and a percentage increase of 17.1 point than that for the year 1981, which was only 23.2% (Chart 3-2-5).

Looking at the situation by department, the majority took "Humanities"; however, the new enrollment that most increased was "Engineering". Although the new enrollment was small, it was approximately 6 times that for the year 1981 (Chart 3-2-5 (A)).

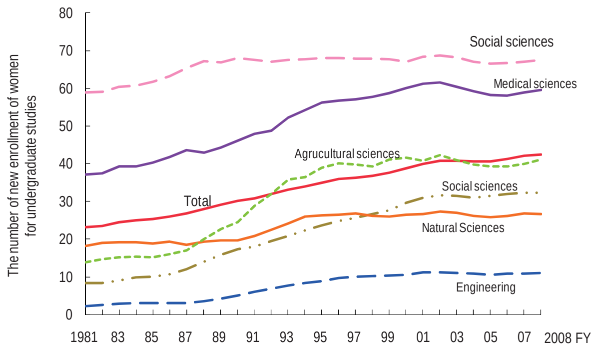
Next, when looking at the percentage of new enrollment by women in master's programs, many take "Humanities" which is the same as in the case of new enrollments for undergraduates. However, the percentage of female students in "Medical sciences" is also high. Although the percentage for the year 1990 was 22.9%, it became 53.0% in 2008, which was more than the percentage of men.

The percentage of new enrollment of female students in doctoral programs for the year 2008 was 30.8%, which was 1.2 points higher than the percentage of new enrollment of female students in master's programs in the same year.

Until the early 1990s, the percentage of new enrollment of women in "Natural sciences and Engineering" had a rising trend. While the trend has slowed down recently, the percentage of women who are entering higher education, such as at master's program or doctoral program level, has been increasing in "Natural sciences and engineering" (Chart 3-2-5 (B)).

Chart 3-2-5: The ratio of new enrollment of female students for undergraduate studies

(A) The transition of the ratio of new enrollment of female students for graduate studies



(B) The transition of the ratio of new enrollment of female students for graduate studies by departments・master's program・doctoral program, major fields and major subjects

(Unit:%)

	FY	Total	Humanities	Social sciences	Natural sciences	Engineering	Agricultural sciences	Medical sciences	Others
Undrgraduate students	1990	30.2	67.9	17.3	19.7	5.1	24.5	46.0	59.1
	2000	38.8	67.1	29.6	26.5	10.5	41.5	60.1	62.6
	2008	42.0	67.5	32.3	26.6	11.1	41.1	59.5	61.1
Master's grpgrams	1990	16.1	46.3	25.2	12.5	3.4	11.8	22.9	41.4
	2000	26.3	55.0	30.8	21.6	9.0	33.9	52.0	46.9
	2008	29.6	60.8	38.7	22.0	10.0	33.3	53.0	47.5
Doctoral programs	1990	15.5	34.0	22.4	7.0	4.6	12.1	14.7	36.6
	2000	26.8	52.5	30.1	15.6	9.9	25.8	27.6	39.3
	2008	30.8	51.2	34.2	16.2	13.5	28.6	32.4	41.6

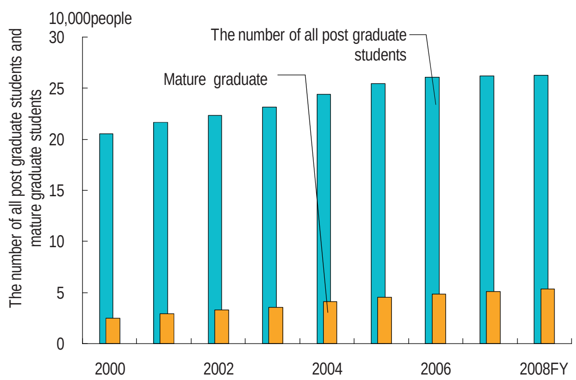
Source: MEXT, "Report on School Basic Survey"

3.2.5 Mature students in higher education institutions

Utilization of higher education institutions to give opportunities for the reeducation of people in the working world who are highly motivated to study is helpful to advance the cultivation of excellent human resources and use them. Moreover, it contributes to energizing society as a whole.

Of all postgraduate students in Japan for the year 2008, the number of working people was 53,667, which accounts for 20.4%. Compared with 12.1% in the year 2000 when statistical data on mature students was first gathered, this is about double (Chart 3-2-6).

Chart 3-2-6: The transition of the number of mature graduate students in Japan

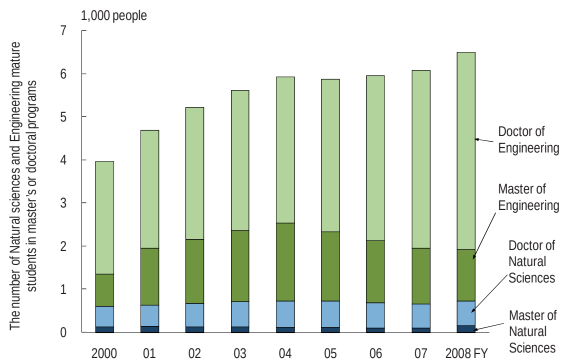


Note: 1) "Mature" is the persons who enter into employment for taking current income such as pay or wage as of May 1st in each year, and include retired employees and house wives.
2) Postgraduate students here are persons who are registered in a master's program and the preliminary term of a doctoral program, or in a doctoral program and the latter term of doctoral program, and in professional graduate schools.
Source: MEXT, "Report on School Basic Survey"

Looking at the number of "Natural sciences" and "Engineering" mature graduate students by degree, those who enrolled in doctoral programs in "Engineering" were 4,569 in 2008, which is more than a 1.75 times increase on those in the year 2000. The number of mature graduate students in master's programs in "Engineering" has been tending to decrease since 2004, and it was 1,198 in 2008, which is one-third compared with the number of mature students in doctoral programs.

Mature students who take doctor's courses in "Natural sciences" were 573 and those who take master's courses in "Natural sciences" were 156 in 2008. Compared with "Engineering", this number is lower and the increase was also only from 1.1 to 1.2 times (Chart 3-2-7).

Chart 3-2-7: The transition of Natural sciences and Engineering mature graduate students



Source: MEXT, "Report on School Basic Survey"

3.3 Career options for students in Natural sciences and Engineering

Key Points

○Looking at career options for undergraduate students in "Natural sciences and engineering" after graduation, students who enter employment are about 60% and those who proceed to higher education are about 30%. When it comes to master's students, those who enter employment are about 90% and those who go on to the next stage of education are about 10%. The percentage of students who head into the workforce has increased during recent years.

○Looking at those who enter employment among the graduates of "Natural sciences and engineering" by industrial classification, in case of undergraduates, the "Manufacturing industry", "Service type industries" and "Others" comprise one-third each. And in the case of master's students, the percentage of students who enter employment in the "Manufacturing industry" is about 60%, and the percentage of students who find employment in "Service type industries" is about 20%.

○Looking at students in undergraduate, master's, and doctoral courses in "Natural sciences and engineering" who enter employment by industrial classification, those, who become "professional and technical workers", account for over 80%. The breakdown shows that many undergraduate students and masters course students become "Engineers". In the case of doctoral students, more enter the academic profession, so that "Scientific researchers" are about 30%, "Engineers" are about 40% and "teachers" are about 20%.

3.3.1 The status of employment and continuing education among students of Natural sciences and Engineering

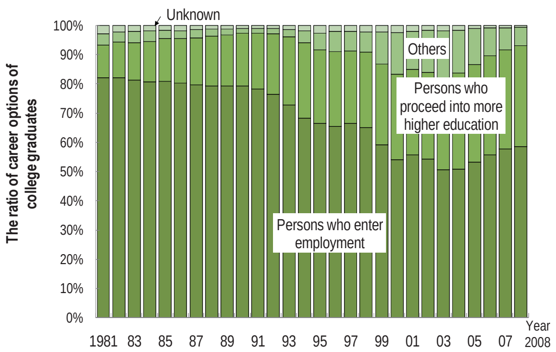
This section describes career options particularly for students of "Natural sciences" and "Engineering". "Persons who enter employment" as used herein represents those who get jobs with routine income. Persons who get temporary or part time jobs are included in "Others". This data was based on a survey of the employment status of students for whom universities and colleges could provide information at the time of the survey being conducted (as of May 1st of respective years).

(1) Career options of college graduates

Looking at the career options of "Natural sciences and Engineering" college graduates for the year 008, the percentage of "persons who entered employment" was 58.5%, which is the biggest share, and that of "persons who proceeded with more higher education" was 34.5% in the second place. Seen in the long term, the percentage of "persons who entered employment" was approximately 80% in the 1980s, however, it largely declined in the 1990s.

Partly due to the influence of upgrading and expanding graduate schools since the late 1990s, the percentage of "persons who proceed to higher education" has been consistently increasing. (Chart 3-3-1)

Chart 3-3-1: Career options of "Natural sciences and Engineering" college graduates



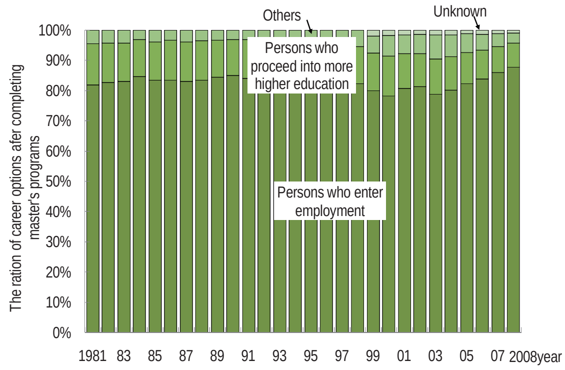
Note: 1) This chart includes both "persons who entered employment" and "persons who proceeded with more higher education" in the "number of persons who entered employment".
2) Persons who entered employment are persons who work for current income
3) Persons who proceeded with more higher education are persons who proceeded to undergraduate schools, etc. Persons who enrolled in special training schools and schools overseas are excluded.
4) Unclear: Deceased/Unknown
5) The others: Do not fall under above mentioned

Source: MEXT, "Report on School Basic Survey"

(2) Career options of persons who complete master's programs

Looking at career options of persons who complete master's programs in "Natural sciences and Engineering" over the long term, the composition ratio did not show a big change until the early 2000s and the percentage of "persons who entered employment" accounted for about 80% of the total. At the beginning of the 2000s, the percentage increased more and it accounted for 87.8% in 2008. The percentage of "Person who proceed to higher education" has been declining in the 2000s and it was 8.0% in 2008 (Chart 3-3-2).

Chart 3-3-2: Career options of persons who complete master's programs in "Natural sciences and Engineering"



Note: Same as Chart 3-3-1

Source: MEXT, "Report on School Basic Survey"

Column: Postdoctoral career options in Natural sciences and Engineering

There are statistics on postdoctoral career options collected in the School Basic Survey, however, it is necessary for this data to be interpreted with care.

Chart 3-3-3 shows "postdoctoral career options for Natural sciences and Engineering". The percentage of "The others" is indicated as higher than that of college graduates and people who complete master's degree programs. "The others" used herein means the sum of "residents", "persons who enrolled in special course schools and schools abroad", "persons who have temporary jobs" and "the other persons who were not applicable to these categories". The following two points are considered as reasons why the percentage of "not otherwise classified" is high.

(1) Influence of the classification of the career options on doctoral graduates

After graduation from a doctoral program, persons who work for universities and colleges or public organizations as doctoral graduates have been increasing. However, it is not clear whether doctoral graduates are included in "persons who enter employment", "persons who got temporary jobs" or "other persons who were not applicable in these categories" in the classification of the career options in School Basic Survey. As the employment patterns of doctoral graduates are diverse, there are some cases in which they are employed on the basis of a few months at a time. Therefore, there is a possibility that some doctoral graduates can be categorized into "persons who got temporary jobs" or "other persons who were not applicable in these categories".

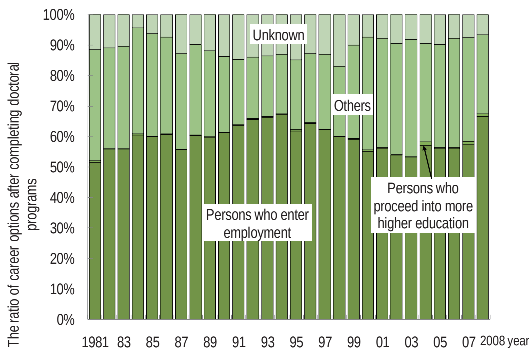
(2) Influence of graduates of doctoral programs whose career path was not decided at the time of the survey being carried out

Different from college graduates and persons who complete master's degree programs, there are many doctoral graduates who aim at academic careers. As for getting into a company, the recruiting time is more or less set. However, academic recruitment occurs throughout the year. Therefore, there are many people, who seek academic careers, who have not still set their career in concrete as of May 1st of the year after graduation, which is scope of target for School Basic Survey. Regarding career options for these people who are not employed or proceed to higher education, they are sorted into "other persons who were not applicable in these categories". Actually, the percentage of "other persons who were not applicable in these categories" in "not otherwise classified" (1,360 persons) for the year 2008 was about 80%, which was the largest.

Moreover, since career options have not been determined at the time of the survey being carried out, there might be some persons who did not reply to the survey (such cases become unknown).

Thus, the percentage of doctoral graduates in Natural sciences and Engineering who enter employment is about 60%, and it can be said that the reason for the percentage of "not otherwise classified" being high is that the career path pattern of doctoral graduates is different from that of college graduates and master's graduates. Based on this data, one should not conclude, for example, that the reason why the percentage of doctoral graduates who enter employment has remained around 60% is because there is mismatch between the ability of doctoral graduates and social needs. Regarding whether there is mismatch between supply and demand, it would be necessary to analyze occupations and industries, in which doctoral degree awarded work, by implementing continuous follow-up surveys on human resources with doctoral degrees as is carried out in U.S.

Chart 3-3-3: Postdoctoral career options in Natural sciences and Engineering



Note: Same as Chart 3-3-1
Source: MEXT, "Report on School Basic Survey"

3.3.2 The employment status of students of Natural sciences and Engineering by industry classification

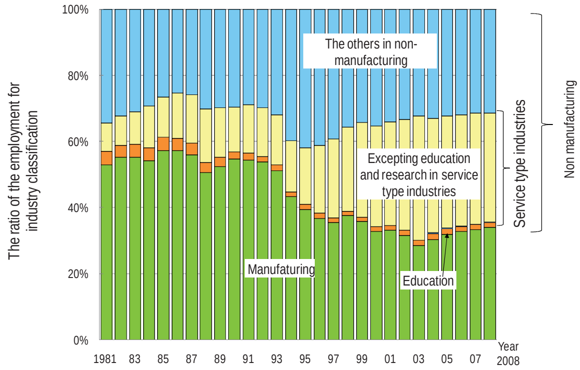
This section shows the place of employment by industry classification of the students described in section 3.3.1, "The status of employment and continuing education among students of Natural sciences and Engineering." The industry classification used herein is the "Japan Standard Industry Classification: JSIC" which determines an industry by the main services of its business enterprises (The revision of JSIC was conducted in 1993, 2002 and 2007 and all were applied from the next year). "Education" as used herein is "school education" and includes elementary schools, junior high schools, high schools and universities and colleges. And "Research" means "Academic and R&D institutes", which refers to business premises doing academic, experimental and R&D research.

(1) College graduates entering employment

Looking at the change in the percentage of college graduates who enter employment by industry classification, the percentage of employment in "Manufacturing" was at the 50% level in the 1980s. However, it has declined to a 30% level in recent years. On the other hand, the percentage of employment in "Service-type industry" of "Non-manufacturing" has increased from a 10% level to a 30% level. And the percentage of employment in "education" in "Service-type industry" has decreased from a 4% level to a 1% level in recent years.

The places of employment of the latest college graduates in Natural sciences and Engineering by industry classification show the almost same percentage for "Service-type industry", "Manufacturing" and "others in Manufacturing" (Chart 3-3-4).

Chart 3-3-4: College graduates in Natural sciences and Engineering entering employment



Note: 1) Includes both "persons who entered employment" and "persons who proceeded with more higher education" in the "number of persons who entered employment".

2) 1981 - 2001

Service-type industry: Service industry in Japan Standard Industry Classification (revised in 1993)

Education/Research: "Education" within the service industry in Japan Standard Industry Classification (JSIC, revised in 1993)

2002 – 2006

Service-type industry: In Japan Standard Industry Classifications (revised in 2002), "Information and communication industry", "Catering establishment, Service industry", "Medical services, Welfare", "Education、Study-support service" excludes "School education": "Combined services", "unclassified other services" excepting "Academic field/R&D"

Education/Research: refers to "School education" within "Education/Study-support services", and "Academic field/R&D" within "unclassified other services".

2007 -

Service-type industry: In Japan Standard Industry Classifications (revised in 2007), refers to "Academic research, Specialty services" excluding "Academic field/R & D institutions": "Lodging industry, Catering establishment", "Living-related services" and "Education, Study-support services" without "School education": "Medical services, Welfare", "Combined services", "unclassified other services" and "Information and communication services"

Education/Research: In Japan Standard Industry Classification (revised in 2007), refers to "Academic field/R&D institutions" within "Academic research/Specialty services": "School education" within "Education/Study-support services"

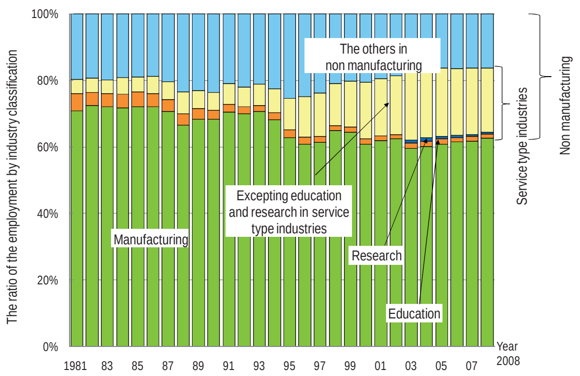
Source: MEXT, "Report on School Basic Survey"

(2) Master's degree program graduates entering employment

Looking at the change in the percentage of graduates from master's degree programs in Natural sciences and Engineering entering employment by industry classification, the percentage of employment in "Manufacturing" was at the 70% level in the 1980s. However, it has undergone a transition to a 60% level in recent years. The percentage of employment in the "Service-type industry" of "Non-manufacturing" has increased from a 10% level to a 20 % level, and "Education" in "Service-type industry" has gone from a 4% level to 1%, which is the same as for college graduates. And "Research" is under 1%.

The places of employment of graduates from master's degree programs in Natural sciences and Engineering recently in "Manufacturing" was nearly 60%, and the other 40% was shared by "Service-type industry" and "Others in Non-manufacturing" (Chart 3-3-5).

Chart 3-3-5: Graduates from master's degree programs in Natural sciences and Engineering entering employment



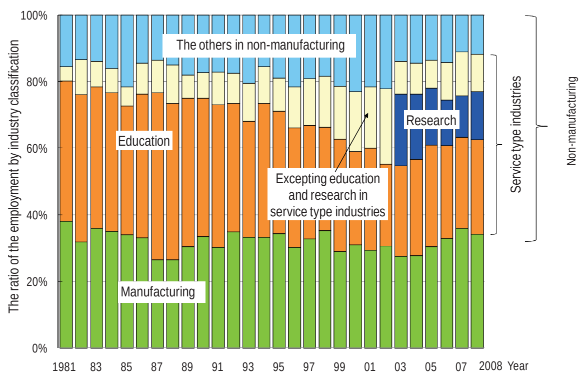
Note: The same as Chart 3-3-4
Source: MEXT, "Report on School Basic Survey"

(3) Doctoral graduates entering employment

Looking at the change in the percentage of doctoral graduates in Natural sciences and Engineering entering employment by industry classification, it was different from the employment status of undergraduate students and master's students. The percentage of employment in "Manufacturing" was approximately 30% and the percentage of "Non-manufacturing" was higher than this. Moreover, the percentage in "Service-type industry" in "Non-manufacturing" was large, at around 50%. Although "Education" in "Service-type industry" went from 40% to 50% in the 1980s, it has declined to less than 30% in the 2000s. And the percentage of employment in "Research" , which has been measured since 2003, was also large. It was 21.5% in 2003, however, it decreased to 14.3% in 2008.

Recent employment of doctoral graduates in Natural sciences and Engineering by industry classification was about 30% in "Manufacturing", around 30% in "Education" and approximately 10% in "Research" (Chart 3-3-6).

Chart 3-3-6: Doctoral graduates in Natural sciences and Engineering entering employment



Note: The same as Chart 3-3-4
Source: MEXT, "Report on School Basic Survey"

3.3.3 The employment status of Natural sciences and Engineering students

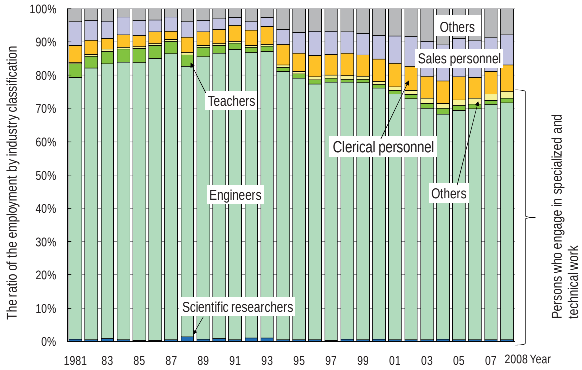
This section shows the place of employment by occupation classification of the students described in section 3.3.1, "The status of employment and education continuance on Natural sciences and Engineering students." Occupation classification referred to herein means the "Japan Standard Occupational Classification" and it classifies individual occupations. Therefore, it is without regard for the business activities of Business enterprises which individuals belong to.

"Scientific researchers" as used herein means "persons who engage in research which requires specialized and scientific knowledge for research and testing in facilities such as laboratories and test stations," and so-called researchers are included in it. "Engineers" mean "persons who engage in scientific and technical work which applies specialized, scientific knowledge and means for production such as project, management, supervision and research." "Teachers" are "persons who engage in education and advocacy for students in facilities which provide education such as schools and kindred class of school education." Teachers at universities and colleges are included in this category.

(1) College graduates entering employment

Looking at the employment percentage of Natural sciences and Engineering college graduates by occupation classification, "persons who engage in specialized and technical work" has changed from 70% to 80% of the total. The breakdown shows a large number of "Engineers", which accounts for 70 % of the total. Persons who engage in "Scientific researchers" have changed to 0.5% of the total (Chart 3-3-7).

Chart 3-3-7: The status of Natural sciences and Engineering college graduates by occupation

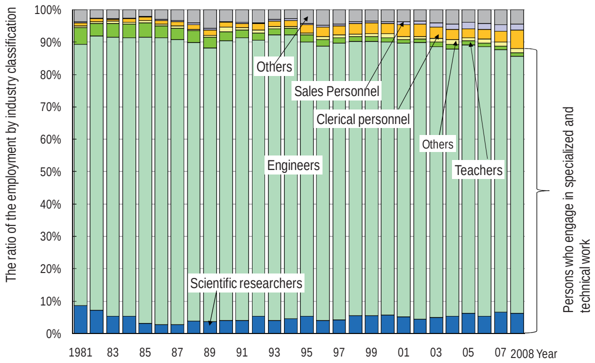


Source: MEXT, "Report on School Basic Survey"

(2) Master's degree program graduates entering employment

Looking at the employment percentage of persons who completed master's program in Natural sciences and Engineering by occupation classification, "persons who engage in specialized and technical work" is approximately 90% of the total and consistently accounts for the large portion. The breakdown shows that "Engineers" is in the 80% range and "Scientific researcher" is in a 5~6% range in recent years. The percentage of "Teachers" has been decreasing in the long term and it is about 1% in these years. On the other hand, "persons who engage in clerical work" has continued to increase slightly (Chart 3-3-8).

Chart 3-3-8: The status of the employment of persons who completed master's program in Natural sciences and Engineering by occupation

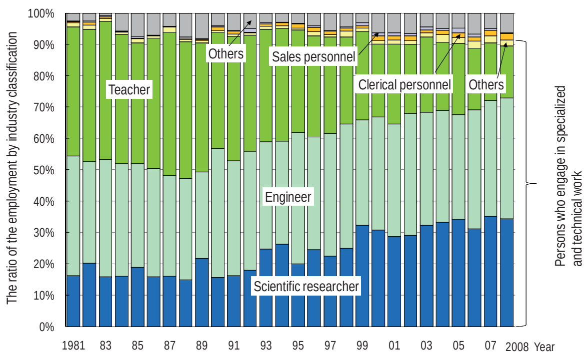


Source: MEXT, "Report on School Basic Survey"

(3) Doctoral graduates entering employment

Looking at the employment percentage of doctoral graduates in Natural sciences and Engineering by occupation classification, "persons who engage in specialized and technical work" comprise a high level of over 90%. The breakdown shows that the percentage of "Scientific researchers" was less than 20% and "Engineers" was consistently 30~40% in 1980s, however, it has changed to around 30% in recent years. On the contrary, although the percentage of "Teachers" used to be 40%, now it has declined to less than 20% (Chart 3-3-9).

Chart 3-3-9: The status of the employment of doctoral graduates in Natural sciences and Engineering by occupation



Source: MEXT, "Report on School Basic Survey"

3.4 International comparison of degree awarded

Key Points

○Looking at the number of persons who have degrees per one million of the population, bachelor's degrees awarded in Japan are about 4,400. This is less than the U.S. and U.K., however, it greatly surpasses Germany and France. Meanwhile, the number of doctoral degree awarded is about 100, which is half as many as that in the U.K. and Germany and falls below that of the U.S. and France.

○When the rate of increase of the number of doctoral degree awarded per one million of the population is compared with the rate of increase during the 10 years from 1995, the U.K. has been enlarged 1.71 times, which has reached approximately the same level as Germany. During these years, Japan has enlarged 1.25 times, which is a higher increase than the U.S. and Germany.

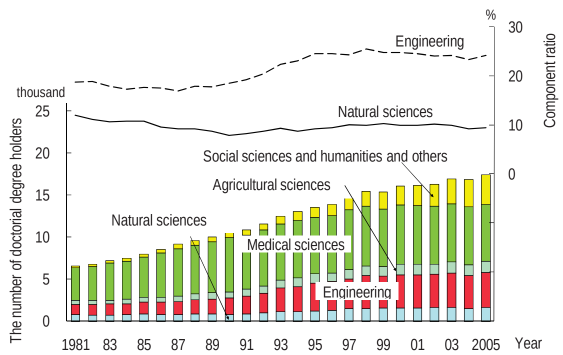
3.4.1 Doctoral degree awarded in Japan

The number of doctoral degree awarded is considered to be as one of important indicators for evaluating the quality of human resources in science and technology.

Chart 3-4-1 shows the change in the number of degrees conferred by major field. Conferral of degrees as used herein is the number of degrees given in the year which is based on degree rules (the so-called new Ph.D. system). This was about 6,000 in the year 1981, however, it has been increasing after that and it reached 17,396 in 2005.

The breakdown by main subjects of special study of the number of degrees conferred in the year 2005 shows that "Medical sciences" (science of medicine, dentistry, pharmaceutical sciences and health science) were 6,760, which accounts for 38.9% of the total. "Natural sciences" were 1,633 (9.4%) and "Engineering" was 4,195 (24.1%).

Chart 3-4-1: The transition of the number of doctorates awarded



Note: 1) "Medical sciences" is for "Science of medicine", "Dentistry", "Pharmaceutical sciences" and "Health sciences".
2) "Education", "Art" and "Home economics" are included in "Education".
Source: Until the year 1986, surveyed by Education Research Center, Hiroshima University "Higher Education Statistical Data (1989)"
After the year 1987, surveyed by MEXT

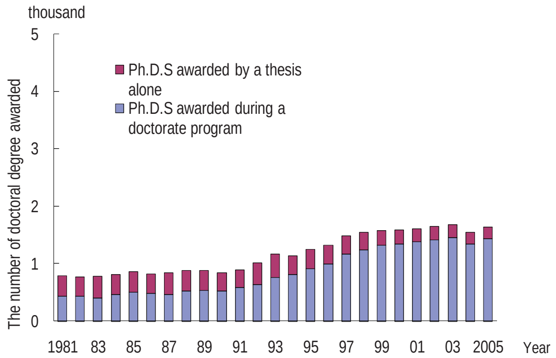
Chart 3-4-2 shows the change in the number of degrees awarded by the breakdown of the number of Ph.D.s awarded during a doctoral program and Ph.D.s awarded by a thesis alone. The number of degrees awarded in "Natural sciences" has been increasing since 1991. Looking at the breakdown of Ph.D.s awarded during a doctoral program and Ph.D.s awarded by a thesis alone, the number of Ph.D.s awarded during a doctoral program exceeds the number of Ph.D.s conferred by a thesis alone throughout the years. Particularly, the increase in the recent number of conferral of degrees is almost entirely brought about by the increase in the number of

Ph.D.s awarded during a doctoral program, the percentage of which has grown to 87.7%.

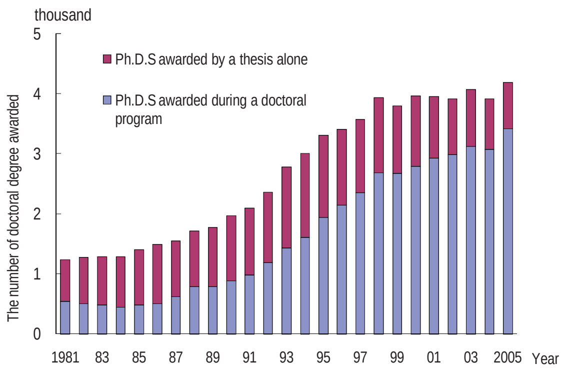
Against this, there has been a strong increase in the number of degrees conferred in "Engineering" since the late 1980s. Looking at the breakdown, the number of Ph.D.s awarded by a thesis alone used to exceed the number of Ph.D.s awarded during a doctoral program. However, recent years the number of Ph.D.s awarded during a doctoral program has increased remarkably, to account for 81.5% of the total in 2005.

Chart 3-4-2: The Change of the number of doctorates awarded (the number of Ph.D.s conferred by a thesis alone/the number of Ph.D.s awarded during a doctoral program)

(A) Natural sciences



(B)Engineering



Source: The same as Chart 3-4-1

3.4.2 International comparison of the number of bachelor's degrees, master's degrees and doctorates degrees awarded

Regarding the number of bachelor's degrees, master's degrees and doctoral degrees awarded per one million of the population by country, persons counted here are those who are considered to be awarded bachelor's degrees, master's degrees and doctoral degrees by Japanese standards, although there are differences in the contents of academic degrees according to the country (refer to notes for details). Therefore, the data on master's degrees awarded in Germany is excluded [(1)].

(1) Bachelor's degrees awarded per one million of the population

When looking at bachelor's degrees awarded per one million of the population, Japan had about 4,400 in 2007. Korea had about 5,900 (in 2007), which was the largest. The second was the U.K., which had about 5,300 (in 2006) and the U.S. which had about 5,000 (in 2005).

Regarding the rate of increase when comparing the figures for 1995 and that of the latest year in each country, the U.K. represents an increase of 1.2 times, which is the largest of the countries, and the second was France. Japan showed an increase of 1.07 times.

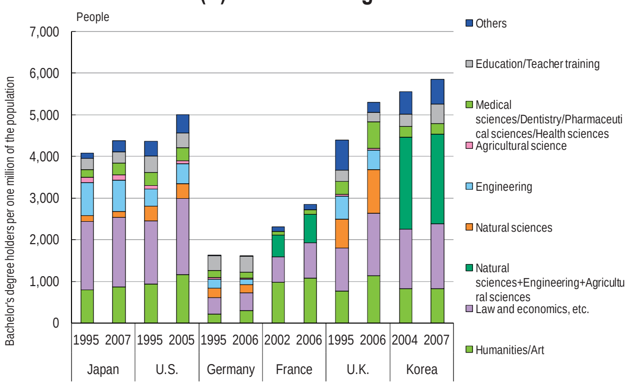
When the percentage of the composition is divided by the subjects of special study, such as "Natural science and engineering" ("Natural sciences", "Engineering", "Agricultural sciences" and "Medical sciences", etc.) and "Social sciences and humanities" ("Social science", "Art", "Law", etc.), each country had a large percentage in "Social sciences and humanities", and this accounts for about 60% in Japan. That of France was particularly high, which accounts for 70%. On the other hand, Korea accounts for 40%,

(1) The number of bachelor's degrees and master's degrees awarded under a newly introduced system in universities and colleges in recent years (Standard term for bachelor's degree is during 3-4 years and that for master's degree is during 1-2 years. However, the total years for college program and master's program are 5 years) are 15,050 for bachelor's degrees awarded and 11,268 for master's degrees awarded in the year 2006 (including degrees awarded in higher professional schools).

which is the same level as "Natural science and engineering". In the U.K., there is little difference between "Natural sciences" and "Engineering" and "Social sciences" and "Humanities", which account for about 40% each.

Chart 3-4-3: The international comparison of the number of bachelor's degrees awarded per one million of the population

(A) Bachelor's degrees awarded



Note: <Japan>Accounted for college graduates as of March in the year represented.
"Others" are "General education course", "International relations" and "Mercantile marine".
<U.S.>Accounted for bachelor's degrees awarded in the year starting from September of the year represented.
"Science of medicine, Dentistry, Pharmaceutical sciences and Health sciences" include "Veterinary medicine". "Others" includes "Military science" and "Interdisciplinary science".
<Germany>The number of successful applicants for Diploma Examination in winter term of the year represented and the summer term of the following year/ Teacher Testing (national exam).
Successful applicants not in Education/Teacher training are also included in "Education/Teacher training"
<France>The number of college graduates in the year represented (calendar year). Bachelor's degree of national universities and colleges (3 years) and first degree in Science of medicine/Dentistry/Pharmaceutical sciences. The number of conferred "Diplome de docteur" (5 – 8.5 years).
<U.K.>Accounted for the number of first degrees awarded from universities and higher education colleges
<Korea>The number of college graduates of March in the year represented.
"Humanities/Art" is for "Humanities" alone, and "Art" is included in "Others".
Source: MEXT, "International Comparison of Education Indicators".
The population of each country is the same as Reference Statistics A.

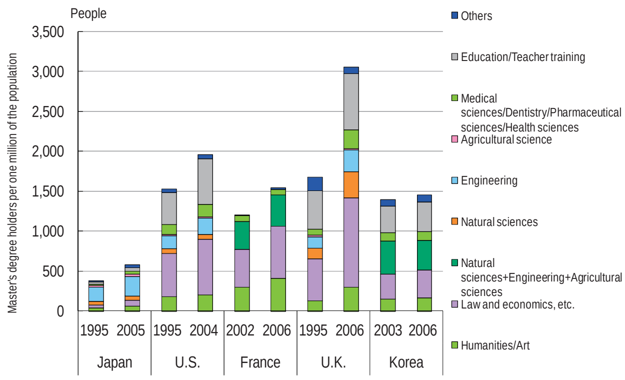
(2) Master's degrees awarded per one million of the population

When looking at the number of master's degrees awarded in each country per one million of the population, Japan marked about 600 (in 2005), which was less than the other countries. U.K. marked the largest figure by far, and U.S. was also large.

When the rate of increase was compared between figures for 1995 and those for the latest year in each country, U.K. showed the remarkable increase, which was 1.82 times, and Japan also increased 1.53 times.

Regarding the percentage of the composition by the subject of special study, Japan had about 60% in the field of "Natural science and engineering", which was the opposite of the ratio for bachelor's degrees awarded. In the other countries, the ratio was almost the same as that of bachelor's degrees awarded.

(B) Master's degrees awarded



Note: <Japan>Accounted for the number of master's degrees awarded from April of the year represented to March of the following year.
<U.S.>Accounted for the number of master's degrees awarded in the year starting from September of the year represented.
<France>The number of master's degrees awarded (5 years) in the year represented (calendar year). Accounted for "Natural sciences", "Engineering" and "Agricultural sciences" together.
<U.K.>Accounted for the number of advanced academic degrees awarded from universities and higher education colleges in the year represented (calendar year).
<Korea>The number of master's degrees awarded from March of the year represented to February of the following year.
Accounted for "Natural sciences", "Engineering" and "Agricultural sciences" together.
Source: The same as Chart 3-4-3

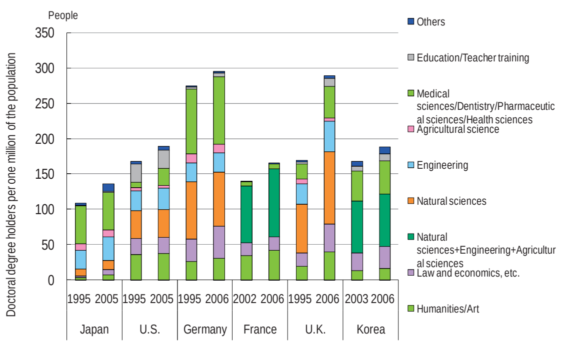
(3) Doctoral degrees awarded per one million of the population

When looking at the number of doctoral degrees awarded in each country per one million heads of the population, Japan had about 136 (in 2005), which is less than in other countries. The number for Germany was 295 (year 2006), which was the largest of the countries. And that of the U.K. was also high, at 289.

Regarding the rate of increase when comparing the figures for 1995 and the figures for the latest year in each country, the U.K. increased greatly, at 1.71 times. Japan increased by 1.25 times, which was next to U.K.

Looking at the percentage of the composition by the subject of special study, in case of doctoral degrees awarded, the ratio of "Natural sciences and Engineering" was large in every country. The ratio of bachelor's and master's degrees awarded in "Social sciences and humanities was high in France, however, as for doctoral degrees, "Natural science and engineering" accounted for about 60%.

(C) Doctoral degrees awarded



Note: <Japan> Accounted for the number of doctoral degrees awarded from April of the year represented to March of the following year.
<U.S.>Accounted for the number of doctoral degrees awarded in the year starting from September of the year represented.
<Germany>Accounted for the number of successful applicants in the examination for doctoral degree in winter term of the year represented and summer term of the following year
<France>The number of doctoral degrees awarded (8 years) in the year represented (calendar year). Accounted for "Natural sciences", "Engineering" and "Agricultural sciences" together.
<U.K.>Accounted for the number of advanced academic degrees awarded from universities and higher education colleges in the year represented (calendar year).
<Korea>The number of doctoral degrees awarded from March of the year represented to February of the following year. Accounted for "Natural sciences", "Engineering" and "Agricultural sciences" together.
Source: The same as Chart 3-4-3

(4) The ratio of students from overseas in the total graduates of higher education

Next, we shall look at which country's higher education is more attractive from the point of the ratio of students from overseas and foreign students in the total graduates of higher education in each country.

Chart 3-4-4 represents the ratio of students from overseas among graduates, after higher education in each country is divided by the OECD's education level classification. Japan showed a lower ratio than the U.S. and U.K. in all classifications. The ratio of Japan's "Advanced research degree program (equivalent to a "doctoral program" in Japan) was 16%, which was higher than Germany's, and other countries' ratio were higher than Japan's for "University-type higher education (the first degree) (equivalent to "undergraduate schools" in Japan)" and for "University-type higher education (the second degree) (equivalent to master's programs).

The U.K. showed the high ratio of oversea students in each level. The ratio for most of the countries was higher in "University-type higher education (first degree)", than in "University-type higher education (second degree)" and "Advanced research degree program", however, in Germany, the "University-type higher education (the second degree)" was the highest.

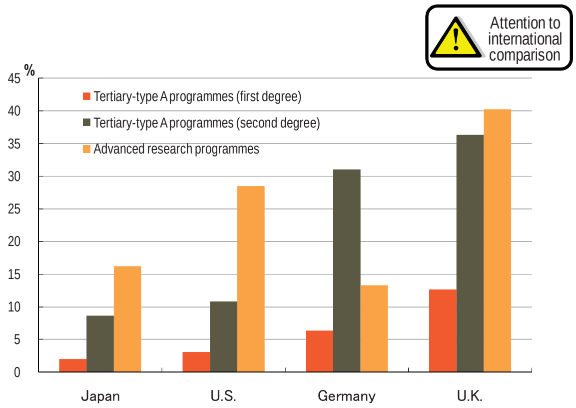
The ratio of oversea students in "University-type higher education (the first degree)" and "University-type higher education (the second degree)" was close in Japan and the U.S. However, the difference in the absolute value [(2)] is large. Regarding "University-type higher education (the first degree)", the number of students from overseas among Japan's graduates (approx 560,000) was about 10,000, and that among the U.S.'s graduates (approx 1,500,000) was approximately 50,000.

Moreover, in "University-type higher education

(2) In OECD source of Chart 3-4-5, only ratio is described.
Therefore, the value is calculated by the graduates of each phase (domestic data).

(the second degree)", the number of students from overseas among Japan's graduates (approx 72,000) was approximately 6,000, and that among the U.S.'s graduates (approx 600,000) was approximately 60,000.

Chart 3-4-4: The ratio of students from overseas in the total graduates of higher education (2006)



Note: 1) Because of the differences in the definition of students from overseas differs in each country, it is necessary to pay attention when making international comparisons
"Students from overseas" of Japan, the U.S. and the U.K. refers to students who do not reside permanently or are not domiciled in these countries.
"Students from overseas" in Germany refers to students who received their last education in another country just before higher education.
2) University-style higher education (First degree), ISCED5A short term: Undergraduate school in Japan's level
3) University-style higher education (Second degree), ISCED5A long term: Master's program in Japan's level
4) Advanced research degree program, ISCED6: Doctoral program in Japan's level
Source: OECD, "Education at a Glance".

Chart 3-4-5 is a ratio listing which represents the top five national origins of students from overseas in each country (the former country of residence or the country where received the last education). The top 5 countries account for 85.5% of all in Japan, and the percentage of Chinese students in it was 66.4%. On the other hand, there was less concentration in other countries toward certain countries, so that the concentration in the top five countries in the U.S. was 51.9%, the U.K. was 36.1% and Germany was 30.1%.

Chart 3-4-5: The national origins and the former country of residence of students overseas and foreign students who are in higher education（2006）

（Unit：%）

	1st	2nd	3rd	4th	5th	Total
Japan	China	Korea	U.S.	Brazil	India	
	66.4	17.2	1.3	0.4	0.3	85.6
U.S.	China	India	Korea	Japan	Canada	
	16.0	13.5	10.5	6.9	5.0	51.9
Germany	China	Poland	Russia	Turkey	France	
	11.6	6.4	5.8	3.4	2.9	30.1
U.K.	China	India	Greece	Ireland	U.S.	
	15.4	5.8	5.4	5.1	4.5	36.1

Note: Since the definition of students from overseas and foreign students differs in each country, it is necessary to pay attention when making international comparisons ①"Foreign students" of Japan and France refers to students who do not have nationality of the host countries. ②"Students from overseas" of the U.S. and the U.K. refers to students who do not reside permanently or are not domiciled in the host countries. ③"Students from overseas" in Germany refers to students who received their last education in another country just before higher education.
Source: OECD, "Education at a Glance".

Chapter 4 : The output of R&D

In recent years, accountability for investments in R&D has become strongly demanded, and understanding the output of R&D has become a major theme. This chapter introduces changes in and features of the world's and main countries' R&D activities, focusing attention on scientific papers and patents as measurable output of such R&D activities.

4.1 Papers

Key Points

○The quantity of papers, which are the output of the world's research activities, has consistently shown an upward trend.

○Research activities themselves have changed from the activities of a single country into joint activities that are conducted by multiple countries. Now international co-authorship papers have increased, and a difference has emerged between the "degree of participation in papers in the world" and the "degree of contribution to the production of papers in the world".

○Regarding the numbers of papers produced in Japan (the average from 2005 – 2007), in terms of the "degree of participation in papers in the world (number counts)" Japan is ranked third in the world, after U.S. and China, and is at the same level as U.K. and Germany. Meanwhile, although in terms of the "degree of contribution to the production of papers in the world (fractional counts)" Japan is third ranked as well, it has more than 1% more than U.K. and Germany in the world share.

○China has increased both in terms of the "degree of participation in papers in the world" and the "degree of contribution to the production of papers in the world" since the late 1990s, and has gone up to second place.

○Looking at the balance of the fields in Japan, the share of Chemistry has decreased and that of Clinical medicine has increased.

○On the other hand, looking at the field portfolios in main countries by world share, Japan has more weight on Chemistry, Material science and Physics, and less weight on Computer science/Mathematics, Environment/Geoscience, Basic biology and Clinical medicine. In U.S. and U.K., there is much weight placed on Basic biology and Clinical medicine.

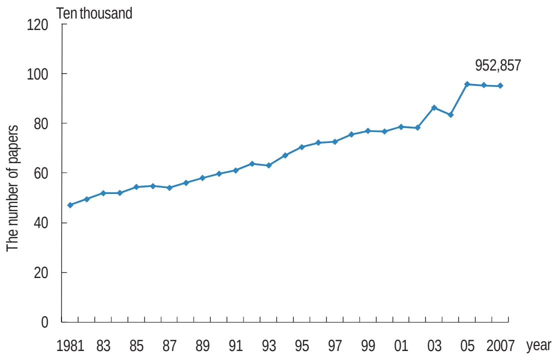
○The percentage of international co-authorship for 2007 was 48% for Germany, 46% for U.K. and 50% for France, while U.S. was 30% and Japan was 24%.

4.1.1 Quantitative and qualitative changes in research activities in the world

(1) The change in the numbers of papers

Chart 4-1-1 shows the change in the quantity of the world's papers. Compared with the early 1980s, the quantity of papers presented in the world has currently reached about double, and the world's research activities have a consistent tendency to expand from a quantitative standpoint today. For this period, journals recorded in Databases, which have been used for analysis, were revised in order of precedence, and the numbers of the journals has been enlarged. This factor is contributing to expanding the numbers of papers as well.

Chart 4-1-1: The change in the numbers of papers in the world



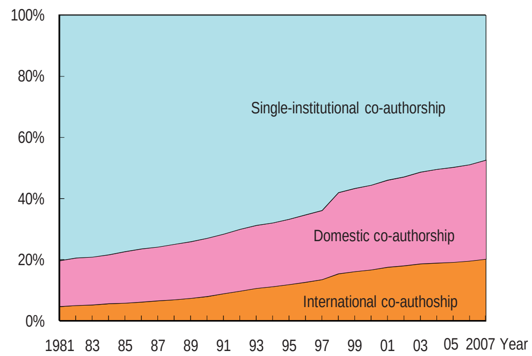
Note: Analyzed article, letter, note, review by number counts
Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

(2) The change in the style of the production of papers

While research activities in the world have moved toward a quantitative expansion, the style of research activities has changed to a large extent. Chart 4-1-2 shows the change in form of the co-authorship of papers in main countries by the three categories: ① Single-institutional co-authorship papers (Papers by authors who belong to a single institute), ② Domestic co-authorship papers (Papers by authors who belong to multiple institutes located in a single country), ③ International co-authorship papers (Papers by authors who belong to institutes located in different countries).

This figure shows that the ratio of single-institutional co-authorship papers has declined, and that of domestic co-authorship papers and international co-authorship papers has increased. In the 1980s, single-institutional co-authorship papers accounted for approximately 80%, however, after that, domestic co-authorship papers and international co-authorship papers increased. It can be said that activities for knowledge production have been done by transcending the framework of institutes and countries.

Chart 4-1-2: The change in the ratio of the co-authorship forms in the world



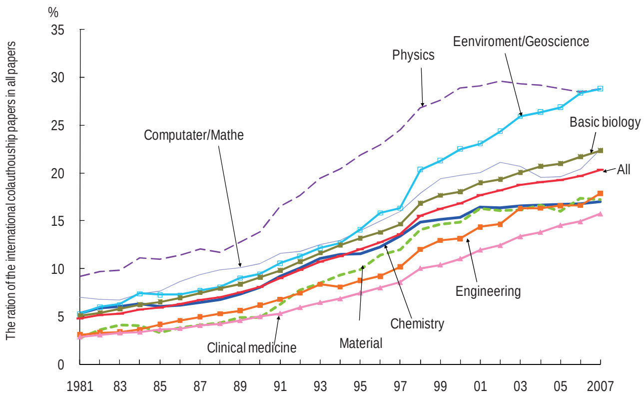
Note: Analyzed article, letter, note, review by number counts
Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

Moreover, since international co-authorship papers are a fruit made from international research cooperation and joint activities, they depend upon the background of each field. For instance, in a case where it is impossible for every country to have large research facilities, joint research is promoted by countries with them becoming core. Chart 4-1-3 shows the change of the ratio on international co-authorship papers by field.

In every field, the share of international co-authorship papers has been on an upward trend from the early 1980s up to the present date. And it can be seen that the share of international co-authorship papers is higher in Physics, Environment/Ecology science, and Geoscience than in the other fields. At the same time, the share of Clinical Medicine is about 13%, which is the lowest share of international co-authorship papers.

Chart 4-1-3: International co-authorship papers by field

(A) The change in the percentage



(B) Classification fields

Category	Consolidated ESI 22 field classification
Chemistry	Chemistry
Material	Material science
Physics	Physics, Space science
Computater/Mathe	Computer science, Mathematics
Engineering	Engineering
Eenviroment/Geoscience	Enviroment/Ecology, Geoscience
Clinical Medicine	Clinical medicine, Psychiatry/Psychology
Basic biology	Agricultural science,Biology・Biochemistry, Immunology, Microbiology, Molecular biology、Genetics, Neuroscience・Behavioristics, Pharmacology・Toxicology, Botany・Zoology

Note: 1) Analyzed article, letter, note, review by number counts
2) Used (B) for the classification fields of (A).
3) Reclassified the papers included in "Web of Science" by ESI22 classification fields and analyzed by field for the classification fields of (B). By http://www.in-cites.com/journal-list/index.html (2007 May) for the classification of journals. Analyzed ESI19 classification fields excluded Economics/Economic & Business, Multidisciplinary and Social science general.

Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

4.1.2 A comparison of research activities by country

(1) A comparison of countries by "the degree of participation in papers in the world" and "the degree of contribution to the production of papers in the world"

As an "easily understandable indicator", the numbers of papers is used for measuring the quantity of a country's capacity for scientific research, and the number of times cited or the number of top 10% papers is applied to indicate quality. Top 10% papers mean papers which the number of times cited (value at the end of 2007) enter into the top 10% in each field. Since average the number of times cited is different for each field, fields are calculated by each in order to standardize differences. The fields are pursuant to Chart 4-1-3.

There are two methods for the calculation (Chart 4-1-4), which are the method of number counts and the method of fractional counts. It is considered that the method of number counts measures "the degree of participation in papers in the world" and that of fractional counts measures "the degree of contribution to the production of papers in the world".

Chart 4-1-5 shows the numbers of each country's papers, that of Top 10% papers and a ranking in the world by applying the method of number counts and fractional counts. Since the numbers of each country's papers is different according to the method of counting, the rankings may be different in each case.

For 1987, differences were not seen on each country's ranking in the world by the method of number counts and fractional counts, however, from 1997 and 2007, it is can be seen that differences have appeared. This is the result of international co-authorship papers having increased.

Chart 4-1-4: The methods of number counts and fractional counts

	Method of number counts	Method of fractional counts
The ways of counting	In the case of international co-authorship papers, 1 is counted for each country. Therefore, when the world shares of the number of papers for each country are summed up, it is over 100%.	In case of international co-authorship papers (for instance, co-authorship by Country A and Country B), the counting is done so that Country A is 1/2 and Country B is 1/2. Therefore, when the world shares of the number of papers for each country are summed up, it totals 100%.
The sorts of targeted papers for	Article, Review, Letter & Note	Article, Review, Letter & Note
The number of papers	Degree of Participation in producing papers in the world	Degree of Contribution to the production of papers in the world
The number of the top 10% papers	Degree of Participation in high impact papers in the world	Degree of Contribution to the production high impact papers in the world

Note: Top 10% papers means the papers which the number of times cited make the top 10% in each field. The fields are made according to the note of Chart4-1-3(B).The value of the end of 2007 is used for the number of times cited.

Chart 4-1-5: The numbers of the papers presented by country and region: Top 25 countries and regions

1985 — 1987 (Average) The number of papers						
Country	Number counts			Fractional counts		
	The number of papers	Share	World rank	The number of papers	Share	World rank
U.S.	187,553	34.4	1	179,059	32.9	1
U.K.	47,591	8.7	2	44,061	8.1	2
Germany	40,645	7.5	3	37,059	6.8	3
Russia	37,431	6.9	4	36,824	6.8	4
Japan	36,909	6.8	5	35,564	6.5	5
France	29,134	5.4	6	26,452	4.9	6
Canada	23,940	4.4	7	21,635	4.0	7
Italy	13,848	2.5	8	12,433	2.3	9
India	13,641	2.5	9	13,128	2.4	8
Australia	11,669	2.1	10	10,800	2.0	10
Netherlands	9,965	1.8	11	8,918	1.6	11
Sweden	9,133	1.7	12	8,064	1.5	12
Switzerland	7,600	1.4	13	6,307	1.2	14
Spain	7,208	1.3	14	6,724	1.2	13
Israel	6,006	1.1	15	5,184	1.0	15
Poland	5,354	1.0	16	4,795	0.9	16
Belgium	5,209	1.0	17	4,461	0.8	17
China	4,882	0.9	18	4,382	0.8	18
Denmark	4,474	0.8	19	3,890	0.7	19
Czechoslovakia	4,106	0.8	20	3,767	0.7	20
Finland	3,512	0.6	21	3,165	0.6	22
South Africa	3,397	0.6	22	3,192	0.6	21
Austria	3,308	0.6	23	2,916	0.5	23
Hungary	2,977	0.5	24	2,592	0.5	24
Norway	2,737	0.5	25	2,395	0.4	25

1985 — 1987 (Average) The number of Top 10% papers						
Country	Number counts			Fractional counts		
	The number of papers	Share	World rank	The number of papers	Share	World rank
U.S.	29,267	56.2	1	27,626	53.0	1
U.K.	5,507	10.6	2	4,833	9.3	2
Germany	3,361	6.5	3	2,793	5.4	4
Japan	3,119	6.0	4	2,926	5.6	3
Canada	2,850	5.5	5	2,436	4.7	5
France	2,562	4.9	6	2,109	4.0	6
Australia	1,324	2.5	7	1,159	2.2	7
Netherland	1,281	2.5	8	1,081	2.1	8
Sweden	1,261	2.4	9	1,054	2.0	9
Italy	1,054	2.0	10	837	1.6	10
Switzerland	1,040	2.0	11	781	1.5	11
Israel	604	1.2	12	452	0.9	12
Denmark	563	1.1	13	441	0.8	13
Belgium	514	1.0	14	382	0.7	14
Finland	344	0.7	15	280	0.5	16
Russia	331	0.6	16	290	0.6	15
Spain	324	0.6	17	260	0.5	17
Norway	281	0.5	18	224	0.4	19
India	278	0.5	19	238	0.5	18
Austria	259	0.5	20	191	0.4	21
New zealand	236	0.5	21	199	0.4	20
China	206	0.4	22	146	0.3	22
Poland	193	0.4	23	141	0.3	24
South Africa	169	0.3	24	143	0.3	23
Brazil	120	0.2	25	85	0.2	25

1995 — 1997 (Average) The number of papers						
Country	Number counts			Fractional counts		
	The number of papers	Share	World rank	The number of papers	Share	World rank
U.S.	233,248	32.5	1	212,713	29.6	1
U.K.	63,827	8.9	2	54,471	7.6	3
Japan	63,724	8.9	3	59,053	8.2	2
Germany	57,204	8.0	4	47,315	6.6	4
France	44,520	6.2	5	36,761	5.1	5
Canada	31,429	4.4	6	26,266	3.7	6
Italy	27,956	3.9	7	23,376	3.3	8
Russia	27,333	3.8	8	23,681	3.3	7
Spain	17,959	2.5	9	15,169	2.1	10
Australia	17,872	2.5	10	15,291	2.1	9
Netherland	17,158	2.4	11	13,753	1.9	13
China	16,728	2.3	12	14,674	2.0	12
India	15,816	2.2	13	14,786	2.1	11
Sweden	13,413	1.9	14	10,576	1.5	14
Switzerland	12,041	1.7	15	8,728	1.2	15
Belgium	8,725	1.2	16	6,570	0.9	18
Israel	8,236	1.1	17	6,582	0.9	17
Poland	7,739	1.1	18	5,946	0.8	20
Taiwan	7,455	1.0	19	6,798	0.9	16
Korea	7,051	1.0	20	6,100	0.8	19
Denmark	6,668	0.9	21	4,994	0.7	22
Brazil	6,391	0.9	22	5,121	0.7	21
Finland	6,078	0.8	23	4,907	0.7	23
Austria	5,825	0.8	24	4,480	0.6	24
Ukraine	4,173	0.6	25	3,500	0.5	25

1995 — 1997 (Average) The number of Top 10% papers						
Country	Number counts			Fractional counts		
	The number of papers	Share	World rank	The number of papers	Share	World rank
U.S.	35,395	51.2	1	31,541	45.6	1
U.K.	7,494	10.8	2	5,811	8.4	2
Germany	6,288	9.1	3	4,637	6.7	3
Japan	5,032	7.3	4	4,309	6.2	4
France	4,605	6.7	5	3,320	4.8	5
Canada	3,872	5.6	6	2,906	4.2	6
Italy	2,728	3.9	7	1,926	2.8	7
Nertherland	2,435	3.5	8	1,771	2.6	8
Switzerland	1,942	2.8	9	1,235	1.8	11
Australia	1,907	2.8	10	1,445	2.1	9
Sweden	1,771	2.6	11	1,243	1.8	10
Spain	1,510	2.2	12	1,078	1.6	12
Belrium	1,021	1.5	13	648	0.9	13
Denmark	952	1.4	14	615	0.9	15
Islael	938	1.4	15	619	0.9	14
Russia	865	1.3	16	439	0.6	18
China	814	1.2	17	582	0.8	16
Finland	757	1.1	18	536	0.8	17
Austria	608	0.9	19	391	0.6	20
Taiwan	484	0.7	20	399	0.6	19
Norway	476	0.7	21	320	0.5	23
India	459	0.7	22	355	0.5	21
Korea	451	0.7	23	331	0.5	22
Poland	405	0.6	24	214	0.3	25
New Zealand	377	0.5	25	267	0.4	24

2005 — 2007 (Average) The number of papers						
Country	Number counts			Fractional counts		
	The number of papers	Share	World rank	The number of papers	Share	World rank
U.S.	282,757	29.6	1	240,462	25.2	1
China	81,639	8.5	2	72,649	7.6	2
Japan	77,248	8.1	3	67,539	7.1	3
U.K.	77,147	8.1	4	56,911	6.0	4
Germany	75,788	7.9	5	55,426	5.8	5
France	54,518	5.7	6	39,471	4.1	6
Italy	43,414	4.5	7	33,938	3.6	7
Canada	42,946	4.5	8	31,922	3.3	8
Spain	32,833	3.4	9	25,511	2.7	9
India	28,519	3.0	10	25,484	2.7	10
Korea	27,583	2.9	11	23,840	2.5	11
Australia	27,473	2.9	12	20,737	2.2	12
Russia	24,219	2.5	13	18,917	2.0	13
Netherland	23,619	2.5	14	16,527	1.7	14
Brazil	18,536	1.9	15	15,484	1.6	16
Switzerland	17,696	1.9	16	10,989	1.1	19
Taiwan	17,472	1.8	17	15,687	1.6	15
Sweden	17,020	1.8	18	11,708	1.2	18
Turkey	15,601	1.6	19	14,305	1.5	17
Poland	14,327	1.5	20	10,940	1.1	20
Belgium	13,260	1.4	21	8,752	0.9	21
Islael	10,414	1.1	22	7,884	0.8	22
Denmark	9,267	1.0	23	6,101	0.6	24
Austria	9,190	1.0	24	6,066	0.6	26
Greece	8,718	0.9	25	6,904	0.7	23

2005 — 2007 (Average) The number of Top 10% papers						
Country	Number counts			Fractional counts		
	The number of papers	Share	World rank	The number of papers	Share	World rank
U.S.	35,166	44.8	1	29,285	37.3	1
U.K.	8,808	11.2	2	5,742	7.3	2
Germany	8,771	11.2	3	5,644	7.2	3
Japan	5,664	7.2	4	4,410	5.6	4
France	5,463	7.0	5	3,361	4.3	6
China	4,779	6.1	6	3,799	4.8	5
Canada	4,581	5.8	7	2,924	3.7	7
Italy	4,153	5.3	8	2,632	3.4	8
Nertherland	3,109	4.0	9	1,898	2.4	9
Spain	2,919	3.7	10	1,893	2.4	10
Australia	2,694	3.4	11	1,755	2.2	11
Switzerland	2,606	3.3	12	1,399	1.8	12
Sweden	1,852	2.4	13	1,053	1.3	14
Korea	1,598	2.0	14	1,198	1.5	13
Belgium	1,544	2.0	15	846	1.1	17
India	1,263	1.6	16	975	1.2	15
Denmark	1,226	1.6	17	675	0.9	18
Taiwan	1,066	1.4	18	860	1.1	16
Israel	1,041	1.3	19	634	0.8	19
Austria	1,012	1.3	20	531	0.7	20
Russia	1,003	1.3	21	430	0.5	24
Finland	879	1.1	22	521	0.7	21
Brazil	849	1.1	23	518	0.7	22
Poland	817	1.0	24	412	0.5	25
Norway	742	0.9	25	393	0.5	27

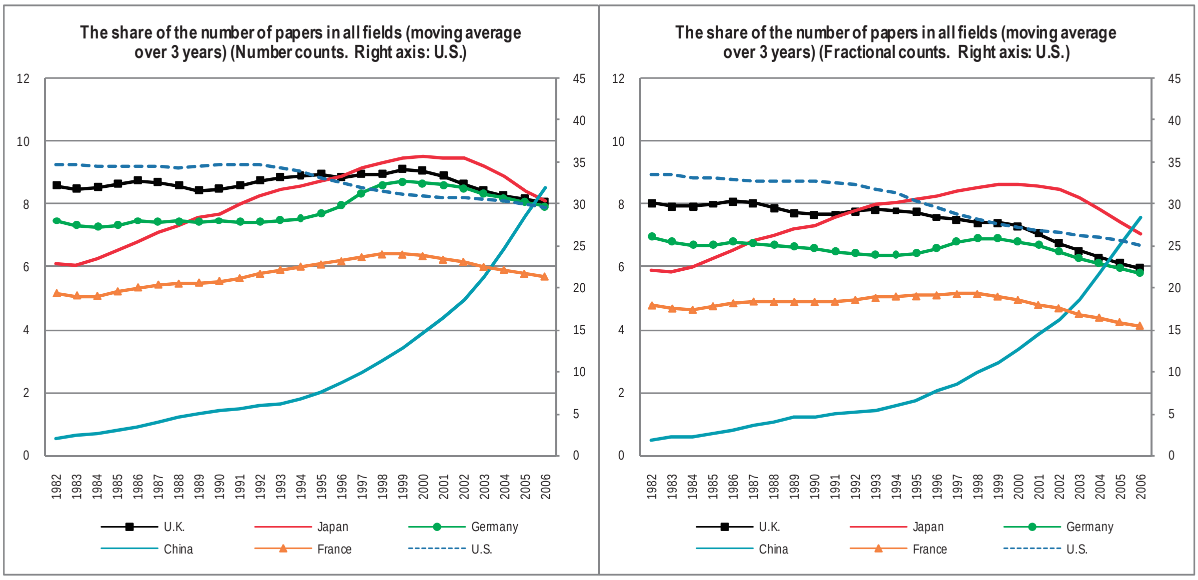
Source: Complied d by NISTEP based on Thomson Reuters Scientific “Web of Science”

(2) A comparison of the share of the numbers of papers

First, Chart 4-1-6 shows the “degree of participation in papers in the world” by number counts and the “degree of contribution to the production of papers in the world” by fractional counts for each country’s share of the numbers of papers, in order to grasp the quantitative aspect of each country’s research activities. Looking at the “degree of participation for papers in the world”, U.S. largely outperforms the other countries and it can be said that U.S. is a country which produces a lot of papers. However, there has been a downward turn since the 1980s. Until the middle of the 1990s, U.K., Japan, Germany and France continued to follow after U.S. However, China has increased the quantity of its production of papers since the late 1990s. Now it has gotten ahead of U.K., Japan, Germany and France and gone up to the world second largest producing county in the average from 2005 to 2007.

On the other hand, Japan became the world second largest in terms of the “degree of contribution to producing papers in the world” after 1990, and maintained the same position for over 15 years. However, it was surpassed by China and became the world third largest country in the average from 2005 to 2007. It can be seen that Japan had about 1% more than U.K. and Germany.

Chart 4-1-6: The change in the share of the numbers of papers in main countries (All fields, moving average over 3 years)



Note: Moving average over 3 years of the share of the papers in all fields (if the year is 2006, the average value from 2005 to 2007). (A) is number counts; (B) is fractional counts.
Source: Compiled by NISTEP based on Thomson Reuters Scientific “Web of Science”

(3) A comparison of the numbers of Top 10% papers and the number of times cited

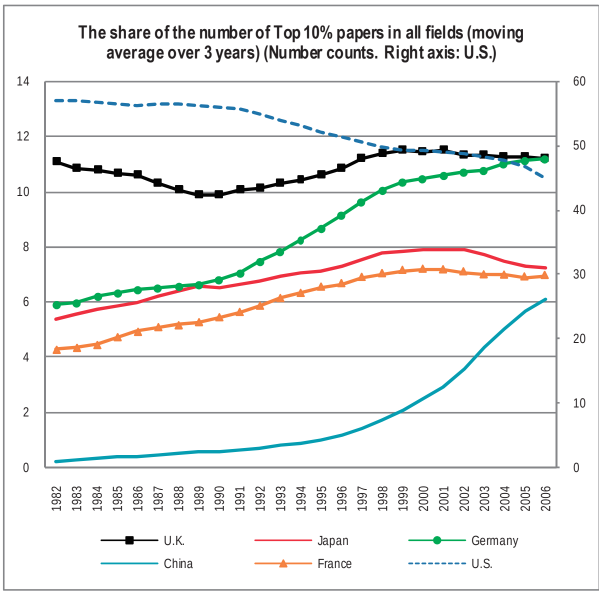
Next, to understand the qualitative aspect of each country's research activities, Chart 4-1-7 shows the "degree of participation in high impact papers in the world" by number counts and the "degree of contribution to the production of high impact papers in the world", in which the share of the numbers of each country's Top 10% papers is calculated by the method of fractional counts. Regarding the "degree of participation in high impact papers in the world", U.K. and Germany have sharply increased their share since the 1990s, and gotten a big lead on Japan.

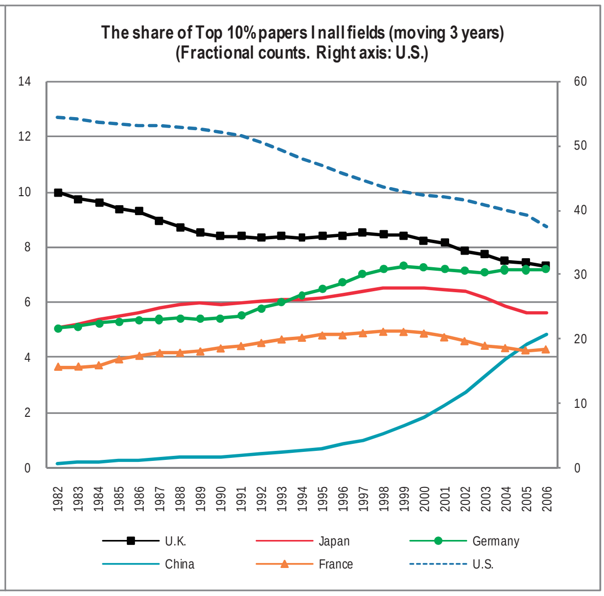
On the other hand, regarding the "degree of contribution to the production of high impact papers in the world", U.K. has had a downward turn over the past 20 years, and Germany has moderately increased its share. Currently, there does not seem to be big differences in the degree of contribution to generating important knowledge between Japan, U.K. and Germany.

Chart 4-1-7: The change in the share of the numbers of Top 10% papers in main countries (All fields, moving average over 3 years)

(A) The degree of participation in high impact papers in the world

(B) The degree of contribution to the production of high impact papers in the world





Note: Moving average over 3 years on the share of the papers in all fields (if the year is 2006, the average value from 2005 to 2007). (A) is number counts; (B) is fractional counts.
Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

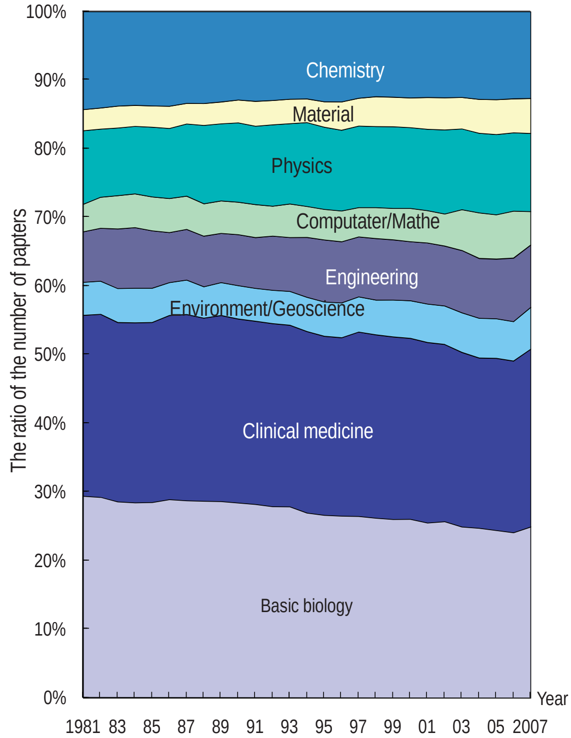
4.1.3 The characteristics of the research activities of main countries

(1) The ratio of the numbers of papers in the world and main countries by field

While there are a variety of fields of research activities, the number of papers and the number of times cited are influenced by whether emphasis is placed on the production of papers in each field of research activities, by whether the number of researchers is large or small, and by whether the numbers of past papers that each paper refers to is large or small on average. Therefore, in the case of comparing countries, it is also important not only to look at the total number of papers and the number of times cited but also to understand the research activities of each field. Here, the method of number counts is used in order to see the percentage of each field in the world and for every country.

First, Chart 4-1-8 shows the change in the ratio of the numbers of papers which each field occupies throughout the world. Comparing the 1980s with nowadays, the ratio of Basic biology and Chemistry has slightly declined and Material science, Computer science/Mathematics, Engineering, Environment/Ecology science, Geoscience have somewhat increased. However, Life sciences such as Basic biology and Clinical medicine account for approximately half of papers, and a large shift in characteristics cannot be seen.

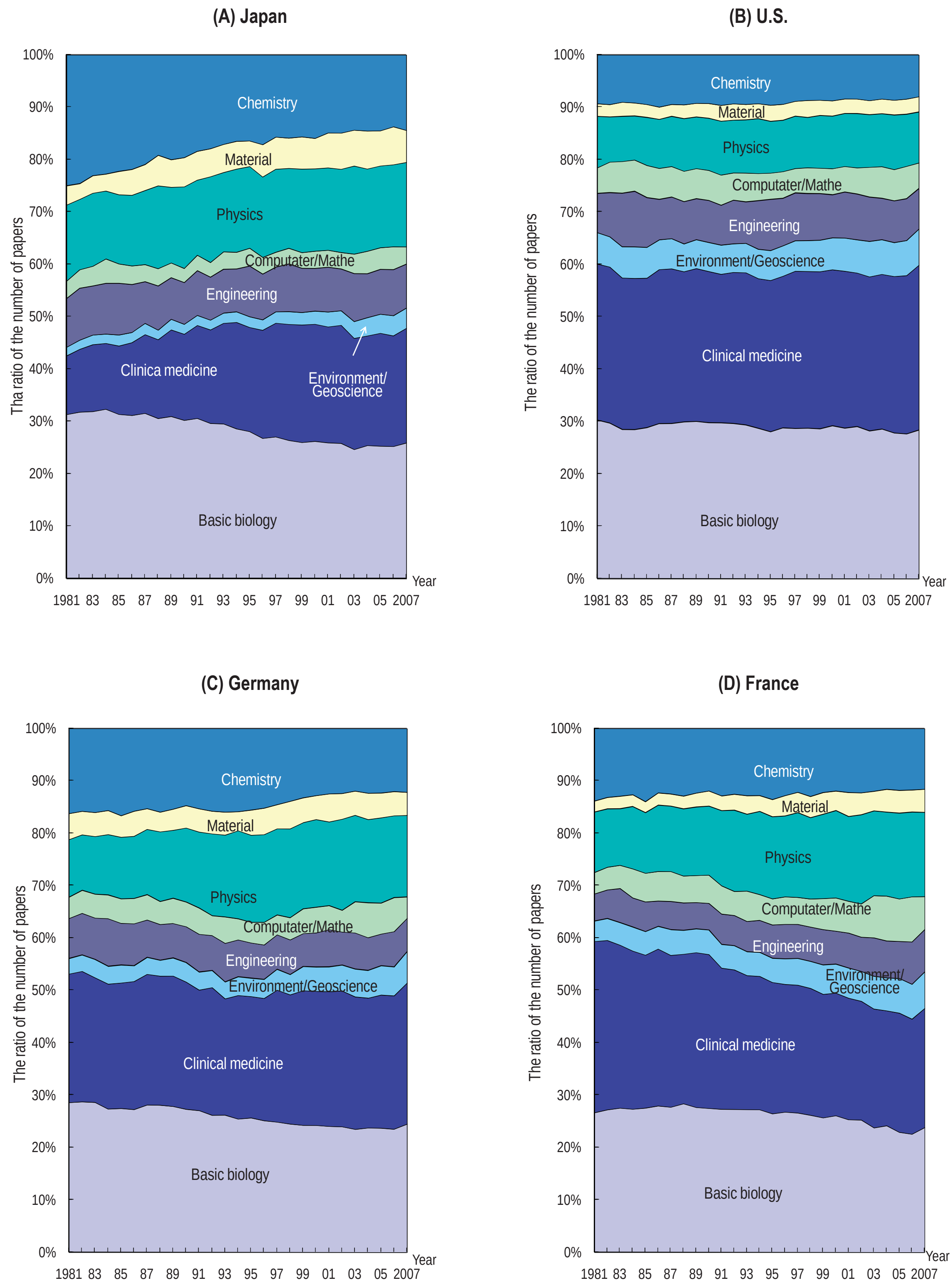
Chart 4-1-8: The change in the ratio of the numbers of the papers in the world by field



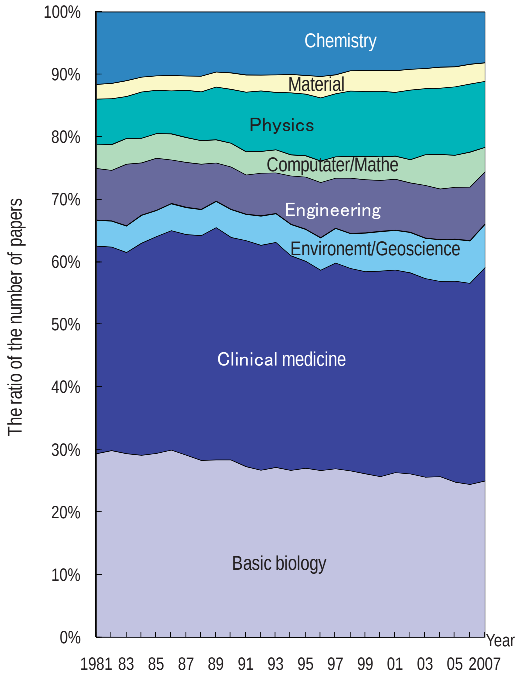
Note: The fields are in accordance with the note of Chart 4-1-3 (B).
Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

Next, Chart 4-1-9 provides the change in the share of papers in the main countries for each field, in order to see the internal structure of main countries. Japan had a large ratio in Basic biology, Chemistry and Physics in the early 1980s, however, now the ratio of Basic biology and Chemistry is on a decreasing trend. On the other hand, Clinical medicine and Material science have been on an expanding trend. U.S. has not shown a big change from the 1980s until now. In Germany, the ratio of Clinical medicine declined, and that of Physics somewhat increased. In U.K. and France, the ratio of Basic biology declined, and that of Physics somewhat increased. Regarding Asia, the ratio of the field of Life sciences such as Basic biology and Clinical medicine in Korea and China was very low compared with other main countries.

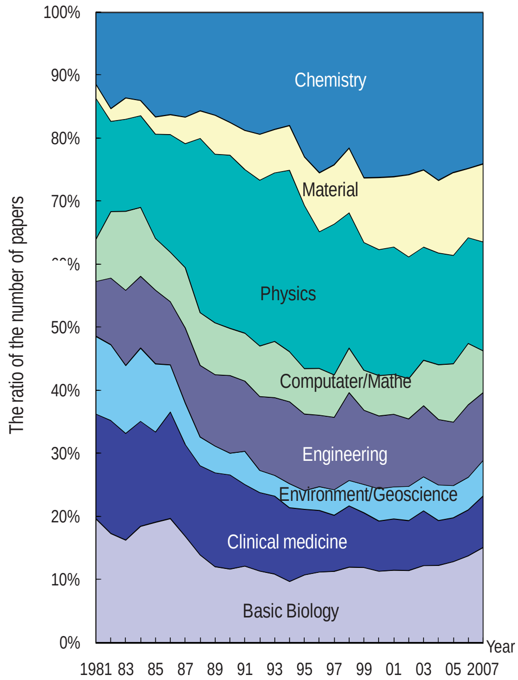
Chart 4-1-9: The change in the ratio of the numbers of the papers in main countries by field



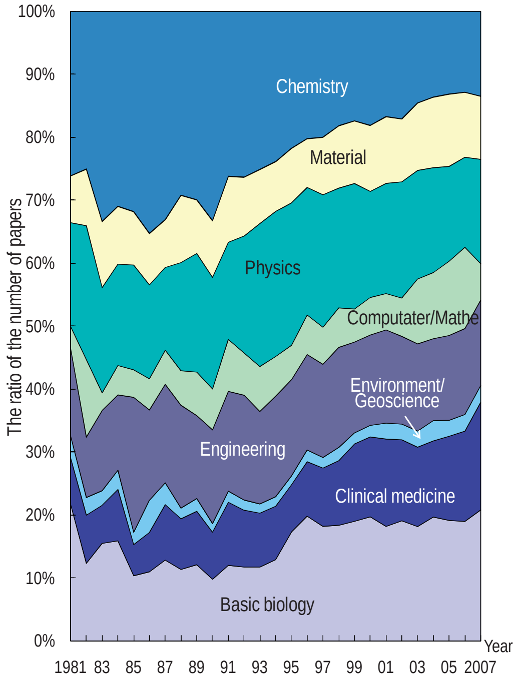
(E) U.K.



(F) China



(G) Korea



Note: The fields are in accordance with the note of Chart 4-1-3 (B).
Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

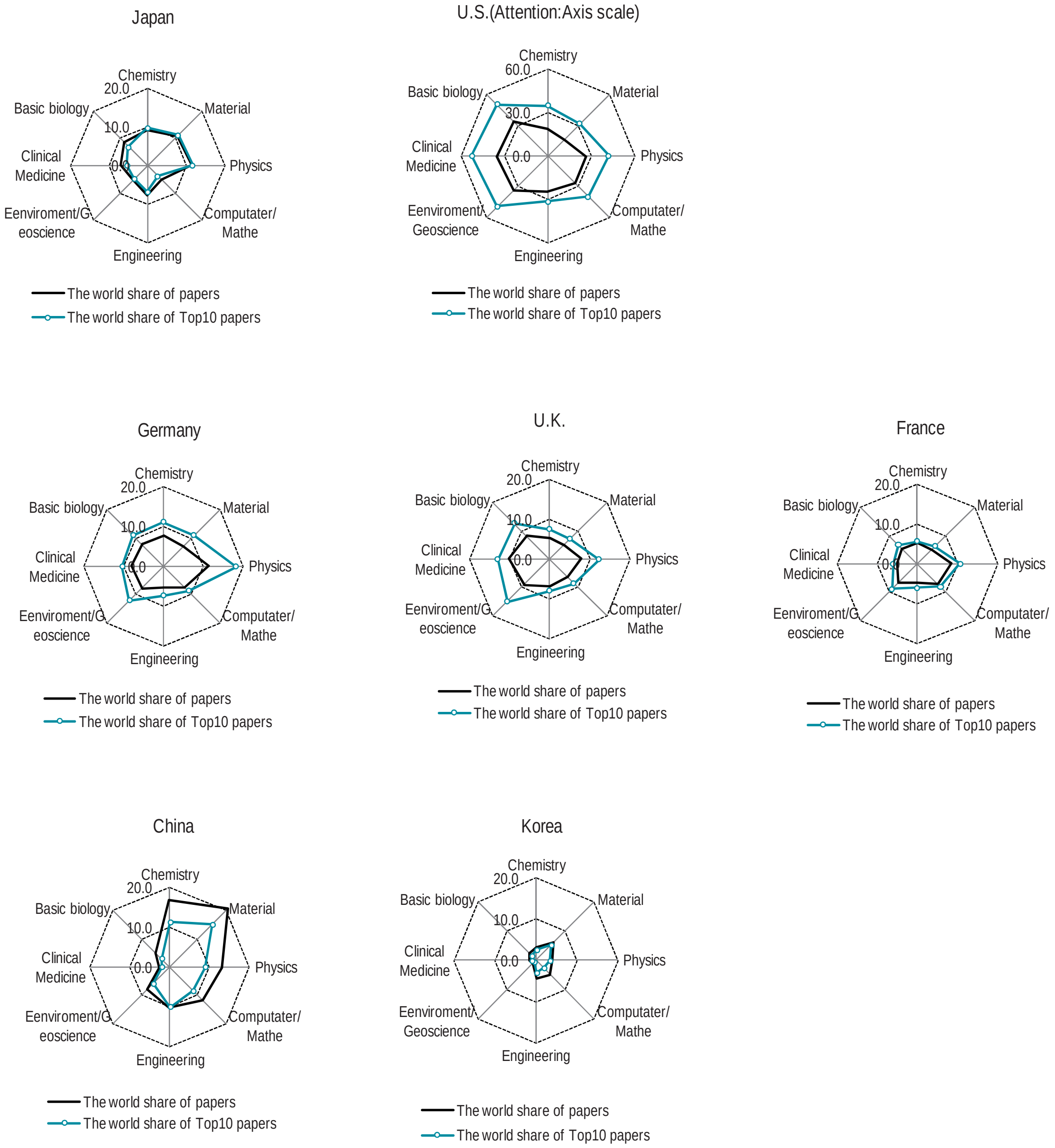
(2) A comparison of the field balance by quantity and quality in the main countries

In Chart 4-1-10, a comparison is shown, which is the results of field portfolio (2005-2007) of the share of papers and the share of Top 10% papers. Here the method of number counts is used, in order to find the ratio that is occupied by each field in the world and in each country from the viewpoint of participation.

Comparing the papers share and Top 10% papers share, the countries can be divided into those where the Top 10% papers share is higher than the overall papers share (U.S., U.K., Germany and France) and the countries where the Top 10% share is lower than the overall papers share (Japan, China and Korea). Looking at the Top 10% papers share, the strengths and weaknesses of each country are more highlighted than in the field balance by paper share.

Japan shows a portfolio where the weight of Chemistry, Material science and physics are high, and Computer science/Mathematics, Environment/Geoscience, Basic biology and Clinical medicine are low. In Chart 4-1-9, the share of Clinical medicine in Japan's papers is shown to have increased, and the share of Chemistry has declined. However, when it comes to the share against the numbers of papers for each field in the world, it can be seen that Chemistry is higher than Clinical medicine in Japan. It can be said that the strengths of U.K. are Clinical medicine, Environment/Ecology, Geoscience, that of Germany and France are Physics.

Chart 4-1-10: A comparison of the share of the papers and Top 10% papers in main countries by field (%, 2005-2007)

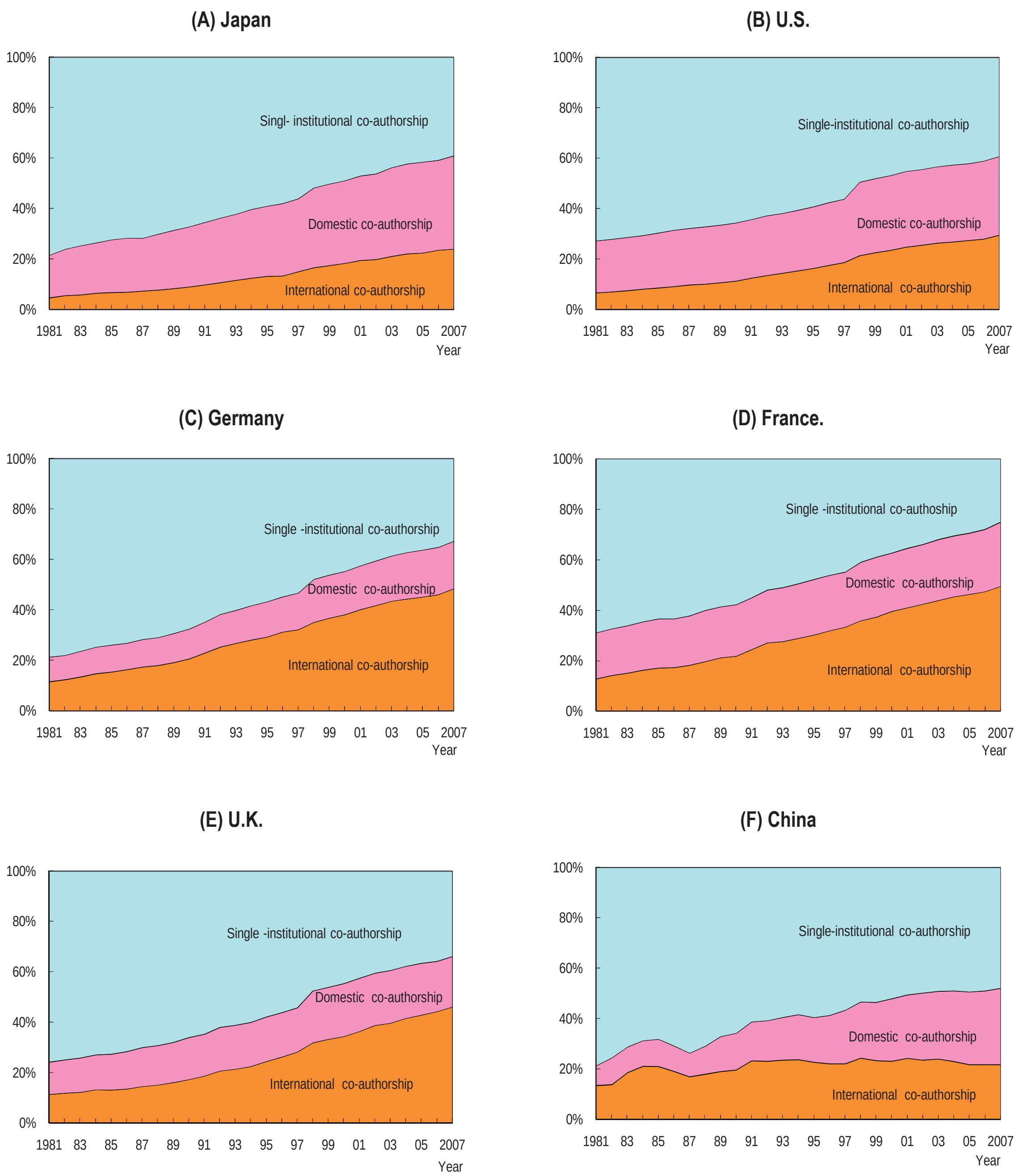


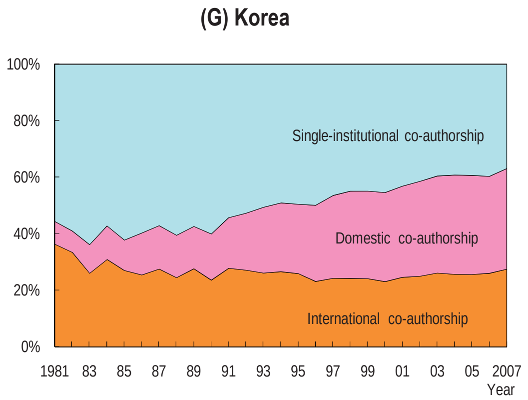
Note: Analyzed article, letter, note and review by number counts. The fields are in accordance with the note of Chart 4-1-3 (B).
Source: Compiled by NISTEP based on Thomson Reuters Scientific “Web of Science”

(3) The change in the production styles of papers in main countries

Chart 4-1-11 represents the change in the ratio of the numbers of papers in main countries by form of co-authorship of papers. The growth in the ratio of international co-authorship papers is common to every country; however, compared with Japan at 24% and U.S. at 30%, the ratio is very high in Germany at 48%, France at 50% and U.K. at 46%. In Japan and U.S., the ratio of domestic co-authorship papers has increased together with international co-authorship papers. However, no big change can be seen in Germany, France and U.K.

Chart 4-1-11: The change in the ratio of the numbers of papers in main countries by co-authorship form





Note: Analyzed article, letter, note and review by number counts.
Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

Column: Times cited in domestic co-authorship papers and international co-authorship papers

What sorts of influence has the expansion of research activities across national borders given the qualitative indicator of research, that is, the number of Top 10% papers and the number of times cited? What sorts of differences exist between the research papers produced by domestic institutes (for instance, in case of Japan, it means papers produced by Japan's institutes alone) and international co-authorship papers produced across countries (for instance, in case of Japan, co-authorship papers produced by institutes in both Japan and U.S.)?

In Chart 4-1-12, a comparison was conducted whereby the papers of main countries were divided into the research papers produced by domestic institutes (hereinafter "domestic papers") and international co-authorship papers. As it takes certain amount of time for the number of times cited to become stable, the period of 1996-2000 was targeted.

First, the ratios of domestic papers within all papers and of international co-authorship papers within all papers were compared (Chart 4-1-12 ②). It can be seen that European countries, such as U.K., Germany and France, maintain high ratio of international co-authorship papers.

Next, the ratio occupied by Top 10% papers within domestic papers and international co-authorship papers was compared (Chart 4-1-12 ③). Basically, if a Top 10% papers share is higher than 10%, a country can be said to be producing high quality papers.

The ratio of Top 10% papers of international co-authorship papers, compared with domestic papers alone, was higher in every country. This indicates that citation frequencies of international co-authorship papers are higher than that of domestic papers alone.

Also, the times cited per paper in domestic papers and international co-authorship papers was compared (Chart 4-1-12 ④). This showed that every country had more number of times cited in international co-authorship papers than in domestic papers. This trend was the same as that for the percentage of Top 10% papers.

Also in Japan, just as the same as in U.S., U.K. and Germany, the number of times cited in international co-authorship papers was higher than that of domestic papers in the case of the percentage of Top 10% papers(③) and the number of cited per paper (④) . However, as shown in Chart 4-1-12②, the percentage of international co-authorship papers was low in Japan, and it is considered that this is one of the reasons why the number of times cited of entire papers was lower than for U.K. and Germany.

Chart 4-1-12: A comparison of papers in main countries, when divided into domestic papers and international co-authorship papers (1996-2000)

Country	①The number of papers(Volume)			②The ratio of the number of papers (%)			③The ratio of Top 10 % papers (%)			④The number of times cited per paper		
	All papers	Domestic papers	International co-authorship papers	All papers	Domestic papers	International co-authorship papers	All papers	Domestic papers	International co-authorship papers	All papers	Domestic papers	International co-authorship papers
U.S.	1,244,956	995,373	249,583	100.0	80.0	20.0	14.5	13.5	18.4	21.2	20.0	25.9
U.K.	357,832	250,920	106,912	100.0	70.1	29.9	11.4	9.1	16.8	16.9	13.6	24.4
Japan	353,123	295,925	57,198	100.0	83.8	16.2	7.9	6.7	14.0	12.6	11.1	20.7
Germany	327,538	215,081	112,457	100.0	65.7	34.3	11.1	8.6	15.8	15.9	12.7	22.0
China	116,052	89,240	26,812	100.0	76.9	23.1	5.4	3.9	10.2	7.2	5.7	12.0
France	243,775	157,884	85,891	100.0	64.8	35.2	10.4	7.8	15.2	15.2	11.7	21.7

Note: The objects for analysis are article, letter, note, and review. Analyzed by number counts.
Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

4.2 Patents

Key Points

- ○The numbers of patent applications had been increasing with an annual average growth rate of about 5% since the mid 1990s, and reached 1.76 Million for the year 2006.
- ○The numbers of patent applications to the Japan Patent Office (hereinafter "JPO") have been about 400,000 over these past several years. The numbers of patent applications to U.S. Patent and Trademark Office (hereinafter "USPTO") have been rapidly increasing, and it was more than that to JPO in the year 2006. The applications to JPO from Non-Residents have been increased, and accounted for over 15% of all in the year 2006. However, this ratio is small compared with that of USPTO, about a half of whose applications are from Non-Residents.
- ○All main countries including Japan have steadily increased their numbers of patent applications. Of these, the growth of Korea and China is especially large. Many applications from China are still to State Intellectual Property Office of the P.R.C. (hereinafter SIPO), and its presence in the world is still small. Korea has been applying for patents from patent offices in every country and has strengthened its world presence.
- ○Looking at the numbers of patent applications for JPO, USPTO and The European Patent Office (hereinafter EPO), Japan has shown a big presence since 10 years ago. Looking at the applications by technical field, Japan has a big share in Nanotechnology and Information and communication technology.
- ○The relation between patents and scientific papers has been getting stronger. The Science Linkage, which indicates the degree to which patent literature cites scientific literature, has been increasing. From 1996-1998 to 2004-2006, the values in all fields increased from 1.86 to 2.42. The value of Medical and chemical manufacturing is highest. Science Linkage has recently increased in Petroleum/Coal product manufacturing.

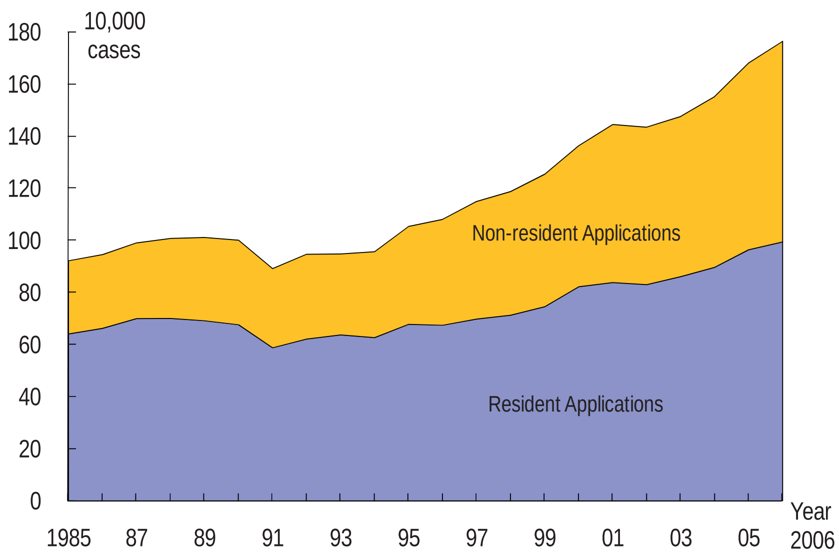
4.2.1 The patent applications in the world
(1) The number of patent applications in the world

Chart 4-2-1 shows the change in the numbers of patent applications for about 230 countries and regions as of December 2008. The data is obtained from the "Statistics on Patents" by WIPO (World Intellectual Property Organization). Here, the applications are divided to show Resident Applications, which mean that the first applicants make applications directly to countries or regions in where they live, and Non-Resident Applications, which mean that the first applicants make applications to countries and regions where they do not have residency.

The numbers of patent applications are counted by both direct applications to patent authorities in each country or region; and PCT (Patent Cooperation Treaty) applications. As for PCT applications, applications have been transferred to the national/regional phase, were counted.

The numbers of patent application in the entire world have increased at an annual average rate of 5% since the mid 1990s, and it reached 1.76 Million in 2006. Non-Resident Applications, which occupied about 30% in the mid 1980s, have increased more than that of Resident Applications at a rapid pace, and have occupied about 40% of the total numbers of applications in recent years.

Chart 4-2-1: The change in the numbers of patent applications in the world



Note: 1) Resident Applications means that first applicants make applications directly to countries or regions in where they live or do PCT applications.
2) Non-Resident Applications mean that applicants make applications directly to countries or regions in where they do not live or do PCT applications.
3) PCT applications mean applications made through PCT international patent application.
Source: WIPO, "Statistics on Patents"(Last update: December 16, 2008)

(2)The situation of patent applications in main countries

Next, the breakdown of Chart 4-2-1 is described. Here, the situation of the patent applications to and from the main countries is shown.

Chart 4-2-2 (A) shows the situation of patent applications to the main countries. The patent applications for Japan, U.S., Europe, China, Korea, Germany, France and U.K. are covered. The patent applications to these eight patent authorities are about 80% of the patent applications in the entire world. Here, the breakdown of the numbers of patent applications, which are divided into applications by Residents and those by Non-Residents, are shown.

The numbers of applications to JPO are considerably large compared with the other countries. Looking at the breakdown, the applications to JPO from applicants, who have their residency in Japan, accounts for over 80%. On the other hand, applications from Non-Residents were less than 20%.

The numbers of applications to USPTO have become almost double over the past 10 years. The ratio of applications from Residents and Non-Residents has been consistently half each. This is considered to show that U.S. market is always attractive to overseas. The provisional application, which was introduced in 1995, is considered to be a reason that the numbers of applications has increased.

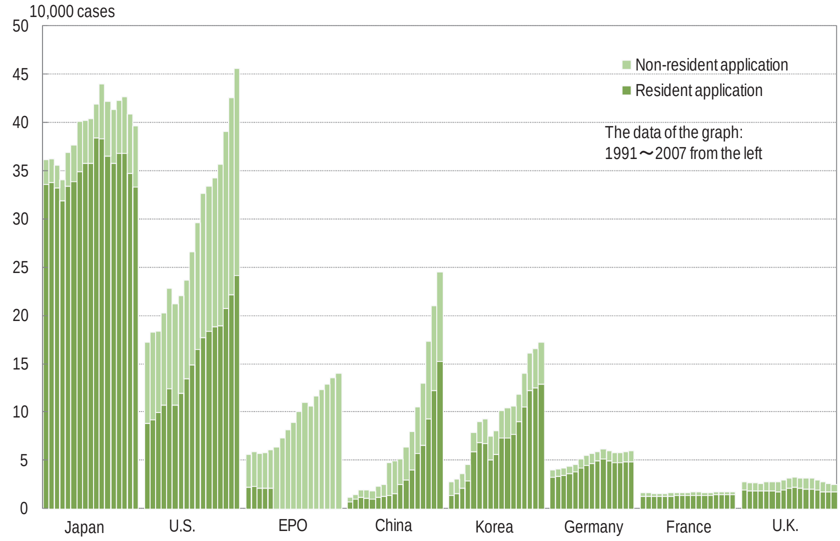
The number of applications to EPO has also increased. However, the numbers of applications to Germany and France have been broadly flat and that to U.K. has declined. Since patent applications to the countries which have ratified European Patent Convention can be made through the applications for European Patent Office, the numbers of applications to each country are on a flat or decreasing trend.

The number of applications to SIPO has drastically increased. It has increased by about 10 times over 10 years (1997-2007). The number of applications from Residents was about 50% from 2000 to 2002, however, it became about 60% from 2005 to 2007. This indicates that applications from applicants in China have especially increased.

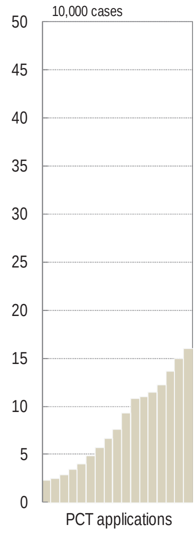
The applications based on PCT have been increasing. PCT applications can be seen a bundle of patent applications to the various patent authorities, and its feature is that a PCT application is enough to obtain the priority of designated patent authorities. Chart 4-2-2 (B) shows the numbers of PCT applications. This indicates that the numbers of PCT applications have been steadily increasing. It reached about 160,000 in 2007 and marked a threefold increase over the past 10 years.

Chart 4-2-2: The situation of patent applications to and from main countries

(A)The numbers of patent applications for main countries (1991 – 2007)



(B)The change in the numbers of patent applications (1991-2007)



Note: 1) Regarding the breakdown of the numbers of applications, in the case of Japan, it is divided according to: “direct applications from Residents” to JPO, which is from those who live in Japan, and “direct applications from Non-residents” to JPO, which is from those who do not live in Japan (for instance, those who live in U.S.).
2) The value of “applications from Residents” of EPO has not been included since 1996.
Source: WIPO, “Statistics on Patents”(Last update: December 16, 2008)

The next Chart shows the situation of patent applications from main countries (Chart 4-2-2 (C)). Here, the numbers of applications are divided into two categories and shown as applications to the country of residence and applications to a country of non-residence. Direct applications to patent authorities in each county or region; and PCT patent applications which are transferred to the national/regional phase were counted. In all countries, applications to EPO were counted as Non-Resident Applications.

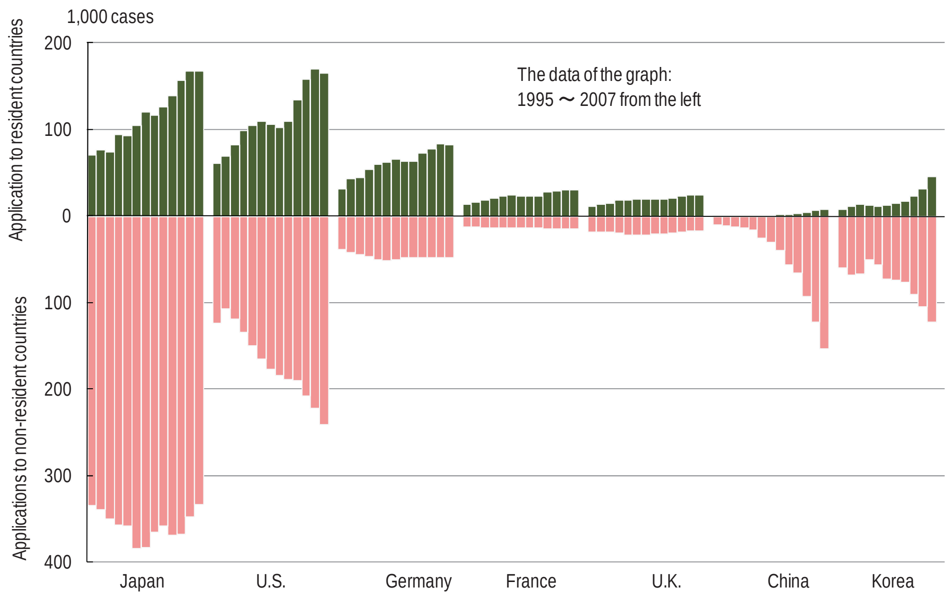
The results shown here are from the WIPO “Statistics on Patents” as of December 2008. This analysis calculates the share for each country by using the country that the first applicant belongs to. For instance, if there is a joint application with an applicant (the first) in Japan and an applicant (the second) in U.S.., only Japan is counted.

In Japan, U.S., China and Korea, the numbers of applications to the country of residence are more than those to countries of non-residence. Approximately 70% of the total numbers of applications from Japan are to JPO.

Paying attention to the change in the numbers of applications to the country of residence, Japan has been decreasing slightly recently. U.S., China and Korea have been greatly increasing. In Germany, France and U.K., the numbers of applications to the country of residence have been almost flat or a little bit decreased. One of the factors is considered to be that a certain number of patent applications, which have been applied for to the patent authorities of the country of residence, are now being applied for to EPO.

Looking at the numbers of applications to countries of non-residence, it can be seen that the number of applications from Japan to overseas has increased in these years. As for U.S. and Korea, the numbers of applications to overseas have also been increasing. Although China has increased its domestic patent applications, its number of applications to overseas is still small.

(C)The numbers of patent applications from main countries (1995 – 2007)



Note: 1) Regarding the breakdown of the numbers of applications, in the case of Japan, "Applications to resident countries" refer the applications to JPO applied by applicants who live in Japan, and "Applications to non-resident countries" refer the applications, applied by applicants who live in Japan, to other countries.
2) Every country includes the numbers of the applications to EPO.
Source: WIPO, “Statistics on Patents”(Last update: December 16, 2008)

4.2.2 The patent applications to trilateral patent offices from the main countries

One of the points that makes an international comparison of the numbers of patent applications difficult is that a patent right is a principle of territorial jurisdiction and applications are often applied to several countries in which applicants want to have patent rights. Generally, in terms of applications made to Country A, applications from Country A comprise the majority (Home advantage). In order to improve the international comparability, the applications to the trilateral patent offices, JPO, EPO and USPTO, are analyzed here.

The number of the world's patent applications in 2006 was approximately 1.76 Million, as shown in Chart 4-2-1. The numbers of applications to the trilateral patent offices accounted for about 55% of the world's patent applications. In recent years, the numbers of patent applications to China and Korea have been rapidly increasing, and the weight of the trilateral patent offices in the world has been declining.

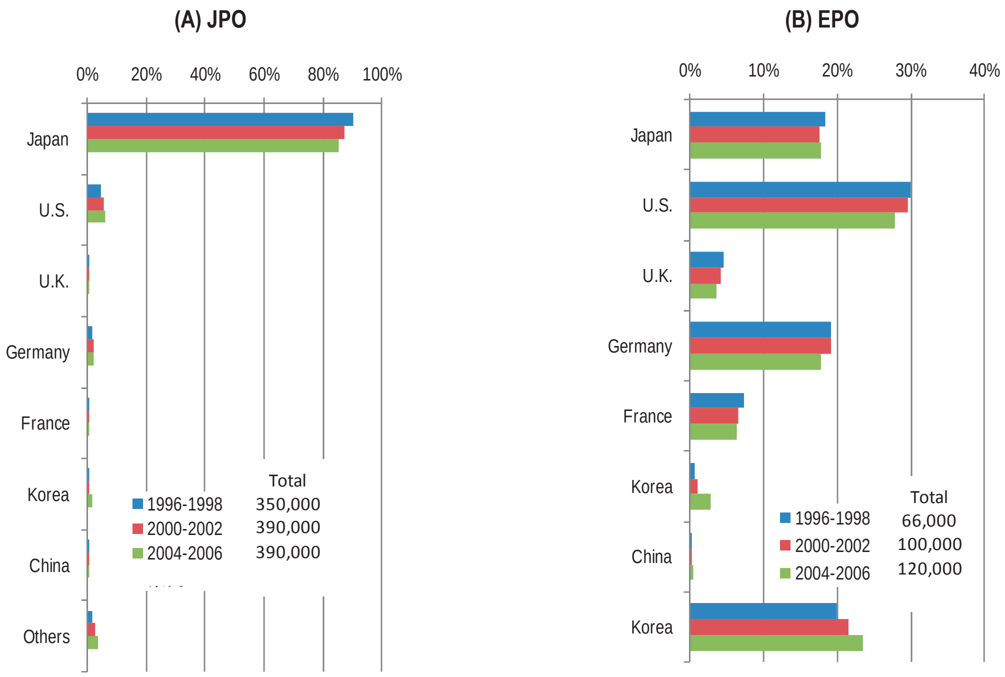
Chart 4-2-3 shows the share of the main countries of patent applications to JPO and EPO, and Chart 4-2-4 shows the share of the main countries in the granted patents of USPTO. Regarding JPO and EPO, the number of unexamined publications was counted, and the number of granted patents was counted for USPTO. When the numbers of patent applications or the numbers of patents were counted, it was done by fractional count using applicants as a unit. For instance, in a case where applicants consist of three persons, of which two persons have their addresses in Japan and the other person has an address in U.S.., the number of the patent applications was counted as 2/3 for Japan and 1/3 for U.S..

Looking at the each country's share of the applicants on unexamined publication by Japan Patent Office (Chart 4-2-3 (a)), Japan had overwhelming share and it was about 86% from 2004 to 2006. U.S. has kept second place over the past 10 years, however, its share did not reach 10%. The share of Germany was in third place (approximately 2.1% during 2004-2006). The numbers of the applications from Korea have grown recently (approximately 1.6% during 2004-2006), and now it is closing in on Germany.

Looking at the share of the applicants on unexamined publication by EPO (Chart 4-2-3 (b)), Japan presented the next largest number to U.S.. By the share of main countries on unexamined publication from 2004 to 2006, the share of U.S. was about 28%, which is in first place. The share of Japan and Germany was the same at approximately 18%. France (about 6%) and U.K. (about 4%) followed them. Also here, the growth of Korea was shown, it became about 3% from 2004 to 2006.

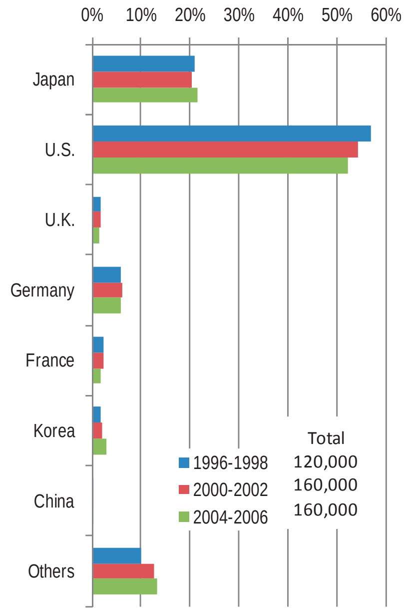
Looking at the share of applicants in the patent registrations to USPTO, the share of U.S. was the largest. It was 57% from 1996 to 1998; however, it declined to 52% from 2004 to 2006. Japan had the second largest share, and the ratio was kept at about 20% from 1996. The share of Germany was in third place, which was at about 6% from 2004 to 2006. Korea has been steadily expanding its share and had about 3%, which was in fourth place next to Germany.

Chart 4-2-3: The share of the patent applications of the main countries to JPO and EPO



Note: Regarding the numbers of open patents of JPO, the numbers in the laid-open disclosure public bulletin, published Japan translations of PCT international publications for patent applications and the release of published Japan translations of PCT international publications for patent applications were counted. Regarding the numbers of unexamined publications of EPO, unexamined publications (A1) with search reports and gazettes (A2) without search reports were counted by publication dates.
Source: (JPO) Compiled by NISTEP based on gazette Database and standardized Database
(EPO) Compiled by NISTEP based on PATSTAT (October 2008 version)

Chart 4-2-4: The share of main countries of patent registrations to USPTO



Note: The granted patents were counted by granted date.
Source: Compiled by NISTEP based on PATSTAT (October 2008 version)

4.2.3 The patent applications by technological field

Next, the result of the analysis of the parent applications by technological field is described. The applications to EPO and USPTO were analyzed in order to do an international comparison by technological field. Technological fields for analysis are targeted in four technological fields: Biotechnology; Information and communication technology; Renewable energy; and Nanotechnology.

The patent applications for Biotechnology, Information and communication technology and Renewable energy were extracted by International Patent Classification (IPC). The same definition is also used in the patent analysis of OECD. The patent applications for USPTO are classified by United States Patent Classification (USPC). Therefore, the technological classification was done by using the correspondence table of USPC and International Patent Classification (IPC) and transforming International Patent Classification (IPC) into USPC.

Regarding Nanotechnology, the classification called Y01N by EPO was used. At present, there is no unified definition for Nanotechnology in the world. Therefore, EPO defines Nanotechnology on it own accord. And then, based on it, the applications relating to Nanotechnology are extracted from the patent applications to major patent authorities in the world and given the tag of Y01N. The objects analyzed herein are the patent applications with Y01N tags for EPO and USPTO.

The patent applications to JPO were excluded here. The reason was that due to a problem on the patent database, the extraction accuracy of the patent applications on Nanotechnology was low.

(1) The patent applications to EPO by field

Looking at the situation of applications to EPO by technological field, Japan has a large share in Nanotechnology and Information and communication technology. The share of Nanotechnology was approximately 30% from 1996 to 1998; however, it was approximately 20% from 2004 to 2006. The share of Japan in Biotechnology is about 10%, and it was less than about 18% of Japan's share as a whole.

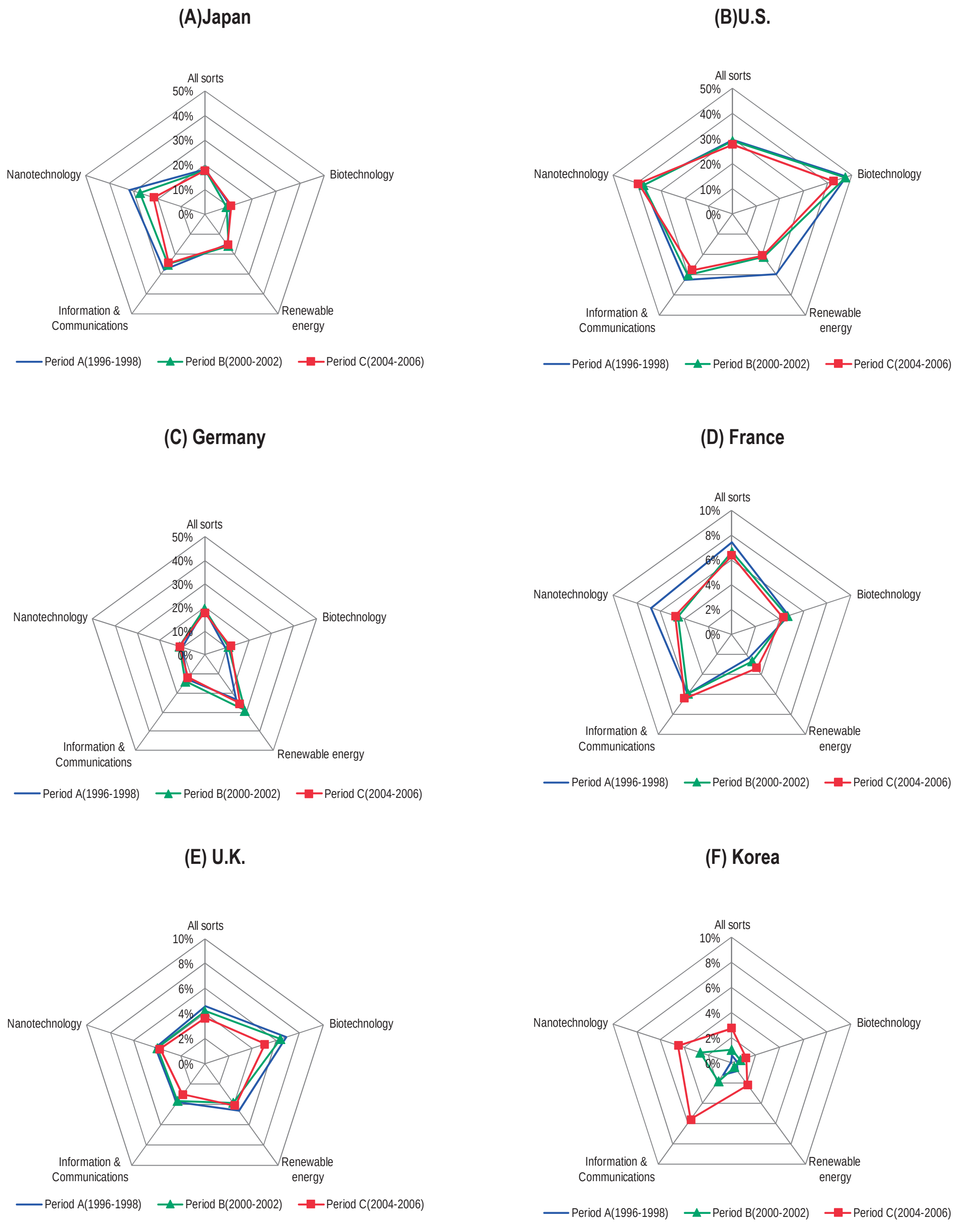
The share of Biotechnology is large for U.S. and U.K., and Germany had a relatively large share in Renewable energy. The share of Korea has been increasing over the past 10 years. Especially, the growth in Information and communication technology and Nanotechnology is remarkable (Chart 4-2-5).

(2) The granted patents in USPTO by field

Looking at the granted patent in USPTO by field, Japan has a large share in Nanotechnology and Information and communication technology, the same as in the case of EPO. Its share of Nanotechnology from 2004 to 2006 was about 30%.

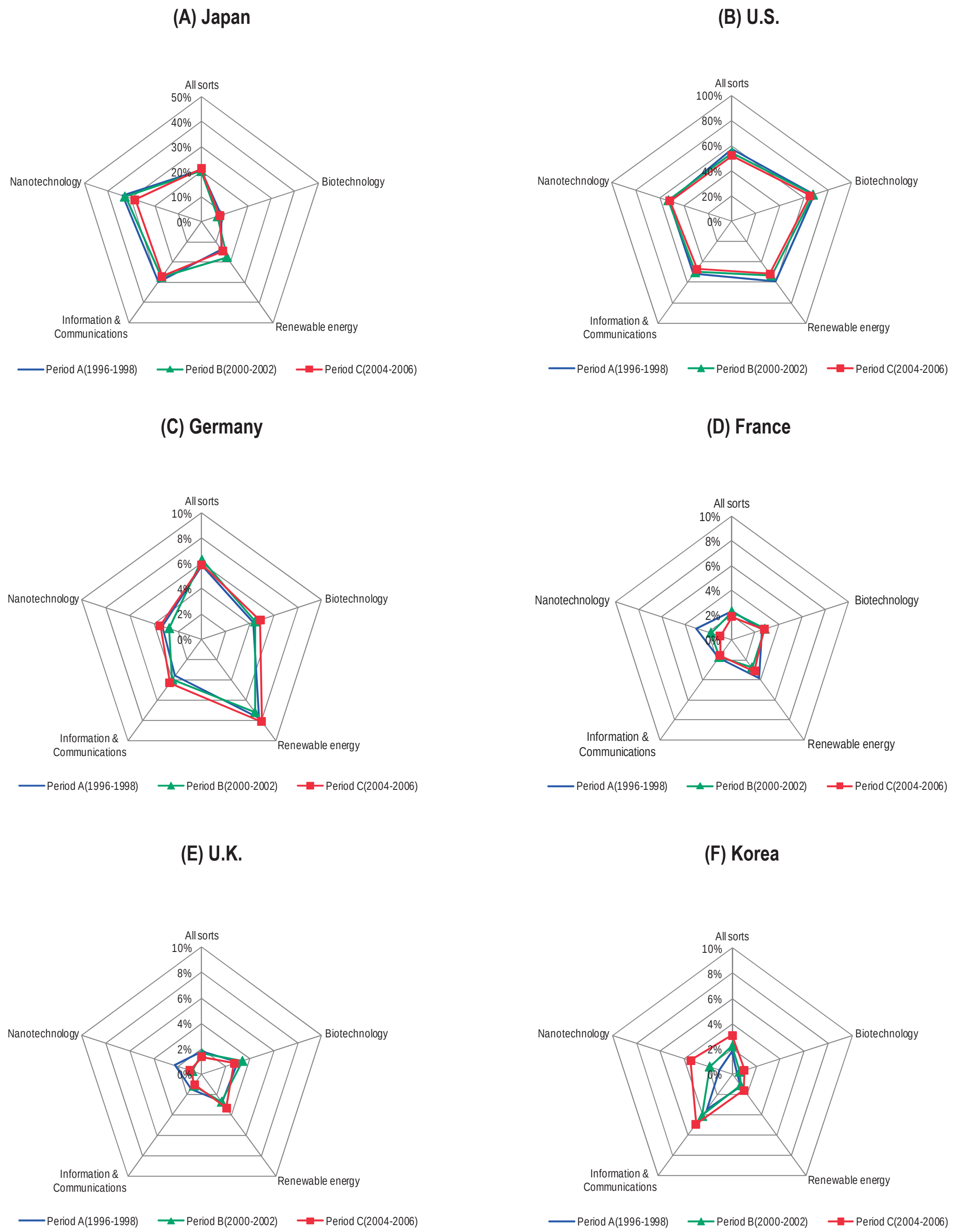
The share of Biotechnology was large in U.S., and Germany has a large share of Renewable energy in comparison. Regarding Korea, it can be seen that the growth in the share of Nanotechnology is especially large (Chart 4-2-6).

Chart 4-2-5: The situation of patent applications to EPO by field



Note: 1) Counted unexamined publications (A1, A2) for the numbers of the applications.
2) Used International Patent Classification for the technological classification about Information and communications, Biotechnology and Renewable energy. Y01N was used for the technological classification of Nanotechnology.
3) The ratio of applicants was counted by fractional count per applicant.
Source: Compiled by NISTEP based on PATSTAT (October 2008 version)

Chart 4-2-6: The situation of patent applications to USPTO by field



Note: 1) Counted by granted dates. The share of main countries is the average over 3 years.
2) Uses International Patent Classification for the technological classification about Information and communications, Biotechnology and Renewable energy. Y01N was used for the technological classification about Nanotechnology.
3) The ratio of applicants was counted by fractional count per applicant.
Source: Compiled by NISTEP based on PATSTAT (October 2008 version)

4.2.4 The analysis of Science Linkage and Technological Cycle Time for US Patents

The following describes “Science Linkage” which is an indicator for showing a close relationship between the patents and scientific literature, and “Technological Cycle Time” which is an indicator for the velocity of technological development.

Science Linkage means the numbers of the citations of scientific literature per patent on U.S. Patent Examination Reports. U.S. Patent Examination Reports have citations of various documents and existing patents that are in close relation to the patent application. The citation of scientific literature in patents shows relevance to the relationship between technology (Patents) and science. Therefore, science Linkage is considered to indicate closeness between science and patents.

U.S. Patent Classification System made by USPTO and the corresponding list of Standard Industrial Classification System were used to analyze changes in Science Linkage of U.S. Patents by the industrial classification. It is possible to analyze by International Patent Classification (IPC), in which patent documents are categorized by the types of technology, however, the image of the technology is not easily seen by this method. Therefore, the following shows the correspondence with the industrial classification.

From 2004 to 2006, the largest numbers of granted patents were for Communication equipment and electronics components manufacturing, followed by Machinery manufacturing (excluding Electrical); Professional equipment and scientific instrument manufacturing. Paying attention to the annual average growth rate, Communication equipment and electronics components manufacturing are the largest, and the second largest is Petroleum and natural gas extraction and refining (Chart 4-2-7).

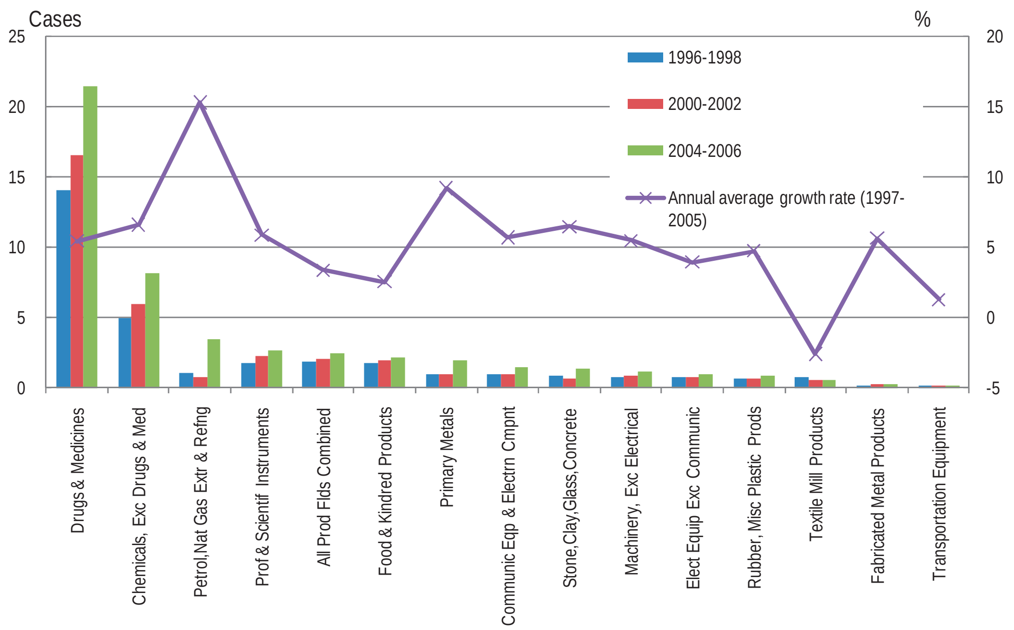
The value of Science Linkage tends to be increasing as a whole (Chart 4-2-8). From 1996-1998 to 2004-2006, the value of Science Linkage in all manufacturing increased from 1.89 to 2.42. Drug and medicines manufacturing had a much higher value for Science Linkage and marked 21.5 from 2004 to 2006. Chemicals (excluding Drug and medicines) followed after it; however, the value of Science Linkage was less than half the value for Drug and medicines manufacturing. Regarding Petroleum and natural gas extraction and refining, the value of Science Linkage was 0.73 from 2000 to 2002, which was not so high; however, it was rapidly increased to 3.46 from 2004 to 2006. Science Linkage of Primary metals manufacturing increased to about double over 10 years.

Chart 4-2-7: The numbers of registrations of patents by industrial classification (the average value over 3 years)

	1996-1998	2000-2002	2004-2006	Annual average growth rate (%, 1997-2005)
Communic Eqp & Electrn Cmpnt	22,439	36,025	42,609	8.3
Machinery, Exc Electrical	26,730	35,820	37,665	4.4
Prof & Scientif Instruments	17,196	20,892	21,526	2.8
Elect Equip Exc Communic	8,001	11,152	11,653	4.8
Chemicals, Exc Drugs & Med	12,259	13,977	10,324	-2.1
Transportation Equipment	5,030	7,359	6,782	3.8
Fabricated Metal Products	6,610	8,363	6,589	0.0
Drugs & Medicines	5,154	6,377	4,715	-1.1
Rubber, Misc Plastic Prods	4,337	5,081	3,687	-2.0
Stone,Clay,Glass,Concrete	1,890	2,285	1,920	0.2
Primary Metals	852	1,154	938	1.2
Petrol,Nat Gas Extr & Refng	523	756	797	5.4
Textile Mill Products	705	700	541	-3.2
Food & Kindred Products	615	855	447	-3.9

Source: Compiled by NISTEP based on Patent Board

Chart 4-2-8: Science Linkage in US Patents

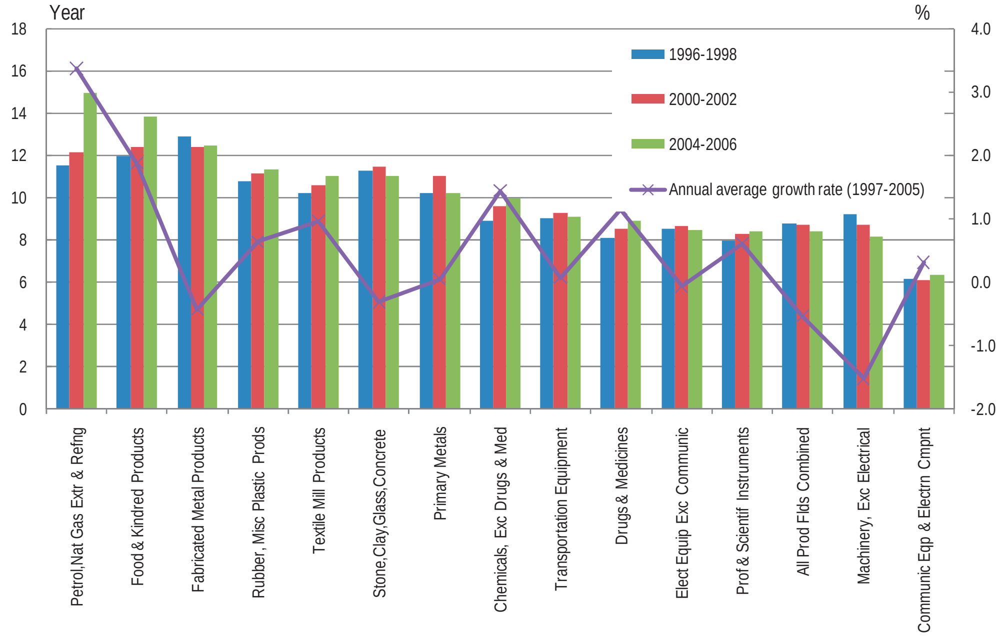


Note: Annual average growth rate indicates the growth rate of 1997 - 2005.
Source: Compiled by NISTEP based on Patent Board

Next, the results of the analysis of Technology Cycle Time are described. Technology Cycle Time is an indicator to show that the patent literature of how long before in the past is cited in examination reports. To be more precise, Technology Cycle Time is calculated by taking the time lags between examination reports and the publication year of patent literature cited in them and then calculating the median value of the time lags. The fields which have a shorter Technology Cycle Time have a shorter length of time between a certain patent being made and the next patents being created based on it. The length of time lags between creating new patents is dependent on factors such as the characteristics of the technological field or the patent strategy of business enterprises. Technology Cycle Time is also considered to depend on these factors.

The Technology Cycle Time of Petroleum and natural gas extraction and refining was the longest, which was 15 years from 2004 to 2006. Food & kindred products, Fabricated metal products, Rubber, misc plastic products manufacturing followed after it. In contrast, Technology Cycle Time of Communication equipment and electronics components manufacturing was the shortest, whose value was 6 years (Chart 4-2-9).

Chart 4-2-9: Technology Cycle Time for US Patents



Note: Annual average growth rate indicates the growth rate for 1997 - 2005.
Source: Compiled by NISTEP based on Patent Board

Chapter 5 : The outcome of R&D

This chapter is entitled the outcome of R&D, and shows the results brought by R&D: the direct results such as the number of papers and patents produced, and actually what influence investing the costs and human resources required for R&D has on society. However, it is inherently difficult to measure the outcome of R&D, and there are few indicators at the present time. In this chapter, technology trade, which shows international competitiveness in terms of technical strength; high technology trade; and Total Factor Productivity (TFP), which is frequently used as a proxy for the outcome of innovation, are used.

5.1 Technology trade

Key Points

○Looking at technology trade balance, Japan was 3.49 in 2007, and its export surplus has been continuing since 1993. Looking at the technology trade excluding transactions with affiliates overseas, which is with so-called parent companies and subsidiaries, its technology trade balance was 1.1 in 2007 and it has been flat since 2001.

○The technology trade balance of U.S. has a trend of decline in the long run, and it has been lower than that of Japan since 2001. In 2006, the export surplus marked 2.12. However, regarding the technology trade balance, excluding transactions among affiliates, which are considered more appropriate as indicators for technology strength, U.S. is substantially higher than Japan (Japan has 1.1 for other companies excluding parent companies and subsidiaries. U.S. has 3.7 for other companies excluding associated companies.)

5.1.1 Scientific and technological knowledge going beyond national borders: Technology trade

In general, technology exports means that the rights of using a technology[(1)],are given to business enterprises or individuals located in or having residence overseas in exchange for payment, and technology imports (technology introduction) means that the rights of using a technology are received from business enterprises or individuals located in or having residence in overseas in exchange for payment. This is called technology trade. It is used as an indicator for measuring internationally the technology level of a country, and is also used

as an indicator to reflect technology strength with the ratio (technology trade balance) found by contrasting the technology trade with the amount of technology exports (receipts) or the amount of technology imports (payments). As the technology trade of each country is different in various contexts, the comparison cannot be made simply. Thus, here it is considered by focusing on changes over time and the correlation between the amounts for technology exports and technology imports of each country.

Looking at the amount of the technology trade of each country (Chart 5-1-1 (A)), the trend for each country is not the same; however, it has generally been increasing on the whole. Looking at it by country, the amount of technology exports for Japan has shown an export surplus since 1993, which means that the amount of technology exports is higher than that of tech-

(1)Including rights related to the technologies of intellectual property rights, engineering drawings, blueprints and so-called know-how as provided for by the laws of patent rights, utility model rights, trademark rights, design rights and copy rights.

nology imports. The amount of technology exports was approximately approx. ¥2.48 trillion and that of technology imports was about approx. ¥0.71 trillion in 2008.

The amount of technology exports of U.S. was overwhelmingly high: the amount for 2006 was four times that of Japan. Looking at the changes over time, both technology imports and technology exports have been consistently increasing. The amount of technology imports is less than that of technology exports, and the technology trade balance shows an export surplus.

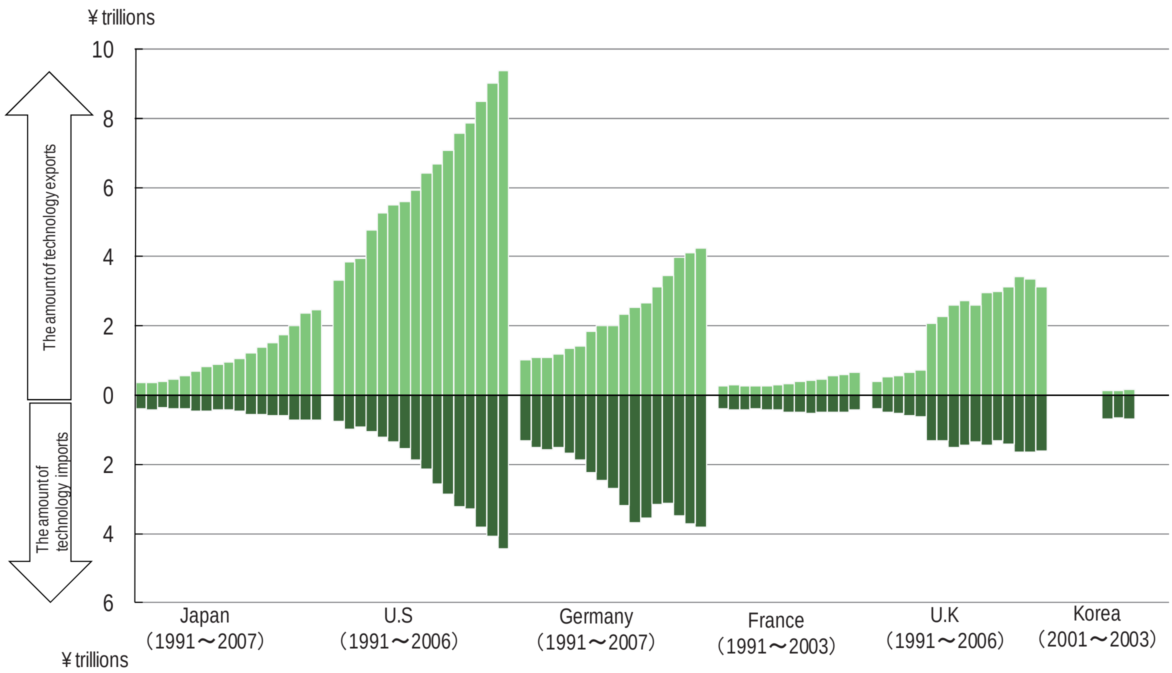
In Germany, both the amount of technology exports and imports greatly exceeds that of Japan. The amount of technology exports has consistently increased over time; however, the amount of technology imports has been repeatedly increasing and decreasing since 2002.

Of the countries in the Chart, France is one of the countries which have a small amount of both technology exports and technology imports. Looking at the change over time, its amount of technology exports has tended to increase after 1998, and its amount of technology exports has remained flat. The technology trade balance has had an export surplus since 2000.

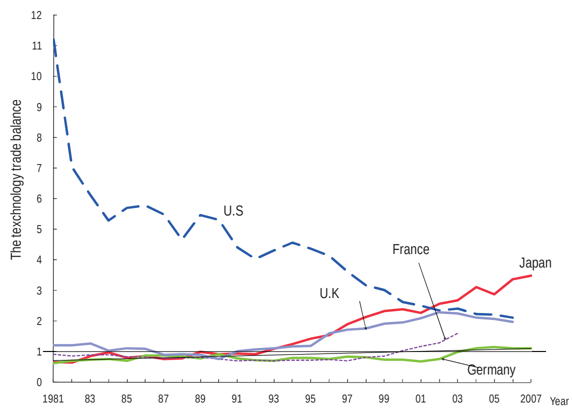
Regarding U.K., it is necessary to be careful when looking at the change over time because the ways of gathering statistics was changed after 1996. However, the amount of technology exports has generally tended to increase.

Chart 5-1-1: The technology trade of main countries

(A) The trend in the amount of technology trade



(B) The trend in the technology trade balance



Note :<Japan>The sorts of technology trade are as follows (excluding trademark rights):
①Patent rights, utility model rights and copy rights
②Design rights
③Each kind of technological know-how provision and technical guidance (excluding free provision)
④Technological aid for developing countries (including government-commissioned works)
<U.S.>Only royalties and licenses
<Germany>West Germany until 1990. Until 1985 includes patents, know-how, trademarks, and design. From 1986, additionally included technical services, computer services and R&D in industrial fields.
<U.K.>from 1984, included oil companies. From 1996, includes patents, inventions, know-how, trademarks, design and services related to technology and R&D.
Statistical reference E was used for purchasing power parity conversion.
Source :<Japan> Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development."
<U.S., Germany, France, U.K. and Korea>
OECD, "Main Science and Technology indicators 2008/2."

Looking at the technology trade balance (the amount of technology exports/the amount of technology imports), the technology trade balance of Japan has increased since it was more than 1 for the first time in 1993, and the amount of the year 2007 marked the high figure of 3.49.

The technology trade balance of U.S. is tending to decrease in the long run. It has been below that of Japan since 2001, and had an export surplus of 2.12 in 2006. The technology trade balance of Germany was over 1 in 2003, and has been fluctuating around 1.1 since then. That of France was over 1 for the first time in 2000, and has shown high figures since then. It marked 1.6 in 2003. The technology trade balance of U.K. shifted around 1 until 1995; however, it has had an export surplus since 1996 and moved around 2 since 2000.

When the Source on technology trade is looked at, it can be seen that a significant ration of technology trade among nations is accounted for technology transfers within corporate groups such as technology trade with affiliated companies overseas. Technology trade with affiliated companies is an indicator for international transfer of technical knowledge; however, it is not a strong indicator for Selecting the international competitiveness of technological strength. When technology trade is used as an indicator for seeing each country's technological strength, it is better to consider it by excluding technology transfers within corporate groups. Thus, regarding the amount of technology exports and imports of Japan and U.S. whose Source it is available, technology trade between affiliated companies and that between other companies are compared.

In Japan's survey(2), "Parent companies and subsidiaries" is defined as where the controlling share is over 50% in the capital ties between technology exporters and importers. With this definition, technology trade among parent companies and subsidiaries, and that among other companies are surveyed.

The amount of technology exports in Japan, for which the export between parent companies and subsidiaries were excluded, was approx.¥0.66 trillion in the year 2007, which accounted for 26.5% of the total. In the year 2001, it was approx. ¥0.54 trillion and accounted for 43.3% of the total. Compared with the year 2007 and the year 2001, there was a decrease of 16.8 points. However, technology exports greatly increased. The amount of technology trade was ¥0.6 trillion in the year 2007, and companies excluding parent companies and subsidiaries accounted for 83.9% for the total. Looking at the ratio of the total in the long run, it has consistently had a proportion of over 80%.

In the Source for U.S., technology trade of "associated companies" is defined as the companies which own directly or indirectly 10% or more of voting rights or shares.

The amount of technology exports of companies excluding associated companies was approx. ¥2.0 trillion and accounted for 26.7% of the total. Compared with 1999 (approx.¥1.7 trillion, 26.2%) at the time of changing U.S. industry classification to the current one, the amount of technology exports of companies excluding associated companies has increased 1.2 times; however, the percentage of the total is 26.7%, which shows less change. Regarding the amount of technology imports, the amount of technology imports of companies excluding associated companies was approx.¥0.53 trillion in 2005, which accounted for 16.9% of the total. Compared with it being approx. ¥0.44 trillion and 20.9% of the total in 1999, although the amount of technology imports of companies excluding associated companies has increased by about 1.2 times, it shows a 4.0 point decrease in the ratio .

Regarding technology trade of companies excluding parents companies and subsidiaries or associated companies, both exports and imports of U.S. account for 20% of the total. However, differences can be seen in the technology imports and exports of Japan: exports are about 30%, and imports are about 80% (Chart 5-1-2 (A)).

Also, looking at the technology trade balance of companies excluding parents companies and subsidiaries, Japan has moved back and forth around 1, and U.S. has moved around 3. The amount of U.S. in 2005 was an export surplus of 3.7 (Chart 5-1-2 (B)).

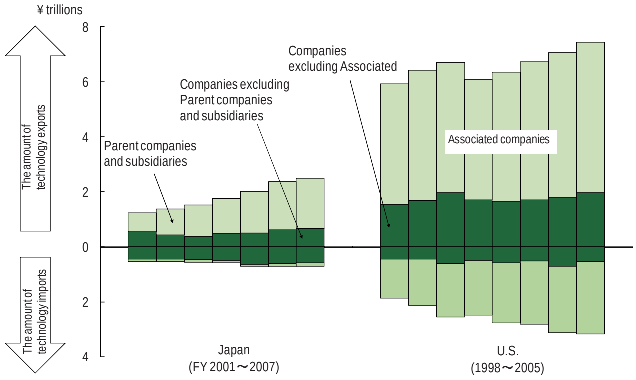
Since definitions for parent companies and subsidiaries in Japan or associated companies in U.S. are different, a simple comparison cannot be made. However, the Source indicates that the technological strength of U.S. surpasses that of Japan (Chart 5-1-2 (C)).

(2) Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development" was a survey conducted on the Source of the technology trade of Japan by dividing it into the amount of the technology trade of parent companies and subsidiaries, and that for companies excluding parent companies and subsidiaries, since the survey for the year 2002

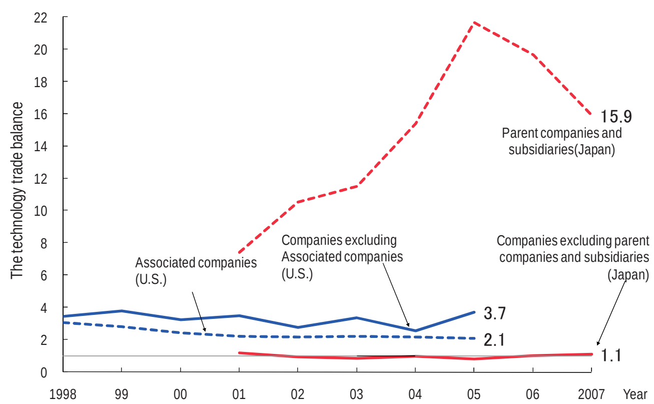
Chart 5-1-2: The change in the amount of technology trade in Japan and U.S. (Technology trade among parent companies and subsidiaries, associated companies and others)

Attention to international comparison

(A) The amount of technology trade



(B) Technology trade balance



(C) Definitions of parent companies and subsidiaries (associated companies) by capital ties, and the amount of technology trade

(Unit: ¥ trillions)

Capital ties	Japan Technology Exports	Japan Technology imports	U.S. Technology Exports	U.S. Technology imports	Capital ties
And/over 50% ↑	1.8	0.1	5.5	2.6	↑ And/over 10%
Under 50% ↓	0.7	0.6	2.0	0.5	↓ Under 10%

Note: Attention should be paid to when international comparisons are done, because definitions for parent companies and subsidiaries (affiliated companies) are different in Japan and in U.S. as follows:
①Japan's parent companies and subsidiaries are companies whose controlling share is over 50%.
②U.S.'s associated companies are companies which own directly or indirectly 10% or more voting rights or shares.
<Japan>For classifying industries, the industry classification of the "Survey of Research and Development" based on the Japan Standard Industry Classification was used. For before 2006, the Japan Standard Industry Classification revised edition 2002 (the 11th) was used. For the year 2007, Japan Standard Industry Classification revised edition 2007 (the 12th) was used.
<U.S.>1) NAICS was used for industry classification.
2) Excludes FFRDCs from 2001.

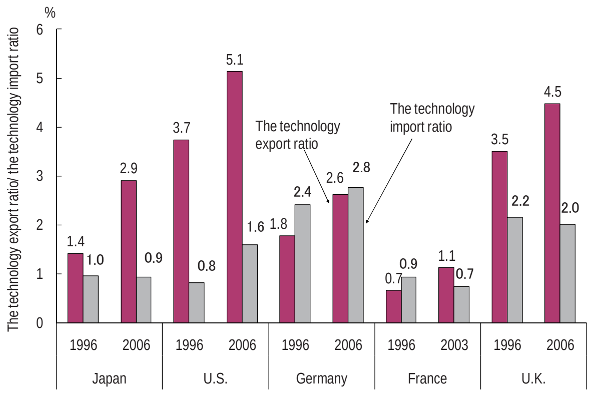
Source :<Japan>Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development."
<U.S.>NSF, "Science & Engineering Indicators 2008."

Chart 5-1-3 is the ratio of the amount of the technology trade against the whole amount of trade. The level of the amount of the technology trade is shown by comparison with the entire trade amount of goods and services. Hereinafter, the ratio of the amount of technology exports which it occupies out of total exports is called the "Technology export ratio," and that for technology imports is called the "Technology import ratio."

The technology export ratio of U.S. was the highest. It was 5.1% in 2006, and had increased 1.4 points compared with that of 1996 (3.7%). U.K. was 4.5% in 2006, which was an increase of 1 point compared with that of 1996 (3.5%). The technology export ratio of Japan in 2006 was 2.9%, which was increased of over double compared with that of 1996 (1.4%). Japan was the country where the technology export ratio was most extended.

On the other hand, the technology import ratio of Germany (in 2006, 2.8%) was high, moreover, it was higher than its technology export ratio. Compared with 1996 (1.8%), it increased by 1 point. Next to Germany was U.K.; however, the technology import ratio of U.K. declined by 0.2 point compared with that of 1996. That of U.S. was 1.6% in 2006, which was extended more than double that of 1996 (0.8%). That of Japan was 1.0% in 1996 and 0.9 in 2006, which did not change much.

Chart 5-1-3: The ratio of the amount of technology trade against the whole amount of trade



Note: 1) The sorts of technology trade are the same as in Chart 5-1-1.
2) The amount of technology imports and exports is the same as in Chart 5-1-1.
Source: <The amount of technology imports and exports>is the same as in Chart 5-1-1.
<The amount of the whole imports and exports>
OECD, "Annual National Accounts 2008/1)

5.1.2 The Technology Trade of Japan

Key Points

○Looking at the amount of technology exports of Japan, “Transportation equipment manufacturing” accounts for about 50% of all industries, and it is followed by “Pharmaceutical manufacturing”, which accounts for about 10% of all industries. Regarding “Transportation equipment manufacturing”, the ratio of parent companies and subsidiaries is approximately 90%. However, that of “Pharmaceutical manufacturing” remains at approximately 40%. “Pharmaceutical manufacturing” can be said to be an industry involving more international technology transfer for technology exports in Japan, many of which transactions are made among parent companies and subsidiaries.

○Although a lot of transactions for technology imports in Japan are made in companies excluding parent companies and subsidiaries, in “Electric equipment manufacturing” those among parent companies and subsidiaries comprise more than 50%.

○Looking at the partners of technology exports from Japan, U.S. accounts for about 40% of them all, which is first, and China follows it at about 10%. U.K. accounts for less than 10%, which is third place. On the other hand, regarding technology imports, U.S. accounts for 70% of the total, and Germany, France and U.K. follow it with about 5% each.

(1) Technology trade by industry classification

Looking at the technology trade of Japan by industry classification, the industry which had the largest amount of technology exports in the year 2007 was “Transportation equipment manufacturing.” The amount was approx. ¥1.25 trillion and accounted for 50.4% of the entire industries. It was followed by “Pharmaceutical manufacturing” (approx. ¥0.28 trillion 11.4%) and “Telecommunications equipment manufacturing” (approx. ¥0.25 trillion, 9.9%). Compared with the year 2002, there was a 5.2 point decrease in the ratio of “Transportation equipment manufacturing”, a 1.1 point increase in that of “Pharmaceutical manufacturing” and a 0.1 point increase in that of “Telecommunication equipment manufacturing.”

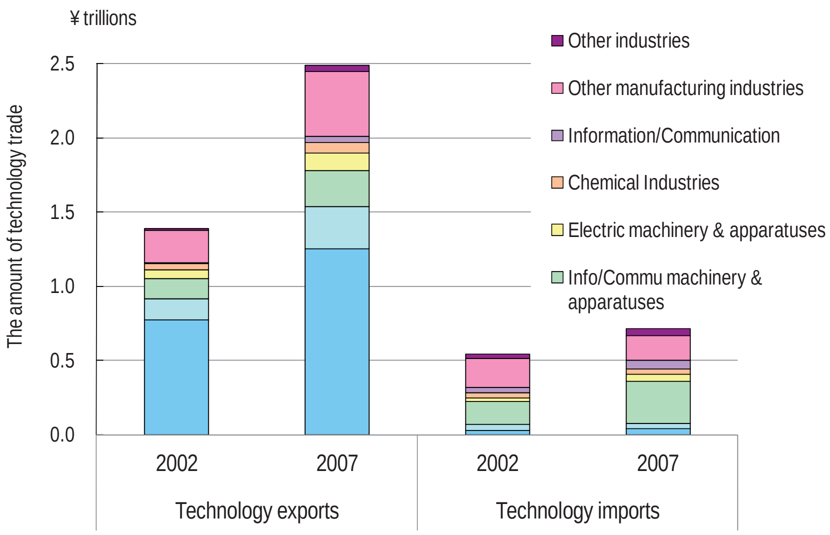
On the other hand, looking at in the year 2007, the industry which had the large amount of technology imports was “Telecommunications equipment manufacturing.” The amount was approx. ¥0.29 trillion and accounted for 40.2% of the entire industries. It was followed by “Telecommunications industry” (¥57.9 billion, 8.2%), and “Electric equipment manufacturing” (¥45.3 billion, 6.4%). Compared with the year 2002, there was a large increase of 12.2 points in the ratio of “Telecommunications equipment manufacturing”, and a 1.2 point increased in the ratio of the “Telecommunications industry.” “Pharmaceutical manufacturing” accounted for 7.7% of all industries in the year 2002; however, it decreased to 5.2% (¥36.9 billion) in the year 2007 (Chart 5-1-4 (A)).

Looking at the amount of technology trade of parent companies and subsidiaries and that of companies excluding parent companies and subsidiaries by industry classification, parent companies and subsidiaries in most industries have a large amount for technology trade. The trade among parent companies and subsidiaries in “Transportation equipment manufacturing” accounts for 90% of trade in the industry, and that in the “Telecommunication industry” accounts for 80%. In the year 2002, the trade among parent companies and subsidiaries in the "Telecommunication industry" was about 50%. Compared to this, it can be said that transactions among parent companies and subsidiaries increased more. In contrast, the ratio of companies excluding parent companies and subsidiaries in "Pharmaceutical manufacturing" and "Chemical industry" is larger, and accounts for about 60%. That of "Pharmaceutical manufacturing" in the year 2002 was 70%.

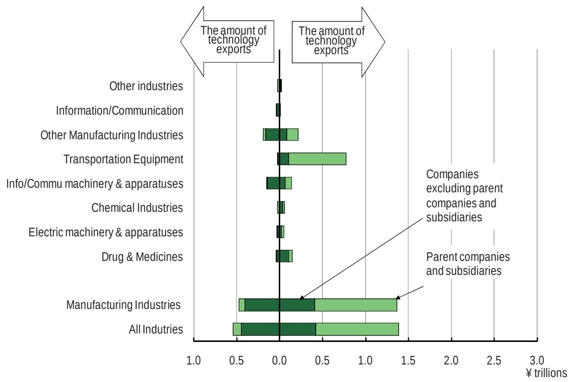
In technology imports, the ratio of companies excluding parent companies and subsidiaries was larger in most industries; however, the ratio of parent companies and subsidiaries of "Electric equipment manufacturing" was more than 50%. It was 70% in the year 2002, however, it has a trend of decreasing (Chart 5-1-4 (B and C)).

Chart 5-1-4: The technology trade of Japan by industry classification

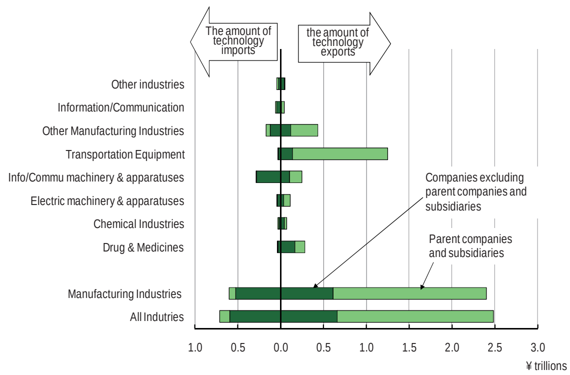
(A) The amount of technology trade



(B) The amount of technology trade of parent companies and subsidiaries, and that of companies excluding parent companies and subsidiaries (the year 2002).



(C) The amount of technology trade of parent companies and subsidiaries, and that of companies excluding parent companies and subsidiaries (the year 2007)



Note: 1) For the names of the components, the names of the components in the latest Survey of Research and Development are used.
2) For the industry classification for the year 2002, the industry classification of the Survey of Research and Development based on Japan Standard Industry Classification revised edition 2002 (the 11th) is used.
3) For the industry classification for the year 2007, used the industry classification of the Survey of Research and Development based on Japan Standard Industry Classification revised edition 2007 (the 12th) is used.
4) The targets for technology trade are patent, know-how and technical guidance.
5) Parent companies and subsidiaries are defined that their controlling share is over 50%.
Source: Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development"

(2) Technology trade by industry classification and partner

In this section, the relations related to technology between Japan and other countries are explained, by using technology trade statistics looking from the view point of industry classification and partner.

Chart 5-1-5 (A and B) shows how much trade Japan does in terms of technology trade with main countries and whether its partners are parent companies and subsidiaries or companies excluding these. Japan's amount of technology exports, which means the amount received from partners, was exceptionally large from U.S. It was approx.¥0.95 trillion. Of this, the amount from companies excluding parent companies and subsidiaries was approx. ¥0.22 trillion which accounted for 23.1%. China followed it with approx.¥0.25 trillion. Of this, the amount from companies excluding parent companies and subsidiaries was ¥83.4 billion, which accounted for 33.0%. Korea showed a large ratio of companies excluding parent companies and subsidiaries, which accounted for 70.0% of the total. Also of the transactions, with Germany that from companies excluding parent companies and subsidiaries accounted for 49.6%. The total amount of technology trade with the other countries except the 6 countries described herein was equal to that of U.S. Thailand, Taiwan and Canada, etc. were included in the other countries.

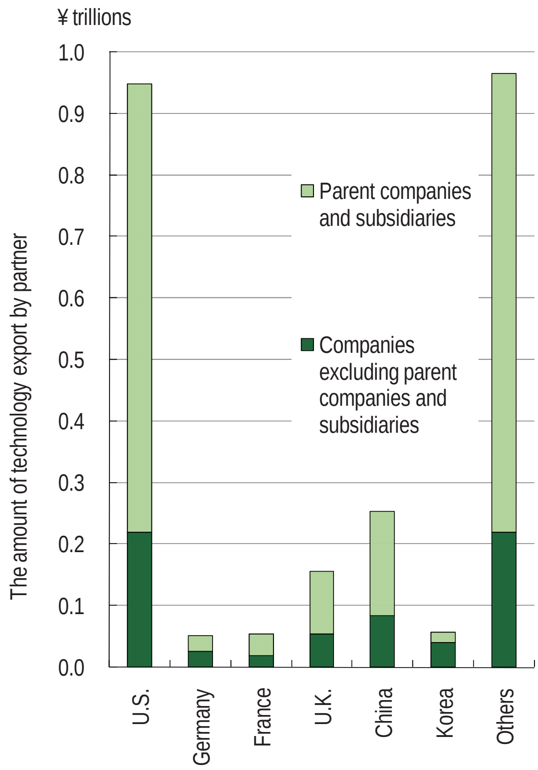
Japan's amount of technology imports, which means the amount paid to partners, was also exceptionally large toward U.S. It was approx. ¥0.51 trillion. The ratio of companies excluding parent companies and subsidiaries accounted for 84.6%. Germany followed it, with ¥37.2 billion. The ratio of companies excluding parent companies and subsidiaries accounted for 54.4%, which was less than the other countries when compared.

The left side of Chart 5-1-5 (C) is for the amount of technology exports, and the right side of the Chart is for the amount of technology imports showing partners, industry classification, and whether parent companies and subsidiaries or companies excluding parent companies and subsidiaries.

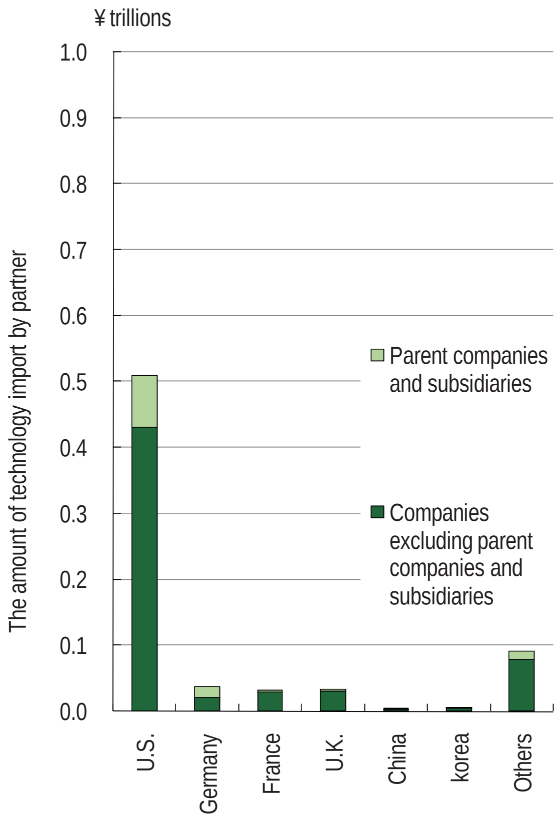
Looking at technology exports by major industries, U.S. had a large amount in "Pharmaceutical manufacturing", and U.K. followed it. However, there was a big difference between them. Looking at the ratio by companies excluding parent companies and subsidiaries, that for Germany, France and U.K. accounted for more than 80%. U.S. had a large amount in "Transportation equipment manufacturing" as well. Although U.K. followed it, there was also a big difference between them. Most transactions in this industry are done among parent companies and subsidiaries, however, as for China, the ratio of the transactions with companies excluding parent companies and subsidiaries wais high. In "Telecommunications equipment manufacturing", the amount of U.S. and China was large. This is an industry in which the ratio of companies excluding parent companies and subsidiaries is high, however, in the case of trading with China, most of the companies were parent companies and subsidiaries. Regarding the "Telecommunications industry", the amount of Germany was large, and most of the transactions were done among parent companies and subsidiaries.

Chart 5-1-5: The amount of technology trade of Japan by partner (FY 2007)

(A)The amount of technology exports by partner

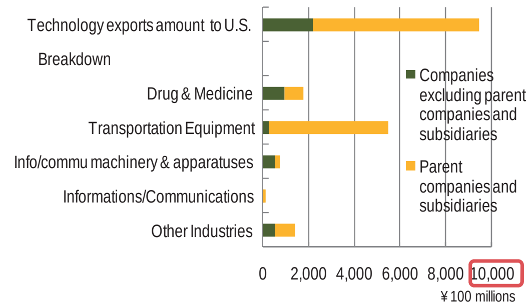


(B)The amount of technology imports by partner

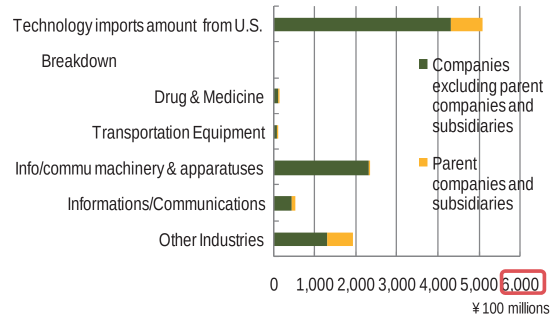


(C)The breakdown of the amount of technology trade by partner and major industry (YF 2007)

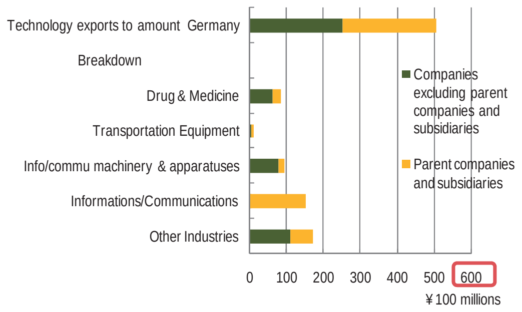
<table>
<tr><th>Country</th><th>The amount of Japan’s technology exports</th><th>The amount of Japan’s technology imports</th></tr>
<tr><td>(A)
With U.S.</td><td>



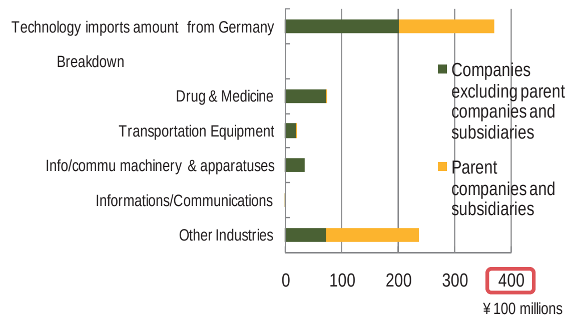
</td><td>



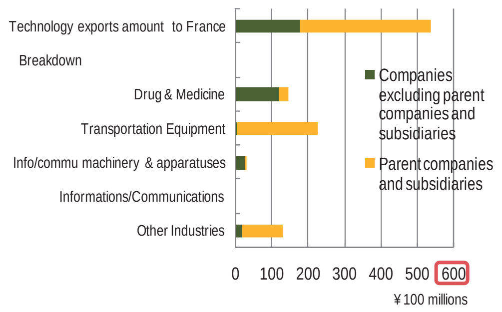
</td></tr>
<tr><td>(B)
With
Germany</td><td>



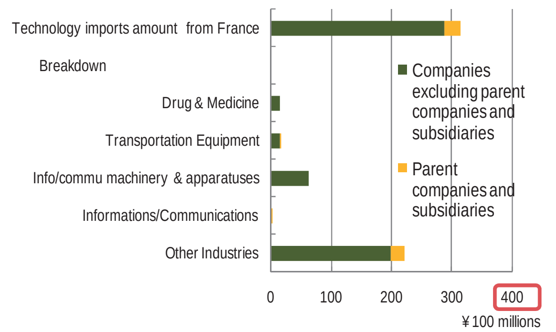
</td><td>



</td></tr>
<tr><td>(C)
With
France</td><td>



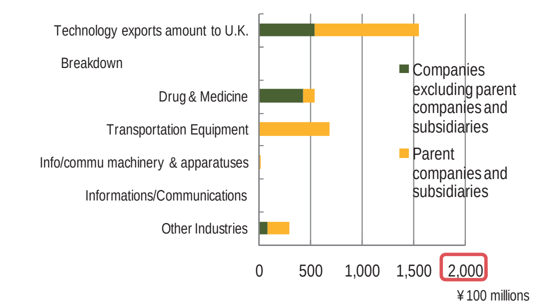
</td><td>

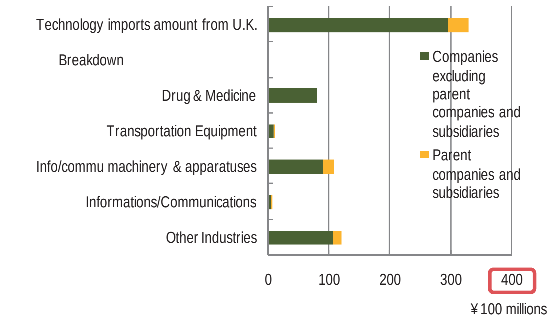


</td></tr>
</table>

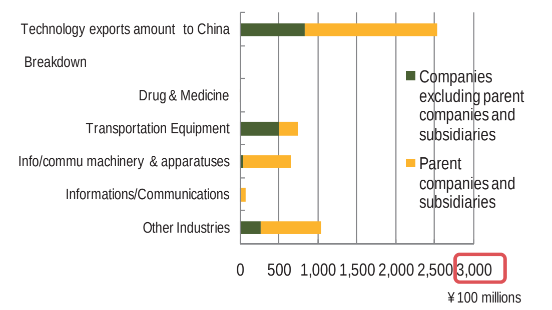
Country | **The amount of Japan's technology exports** | **The amount of Japan's technology imports**

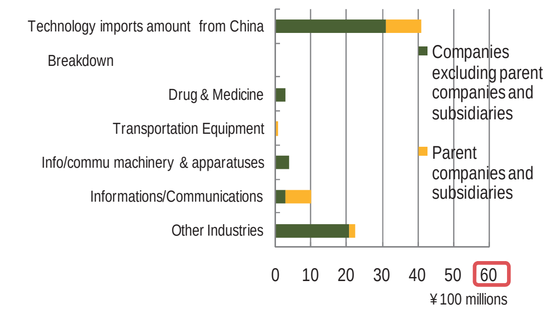
(D) With U.K.



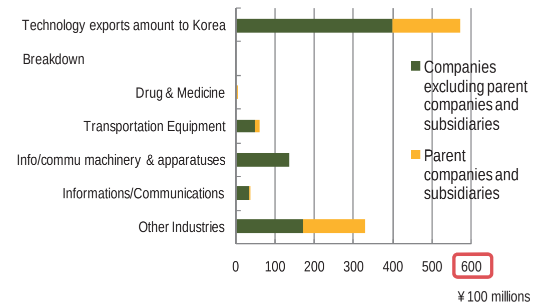


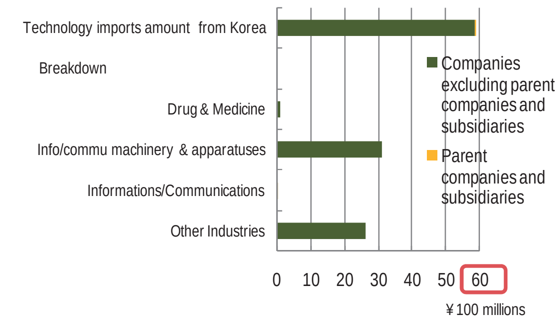
(E) With China





(F) With Korea





Note: Same as the Chart 5-1-4
Source: Ministry of Internal Affairs and Communications, "Report on the Survey of Research and Development."

5.2 The High Technology Industry Trade

Key Points

- ○The high technology industry trade of the entire world increased by about double in recent 5 years. Especially, the "Radio, Television and Communication Equipment" industry was the largest, which accounted for about 40% of the total.
- ○Looking by country, the trade scale of U.S. was large and is tending to expand. However, China has increased its trade amount rapidly during recent years and it is getting near to U.S. level. The trade amount of Germany has also rapidly expanded. Japan has followed it, and is in fourth place .
- ○The trade balance of Japan's high technology industry had an export surplus of over 3 in the early 1990s. After that, the trade balance tended to decrease and it was an export surplus of over 1.3 in 2006. Europe and China have moved around 1 since 1990s, and U.S. has shifted to less than 1 since 2000, which means it now has an import surplus.
- ○Looking at it by field, the "Radio, Television and Communication Equipment" industry showed a large ratio, and particularly the amount of the imports and the exports of China have been larger than those of U.S. in recent years.
- ○The "Radio, Television and Communication Equipment" industry and the "Medical, Precision and Optical Instruments" industry of Japan have an export surplus. The "Aircraft and Spacecraft" industry of U.S. has an export surplus, and the "Pharmaceuticals" and "Medical, Precision and Optical Instruments" industries of Germany have an export surplus.

The trade amount of the high technology industry is not the direct Source of scientific technical knowledge like the technology trade, but is an indirect indicator of scientific technical knowledge which has been turned to practical use in product development. High technology industry referred to herein follows the classifications found in the OECD statistics: "Pharmaceuticals", "Office, Accounting and Computing Machinery", "Radio, Television and Communication Equipment", "Medical, Precision and Optical Instruments", and "Aircraft and Spacecraft".

In Chart 5-2-1, regarding 30 OECD member-countries and 17 Non-OECD countries and regions [2(3)], the change in the total amount of the trade amount[(4)] (export amount and import amount) of high technology industry is shown. This can be considered as the high technology trade of the entire world.

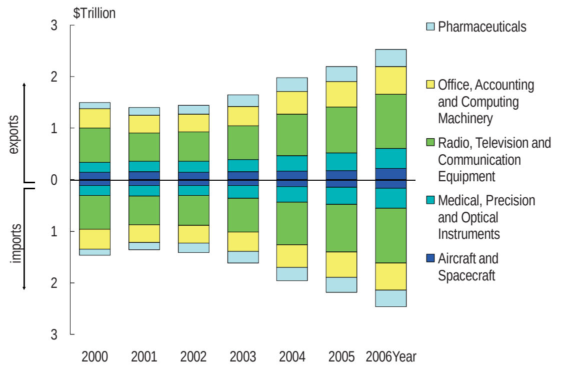
In this, the "Radio, Television and Communication Equipment" is the largest. The ratio of the total is also large; however, it has been tending to decrease compared with 2000. On the other hand, the "Pharmaceuticals" and "Medical, Precision and Optical Instruments" industries have been tending to increase.

Chart 5-2-2 shows the change in the trade balance of the entire high technology industry of 6 countries. Japan's balance is large, however, it has been tending to decrease in the long run since its peak in 1984. And it was overtaken by Korea in 2003. The trade balance of U.S., Germany, France and U.K. has been fluctuating around 1.

(3) Algeria, Brazil, Chile, China, Estonia, Hong Kong, India, Indonesia, Israel, Malaysia, the Philippines, Russia, Singapore, Slovenia, Thailand, Taiwan, and South Africa

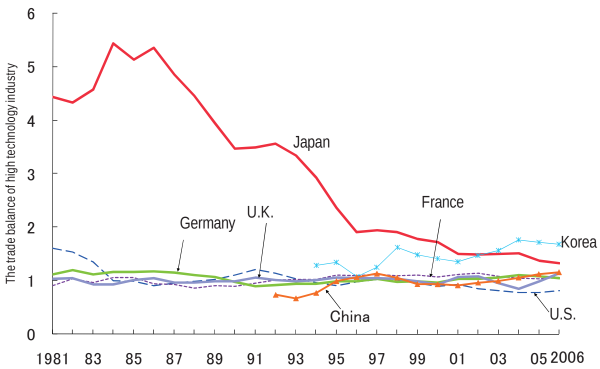
(4) Summed up the amount which each country trades with other countries.

Chart 5-2-1: The change of the trade amount of the high technology industry of 30 OECD member-countries and 17 Non-OECD countries and regions



Source: OECD, "STAN BILATERAL TRADE DATABASE (EDITION 2008)"

Chart 5-2-2: The trade balance of High Technology industries in main countries

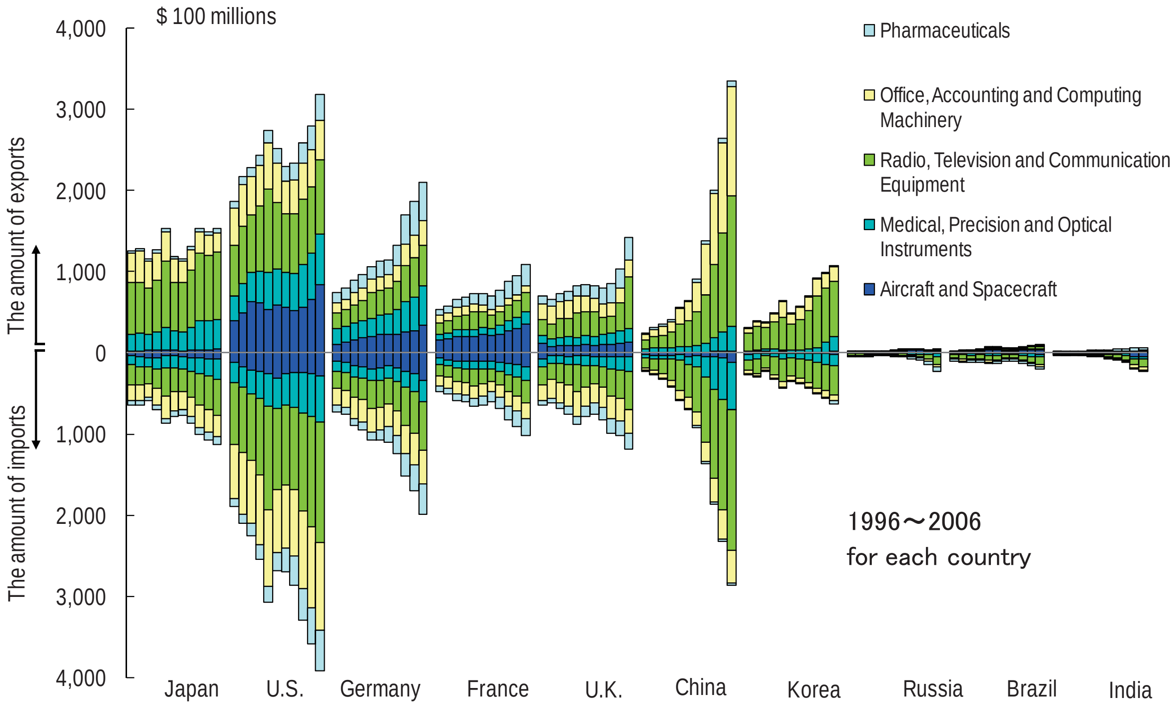


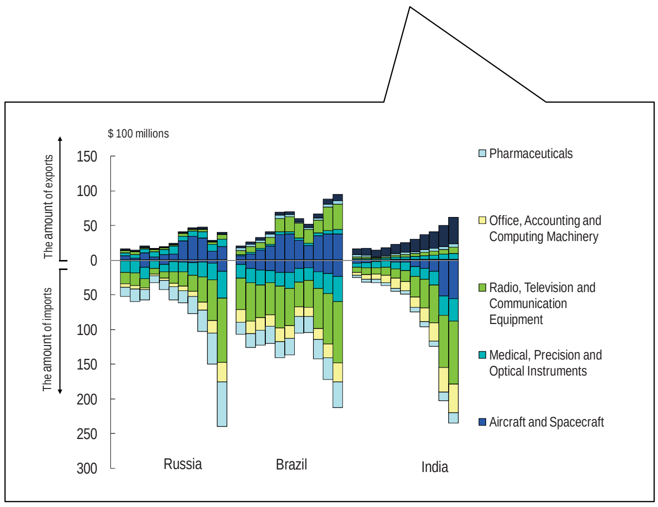
Source: The same as Chart 5-2-1

Looking at the breakdown of each country's high technology industry, the "Radio, Television and Communication Equipment" industry contributes significantly to the trade surplus of Japan's high technology industry. The "Medical, Precision and Optical Instruments" also has an export surplus; however, regarding the "Office, Accounting and Computing Machinery" industry, it has had an import surplus since 2003. The "Aircraft and Spacecraft" industry and the "Pharmaceuticals" industry have an import surplus.

The "Aircraft and Spacecraft" industry of U.S. has an export surplus. The "Pharmaceuticals" and the "Medical, Precision and Optical Instruments" industries of Germany have an export surplus. France and U.K. have an export surplus in "Aircraft and Spacecraft" and "Pharmaceuticals". The amount of the high technology trade of China has been largely expanded. Particularly, its "Radio, Television and Communication Equipment" industry has been strongly increased; however, the trade balance remains less than 1. The increase of the "Radio, Television and Communication Equipment" industry of Korea is also prominent. Looking at the Source for the BRICs whose economic development is remarkable, the import amount is large. Focusing on the export amounts that of "Aircraft and Spacecraft" is large in Russia and Brazil, and India is big on "Pharmaceuticals".

Chart 5-2-3: The change in the trade amount of high technology industry in main countries





Source: The same as Chart 5-2-1

5.3 Total Factor Productivity (TFP)

Key points

○Looking at the change in TFP which has had the contribution of labor and capital is excluded from economic growth, Japan's TFP has gradually been increasing since the early 1990s and throughout the later 1990s and into the early 2000s.

○The TFP contribution for the early 2000s is about the same level among Japan, Germany, France and U.K. The TFP contribution of U.S. is higher than that of these countries.

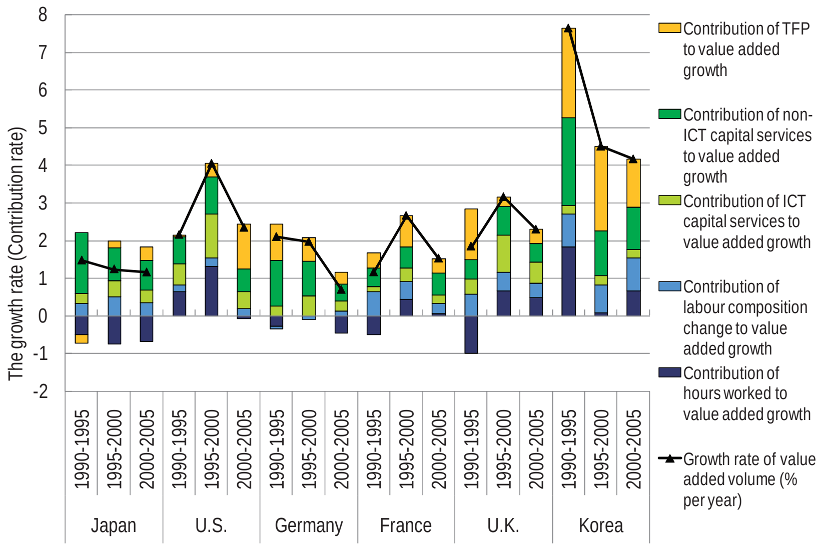
Total Factor Productivity (TFP) is the amount that remains when the contribution of the production factors of labor and capital are deducted from economic growth, and there are many cases when it is used as a surrogate indicator to show the outcome of innovation by R&D activities. In this section, the factors of economic growth of countries are divided by 5 factors (Contribution of hours worked, Contribution of labor composition change, Contribution of ICT capital services, Contribution of non-ICT capital services and Contribution of TFP) based on EU-KLEMS Database, and the Source is looked at by average amount every 5 years (Chart 5-2-4).

Although Japan's growth rate of the amount added volume has gradually been decreasing, Japan's TFP has changed so that the contribution of labor and capital is deducted from economic growth has gradually been rising over the periods 1990-1995, 1995-2000 and 2000-2005.

U.S. showed high growth rate for its amount of added volume during the period 1995-2000, however, it reduced during the period 2000-2005. In contrast, its TFP showed a larger amount during 2000-2005. Korea showed high growth rate of its amount added volume during the period 1990-1995; however, it has reduced together with its TFP after that. Germany has also had the same phenomenon.

The contribution of TFP in the early 2000s is nearly the same among Japan, Germany, France and U.K.. That of U.S. was higher than these countries.

Chart 5-2-4: The breakdown of the factors of economic growth in main countries



Note: Amounts are 5-year averages. For instance, in the case of 1990-1995, the amount for the 5 years 1990-1991, 1991-1992, 1992-1993, 1993-1994, 1994-1995.
Source: Made by EU-KLEMS Database, June 2009

Reference materials

Reference Materials : Indicators for the regions

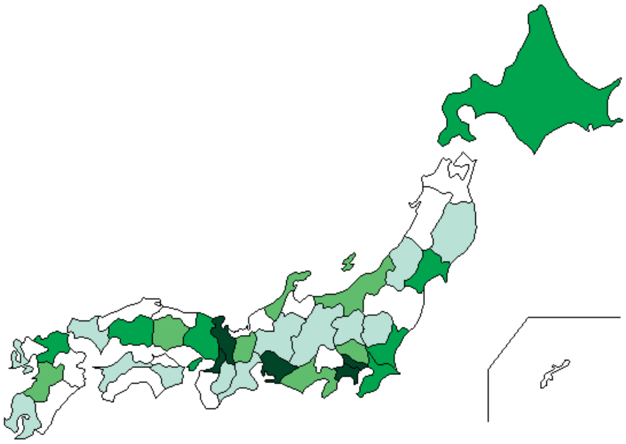
Here, regarding the following 7 items representing the situation of the output of scientific technology activities, the distributions or the changes in the values for the prefecture of Japan indicated are given.

1. The number of graduate students in national, public and private Universities and Colleges
2. The number of papers (all fields)
3. The number of papers (the field of Life sciences)
4. The number of papers (the field of Natural sciences and Engineering)
5. The balance of the papers between the field of Life sciences and the field of Natural sciences and Engineering
6. The number of patent applications
7. The number of inventors

In making these charts, the methods of grouping by the prefecture were standardized as far as possible.

1. The number of graduate students in national, public and private universities and colleges

Chart 1-1: The share of the number of graduate students in national, public and private universities and colleges
The average value for 2005-2007

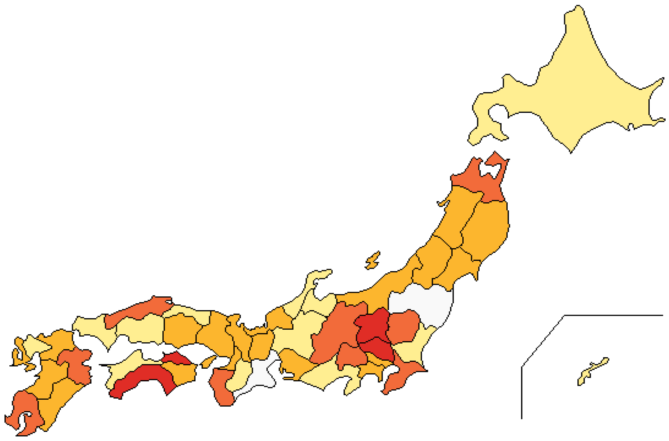


Legend	Classification			The number of prefectures
	5.00% or over	～		5
	2.00%	～	Under 5.00%	7
	1.00%	～	2.00%	7
	0.50%	～	1.00%	13
		～	0.50%	15

Top 5	Share	Low rank 5	Share
Tokyo	26.41%	Akita	0.27%
Osaka	7.07%	Miyazaki	0.27%
Kyoto	6.82%	Shimane	0.29%
Aichi	5.73%	Wakayama	0.30%
Kanagawa	5.59%	Fukushima	0.31%

Source: MEXT, “School Basic Survey”

Chart 1-2: The share increase rate of the number of graduate students in national, public and private universities and colleges
The comparison of the average values between 2000-2002 and 2005-2007



Legend	Classification			The number of prefectures
	1.15 or over	～		4
	1.05	～	Under 1.15	9
	0.95	～	1.05	19
	0.85	～	0.95	13
		～	0.85	2

Top 5	Growth rate	Low rank 5	Growth rate
Kagawa	1.45	Mie	0.82
Kouchi	1.23	Fukushima	0.83
Gunma	1.20	Ehime	0.85
Saitama	1.18	Ishikawa	0.87
Tochigi	1.14	Saga	0.88

Source: MEXT, “School Basic Survey”

【Key Points】

- The prefecture, which has major metropolitan areas, have more graduate students(Chart 1-1).
- Looking at the share increase rate from 2000-2002 to 2005-2007, those for Kanagawa Prefecture and Kochi Prefecture in Shikoku, and the Prefectures around Tokyo were high. On the other hand, there were 15 prefectures whose shares of increase rate decreased less than 0.95% (Chart 1-2).

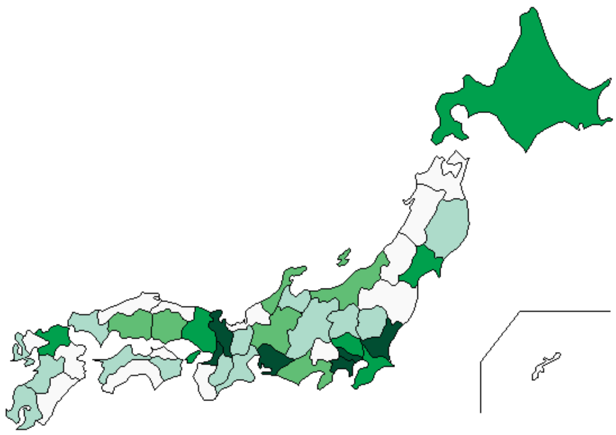
Table 1: The number of graduate students in national, public and private universities and colleges

Prefectures	3-year moving average				
	2000-2002 Unit: people	2005-2007 Unit: people	2000-2002 Share (A)	2005-2007 Share (B)	The growth rate of the share (B)/(A)
Hokkaido	8,033	9,107	3.74%	3.51%	0.94
Aomori	718	936	0.33%	0.36%	1.08
Iwate	1,132	1,358	0.53%	0.52%	1.00
Miyagi	6,767	7,853	3.15%	3.03%	0.96
Akita	575	696	0.27%	0.27%	1.01
Yamagata	1,262	1,471	0.59%	0.57%	0.97
Fukushima	815	816	0.38%	0.31%	0.83
Ibaraki	5,997	6,647	2.79%	2.56%	0.92
Tochigi	1,375	1,892	0.64%	0.73%	1.14
Gunma	1,317	1,906	0.61%	0.74%	1.20
Saitama	3,434	4,894	1.60%	1.89%	1.18
Chiba	6,704	9,166	3.12%	3.54%	1.13
Tokyo	55,424	68,467	25.77%	26.41%	1.02
Kanagawa	11,950	14,493	5.56%	5.59%	1.01
Niigata	3,905	4,595	1.82%	1.77%	0.98
Toyama	1,197	1,274	0.56%	0.49%	0.88
Ishikawa	3,895	4,105	1.81%	1.58%	0.87
Fukui	1,011	1,162	0.47%	0.45%	0.95
Yamanashi	876	1,196	0.41%	0.46%	1.13
Nagano	1,802	2,401	0.84%	0.93%	1.11
Gifu	1,901	2,155	0.88%	0.83%	0.94
Shizuoka	2,380	2,654	1.11%	1.02%	0.93
Aichi	12,703	14,855	5.91%	5.73%	0.97
Mie	1,347	1,332	0.63%	0.51%	0.82
Shiga	2,147	2,593	1.00%	1.00%	1.00
Kyoto	14,531	17,688	6.76%	6.82%	1.01
Osaka	15,738	18,339	7.32%	7.07%	0.97
Hyogo	8,121	9,861	3.78%	3.80%	1.01
Nara	2,088	2,340	0.97%	0.90%	0.93
Wakayama	582	771	0.27%	0.30%	1.10
Tottori	1,043	1,125	0.49%	0.43%	0.89
Shimane	594	758	0.28%	0.29%	1.06
Okayama	3,655	4,413	1.70%	1.70%	1.00
Hiroshima	5,416	5,989	2.52%	2.31%	0.92
Yamaguchi	1,772	1,944	0.82%	0.75%	0.91
Tokushima	2,033	2,424	0.95%	0.94%	0.99
Kagawa	502	878	0.23%	0.34%	1.45
Ehime	1,329	1,362	0.62%	0.53%	0.85
Kouchi	764	1,131	0.36%	0.44%	1.23
Fukuoka	9,691	11,925	4.51%	4.60%	1.02
Saga	912	966	0.42%	0.37%	0.88
Nagasaki	1,368	1,671	0.64%	0.64%	1.01
Kumamoto	2,219	2,636	1.03%	1.02%	0.99
Oita	750	1,011	0.35%	0.39%	1.12
Miyazaki	604	712	0.28%	0.27%	0.98
Kagoshima	1,554	2,044	0.72%	0.79%	1.09
Okinawa	1,116	1,200	0.52%	0.46%	0.89
Whole	215,048	259,214	100.00%	100.00%	

Note: "The number of graduate students" is the total of national, public and private universities and colleges. Surveyed by the address with graduate courses in which students enroll.
Source: MEXT, "School Basic Survey"

2. The number of papers (all fields)

Chart 2-1: The share of the number of papers (all fields) The average value of 2005-2007

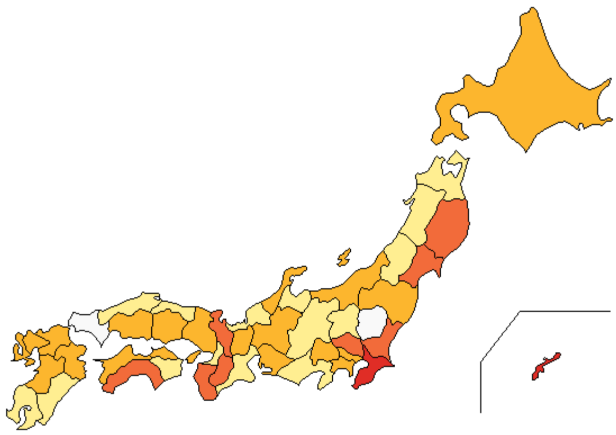


Legend	Classification			The number of prefectures
	5.00% or over	～		6
	2.00%	～	Under 5.00%	6
	1.00%	～	2.00%	6
	0.50%	～	1.00%	14
		～	0.50%	15

Top 5	Share	Low rank 5	Share
Tokyo	18.96%	Wakayama	0.33%
Osaka	8.01%	Miyazaki	0.34%
Ibaraki	7.49%	Shimane	0.35%
Kanagawa	6.97%	Yamanashi	0.37%
Kyoto	6.23%	Fukushima	0.37%

Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

Chart 2-2: The share increase rate of the number of papers (all fields)
The comparisons of the average value between 2000-2002 and 2005-2007



Legend	Classification			The number of prefectures
	1.15 or over	～		2
	1.05	～	Under 1.15	8
	0.95	～	1.05	20
	0.85	～	0.95	15
		～	0.85	2

Top 5	Growth rate	Low rank 5	Growth rate
Okinawa	1.19	Yamaguchi	0.79
Chiba	1.16	Tochigi	0.82
Wakayama	1.14	Gunma	0.87
Kochi	1.10	Mie	0.87
Saitama	1.10	Tottori	0.88

Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

【Key Points】

- Looking at the distributions of the share of the number of papers, the value is higher in the prefectures which have major metropolitan areas (Chart-2-1).
- Looking at the share increase rate, there is something to be said that Chiba Prefecture (3.09%, the 10th place) and Saitama Prefecture (2.58%, the 12th place), which share of papers during 2000-2002 was comparatively high, Increased the shares during 2005-2007 and they entered into the top 5. On the other hand, there were 17 prefectures whose shares decreased the share increase rate to less than 0.95% (Chart 2-2).

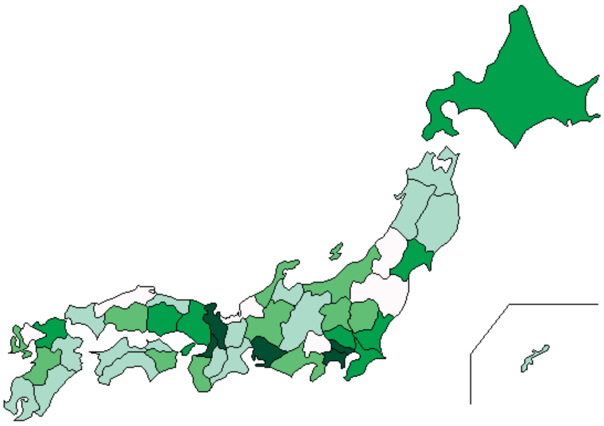
Table 2: The number of the papers (all fields)

Prefectures	3-year moving average				
	2000-2002 Unit: case	2005-2007 Unit: case	2000-2002 Share (A)	2005-2007 Share (B)	The growth rate of the share (B)/(A)
Hokkaido	2,929	3,146	3.96%	4.07%	1.03
Aomori	317	313	0.43%	0.41%	0.95
Iwate	367	404	0.50%	0.52%	1.06
Miyagi	3,018	3,339	4.08%	4.32%	1.06
Akita	347	337	0.47%	0.44%	0.93
Yamagata	387	358	0.52%	0.46%	0.89
Fukushima	275	284	0.37%	0.37%	0.99
Ibaraki	5,150	5,787	6.96%	7.49%	1.08
Tochigi	672	574	0.91%	0.74%	0.82
Gunma	721	653	0.97%	0.85%	0.87
Saitama	1,908	2,187	2.58%	2.83%	1.10
Chiba	2,289	2,761	3.09%	3.57%	1.16
Tokyo	14,092	14,645	19.04%	18.96%	1.00
Kanagawa	5,242	5,386	7.08%	6.97%	0.98
Niigata	899	899	1.22%	1.16%	0.96
Toyama	573	543	0.77%	0.70%	0.91
Ishikawa	1,004	1,034	1.36%	1.34%	0.99
Fukui	360	356	0.49%	0.46%	0.95
Yamanashi	258	283	0.35%	0.37%	1.05
Nagano	678	648	0.92%	0.84%	0.92
Gifu	772	828	1.04%	1.07%	1.03
Shizuoka	1,164	1,132	1.57%	1.47%	0.93
Aichi	4,251	4,469	5.74%	5.78%	1.01
Mie	520	475	0.70%	0.61%	0.87
Shiga	518	522	0.70%	0.68%	0.97
Kyoto	4,255	4,811	5.75%	6.23%	1.08
Osaka	6,537	6,185	8.83%	8.01%	0.91
Hyogo	2,071	2,207	2.80%	2.86%	1.02
Nara	603	663	0.81%	0.86%	1.05
Wakayama	215	257	0.29%	0.33%	1.14
Tottori	332	304	0.45%	0.39%	0.88
Shimane	293	272	0.40%	0.35%	0.89
Okayama	1,268	1,268	1.71%	1.64%	0.96
Hiroshima	1,426	1,429	1.93%	1.85%	0.96
Yamaguchi	617	509	0.83%	0.66%	0.79
Tokushima	625	591	0.84%	0.76%	0.91
Kagawa	298	306	0.40%	0.40%	0.98
Ehime	430	441	0.58%	0.57%	0.98
Kouchi	315	362	0.43%	0.47%	1.10
Fukuoka	3,130	3,312	4.23%	4.29%	1.01
Saga	329	328	0.44%	0.42%	0.95
Nagasaki	572	587	0.77%	0.76%	0.98
Kumamoto	648	660	0.88%	0.85%	0.98
Oita	281	294	0.38%	0.38%	1.00
Miyazaki	287	264	0.39%	0.34%	0.88
Kagoshima	443	425	0.60%	0.55%	0.92
Okinawa	264	328	0.36%	0.43%	1.19
Unknown	59	87	0.08%	0.11%	1.41
Whole	74,008	77,248	100.00%	100.00%	

Note: 1) The papers of the prefectures are done by fractional counts by the locations of the prefectures those institutions (faculties, research courses) to which the authors of papers belong. Especially, in case of international co-authorship papers, which institutions overseas are engaged in, the parts of Japan's institutions alone are done by fractional counts. As for the parts of institutions overseas, they are not counted. For example, if a paper is written collectively by Tokyo University (the faculty of Engineering department) (Tokyo), Tokyo University (the faculty of Natural sciences) (Tokyo), Keio University (Tokyo), Chiba University (Chiba Prefecture), Stanford University (the U.S.), the result of the count becomes third-quarters of Tokyo and a quarter of Chiba.
2) Since there are some magazines that can not be classified, the total of Chart 3 and Chart 4 is not added up to the entire figures (Chart 2).
Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

3. The number of papers (the field of Life sciences)

Chart 3-1: The share of the number of papers (the field of Life sciences)
The average value of 2005-2007

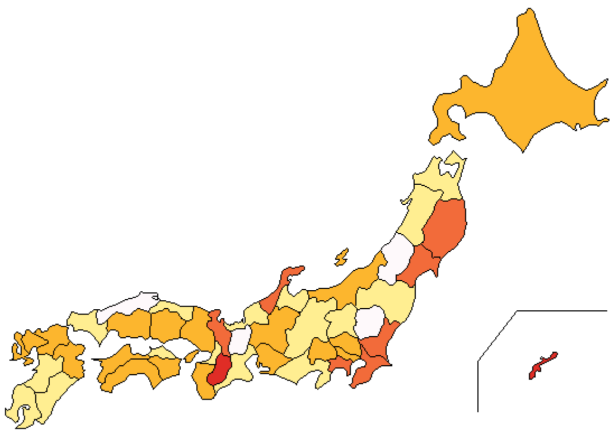


Legend	Classification			The number of prefectures
	5.00% or over	～		5
	2.00%	～	Under 5.00%	8
	1.00%	～	2.00%	11
	0.50%	～	1.00%	17
		～	0.50%	6

Top 5	Share	Low rank 5	Share
Tokyo	19.82%	Saga	0.41%
Osaka	7.80%	Yamagata	0.42%
Kyoto	5.40%	Yamanashi	0.43%
Aichi	5.13%	Shimane	0.44%
Kanagawa	5.01%	Fukushima	0.46%

Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

Chart 3-2: The share increase rate of the number of papers (the field of Life sciences)
The comparisons of the average value between 2000-2002 and 2005-2007



Legend	Classification			The number of prefectures
	1.15 or over	～		2
	1.05	～	Under 1.15	7
	0.95	～	1.05	18
	0.85	～	0.95	16
		～	0.85	4

Top 5	Growth rate	Low rank 5	Growth rate
Okinawa	1.28	Tochigi	0.80
Nara	1.21	Shimane	0.82
Chiba	1.12	Yamagata	0.82
Ibaraki	1.11	Shiga	0.85
Mikyagi	1.10	Nagano	0.87

Source: Collected by NISTEP based on Thomson Reuters Scientific "Web of Science"

【Key Points】

- Here, data for Life sciences are shown, after the fields of papers dividing into the fields of Life sciences and the fields of Natural sciences and Engineering. The fields of Life sciences are Clinical medicine, Psychiatric medicine and Psychology, Agricultural science, Biology and Biochemistry, Immunology, Microbiology, Molecular biology and Genetics, Neural science and Behavioral science, Pharmacology and Toxicology, and Botany and Zoology[1].
- The distributions of the share of the number of papers in the fields of Life sciences (Chart 3-1) tend to be different from that for all fields (Chart 2-1). There were a lot of prefectures whose shares were less than 0.5% (29) when seen from all fields; however, in case of the papers of Life sciences alone, a lot of these prefectures had shares of 0.5%-1.00% (17).
- Looking at the share increase rate, attention should be paid to the fact that Ibaraki Prefecture (3.85%, 8th place), Chiba Prefecture (3.09%, 9th place) and Miyagi Prefecture (2.51%, 12th), whose share of papers during 2000-2002 was comparatively high, then increased their shares more during 2005-2007 and as a result entered the top 5. On the other hand, there were 20 prefectures whose shares decreased and whose share increase rate was less than 0.95% (Chart 3-2).

Table 3: The number of papers (the field of Life sciences)

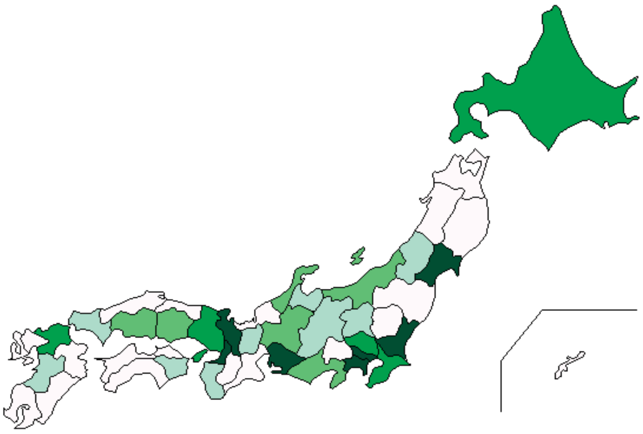
Prefectures	3-year moving average				
	2000-2002 Unit: case	2005-2007 Unit: case	2000-2002 Share(A)	2005-2007 Share(B)	The growth rate of the share(B)/(A)
Hokkaido	1,699	1,761	4.83%	4.98%	1.03
Aomori	244	222	0.69%	0.63%	0.90
Iwate	214	235	0.61%	0.67%	1.10
Miyagi	884	976	2.51%	2.76%	1.10
Akita	223	197	0.63%	0.56%	0.88
Yamagata	181	149	0.51%	0.42%	0.82
Fukushima	172	163	0.49%	0.46%	0.94
Ibaraki	1,353	1,509	3.85%	4.27%	1.11
Tochigi	520	419	1.48%	1.18%	0.80
Gunma	416	376	1.18%	1.06%	0.90
Saitama	951	950	2.71%	2.69%	0.99
Chiba	1,087	1,222	3.09%	3.46%	1.12
Tokyo	6,772	7,009	19.26%	19.82%	1.03
Kanagawa	1,639	1,771	4.66%	5.01%	1.08
Niigata	494	474	1.40%	1.34%	0.96
Toyama	318	293	0.90%	0.83%	0.92
Ishikawa	527	559	1.50%	1.58%	1.06
Fukui	192	171	0.55%	0.48%	0.88
Yamanashi	147	154	0.42%	0.43%	1.04
Nagano	381	332	1.08%	0.94%	0.87
Gifu	398	403	1.13%	1.14%	1.01
Shizuoka	680	641	1.93%	1.81%	0.94
Aichi	1,754	1,816	4.99%	5.13%	1.03
Mie	350	330	1.00%	0.93%	0.94
Shiga	272	232	0.77%	0.66%	0.85
Kyoto	1,759	1,909	5.00%	5.40%	1.08
Osaka	3,058	2,759	8.70%	7.80%	0.90
Hyogo	970	1,003	2.76%	2.84%	1.03
Nara	147	179	0.42%	0.51%	1.21
Wakayama	362	360	1.03%	1.02%	0.99
Tottori	212	203	0.60%	0.57%	0.95
Shimane	190	156	0.54%	0.44%	0.82
Okayama	798	782	2.27%	2.21%	0.97
Hiroshima	710	691	2.02%	1.95%	0.97
Yamaguchi	316	283	0.90%	0.80%	0.89
Tokushima	372	363	1.06%	1.03%	0.97
Kagawa	225	204	0.64%	0.58%	0.90
Ehime	251	249	0.71%	0.70%	0.99
Kouchi	222	227	0.63%	0.64%	1.02
Fukuoka	1,724	1,670	4.90%	4.72%	0.96
Saga	148	144	0.42%	0.41%	0.97
Nagasaki	431	431	1.22%	1.22%	1.00
Kumamoto	423	397	1.20%	1.12%	0.93
Oita	211	211	0.60%	0.60%	0.99
Miyazaki	215	188	0.61%	0.53%	0.87
Kagoshima	332	305	0.94%	0.86%	0.91
Okinawa	183	235	0.52%	0.66%	1.28
Unknown	-	-	-	-	-
Whole	35,164	35,363	100.00%	100.00%	

Note: The method of counting the papers is in accordance with the note for Table：2.
Source: Compiled by NISTEP based on Thomson Reuters Scientific “Web of Science”.

1 Refer to NISTEP, “Benchmarking Research & Development Capacity of Japan Based on Dynamic Alteration of Research Activity in the World” p.3

4. The number of papers (the field of Natural sciences and Engineering)

Chart 4-1: The share of the number of papers (the field of Natural sciences and Engineering) The average value for 2005-2007

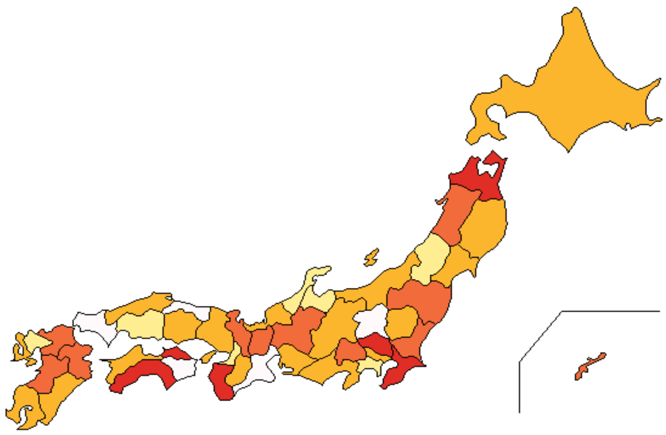


Legend	Classification			The number of prefectures
	5.00% or over	~		7
	2.00%	~	Under 5.00%	5
	1.00%	~	2.00%	6
	0.50%	~	1.00%	9
		~	0.50%	20

Top 5	Share	Low rank 5	Share
Tokyo	18.01%	Nara	0.17%
Ibaraki	10.46%	Miyazaki	0.17%
Kanagawa	8.79%	Oita	0.19%
Osaka	8.20%	Aomori	0.21%
Kyoto	6.93%	Okinawa	0.21%

Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

Chart 4-2: The share increase rate of the number of papers (the field of Natural sciences and Engineering) A comparison of average values between 2000-2002 and 2005-2007



Legend	Classification			The number of prefectures
	1.15 or over	~		6
	1.05	~	Under 1.15	11
	0.95	~	1.05	18
	0.85	~	0.95	7
		~	0.85	5

Top 5	Growth rate	Low rank 5	Growth rate
Kouchi	1.40	Yamaguchi	0.70
Kagawa	1.34	Tottori	0.80
Saitama	1.21	Mie	0.81
Aomori	1.20	Tokushima	0.83
Chiba	1.19	Gunma	0.84

Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

【Key points】

- The fields of Natural sciences and Engineering are Chemistry, Material science, Physics, Cosmic science, Computer science, Mathematics, Engineering, Environmentology and Ecology, and Geoscience.(2)
- Regarding the share of the number of papers of the fields of Natural sciences and Engineering, Ibaraki Prefecture, which enters into the second place can be mentioned as characteristic of this. And the top 5 shares of the prefectures account for about 52% (The total for all papers is about 48%, and papers in the fields of Life sciences alone is about 48%) (Chart 4-1).
- Looking at the share increase rate, Chiba Prefecture (3.11%, the 10th place) and Saitama Prefecture (2.43%, the 12th place), which had comparatively large shares of papers during 2000-2002, extended their share more during 2005-2007 and entered into the top 5 of the Prefectures. On the other hand, there were 12 prefectures whose shares were decreased and whose share increase rate was less than 0.95% (Chart 4-2).

Table 4: The number of papers (the field of Natural sciences and Engineering)

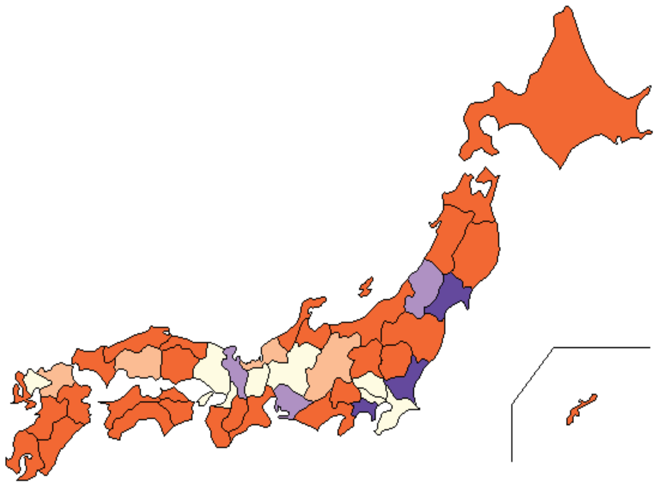
Prefectures	3-year moving average 2000-2002 Unit: case	2005-2007 Unit: case	2000-2002 Share (A)	2005-2007 Share (B)	The growth rate of the share (B)/(A)
Hokkaido	1,173	1,302	3.12%	3.26%	1.04
Aomori	65	83	0.17%	0.21%	1.20
Iwate	145	154	0.38%	0.39%	1.00
Miyagi	2,088	2,286	5.56%	5.73%	1.03
Akita	118	131	0.31%	0.33%	1.05
Yamagata	202	203	0.54%	0.51%	0.95
Fukushima	99	111	0.26%	0.28%	1.06
Ibaraki	3,733	4,171	9.94%	10.46%	1.05
Tochigi	139	142	0.37%	0.36%	0.96
Gunma	290	258	0.77%	0.65%	0.84
Saitama	914	1,173	2.43%	2.94%	1.21
Chiba	1,169	1,481	3.11%	3.71%	1.19
Tokyo	7,058	7,186	18.79%	18.01%	0.96
Kanagawa	3,534	3,508	9.41%	8.79%	0.93
Niigata	392	399	1.04%	1.00%	0.96
Toyama	244	228	0.65%	0.57%	0.88
Ishikawa	462	448	1.23%	1.12%	0.91
Fukui	161	172	0.43%	0.43%	1.01
Yamanashi	105	123	0.28%	0.31%	1.11
Nagano	285	299	0.76%	0.75%	0.99
Gifu	363	412	0.97%	1.03%	1.07
Shizuoka	456	460	1.21%	1.15%	0.95
Aichi	2,428	2,539	6.46%	6.37%	0.98
Mie	158	136	0.42%	0.34%	0.81
Shiga	236	276	0.63%	0.69%	1.10
Kyoto	2,420	2,765	6.44%	6.93%	1.08
Osaka	3,380	3,272	9.00%	8.20%	0.91
Hyogo	1,065	1,137	2.83%	2.85%	1.01
Nara	64	67	0.17%	0.17%	1.00
Wakayama	229	281	0.61%	0.70%	1.16
Tottori	111	94	0.29%	0.24%	0.80
Shimane	95	105	0.25%	0.26%	1.04
Okayama	443	451	1.18%	1.13%	0.96
Hiroshima	695	698	1.85%	1.75%	0.95
Yamaguchi	291	216	0.77%	0.54%	0.70
Tokushima	242	214	0.65%	0.54%	0.83
Kagawa	65	92	0.17%	0.23%	1.34
Ehime	172	184	0.46%	0.46%	1.01
Kouchi	86	128	0.23%	0.32%	1.40
Fukuoka	1,341	1,564	3.57%	3.92%	1.10
Saga	177	178	0.47%	0.45%	0.94
Nagasaki	131	138	0.35%	0.34%	0.99
Kumamoto	211	250	0.56%	0.63%	1.12
Oita	65	75	0.17%	0.19%	1.10
Miyazaki	65	69	0.17%	0.17%	1.00
Kagoshima	105	109	0.28%	0.27%	0.98
Okinawa	72	85	0.19%	0.21%	1.12
Unknown	-	-	-	-	-
Whole	37,562	39,889	100.00%	100.00%	

Note: The ways of the count of the papers is followed by Note of Chapter 2.
Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

(2) Refer NISTEP, "Benchmarking Research & Development Capacity of Japan Based on Dynamic Alteration of Research Activity in the World" p.3

5. The balance of papers between the field of Natural sciences and Engineering and the field of Life sciences

Chart 5: The balance of papers between the field of Natural sciences and Engineering and the field of Life sciences (Natural sciences and Engineering/Life sciences)



Legend	Classification			The number of prefectures	
	1.500 or over	～		3	The number of Natural sciences and Engineering is very large (Approximately over twice)
	1.100	～	Under 1.500	3	The number of Natural sciences and Engineering is slightly large
	0.900	～	1.100	8	The number of Natural sciences and Engineering, and Life sciences are fifty-fifty split
	0.750	～	0.900	4	The number of Life sciences is slighly large
		～	0.750	29	The number of Life sciences is very large (The number of Natural sciences and engineering is undr half of that of Life sciences)

Source: Compiled by NISTEP based on Thomson Reuters Scientific “Web of Science”

【Key Points】

- The balance of the share of the papers between the field of Natural sciences and Engineering and the field of Life sciences is shown by each prefecture (Chart 5). To calculate the balance, the share of papers in the field of Natural sciences and Engineering during 2005-2007 was divided by the share of papers in the field of Life sciences.
- All in all, there were many prefectures whose shares of papers in the field of Life sciences were larger than those for the field of Engineering. In contrast, the prefectures with a balance of over 1 among the Prefectures having over 1% of the share of the papers of the fields of Natural sciences and Engineering alone, were limited to Ibaraki Prefecture (2.45), Miyagi Prefecture (2.08), Kanagawa Prefecture (1.76), Kyoto Prefecture (1.28), and Aichi Prefecture (1.24).

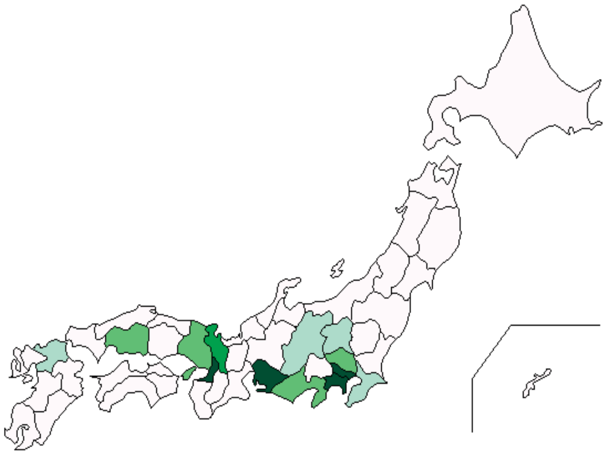
Table 5: The shares of and the balance between papers in the field of Natural sciences and Engineering and the field of Life sciences

Prefectures	Natural sciences and Engineering 3-year moving average			Life sciences 3-year moving average			Balance
	2000-2002 Share (A)	2005-2007 Share (B)	The grwoth rate of the share (B)/(A)	2000-2002 Share (C)	2005-2007 Share (D)	The growth trate of the share (D)/(C)	Natural sciences and Engineering(B)/ Life sciences(D)
Hokkaido	3.12%	3.26%	1.04	4.83%	4.98%	1.03	0.66
Aomori	0.17%	0.21%	1.20	0.69%	0.63%	0.90	0.33
Iwate	0.38%	0.39%	1.00	0.61%	0.67%	1.10	0.58
Miyagi	5.56%	5.73%	1.03	2.51%	2.76%	1.10	2.08
Akita	0.31%	0.33%	1.05	0.63%	0.56%	0.88	0.59
Yamagata	0.54%	0.51%	0.95	0.51%	0.42%	0.82	1.21
Fukushima	0.26%	0.28%	1.06	0.49%	0.46%	0.94	0.60
Ibaraki	9.94%	10.46%	1.05	3.85%	4.27%	1.11	2.45
Tochigi	0.37%	0.36%	0.96	1.48%	1.18%	0.80	0.30
Gunma	0.77%	0.65%	0.84	1.18%	1.06%	0.90	0.61
Saitama	2.43%	2.94%	1.21	2.71%	2.69%	0.99	1.09
Chiba	3.11%	3.71%	1.19	3.09%	3.46%	1.12	1.07
Tokyo	18.79%	18.01%	0.96	19.26%	19.82%	1.03	0.91
Kanagawa	9.41%	8.79%	0.93	4.66%	5.01%	1.08	1.76
Niigata	1.04%	1.00%	0.96	1.40%	1.34%	0.96	0.75
Toyama	0.65%	0.57%	0.88	0.90%	0.83%	0.92	0.69
Ishikawa	1.23%	1.12%	0.91	1.50%	1.58%	1.06	0.71
Fukui	0.43%	0.43%	1.01	0.55%	0.48%	0.88	0.89
Yamanashi	0.28%	0.31%	1.11	0.42%	0.43%	1.04	0.71
Nagano	0.76%	0.75%	0.99	1.08%	0.94%	0.87	0.80
Gifu	0.97%	1.03%	1.07	1.13%	1.14%	1.01	0.91
Shizuoka	1.21%	1.15%	0.95	1.93%	1.81%	0.94	0.64
Aichi	6.46%	6.37%	0.98	4.99%	5.13%	1.03	1.24
Mie	0.42%	0.34%	0.81	1.00%	0.93%	0.94	0.37
Shiga	0.63%	0.69%	1.10	0.77%	0.66%	0.85	1.05
Kyoto	6.44%	6.93%	1.08	5.00%	5.40%	1.08	1.28
Osaka	9.00%	8.20%	0.91	8.70%	7.80%	0.90	1.05
Hyogo	2.83%	2.85%	1.01	2.76%	2.84%	1.03	1.01
Nara	0.17%	0.17%	1.00	0.42%	0.51%	1.21	0.33
Wakayama	0.61%	0.70%	1.16	1.03%	1.02%	0.99	0.69
Tottori	0.29%	0.24%	0.80	0.60%	0.57%	0.95	0.41
Shimane	0.25%	0.26%	1.04	0.54%	0.44%	0.82	0.60
Okayama	1.18%	1.13%	0.96	2.27%	2.21%	0.97	0.51
Hiroshima	1.85%	1.75%	0.95	2.02%	1.95%	0.97	0.90
Yamaguchi	0.77%	0.54%	0.70	0.90%	0.80%	0.89	0.68
Tokushima	0.65%	0.54%	0.83	1.06%	1.03%	0.97	0.52
Kagawa	0.17%	0.23%	1.34	0.64%	0.58%	0.90	0.40
Ehime	0.46%	0.46%	1.01	0.71%	0.70%	0.99	0.65
Kouchi	0.23%	0.32%	1.40	0.63%	0.64%	1.02	0.50
Fukuoka	3.57%	3.92%	1.10	4.90%	4.72%	0.96	0.83
Saga	0.47%	0.45%	0.94	0.42%	0.41%	0.97	1.09
Nagasaki	0.35%	0.34%	0.99	1.22%	1.22%	1.00	0.28
Kumamoto	0.56%	0.63%	1.12	1.20%	1.12%	0.93	0.56
Oita	0.17%	0.19%	1.10	0.60%	0.60%	0.99	0.32
Miyazaki	0.17%	0.17%	1.00	0.61%	0.53%	0.87	0.33
Kagoshima	0.28%	0.27%	0.98	0.94%	0.86%	0.91	0.32
Okinawa	0.19%	0.21%	1.12	0.52%	0.66%	1.28	0.32
Unknown	-	-	-	-	-	-	-
Whole	100.00%	100.00%	-	100.00%	100.00%	-	-

Note: The method of counting the papers was in accordance with the note to Table 2. The values of the 3-year moving averages for the field of Natural sciences and Engineering and the field of Life sciences were the same as in Table 3 and Table 4.
Source: Compiled by NISTEP based on Thomson Reuters Scientific "Web of Science"

6. The number of patent applications

Chart 6-1: The share of the number of the patent applications
The average value between and 2005-2007

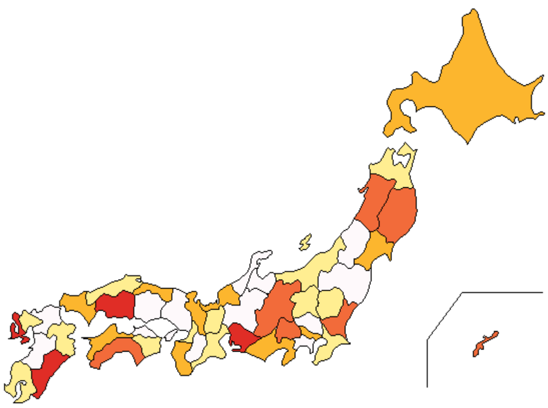


Legend	Classification			The number of prefectures
	5.00% or over	～		4
	2.00%	～	Under 5.00%	1
	1.00%	～	2.00%	4
	0.50%	～	1.00%	4
		～	0.50%	34

Top 5	Share	Low rank 5	Share
Tokyo	50.34%	Tottori	0.04%
Osaka	16.43%	Aomori	0.05%
Aichi	8.32%	Oita	0.05%
Kanagawa	6.59%	Akita	0.06%
Kyoto	2.78%	Kochi	0.06%

Source: Japan patent Office, "Japan Patent Office Annual Report"

Chart 6-2: The share increase rate of the number of the patent applications
The comparison of average values for 2005-2007



Legend	Classification			The number of prefectures
	1.15 or over	～		4
	1.05	～	Under 1.15	7
	0.95	～	1.05	10
	0.85	～	0.95	13
		～	0.85	13

Top 5	Growth rate	Low rank 5	Growth rate
Hitoshima	1.61	Gifu	0.61
Nagasaki	1.29	Fukushima	0.67
Aichi	1.27	Okayama	0.69
Miyazaki	1.24	Kumamoto	0.69
Yamanashi	1.12	Yamagata	0.72

Source: Japan Patent Office, "Japan Patent Office Annual Report"

【Key Points】

- Looking at the distributions of the share of the number of patent applications, Tokyo alone accounts for about 50%. Moreover, the top 4 prefectures alone account for about over 80% (Chart 6-1). This is because the headquarters of many business enterprises are concentrated in Tokyo and there are many cases that the addresses of the headquarters are written down when patents are applied for.
- Looking at the share increase rate from 2000-2002 to 2005-2007, the ranges of growing prefectures were in Tohoku region, Chubu region, Chugoku region, Shikoku region and Kyushu region. However, looking at the whole, there were 26 prefectures whose share increase rate was less than 0.95% and which represents over half of all prefectures (Chart 6-2).

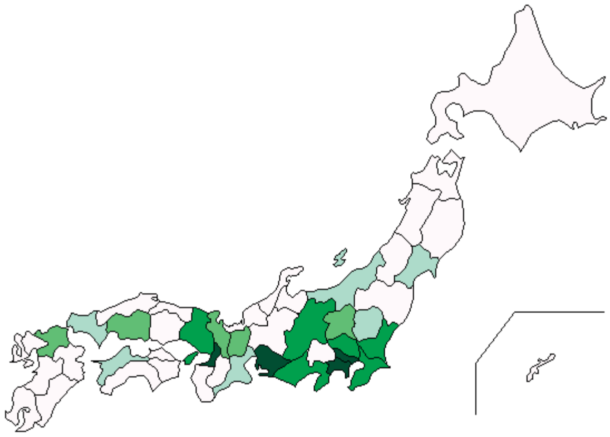
Table 6: The number of patent applications

Prefectures	3-year moving average				
	2000-2002 Unit: case	2005-2007 Unit: case	2000-2002 Share (A)	2005-2007 Share (B)	The growth rate of the share (B)/(A)
Hokkaido	1,208	1,070	0.32%	0.31%	0.97
Aomori	218	172	0.06%	0.05%	0.86
Iwate	303	302	0.08%	0.09%	1.09
Miyagi	1,370	1,299	0.36%	0.37%	1.03
Akita	199	193	0.05%	0.06%	1.06
Yamagata	519	341	0.14%	0.10%	0.72
Fukushima	475	291	0.12%	0.08%	0.67
Ibaraki	1,638	1,664	0.43%	0.48%	1.11
Tochigi	750	600	0.20%	0.17%	0.87
Gunma	3,240	2,573	0.85%	0.74%	0.87
Saitama	5,996	4,619	1.57%	1.32%	0.84
Chiba	3,570	2,943	0.94%	0.84%	0.90
Tokyo	183,045	175,955	48.02%	50.34%	1.05
Kanagawa	30,258	23,041	7.94%	6.59%	0.83
Niigata	1,415	1,163	0.37%	0.33%	0.90
Toyama	1,085	816	0.28%	0.23%	0.82
Ishikawa	1,086	743	0.28%	0.21%	0.75
Fukui	876	775	0.23%	0.22%	0.96
Yamanashi	760	783	0.20%	0.22%	1.12
Nagano	2,677	2,589	0.70%	0.74%	1.05
Gifu	2,038	1,141	0.53%	0.33%	0.61
Shizuoka	5,943	5,331	1.56%	1.53%	0.98
Aichi	24,872	29,062	6.52%	8.32%	1.27
Mie	1,580	1,286	0.41%	0.37%	0.89
Shiga	1,036	846	0.27%	0.24%	0.89
Kyoto	10,798	9,732	2.83%	2.78%	0.98
Osaka	66,433	57,431	17.43%	16.43%	0.94
Hyogo	9,586	6,719	2.51%	1.92%	0.76
Nara	625	473	0.16%	0.14%	0.83
Wakayama	801	726	0.21%	0.21%	0.99
Tottori	147	140	0.04%	0.04%	1.04
Shimane	453	393	0.12%	0.11%	0.94
Okayama	1,875	1,194	0.49%	0.34%	0.69
Hiroshima	2,476	3,663	0.65%	1.05%	1.61
Yamaguchi	1,631	1,487	0.43%	0.43%	0.99
Tokushima	662	551	0.17%	0.16%	0.91
Kagawa	644	492	0.17%	0.14%	0.83
Ehime	1,815	1,734	0.48%	0.50%	1.04
Kouchi	208	213	0.05%	0.06%	1.12
Fukuoka	4,015	2,778	1.05%	0.79%	0.75
Saga	258	219	0.07%	0.06%	0.92
Nagasaki	224	264	0.06%	0.08%	1.29
Kumamoto	478	305	0.13%	0.09%	0.69
Oita	220	184	0.06%	0.05%	0.91
Miyazaki	259	295	0.07%	0.08%	1.24
Kagoshima	314	271	0.08%	0.08%	0.94
Okinawa	222	217	0.06%	0.06%	1.07
Unknown	891	428	0.23%	0.12%	0.52
Whole	381,196	349,506	100.00%	100.00%	

Note:1) By Japanese people.
2) The column for others indicates that the prefecture cannot be determined.
3) The address of the first listed applicant is counted
Source: Japan Patent Office, "Japan Patent Office Annual Report"

7. The number of inventors

Chart 7-1: The share of the number of inventors

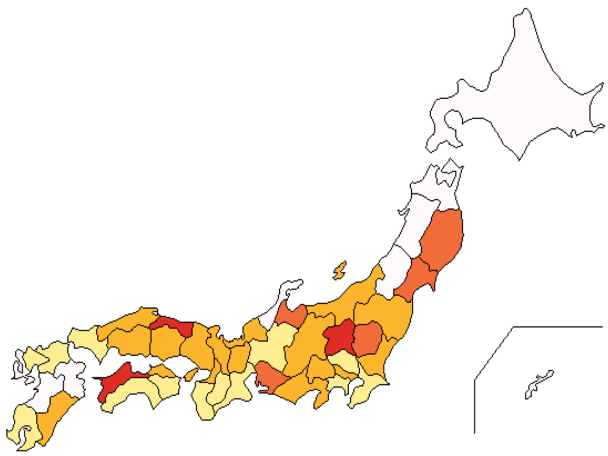


Legend	Classification			The number of prefectures
	5.00% or over	～		4
	2.00%	～	Under 5.00%	6
	1.00%	～	2.00%	5
	0.50%	～	1.00%	6
		～	0.50%	26

Top 5	Share	Low rank 5	Share
Tokyo	32.73%	Okinawa	0.04%
Osaka	13.75%	Kouchi	0.06%
Kanagawa	10.62%	Aomori	0.07%
Aichi	9.36%	Akita	0.08%
Ibaraki	3.46%	Saga	0.08%

Source: Japan Patent Office, "Japan Patent Office Annual Report"

Chart 7-2: The share increase rate of the number of inventors
A comparison of the values for 2005 and those for 2007



Legend	Classification			The number of prefectures
	1.15 or over	～		3
	1.05	～	Under 1.15	5
	0.95	～	1.05	17
	0.85	～	0.95	13
		～	0.85	9

Top 5	Growth rate	Low rank 5	Growth rate
Aichi	1.27	Okinawa	0.64
Tottori	1.22	Yamagata	0.73
Gunma	1.16	Akita	0.74
Iwate	1.13	Hokkaido	0.81
Aichi	1.12	Aomori	0.83

Source: Japan Patent Office, "Japan Patent Office Annual Report"

【Key Points】

- Regarding addresses when patents are applied for, there are many cases where applicant companies write down the addresses of the headquarters in the space for applicants. However, it is generally considered that the addresses of the inventors themselves are written down in them. When comparing the status of the patent applications which are the results of intellectual production activities with the distribution of the share of the number of applications (Chart 6-1) and the distribution of the share of actual inventors, it shows that the prefectures which have high shares for inventors are widely located around the prefectures which have the largest shares of patent applications.
- Looking at the share increase rate of inventors from 2005 to 2007, attention should be given to the fact that Aichi Prefecture whose share in 2005 was comparatively high (8.38%; 4th place) extended its share further in 2007. On the other hand, there were 22 prefectures whose shares decreased and whose share increase rate was less than 0.95% (Chart 7-2).

Table 7: The number of inventors

Prefectures	The number of inventors (Unit：people)			Share		
	2005	2006	2007	2005 (A)	2007 (B)	The growth rate of the share (B)/(A)
Hokkaido	3,503	3,037	2,571	0.44%	0.36%	0.81
Aomori	629	493	469	0.08%	0.07%	0.83
Iwate	774	772	788	0.10%	0.11%	1.13
Miyagi	4,348	4,030	4,276	0.55%	0.60%	1.09
Akita	816	787	548	0.10%	0.08%	0.74
Yamagata	1,518	1,170	1,000	0.19%	0.14%	0.73
Fukushima	2,175	1,695	1,901	0.27%	0.27%	0.97
Ibaraki	26,312	25,309	24,801	3.31%	3.46%	1.04
Tochigi	7,154	6,854	7,112	0.90%	0.99%	1.10
Gunma	8,514	8,951	8,942	1.07%	1.25%	1.16
Saitama	28,292	24,493	23,183	3.56%	3.23%	0.91
Chiba	19,699	18,874	16,132	2.48%	2.25%	0.91
Tokyo	247,803	234,463	234,603	31.22%	32.73%	1.05
Kanagawa	98,900	87,189	76,115	12.46%	10.62%	0.85
Niigata	4,101	4,005	3,872	0.52%	0.54%	1.05
Toyama	2,572	2,548	2,471	0.32%	0.34%	1.06
Ishikawa	2,319	1,877	1,751	0.29%	0.24%	0.84
Fukui	1,938	1,861	1,669	0.24%	0.23%	0.95
Yamanashi	2,452	2,202	2,284	0.31%	0.32%	1.03
Nagano	20,098	18,027	17,997	2.53%	2.51%	0.99
Gifu	3,326	2,714	2,712	0.42%	0.38%	0.90
Shizuoka	23,255	22,411	19,990	2.93%	2.79%	0.95
Aichi	66,501	65,123	67,071	8.38%	9.36%	1.12
Mie	6,072	5,642	5,116	0.76%	0.71%	0.93
Shiga	10,906	11,192	10,247	1.37%	1.43%	1.04
Kyoto	15,537	15,484	14,222	1.96%	1.98%	1.01
Osaka	109,008	102,214	98,560	13.73%	13.75%	1.00
Hyogo	21,727	20,412	19,232	2.74%	2.68%	0.98
Nara	2,121	1,738	1,751	0.27%	0.24%	0.91
Wakayama	3,089	3,107	2,490	0.39%	0.35%	0.89
Tottori	979	996	1,079	0.12%	0.15%	1.22
Shimane	984	840	896	0.12%	0.12%	1.01
Okayama	3,408	3,053	3,134	0.43%	0.44%	1.02
Hiroshima	11,228	11,034	10,078	1.41%	1.41%	0.99
Yamaguchi	4,652	4,207	3,831	0.59%	0.53%	0.91
Tokushima	1,690	1,606	1,358	0.21%	0.19%	0.89
Kagawa	1,624	1,520	1,420	0.20%	0.20%	0.97
Ehime	5,620	6,151	6,456	0.71%	0.90%	1.27
Kouchi	527	667	411	0.07%	0.06%	0.86
Fukuoka	10,295	9,749	8,529	1.30%	1.19%	0.92
Saga	758	668	585	0.10%	0.08%	0.85
Nagasaki	1,469	1,133	1,122	0.19%	0.16%	0.85
Kumamoto	1,148	935	865	0.14%	0.12%	0.83
Oita	936	904	708	0.12%	0.10%	0.84
Miyazaki	763	849	702	0.10%	0.10%	1.02
Kagoshima	1,779	1,865	1,481	0.22%	0.21%	0.92
Okinawa	534	370	311	0.07%	0.04%	0.64
Whole	793,853	745,221	716,842	100.00%	100.00%	

Note: 1) The number of people is the total numbers of people who are abstracted from “Applicants” who were written on one application.
2) Excluding international applications (PCT applications)
Source: Japan Patent Office, “Patent Administration Annual Report”

Statistical Reference A Population of the main countries

(Unit: thousand people)

Year	Japan	U.S.	Germany	France	U.K.	China	Korea	EU-15	EU-27
1981	117,902	229,966	61,682	55,419	56,357	1,000,720	38,723	341,071	-
1982	118,728	232,188	61,638	55,751	56,291	1,016,540	39,326	341,786	-
1983	119,536	234,307	61,423	56,049	56,316	1,030,080	39,910	342,292	-
1984	120,305	236,348	61,175	56,321	56,409	1,043,570	40,406	342,773	-
1985	121,049	238,466	61,024	56,600	56,554	1,058,510	40,806	343,383	-
1986	121,660	240,651	61,066	56,886	56,684	1,075,070	41,214	344,125	-
1987	122,239	242,804	61,077	57,192	56,804	1,093,000	41,622	344,843	-
1988	122,745	245,021	61,450	57,519	56,916	1,110,260	42,031	345,962	-
1989	123,205	247,342	62,063	57,859	57,076	1,127,040	42,449	347,427	-
1990	123,611	250,132	63,254	58,171	57,237	1,143,330	42,869	349,511	-
1991	124,101	253,493	79,984 a	58,459	57,439	1,158,230	43,296	367,272 a	-
1992	124,567	256,894	80,594	58,745	57,585	1,171,710	43,748	368,865	-
1993	124,938	260,255	81,179	58,995	57,714	1,185,170	44,195	370,343	-
1994	125,265	263,436	81,422	59,210	57,862	1,198,500	44,642	371,368	-
1995	125,570	266,557	81,661	59,419	58,025	1,211,210	45,093	372,313	477,893
1996	125,859	269,667	81,896	59,624	58,164	1,223,890	45,525	373,285	478,680
1997	126,157	272,912	82,052	59,831	58,314	1,236,260	45,954	374,225	479,425
1998	126,472	276,115	82,029	60,047	58,475	1,247,610	46,287	375,045	480,050
1999	126,667	279,295	82,087	60,348	58,684	1,257,860	46,617	376,136	480,965
2000	126,926	282,430	82,188	60,751	58,886	1,267,430	47,008	377,978	482,657
2001	127,291	285,454	82,340	61,182	59,113	1,276,270	47,357	379,685	483,774
2002	127,435	288,427	82,482	61,616	59,322	1,284,530	47,622	381,682	485,591
2003	127,619	291,289	82,520	62,042	59,554	1,292,270	47,859	383,907	487,628
2004	127,687	294,056	82,501	62,445	59,834	1,299,880	48,039	386,220	489,798
2005	127,768	296,940	82,464	62,818	60,218	1,307,560	48,138	388,491	491,958
2006	127,770	299,801	82,366	63,195	60,587	1,314,480	48,297	390,567	493,926
2007	127,771	302,045	82,262	63,573	60,783	-	48,456	392,534	-

Note: a: Break in series with previous year for which data is available.
<Germany> Until 1990, data is for the former West Germany. After 1991, data is for the unified Germany.
Source :<Japan> Ministry of Internal Affairs and Communications, Statistics Bureau "Population Estimates" Annual Report (Web site).
<U.S.>The Executive Office of the President, "Economic Report of the President 2008" (Web site).
<Germany, France, the U.K., Korea, EU>OECD, "Main Science and Technology Indicators 2008/2".
<China>National Bureau of Statistics of China, China Statistical Yearbook 2001, 2007 (Web site).

Statistical Reference B Labor force population of the main countries

(Unit: thousand people)

Year	Japan	U.S.	Germany	France	U.K.	China	Korea	EU-15	EU-27
1981	56,610	108,670	28,305	23,672	26,740	-	14,683	146,966	-
1982	57,770	110,204	28,558	23,899	26,678	-	15,032	148,056	-
1983	58,070	111,550	28,605	23,969	26,610	-	15,118	148,958	-
1984	58,650	113,544	28,298	24,118	27,235	-	14,997	149,888	-
1985	58,710	115,461	28,434	24,162	27,486	-	15,592	150,663	-
1986	59,550	117,834 a	28,768	24,318	27,491	-	16,116	151,759	-
1987	60,610	119,865	29,036	24,442	27,943	-	16,873	154,071	-
1988	61,360	121,669	29,220	24,540	28,345	-	17,305	155,723	-
1989	62,630	123,869	29,624	24,720	28,764	-	18,023	157,147	-
1990	63,680	125,840 a	30,771	24,824	28,909	651,322	18,539	159,650	-
1991	65,040	126,346	39,577 a	24,984	28,545	658,432	19,109	168,511 a	-
1992	65,660	128,105	39,490	25,087	28,306	665,159	19,499	168,210	-
1993	66,070	129,200	39,557	25,139	28,103	672,281	19,806	166,947 a	-
1994	65,870	131,056 a	39,492	25,312	28,052	679,314	20,353	167,344	-
1995	66,100	132,304	39,376	25,348	28,024	685,846	20,845	167,788	217,681
1996	66,630	133,943	39,550	25,611	28,134	695,028	21,288	169,009	218,241
1997	67,260	136,297 a	39,804	25,758	28,252	703,968	21,782	170,190	219,271
1998	67,170	137,673 a	40,131	26,027	28,223	712,080	21,428	171,974	220,895
1999	67,150	139,368 a	39,614	26,324	28,508	719,690	21,666	172,984	221,873
2000	67,380	142,583 a	39,533	26,606	28,740	726,800	22,134	174,850	223,697
2001	66,990	143,734	39,686	26,838	28,774	737,060	22,471	175,697	224,523
2002	66,220	144,863	39,641	27,095	29,030	745,100	22,921	177,436	225,288
2003	66,070	146,510 a	39,507	27,404	29,235	752,320	22,957	178,987	225,983
2004	65,760	147,401 a	39,948	27,453	29,369	760,270	23,417	180,776	227,939
2005	65,800	149,320 a	41,040	27,576	29,557	766,640	23,743	183,549	230,872
2006	65,980	151,428 a	41,521	27,575	29,942	772,470	23,978	185,808	233,339
2007	66,270	153,124 a	41,685	27,742 b	30,006	-	24,216	187,546	235,102
2008	66,010	-	-	-	-	-	-	-	-

Note: a: Break in series with previous year for which data is available.
b: Calculated estimates of OECD based on the materials of each country.
Source: <Japan>Ministry of Internal Affairs and Communications, Labour Force Survey, Labor Force Population, The value of December of each year (Web site)
<U.S.>Bureau of Labor Statistics, U.S. Department of Labour, Current Population Survey (Web site)
<Germany, France, U.K., China, Korea, EU>OECD, "Main Science and Technology Indicators 2008/2

Statistical Reference C Gross Domestic Product (GDP) of the main countries

(A) National Currencies

Year	Japan (Billion yen)	U.S. (Billion dollar)	Germany (Billion euro)	France (Billion euro)	U.K. (Billion pound)	China (Billion yuan)	Korea (Billion won)	EU-15 (Billion dollar)	EU-27 (Billion dollar)
1981	261,914.3	3,128.4	825.8	500.8	253.6	489.2	48,672.7	3,443.8	-
1982	274,572.2	3,255.0	860.2	574.4	277.7	532.3	55,721.7	3,687.9	-
1983	286,278.2	3,536.7	898.3	636.6	303.6	596.3	65,559.0	3,898.6	-
1984	306,809.3	3,933.2	942.0	693.1	325.3	720.8	75,126.3	4,144.0	-
1985	327,433.2	4,220.3	984.4	743.9	356.1	901.6	84,061.0	4,378.6	-
1986	341,920.5	4,462.8	1,037.1	802.4	382.8	1,027.5	98,110.2	4,601.2	-
1987	359,508.9	4,739.5	1,065.1	845.2	421.6	1,205.9	115,164.3	4,862.4	-
1988	386,736.1	5,103.8	1,123.3	911.2	470.7	1,504.3	137,111.5	5,244.3	-
1989	414,742.9	5,484.4	1,200.7	980.5	517.1	1,699.2	154,753.4	5,642.3	-
1990	449,997.1	5,803.1	1,306.7	1,033.0	560.9	1,866.8	186,690.9	6,033.6	-
1991	472,261.4	5,995.9	1,534.6 a	1,070.0	589.7	2,178.1	226,007.6	6,485.7 a	-
1992	483,837.5	6,337.7	1,646.6	1,107.8	614.8	2,692.3	257,525.4	6,714.1	-
1993	480,661.5	6,657.4	1,694.4	1,114.7	645.5	3,533.4	290,675.6	6,845.5	-
1994	487,017.5	7,072.2	1,780.8	1,154.7	684.1	4,819.8	340,208.3	7,187.4	-
1995	496,457.3	7,397.7	1,848.5	1,194.6	723.1	6,079.4	398,837.7	7,522.5	8,330.2
1996	508,432.8	7,816.9	1,876.2	1,227.3	768.9	7,117.7	448,596.4	7,813.9	8,671.0
1997	513,306.4	8,304.3	1,915.6	1,267.4	815.9	7,897.3	491,134.8	8,174.3	9,071.6
1998	503,304.4	8,747.0	1,965.4	1,323.7	865.7	8,440.2	484,102.8	8,550.4	9,485.8
1999	499,544.2	9,268.4	2,012.0	1,368.0	911.9	8,967.7	529,499.7	8,896.2	9,866.4
2000	504,118.8	9,817.0	2,062.5	1,441.4	958.9	9,921.5	578,664.5	9,502.3	10,531.2
2001	493,644.7	10,128.0	2,113.2	1,497.2	1,003.3	10,965.5	622,122.6	10,018.3	11,120.8
2002	489,875.2	10,469.6	2,143.2	1,548.6	1,055.8	12,033.3	684,263.5	10,417.7	11,599.8
2003	493,747.5	10,960.8	2,163.8	1,594.8	1,118.2	13,582.3	724,675.0	10,682.4	11,931.6
2004	498,490.6	11,685.9	2,210.9	1,660.2	1,184.3	15,987.8	779,380.5	11,215.8	12,570.8
2005	503,186.7	12,421.9	2,243.2	1,726.1	1,234.0	18,386.8	810,515.9	11,606.0	13,037.2
2006	510,924.7	13,178.4	2,321.5	1,807.5	1,303.9	21,087.1	848,044.6	12,269.9	13,837.6
2007	515,857.9	13,807.5	2,422.9	1,892.2	1,381.6	-	901,188.6	12,900.5	14,600.5

(B) OECD Purchasing Power Parity Equivalent

(Unit:Billion yen)

Year	Japan	U.S.	Germany	France	U.K.	China	Korea	EU-15	EU-27
1981	261,914.3	683,321.0	170,458.1	126,813.6	110,794.5	62,403.8	25,562.9	752,214.1	-
1982	274,572.2	684,488.1	173,416.3	132,676.3	115,326.7	69,498.1	28,022.3	775,532.1	-
1983	286,278.2	732,352.5	180,308.5	137,436.2	122,211.6	78,843.7	31,775.7	807,282.6	-
1984	306,809.3	810,059.8	191,321.8	143,933.0	129,347.6	93,769.2	35,447.7	853,476.2	-
1985	327,433.2	862,783.7	200,298.3	149,774.2	137,016.1	108,950.9	38,733.6	895,153.2	-
1986	341,920.5	907,360.9	208,299.5	156,007.9	144,838.8	120,684.1	43,561.8	935,492.6	-
1987	359,508.9	940,403.8	211,823.1	160,340.9	151,908.3	135,186.1	48,537.2	964,781.1	-
1988	386,736.1	986,575.8	221,352.5	168,993.4	160,719.5	151,555.9	54,112.0	1,013,744.3	-
1989	414,742.9	1,044,969.4	235,286.7	180,094.1	168,028.9	160,970.4	59,095.0	1,075,046.0	-
1990	449,997.1	1,090,130.7	253,609.3	189,302.1	173,401.6	171,371.2	66,057.2	1,133,436.4	-
1991	472,261.4	1,120,272.0	297,419.5 a	196,842.4	176,056.0	192,846.5	74,384.8	1,211,787.6 a	-
1992	483,837.5	1,176,347.5	308,995.6	202,784.5	179,308.1	224,518.2	80,039.2	1,246,214.5	-
1993	480,661.5	1,214,335.2	308,140.9	201,996.5	184,343.2	254,579.0	85,398.7	1,248,650.2	-
1994	487,017.5	1,264,516.9	316,620.2	206,661.9	192,478.0	288,194.2	92,774.2	1,285,116.1	-
1995	496,457.3	1,289,747.5	320,979.9	209,973.0	197,144.0	317,995.6	100,770.1	1,311,503.9	1,452,328.4
1996	508,432.8	1,329,776.3	321,852.6	211,464.1	204,189.4	347,807.9	107,210.2	1,329,270.4	1,475,071.0
1997	513,306.4	1,397,803.9	325,819.9	219,121.9	216,425.9	382,433.4	112,868.5	1,375,917.1	1,526,961.6
1998	503,304.4	1,456,583.5	331,313.7	227,969.0	223,516.5	412,389.4	105,163.8	1,423,839.2	1,579,618.4
1999	499,544.2	1,501,812.1	334,410.0	230,926.0	226,413.8	438,009.4	113,655.7	1,441,503.3	1,598,707.4
2000	504,118.8	1,521,076.4	330,078.3	237,520.5	233,325.5	463,913.8	119,734.7	1,472,308.9	1,631,736.0
2001	493,644.7	1,513,506.0	330,639.0	243,678.9	239,341.5	496,242.4	122,799.4	1,497,118.9	1,661,867.7
2002	489,875.2	1,505,258.4	327,150.1	246,021.6	241,856.5	529,995.2	127,803.4	1,497,802.5	1,667,754.8
2003	493,747.5	1,531,094.6	329,663.1	237,711.0	243,913.4	578,497.6	127,243.4	1,492,211.3	1,666,697.9
2004	498,490.6	1,569,725.9	331,702.8	237,579.2	251,859.9	629,856.7	131,827.5	1,506,581.9	1,688,591.8
2005	503,186.7	1,609,281.4	325,591.9	242,394.8	246,370.2	690,930.3	133,098.3	1,503,578.6	1,688,989.6
2006	510,924.7	1,640,243.8	327,441.9	246,322.1	248,935.6	758,235.2	138,515.3	1,527,170.1	1,722,288.3
2007	515,857.9	1,661,198.9	330,031.7	250,735.5	249,654.3	-	144,285.8	1,552,074.3	1,756,609.8

Note: <Japan>Fiscal year. The data before the year 1993 is calculated based on the 93SNA (Benchmark year = 1995). The data after 1994 is calculated based on the93SNA (Benchmark year = 2000).
<Germany>Until 1990, data is for the former West Germany. After 1991, data is for the unified Germany.
<China>Fiscal data.

Source :<Japan>Cabinet Office, Economic and Social Research Institute "SNA(System of National Accounts) Time-series table by demand component (93SNA)" (Web site).
<U.S.>Bureau of Economic Analysis, "National Economic Accounts" (Web site).
<Germany, France, U.K., Korea, EU>OECD, "Main Science and Technology Indicators 2008/2".
<China>State Statistical Bureau of the People's Republic of China, China Statistical Yearbook 2007 (Web site).

Statistical Reference D Gross Domestic Product (GDP) deflator of the main countries

Year	Japan	U.S.	Germany	France	U.K.	China	Korea
1981	82.8	59.1	66.9	53.1	44.3	-	33.0
1982	84.6	62.7	70.0	59.5	47.6	-	35.2
1983	86.6	65.1	71.9	65.1	50.3	-	37.4
1984	89.3	67.6	73.4	69.8	52.5	-	39.6
1985	91.4	69.7	74.9	73.7	55.5	-	41.5
1986	92.9	71.2	77.2	77.6	57.4	-	43.8
1987	93.2	73.2	78.2	79.8	60.4	-	46.3
1988	93.9	75.7	79.5	82.2	64.3	-	49.8
1989	96.1	78.6	81.8	84.9	69.1	-	52.7
1990	98.4	81.6	84.6	87.2	74.4	-	58.2
1991	101.3	84.5	87.2 a	89.4	79.3	56.4	64.4
1992	102.9	86.4	91.5	91.3	82.5	60.3	69.3
1993	103.5	88.4	94.9	92.7	84.7	70.9	73.7
1994	103.6	90.3	97.2	94.0	86.0	85.3	79.5
1995	103.0	92.1	99.0	95.2	88.3	96.8	85.4
1996	102.4	93.8	99.5	96.7	91.4	103.2	89.8
1997	103.1	95.4	99.8	97.7	94.1	104.0	93.9
1998	103.1	96.5	100.3	98.6	96.6	102.2	99.4
1999	101.8	97.9	100.7	98.6	98.7	99.9	99.3
2000	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2001	98.8	102.4	101.2	102.0	102.2	101.9	103.5
2002	97.2	104.2	102.6	104.4	105.4	103.1	106.5
2003	95.7	106.4	103.9	106.4	108.6	106.3	109.4
2004	94.7	109.5	104.8	108.1	111.4	113.4	112.3
2005	93.5	113.1	105.6	110.3	114.0	121.2	112.1
2006	92.6	116.7	106.1	113.0	117.0	128.3	111.5
2007	91.9 b	119.8	108.1	115.8	120.3	-	112.9

Note: <Germany>Until 1990, data is for the former West Germany. After 1991, data is for the unified Germany.
a: This data has impaired continuity with the data for the previous fiscal year.
b: Calculated estimates of OECD Secretariat based on the materials of each country.
Source: OECD, "Main Science and Technology Indicators 2008/1"

Statistical Reference E Purchasing Power Parity of the main countries

Year	Japan [yen／yen]	U.S. [yen／dollar]	Germany [yen／euro]	France [yen／euro]	U.K. [yen／pound]	China [yen／yuan]	Korea [yen／wan]
1981	1.0000	218.4251	206.4182	253.2444	436.9507	127.5744	0.5252
1982	1.0000	210.2882	201.5976	230.9642	415.2624	130.5533	0.5029
1983	1.0000	207.0723	200.7286	215.8837	402.5735	132.2292	0.4847
1984	1.0000	205.9544	203.1017	207.6691	397.5976	130.0896	0.4718
1985	1.0000	204.4366	203.4704	201.3393	384.8226	120.8412	0.4608
1986	1.0000	203.3165	200.8423	194.4352	378.3500	117.4521	0.4440
1987	1.0000	198.4184	198.8706	189.7158	360.3489	112.1075	0.4215
1988	1.0000	193.3022	197.0573	185.4637	341.4131	100.7496	0.3947
1989	1.0000	190.5349	195.9645	183.6695	324.9604	94.7313	0.3819
1990	1.0000	187.8532	194.0868	183.2502	309.1560	91.8003	0.3538
1991	1.0000	186.8397	193.8091	183.9610	298.5321	88.5368	0.3291
1992	1.0000	185.6111	187.6545	183.0498	291.6641	83.3913	0.3108
1993	1.0000	182.4038	181.8616	181.2117	285.5820	72.0495	0.2938
1994	1.0000	178.8011	177.7986	178.9694	281.3730	59.7940	0.2727
1995	1.0000	174.3444	173.6482	175.7684	272.6448	52.3073	0.2527
1996	1.0000	170.1156	171.5468	172.3071	265.5587	48.8655	0.2390
1997	1.0000	168.3229	170.0894	172.8874	265.2665	48.4258	0.2298
1998	1.0000	166.5238	168.5749	172.2270	258.1887	48.8600	0.2172
1999	1.0000	162.0357	166.2077	168.8097	248.2757	48.8430	0.2146
2000	1.0000	154.9431	160.0379	164.7878	243.3183	46.7586	0.2069
2001	1.0000	149.4378	156.4666	162.7580	238.5550	45.2548	0.1974
2002	1.0000	143.7742	152.6471	158.8717	229.0757	44.0442	0.1868
2003	1.0000	139.6882	152.3538	149.0525	218.1216	42.5921	0.1756
2004	1.0000	134.3265	150.0307	143.1037	212.6664	39.3960	0.1691
2005	1.0000	129.5520	145.1462	140.4318	199.6556	37.5775	0.1642
2006	1.0000	124.4646	141.0476	136.2806	190.9140	35.9573	0.1633
2007	1.0000	120.3113	136.2135	132.5072	180.7040	-	0.1601

Note: The value of 2007 is Secretariat estimate or projection based on national sources.
Source: OECD, "Main Science and Technology Indicators 2008/1"

A List of Science and Technology Indicators

1991 First edition The Japanese Science and Technology Indicator System:
Analysis of Science and Technology Activities NISTEP REPORT No. 19

1995 Second edition Science and Technology Indicators: 1994
- A Systematic Analysis of Science and Technology Activities in Japan - NISTEP REPORT No. 37

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- Data Updated in 2006 for 5th edition - Research Materials - 126

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- Data Updated in 2007 for 5th edition - Research Materials - 140

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- Data Updated in 2008 for 5th edition –
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2009 Science and Technology Indicators 2009 Research Materials - 170

Authors

Yumiko KANDA — Research Fellow, Research Units for Science and Technology Analysis and Indicators
〔Total coordination and overall editing〕

Ayaka SAKA — Research Fellow, Research Units for Science and Technology Analysis and Indicators
〔Chapter 4　4.1 Papers〕

Masatsura IGAMI — Senior Researcher, Research Fellow,
Research Units for Science and Technology Analysis and Indicators
〔Chapter 4　4.2 Patents〕

Hiroko EBIHARA — Research Fellow, Research Units for Science and Technology Analysis and Indicators
〔Reference Material　Indicators for the regions〕

Terutaka KUWAHARA — Deputy Director General, NISTEP 〔Director of the overall production〕

Cooperators

Fujio NIWA — Affiliated Fellow, Research Units for Science and Technology Analysis and Indicators
(Honor Professor, National Graduate Institute for Policy Studies)

Tomohiro IJICHI — Affiliated Fellow, 1st Theory Oriented Research Group
(Professor, Seijo University Faculty of Social Innovation)

Eiji ISHIBASHI — Assistant Director of Research,
Research Units for Science and Technology Analysis and Indicators

Chiemi YAMADA — Clerical Assistant, Research Units for Science and Technology Analysis and Indicators

Emi AOKI — Research Units for Science and Technology Analysis and Indicators
(January 2009-March 2009: Contract basis assistant for updating data)