

2.1 R&D Expenditures

2.1.1 Total R&D Expenditures

2.1.1.1 Trends in R&D Expenditures in Selected Countries

When a country examines its R&D expenditures⁵, its statistical contents and approach may differ from other nations. As a result, a simple comparison of R&D expenditures among countries may not present comparable data, although it gives a general

idea as to a country's attitude towards science and technology. In terms of R&D expenditures, the United States registered the highest total, at 36.6 trillion yen at the IMF currency conversion rate (42.4 trillion yen at the OECD purchasing power parity conversion rate), followed by the EU at 18.6 trillion yen at an IMF exchange rate conversion (28.0 trillion yen in OECD purchasing power parity), and Japan at 16.7 trillion yen (or 15.6 trillion yen at the FTE value) (Figure 2-1-3).

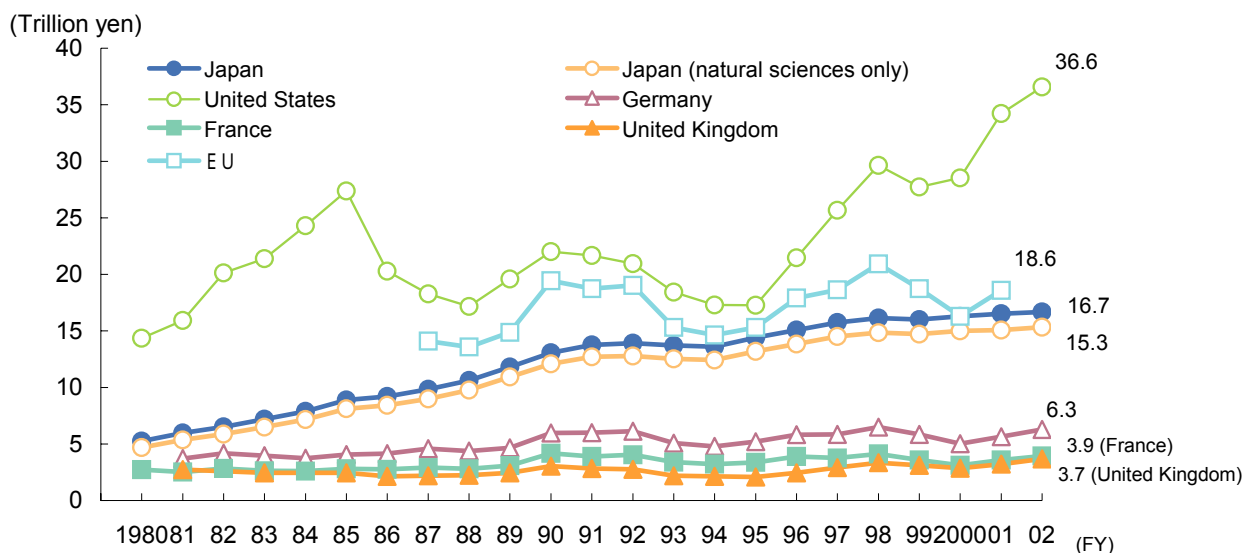


Figure 2-1-3 (1) Trends in R&D expenditures of selected countries - IMF exchange rate conversion

5 Definition of R&D expenditures: In the "Report on the Survey of Research and Development" by the Statistics Bureau of the Ministry of Internal Affairs and Communications, "research" is defined as "creative efforts and investigations conducted to obtain new knowledge about things, functions, and phenomena, or to open paths toward new applications of existing knowledge." All outlays incurred for these activities (labor costs, materials, expenditures on tangible fixed assets, etc.) are treated as research expenditures.

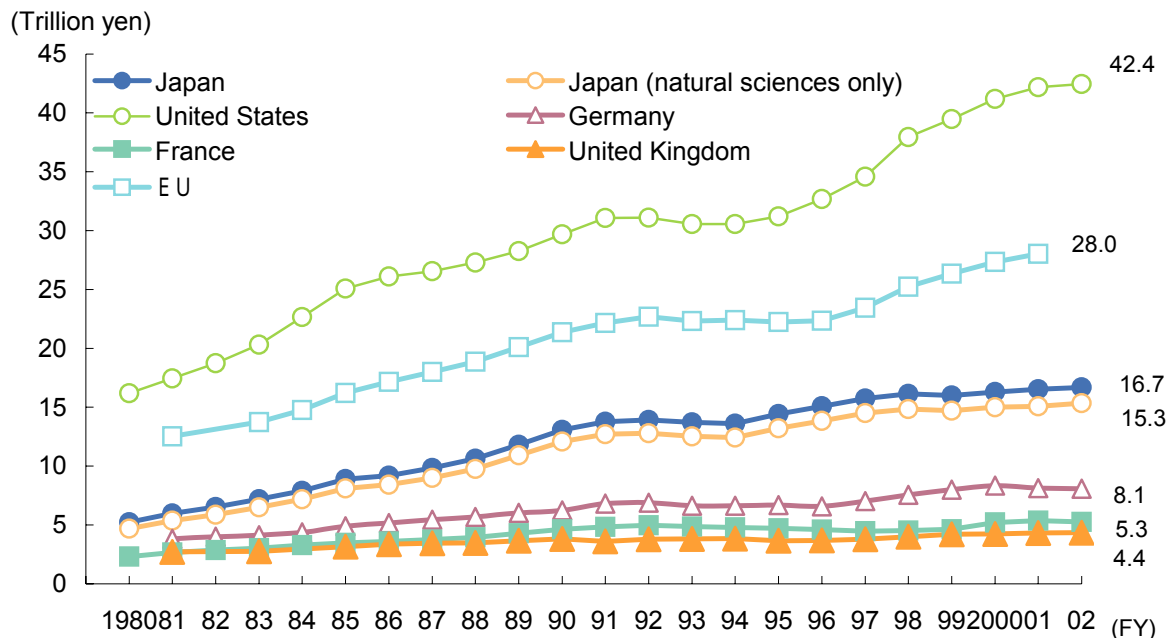


Figure 2-1-3 (2) Trends in R&D expenditures of selected countries - OECD purchasing power parity

- Notes:
1. For comparison, statistics for all countries include research in social sciences and humanities. The figure for Japan shows also the amount for natural sciences only.
 2. Japan added industries as new survey targets in FY1996 and FY2001.
 3. U.S. figures are for calendar years, and figures for 2001 and later are provisional.
 4. French figure for FY2002 is provisional.
 5. The EU figures converted at the IMF currency conversion rate are estimates by Eurostat, while the figures based on the purchasing power parity conversion are OECD estimates.

Source: Japan — Statistics Bureau. "Report on the Survey of Research and Development"

United States — National Science Foundation. "National Patterns of R&D Resources"

Germany — Federal Ministry of Education and Research. "Bundesbericht Forschung"

France — "Project de Loi de Finance: Rapport annexe sur l'Etat de la Recherche et du Developpement Technologique"

United Kingdom — Office for National Statistics. "Gross Domestic Expenditure on Research and Development"
Data before 1983 — OECD. "Main Science and Technology Indicators"

EU — Eurostat. "Research and development : annual statistics," "Statistics on S&T 2003 edition"

OECD. "Main Science and Technology Indicators"

(See Appendix 3.(1))

2.1.1.2 Increase of R&D Expenditures in Real Terms

R&D expenditures in real terms for selected countries are calculated in order to compare national growth rates. The trend in recent years shows the United States, Germany⁶ and Japan registering high growth. The high growth in the United States is seemingly due to increased research and devel-

opment investment by private corporations with the economic boom while that for Japan reflects expansion in private-sector companies' research and development investment, which registered eight straight years of growth beginning in FY1995, despite Japan's long-running economic slump (Figure 2-1-4).

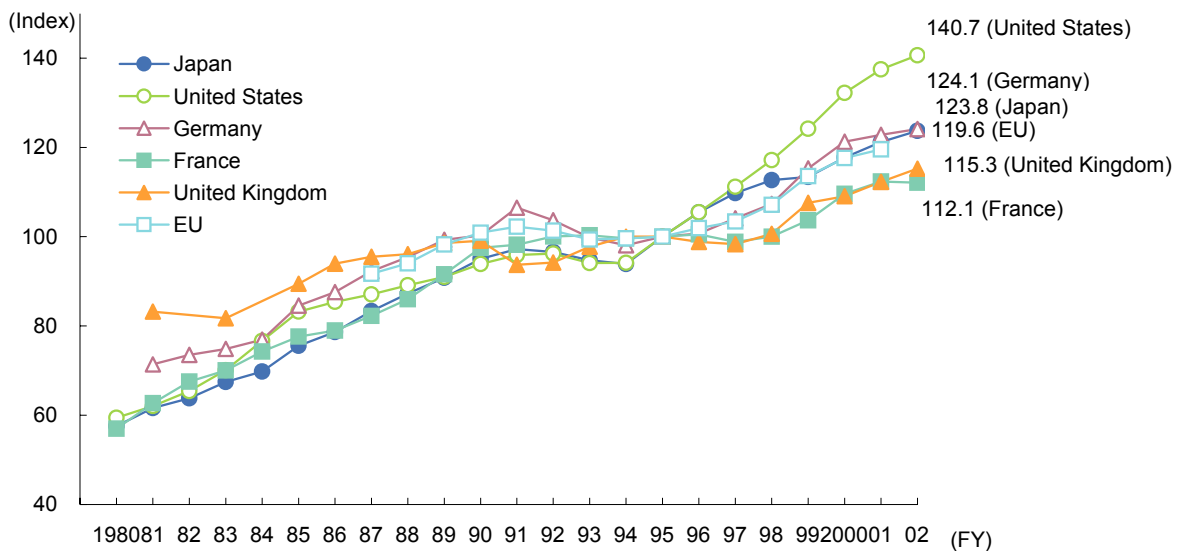


Figure 2-1-4 Growth of R&D expenditures (in real terms) in selected countries, with FY1995 as 100

- Notes: 1. For comparison, statistics for all countries include research in social sciences and humanities.
 2. Japan added industries as new survey targets in FY1996 and FY2001.
 3. U.S. figures are for calendar years, and figure for 2001 is provisional.
 4. French figure for FY2002 is provisional.
 5. EU figures are Eurostat estimates.

Source: Same as in Figure 2-1-3.

(See Appendix 3. (1), (15))

⁶ Germany: The data for Germany in Chapter 2.1 and 2.2 cover Western Germany only until 1990, and Unified Germany from 1991. In Chapter 2.3, Germany before FY1990 refers to a combination of the figures of West and East Germany.

2.1.1.3 R&D Expenditures as a Percentage of Gross Domestic Product (GDP)

R&D expenditures as a percentage of GDP show the level of research investment. While the rate of

investment in European countries has drifted downward in recent years, the trend has turned upward in Japan and the United States since FY1995. Japan continues to maintain the highest standard among the major advanced nations, at 3.35% of GDP (3.09%, using the FTE) (Figure 2-1-5).

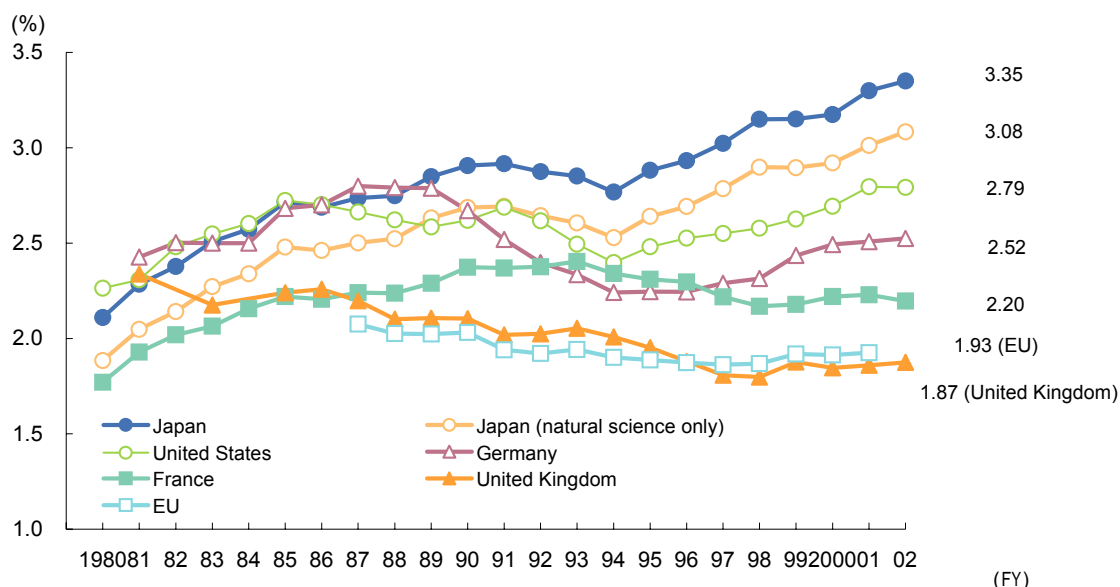


Figure 2-1-5 R&D expenditures as a percentage of GDP in selected countries

- Notes: 1. For comparison, statistics for all countries include research in social sciences and humanities. The figures for Japan show also the amount for natural sciences only.
 2. Japan added industries as new survey targets in FY1996 and FY2001.
 3. U.S. figures are for calendar years, and figure for 2001 is provisional.
 4. French figure for FY2002 is provisional.
 5. EU figures are Eurostat estimates.

Source: Same as in Figure 2-1-3.
 (See Appendix 3. (1))

2.1.2 R&D Expenditures by Financing and Performance

R&D expenditures can be characterized by the financing and performance aspects of categorized sectors. The statistics compiled by the OECD cate-

gorize sectors into government⁷, industry, universities and colleges, private research institutions, and overseas. Shares of R&D expenditures by financing and performance in selected countries are compared by OECD-categorized sectors.

2.1.2.1 Share of R&D Expenditures

A look at the share of total research expenditures held by governments⁷ shows France with the highest percentage, at about 40% of expenditures. Japan's share shows the lowest level among selected countries, a figure that is probably affected by such

factors as the extremely low share held by defense research and by the large amount of activity in the private sector (Figure 2-1-6). The large share of R&D expenditures carried by the private sector means that the figures tend to be easily swayed by fluctuations in the business environment (Figure 2-1-7).

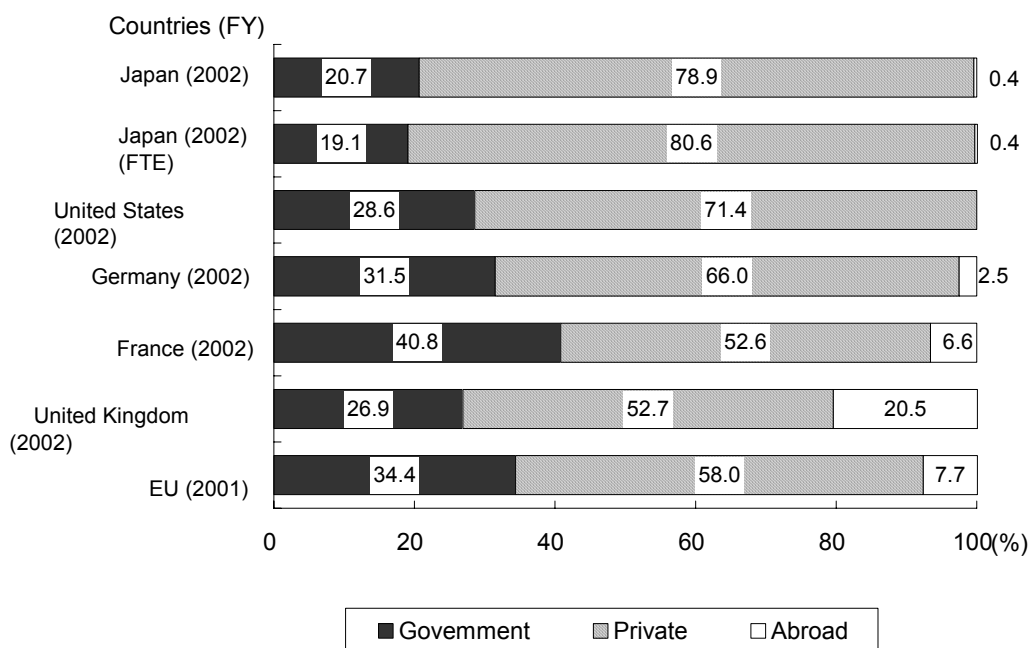


Figure 2-1-6 Share of R&D expenditures by financing sector in selected countries

Notes:1. For comparison, statistics for all countries include research in social sciences and humanities. The figure for Japan includes the FTE value.

2. Japan's FTE value is calculated by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) based on the Statistics Bureau data.

3. U.S. figures are for calendar years and provisional. France's figures are provisional.

4. Everything other than government and abroad is classified as private sector.

5. EU figures are OECD estimates.

Source: EU – OECD. "Main Science and Technology Indicators"

Others – Same as in Figure 2-1-3.

(See Appendix 3. (1), (2), (4))

⁷ Government: In Chapters 2.1 and 2.2, when research expenses and numbers of researchers are expressed, "governments" means central govern

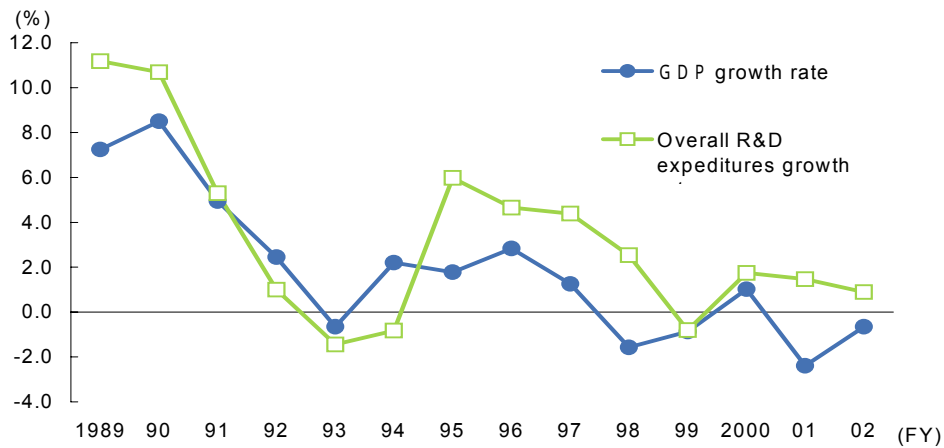


Figure 2-1-7 Trends in overall growth in R&D expenditures, and gross domestic product (GDP) growth rates

Source: Cabinet Office. "National Accounts"
 Statistics Bureau. "Report on the Survey of Research and Development"

The decline in defense-related R&D expenditures since the end of the Cold War structure has resulted in a gradual, continuous decline in the share of R&D expenditures financed by governments in other countries, although it has been on the rise again in recent years. The share of R&D expenditures financed by the Japanese government has declined slightly for the third straight year. (Figure 2-

1-8)

For the government share of expenditures in relation to gross domestic product (GDP), France had the highest percentage, followed in order by the United States, Germany, Japan, and the United Kingdom. The shares for the United States, Germany and France have been increasing, while that for Japan has remained flat (Figure 2-1-9).

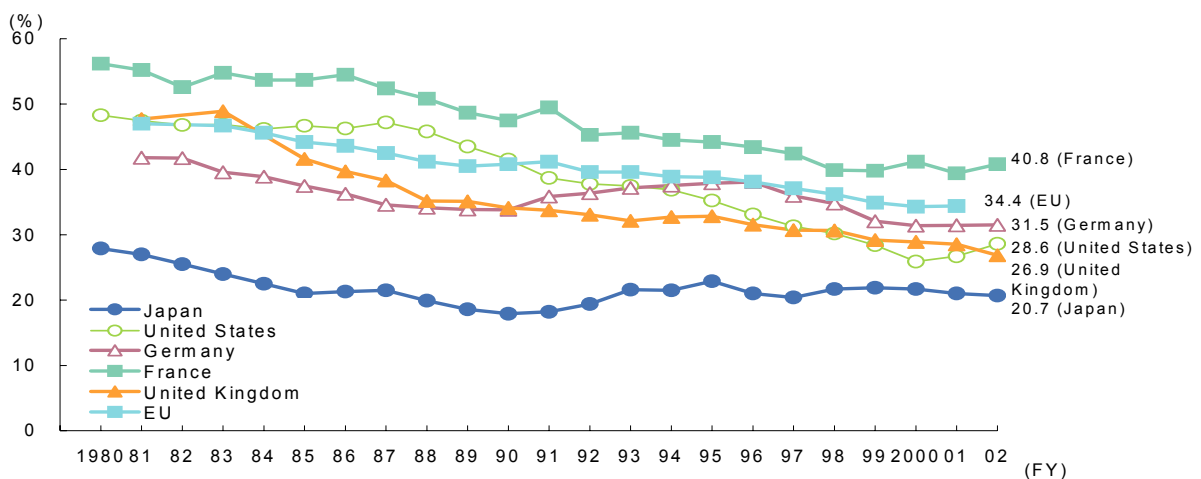


Figure 2-1-8 (1) Trends in government-financed R&D expenditures - Share of R&D expenditures financed by government

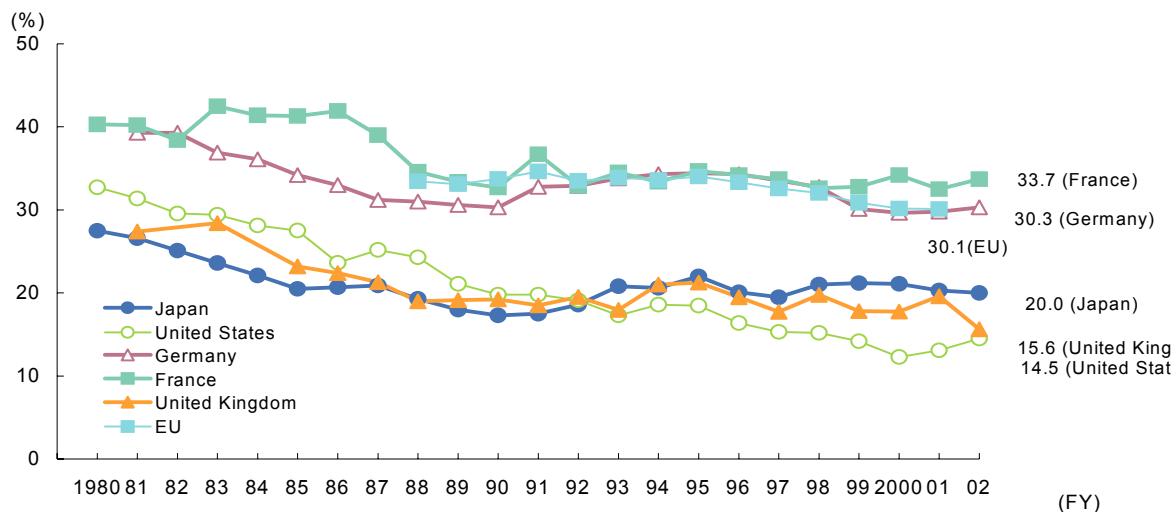


Figure2-1-8 (2) Trends in government-financed R&D expenditures - Share of R&D expenditures exclusive of defense-related R&D expenditures

Notes: 1. For comparison, statistics for all countries include research in social sciences and humanities.

2. Government percentages exclusive of defense-related research expenditures are calculated by the following equation.

$$\frac{(\text{Government - financed R \& D expenditures}) - (\text{Defense - related R \& D expenditures})}{(\text{R \& D expenditures}) - (\text{Defense - related R \& D expenditures})} \times 100\%$$

It should be noted that the results of defense-related R&D often not only affect defense but also contribute to the development of science and technology for the civil welfare.

3. Japan added industries as new survey targets in FY1996 and FY2001.

4. U.S. figures are for calendar years, and figures for FY2001 and later are provisional.

5. French figure for FY2002 is provisional.

6. EU government share is OECD estimates.

Source: Defense-related R&D expenditures in Japan - MEXT. "Budget for Science and Technology".

Defense-related R&D expenditures in the U.S. - The Budget of the U.S. Government

Defense-related R&D expenditures in the U.K. - "SET Statistics".

Others - Same as in Figure 2-1-3

(See Appendix 3. (1))

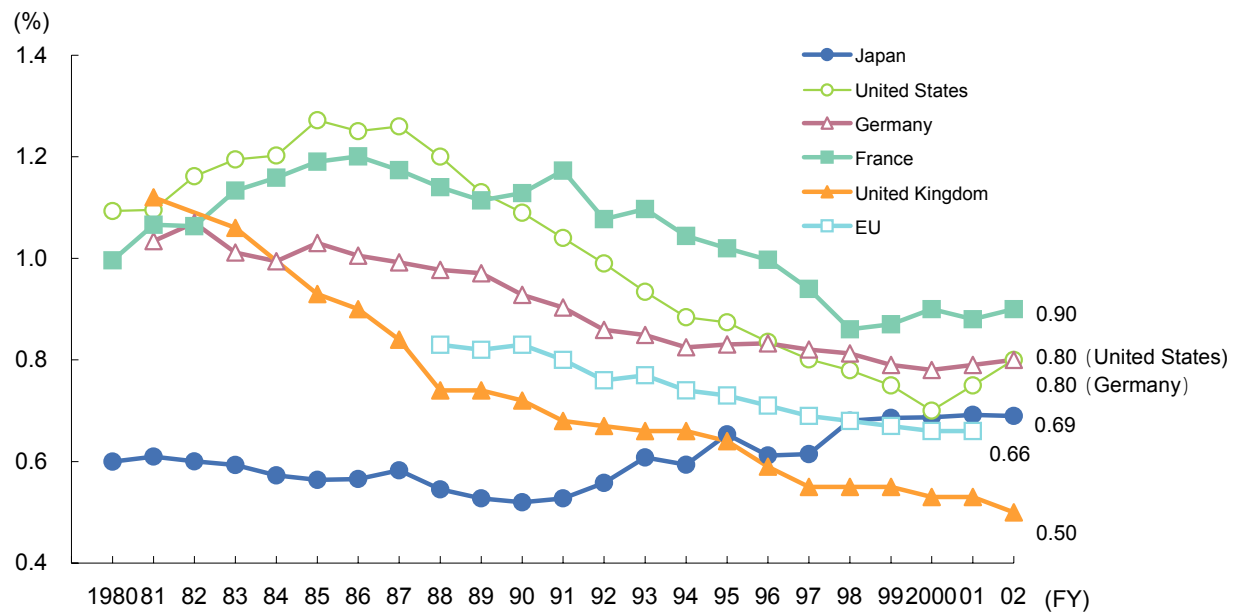


Figure 2-1-9 Trends in the proportion of government-financed R&D expenditures to gross domestic product (GDP) in selected countries

Notes :1. For comparison, statistics for all countries include research in social sciences and humanities.

2. Japan added industries as new survey targets in FY1996 and FY2001.

3. U.S. figures are for calendar years, and figures for 2001 is provisional.

4. French data for FY2002 is provisional.

Source: Same as in Figure 2-1-3.

(See Appendix 3. (1))

2.1.2.2 Share of R&D expenditures by performance

Industry spends approximately two-thirds of total R&D expenditures in all selected countries, demonstrating just how large a role private-sector companies play in research and development. Among the selected countries, government research institutions' share of R&D expenditures was highest in France (Figure 2-1-10). In the selected countries, the trends in real R&D expenditures by type of organization reveals that industry has contributed

the most greatly in all countries to growth in R&D expenditures (Figure 2-1-11). In Japan, a look at the contribution by type of organization to year-on-year growth of R&D expenditures (in real terms) shows that R&D expenses at private companies have a large effect on trends in Japan's R&D expenses. For the degree of contribution, private companies made a positive contribution from FY1995 to FY1998, but then fell into a negative contribution for FY1999. Private companies returned to a positive contribution in FY2000 (Figure 2-1-12).

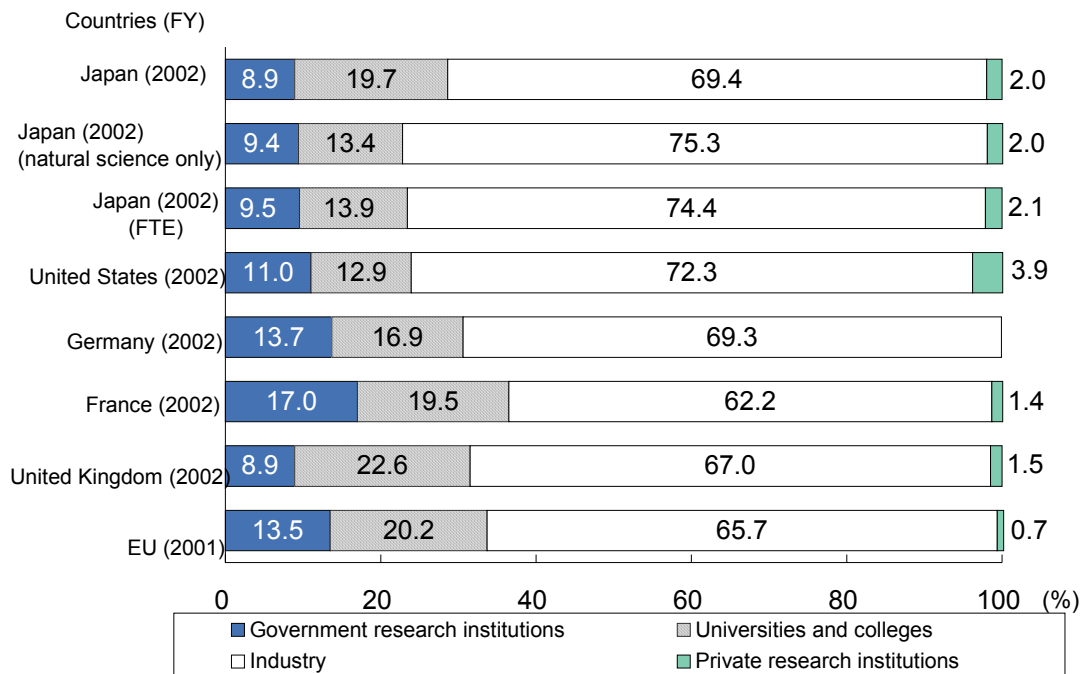


Figure 2-1-10 Share of R&D expenditures by performance sector in selected countries

- Notes: 1. For comparison, statistics for all countries include research in social sciences and humanities.
 The figures for Japan show also the amount for natural sciences only and FTE value.
2. Figures for Japan's FTE value are prepared from the Statistics Bureau data.
3. U.S. figures are for calendar years and provisional. French figures are provisional. In addition, Germany's re-search expenditures at "private research institutions" are included in "government" research institutions.
4. EU figures are Eurostat estimates.

Source: France - OECD. "Main Science and Technology Indicators"

Others - Same as in Figure 2-1-3.

(See Appendix 3. (2), (5))

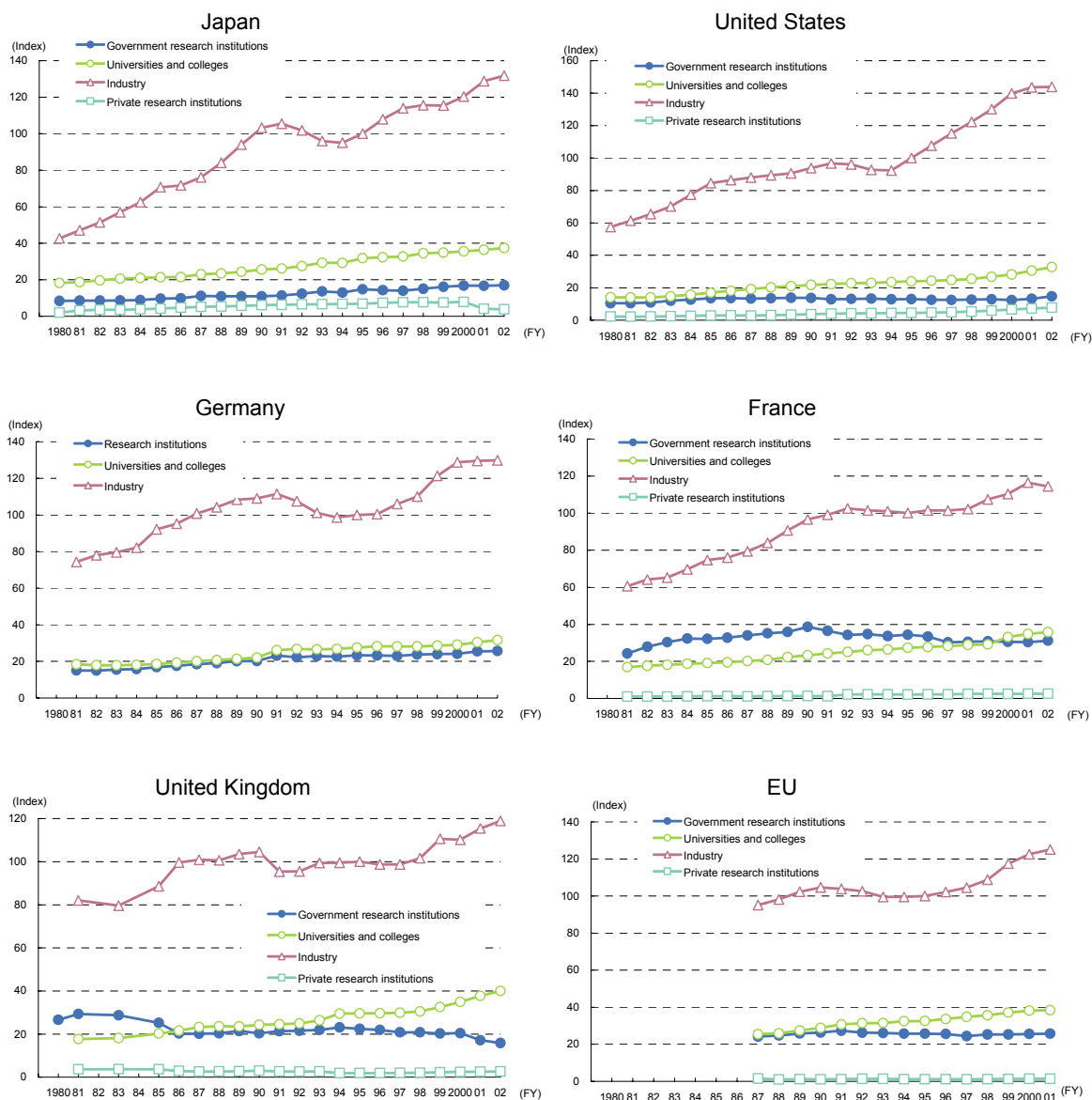


Figure 2-1-11 R&D expenditures growth (in real terms) by sector in selected countries

- Notes: 1. All countries include social sciences and humanities for purposes of international comparison. In addition, industry's real research expenditures for FY1995 are set at 100.
2. U.S. data are for calendar years, and data for FY2001 is provisional.
3. FY2002 data for France is provisional.
4. Since no differentiation has been made between "government research institutions" and "private research institutions" in Germany, they are listed simply as "research institutions."
5. Japan added some industries as new survey targets in FY1996 and FY2001.
6. EU figures are Eurostat estimates.

Source: France — OECD. "Main Science and Technology Indicators"

Others — Same as in Figure 2-1-3.

(See Appendix 3. (15))

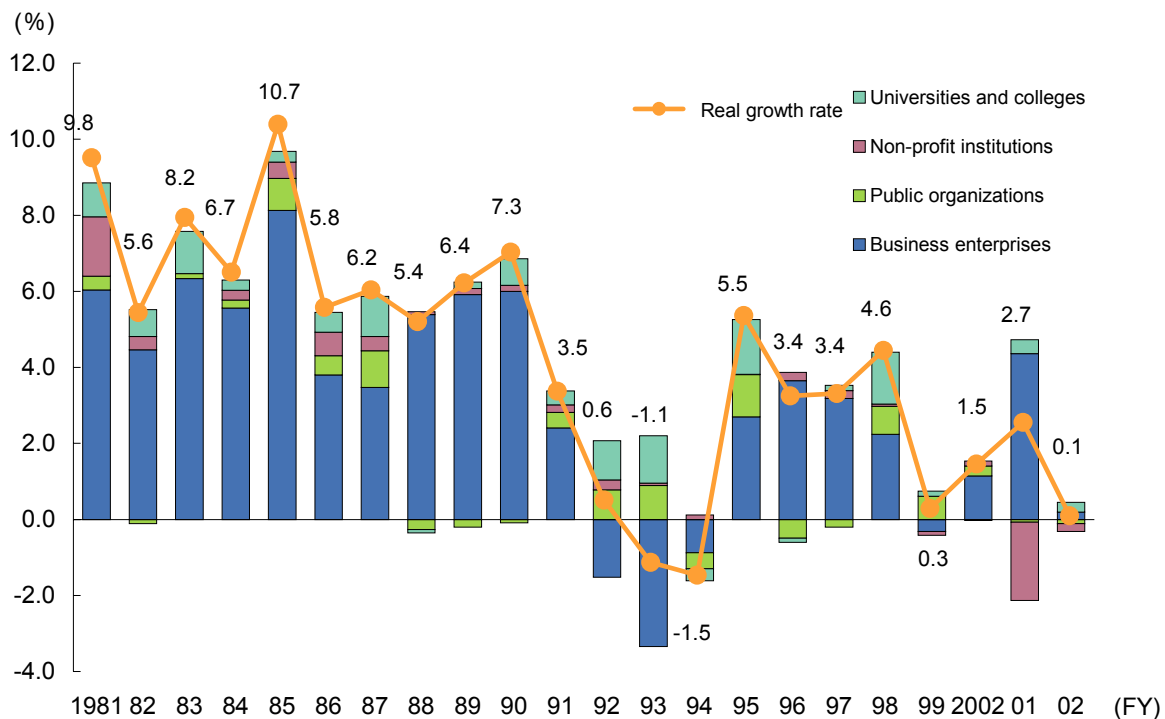


Figure 2-1-12 The contribution by organization to the year-on-year growth rate in Japan's real R&D expenditures

- Notes: 1. The deflation referring for each sector is based on FY1995.
 2. Japan added some industries as new survey targets in FY1996 and FY2001.
 3. Survey coverage categories were changed in FY2001; figures up to FY2000 are for the following categories:

Up to FY2000	FY2001
Companies	Business Enterprises
Private research	Non-profit institutions
Government research institutions	Public organizations

Source: Statistics Bureau. "Report on the Survey of Research and Development"
 (See Appendix 3. (5), (15))

2.1.2.3 R&D Expense Flows

Japan's R&D expense flows between sources of funding and sectors of performance reveal that about 48% of government funding goes to universities, about 42% to government research institutions, and about 10% to the private sector. In private-sector funding, by contrast, about 98.6% goes to the private sector, with about 1.0% to universities and about 0.4% to government research institutions.

Comparing flows of R&D expenditures between the financing and performance sectors shows that in Japan there is a lesser flow of R&D expenditures between sectors (government, industry, universities and colleges) than exists in other countries. The ratio of private sector R&D expenditures funded by government is high in the United States and in France. The United Kingdom is characterized by a

large proportion of R&D expenditures being borne from abroad (Figure 2-1-13).

On the reason why R&D expenses flow from government to the private sector, and from the private sector to universities, are so low in Japan, it can be pointed out that research and development in Japan often relies more on private-sector activities than it does in other countries. The large flows from government to the private sector in the United States, France, and elsewhere are due to the large flows of aerospace research and defense research funds. Moreover, a major reason for the large flow of research funds from foreign countries into the United Kingdom is likely the existence in that country of many foreign-capitalized corporations with research and development centers in operation, which would therefore be sending R&D funds to the United Kingdom from their own home countries.

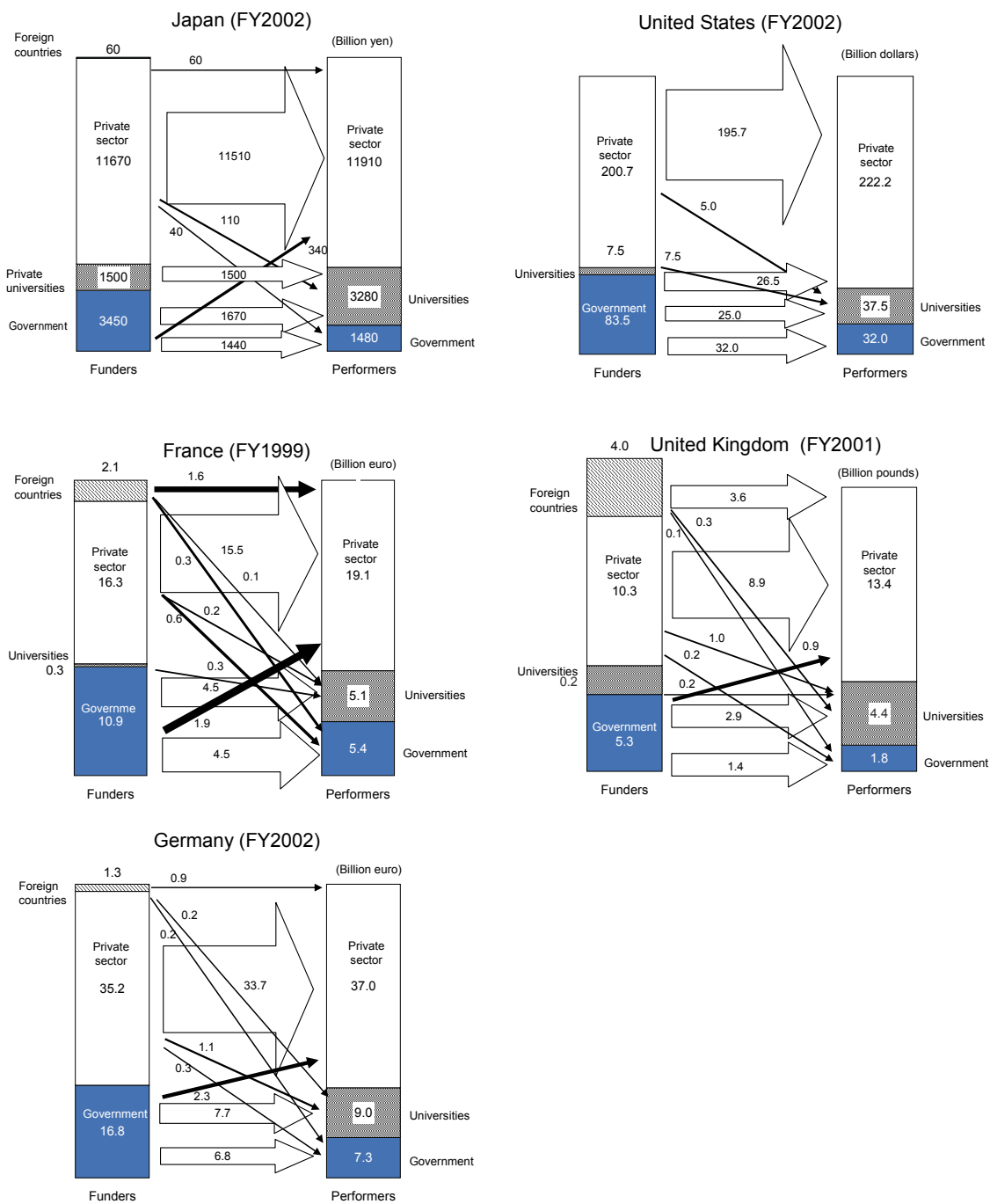


Figure 2-1-13 R&D expense flows in selected countries

Notes: 1. For comparison, statistics for all countries include research in social sciences and humanities.

2. U.S. figures are for calendar years and provisional.

3. In Germany, data from private research institutions are included in the government figures, and in the other countries are included in the private sector.

Source: France – OECD. "Basic Science and Technology Statistics"

Other countries – Same as in Figure 2-1-3.

(See Appendix 3. (2))

2.1.3 R&D Expenditures per Researcher

Because of differences in how researchers are targeted, in survey methods used, and in exchange rates, simple comparisons between countries of R&D expenditures per researcher may not

be precise. Nevertheless, a look at statistics for five major countries shows Japan ranked first when the yen was converted to the IMF exchange rate, and ranked last when the OECD's purchasing power parity conversion rate was used (Figure 2-1-14).

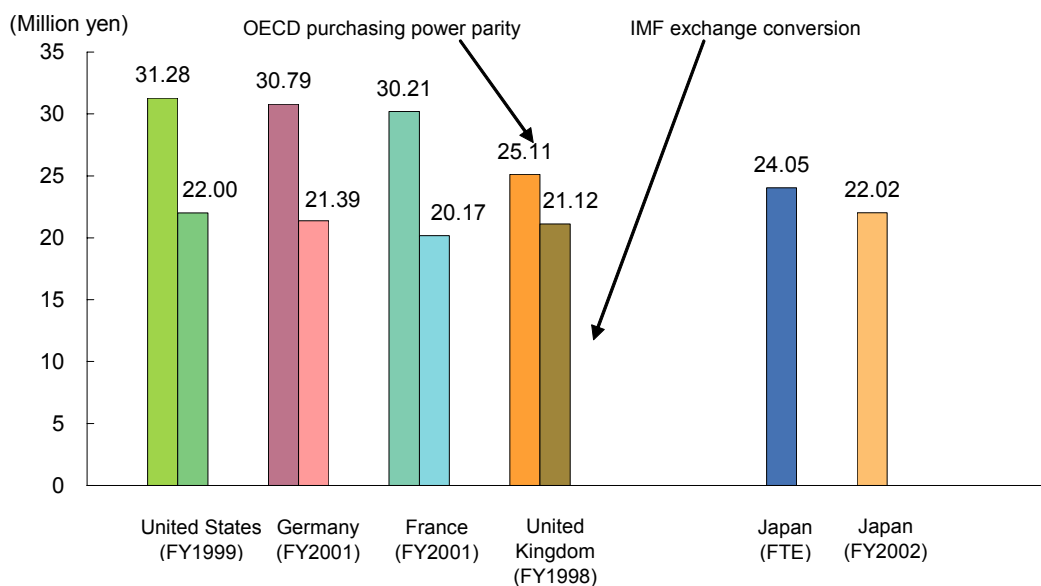


Figure 2-1-14 R&D expenditures per researcher

Notes: 1. For comparison, figures for all countries include social sciences and humanities. The figure for Japan includes the FTE value.

2. R&D expenditures for the U.S. are for calendar year.

Source: Numbers of researchers in France and UK -- OECD "Main Science and Technology Indicators"

Others -- Same as in Figure 2-1-3.

(See Appendix 3. (1))

Japan's R&D expenditures per researcher have been hovering around 22 million yen in recent years.

For R&D expenditures per researcher by type of organization in FY2002, public organizations and non-profit institutions with high ratios of

non-personnel R&D expenditures also registered high R&D expenditures per researcher, while universities and colleges, where the ratio of non-personnel R&D expenditures were low, registered lower expenditures per researcher (Figure 2-1-15).

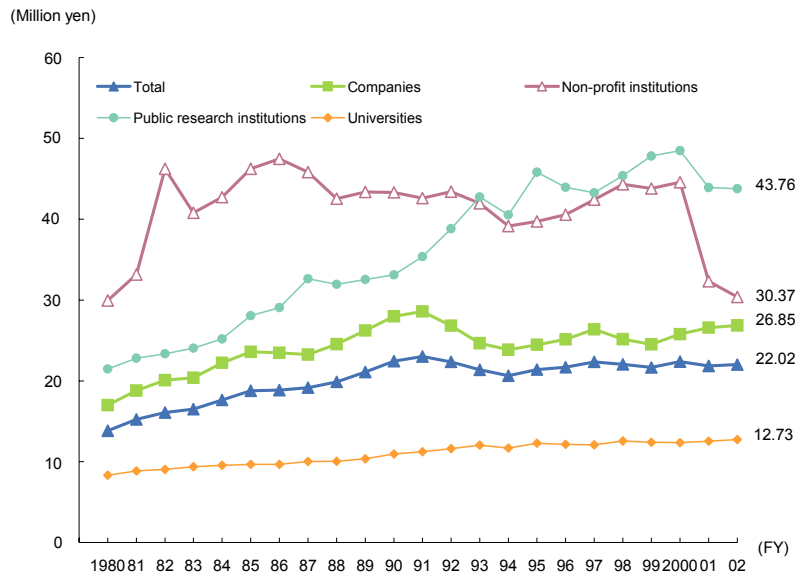


Figure 2-1-15 (1) Trends in R&D expenditures per researcher (in nominal terms)

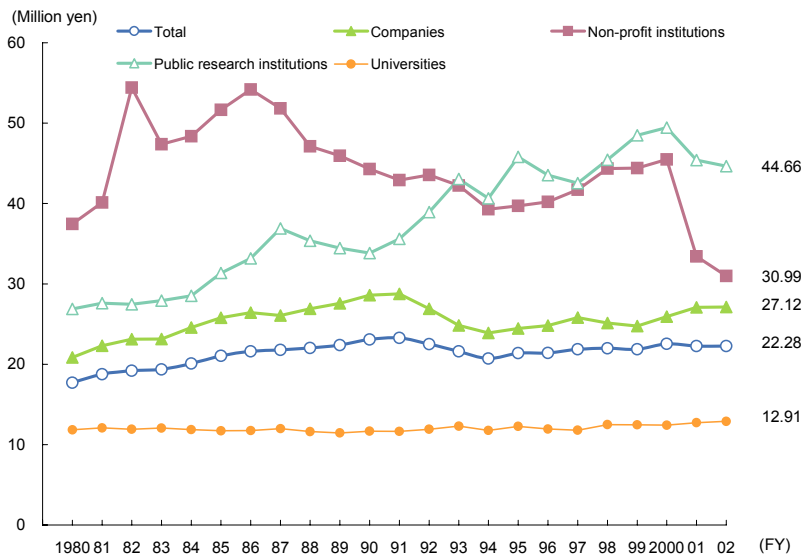


Figure 2-1-15 (2) Trends in R&D expenditures per researcher (in real terms)

Note: 1. Survey coverage categories were changed in FY2001; figures up to FY2000 are for the following categories

Up to FY2000	FY2001
Companies	Business enterprises
Private research institutions	Non-profit institutions
Government research institutions	Public organizations

2. Figures in real terms are converted in constant FY1995.

Source: Statistics Bureau. "Report on the Survey of Research and Development"

If we limit the R&D expenditures per researcher at universities and colleges to those invested in those teachers, then the national universities with particularly high non-personnel R&D expenditures have the highest expenditures per

researcher, followed by private universities and other public universities. By specialty (academic field), the rankings were, in order, physical science, engineering, agricultural sciences, and health sciences (Figure 2-1-16).

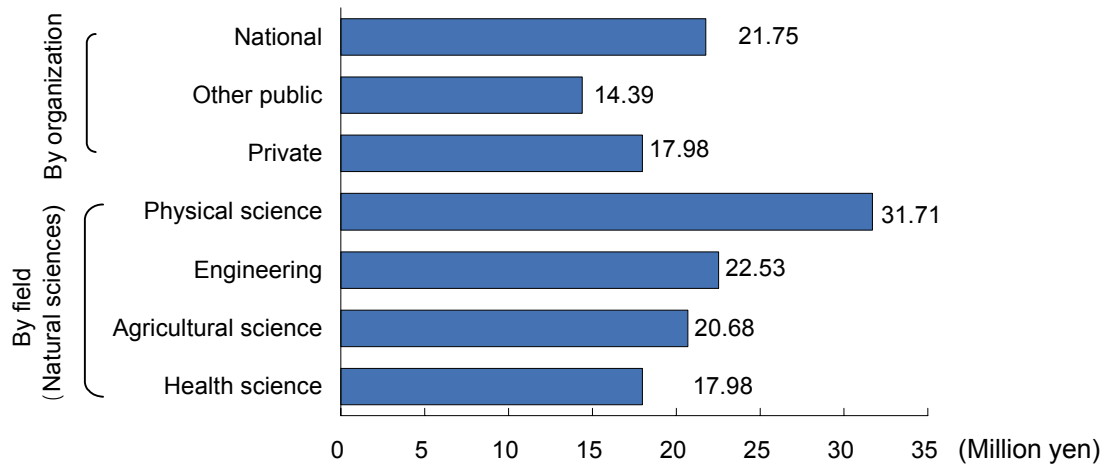


Figure 2-1-16 R&D expenditures per researcher at universities and colleges (FY2002)

- Notes: 1. Figures by organization include the humanities and social sciences.
 2. Figures are for faculty members only, out of all researchers.
 3. The number of researchers is as of March 31, 2003.

Source: Statistics Bureau. "Report on the Survey of Research and Development"

2.1.3.1 R&D expenditures per Researcher, by Type of Industry

For the R&D expenditures per researcher at companies by type of industry, the top five industrial categories were led by the telecommunications industry, with its high purchase rates of

large machinery, equipment, facilities, and other tangible fixed assets, and followed by the broadcast industry, the pharmaceutical industry, the transportation industry, and academic research institutions (Figure 2-1-17).

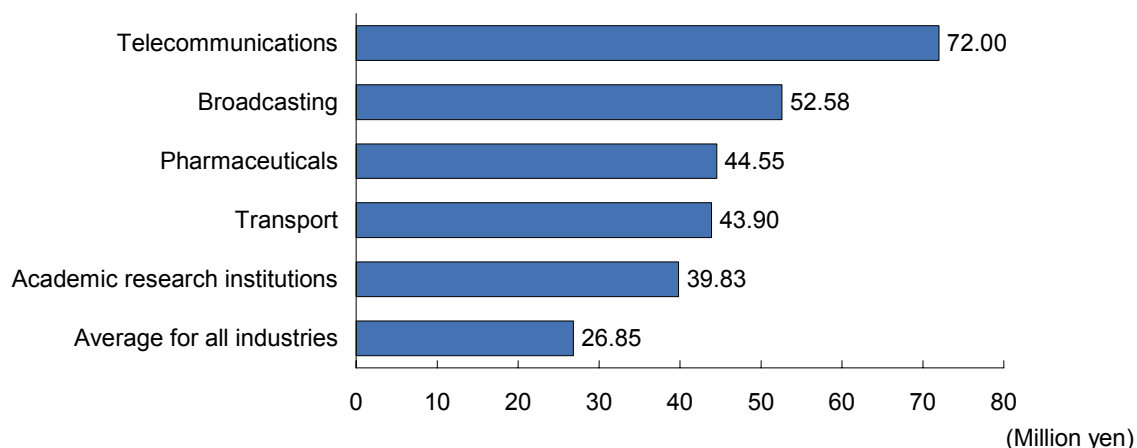


Figure 2-1-17 R&D expenditures per researcher, by industry (top five industrial categories) (FY2002)

Note: The number of researchers is as of March 31, 2003.

Source: Statistics Bureau. "Report on the Survey of Research and Development"

2.1.4 R&D Expenditures by Character of Work

Classification into basic research, applied research, and development⁸, may differ from country to country. Although it is difficult to make a comparison due to differences in distinctions be-

tween the three among the countries concerned, R&D expenditure data by character of work generally reflects the R&D activity of each country. Recent statistical data for Japan, the United States, Germany and France shows that France and Germany spend more on basic research, and that Japan spends less on basic research (Figure 2-1-18).

8 • Research classification: "Report on the Survey of Research and Development" by the Statistics Bureau defines research by type of characteristics as follows:

- Basic research: Basic or experimental research conducted with no direct consideration for specific applications or uses, in order to form hypotheses or theories, or to obtain new knowledge about phenomena or observable reality.
- Applied research: Research that utilizes knowledge discovered through basic research to confirm the feasibility of commercialization for a specific objective, and research that searches for new applications for methods that have already been commercialized.
- Experimental development: Research that utilizes knowledge obtained from basic research, applied research, or actual experience for the objective of introducing new materials, devices, products, systems, processes, etc., or of making improvements to those already existing.

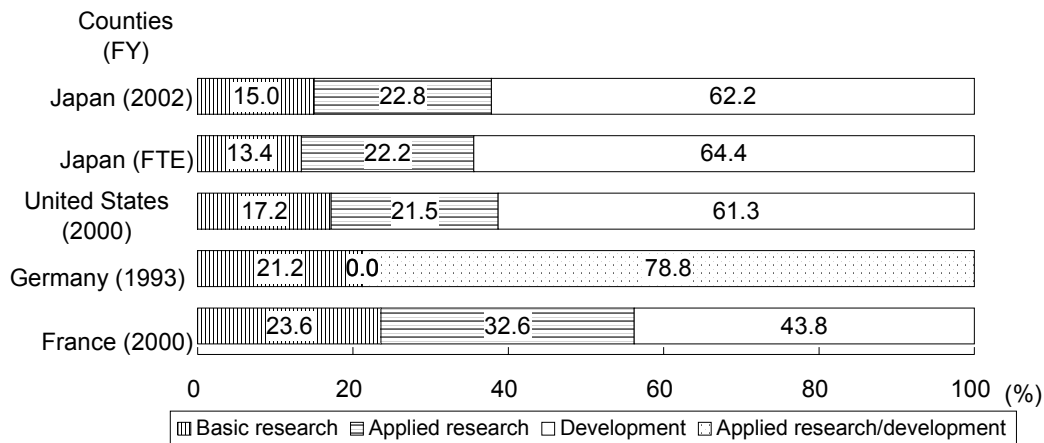


Figure 2-1-18 R&D expenditures by character of work in selected countries

- Notes: 1. Figures for Japan's FTE value are prepared from Statistics Bureau data.
 2. U.S. figures are for calendar years and provisional.
 3. There is no distinction in Germany between applied research and development.

Source: Japan, U.S. — Same as in Figure 2-1-3.

Germany, France — OECD. "Basic Science and Technology Statistics"

(See Appendix 3. (3))

A look at the trend for the share held by basic research in selected countries shows that Japan's allotment for basic research began rising in FY1991, but then turned downward in FY1996 and rose again in FY1998. The United States, while showing some minor fluctuations, has generally increased its share of basic research since FY1986 (Figure 2-1-19). In Japan, research expenses in the different types of organizations, classified into companies, research institutions,

and universities and colleges, are clearly differentiated in structure. For companies, development plays an extremely important role due to their corporate business functions, and this trend has become even more intensified in recent years. On the other hand, universities and colleges place emphasis on basic research and applied research. Non-profit institutions and public organizations, meanwhile, both exhibit intermediate trends (Figures 2-1-20, 21).

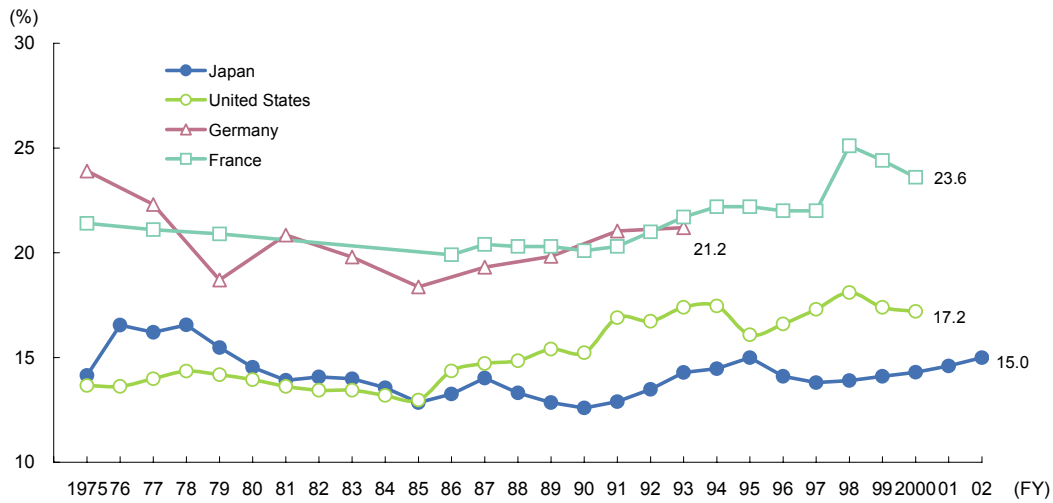


Figure 2-1-19 Trends in the proportion of basic research expenditures in selected countries

Note: United States figures are for calendar years.

Source: Japan, United States – Same as in Figure 2-1-3.

Germany, France – OECD. "Basic Science and Technology Statistics"

(See Appendix 3. (3))

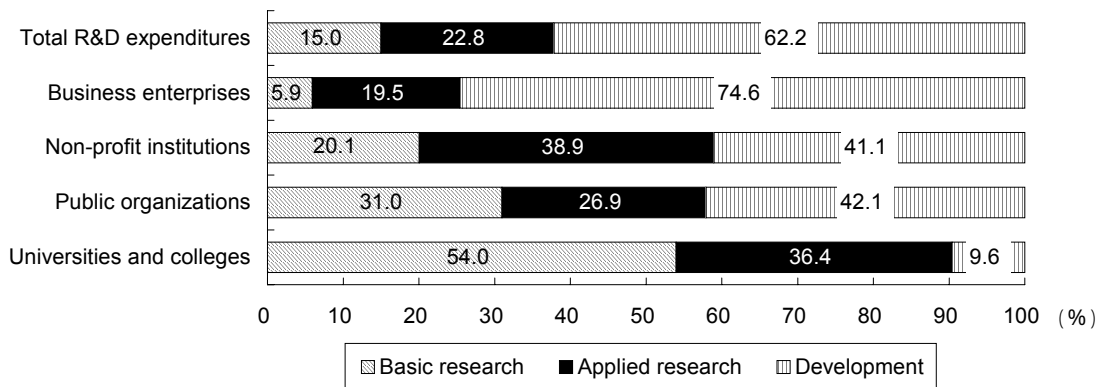


Figure 2-1-20 Composition of R&D expenditures by character of work by sector in Japan (FY2002)

Note: The figures are for the composition of R&D expenditures by character of work in the natural sciences (physical science, engineering, agricultural science, and health science).

Source: Statistics Bureau. "Report on the Survey of Research and Development"

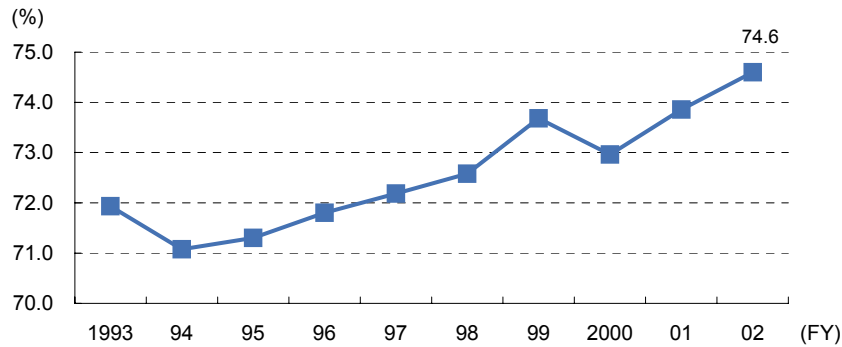


Figure 2-1-21 Trend in the share of development expenditures out of total research expenditures of companies

Note: The share of research expenditures is only for the natural sciences.

Source: Statistics Bureau. "Report on the Survey of Research and Development"

2.1.5 R&D Expenditures by Industry

2.1.5.1 R&D Expenditures by Industry

While the statistical survey range varies from country to country, making simple comparisons

difficult, it is plain that research expenses in the service industry have been increasing in all countries since the mid-1980s, in response to the shift of industrial structure from manufacturing to services in major countries. The figures for services are particularly high in the United States and the United Kingdom (Figure 2-1-22).

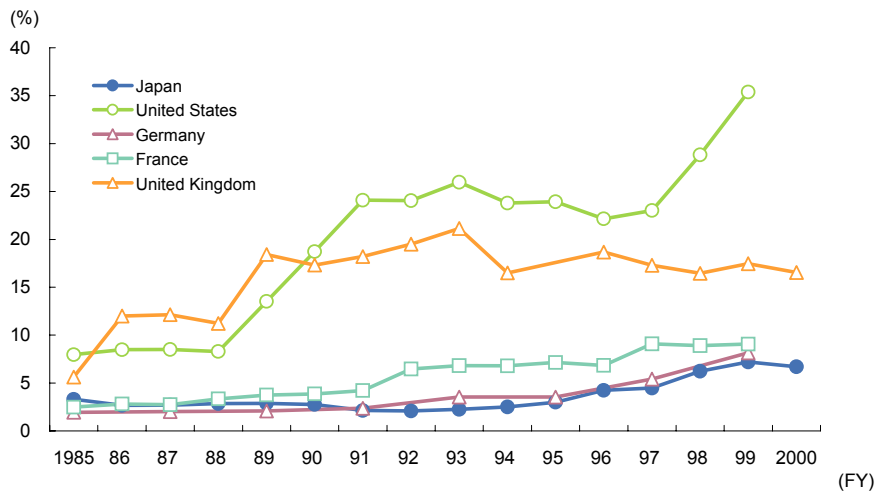


Figure 2-1-22 Share of services industry in total R&D expenditures

Notes: 1. For purposes of international comparison, the figures for each country include the humanities and social sciences.

2. Japan added some industries as new survey targets in FY1996.

Source: OECD. "Basic Science and Technology Statistics"

2.1.5.2 R&D Expenditures by Type of Manufacturing Industry

For the top six R&D expenditure manufacturing industry sectors in major countries, all countries showed high ratios for the telecommunications, electronics and electrical instrument industry, the automobile industry, and the pharmaceuticals industry, which are all subject to severe competition internationally. For the total share of the top three industries, the information and telecommunications machinery and equipment industry, the automobile industry, and the pharmaceuticals industry accounted for 48.4% of the total in Japan; in the United States, the chemical industry, the precision instrument, and the automobile in-

dustry accounted for 49.7%; in Germany, the automobile industry, the telecommunications, electronics and electrical instrument industry, and the chemicals industry other than pharmaceuticals accounted for 54.5%; in France, the automobile industry, the pharmaceuticals industry, and the telecommunications, electronics and electrical instrument industry accounted for 45.6%; and in the United Kingdom, the pharmaceuticals industry, the aerospace industry, and the telecommunications, electronics and electrical instrument industry accounted for 53.7% of the total. In all major countries, therefore, R&D expenses are concentrated in the top-ranking industries (Figure 2-1-23).

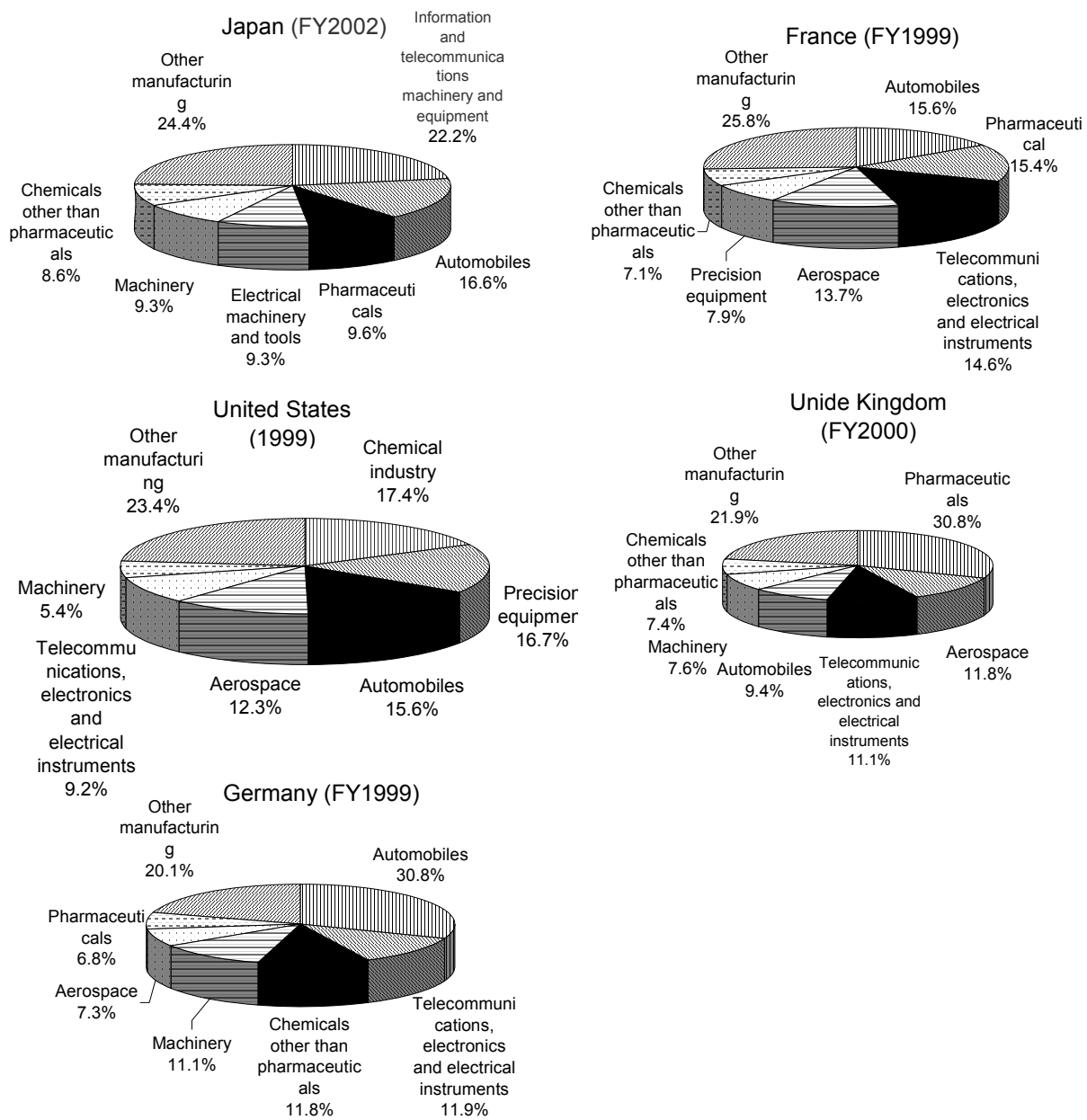


Figure 2-1-23 Manufacturing industry research expenditures in selected countries, by Industry

Source: Japan — Statistics Bureau. "Report on the Survey of Research and Development"
 Other countries — OECD. "Basic Science and Technology Statistics"

2.1.6 R&D Expenditures in Japan by Sector

The following section gives R&D expenditures in Japan by sector⁹ on the basis of the Survey of Research and Development (2001) conducted by the Ministry of Internal Affairs and Communications.

2.1.6.1 Business Enterprises¹⁰

According to the survey, the business enterprises that engaged in research in FY2002 numbered 14,300 companies, with the manufacturing industry accounting for the vast majority of these, at almost 77% of all industry types. Within the manufacturing sector, the machinery, electrical machinery, and food industries held the largest shares.

Also, the total of R&D expenses incurred by companies in FY2002 rose by 1.1% from the previous fiscal year to 11.5768 trillion yen, accounting for about 69% of Japan's total R&D expenditures.

By source of funding for R&D expenditures, companies accounted for almost all of the total, dwarfing the government funding of about 2% of the total. Moreover, for R&D expenses incurred by companies excluding public corporations and incorporated administrative agencies, classified by company capitalization, those with a capitalization of 10 billion yen or more accounted for about 75% of the total, a result that showed R&D expenditures were concentrated in larger corporations. Furthermore, growth rates since FY2001 show that companies with a capitalization of 10 billion yen or more have experienced increases while companies with a capitalization of less than 100 million yen have witnessed year-on-year declines (Table 2-1-24).

Table 2-1-24 R&D expense growth rates and component ratio, by size of company capitalization

Capitalization	R&D expenditures (Million yen)	Growth rate over the previous year (%)	Component ratio (%)
Less than 100 million yen	294,236	-31.3	2.6
100 million to 1 billion yen	651,930	0.8	5.7
1 billion to 10 billion yen	1,977,659	-1.2	17.2
10 billion yen or more	8,573,031	3.4	74.6
Total	11,496,856	1.2	100.0

Source: Statistics Bureau. "Report on the Survey of Research and Development"

⁹ Research Performing Sector: Research activities in Japan in this paper are provided by business enterprises, public organizations, non-profit institutions, and universities and colleges. These classifications are based on the "Report on the Survey of Research and Development" compiled by the Statistics Bureau. The following defines some of these organizations.

¹⁰ Business enterprises: Corporate companies (Capital: 1 million or more yen (FY1974 or before), Capital: 300 million yen or more (between FY1975 and FY1978), Capital: 5 million yen or more (between FY1979 and FY1993), Capital: 10 million yen or more (FY1994 and after)) and profit-oriented public corporations. The public corporations and independent administrative institutions specializing in research are excluded, and are included in the research institutions defined below.

2.1.6.2 Non-profit Institutions¹¹

In FY 2002, the government and the private sector were sources for nearly equal shares of funding for non-profit institutions. The total R&D expenditures at non-profit institutions were 332.7 billion yen, accounting for about 2% of Japan's total R&D expenditures (Figure 2-1-25).

2.1.6.3 Public Organizations¹²

The government was the source for nearly all R&D expenditures at public organizations in FY2002, with private-sector funding accounting for only about 3%.

Total R&D expenditures at government research institutions increased by 0.1% over the previous fiscal year to 1.4832 trillion yen, representing about 9% of Japan's total R&D expenditures. When looking at expenditures by type of institution, national government-owned and publicly-

owned research institutions witnessed year-on-year declines despite increases at public corporations and incorporated administrative agencies (Figure 2-1-25).

2.1.6.4 Universities and Colleges¹³

By source of funding for R&D expenditures at universities and colleges in FY2002, the government accounted for about 50% of the total. The total R&D expenditures at universities and colleges increased by 1.5% over the previous fiscal year to 3.2823 trillion yen, accounting for about 20% of Japan's total R&D expenditures .

For trends in R&D expenditures by type of university, national and private universities registered year-on-year increases. Likewise, all fields of study within the natural sciences registered year-on-year increases (Figure 2-1-26).

11 Non-profit institutions: Corporations, groups, etc., such as incorporated foundations or incorporated bodies that do not seek private profit.

12 Public organizations: National and local government-owned research institutions and public corporations and independent administrative institutions whose primary business is research and development

13 Universities and colleges: Departments of universities and colleges (including graduate schools), junior colleges, colleges of technology, research institutions attached to the universities and colleges and inter-university research institutes, National Institution for Academic Degrees and Center for National University Finance.

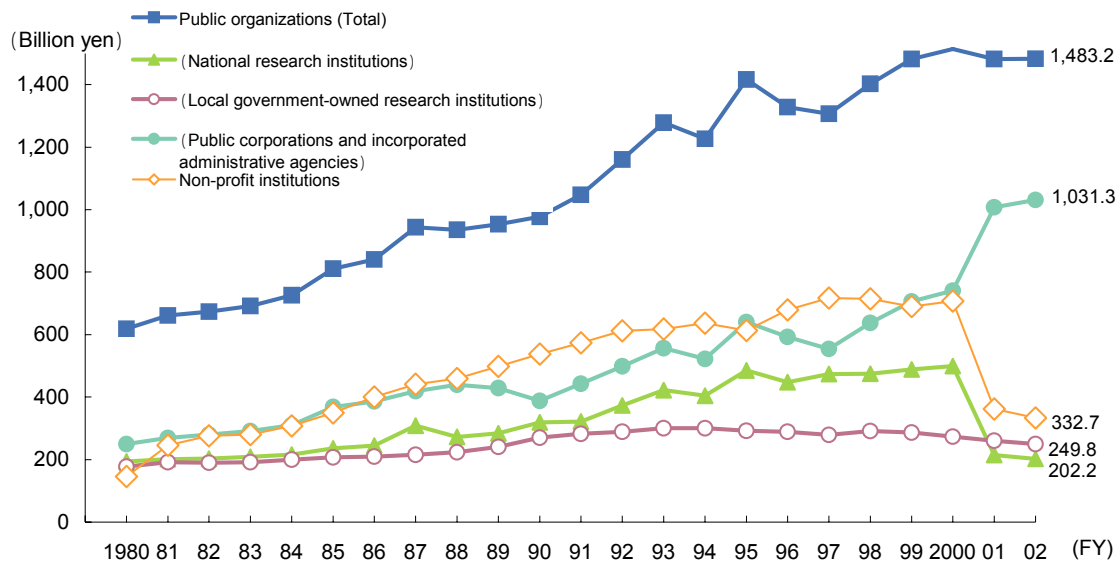


Figure 2-1-25 Trends in R&D expenditures for non-profit institutions and public Organizations

Note: Survey coverage categories were changed in FY2001; figures up to FY2000 use values for the following organizations:

Public organizations: Government research institutions (within which, "Public corporations and independent administrative institutions" uses the values for "Public corporations" up to FY2000)

Non-profit institutions: Private research institutions

Source: Statistics Bureau. "Report on the Survey of Research and Development" (See Appendix 3. (5))

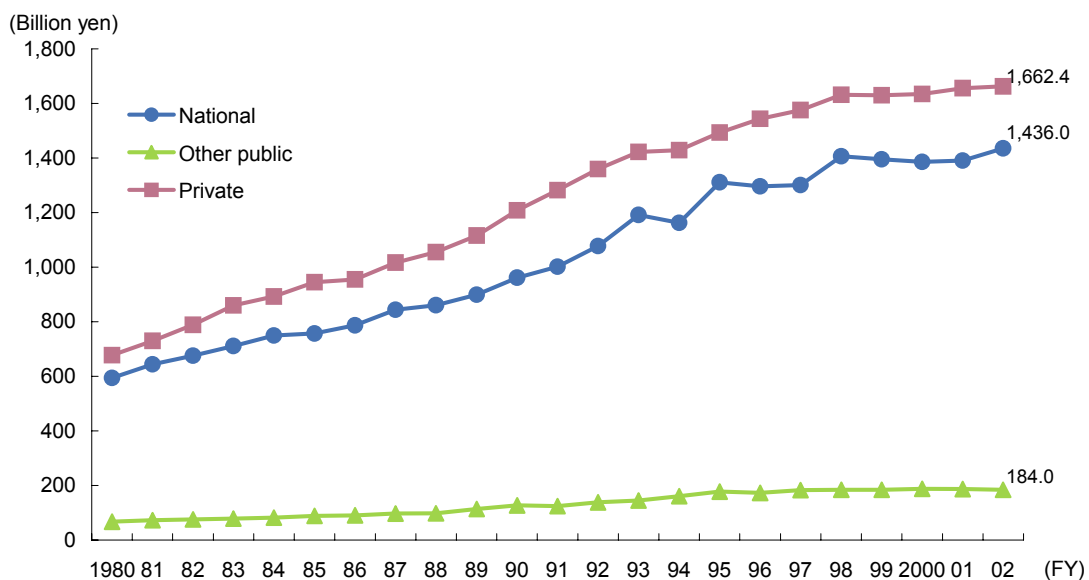


Figure 2-1-26 (1) Trends in R&D expenditures at universities and colleges, by type of university

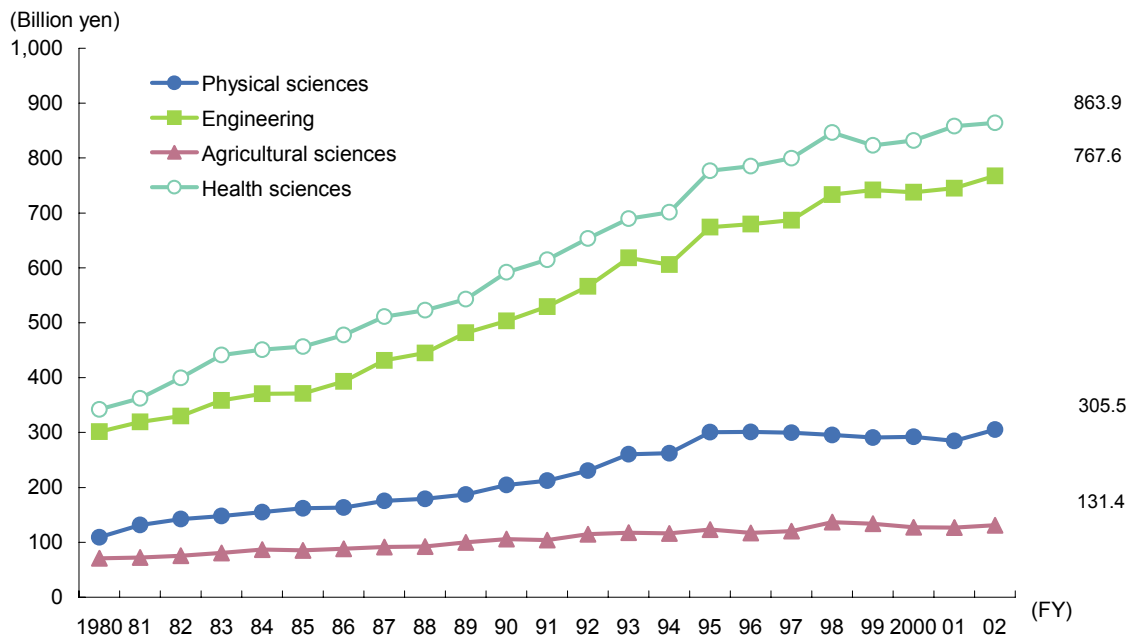


Figure 2-1-26 (2) Trends in R&D expenditures at universities and colleges, by field

Note: The figures by type of university include the humanities and social sciences.

Source: Statistics Bureau. "Report on the Survey of Research and Development"

(See Appendix 3. (5))

2.1.7 R&D Expenditures in Japan by Type

R&D expenditures break down into labor costs, materials, expenditures on tangible fixed assets (land and buildings, machinery, instruments, equipment and others), and lease fees (newly established in the FY2001 survey) and other expenses.

An examination of Japan's R&D expenditures by type reveals that total labor costs decreased by 0.1% over the previous fiscal year to 7.3996 trillion yen. The total expenditures for materials decreased by 3.9% over the previous fiscal year to 2.7502 trillion yen. The total expenditures for tangible fixed asset purchases also decreased, registering a 3.0% decrease over the previous fiscal year to 1.7526 trillion yen. On the other hand, the total expenditures

for lease fees increased by 6.2% over the previous fiscal year to 177.2 billion yen. The share of other expenses required for research, such as books and journals, utilities, travel, and telecommunications, etc., increased by 7.2 % over the previous fiscal year to 4.5955 trillion yen (Figure 2-1-27).

Moreover, the trends in the composition of expenditures reveal that while labor cost has long held the largest share of overall expenditures, that share has been declining in recent years. Tangible fixed asset purchase expenditures are also declining. The shares of materials cost and other expenditures have remained almost the same (Figure 2-1-28).

Company R&D expenditures by category rose with the exception of tangible fixed asset purchase expenditures and lease fees (Figure 2-1-29).

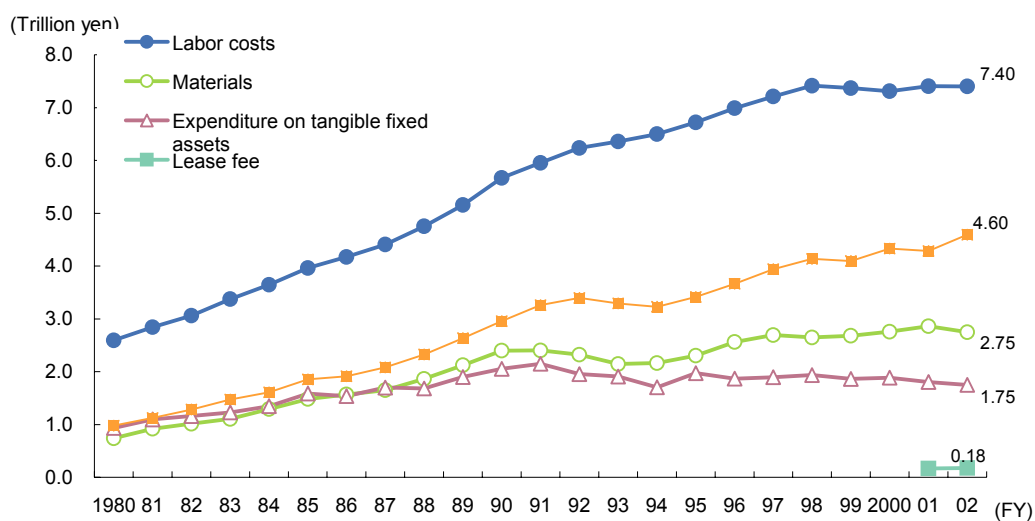


Figure 2-1-27 Trends in R&D expenditures by type

- Notes: 1. The humanities and social sciences are included.
 2. Lease fee was added as an expenditure in FY2001.
 3. Some Industries were added as new survey targets in FY1996 and FY2001.

Source: Statistics Bureau. "Report on the Survey of Research and Development"
 (See Appendix 3. (6))

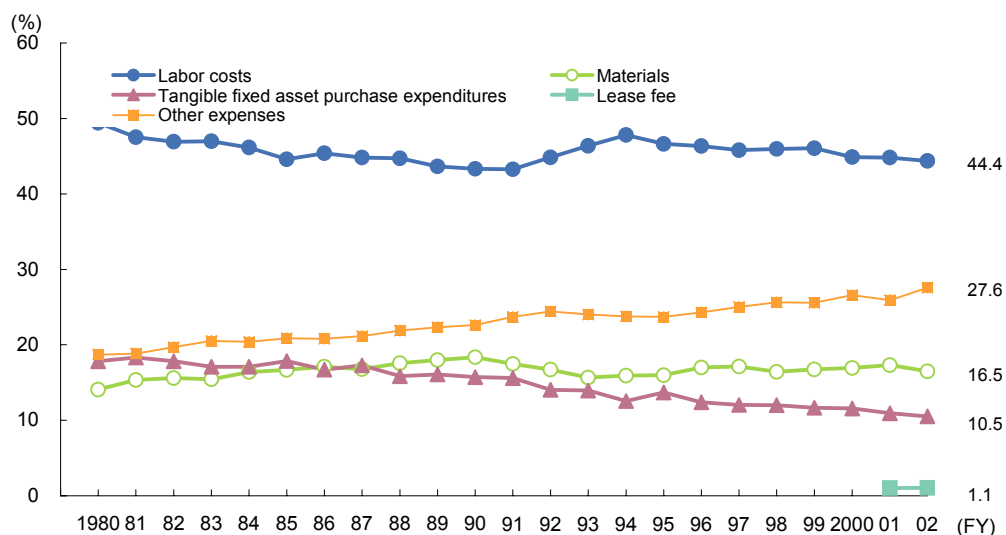


Figure 2-1-28 Trends in R&D expenditures by constituent elements

- Notes: 1. The humanities and social sciences are included.
 2. Lease fee was added as an expenditure in FY2001.
 3. Some Industries were added as new survey targets in FY1996 and FY2001.

Source: Statistics Bureau. "Report on the Survey of Research and Development"
 (See Appendix 3. (6))

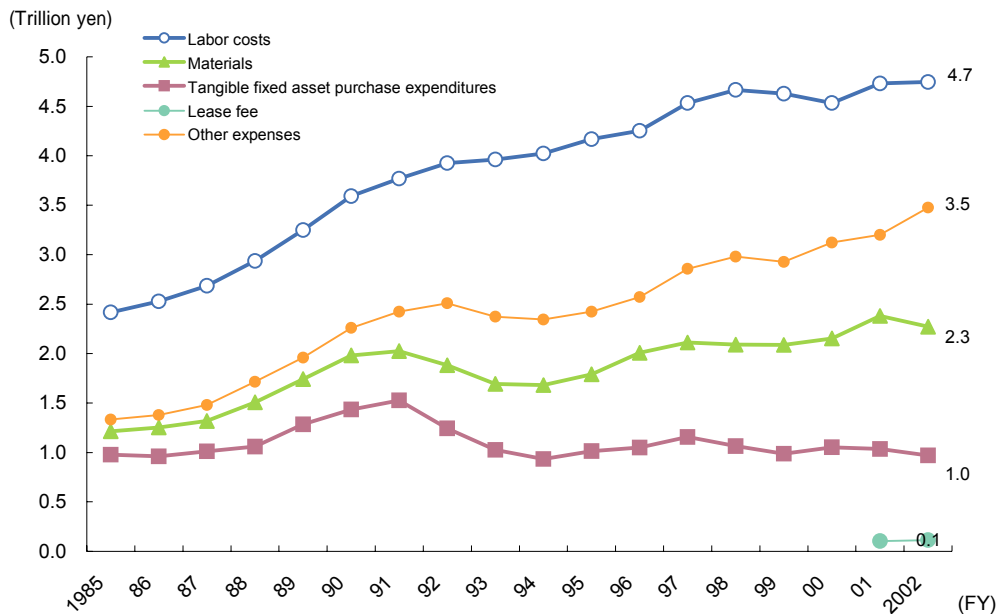


Figure 2-1-29 Trends in R&D expenditures at business enterprises, by type

Notes: 1. Lease fee was added as an expenditure in FY2001.

2. The software industry and wholesale trade were newly added to the scope of the survey in FY1996 and FY2001, respectively.

Source: Statistics Bureau. "Report on the Survey of Research and Development"

(See Appendix 3. (6))

Non-profit institutions and public organizations had lower ratios than any other institutions on expenditures for labor costs, while their tangible fixed asset purchase expenditures showed higher ratios. When looking at expenditures by type of institution, local government-owned institutions were characterized by exceptionally high labor costs. On the other hand, public corporations and incorporated administrative agencies have higher ratios of expenditures for the purchase of tangible fixed assets, because they include those requiring large-scale

facilities and equipment for nuclear and space R&D (Figure 2-1-30).

Universities and colleges had a higher share of labor costs than other institutions, accounting for about 65% of expenditures, while raw material costs were the lowest in share. When looking at expenditures by the field of study within the natural sciences, all areas had lower than average shares of labor costs, while the physical sciences and engineering in particular tended to require larger than average shares of total costs for tangible fixed assets (Figure 2-1-31).

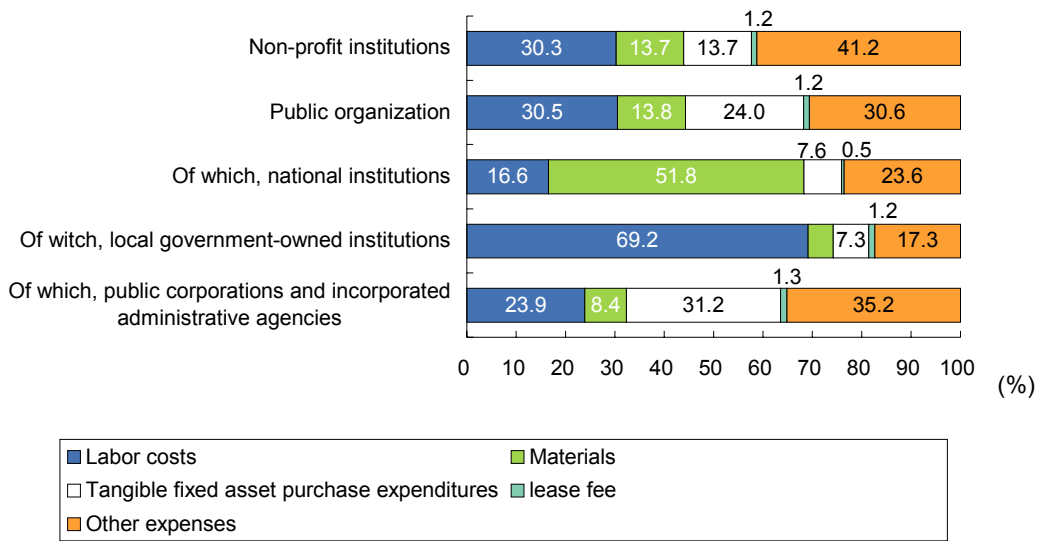


Figure 2-1-30 Composition of research expenditures at non-profit institutions and public organizations by type (FY2002)

Source: Statistics Bureau. "Report on the Survey of Research and Development"
(See Appendix 3. (6))

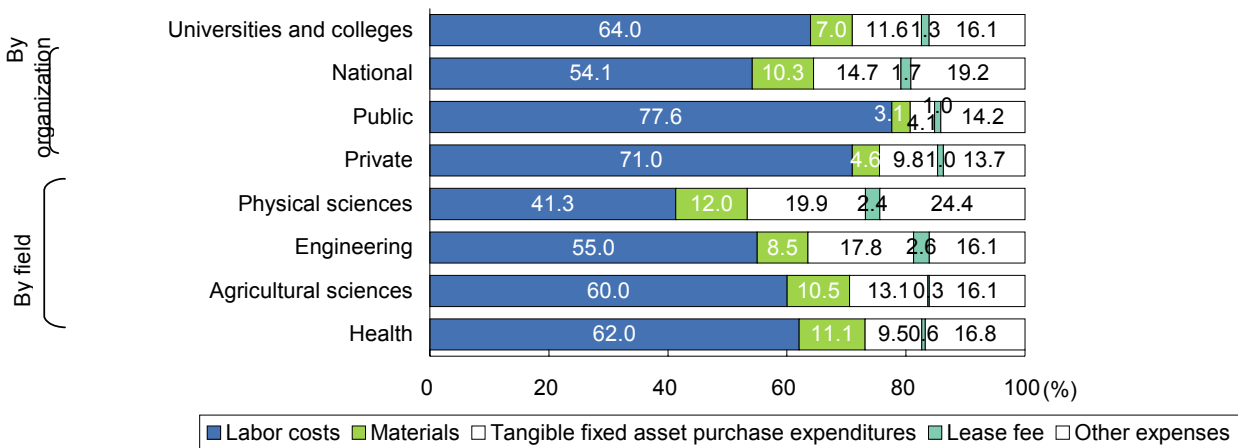


Figure 2-1-31 Composition of R&D expenditures at universities and colleges, by type (FY2002)

Note: The figures for all universities and colleges and those by organization include the humanities and social sciences.
Source: Statistics Bureau. "Report on the Survey of Research and Development"
(See Appendix 3. (6))