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Japanese Science and Technology Resources Continue to Increase

Japan has developed a strong science and technology (S&T) system, surpassed in size only by those of the United States and the Soviet Union. This is due largely to the money and personnel invested in research and development. Japanese R&D expenditures increased at an average annual rate of 11.1 percent since the mid-1970s, reaching \$42.3 billion (in constant dollars) in 1985. R&D expenditures in the United States grew at a slower average annual rate (5.2 percent) over the same period and in 1985 totaled \$97.3 billion (in constant dollars).

Viewed in relation to total economic activity, Japan's R&D investment is now about the same as that of the United States. Japan's R&D/GNP ratio rose from 2.0 percent in 1975 to 2.8 percent in 1985. The U.S. ratio during this period increased from 2.2 percent to 2.7 percent. The defense R&D component is the major difference between Japan and the United States. Only about 3 percent of the Japanese government's R&D funds is devoted to defense objectives, compared to more than two-thirds of the U.S. federal R&D funds in 1985 (and about 70 percent or more in subsequent years). Therefore, Japan's ratio of nondefense R&D expenditures to GNP was higher—an estimated 2.8 percent in 1985 compared with 1.9 percent for the United States.

Japan employs 381,000 scientists and engineers in research and development—about half the number employed in the United States (790,000). The ratio of these S/E's to the total

work force in Japan is similar to that in the United States. Japan's ratio of R&D scientists and engineers to 10,000 persons in the labor force was 63.2 in 1985, compared with the U.S. ratio of 67.4. Most Japanese industries have a higher ratio of R&D scientists and engineers to the labor force than the corresponding U.S. industries do.

Japan has a ratio of engineers to scientists in the labor force of about 4 to 1, compared with the U.S. ratio of about 3 to 2. Relatively greater emphasis is placed on educating engineers in Japan than in the United States. Though the ratio of first degree graduates to the college-age population is equal, a greater proportion of the degrees are given in engineering in Japan (19 percent) than are given in the United States (7 percent). Only 3 percent of bachelor's degrees are granted in natural science fields in Japan compared with 10 percent in the United States. Japan graduates far fewer doctorates in both science and engineering fields than the United States does.

Government provides a little more than one-fifth of all R&D funds in Japan compared with almost one-half in the United States. The Japanese government's R&D funding share has decreased because of its strict deficit reduction policy. Regardless of this, however, the Japanese government has allowed greater growth for research and development than for most other government program areas. Japanese industry accounts for a larger proportion (67 percent) of national R&D expenditures than U.S.

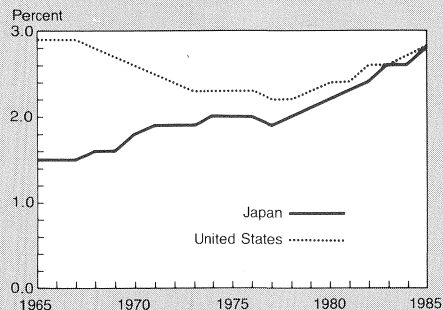
industry (50 percent) does. In Japan, however, only 2 percent of industry's R&D is funded by the government. In the United States a much larger proportion of industrial R&D (32 percent) is funded by the federal government, due in part to the much larger U.S. allocation to defense R&D.

Japanese industrial R&D expenditures are increasing most rapidly in the electronics and communication, precision instruments, and pharmaceuticals industries. These increases reflect Japan's policy since the early 1970s of shifting emphasis from industries perceived as older and somehow environmentally damaging to those viewed as environmentally clean and information-based.

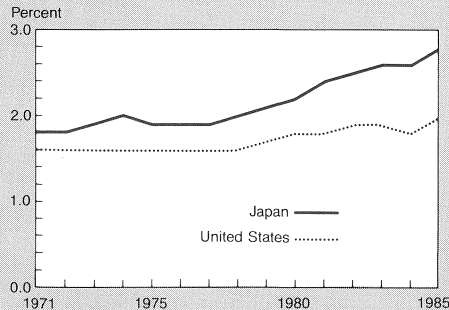
Japan has been especially vigorous in patenting its inventions. Japanese patenting activity in the United States has steadily increased. In 1985 almost one-fifth (18 percent) of all patents granted in the United States were to Japanese inventors, compared to only 4 percent in 1970. Japan is the leading foreign country patenting in the United States—representing 40 percent of all the foreign-origin patents granted in the United States in 1985.

This and much more on the S&T resources of Japan and other countries can be found in the following reports: *Statistical Profile of Japanese Scientific and Technical Research and Development* (in press), *The Science and Technology Resources of West Germany: A Comparison with the United States* (NSF 86-310), and *International Science and Technology Data Update 1987*.

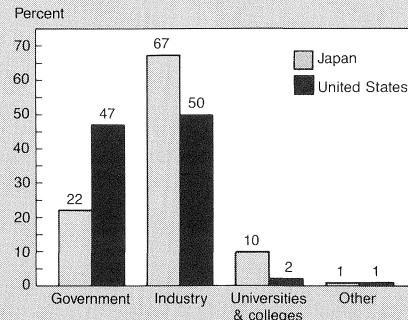
Total R&D/GNP ratios



National R&D funding by source: 1984



Nondefense R&D/GNP ratios



Source: National Science Foundation, SRS