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## International science and technology resources, investments, compared

Although the United States spends more on research and development than do Japan, West Germany, France, and the United Kingdom combined, each of these five countries spends roughly an equal percentage of its gross national product on research and development. In 1985 the United States spent \$96.5 billion (in constant 1982 dollars) on R&D activities, compared with a total amount of \$78.6 billion for the other four industrialized nations. The R&D/GNP ratios ranged from about 2.3 percent for the United Kingdom and France to about 2.7 percent for Japan, West Germany, and the United States. Because such a high proportion of U.S. government R&D expenditures is devoted to defense (about 70 percent), the United States has a much lower nondefense R&D/GNP ratio (1.8 percent) than Japan (2.8 percent) or West Germany (2.6 percent).

Industry is a significant source of R&D funds in all five nations, financing 41 percent to 67 percent of national R&D expenditures. In 1985, industry financed 67 percent of the R&D expenditures in Japan, 61 percent in West Germany, and 50 percent in the United States. Most funding of industrial research and development comes from industrial investments, not from government; in Japan and West Germany the preponderance of industrial R&D activities is financed privately (98 percent and 82 percent, respectively), compared to 73 percent in France, 67 percent in the United States, and 61 percent in the United Kingdom. The largest concentration of industrial R&D expenditures in all five countries during 1984-85 was in the electrical equipment manufacturing sector.

### Science and engineering personnel

The characteristics of the science and engineering (S/E) workforce differ significantly among the five countries. France had the lowest number of nonacademic scientists and engineers per 10,000 members of the labor force in the early-to-mid-1980s (165), the United States, the highest (276). And the Japanese had the most youthful (almost half the Japanese scientists and engineers were 35 years old or younger, compared to only 28 percent of the S/E workers in the United States). The concentration of scientists per 10,000 in the labor force was much higher in the United States and the United Kingdom (101 and 113, respectively) than in the other countries, and West Germany and Japan had higher concentrations of engineers per 10,000 in the labor force (194 and 187, respectively) than the United States (175). The United States had twice the number of scientists and engineers engaged in R&D pursuits as Japan, and the largest concentration of R&D scientists and engineers per 10,000 labor-force members (69 in 1986) of the five countries.

The United States grants nearly 2.5 times the number of first-university degrees in the natural sciences as do the other four countries combined (120,000 to 49,000) but grants fewer degrees in engineering than the total for the other four nations. Because engineering training receives greater emphasis in these other

countries, a much lower proportion of university graduates in the United States receives first degrees in engineering (8 percent) than in France (27 percent), Japan (19 percent), and West Germany and the United Kingdom (14 percent each). Japan, with only one-half the population of the United States, grants almost the same number of first-university degrees in engineering (71,000 compared to the United States' 78,000 in 1985). A higher proportion of the college-age population receives natural science and engineering degrees in Japan and the United States (almost 6 percent) than do the other three countries (between 2 percent and 3 percent).

The United States also grants a much higher total number of doctoral degrees in natural sciences and engineering than does each of the other countries. But the proportion of the 27-year-old population that receives such degrees is lower in the United States than in each of the other countries except Japan. In addition, a significant and growing proportion of U.S. doctorates is granted to foreign students (almost 25 percent in the sciences and almost 60 percent in engineering).

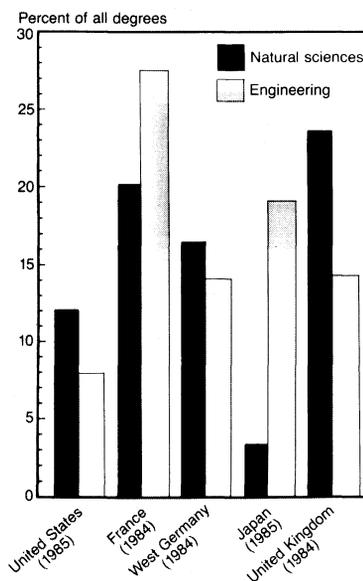
### S&T outputs and impacts

United States scientists and engineers authored 35 percent of the science and technology (S&T) articles in a set of the world's influential S&T journals in 1984. This share remained constant from 1981, with only slight shifts occurring within fields. The United States' share of patents within its own patent system, however, has been declining steadily since 1970. In 1984, 54 percent of the patents granted in the United States were to U.S. inventors and 46 percent to foreign inventors. Japanese patents now account for 40 percent of all foreign-origin patents in the United States.

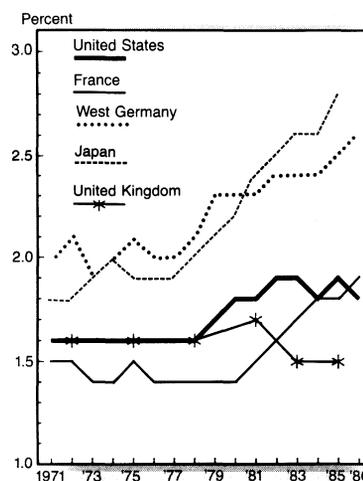
The United States had the lowest rate of productivity increase in manufacturing from 1977 to 1986 (26 percent, compared to a range of 31 percent to 68 percent for the other four nations). In addition, the United States ran a deficit in high-technology trade for the first time in 1986, the result primarily of deficits with Japan and the East-Asian newly industrializing countries. Nevertheless, the United States' share of world exports of technology-intensive products has remained relatively constant at about 25 percent since 1980, after dropping from 27 percent in 1970. Japan's share nearly doubled from 14 percent to 19 percent over the same period. The United States continues to be a net exporter of technological know-how by a significant amount.

Additional information on the S&T resources of the five major industrialized nations can be found in *International Science and Technology Data Update 1987* (NSF 87-319).

First-university degrees by field



Estimated nondefense R&D expenditures as a percent of GNP



SOURCE: National Science Foundation, SRS