dustry is often funded with other purposes in mind such as defense and space (and is therefore classified under other socioeconomic objectives).

Japanese, German, and Italian government R&D appropriations in 1998–99 were invested relatively heavily in advancement of knowledge (50 percent or more of the $20 billion total for Japan, 55 percent of Germany's $16 billion total, and 59 percent of the $7 billion total in Italy). "Advancement of knowledge" is the combined support for advancement of research and GUF.[70] Indeed, the GUF component of advancement of knowledge, for which there is no comparable counterpart in the United States, represents the largest part of government R&D expenditure in most OECD countries.

R&D Tax Policies. In many OECD countries, government not only provides direct financial support for R&D activities but also uses indirect mechanisms such as tax relief to promote national investment in S&T. Indeed, tax treatment of R&D in OECD countries is broadly similar, with some variations in the use of R&D tax credits (OECD 1996, 1999a). The main features of the R&D tax instruments are as follows:

- Almost all OECD countries (including the United States) allow 100 percent of industry R&D expenditures to be deducted from taxable income in the year they are incurred.
- About one-half of OECD countries (including the United States) provide some type of additional R&D tax credit or incentive with a trend toward using incremental credits. A few countries also use more targeted approaches, such as those favoring basic research.
- Several OECD countries have special provisions that favor R&D in small and medium-size enterprises. (In the United States, credit provisions do not vary by firm size, but direct Federal R&D support is provided through grants to small firms.)

A growing number of R&D tax incentives are being offered in OECD countries at the subnational (provincial and state) levels, including in the United States. See Poterba (1997) for a discussion of international elements of corporate R&D tax policies.

International Industrial R&D Investments

International R&D investments refer to R&D and related long-term activities by private companies outside of the home country. Broadly speaking, these activities include the acquisition or establishment of R&D facilities abroad, R&D spending in foreign subsidiaries (in manufacturing, services, or research facilities), international R&D alliances, licensing agreements, and contract research overseas. These activities fulfill different objectives in corporate R&D strategies and exhibit various degrees of managerial and financial commitment from the parties involved. Although public data on these international business activities are key for S&T policy analysis and design, their availability varies considerably, even within advanced economies.

In this section, the focus is on R&D spending trends to and from the United States, with a brief overview of overseas and foreign-owned domestic R&D facilities.[71] In principle, trends in R&D facilities are tied to overall foreign direct investment (FDI) trends, especially in high-technology industries. However, comprehensive FDI data on acquired and established facilities by type of major activity (i.e., manufacturing versus research) are not available in most countries.[72] On the other hand, R&D spending by multinational corporations are readily available from financial and operating data collected in FDI statistics.

By definition, R&D spending in subsidiaries abroad is preceded by the acquisition or establishment of foreign facilities. More fundamentally, however, the economics of these two activities have become increasingly intertwined in advanced economies. For one, FDI flows are becoming a key element in understanding the overall corporate R&D strategy of global companies. Conversely, knowledge-based assets are becoming an increasingly important factor in FDI decisions by multinational companies. However, empirical links are elusive with the available data. For example, mere changes in ownership can affect R&D spending statistics without representing changes in the actual performance of R&D domestically.

Foreign Direct Investments and R&D Facilities

Total foreign direct investments have increased steadily in recent years in the United States and elsewhere, according to data from the Bureau of Economic Analysis (BEA). Recent increases worldwide have been fueled by motives ranging from market liberalization efforts leading to privatization drives in some emerging markets, proximity to existing or potential large consumer markets, and regional technological advantages. Foreign direct investment flows into the United States are dominated by the lure of a large domestic market and by the technological sophistication of many of its firms. Technology-related factors driving FDI include an educated and skilled workforce, a favorable regulatory environment, and the need for complementary technologies in an increasingly complex and rapid innovation process.

According to an OECD study, as much as 85 percent of FDI activity worldwide consists of mergers and acquisitions (M&As), compared to the establishment of new industrial facilities or so-called greenfield investments (Kang and Johansson

[70] In the United States, "advancement of knowledge" is a budgetary category for research unrelated to a specific national objective. Furthermore, although GUF are reported separately for Japan, Canada, and European countries, the United States and Russia do not have an equivalent GUF category. In the United States, funds to the university sector are distributed to address the objectives of the Federal agencies that provide the R&D funds. GUF is not equivalent to basic research. For 1999, the GUF portion of total national governmental R&D support was 48 percent in Italy, 39 percent in Germany, 37 percent in Japan, and between 18 and 24 percent in the United Kingdom, Canada, and France.

[71] Data limitations preclude the inclusion of contract R&D with (or grants to) foreign organizations, whereas international technology alliances are discussed earlier in this chapter.

[72] As discussed below, a DOC survey with 1997 and 1998 data provides the latest available indicators of overseas and foreign-owned domestic R&D facilities.

2000). M&As involving high-technology facilities supply not only vital research infrastructure (such as specialized facilities and equipment) but also an existing base of intangible assets key in the development and marketing of new technologies including technical know-how and skilled workers, organizational knowledge, marketing networks, and trademarks.

In the United States, data on foreign-owned research facilities are available only to 1998 from a DOC survey (Dalton, Serapio, and Yoshida 1999). In 1998, 715 U.S. R&D facilities were operated by 375 foreign-owned companies, including 251 facilities (35 percent) owned by Japanese parent companies. Other countries with a major presence were Germany 107 (15 percent) and the United Kingdom 103 (14 percent). One-third of the facilities were chemicals/rubber, drugs, and biotechnology centers, most with German, Japanese, or British parent companies. Another 10 percent (74) were computer and semiconductor R&D facilities, and 7 percent (53) conducted software research. Almost two-thirds of these computer and software research centers were Japanese owned, with a good share located in California. On the other hand, by 1997 U.S. companies had established at least 186 R&D facilities overseas. Two-thirds of these facilities were located in five countries: Japan (43), United Kingdom (27), Canada (26), France (16), and Germany (15).[73]

Foreign R&D and R&D Expenditure Balance

R&D spending by U.S. affiliates of foreign companies in the United States (or foreign R&D spending) increased 28 percent in 1997–98, from $17 billion to $22 billion, the largest single-year increase since 1990, as compiled by BEA (2000).[74] (See appendix table 4-50.) This pushed foreign R&D as a proportion of company-funded industrial R&D in the United States to a record 15 percent in 1998, after fluctuating around 13 percent since 1994. (See figure 4-35.)

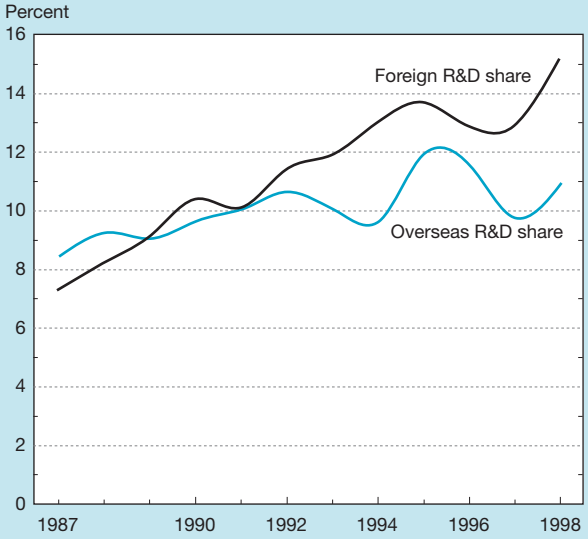
When combined with the $15 billion of R&D spent abroad by U.S.-based companies, this yields a "net inflow" of R&D expenditures of more than $7 billion in 1998 compared with $3 billion a year earlier.[75] (See figure 4-36.) However, this record increase in net U.S. inflows needs to be put in perspective. In particular, data on foreign R&D spending in the United States are affected by changes in ownership involving domestic and foreign companies, as in cross-country M&As. In 1998, two of the largest M&As included the Daimler-Benz (Germany) merger with Chrysler and the British Petroleum (United Kingdom) merger with Amoco. Acquisition of Ameri-

[73]For a detailed discussion of the results of the DOC survey, see NSB (2000), pages 2–65/66.

[74]Data are for R&D performed in the United States by majority-owned (more than 50 percent) nonbank U.S. affiliates of foreign parent companies. See appendix tables 4-50 and 4-51. Appendix table 4-49 has R&D spending data based on 10 percent foreign ownership. Data are based on the concept of an ultimate beneficial owner, which is the person "proceeding up the U.S. affiliate's ownership chain beginning with and including the foreign parent, that is not owned more than 50 percent by another person." For more details and definitions, see Quijano (1990).

[75]Note that the BEA data used here are based on R&D performance, not funding source (domestic or foreign). Still, these R&D spending trends do provide an indication of the industrial and R&D strategies of multinational companies based in, or with activities in, the United States.

Figure 4-35.
Ratio of foreign and overseas R&D spending to company-funded industrial R&D



NOTES: Foreign R&D refers to R&D performed in the United States by U.S. affiliates of foreign parent companies. Overseas R&D refers to R&D performed abroad by foreign affiliates of U.S. parent companies.

See appendix tables 4-32, 4-46, and 4-50.

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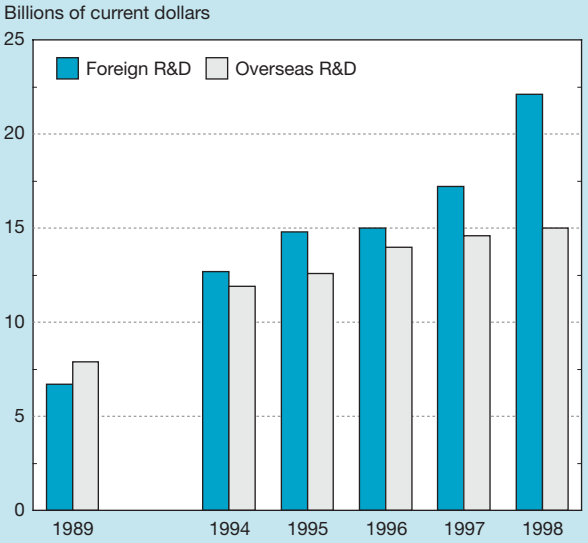
Figure 4-36.
Globalization of U.S. industrial R&D



NOTES: Foreign R&D refers to R&D performed in the United States by U.S. affiliates of foreign parent companies. Overseas R&D refers to R&D performed abroad by foreign affiliates of U.S. parent companies.

See appendix tables 4-48 and 4-50.

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can R&D-performing companies increases reported R&D funded by foreign affiliates that may or may not represent actual changes in research activities beyond a change in ownership. Difficulties in the valuation of purchased in-process R&D, the cumulative (and more difficult to track) effect of smaller acquisitions, and the offsetting effects of divestitures also make it difficult to assess the effect of cross-border M&A activity in international R&D spending flows.

Chemical manufacturing and the new NAICS sector of computer and electronic product manufacturing had the largest single-industry shares of foreign R&D in 1998 (33 and 20 percent, respectively). They include the largest subsectors attracting foreign R&D funding: pharmaceuticals and communications equipment (see appendix table 4-51). As detailed below, more than one-half of foreign-owned chemicals and pharmaceuticals R&D in the United States is performed by Swiss and German subsidiaries. Transportation equipment (mostly motor vehicles and bodies) had a 12 percent share in 1998, up sharply from the 1997 share, in part due to cross-border M&A activity. The most notable nonmanufacturing sectors are professional, scientific, and technical services (NAICS sector 54), which include R&D services, with a 3 percent share, and information services (NAICS sector 51), with 2 percent share. The latter includes such R&D-intensive industries as telecommunications and data processing services.

Comparable to statistics on high-technology trade and FDI flows, European, Japanese, and Canadian companies make the largest R&D investments in the United States. (See figure 4-37.) In 1998, American affiliates of European parent companies represented 72 percent of the $22 billion R&D spending in the United States, down slightly from 75 percent in 1996, Asia-Pacific (14.4 percent, including Japan at 11.7 percent), and Canada (10.7 percent). Among the European countries, the largest shares correspond to Germany (22.1 percent), the United Kingdom (16.7 percent), and Switzerland (14.0 percent).

Furthermore, specific countries dominate foreign majority-owned R&D expenditures in certain U.S. industries. Swiss subsidiaries performed 34 percent of foreign-owned R&D in chemicals as well as 26 percent of foreign-owned industrial machinery R&D in 1998. German subsidiaries performed 20 percent of foreign-owned chemical R&D. At the same time, more than 90 percent of R&D spending by foreign-owned transportation equipment affiliates is performed by European subsidiaries.[78] On the other hand, 25 percent of the Japanese-owned $2.6 billion R&D spending in the United States is performed in the area of computers and other electronic products. (See text table 4-18.)

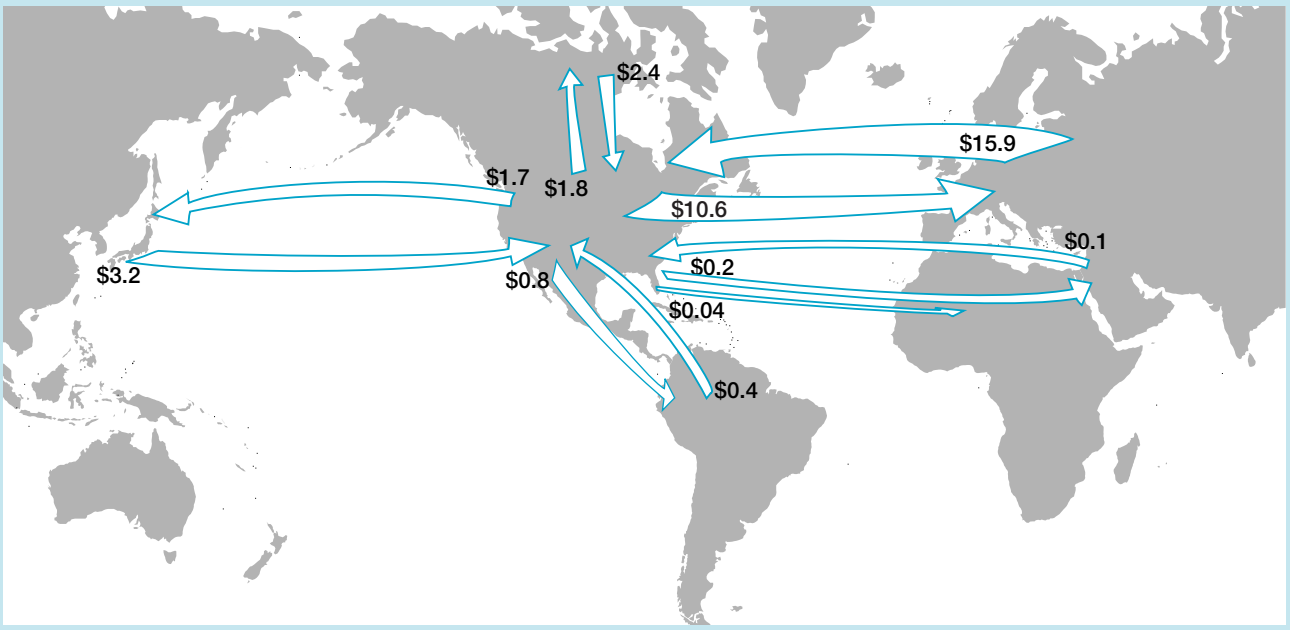
Overseas R&D Spending

According to data from the NSF Industrial R&D survey (NSF 2001e), R&D performed abroad by foreign affiliates of U.S. parent companies (or overseas R&D spending) reached

[78]Disclosure limitations preclude further country-specific analysis.

Figure 4-37.
Industrial R&D spending of U.S. and foreign affiliates, by world region: 1998

Billions of current dollars



See appendix tables 4-48 and 4-50.

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Text table 4-18.
R&D performed by majority-owned U.S. affiliates of foreign companies in the United States, by NAICS industry of affiliate and country: 1998
(Millions of U.S. dollars)

Country	All industries	Manufacturing						Non-manufacturing
		Total	Chemicals	Machinery	Computers	Electrical equipment	Transportation equipment	
Total	22,073	18,256	7,193	725	4,509	898	2,678	3,817
Canada	2,353	2,127	12	5	D	D	D	226
Europe	15,904	14,197	6,749	D	D	D	2,416	1,707
France	1,905	1,807	712	3	535	123	88	98
Germany	4,880	4,570	1,387	D	77	D	D	310
Netherlands	985	941	359	D	D	1	D	44
Switzerland	3,083	2,956	2,443	189	28	3	0	127
United Kingdom	3,685	3,005	D	177	220	72	128	680
Asia and Pacific	3,180	1,600	408	D	664	D	224	1,580
Japan	2,578	1,470	D	D	637	7	171	1,108
Western hemisphere	393	D	—	0	5	0	8	D
Middle East	129	116	D	4	91	0	0	13
Africa	D	D	0	0	0	0	0	D

NAICS = North American Industry Classification System; D = withheld to avoid disclosing operations of individual companies; — = less than $500,000

NOTES: Data are for majority-owned (more than 50 percent ownership) non–bank affiliates of foreign parents by country of ultimate beneficial owner (UBO). Industry of affiliate based on NAICS industrial classification system. Data include expenditures for R&D conducted by affiliates, whether for themselves or for others under contract. Data exclude expenditures for R&D conducted by others for affiliates under contract. See also appendix tables 4-50 and 4-51.

SOURCE: U.S. Bureau of Economic Analysis, *Foreign Direct Investment in the United States: Operations of U.S. Affiliates of Foreign Companies,* Preliminary 1998 Estimates (Washington, DC, 2000).

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$17 billion in 1999. (See appendix table 4-47.)[79] In the three-year period for which NAICS-based data are available from this survey (1997 to 1999) this spending grew 28 percent (25 percent after adjusting for inflation).[80] Although the manufacturing share in R&D spending by American subsidiaries abroad declined from 90 percent in 1997 to 74 percent in 1999,[81] the largest single-industry shares in 1999 are all in this sector: transportation equipment (24 percent), chemicals (19 percent), pharmaceuticals, (17 percent), and computer and electronic products (11 percent). The nonmanufacturing information sector represented 8 percent of spending by foreign affiliates of American companies in 1999, up from a 5 percent share in 1997. Professional, scientific, and technical services had a 3 percent share in 1999 compared to 2 percent in 1998 and 1 percent in 1997.

Data on overseas R&D spending are available with country detail from a separate BEA survey but only through 1998. BEA data show that R&D expenditures overseas by majority-owned foreign affiliates (MOFAs) of U.S. multinationals increased from $12 billion in 1994 to $15 billion in 1998, for an annual growth rate of 4.8 percent.[82] The 1998 figure represents an increase of 2.7 percent over 1997 (1.4 percent after adjusting for inflation). However, this increase in R&D overseas did not keep pace with domestic industrial R&D, as shown in figure 4-35, where overseas R&D spending is presented relative to domestic company-funded industrial R&D.

More than two-thirds ($10.3 billion) of R&D performed overseas in 1998 took place in five countries: the United Kingdom, Germany, Canada, France, and Japan. (See appendix table 4-48.) This concentration of R&D spending abroad corresponds with other overseas activities by U.S. multinational companies. In particular, Mataloni (2000) notes an increase in new or acquired MOFAs by U.S. multinationals in large markets with high wages, especially to the United Kingdom, as opposed to low-wage countries. Not surprisingly, R&D expenditures by majority-owned foreign affiliates of U.S. parent companies were also the highest in the United Kingdom ($3 billion, or 21 percent of overseas R&D). Cultural and economic similarities with the United States, such as the low level of market regulation, as well as the duty-free access to customers in other European Union members, makes the United Kingdom a prime target for new MOFA operations.[83] In addition, advanced economies offer U.S. affiliates either large or high-income markets, and technological know-how

[79]The 1998 NSF figure for R&D abroad is $16 billion, higher than the BEA tally of $15 billion in 1998 discussed below. At the time this report was written, 1999 BEA data were not available.

[80]For historical data, see appendix table 4-46.

[81]Note that manufacturing shares for 1997–99 are not completely comparable with previous years based on the SIC system. For example, some of the new nonmanufacturing sectors in NAICS contain activities previously classified in manufacturing.

[82]In constant 1996 dollars, the annual growth rate was 3.3 percent, reaching $14.5 billion in 1998.

[83]U.S. MNCs acquired or established 84 of 477 foreign affiliates in the United Kingdom in 1998, the largest single-country figure. These new MOFAs in the United Kingdom accounted for the largest share (44 percent) of the gross product of all new MOFAs in 1998, the latest figure available from BEA. Other key locations for new U.S. affiliates in 1998 were Canada (38), Germany (36), the Netherlands (36), and France (27).

that complements or expands the parents' capabilities.

As a region, majority-owned European subsidiaries of American companies performed $10.6 billion (71 percent) of overseas R&D in 1998, the highest regional share. (See first data column in text table 4-19.) Canadian subsidiaries had a 12 percent share in 1998 but more than doubled R&D spending over 1994–98. On the other hand, Japanese subsidiaries performed 7 percent of U.S.-owned R&D abroad in 1998, down from a 10 percent share in 1994, reflecting the impact of the decade-long recession in that Asian economy. In fact, Canadian subsidiaries have been spending more than the Japanese units on R&D activities since 1996, something that had not happened since 1982. (See appendix table 4-48.)

According to the BEA data, about three-fourths of all R&D performed overseas by majority-owned affiliates in 1998 was undertaken in four manufacturing sectors: transportation equipment (30 percent), chemicals (27 percent), industrial machinery, including computers (7 percent), and electronic equipment and components, except computers (8 percent). (See text table 4-19.) Almost one-fourth of the $4 billion spent by majority-owned U.S. affiliates overseas in chemicals research (which includes pharmaceuticals and some biotechnology research) was performed in the United Kingdom; another 16 percent was performed in France.

On the other hand, of the $4.5 billion in automotive and other transportation equipment research overseas in 1998, 42 percent was performed in Germany and another 21 percent in Canada. This is not surprising, given the strong presence of American automobile factories and related technical centers in both countries. For industrial machinery, 31 percent of research abroad was performed in the United Kingdom and 22 percent in Germany. For electronic equipment, the countries with the largest shares were Germany (16 percent) and Japan (11 percent).

Text table 4-19.
R&D performed overseas by majority-owned foreign affiliates of U.S. parent companies, by SIC industry of affiliate and country: 1998
(Millions of U.S. dollars)

Country	All industries	Manufacturing					Non-manufacturing
		Total	Chemicals	Industrial machinery	Electronic equipment	Transportation equipment	
Total	14,986	12,746	4,002	1,116	1,212	4,465	2,240
Canada	1,771	1,569	395	23	124	917	202
Europe	10,580	9,154	2,988	874	724	3,084	1,426
Belgium	326	232	173	3	5	15	94
France	1,321	1,143	656	75	52	151	178
Germany	3,042	2,908	258	250	194	1,872	134
Italy	586	521	275	50	71	60	65
Netherlands	501	301	D	9	61	63	200
Spain	198	181	75	8	41	45	17
Sweden	448	385	D	23	8	D	63
Switzerland	234	164	35	66	17	0	70
United Kingdom	3,144	2,610	956	342	104	D	534
Rest of Europe	780	709	D	48	171	D	71
Asia and Pacific	1,690	1,267	445	162	237	139	423
Australia	302	240	54	9	1	D	62
Japan	1,030	722	317	76	132	5	308
Rest of Asia/Pacific	358	305	74	77	104	D	53
Western hemisphere	753	662	137	18	119	322	91
Brazil	448	435	72	13	D	D	13
Mexico	191	140	21	5	D	D	51
Middle East (Israel)	157	62	13	D	8	0	95
Africa	35	32	23	D	—	3	3

SIC = Standard Industrial Classification System; D = withheld to avoid disclosing operations of individual companies; — = less than $500,000

NOTES: Data are for majority-owned (more than 50% ownership) non-bank affiliates of nonbank U.S parents by SIC industry of affiliate. Data include expenditures for R&D conducted by foreign affiliates, whether for themselves or for others under contract. Data exclude expenditures for R&D conducted by others for affiliates under contract. Industrial machinery includes computer equipment.

See also appendix table 4-48.

SOURCE: U.S. Bureau of Economic Analysis, *U.S. Direct Investment Abroad: Operations of U.S. Parent Companies and Their Foreign Affiliates,* Preliminary 1998 Estimates (Washington, DC, 2000).

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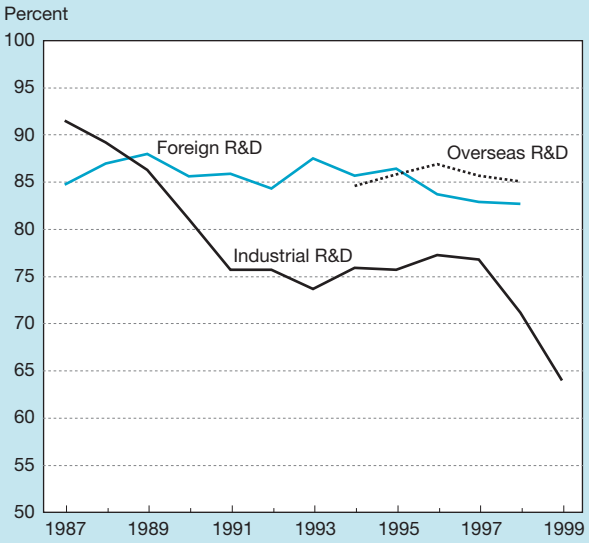
Industrial Structure of International R&D Spending and the IGRD Index

Manufacturing activity still dominates trends in total domestic, foreign, and overseas R&D spending, but such dominance has declined in recent years. Of these indicators, overseas R&D continue to have the heaviest concentration of manufacturing activity, followed by foreign R&D and total domestic industrial R&D. (See figure 4-38.)

Different industries dominate these three categories of R&D spending, revealing diverse technological and financial opportunities across U.S. borders. For example, 27 percent of R&D spending by foreign affiliates of U.S. companies was performed in transportation equipment, the highest proportion among all major R&D performing industries in 1998. (See figure 4-39 and appendix table 4-52.) However, this proportion is more than twice its 12 percent share of foreign R&D spending in the United States. On the other hand, chemicals research, which includes pharmaceuticals and some biotechnology, represented 33 percent of foreign R&D in the United States, twice its 17 percent overseas R&D share. Furthermore, the proportion of chemicals R&D in either foreign or overseas R&D spending is higher than its domestic company-funded R&D share of 13 percent, reflecting a high degree of globalization of R&D activity in this industry.

Another interesting pair of industries is computer manufacturing and information services (software publishing and data processing services). They represent the manufacturing

Figure 4-38.
Manufacturing shares in foreign, overseas, and total domestic industrial R&D



NOTES: Foreign R&D refers to R&D performed in the U.S. by United States affiliates of foreign parent companies. Overseas R&D refers to R&D performed abroad by foreign affiliates of U.S. parent companies. The industrial classification system used in industrial R&D and foreign R&D data changed from SIC to NAICS in 1997.

See appendix tables 4-31, 4-48, and 4-50.

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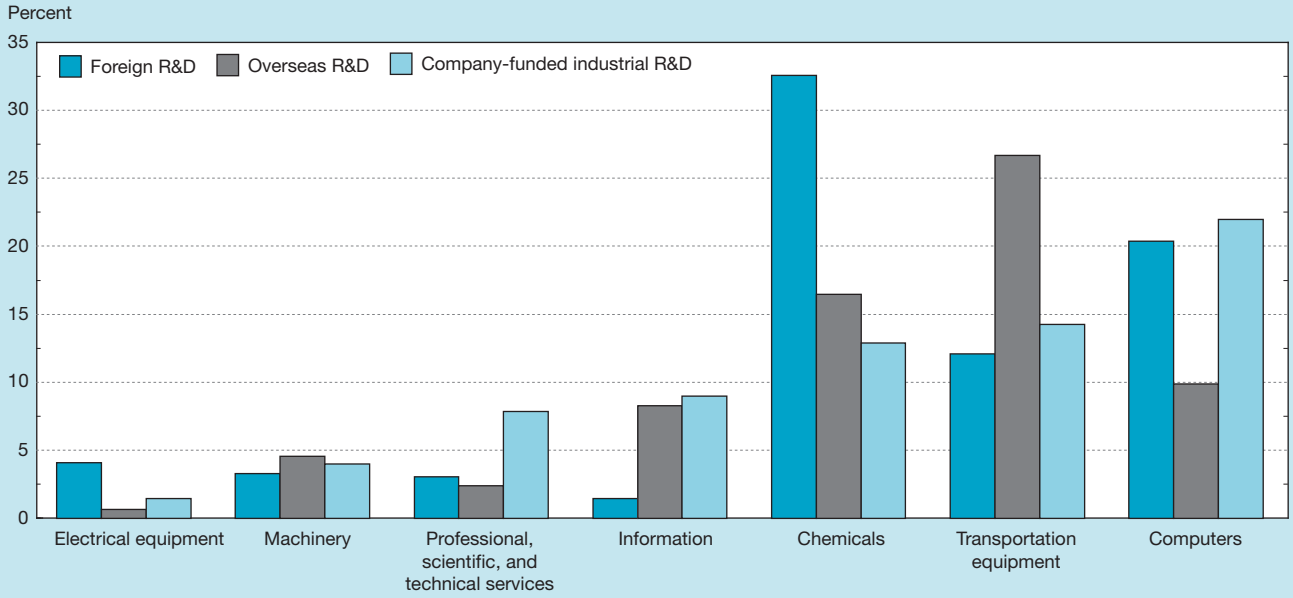
Figure 4-39.
Share of selected industries in foreign, overseas, and company-funded industrial R&D in the United States: 1998



NOTES: Foreign R&D refers to R&D performed in the United States by U.S. affiliates of foreign parent companies. Overseas R&D refers to R&D performed abroad by foreign affiliates of U.S. parent companies. The seven industries in this figure account for 77 percent, 69 percent, and 72 percent of foreign, overseas, and domestic company-funded R&D, respectively.

See appendix table 4-52.

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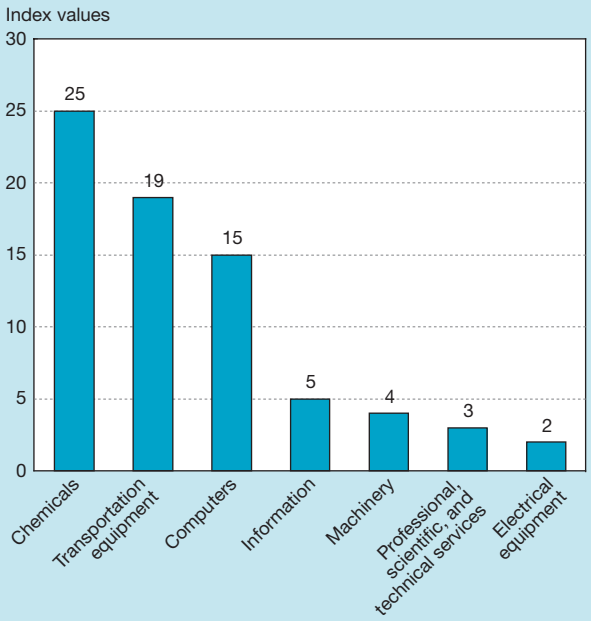
and services sides, respectively, of information technology activity. Remarkably, the share of information services in R&D spending abroad (8.3 percent) is five times larger than that industry's foreign R&D share (1.5 percent) in 1998. The opposite is true for computer and electronic products. The computer industry accounts for 20 percent of total foreign R&D in the United States, twice as large as its 10 percent share in R&D funds spent abroad. However, more data based on the newly established NAICS classification system would be needed over time to form a more accurate picture of the R&D flows in these two components of IT R&D.

Another measure of the degree of globalization of R&D activity is obtained by combining these R&D spending shares. Specifically, the Industrial Globalization R&D (IGRD) index is defined as the average of foreign and overseas R&D spending shares for a given industry.[84] This average indicates how open an industrial innovation system is to R&D flows, not unlike the sum of exports and imports, which quantifies the openness of national economies to the flow of goods. By this measure, chemical manufacturing in the U.S. exhibit the highest degree of internationalization with an IGRD index of 25, followed by transportation equipment (19), and computer manufacturing (15). (See figure 4-40.)

Several implications may be drawn from this indicator. An industry with a high IGRD index may be less constrained by national R&D expenditure trends. Furthermore, such an industry is more likely to have the institutional setup required to take advantage of technological opportunities elsewhere. The index could be used in conjunction with other international S&T indicators discussed in this volume, including bibliometric indicators, foreign-origin patents, international alliances and R&D facilities, and high-technology trade.[85]

[84]In principle, the IGRD index has a range of [0, 100]. However, reasonable index values for R&D-intensive industries in advanced economies are not likely to exceed or even be close to 50.

Figure 4-40.
Industrial Globalization R&D index for selected U.S. industries



NOTE: The Industrial Globalization R&D (IGRD) index is the average of foreign and overseas R&D spending shares for a given industry.

See appendix table 4-52. *Science & Engineering Indicators – 2002*

Conclusion

A resurgence in R&D investment in the United States in the mid-1990s has continued through to the beginning of 2000. A prosperous economy invigorated companies in both the manufacturing and service sectors, enabling them to allocate more resources toward the discovery of new knowledge and the application of that knowledge toward the development of new products, processes, and services. An upsurge in innovation is further contributing to a buoyant economy.

At the same time that the private sector's role in maintaining the health of U.S. R&D enterprise has been expanding, the Federal Government's contribution has been receding, as the Federal share has become less prominent in both the funding and the performance of R&D. Similar developments have been seen in many countries throughout the world. As a result of these two divergent funding trends in the United States, the composition of the nation's R&D investment is slowly shifting. For example, a growing percentage of the nation's R&D total has been directed toward nondefense activities.

Concurrent with these broad patterns of change, the locus of R&D activities is also shifting as a reflection of broad technological changes and new scientific research opportunities. For example, a growing amount of industrial R&D is now undertaken in services (versus manufacturing) industries, and much of the industry R&D growth has been in biotechnology and information technology. Reflecting the political reality of tremendous increases in research funding for NIH relative to other Federal agencies, the composition of these Federal funds has shifted markedly toward the life sciences during the past several years. Whereas industry has focused its R&D on new product development, the Federal Government historically has been the primary funding source for basic research activities.

As part of the changing composition of R&D activities, the organizational process of conducting R&D also has undergone substantial change. Greater reliance is being placed on the academic research community, and all sectors have expanded their participation in a variety of domestic and international partnerships both within and across sectors. The rapid rise in global R&D investments is evident from the expansion of industry's overseas R&D spending and the even more rapid rise in foreign firms' R&D spending in the United States. These domestic and foreign collaborations permit performers to pool and leverage resources, reduce costs, and share the risks associated with research activities. In addition, such alliances and international investments open a host of new scientific opportuni-

[85]See earlier sections in this chapter, as well as chapters 5 and 6 in this volume.