

INCREASE IN U.S. INDUSTRIAL R&D EXPENDITURES REPORTED FOR 2003 MAKES UP FOR EARLIER DECLINE

by Raymond M. Wolfe

Companies spent \$204 billion in current-year dollars on research and development (R&D) performed in the United States during 2003 compared with \$193.9 billion in 2002 (table 1), according to estimates from the Survey of Industrial Research and Development.¹ This \$10.1 billion (5.2 percent) increase followed a decrease of \$8.1 billion (4.0 percent) in 2002 compared with 2001. In inflation-adjusted dollars, R&D expenditures in 2003 increased \$6.2 billion (3.3 percent), following the decrease in 2002 of \$11.0 billion (5.6 percent). The increase for 2003 resumed the long-term trend: annual increases in inflation-adjusted expenditures were reported for all but nine years since the survey's inception in 1953.

Contributions from both the company's own and other nonfederal sources (hereafter, company funding) and from federal sources for R&D were higher in 2003 than in 2002. Company funding amounted to \$183.3 billion in current-year dollars compared with \$177.5 billion during 2002, and federal funding amounted to \$20.7 billion compared with \$16.4 billion during 2002. These changes represent increases in inflation-adjusted expenditures in both categories. Since 1953, inflation-adjusted company-funded R&D has increased each year in all but seven; federally funded R&D has increased in about half of the years. All estimates from the survey are subject to both sampling and nonsampling errors (see Limitations of the Data below).

¹*Company* is defined as a business organization of one or more establishments under common ownership or control. The Survey of Industrial Research and Development is conducted jointly by the National Science Foundation (NSF) and the U.S. Bureau of the Census.

R&D Funds by Sector

In 2003 manufacturing industries performed \$108.1 billion (59 percent) of company-funded and \$15.3 billion (74 percent) of federally funded industrial R&D in the United States. Companies classified in the nonmanufacturing industries sector performed \$75.2 billion of company-funded and \$5.4 billion of federally funded industrial R&D. Amounts of company and federally funded R&D reported by top R&D performing industries are given in table 2. The table lists in order the manufacturing and nonmanufacturing industries that spent the most on company-funded R&D during 2003 and compares 2003 costs with 2002 costs. The table also gives 2002 and 2003 R&D costs for the top performing industries of federally funded R&D in both groups (statistics are available only for selected industries; see table 2 for explanation).

Sales of and Employment in R&D-Performing Industries

Domestic net sales of companies that performed R&D in the United States rose 17 percent from the previous year to \$5.8 trillion in 2003 (see table 1 for definition of terms); manufacturers' sales were \$3.5 trillion and companies in nonmanufacturing industries reported sales of about \$2.3 trillion. Sales for 2002 were \$4.9 trillion, \$3.0 trillion in manufacturing industries and \$1.9 trillion in nonmanufacturing industries. For 2003, the R&D-to-sales ratio was 3.5 percent for manufacturers and 3.6 percent for companies in nonmanufacturing industries, yielding a 3.5 percent ratio for all industrial R&D performers. The overall ratio was 3.9 in 2002.



TABLE 1. Funds expended for industrial R&D performance by performing sector, source of funds, size of company, and sales of R&D-performing U.S. companies: 2002 and 2003

| Selected characteristic | 2002 | 2003 | 2002 | 2003 |
|---------------------------------------|-----------------------------|-----------|-------------------------------------|-----------|
| | Millions of current dollars | | Millions of constant (2000) dollars | |
| Total industrial R&D performance | 193,868 | 204,004 | 186,250 | 192,457 |
| Performing sector | | | | |
| Manufacturing industries | 112,089 | 123,384 | 107,685 | 116,400 |
| Nonmanufacturing industries | 81,779 | 80,620 | 78,566 | 76,057 |
| Source of funds and performing sector | | | | |
| Company and other nonfederal funds | 177,467 | 183,305 | 170,494 | 172,929 |
| Manufacturing industries | 101,344 | 108,079 | 97,362 | 101,961 |
| Nonmanufacturing industries | 76,123 | 75,226 | 73,132 | 70,968 |
| Federal government | 16,401 | 20,699 | 15,757 | 19,527 |
| Manufacturing industries | 10,745 | 15,305 | 10,323 | 14,439 |
| Nonmanufacturing industries | 5,656 | 5,394 | 5,434 | 5,089 |
| Size of company (number of employees) | | | | |
| 5–24 | 4,261 | 5,578 | 4,094 | 5,262 |
| 25–49 | 3,845 | 6,449 | 3,694 | 6,084 |
| 50–99 | 6,164 | 4,829 | 5,922 | 4,556 |
| 100–249 | 13,227 | 9,559 | 12,707 | 9,018 |
| 250–499 | 8,055 | 9,536 | 7,738 | 8,996 |
| 500–999 | 9,925 | 10,383 | 9,535 | 9,795 |
| 1,000–4,999 | 28,625 | 30,484 | 27,500 | 28,758 |
| 5,000–9,999 | 17,942 | 15,434 | 17,237 | 14,560 |
| 10,000–24,999 | 26,458 | 27,571 | 25,418 | 26,010 |
| 25,000 or more | 75,365 | 84,180 | 72,404 | 79,415 |
| Domestic net sales ¹ | 4,917,748 | 5,757,829 | 4,724,515 | 5,431,914 |
| Manufacturing industries | 3,046,924 | 3,503,582 | 2,927,201 | 3,305,266 |
| Nonmanufacturing industries | 1,870,823 | 2,254,246 | 1,797,313 | 2,126,647 |

¹ Dollar values for goods sold or services rendered by R&D-performing companies to customers outside the company, including the federal government, less such items as returns, allowances, freight charges, and excise taxes. Excludes domestic intracompany transfers and sales by foreign subsidiaries but includes transfers to foreign subsidiaries and export sales to foreign companies.

NOTES: Detail may not add to totals because of rounding. 2000 gross domestic product (GDP) implicit price deflators were used to convert current to constant dollars. Statistics exclude data for federally funded research and development centers.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development.

Despite the increase in net sales, domestic employment by companies that performed R&D in the United States during 2003 was 15.3 million, about the same as reported in 2002 (table 3). The number of people employed by R&D-performing manufacturing companies was 9.0 million in 2003, and R&D-performing companies in nonmanufacturing industries reported employment of 6.4 million. Of those, the number of full-time equivalent (FTE) scientists and engineers who performed industrial R&D in manufacturing industries was about 0.6 million and in nonmanufacturing industries was about 0.5 million.

R&D Expenses, Outsourcing, Technology, and Collaborative R&D

To broaden the relevance and usefulness of the statistics resulting from the Survey of Industrial Research and Development, respondents annually are asked to distribute their R&D expenses into various categories. For 2003, these included distribution by type of expense, the sector of the performer of extramural or outsourced R&D, how much R&D companies performed in several technology areas, and the cost of R&D performed in collaboration with various types of partners.

TABLE 2. Largest R&D performing industries, by source of funds and sector: 2002 and 2003
(Billions of current dollars)

| Source of funds and performing sector | 2002 | 2003 |
|--|------|------|
| Company and other nongovernment sources | | |
| Manufacturing industries | | |
| Motor vehicles, trailers, and parts | 15.2 | 16.9 |
| Pharmaceuticals and medicines | 14.2 | 15.9 |
| Semiconductor and other electronic components | 11.9 | 12.6 |
| Communications equipment | 9.5 | 8.9 |
| Aerospace products and parts | 9.7 | 8.2 |
| Navigational, measuring, electromedical, and control instruments | 8.5 | 7.8 |
| Nonmanufacturing industries | | |
| Software publishing | 12.9 | 15.1 |
| Scientific R&D services | 10.7 | 10.6 |
| Professional and commercial equipment and supplies, including computers, wholesalers | 11.7 | 9.7 |
| Drugs and druggist sundries wholesalers | 6.8 | 9.5 |
| Computer systems design and related services | 10.4 | 8.6 |
| Federal government sources ¹ | | |
| Manufacturing industries | | |
| Aerospace products and parts | 4.3 | 7.5 |
| Navigational, measuring, electromedical, and control instruments | 5.2 | 6.2 |
| Communications equipment | 0.2 | 0.3 |
| Machinery | 0.1 | 0.1 |
| Nonmanufacturing industries | | |
| Architectural, engineering, and related services | 1.3 | 1.9 |
| Scientific R&D services | 2.3 | 1.9 |
| Computer systems design and related services | 1.6 | 1.1 |

¹When a small number of respondents account for a large percentage of an industry estimate, statistics must be suppressed. For that reason federally funded R&D estimates for some industries are not included in this table.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development.

Wages paid to R&D personnel amounted to \$91.8 billion and employers' costs of fringe benefits were \$18.0 billion during 2003. All together, these personnel costs accounted for approximately 53.8 percent of total R&D. Expenditures for materials and supplies used for R&D amounted to \$22.8 billion, or 11.2 percent, of total R&D. Depreciation on R&D facilities and equipment accounted for an additional \$10.2 billion, or 5.0 percent. The remaining costs, which included items attributable to R&D but not separately reported such as company overhead, taxes, utilities, and reference material, accounted for the remaining \$61.2 billion, or 30.0 percent, of total R&D. Percentages are similar for manufacturers and companies in nonmanufacturing industries.

During 2003 approximately 38,000 companies performed R&D in the 50 states and District of Columbia. About 16 percent paid outside organizations \$10.2 billion to perform R&D for them (\$5.2 billion for manufacturers

and \$5.0 billion for companies in nonmanufacturing industries). This figure compares with \$7.8 billion during 2002 (\$4.4 billion for manufacturers and \$3.4 billion for nonmanufacturers). In 2003, companies reported expenditures of \$6.8 billion for the performance of R&D by other for-profit companies, \$0.3 billion for the performance of R&D by universities and colleges, and \$0.1 billion for the performance of R&D by nonprofit organizations other than universities and colleges. The remaining \$3.0 billion was performed by outside organizations, but no type of organization was reported.

Since 2001 the survey has asked respondents to distribute total R&D expenses into several technology areas: biotechnology, materials synthesis and processing, and software development. In 2003, companies reported expenditures of \$14.2 billion for biotechnology R&D (\$5.4 billion for manufacturers and \$8.8 billion for companies in nonmanufacturing industries); \$15.9 billion for materials synthesis and processing R&D (\$12.2 billion for manufacturers and \$3.7 billion for nonmanufacturers); and \$27.1 billion for software development R&D (\$4.9 billion for manufacturers and \$22.3 billion for nonmanufacturers). Of the companies that reported R&D expenditures in these technology

TABLE 3. Employment in R&D-performing U.S. companies: 2002 and 2003 (Thousands)

| Employees | 2002 | 2003 |
|--|-------|-------|
| Domestic employment ¹ | | |
| Manufacturing industries | 9,115 | 8,971 |
| Nonmanufacturing industries | 6,306 | 6,366 |
| Full-time equivalent (FTE) R&D scientists and engineers ² | | |
| Manufacturing industries | 598 | 650 |
| Nonmanufacturing industries | 478 | 506 |

¹Number of people employed in the United States by R&D-performing companies in all activities during the pay period that includes March 12, the date most employers use when paying first-quarter employment taxes to the Internal Revenue Service.

²Number of people domestically employed by R&D-performing companies engaged in scientific or engineering work at a level requiring knowledge, gained formally or by experience, of engineering or the physical, biological, mathematical, statistical, or computer sciences equivalent to at least that acquired through completion of a 4-year college program with a major in one of those fields. Survey statistics show FTE employment of persons employed by the company during the January following the survey year who were assigned full time to R&D, plus a prorated number of employees who worked part time on R&D.

NOTES: Detail may not add to totals because of rounding. Statistics exclude data for federally funded research and development centers.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development.

areas, about 5 percent reported that some of the R&D activities involved nanotechnology.

Since 2002 the survey has asked for both the amount of R&D performed in collaboration with another organization and the sector of the organization. During 2003 companies performed R&D in collaboration with other organizations costing \$8.7 billion. Companies reported expenditures of \$8.6 billion for the performance of R&D in collaboration with other for-profit companies; \$53.0 million with universities and colleges, \$39.0 million with nonprofit organizations other than universities and colleges; and \$42.0 million for the performance of R&D in collaboration with federal laboratories. Detailed statistics for these items will be available in *Research and Development in Industry: 2003* at <http://www.nsf.gov/statistics/industry>, which will contain the full set of tables available from the 2003 survey and historical trends.

Data Notes

Estimates in this report were derived from the annual Survey of Industrial Research and Development. The survey is a nationally representative sample of all for-profit companies, publicly or privately held and with five or more employees, that performed R&D within the 50 states and the District of Columbia (for detailed information, see <http://www.nsf.gov/statistics/industry>). The primary focus of the survey is U.S. industry as a performer of, rather than a source of funds for, research and development.

Beginning in 1989, the amount of federally funded R&D reported by performers began to diverge from the amount reported by federal agencies. For 2003, federal agencies reported obligations of \$93.7 billion in total R&D to all R&D performers compared with \$85.3 billion in federal funding reported by the performers of R&D. Although NSF has not found a definitive explanation for this divergence, the National Research Council notes that comparing federal outlays (as opposed to obligations) for R&D to performer expenditures results in a smaller discrepancy.² For 2003, federal agencies

reported R&D outlays of \$89.8 billion to all R&D performers.

The large amount of R&D attributed to the trade industries results from the methodology used to assign industry classifications and is of particular concern for companies traditionally thought of as pharmaceutical or computer manufacturing firms. As these firms increasingly market their own products and more of their payroll is paid to those involved in selling and distribution activities, the potential for them to be classified among the trade industries increases. Because most of the R&D classified in the trade industry can be attributed to three specific wholesale trade industries, beginning with 2003, NSF now publishes statistics for these separately to identify better the products associated with the R&D performed by these companies. The industries are: electrical goods wholesalers [North American Industrial Classification System (NAICS) 4216], professional and commercial equipment wholesalers (NAICS 4214), and drugs and druggists' sundries wholesalers (NAICS 4222). Figure 1 shows the effects of redistributing the R&D attributed to these wholesale trade categories into their associated manufacturing industry categories electrical equipment, appliances, and components (NAICS 335), computer and electronic products (NAICS 334), and pharmaceuticals and medicines (NAICS 3254).

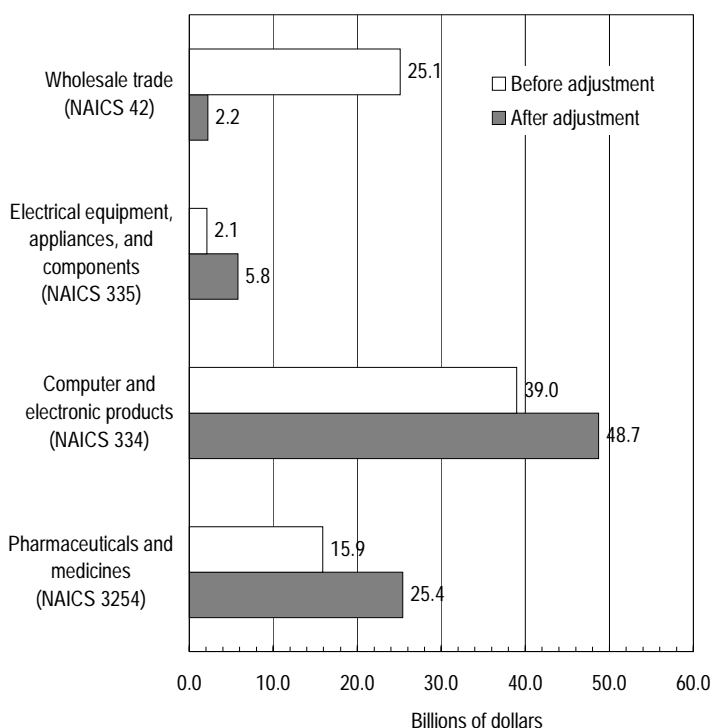
Limitations of the Data

The estimates reported here are subject to both sampling and nonsampling errors. Although the sample was designed with the precision limits stated, the achieved precision limits range from 0.2 to 8.5 percent for manufacturing and 0.7 to 34 percent for nonmanufacturing on total R&D. In general, the larger the estimate is the better the precision. The sample was designed with overlap from year to year to facilitate year-to-year comparisons. Please refer to the annual reports at <http://www.nsf.gov/statistics/industry> for actual sampling results.

Nonsampling errors may be grouped in four broad categories: measurement, processing, coverage, and nonresponse. *Measurement* errors may result from definitions of terms or data availability. Companies may define R&D activities differently or may interpret the definitions differently and variation in company accounting procedures may affect the availability of the data

² National Research Council. (2005). *Measuring Research and Development Expenditures in the U.S. Economy*. Panel on Research and Development Statistics at the National Science Foundation, Committee on National Statistics, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

FIGURE 1. Effect of redistributing wholesale trade R&D, by impacted industry: 2003



NAICS = North American Industry Classification System

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development.

requested. Recordkeeping and respondent debriefing studies are looking at these and other measurement issues. *Processing* errors may result from the way a company's industrial classification is assigned or the way data are edited. During statistical processing, a company is assigned to one industry according to payroll activity, which may not be the same as the company's R&D activity. This difference is of particular concern if the majority of a company's payroll shifts from one activity to another from year to year because all of its R&D activity similarly shifts to the new activity from year to year. Further review and assessment of the industry classification methodology and data editing procedures are underway. *Coverage* errors may occur because of the content and quality of the sample source. The survey sample is selected from the Census Bureau's Business Register. The Register, while comprehensive, suffers from an approximate 6-month lag and is likely missing

some newly eligible companies and may include some ineligible companies. *Nonresponse* is continually addressed and from time to time formal nonresponse studies are conducted. The overall response rate for the survey has been in the 80-85 percent range since the mid-1990's; 90-95 percent for the top 300 R&D performing companies.

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