

U.S. R&D CONTINUES TO REBOUND IN 2004

by Brandon Shackelford

U.S. R&D grew to \$291.9 billion in 2003 after declining in 2002 for the first time since 1953, when these data were first collected.¹ The National Science Foundation (NSF) projects that data for 2004 will show continued growth in U.S. R&D to \$312.1 billion. As a point of reference, in 1990 total U.S. R&D was \$152.0 billion in current dollars, less than half the projected figure for 2004.

After adjusting for inflation, total R&D declined 2.2% between 2001 and 2002, then increased 3.9% in 2003 and increased a projected 4.7% in 2004. These recent growth rates in R&D exceed the average annual inflation-adjusted growth rate over the prior two decades, but they do not match the 6% per year growth of the late 1990s that resulted from substantial increases in industry R&D (figure 1), most notably in information and communications technology industries.²

The decline in 2002 and subsequent recovery of U.S. R&D can largely be attributed to the business sector, which performed 70% of U.S. R&D in 2004 (table 1). The next largest sector in terms of R&D performance, universities and colleges, performed one-fifth the R&D of the business sector. However, universities and colleges performed over half of the nation's basic research (table 1). Federal agencies and all federally

¹Expenditures on R&D performance are used as a proxy for actual R&D performance. In this InfoBrief, the phrases *R&D performance* and *expenditures for R&D* are interchangeable.

²In this InfoBrief, the terms *business sector* and *industry* are used interchangeably.

funded research and development centers (FFRDCs) combined performed 12% of U.S. total R&D in 2004.³

Besides performing the majority of U.S. R&D, the business sector is also the largest source of R&D funding in the United States, providing 64% (\$199 billion) of total R&D funding in 2004. Most businesses spend their R&D budgets on either internal R&D projects or for contract R&D performed by other businesses. Less than 2% of business R&D funding flows to other sectors. The federal government provided the second largest share of R&D funding, 30% (\$93.4 billion). Unlike the business sector, the majority of federal R&D dollars finance R&D in other sectors, with only 40% of these funds financing federal agencies and FFRDCs. The other sectors of the economy (e.g., state governments, universities and colleges, and nonprofit institutions) contributed the remaining 6% (\$20 billion).

Total R&D/GDP Ratios

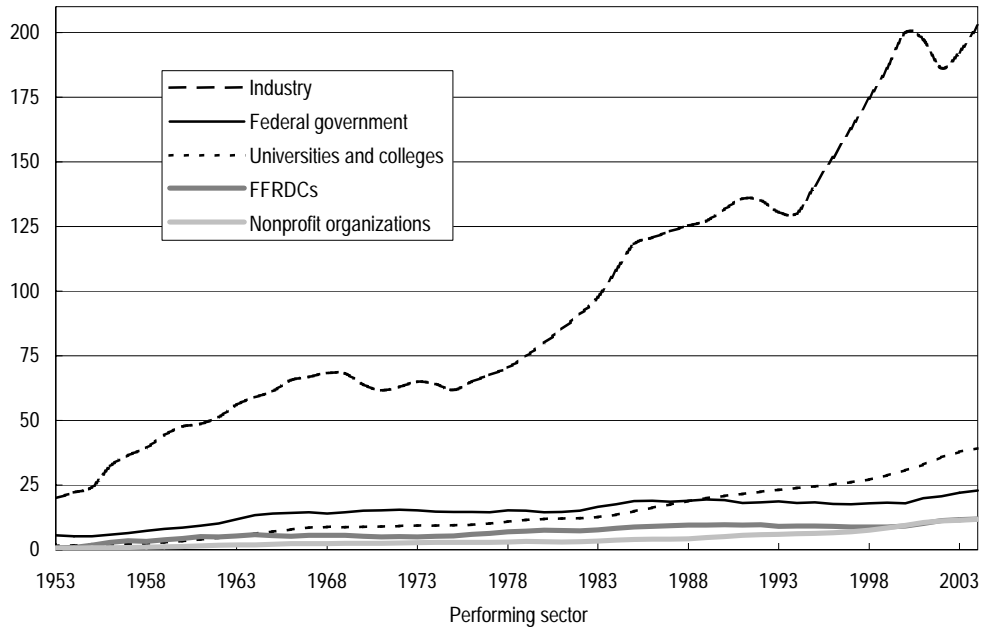
The ratio of R&D expenditures to GDP is an indicator of the intensity of R&D activity in relation to other economic activity and can be used to gauge a nation's

³FFRDCs are R&D-performing organizations that are exclusively or substantially financed by the federal government either to meet a particular R&D objective or, in some instances, to provide major facilities at universities for research and associated training purposes. Each FFRDC is administered either by an industrial firm, a university, or a nonprofit institution. In some of the statistics provided here, FFRDCs are included as part of the sector that administers them. In particular, statistics on the industrial sector often include industry-administered FFRDCs because some of the statistics from the NSF Survey of Industrial Research and Development before 2001 cannot be separated from the FFRDC component.

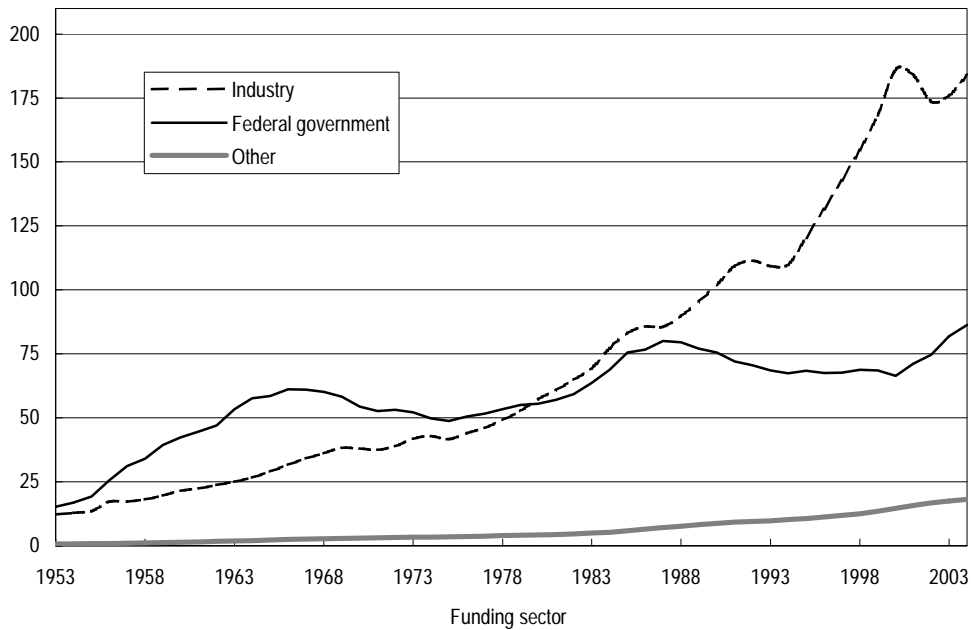


FIGURE 1. U.S. R&D, by performing and funding sector: 1953–2004

Constant 2000 dollars (billions)



Constant 2000 dollars (billions)



FFRDC = federally funded research and development center

NOTE: R&D data for 2004 are projections.

SOURCE: National Science Foundation, Division of Science Resources Statistics, National Patterns of R&D Resources (annual series).

TABLE 1. U.S. R&D expenditures, by character of work, performing sector, and source of funds: 2004 (projected)

Performing sector and character of work	Source of funds (\$ millions)					Total expenditures (% distribution)
	Total	Industry	Federal government	U&C	Other nonprofit institutions	
R&D	312,068	199,025	93,384	11,095	8,565	100.0
Industry	219,226	195,691	23,535	NA	NA	70.2
Industry-administered FFRDCs	2,584	NA	2,584	NA	NA	0.8
Federal government	24,742	NA	24,742	NA	NA	7.9
U&C	42,431	2,135	26,115	11,095	3,087	13.6
U&C-administered FFRDCs	7,500	NA	7,500	NA	NA	2.4
Other nonprofit institutions	12,750	1,199	6,072	NA	5,478	4.1
Nonprofit-administered FFRDCs	2,834	NA	2,834	NA	NA	0.9
Percent distribution by source	100.0	63.8	29.9	3.6	2.7	NA
Basic research	58,356	9,551	36,075	7,579	5,150	100.0
Industry	9,278	1,427	1,851	NA	NA	15.9
Industry-administered FFRDCs	706	NA	706	NA	NA	1.2
Federal government	4,887	NA	4,887	NA	NA	8.4
U&C	31,735	1,458	20,589	7,579	2,109	54.4
U&C-administered FFRDCs	3,917	NA	3,917	NA	NA	6.7
Other nonprofit institutions	6,651	666	2,944	NA	3,042	11.4
Nonprofit-administered FFRDCs	1,181	NA	1,181	NA	NA	2.0
Percent distribution by source	100.0	16.4	61.8	13.0	8.8	NA
Applied research	66,364	35,975	25,315	2,883	2,190	100.0
Industry	41,009	35,117	5,892	NA	NA	61.8
Industry-administered FFRDCs	1,268	NA	1,268	NA	NA	1.9
Federal government	8,407	NA	8,407	NA	NA	12.7
U&C	9,223	555	4,983	2,883	802	13.9
U&C-administered FFRDCs	1,806	NA	1,806	NA	NA	2.7
Other nonprofit institutions	4,287	304	2,595	NA	1,388	6.5
Nonprofit-administered FFRDCs	365	NA	365	NA	NA	0.5
Percent distribution by source	100.0	54.2	38.1	4.3	3.3	NA
Development	187,349	153,498	31,993	633	1,224	100.0
Industry	168,939	153,147	15,792	NA	NA	90.2
Industry-administered FFRDCs	610	NA	610	NA	NA	0.3
Federal government	11,447	NA	11,447	NA	NA	6.1
U&C	1,474	122	543	633	176	0.8
U&C-administered FFRDCs	1,778	NA	1,778	NA	NA	0.9
Other nonprofit institutions	1,812	229	534	NA	1,048	1.0
Nonprofit-administered FFRDCs	1,288	NA	1,288	NA	NA	0.7
Percent distribution by source	100.0	81.9	17.1	0.3	0.7	NA

NA = not available

FFRDC = federally funded research and development center; U&C = universities and colleges

NOTES: State and local government support to industry included in industry support for industry performance. State and local government support to U&C (\$2,890 million in total R&D) included in U&C support for U&C performance.

SOURCE: National Science Foundation, Division of Science Resources Statistics, National Patterns of R&D Resources (annual series).

commitment to R&D at different points in time. In the United States, the slowdown in GDP growth in 2001 preceded the decline of R&D in 2002. This resulted in R&D to GDP ratios of 2.7% in 2001 (a recent high) and 2.6% in 2002 (figure 2).⁴ Data for 2003 and projections for 2004 indicate that R&D and GDP grew at roughly the same rates in the subsequent two years.

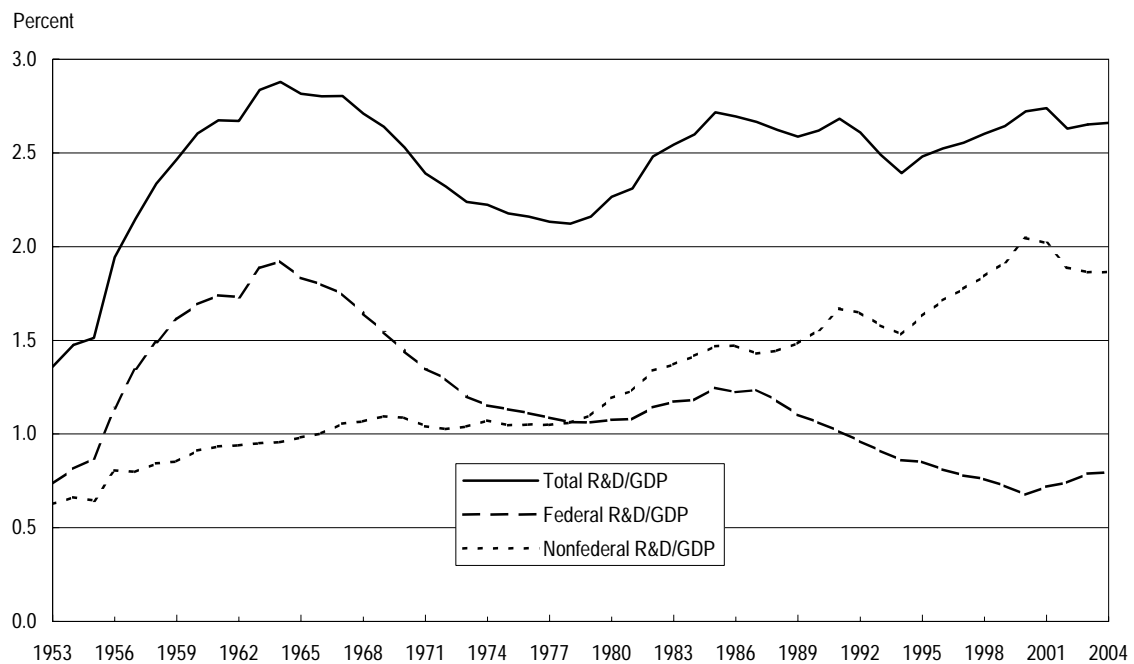
Since 1953, U.S. R&D expenditures as a percentage of GDP have ranged from a minimum of 1.4% (in 1953) to a maximum of 2.9% (in 1964). Most of the growth over time in the R&D/GDP ratio can be attributed to increases in nonfederal R&D spending. Nonfederally financed R&D, the majority of which is financed by industry, increased from 0.6% of GDP in 1953 to an estimated 1.9% of GDP in 2004 (down from a high of 2.1% of GDP in 2000).

Historically, most of the peaks and valleys in the U.S. R&D/GDP ratio can be attributed to changing priorities in federal R&D spending. The drop in the R&D/GDP ratio from the peak in 1964 largely reflected federal cutbacks in defense and space R&D programs. Gains in energy R&D activities between 1975 and 1979 resulted in a relative stabilization of the ratio. Beginning in the late 1980s, cuts in defense-related R&D kept federal R&D spending from keeping pace with GDP growth, whereas growth in nonfederal sources of R&D spending generally kept pace with or exceeded GDP growth. Since 2000, defense-related R&D spending has surged, and federal R&D spending growth has outpaced GDP growth.

International Comparisons

Although spending on R&D in the United States far exceeds spending in any other country, several nations report

FIGURE 2. R&D share of gross domestic product: 1953–2004



GDP = gross domestic product

NOTE: R&D data for 2004 are projections.

SOURCE: National Science Foundation, Division of Science Resources Statistics, National Patterns of R&D Resources (annual series).

⁴Growth in the R&D/GDP ratio does not necessarily imply increased R&D expenditures. For example, the rise in R&D/GDP from 1978 to 1985 was due as much to a slowdown in GDP growth as it was to increased spending on R&D activities.

higher R&D/GDP ratios.⁵ According to data from the Organisation for Economic Co-operation and Development (OECD), the United States ranked sixth among countries with reported R&D/GDP ratios (table 2). Israel, devoting 4.9% of its GDP to R&D, led all countries, followed by Sweden (4.3%), Finland (3.5%), Japan (3.1%), and Iceland (3.1%).⁶ In general, nations in Southern and Eastern Europe tend to have R&D/GDP ratios of 1.5% or lower, whereas Nordic nations

and those in Western Europe report R&D spending shares greater than 1.5%. This pattern broadly reflects the wealth and level of economic development for these regions. A strong link exists between countries with high incomes that emphasize the production of high-technology goods and services and those that invest heavily in R&D activities. The private sector in low-income countries often has a low concentration of high-technology industries, generally resulting in low

TABLE 2. R&D share of gross domestic product, by country/economy: 2000–03

Country/economy	Share (%)	Country/economy	Share (%)
Total OECD (2002)	2.26	China (2002)	1.22
European Union-25 (2002)	1.86	New Zealand (2001)	1.16
Israel (2003)	4.90	Ireland (2001)	1.13
Sweden (2001)	4.27	Italy (2001)	1.11
Finland (2002)	3.46	Brazil (2000)	1.04
Japan (2002)	3.12	Spain (2002)	1.03
Iceland (2002)	3.09	Hungary (2003)	0.95
United States (2003)	2.67	Portugal (2002)	0.94
South Korea (2003)	2.64	Turkey (2002)	0.66
Switzerland (2000)	2.57	Greece (2001)	0.65
Denmark (2002)	2.52	Cuba (2002)	0.62
Germany (2003)	2.50	Poland (2002)	0.59
Belgium (2003)	2.33	Slovak Republic (2003)	0.59
Taiwan (2002)	2.30	Chile (2001)	0.57
France (2002)	2.26	Argentina (2003)	0.41
Austria (2003)	2.19	Panama (2001)	0.40
Singapore (2002)	2.15	Costa Rica (2000)	0.39
Netherlands (2001)	1.88	Mexico (2001)	0.39
Canada (2003)	1.87	Romania (2002)	0.38
United Kingdom (2002)	1.87	Bolivia (2002)	0.26
Luxembourg (2000)	1.71	Uruguay (2002)	0.22
Norway (2002)	1.67	Peru (2003)	0.11
Australia (2000)	1.54	Colombia (2002)	0.10
Slovenia (2002)	1.53	Trinidad and Tobago (2001)	0.10
Czech Republic (2003)	1.34	Nicaragua (2002)	0.07
Russian Federation (2003)	1.28		

OECD = Organisation for Economic Co-operation and Development

NOTES: Civilian R&D only for Israel and Taiwan. Data for latest available year in parentheses. The European Union-25 is comprised of the following countries: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, The Netherlands, and United Kingdom.

SOURCES: National Science Foundation, Division of Science Resources Statistics, National Patterns of R&D Resources (annual series); OECD, *Main Science and Technology Indicators* (2004); and Iberomeric Network of Science and Technology Indicators, <http://www.riicyt.edu.ar>, accessed 1 May 2005.

⁵The United States performs over twice as much R&D as the next largest country, Japan, and accounts for over a third of world R&D expenditures.

⁶Although the United States does not lead the world in this indicator, several of its states have R&D intensities exceeding 4%. Massachusetts, a state with an economy larger than Sweden's and twice that of Israel's, has reported an R&D intensity at or above 5% for the past three years.

R&D/GDP ratios. Because of the business sector's dominant role in global R&D funding and performance, R&D/GDP ratios are most useful when comparing countries with national science and technology (S&T) systems of comparable maturity and development.

Outside the European region, R&D spending has intensified considerably since the early 1990s. Several Asian countries, most notably South Korea and China, have been particularly aggressive in expanding their support for R&D and S&T-based development. In Latin America and the Pacific region, other countries also have attempted to increase R&D investments substantially during the past several years. Even with recent gains, however, most of these countries invest a smaller share of their economic output in R&D than do the developed economies in Asia, Europe, and North America. For example, all Latin American countries for which such data are available report R&D/GDP ratios at or below 1%. This distribution is consistent with broader indicators of economic growth and wealth.

User Notes

The U.S. R&D data presented here are derived by adding up the R&D performance for all sectors of the economy for which it can be reasonably estimated. The sources of data for sector-specific R&D performance are the following National Science Foundation's surveys: Survey of Industrial R&D, Survey of R&D Expenditures at Universities and Colleges, Survey of Federal Funds for R&D, and Survey of R&D Funding & Performance by Nonprofit Organizations. Preliminary estimates for 2003 and 2004 were based in part on time-series modeling and econometric techniques.

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R&D expenditure levels from federal sources, presented here based on performer-reported surveys, differ from R&D data reported by the federal agencies that provide those funds. Beginning in 1989, the amount of federally funded R&D reported by performers began to diverge from the amount reported by federal agencies. For FY 2004, federal agencies reported obligating \$102.7 billion in total R&D to all R&D performers (\$38.9 billion, or 37.9 percent, to industry), compared with \$93.4 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. For FY 2004, federal agencies reported R&D outlays of \$97.3 billion to all R&D performers. The difference in the federal R&D totals appears to be concentrated in the funding of industry R&D by the Department of Defense. See *National Patterns of R&D Resources: 2003* (2005) for further discussion of these differences and a more detailed analysis of national R&D trends. National Patterns reports can be found online at <http://www.nsf.gov/statistics/natlpatterns/>.

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