



U.S. R&D Increased in 2013, Well Ahead of the Pace of Gross Domestic Product

by Mark Boroush¹

Research and development performed in the United States totaled \$456.1 billion in 2013, according to new data from the National Center for Science and Engineering Statistics, National Science Foundation (NSF) (table 1). This is compared to \$435.3 billion in 2012 (revised downward from an earlier estimate) and \$427.8 billion in 2011. In 2008—just before the onset of the main economic effects of the national and international financial crisis and the Great Recession—U.S. R&D totaled \$407.0 billion.

In 2013, U.S. total R&D increased by \$20.7 billion over the 2012 level (figure 1). This is on top of gains of \$7.5 billion in 2012 and \$19.6 billion in 2011—in contrast to the negligible changes in 2009 and 2010. Much of the increase in these most recent years has arisen from a return of sizable yearly increases in business R&D performance. (All amounts and calculations are in current dollars, unless otherwise noted.)

Inflation-adjusted growth in U.S. total R&D averaged only 0.8% annually over the 5-year period 2008–13, behind the 1.2% annual average for U.S. gross domestic product (GDP) (table 2)—although, compared to this 5-year average, the single-year metrics were markedly more favorable for 2010–11

(2.7% for R&D versus 1.6% for GDP) and 2012–13 (3.2% versus 2.2%). In trend comparisons for earlier years, the growth of U.S. R&D averaged 3.9% annually in 2003–08, ahead of the annual average of the GDP (2.2%). And from 1993 to 2003, U.S. R&D growth averaged 3.9% annually, whereas the average annual growth of the GDP was 3.4%. Although data indicate that total R&D has seen substantial growth annually in several recent years, well ahead of the pace of GDP, the longstanding trend of this type of growth has yet to return.

R&D Performers and Funders

The U.S. R&D system consists of the R&D activities of multiple performers and the sources of funding for these activities. Performers and funders include private businesses, the federal government, nonfederal government agencies, universities and colleges, and other nonprofit organizations.² Organizations that perform R&D often receive significant levels of outside funding; furthermore, R&D funders may also be significant performers.

R&D Performers

The business sector continues to be the largest performer of U.S. R&D. In 2013, domestically performed business R&D accounted for \$322.5 billion, or

71%, of the \$456.1 billion national total (table 1, figure 2). The business sector's predominance in the composition of national R&D performance has long been the case, with its annual share ranging between 68% and 74% over the 20-year period 1993–2013.

Business R&D performance increased \$20.3 billion between 2012 and 2013, following gains of \$8.2 billion in 2012 and \$15.1 billion in 2011. These increases are in contrast to the essentially unchanged levels of R&D performance in both 2009 and 2010. These recent-year increases in business R&D performance are the main reason for the sizable increases in total U.S. R&D (figure 1).

Inflation-adjusted growth in business R&D averaged 0.6% annually over the 5-year period 2008–13, behind the 0.8% annual average for total R&D and the 1.2% annual average for GDP (table 2). However, growth in business R&D substantially surpassed the growth rates for both total R&D and GDP in 2011 and 2013.

The higher education sector is the second-largest performer of U.S. R&D. Universities and colleges performed \$64.7 billion, or 14%, of U.S. R&D in 2013 (table 1, figure 2). Over the 20-year period 1993–2013, academia's

TABLE 1. U.S. R&D expenditures, by performing sector and source of funding: 2008–13

Sector	2008	2009	2010	2011	2012	2013 ^a
	Current \$millions					
All performing sectors	406,952	405,136	408,197	427,833	435,347	456,095
Business	290,680	282,393	278,977	294,092	302,251	322,528
Federal government	45,649	47,363	49,955	52,668	51,318	49,859
Federal intramural ^b	29,839	30,560	31,970	34,950	34,017	33,026
FFRDCs	15,810	16,804	17,985	17,718	17,301	16,833
Nonfederal government	343	405	490	493	468	467
Universities and colleges	53,917	56,972	60,374	62,446	63,284	64,680
Other nonprofit organizations ^c	16,363	18,002	18,401	18,134	18,026	18,561
All funding sources	406,952	405,136	408,197	427,833	435,347	456,095
Business	258,131	246,770	248,314	266,606	275,892	297,279
Federal government	119,113	127,180	127,559	128,039	124,956	121,808
Nonfederal government	4,257	4,287	4,287	4,355	4,105	4,113
Universities and colleges	11,640	11,917	12,105	12,951	14,136	15,240
Other nonprofit organizations ^c	13,811	14,983	15,932	15,882	16,258	17,655
	Constant 2009 \$millions					
All performing sectors	410,043	405,136	403,270	414,122	413,961	427,323
Business	292,888	282,393	275,610	284,667	287,403	302,182
Federal government	45,995	47,363	49,352	50,981	48,797	46,714
Federal intramural ^b	30,066	30,560	31,584	33,830	32,346	30,943
FFRDCs	15,930	16,804	17,768	17,150	16,451	15,771
Nonfederal government	345	405	484	477	445	438
Universities and colleges	54,327	56,972	59,645	60,445	60,176	60,600
Other nonprofit organizations ^c	16,487	18,002	18,179	17,552	17,141	17,390
All funding sources	410,043	405,136	403,270	414,122	413,961	427,323
Business	260,092	246,770	245,317	258,062	262,339	278,525
Federal government	120,017	127,180	126,019	123,936	118,817	114,124
Nonfederal government	4,289	4,287	4,235	4,216	3,904	3,853
Universities and colleges	11,728	11,917	11,959	12,536	13,442	14,278
Other nonprofit organizations ^c	13,916	14,983	15,739	15,373	15,459	16,542

FFRDCs = federally funded research and development centers.

^a Data for 2013 include some estimates and may later be revised.

^b Includes expenditures of federal intramural R&D as well as costs associated with administering extramural R&D.

^c Some components of the R&D performed by other nonprofit organizations are projected and may later be revised.

NOTES: Data are based on annual reports by performers, except for the nonprofit sector. Expenditure levels for academic, federal government, and nonfederal government performers are calendar-year approximations based on fiscal year data. Gross domestic product implicit price deflators for 2009 were used to convert current to constant dollars.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series).

share in U.S. R&D has ranged between 11% and 15% annually. As discussed below, universities and colleges have a special niche in the nation's R&D system: they performed more than half (51%) of the nation's basic research in 2013.

Academic R&D performance has increased by one to several billion dollars each year since 2008 (figure 1).

After adjustment for inflation, growth in this sector's R&D performance has averaged 2.2% annually over 2008–13, ahead of that for U.S. total R&D (0.8%) and GDP (1.2%). However, when growth is examined in each year, the sector's growth has been noticeably stronger in the first half of this period (2008–09 and 2009–10) (table 2).

The federal government conducted \$49.9 billion, or 11%, of U.S. R&D in 2013 (table 1, figure 2). This included \$33.0 billion (7% of the U.S. total) for intramural R&D performed by federal agencies in their own research facilities and \$16.8 billion (4%) of R&D performed by the 40 federally funded research and development centers (FFRDCs).

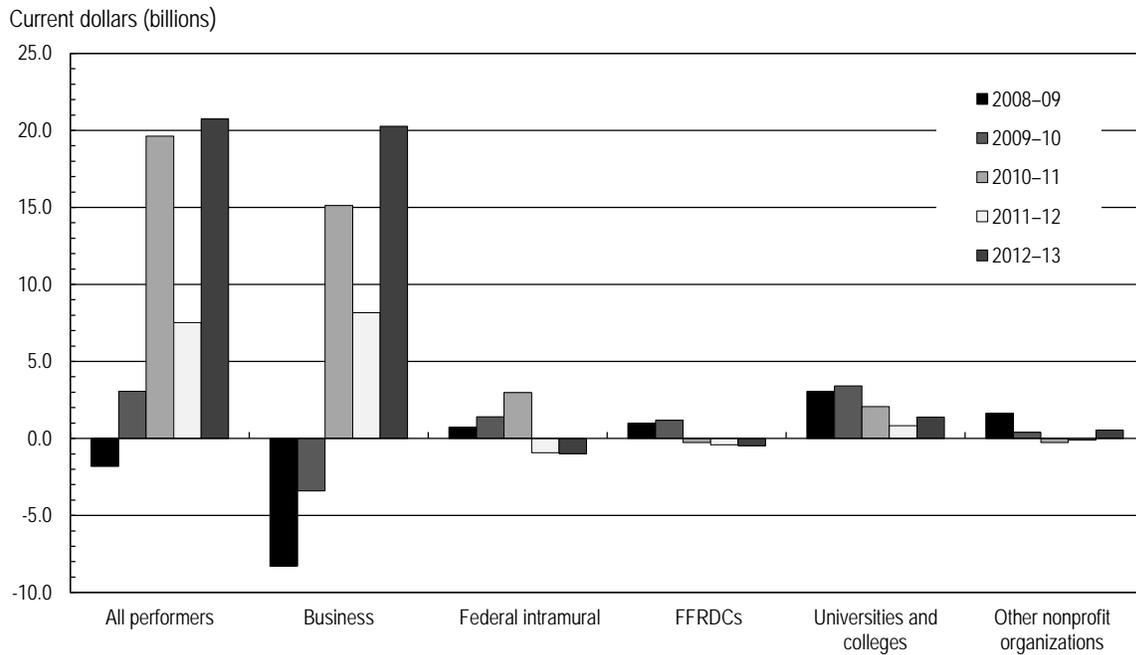
The federal total decreased \$1.5 billion between 2012 and 2013, following a decrease of \$1.4 between 2011 and 2012. These declines affected both federal intramural R&D and FFRDCs (table 1). From 2008 to 2011, the story was much the opposite: year-over-year increases of \$1 billion to \$2 billion in the federal total. This reversal in recent years reflects both the waning after 2010 of the incremental funding from the American Recovery and Reinvestment Act of 2009 (ARRA) and the more challenging budget environment for increases in federal R&D funding after 2011. In 1993, the federal performance share was about 15%, but it has gradually declined in the years since.

R&D performed in the United States by other nonprofit organizations (which excludes universities and nonprofit-administered FFRDCs) is estimated at \$18.6 billion in 2013 (table 1). This was 4% of U.S. total R&D in 2013, a share that has been largely the same since the late 1990s (figure 2).

R&D Funders

The business sector is the predominant source of funding for R&D performed in the United States. In 2013, business sector funding accounted for \$297.3 billion, or 65% of the \$456.1 billion of total U.S. R&D performance (table 1, figure 2). Nearly all of the business sector's funding for R&D (98%) is directed toward business R&D performance (table 3). The small remainder goes to R&D performers in higher education, other nonprofit organizations, and FFRDCs.

FIGURE 1. Year-to-year changes in U.S. R&D expenditures, by performing sector: 2008–13



FFRDCs = federally funded research and development centers.

NOTES: Based on the expenditures data reported in table 1. Data for 2013 include some estimates and may later be revised.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series).

Funds from the federal government accounted for \$121.8 billion, or 27%, of U.S. total R&D in 2013 (table 1, figure 2). This funding was mainly directed to R&D performance by the federal government, business, and higher education (table 3). Federal funding accounted for all of the \$33.0 billion of federal intramural R&D performance in 2013 and most of the \$16.8 billion of R&D performed by FFRDCs. (Nonfederal support for FFRDC R&D has been around \$0.4 billion or so in recent years, or 2% of total support.) Federal funding to the business sector accounted for \$29.4 billion of business R&D performance in 2013, or 9% of the sector's R&D total that year (table 3). Federal funds to academia supported \$36.9 billion (57%) of the \$64.7 billion spent on academic R&D in 2013. For the R&D performed by other nonprofit organizations, \$5.9 billion (about 32%)

of this sector's \$18.6 billion of performance was supported by federal funds.

The balance of R&D funding from other sources is small: \$37.0 billion in 2013, or about 8% of all U.S. R&D performance. Of this amount, \$15.2 billion (3%) was academia's own institutional funds, all of which remain in the academic sector; \$4.1 billion (1%) was from state and local governments, primarily supporting academic research; and \$17.7 billion (4%) was from other nonprofit organizations, the majority of which funds this sector's own R&D. In addition, some funds from the nonprofit sector support academic R&D.

R&D by Type of Work

Basic research activities accounted for \$80.5 billion, or 18%, of the total of U.S. R&D expenditures in 2013

(table 3). Applied research was \$90.6 billion, or 20% of the total. Most of the R&D total went toward development: \$285.0 billion, or 63%.

Universities and colleges accounted for just over half (51%) of the \$80.5 billion of basic research in 2013. The business sector performed more than half (56%) of the \$90.6 billion of applied research and an even larger share (88%) of the \$285.1 billion of development.

Federal funding accounted for 47% of the \$80.5 billion of basic research in 2013. But federal funds were less prominent on a proportional basis for applied research (37% of \$90.6 billion) and development (18% of \$285 billion). The business sector provided the greatest share of funding for applied research (55%). It was also by far the largest source of funding for development (81%).

TABLE 2. Annual rates of growth in U.S. R&D expenditures, total and by performing sectors, 1993–2013

(Percent)

Expenditures and gross domestic product	Longer-term trends			Most recent 5 years				
	1993–2003	2003–08	2008–13	2008–09	2009–10	2010–11	2011–12	2012–13
	Current \$							
Total R&D, all performers	5.9	6.8	2.3	-0.4	0.8	4.8	1.8	4.8
Business	5.7	7.7	2.1	-2.9	-1.2	5.4	2.8	6.7
Federal government	4.3	4.2	1.8	3.8	5.5	5.4	-2.6	-2.8
Federal intramural ^a	4.2	3.6	2.1	2.4	4.6	9.3	-2.7	-2.9
FFRDCs	4.4	5.2	1.3	6.3	7.0	-1.5	-2.4	-2.7
Nonfederal government	NA	NA	6.4	NA	20.9	0.6	-5.1	-0.1
Universities and colleges	7.4	5.1	3.7	5.7	6.0	3.4	1.3	2.2
Other nonprofit organizations ^b	9.6	4.5	2.6	10.0	2.2	-1.5	-0.6	3.0
Gross domestic product	5.3	5.0	2.6	-2.0	3.8	3.7	4.2	3.7
	Constant 2009 \$							
Total R&D, all performers	3.9	3.9	0.8	-1.2	-0.5	2.7	0.0	3.2
Business	3.8	4.8	0.6	-3.6	-2.4	3.3	1.0	5.1
Federal government	2.4	1.4	0.3	3.0	4.2	3.3	-4.3	-4.3
Federal intramural ^a	2.3	0.9	0.6	1.6	3.4	7.1	-4.4	-4.3
FFRDCs	2.5	2.4	-0.2	5.5	5.7	-3.5	-4.1	-4.1
Nonfederal government	NA	NA	4.9	NA	19.4	-1.4	-6.8	-1.6
Universities and colleges	5.5	2.3	2.2	4.9	4.7	1.3	-0.4	0.7
Other nonprofit organizations ^b	7.6	1.7	1.1	9.2	1.0	-3.4	-2.3	1.5
Gross domestic product	3.4	2.2	1.2	-2.8	2.5	1.6	2.3	2.2

NA = not available.

FFRDCs = federally funded research and development centers.

^a Includes expenditures of federal intramural R&D as well as costs associated with administering extramural R&D.

^b Some components of the R&D performed by other nonprofit organizations are projected and may later be revised.

NOTES: Longer-term trend rates are calculated as compound annual growth rates. Data for 2013 include some estimates and may later be revised. As a further aid to interpretation, NSF's data series on U.S. R&D performance dates back to 1953. The average annual rate of growth of total R&D for the 1953–2013 period was 7.8%, compared to 6.5% for U.S. Gross domestic product over the same period. After adjustment for inflation, these average annual rates were, respectively, 4.3% and 3.1%. Gross domestic product implicit price deflators for 2009 were used to convert current to constant dollars.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series).

Trend in National R&D Intensity

The ratio of total national R&D expenditures to GDP is often reported as a measure of the intensity of a nation's overall R&D effort and is widely used as an international benchmark for comparing countries' R&D systems. The ratio of U.S. R&D expenditures to GDP totaled 2.72% in 2013, compared to 2.69% in 2012 and 2.76% in 2011 (figure 3).³

The U.S. R&D-to-GDP ratio stood at 2.81% in 2009—the ratio's highest level since the start of the time series

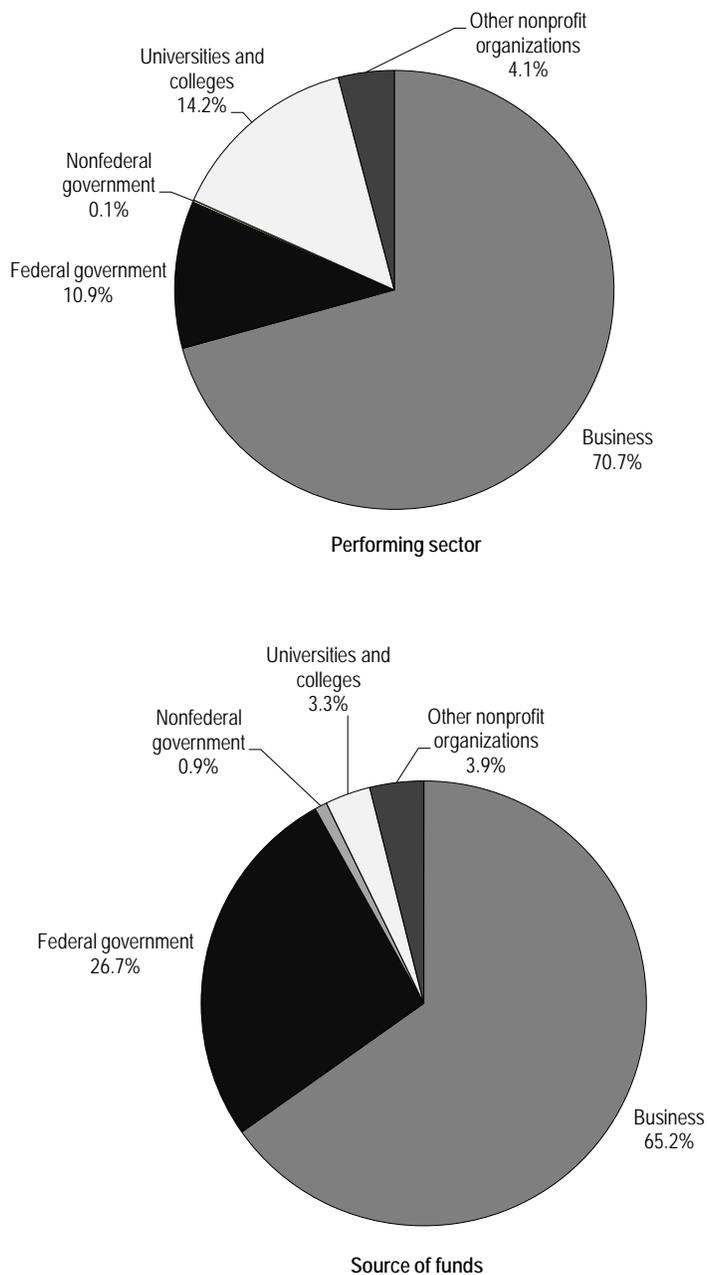
in 1953.⁴ Over the 10-year period from 2003 to 2013, the ratio has fluctuated year to year, between a low of 2.48% in 2004 and a high of 2.81% in 2009. The trend since the later 1990s has been a rising R&D-to-GDP ratio (figure 3). Whether the lower ratios that have resulted since 2009 represent a short-term reversal or something more permanent remains to be seen.

Most of the rise of the R&D-to-GDP ratio over the past several decades has come from the increase of nonfederal spending on R&D, particularly by the business sector (figure 3). This arises

from the growing role of business R&D in the national R&D system, which, in turn, reflects the unabated increase of R&D-dependent goods and services in the national and global economies.

By contrast, the ratio of federal R&D spending to GDP declined from the mid-1980s to the late 1990s, notably from cuts in defense-related R&D. There had been a gradual uptick in the ratio through 2009, the result of increased federal spending on biomedical and national security R&D and the one-time incremental funding for R&D provided by ARRA.

FIGURE 2. Shares of U.S. total R&D expenditures, by performing sector and source of funds: 2013



NOTES: U.S. R&D expenditures totaled \$456.1 billion in 2013. The federal performing sector includes federal agencies and federally funded research and development centers.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series).

Data Sources and Availability

The statistics on U.S. R&D presented here are derived chiefly from integrating the data on R&D expenditures

and funding collected from major national surveys that are conducted by NSF’s National Center for Science and Engineering Statistics to gather information on the organizations that

perform most of U.S. R&D. In some cases, the primary survey data are adjusted to enable consistent integration of the statistics from these separately conducted surveys. Preliminary or otherwise estimated values may be used where final data from one or more of the surveys are not yet available and can reasonably be prepared.

The main R&D surveys utilized include NSF’s Business R&D and Innovation Survey (for 2008 through 2013; for 2007 and earlier years, data from the preceding Survey of Industrial R&D are used), the Higher Education R&D Survey (for 2010 through 2013; for 2009 and earlier years, the preceding Survey of R&D Expenditures at Universities and Colleges), the Survey of Federal Funds for R&D (FYs 2013–15 and earlier years), and the FFRDC Research and Development Survey (FY 2013 and earlier years). Figures for R&D performed by other nonprofit organizations with funding from with the nonprofit sector and from business sources are estimated, based on parameters from the Survey of R&D Funding and Performance by Nonprofit Organizations, 1996–97.

The data on federally funded R&D discussed in this report were derived from surveys of organizations that perform R&D, such as companies, universities, and FFRDCs. These amounts can differ substantially from the R&D that federal agencies have reported funding. For example, federal agencies reported obligating \$138 billion for R&D funding to all R&D performers in 2012 (including \$59 billion to the business sector), compared with an estimated \$125 billion in federal funding reported by all performers of R&D that year (\$31 billion by businesses). Although NSF has not found a definitive explanation for this divergence, the National Academies’ Committee on National Statistics (CNSTAT) has noted that comparing federal outlays (as opposed

TABLE 3. U.S. R&D expenditures, by performing sector, source of funds, and type of work: 2013 (corrected)

Performing sector and type of work	Source of funds (\$millions)						Percent distribution by performer
	Total	Business	Federal government	Nonfederal government	Universities and colleges	Other nonprofit organizations	
R&D	456,095	297,279	121,808	4,113	15,240	17,655	100.0
Business	322,528	292,153	29,362	194	*	819	70.7
Federal government	49,859	180	49,448	50	*	181	10.9
Federal intramural	33,026	0	33,026	0	0	0	7.2
FFRDCs	16,833	180	16,422	50	*	181	3.7
Nonfederal government	467	*	193	274	*	*	0.1
Universities and colleges	64,680	3,502	36,867	3,594	15,240	5,477	14.2
Other nonprofit organizations	18,561	1,444	5,939	*	*	11,178	4.1
Percent distribution by funding source	100.0	65.2	26.7	0.9	3.3	3.9	na
Basic research	80,460	21,213	37,826	2,317	9,384	9,720	100.0
Business	19,508	18,203	1,196	21	*	88	24.2
Federal government	9,531	52	9,413	14	*	52	11.8
Federal intramural	5,355	0	5,355	0	0	0	6.7
FFRDCs	4,176	52	4,058	14	*	52	5.2
Nonfederal government	NA	*	NA	NA	*	*	NA
Universities and colleges	41,275	2,156	24,148	2,213	9,384	3,373	51.3
Other nonprofit organizations	10,029	802	3,021	*	*	6,207	12.5
Percent distribution by funding source	100.0	26.4	47.0	2.9	11.7	12.1	na
Applied research	90,629	46,290	33,357	1,340	4,801	4,841	100.0
Business	51,013	44,738	6,028	47	*	200	56.3
Federal government	15,103	82	14,915	23	*	83	16.7
Federal intramural	8,337	*	8,337	*	0	*	9.2
FFRDCs	6,766	82	6,578	23	*	83	7.5
Nonfederal government	NA	*	NA	NA	*	*	NA
Universities and colleges	18,608	1,103	9,845	1,132	4,801	1,726	20.5
Other nonprofit organizations	5,671	366	2,472	*	*	2,833	6.3
Percent distribution by funding source	100.0	51.1	36.8	1.5	5.3	5.3	na
Development	285,007	229,776	50,625	456	1,054	3,096	100.0
Business	252,007	229,212	22,137	126	*	532	88.4
Federal government	25,225	46	25,120	13	*	46	8.9
Federal intramural	19,334	*	19,334	*	0	*	6.8
FFRDCs	5,890	46	5,786	13	*	46	2.1
Nonfederal government	NA	*	NA	NA	*	*	NA
Universities and colleges	4,797	242	2,874	249	1,054	379	1.7
Other nonprofit organizations	2,861	276	446	*	*	2,139	1.0
Percent distribution by funding source	100.0	80.6	17.8	0.2	0.4	1.1	na

* = small to negligible amount, included as part of the funding provided by other sectors. na = not applicable. NA = not available.

FFRDCs = federally funded research and development centers.

NOTES: Data for 2013 include some estimates and may later be revised. Some components of R&D performance and funding by other nonprofit organizations are projected and may later be revised.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series).

to obligations) for R&D to performer expenditures results in a smaller difference.⁵ For FY 2012, federal agencies reported R&D outlays of \$129 billion to all R&D performers.

For further information on the National Patterns data and methodology, contact the author.

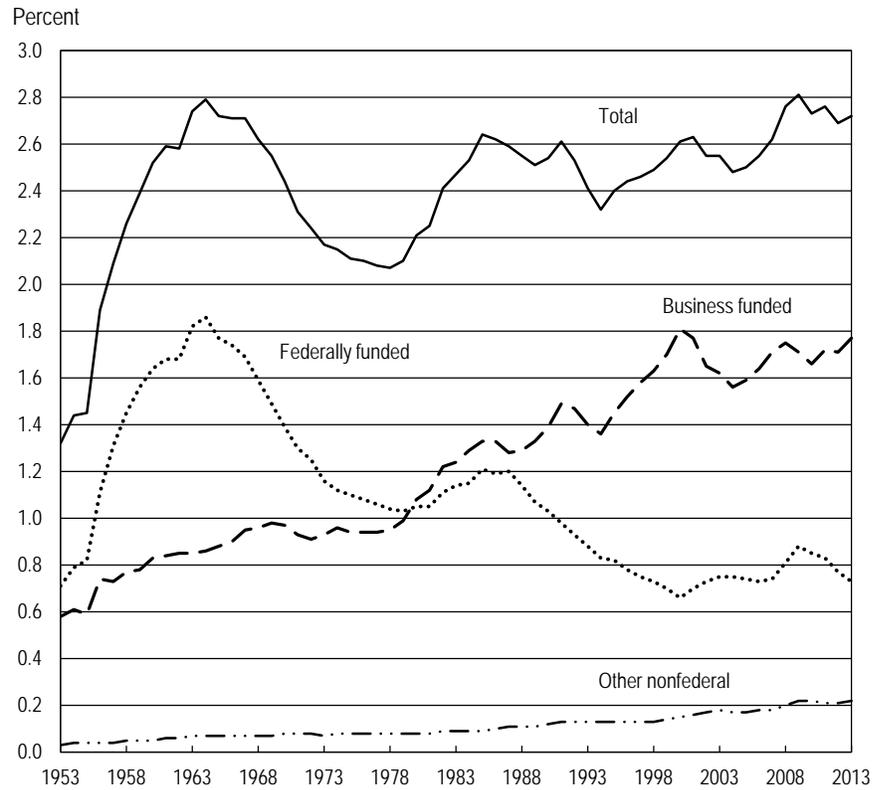
Notes

1. Mark Boroush, Research and Development Statistics Program, National Center for Science and Engineering Statistics, National Science Foundation, 4201 Wilson Boulevard, Suite 965, Arlington, VA 22230 (mborosh@nsf.gov; 703-292-8726).

2. NSF identifies the main categories of R&D performers as follows: businesses, federal agencies, federally funded research and development centers (administered by businesses, universities and colleges, or nonprofit organizations), nonfederal government agencies, universities and colleges, and other nonprofit organizations. For R&D funding, the main categories are businesses, the federal government, nonfederal government, universities and colleges, and other nonprofit organizations.

3. The Department of Commerce's Bureau of Economic Analysis (BEA) introduced a comprehensive set of revisions to the National Income and Product Accounts in July 2013—including explicitly recognizing R&D as investment in the measure of U.S. gross domestic product. These changes resulted in modest revisions to the U.S. GDP time series back to 1929. The U.S. R&D/GDP ratio reported in this InfoBrief reflect BEA's revised GDP data series, both in the present and the past, and differ somewhat from data reported

FIGURE 3. Ratio of U.S. R&D to gross domestic product, roles of federal, business, and other nonfederal funding for R&D: 1953–2013



NOTES: Data for 2013 include some estimates and may later be revised. The federally funded data represent the federal government as a funder of R&D by all performers; similarly, the business funded data reflect the business sector as the funder of R&D by all performers. The other nonfederal category includes R&D funded by all other sources—mainly, universities and colleges, nonfederal government, and other nonprofit organizations. Data on the gross domestic product reflect the Bureau of Economic Analysis's comprehensive revisions of the National Income and Product Accounts of July 2013.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series).

previously in the National Patterns series. For a fuller explanation of this development and its implications see NSF's recent InfoBrief on this topic: <http://www.nsf.gov/statistics/2015/nsf15315/>.

4. The data used to construct the U.S. R&D-to-GDP ratio were the latest available at the time of this report. Due to sample variability in the data for the business R&D component, the calculated ratios for 2008, 2009, and 2011

are not significantly different from one another at a 90% confidence level.

5. 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; Brown LD, Plewes TJ, Gerstein MA, editors. Committee on National Statistics, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academies Press.

Errata: In Table 3, the data for two sources of funds for R&D expenditures by Universities and colleges were inadvertently transposed, creating errors in the "Basic research," "Applied research," and "Development" panels. The reported performance totals were not affected. This table has been replaced with its correct version.

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