



U.S. R&D Increased by \$32 Billion in 2017, to \$548 Billion; Estimate for 2018 Indicates a Further Rise to \$580 Billion

by Mark Boroush¹

New data from the National Center for Science and Engineering Statistics (NCSES) within the National Science Foundation indicate that research and experimental development (R&D)² performed in the United States totaled \$547.9 billion in 2017 (table 1). The estimated total for 2018, based on performer-reported expectations, is \$580.0 billion. These numbers compare with U.S. R&D totals of \$493.7 billion in 2015 and \$406.6 billion in 2010. (All amounts and calculations are reported in current dollars, unless otherwise noted.)

The U.S. R&D system consists of the activities of a diverse group of R&D performers and sources of funding. Included here are private businesses, the federal government, nonfederal governments, higher education institutions, and other nonprofit organizations. The organizations that perform R&D often receive significant levels of outside funding, and organizations that fund R&D may also themselves be performers. The data for this InfoBrief mainly derive from NCSES surveys of the annual R&D expenditures of these performers and funders (see “Data Sources and Availability” for additional information).

Current Trends in U.S. Total R&D and R&D Intensity

U.S. Total R&D

The 2010–17 period has seen sizable year-over-year increases in U.S. R&D expenditures, averaging \$20.2 billion annually—a stark contrast with essentially no change between 2008 and 2010, a period marked by the impacts of the Great Recession. The 2018 estimate represents a \$32 billion increase over the 2017 level. This pattern of sustained annual increase in U.S. total R&D is due mainly to consistently higher levels of business R&D performance (figure 1).

Adjusted for inflation, growth in U.S. total R&D averaged 2.7% annually over the 2010–17 period, moderately higher than the 2.2% average growth of U.S. gross domestic product (GDP) (table 2).³ By comparison, average annual growth of U.S. total R&D in the prior decade (2000–10), was lower at 2.1%, although it still outpaced the 1.7% rate of GDP expansion. The estimate for 2018 shows R&D growing at 3.3%, compared to GDP at 2.9%.

R&D-to-GDP Ratio

The ratio of total national R&D expenditures to GDP is widely used by

national statistical offices and other policy analysts as an overall gauge of the intensity of a nation’s R&D effort. In this new edition of the *National Patterns* data, the ratio of U.S. R&D to GDP was 2.81% in 2017 and estimated to be 2.82% in 2018.⁴

The U.S. ratio generally has been rising since the mid-1990s, though with some periods of decline (figure 2). The highest U.S. ratios recorded are 2.79% in 1964, 2.79% in 2009, 2.81% in 2017, and estimated 2.82% in 2018.⁵

Most of the rise in R&D-to-GDP ratio over the past several decades owes to the increase of nonfederal spending on R&D, particularly by the business sector. This arises largely from the growing role of business R&D in the national R&D system, which in turn reflects the increase of R&D-dependent goods and services in the national and global economies. By contrast, the share of federally funded R&D expenditures declined from the mid-1980s to the late 1990s, notably from cuts in defense-related R&D. This was followed by a gradual uptick through 2009, driven by increased federal spending on biomedical and national security R&D and the one-time

TABLE 1. U.S. R&D expenditures, by performing sector and source of funds: 2010–18
(Current and constant 2012 millions of dollars)

Performing sector and source of funds	2010	2011	2012	2013	2014	2015	2016	2017 ^a	2018 ^b
Current \$millions									
All performing sectors	406,579	426,160	433,619	453,966	475,425	493,684	515,641	547,886	579,985
Business	278,977	294,092	302,251	322,528	340,728	355,821	374,685	400,101	422,070
Federal government	50,798	53,524	52,144	51,086	52,687	52,847	51,187	52,553	58,240
Federal intramural ^c	31,970	34,950	34,017	33,406	34,783	34,199	31,762	32,231	36,856
FFRDCs	18,828	18,574	18,128	17,680	17,903	18,649	19,424	20,322	21,383
Nonfederal government	691	694	665	620	583	595	622	641	641
Higher education	58,083	60,088	60,896	61,547	62,349	64,623	67,800	71,251	74,722
Other nonprofit organizations ^d	18,030	17,762	17,664	18,185	19,078	19,798	21,347	23,340	24,312
All funding sources	406,579	426,160	433,619	453,966	475,425	493,684	515,641	547,886	579,985
Business	248,124	266,422	275,718	297,168	318,383	333,208	355,545	381,137	404,231
Federal government	126,616	127,014	123,837	120,130	118,365	119,524	116,492	120,961	127,246
Nonfederal government	4,303	4,386	4,158	4,244	4,214	4,267	4,481	4,582	4,726
Higher education	12,262	13,103	14,300	15,378	16,210	17,299	18,484	19,723	21,120
Other nonprofit organizations ^d	15,275	15,235	15,607	17,046	18,254	19,386	20,640	21,482	22,662
Constant 2012 \$millions									
All performing sectors	423,033	434,334	433,619	446,136	458,735	471,444	487,370	508,272	525,256
Business	290,267	299,733	302,251	316,965	328,767	339,792	354,142	371,173	382,242
Federal government	52,854	54,551	52,144	50,205	50,837	50,467	48,380	48,753	52,744
Federal intramural ^c	33,264	35,621	34,017	32,830	33,562	32,658	30,021	29,901	33,378
FFRDCs	19,590	18,930	18,128	17,375	17,275	17,809	18,359	18,852	19,365
Nonfederal government	719	707	665	609	563	568	588	594	580
Higher education	60,434	61,240	60,896	60,485	60,160	61,712	64,083	66,099	67,671
Other nonprofit organizations ^d	18,760	18,103	17,664	17,871	18,408	18,906	20,177	21,653	22,018
All funding sources	423,033	434,334	433,619	446,136	458,735	471,444	487,370	508,272	525,256
Business	258,165	271,531	275,718	292,043	307,206	318,197	336,051	353,580	366,087
Federal government	131,740	129,450	123,837	118,058	114,209	114,140	110,105	112,215	115,238
Nonfederal government	4,477	4,471	4,158	4,171	4,066	4,075	4,235	4,251	4,280
Higher education	12,758	13,354	14,300	15,112	15,640	16,520	17,470	18,297	19,127
Other nonprofit organizations ^d	15,893	15,528	15,607	16,752	17,614	18,513	19,508	19,929	20,523

FFRDC = federally funded research and development center.

^a Some data for 2017 are preliminary and may later be revised.

^b The data for 2018 are estimates and will later be revised.

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

^d 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 higher education, federal government, and nonfederal government performers are calendar year approximations based on fiscal year data.

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

incremental funding for R&D provided by the American Recovery and Reinvestment Act of 2009 (ARRA). The federally funded share, however, has returned to a path of mainly decline since 2010 (figure 2).

Performers of R&D

Business

The business sector is by far the largest performer of U.S. R&D. In 2017,

domestically performed business R&D accounted for \$400.1 billion, or 73% of the \$547.9 billion national R&D total (tables 1 and 3).⁶ The business sector's predominance in national R&D performance has long been the case, with its annual share ranging between 69% and 73% in 2000–17.⁷

Adjusted for inflation, growth in business R&D averaged 3.6% annually

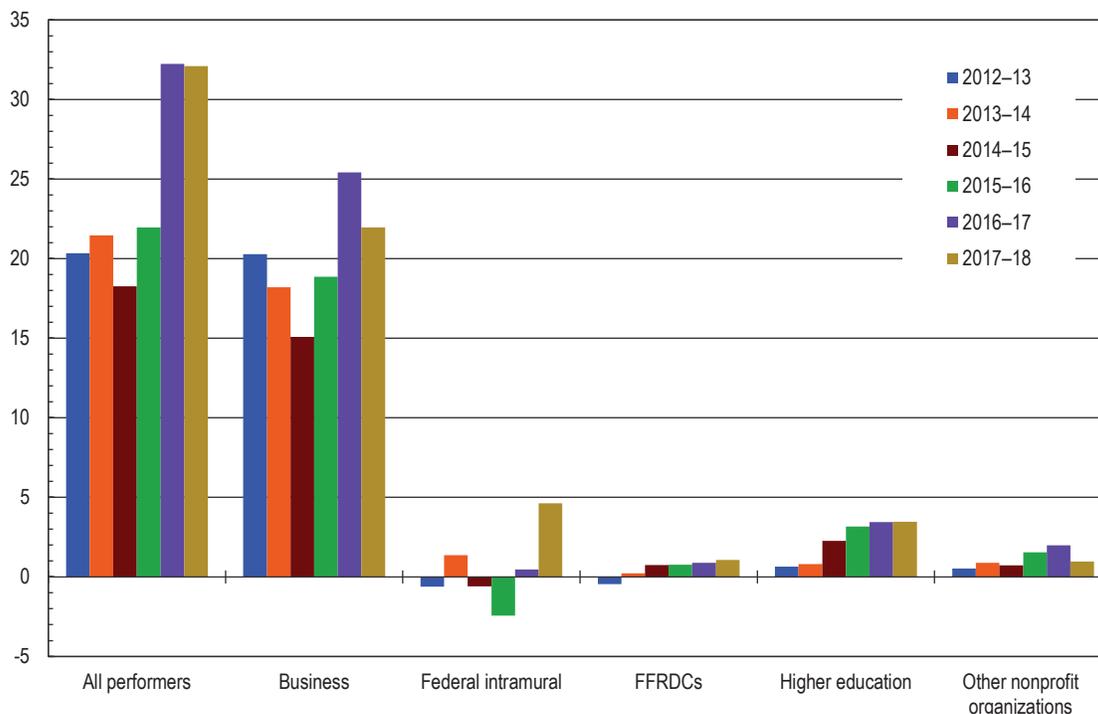
during this period, well ahead of the 2.7% annual average for U.S. total R&D and the 2.2% annual average for GDP (table 2).

Higher Education

R&D performed in the United States by the higher education sector totaled \$71.3 billion in 2017, or 13% of U.S. total R&D (tables 1 and 3). Over the period 2000–17, the higher education

FIGURE 1. Year-to-year changes in U.S. R&D expenditures, by performer: 2012–18

Billions of current dollars



FFRDC = federally funded research and development center.

NOTE: Data for 2017 are preliminary, and those for 2018 are estimates; some of these data may later be revised.

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

share of U.S. R&D has ranged between 11% and 14%.

Adjusted for inflation, growth in this sector's R&D performance averaged 1.3% annually in 2010–17, well behind both U.S. total R&D (2.7%) and GDP (2.2%). The year-by-year trajectory in higher education R&D expenditures has been marked by contrasts: relatively high growth in 2010 and 2011, noticeable slowdown in 2012–14, and return to substantial growth in 2015–17 (table 2).

Federal Agencies and Federally Funded Research and Development Centers

The federal government performed \$52.6 billion, or 10%, of the U.S. R&D total in 2017 (tables 1 and 3). This included \$32.2 billion (6% of the U.S. total) performed by the intramural

R&D facilities of federal agencies and \$20.3 billion (4%) performed by the 42 federally funded research and development centers (FFRDCs). The federal share of U.S. R&D performance rose from about 11% in 2000 to 12% in 2010, but has declined since then, down to about 10% in 2017.

Adjusted for inflation, this sector's R&D performance in 2010–17 declined at an annual average rate of 1.1%—a sharp contrast to the growth in total U.S. R&D (2.7%) and GDP (2.2%) over the same period (table 2). In the previous decade (2000–10), federal R&D performance grew an average of 3.8% yearly, well ahead of U.S. total R&D (2.1%). The reversal in the 2010–17 period reflects mainly the waning after 2010 of the incremental funding from ARRA and the

more challenging environment for federal budget support after 2011. (Also, starting in 2016, a revision to the guidelines governing federal agency reporting of R&D expenditures reduced—particularly for the Department of Defense—the reported level of federal intramural R&D performance by \$5 billion to \$7 billion annually compared to prior years.⁸)

State Government

State agency intramural R&D performance in 2017 is estimated to be \$641 million—a small share (about 0.1%) of the U.S. total (tables 1 and 3). This includes all 50 states and the District of Columbia.

Other Nonprofit Organizations

R&D performed in the United States by other nonprofit organizations (which

TABLE 2. Annual changes in U.S. R&D expenditures and gross domestic product, by performing sector: 1990–2018
(Percent)

Expenditures and gross domestic product	Longer-term trends			Most recent years							
	1990–2000	2000–10	2010–17	2010–11	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18
Current \$											
Total R&D, all performers	5.8	4.3	4.4	4.8	1.8	4.7	4.7	3.8	4.4	6.3	5.9
Business	6.4	3.4	5.3	5.4	2.8	6.7	5.6	4.4	5.3	6.8	5.5
Federal government	1.9	5.9	0.5	5.4	-2.6	-2.0	3.1	0.3	-3.1	2.7	10.8
Federal intramural ^a	2.1	5.2	0.1	9.3	-2.7	-1.8	4.1	-1.7	-7.1	1.5	14.4
FFRDCs	1.7	7.3	1.1	-1.4	-2.4	-2.5	1.3	4.2	4.2	4.6	5.2
Nonfederal government ^b	NA	NA	-1.1	0.4	-4.2	-6.8	-5.9	2.0	4.7	2.9	0.1
Higher education	5.9	6.9	3.0	3.5	1.3	1.1	1.3	3.6	4.9	5.1	4.9
Other nonprofit organizations ^c	8.8	6.6	3.8	-1.5	-0.6	2.9	4.9	3.8	7.8	9.3	4.2
Gross domestic product	5.6	3.9	3.8	3.7	4.2	3.6	4.4	4.0	2.7	4.3	5.4
Constant 2012 \$											
Total R&D, all performers	3.7	2.1	2.7	2.7	-0.2	2.9	2.8	2.8	3.4	4.3	3.3
Business	4.3	1.3	3.6	3.3	0.8	4.9	3.7	3.4	4.2	4.8	3.0
Federal government	-0.1	3.8	-1.1	3.2	-4.4	-3.7	1.3	-0.7	-4.1	0.8	8.2
Federal intramural ^a	0.0	3.0	-1.5	7.1	-4.5	-3.5	2.2	-2.7	-8.1	-0.4	11.6
FFRDCs	-0.4	5.1	-0.5	-3.4	-4.2	-4.2	-0.6	3.1	3.1	2.7	2.7
Nonfederal government ^b	NA	NA	-2.7	-1.7	-6.0	-8.4	-7.6	0.9	3.6	1.0	-2.3
Higher education	3.7	4.7	1.3	1.3	-0.6	-0.7	-0.5	2.6	3.8	3.1	2.4
Other nonprofit organizations ^c	6.6	4.4	2.1	-3.5	-2.4	1.2	3.0	2.7	6.7	7.3	1.7
Gross domestic product	3.4	1.7	2.2	1.6	2.2	1.8	2.5	2.9	1.6	2.4	2.9

NA = not available.

FFRDC = federally funded research and development center.

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

^b Survey data on state internal R&D performance was not available prior to 2006; state data for 2008 were not collected.

^c 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 2018 are estimates and will later be revised.

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

excludes universities and FFRDCs) was an estimated \$23.3 billion in 2017 (tables 1 and 3). This was 4% of U.S. total R&D, a share estimated to have increased only slightly since the late 1990s.

Sources of R&D Funding

Business

Matching its predominant role in R&D performance, the business sector is also the leading source of funding for R&D performed in the United States. In 2017, business sector funding accounted for \$381.1 billion, or 70%, of U.S. total R&D performance (table 3). Nearly all (98%) of the business sector's funding for R&D that year supported business R&D performance—whether

performed by the company itself or in support of the R&D performed by other companies.⁹ The remainder went to R&D performers in higher education, other nonprofit organizations, and FFRDCs.

The business sector's dominant role in U.S. R&D funding began in the early 1980s, when its support started to exceed 50% of the total. In 2000–17, the business sector's funding share ranged from 61% to 70% annually.

Federal Government

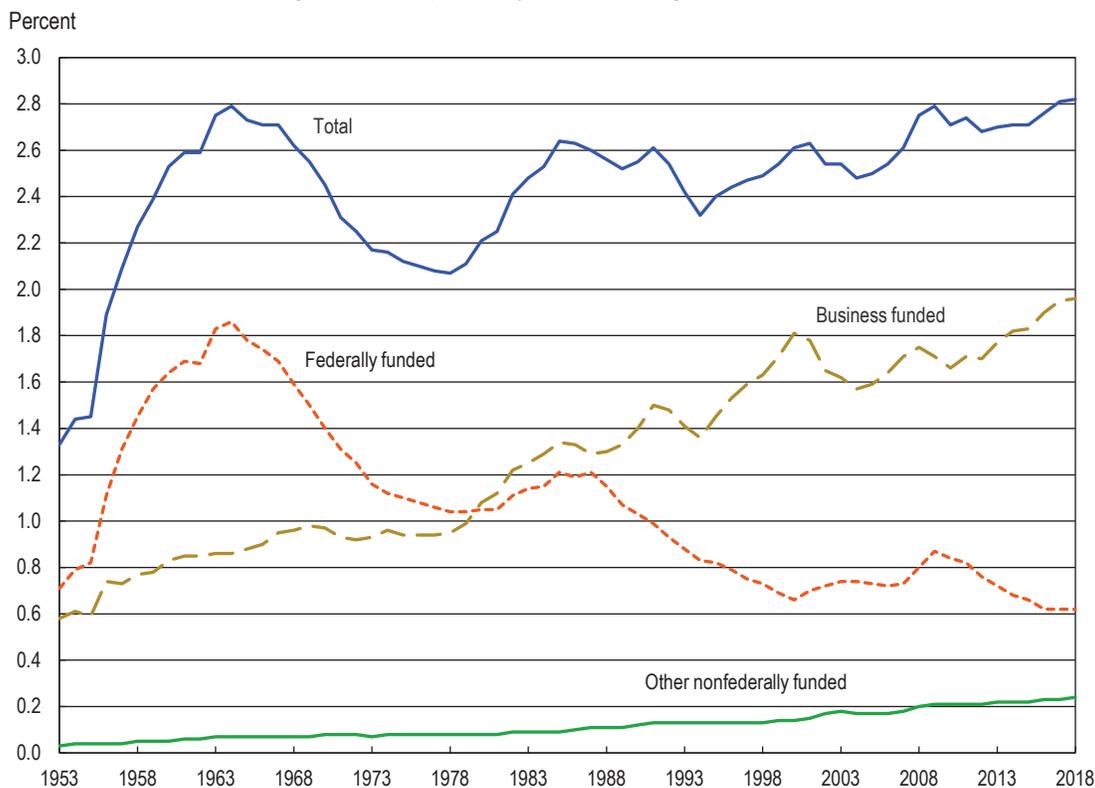
The federal government is the second-largest source of funding for U.S. R&D, behind the business sector. It is a major resource for most of the U.S. R&D

performer sectors, except the business sector, where the federal role is overshadowed by business's own funds.

Funds from the federal government accounted for \$121.0 billion, or 22%, of U.S. total R&D in 2017 (table 1). Federal funding was directed mainly to R&D performance by the federal government, businesses, and higher education (table 3). In 2017, federal funding supported about 51% of academic R&D performance; 6% of business R&D performance; 35% of nonprofit R&D performance; and almost all (98%) of FFRDC R&D performance.

Several decades ago, the federal government was the leading sponsor

FIGURE 2. Ratio of U.S. R&D to gross domestic product, by source of funding for R&D: 1953–2018



NOTES: Data for 2017 are preliminary, and those for 2018 are estimates; some of these data 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 represent businesses as funders of R&D by all performers. The other nonfederal category includes R&D funded by all other sources—mainly, higher education, nonfederal government, and other nonprofit organizations. The gross domestic product (GDP) data used reflect the Bureau of Economic Analysis’s comprehensive revisions of the National Income and Product Accounts of August 2019.

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

of the nation’s R&D—funding 67% of all U.S. R&D in 1964 (figure 2). The federal share decreased to half (49%) of all funding in the late 1970s, to a little over a third (36%) in the mid-1990s, and to a quarter (25%) by the turn of the century. (A major factor in the decrease of the federal share of national R&D was the sharp decline in funding for space R&D after the United States won the race to the moon in the late 1960s. At largely the same time, the business sector was rapidly expanding its energy-related R&D in response to the world oil supply crises.) The share ticked up again to 31% in 2009 and 2010, amid changing business conditions and expanded federal funding for

health, defense, and counterterrorism R&D (including ARRA funding). The federal share, however, again declined in the subsequent years and stands at 22% in 2017. As with the recent decline in the federal share of R&D performance, this decline in the federal share of R&D funding reflects a waning after ARRA and the more challenging federal budget environment since 2011.

Other Sources

The remainder of R&D funding from other sources is a smaller component: \$45.8 billion in 2017, or about 8% of all U.S. R&D performance (table 3). Of this amount, \$19.7 billion was from higher education’s own institutional

funds, all of which remain in the academic sector; \$4.6 billion was from state and local governments, primarily supporting academic research; and \$21.5 billion was from other nonprofit organizations, mostly funding this sector’s own R&D. Of the estimated nonprofit total, some funds (\$7.2 billion) support R&D in higher education, and small amounts support business (\$0.8 billion) and FFRDC (\$0.2 billion) R&D performance.

R&D by Type of Work

In 2017, basic research activities accounted for \$91.5 billion, or 17% of total U.S. R&D expenditures (table 4). Applied research was \$108.8 billion, or

TABLE 3. U.S. R&D expenditures, by performing sector, source of funds, and type of work: 2017
(Millions of dollars and percent distribution)

Performing sector and type of work	Source of funds (\$millions)						Percent distribution by performer
	Total	Business	Federal government	Nonfederal government	Higher education	Other nonprofit organizations	
R&D	547,886	381,137	120,961	4,582	19,723	21,482	100.0
Business	400,101	374,934	24,277	121	*	769	73.0
Federal government	52,553	194	52,174	33	*	152	9.6
Federal intramural	32,231	0	32,231	0	0	0	5.9
FFRDCs	20,322	194	19,943	33	*	152	3.7
Nonfederal government	641	*	258	383	*	*	0.1
Higher education	71,251	4,276	36,034	4,046	19,723	7,173	13.0
Other nonprofit organizations	23,340	1,734	8,218	*	*	13,389	4.3
Percent distribution by funding source	100.0	69.6	22.1	0.8	3.6	3.9	-
Basic research	91,453	26,318	38,653	2,440	12,231	11,811	100.0
Business	24,829	22,942	1,783	14	*	90	27.1
Federal government	10,388	38	10,313	6	*	30	11.4
Federal intramural	6,259	0	6,259	0	0	0	6.8
FFRDCs	4,128	38	4,054	6	*	30	4.5
Nonfederal government	104	*	42	62	*	*	0.1
Higher education	44,302	2,376	23,082	2,357	12,231	4,257	48.4
Other nonprofit organizations	11,830	963	3,434	*	*	7,434	12.9
Percent distribution by funding source	100.0	28.8	42.3	2.7	13.4	12.9	-
Applied research	108,805	58,701	37,620	1,578	5,328	5,578	100.0
Business	62,133	56,904	5,037	26	*	166	57.1
Federal government	18,165	91	17,992	10	*	72	16.7
Federal intramural	10,124	0	10,124	0	0	0	9.3
FFRDCs	8,041	91	7,868	10	*	72	7.4
Nonfederal government	514	*	207	307	*	*	0.5
Higher education	20,009	1,267	10,232	1,234	5,328	1,948	18.4
Other nonprofit organizations	7,984	439	4,152	*	*	3,393	7.3
Percent distribution by funding source	100.0	54.0	34.6	1.5	4.9	5.1	-
Experimental development	347,622	296,118	44,688	559	2,164	4,093	100.0
Business	313,139	295,089	17,457	81	*	513	90.1
Federal government	23,995	64	23,869	11	*	51	6.9
Federal intramural	15,848	0	15,848	0	0	0	4.6
FFRDCs	8,147	64	8,021	11	*	51	2.3
Nonfederal government	22	*	9	13	*	*	0.0
Higher education	6,941	633	2,721	455	2,164	969	2.0
Other nonprofit organizations	3,526	332	632	*	*	2,562	1.0
Percent distribution by funding source	100.0	85.2	12.9	0.2	0.6	1.2	-

* = small to negligible amount, included as part of the funding provided by other sectors.

FFRDC = federally funded research and development center.

NOTES: Data for 2017 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 Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series).

20% of the total. Most of the total of U.S. R&D expenditures was experimental development at \$347.6 billion, or 63%.

Higher education accounted for just under half (48%) of the \$91.5 billion of basic research in 2017 (table 3). The business sector was the second-largest basic research performer (27%). Business was the majority performer (57%) of the \$108.8 billion of applied research in 2017. Higher education was second at 18%; federal intramural performers plus FFRDCs amounted to 17% of the applied research total. Business continued to dominate experimental development, accounting for 90% of the \$347.6 billion of that category in 2017.

Federal funding accounted for 42% of the \$91.5 billion of basic research in 2017. But federal funds were less

prominent for applied research (35% of \$108.8 billion) and experimental development (13% of \$347.6 billion). The business sector provided the greatest share of funding for applied research (54%) and the predominant share for experimental development (85%). It also accounted for a sizable share (29%) of funding for basic research.

The shares of U.S. total R&D expenditures among the three types of R&D have remained largely stable over the 2010–17 period—essentially the same for applied research, somewhat less for basic research, and somewhat more for experimental development (table 4). Adjusted for inflation, about \$6 billion more in basic research was performed in 2017 than in 2010, \$19 billion more in applied research, and \$61 billion more in experimental development.

Between 2010 and 2017, the most notable shifts in the relative roles of performers and funders were in basic research. In 2010, businesses performed 22% of U.S. basic research, but the sector’s role rose to 27% in 2017 (partly because of substantial increases in basic research performed by the pharmaceuticals and medicines industries, as well as the professional, scientific, and technical services sector). Over the same period, the share of U.S. basic research performed by higher education institutions—historically, the nation’s largest basic research performer—declined from 50% in 2010 to 48% in 2017. Businesses funded 23% of U.S. basic research in 2010, rising to 29% in 2017. Over the same period, the federally funded share declined from 53% in 2010 to 42% in 2017.

TABLE 4. U.S. R&D expenditures, by type of work: Selected years, 2000–18
(Current and constant 2012 dollar billions and percent distribution)

Type of work	2000	2010	2012	2013	2014	2015	2016	2017 ^a	2018 ^b
Current \$billions									
All R&D	267.9	406.6	433.6	454.0	475.4	493.7	515.6	547.9	580.0
Basic research	42.0	76.0	73.4	78.6	82.1	83.5	88.6	91.5	96.5
Applied research	56.5	79.2	87.0	88.2	91.8	97.2	104.8	108.8	115.0
Experimental development	169.4	251.4	273.3	287.1	301.5	312.9	322.2	347.6	368.5
Constant 2012 \$billions									
All R&D	343.2	423.0	433.6	446.1	458.7	471.4	487.4	508.3	525.3
Basic research	53.8	79.1	73.4	77.2	79.3	79.8	83.8	84.8	87.4
Applied research	72.4	82.4	87.0	86.7	88.6	92.9	99.1	100.9	104.1
Experimental development	217.0	261.6	273.3	282.2	290.9	298.8	304.5	322.5	333.8
Percent distribution									
All R&D	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Basic research	15.7	18.7	16.9	17.3	17.3	16.9	17.2	16.7	16.6
Applied research	21.1	19.5	20.1	19.4	19.3	19.7	20.3	19.9	19.8
Experimental development	63.2	61.8	63.0	63.3	63.4	63.4	62.5	63.4	63.5

^a Some data for 2017 are preliminary and may later be revised.

^b The data for 2018 are estimates and will later be revised.

NOTES: Data throughout the time series reported here are consistently based on Organisation for Economic Co-operation and Development *Frascati Manual* definitions for basic research, applied research, and experimental development. Prior to 2010, however, some changes were introduced in the questionnaires of the sectoral expenditure surveys to improve the accuracy of respondents’ classification of their R&D. Therefore, small percentage changes in the historical data may not be meaningful.

SOURCE: 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 in this report derive mainly from integrating the data on R&D expenditures and funding collected by NCSES's annual national surveys on the organizations that perform and fund the vast majority of U.S. R&D. In some cases, the primary data from these surveys are adjusted to enable consistent integration of the statistics across these separately conducted surveys. In addition, preliminary or otherwise estimated values may be used where final data from one or more of the surveys are not yet available but can reasonably be calculated.

The R&D surveys involved include NCSES's Business Research and Development Survey (for 2017–18; for 2008–16, the preceding Business R&D and Innovation Survey; for 2007 and earlier years, the Survey of Industrial R&D), the Higher Education Research and Development Survey (for FYs 2010–18; for 2009 and earlier years, the preceding Survey of R&D Expenditures at Universities and Colleges), the Survey of Federal Funds for Research and Development (FYs 2018–19 and earlier years), and the FFRDC Research and Development Survey (FY 2018 and earlier years).¹⁰ Amounts for the R&D performed by other nonprofit organizations with funding from the nonprofit

sector and from business sources are estimated, based on parameters from the 1996–97 Survey of R&D Funding and Performance by Nonprofit Organizations.

A full set of detailed statistical tables associated with the *National Patterns* data will be available in the report *National Patterns of R&D Resources: 2017–18 Data Update*, at <https://www.nsf.gov/statistics/natlpatterns/>. This supplementary report also provides further details on the nature of the data and the *National Patterns* methodologies. For further information and questions, contact the author.

Notes

1. Mark Boroush, Research and Development Statistics Program, National Center for Science and Engineering Statistics, National Science Foundation, 2415 Eisenhower Avenue, Suite W14200, Alexandria, VA 22314 (mboroush@nsf.gov; 703-292-8726).

2. *Research and experimental development* comprise creative and systematic work undertaken in order to increase the stock of knowledge—including knowledge of humankind, culture, and society—and to devise new applications of available knowledge. *Basic research*: Experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view. *Applied research*: Original investigation undertaken in order to acquire new knowledge; directed primarily toward a specific, practical aim or objective. *Experimental development*: Systematic work, drawing on knowledge gained from research and practical experience and producing additional knowledge, which is directed to producing new products or processes or to improving existing products or processes. (Organisation for Economic Co-Operation and Development, *Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development*. 7th ed. Paris.)

3. In this report, dollars adjusted for inflation (i.e., constant dollars) are based on the GDP implicit price deflator (currently in 2012 dollars) as published

by the Department of Commerce, Bureau of Economic Analysis (BEA) (https://www.bea.gov/iTable/index_nipa.cfm). Note that GDP deflators are calculated on an economy-wide scale and do not explicitly focus on R&D.

4. By comparison, against the world's other largest R&D performers in 2017, the U.S.'s 2017 ratio was well ahead of China's 2.15%, France's 2.19%, and the United Kingdom's 1.66%. But it was behind Germany's 3.04% and Japan's 3.20%, and considerably behind South Korea's 4.55%. (Organisation for Economic Co-Operation and Development, *Main Science and Technology Indicators, 2019/1*, Paris.)

5. Due to sample variability in the data for the business R&D component, the calculated R&D-to-GDP ratios for 1965, 2009, 2017, and 2018 are not significantly different from one another at a 90% confidence level.

6. R&D performed in the domestic United States by businesses occurs widely in manufacturing and nonmanufacturing. Presently, most occurs in five sectors: chemicals manufacturing (which includes the pharmaceuticals industry); computer and electronic products manufacturing; transportation equipment manufacturing (which includes the automobiles and aerospace industries); information (which includes the software publishing industry); and professional, scientific, and technical services (which include the computer systems design and scientific R&D services industries). For further details and statistics, see the current report of the NCSES Business Research and Development Survey, <https://www.nsf.gov/statistics/srvybrds/>.

7. Historical data not illustrated in the tables and figures in this report can be found in the full set of detailed statistical tables available at <https://nces.nsf.gov/pubs/nsf20307/>.

8. Starting in FY 2016 and thereafter, the data on federal intramural R&D exclude expenditures for preproduction development. (Preproduction development is nonexperimental work on a product or system before it goes into full production. For example, activities and programs that are categorized as “Operational Systems Development” in the DOD's Research, Development, Test, and Evaluation [RDT&E] budget activity structure.) This change aligns the federal intramural data with a recent change introduced in the definition of R&D by the U.S. Office of Management and Budget. In FYs 2016–18, federal intramural preproduction development totaled \$5 billion to \$7 billion each year.

9. Business funding by business in this report refers to business funding for domestic business R&D performance plus business funding for FFRDCs and U.S. higher education and other nonprofit R&D performers.

10. Estimates from the Business Research and Development Survey, the Business R&D and Innovation Survey, and the Survey of Industrial R&D are all derived from sample data and thereby contain sampling error. Consequently, estimates of total U.S. R&D also contain sampling error. For more information on this topic and other surveys used in the *National Patterns* tabulations, please see the technical notes in the accompanying data update at <https://www.nsf.gov/statistics/natlpatterns/>.