

## NEW ESTIMATES OF NATIONAL RESEARCH AND DEVELOPMENT EXPENDITURES SHOW 5.8% GROWTH IN 2007

by Mark Boroush<sup>1</sup>

National Science Foundation (NSF) estimates indicate that U.S. spending on research and development (R&D) totaled \$368.1 billion (current dollars) in 2007, up from \$347.9 billion in 2006 (table 1). This increase represented growth in 2007 of 5.8% over the 2006 level, or 3.1% in inflation-adjusted year 2000 dollars.

This inflation-adjusted (“real”) pace of growth in R&D expenditures outpaced that for gross domestic product (GDP): 2.2% growth in real GDP in 2007, compared with 3.1% for R&D. These 2007 results followed the pattern of the two prior years: 4.4% growth in real R&D expenditures in 2006, compared with 2.9% for real GDP; 4.3% growth in real R&D expenditures in 2005, compared with 3.1% for real GDP.

Total R&D expenditures in 2007 were some \$9.1 billion higher in real dollars than in 2006. Nearly all of this increase reflected greater R&D expenditures by industry. NSF’s estimates indicate that the federal government’s overall spending on R&D declined somewhat in real dollar terms in 2007.

### R&D Funders and Performers

The U.S. R&D system is comprised by a variety of performers and funding sources, including the federal government, industry, universities and colleges, other government and nonprofit organizations.<sup>2</sup> Organizations that perform R&D often receive outside funding,

and some organizations that fund R&D do not perform all the R&D that they support.

In 2007, industry remained the largest performer, by far, of U.S. R&D, conducting \$265.2 billion, or 72.0%, of the total (table 1, figure 1). Universities and colleges accounted for \$48.9 billion, or 13.3%, of R&D performance. The federal government conducted \$38.6 billion, or 10.5%, (including federal intramural, \$24.7 billion, and federally funded research and development centers, \$13.9 billion<sup>3</sup>). Other nonprofit organizations performed \$15.3 billion, or 4.2%.

This balance of expenditures among performers in 2007 is similar to what prevailed 5 years ago (in 2002): industry performed 70.1%; universities and colleges, 13.4%; federal government (federal intramural and federally funded research and development centers), 12.0%; and other nonprofit organizations, 4.5%. Looking back over several decades, there has been a marked increase in the share of national R&D performed by universities and colleges (which was around 9% of the total in the mid-1980s). Nevertheless, the most striking long run trend is the continuing, far larger, real-dollar expansion in R&D expenditures by industry (figure 2).

With regard to R&D funding, industry was again the predominant source in 2007, providing an estimated \$245.0 billion, or 66.6%, of the total (table 1, figure 1). The federal government accounted for \$98.3 billion, or 26.7%, of the funding total. Universities and colleges



TABLE 1. U.S. R&amp;D expenditures, by performing sector and source of funding: 2002–07

Sector	2002	2003	2004	2005	2006	2007 (estimated)
Current \$millions						
All performing sectors	276,602	289,038	299,905	323,005	347,871	368,098
Industry	193,868	200,724	208,301	226,159	247,669	265,193
Industry-administered FFRDCs	2,263	2,458	2,485	2,601	2,562	4,589
Federal government <sup>a</sup>	21,499	22,752	22,844	24,459	25,327	24,744
U&C	37,202	40,470	43,111	45,191	46,987	48,913
U&C-administered FFRDCs	7,102	7,301	7,658	7,812	7,866	6,076
Other nonprofit organizations	12,349	12,839	12,862	13,954	14,507	15,346
Nonprofit-administered FFRDCs	2,319	2,494	2,644	2,828	2,953	3,236
All funding sectors	276,602	289,038	299,905	323,005	347,871	368,098
Industry	180,711	186,174	191,377	207,841	227,276	245,027
Federal government	77,699	83,606	88,749	93,734	97,701	98,331
U&C	7,343	7,649	7,933	8,575	9,282	9,866
Other nonprofit organizations	8,292	8,868	8,962	9,905	10,542	11,647
Nonfederal government	2,557	2,742	2,884	2,950	3,071	3,226
Constant 2000 \$millions						
All performing sectors	265,470	271,629	273,980	285,832	298,427	307,553
Industry	186,066	188,634	190,295	200,132	212,467	221,574
Industry-administered FFRDCs	2,172	2,310	2,270	2,302	2,197	3,834
Federal government <sup>a</sup>	20,634	21,382	20,869	21,645	21,727	20,675
U&C	35,705	38,032	39,384	39,991	40,309	40,868
U&C-administered FFRDCs	6,816	6,861	6,996	6,913	6,748	5,077
Other nonprofit organizations	11,852	12,066	11,750	12,348	12,445	12,822
Nonprofit-administered FFRDCs	2,226	2,344	2,415	2,502	2,533	2,704
All funding sectors	265,470	271,629	273,980	285,832	298,427	307,553
Industry	173,439	174,960	174,834	183,922	194,973	204,725
Federal government	74,573	78,570	81,077	82,947	83,814	82,158
U&C	7,047	7,189	7,247	7,588	7,963	8,243
Other nonprofit organizations	7,958	8,334	8,187	8,765	9,043	9,731
Nonfederal government	2,454	2,577	2,635	2,610	2,634	2,696

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

<sup>a</sup>Includes expenditures of federal intramural R&D as well as costs associated with administering extramural R&D.

NOTES: Some figures for 2007 are estimates or based on incomplete data and are subject to further revision. Data are based on annual reports by performers except for the nonprofit sector. Expenditure levels for academic and federal government performers are calendar-year approximations based on fiscal year data. For federal government expenditures, approximation is equal to 75% of the amount reported in same fiscal year plus 25% of the amount reported in the subsequent fiscal year. For academic expenditures, the respective percentages are 50 and 50, because those fiscal years generally begin on July 1 instead of October 1.

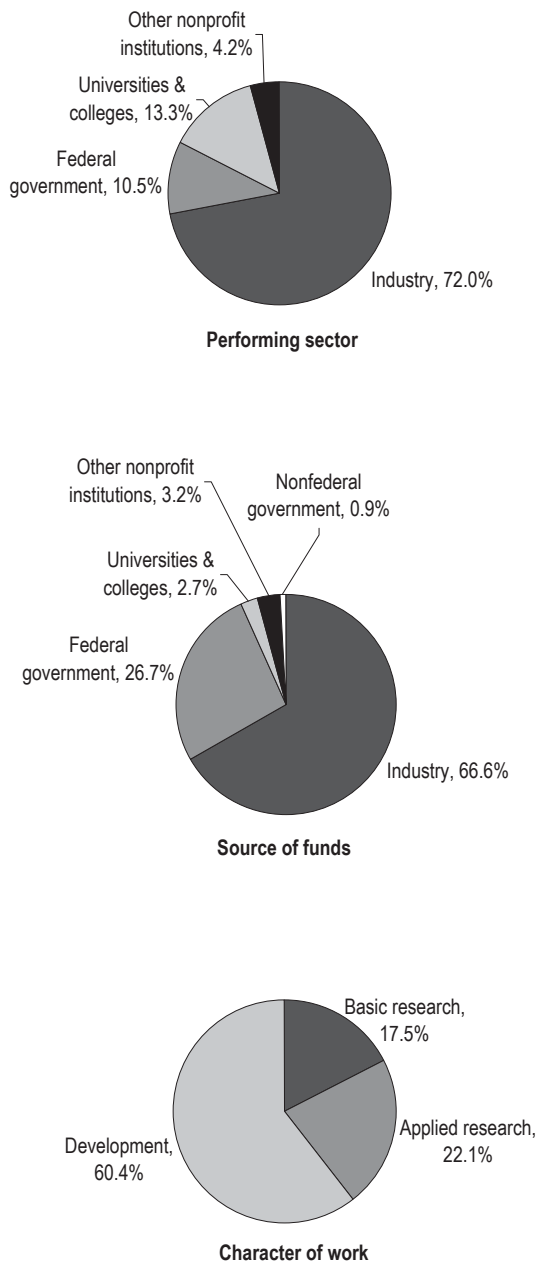
SOURCE: National Science Foundation, Division of Science Resources Statistics, National Patterns of R&D Resources (annual series).

provided \$9.9 billion, or 2.7%; other nonprofit organizations, \$11.6 billion, or 3.2%; and nonfederal government agencies, \$3.2 billion, or 0.9%.

Five years ago, a similar balance among R&D funding sources prevailed: industry, 65.3%; the federal government, 28.1%; universities and colleges, 2.7%; other

nonprofit organizations, 3.0%; and nonfederal government agencies, 0.9%. Even so, looking back over a longer period of history (figure 3), the striking trend is, again, the substantial and sustained, real-dollar expansion of industry R&D funding since the mid-1980s, while federal government support followed a far flatter growth path.

FIGURE 1. Share of U.S. R&D expenditures, by character of work, source of funds, and performing sector: 2007 (estimated)



NOTES: U.S. R&D expenditures totaled an estimated \$368.1 billion in 2007. Federal R&D performers include federal agencies and federally funded research and development centers.

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

### R&D by Character of Work

Basic research activities accounted for an estimated \$64.4 billion, or 17.5%, of total U.S. R&D expenditures in 2007 (table 2, figure 1). Applied research was \$81.2 billion, or 22.1%; development was \$222.5 billion, or 60.4%.

These character-of-work fractions in 2007 are similar to those that prevailed in the last several years. Over the previous 10 years (1997–2007), the basic research fraction has ranged between 15.6% and 19.0%; applied research, between 18.5% and 23.4%; and development, between 57.8% and 63.9%.

Universities and colleges were the predominant performer (57.1%) of the \$64.4 billion of basic research in 2007, with the federal government providing the largest share (59.0%) of the funding (table 2). Industry performed nearly two-thirds (67.4%) of the \$81.2 billion of applied research—and was also by far the largest funder (61.1%). Industry was even more predominant in development, where it both performed the vast majority (90.6%) and also provided the largest fraction (83.2%) of the nation’s \$222.5 billion of development expenditures in 2007.

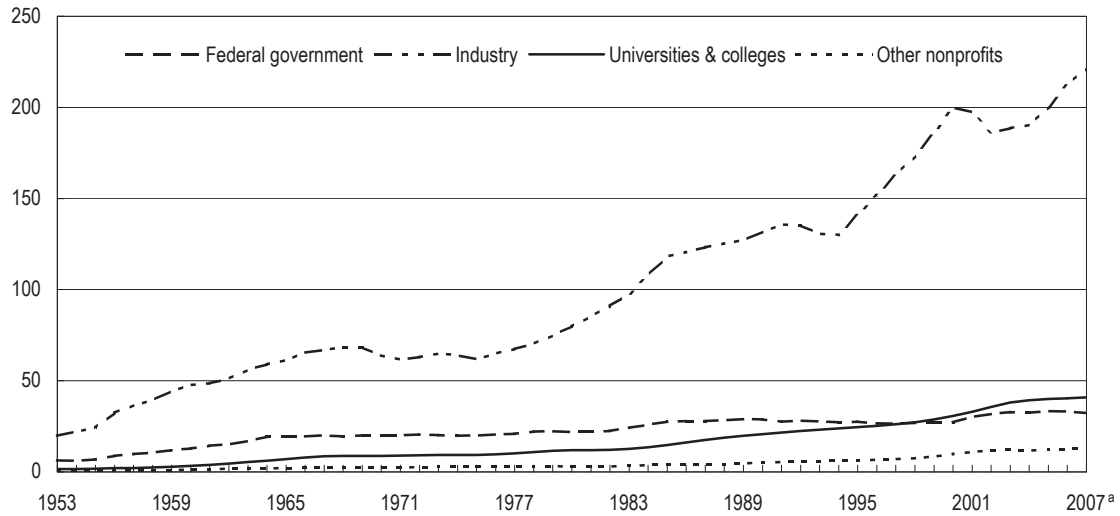
### Ratio of R&D and Gross Domestic Product

The ratio of total national R&D expenditures to GDP is often reported as a measure of the intensity of R&D effort compared to overall economic activity. The ratio is also widely viewed as a useful gauge of a nation’s commitment to R&D at different points in time.

NSF estimates that U.S. expenditures on R&D totaled 2.66 % of GDP in 2007. This estimate is somewhat higher than the ratios prevailing in the last several years (figure 4). Over the last 10 years, the ratio has fluctuated somewhat year to year—between a low of 2.57% in 2004 and a high of 2.74% in 2001. The broader trend has been movement of the ratio toward a modestly higher level since a low point of 2.39% in the mid-1990s. Separating the federal and nonfederal components (figure 4), it is evident that most of the rise of the ratio over the last several decades has come from the increase of nonfederal spending on R&D—particularly that by industry, while the ratio of federal R&D spending to GDP declined from the mid 1980s to the late 1990s and has been relatively stable since the late 1990s.

FIGURE 2. U.S. R&D expenditures, by performer: 1953–2007

2000 constant \$billions

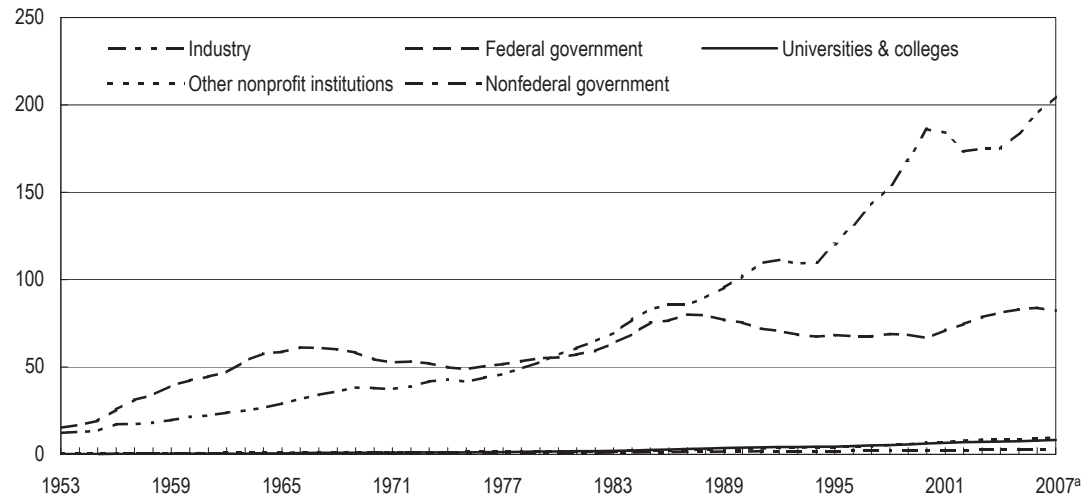


<sup>a</sup> Figures for 2007 are estimates.

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

FIGURE 3. U.S. R&D expenditures, by source of funds: 1953–2007

2000 constant \$billions



<sup>a</sup> Figures for 2007 are estimates.

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

TABLE 2. U.S. R&amp;D expenditures, by character of work, performing sector, and source of funds: 2007 (estimated)

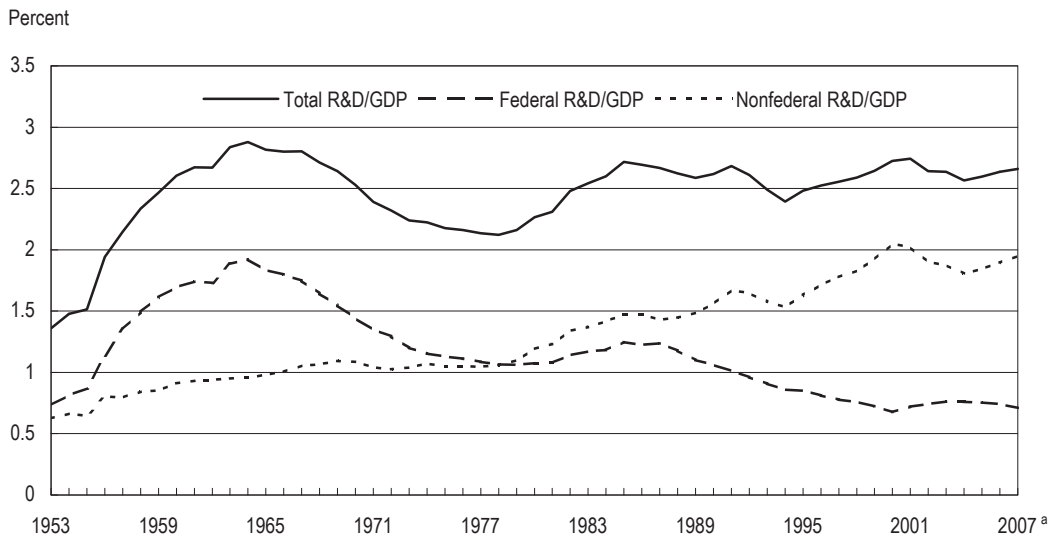
Performing sector and character of work	Source of funds (\$ millions)					Total expenditures (% distribution)
	Total	Industry	Federal government	U&C	Other nonprofit organizations	
<b>R&amp;D</b>	368,098	245,027	98,331	13,093	11,647	100.0
Industry	265,193	240,743	24,450	*	*	72.0
Industry-administered FFRDCs	4,589	*	4,589	*	*	1.2
Federal government	24,744	0	24,744	0	0	6.7
U&C	48,913	2,799	29,468	13,093	3,553	13.3
U&C-administered FFRDCs	6,076	*	6,076	*	*	1.7
Other nonprofit organizations	15,346	1,485	5,767	*	8,094	4.2
Nonprofit-administered FFRDCs	3,236	*	3,236	*	*	0.9
Percent distribution by source	100.0	66.6	26.7	3.6	3.2	na
<b>Basic research</b>	64,417	10,263	38,017	9,158	6,980	100.0
Industry	8,933	7,480	1,453	*	*	13.9
Industry-administered FFRDCs	2,180	*	2,180	*	*	3.4
Federal government	4,869	0	4,869	0	0	7.6
U&C	36,801	1,958	23,199	9,158	2,485	57.1
U&C-administered FFRDCs	1,997	*	1,997	*	*	3.1
Other nonprofit organizations	8,260	824	2,941	*	4,494	12.8
Nonprofit-administered FFRDCs	1,379	*	1,379	*	*	2.1
Percent distribution by source	100.0	15.9	59.0	14.2	10.8	na
<b>Applied research</b>	81,211	49,603	25,455	3,226	2,927	100.0
Industry	54,713	48,537	6,177	*	*	67.4
Industry-administered FFRDCs	1,414	*	1,414	*	*	1.7
Federal government	7,839	0	7,839	0	0	9.7
U&C	10,102	690	5,310	3,226	875	12.4
U&C-administered FFRDCs	1,844	*	1,844	*	*	2.3
Other nonprofit organizations	4,844	376	2,417	*	2,051	6.0
Nonprofit-administered FFRDCs	454	*	454	*	*	0.6
Percent distribution by source	100.0	61.1	31.3	4.0	3.6	na
<b>Development</b>	222,470	185,162	34,859	708	1,741	100.0
Industry	201,547	184,726	16,820	*	*	90.6
Industry-administered FFRDCs	995	*	995	*	*	0.4
Federal government	12,037	0	12,037	0	0	5.4
U&C	2,010	151	958	708	192	0.9
U&C-administered FFRDCs	2,236	*	2,236	*	*	1.0
Other nonprofit organizations	2,242	284	409	*	1,549	1.0
Nonprofit-administered FFRDCs	1,403	*	1,403	*	*	0.6
Percent distribution by source	100.0	83.2	15.7	0.3	0.8	na

FFRDC = federally funded research and development center; U&C = universities and colleges; na = not applicable; \* = small to negligible amount, included as part of the funding provided by other sectors.

NOTES: Some figures for 2007 are estimates or based on incomplete source data and are subject to further revision. Funding for FFRDC performance is chiefly federal, but any nonfederal support is included in the federal figures. State and local government support to industry are included in industry support for industry performance. State and local government support to U&C 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).

FIGURE 4. U.S. R&amp;D share of gross domestic product: 1953–2007



GDP = gross domestic product.

<sup>a</sup> Figures for 2007 are estimates.

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

## International Comparisons

Overall R&D spending by the United States continues to far exceed that of all other countries (table 3). Nevertheless, several nations report R&D/GDP ratios that are above the current U.S. level.<sup>4</sup>

The United States continues to account for somewhat more than half of the total annual R&D expenditures by the Group of Seven (G-7) industrial countries (of which the United States is a member). U.S. R&D expenditures are some 40% larger than the total for the 27 countries of the European Union. Among the 30 nations who are members of the Organization for Economic Co-operation and Development (OECD), U.S. R&D expenditures annually are about 2½ times larger than Japan's (the second ranked country) and more than 5 times that of Germany (the third largest). While fast growing in recent years, China's annual expenditures on R&D are only a quarter of the U.S. level.

The U.S. R&D/GDP ratio in 2006 was 2.62%.<sup>5</sup> This ratio was well ahead of the overall ratio for the main country groupings for the same year: G-7, 2.50%; European Union-27, 1.76%; OECD, 2.26%.

Several individual OECD countries continue to exceed the U.S. R&D/GDP ratio: Finland, 3.41%; Japan, 3.39%; Iceland, 2.78%; South Korea, 3.23%; Sweden, 3.73%; and Switzerland, 2.90%. Among the non-OECD countries tracked, Israel is by far the highest at 4.65%. Across all these countries, however, only Japan's R&D is a sizable fraction of the U.S.'s annual R&D spending.

## Data Sources and Availability

The U.S. R&D statistics presented in this report result from adding up the R&D performance for all sectors of the economy for which information can reasonably be assembled. The data come chiefly from NSF's national surveys of R&D expenditures. Estimates are used where the surveys do not yet provide final data for 2007.

The NSF R&D expenditure surveys utilized are: the Survey of Industrial Research and Development, 2006; the Survey of Federal Funds for Research and Development, FY 2005–07; the Survey of Research and Development Expenditures at Colleges and Universities, FY 2006; and the Survey of Research and Development Funding and Performance by Nonprofit Organizations, 1996–97.

TABLE 3. International comparisons of gross domestic expenditures on R&amp;D and R&amp;D share of gross domestic product, by country/economy: 2004–07 (most recent year available)

Country/economy	GERD (millions PPP\$)	GERD/GDP (%)	Country/economy	GERD (millions PPP\$)	GERD/GDP (%)
United States (2006)	343,747.5	2.62	Denmark (2006)	4,651.6	2.43
G-7 countries (2006)	667,911.1	2.50	Norway (2006)	3,686.2	1.52
European Union-27 (2006)	242,815.6	1.76	Czech Republic (2006)	3,489.1	1.54
OECD, All (2006)	817,768.9	2.26	Poland (2006)	3,110.0	0.56
Japan (2006)	138,782.1	3.39	Ireland (2007)	2,490.4	1.33
Germany (2006)	66,688.6	2.53	Portugal (2006)	1,839.5	0.83
France (2006)	41,436.2	2.11	Hungary (2006)	1,831.3	1.00
South Korea (2006)	35,885.8	3.23	Greece (2006)	1,734.6	0.57
United Kingdom (2006)	35,590.8	1.78	New Zealand (2005)	1,189.3	1.16
Canada (2007)	23,838.9	1.89	Luxembourg (2006)	542.1	1.47
Italy (2005)	17,827.0	1.09	Slovak Republic (2006)	467.1	0.49
Spain (2006)	15,595.7	1.20	Iceland (2005)	293.0	2.78
Sweden (2006)	11,815.3	3.73	Selected other countries/economies:		
Australia (2004)	11,698.1	1.78	China (2006)	86,758.2	1.43
Netherlands (2006)	9,959.0	1.67	Russian Federation (2006)	20,154.9	1.08
Austria (2007)	7,865.3	2.52	Taiwan (2006)	16,552.9	2.58
Switzerland (2004)	7,479.2	2.90	Israel (2006)	7,985.1	4.65
Belgium (2006)	6,472.4	1.83	Singapore (2006)	4,782.5	2.31
Finland (2007)	6,283.3	3.41	South Africa (2005)	3,654.3	0.92
Mexico (2005)	5,919.0	0.50	Argentina (2006)	2,317.9	0.49
Turkey (2006)	4,883.7	0.76	Romania (2006)	1,066.8	0.45
			Slovenia (2006)	784.1	1.59

GDP = gross domestic product; GERD = gross domestic expenditure on R&D; OECD = Organisation for Economic Co-operation and Development (includes the United States and other listed countries); G-7 countries = the Group of Seven industrialized countries, which includes Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States; European Union-27 = Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, the Netherlands, and the United Kingdom.

NOTES: Date of latest available year in parentheses. Figure for Israel is civilian R&D only.

SOURCES: OECD, Main Science and Technology Indicators (2008/1).

Data from the surveys based on fiscal years (i.e., the Survey of R&D Expenditures at Colleges and Universities and the Survey of Federal Funds for R&D) are converted to calendar year figures to provide a consistent annual basis for the national R&D estimates.

The Industrial R&D Survey provides data through 2006. R&D expenditure figures for 2007 are estimates based on the preliminary data for that year reported by the companies in the survey. Estimates for university and college R&D expenditures in 2007 are based on early results from the 2007 Survey of R&D Expenditures at Colleges and Universities.

Data on federal funding for R&D reported here are based on surveys of organizations that conduct R&D,

such as companies, universities, and federally funded research and development centers. These amounts differ substantially from the R&D that federal agencies report funding. The National Academies' Committee on National Statistics (CNSTAT) has recommended that NSF publish an annual reconciliation of estimates for federal R&D funding as reported by performers of R&D and as reported by federal agencies.

For FY 2007, federal agencies reported obligating \$112.8 billion in total R&D to all R&D performers (\$46.5 billion, or 41%, to industry), compared with an estimated \$98.3 billion in federal funding reported by the performers of R&D. Although NSF has not found a definitive explanation for this divergence, CNSTAT notes that comparing federal outlays (as opposed to

obligations) for R&D to performer expenditures results in a smaller discrepancy. For FY 2007, federal agencies reported R&D outlays of \$106.3 billion to all R&D performers.

A full set of detailed statistical tables associated with the National Patterns estimates will be available in the report, *National Patterns of Research and Development Resources, 2007*, accessible at <http://www.nsf.gov/statistics/natlpatterns/>.

For further information, contact the author.

### Notes

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2. In its current classification system, NSF identifies several different R&D performers: industry, federal agency intramural R&D facilities, federally funded R&D centers (FFRDCs—with management by industry, universities/colleges, or nonprofit organizations),

universities and colleges, and other nonprofit organizations. With regard to R&D funding, NSF identifies industry, the federal government, other nonfederal government agencies, universities and colleges, and other nonprofit organizations.

3. \$13.9 billion is the sum of the expenditure figures listed in table 1 for industry-administered FFRDCs, university & college-administered FFRDCs, and nonprofit-administered FFRDCs.

4. The data cited in this section come from the current edition of the OECD's *Main Science and Technology Indicators* (Volume 2008/1). NSF and other U.S. statistical agencies provide data to the OECD in support of these international comparative statistics. However, there are some minor differences in the NSF and OECD approaches to totaling national R&D expenditures. As such, the NSF and OECD calculations of R&D/GDP ratios often differ slightly. Also, to provide a consistent basis for comparison, the OECD converts national currency figures to dollars based on purchasing power parities.

5. The most recent year for the OECD's calculation of the R&D/GDP ratio for the United States is 2006.

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