

EXPENDITURES FOR U.S. INDUSTRIAL R&D CONTINUE TO INCREASE IN 2005; R&D PERFORMANCE GEOGRAPHICALLY CONCENTRATED

by Raymond M. Wolfe

Companies spent \$226 billion in current-year dollars on research and development (R&D) performed in the United States during 2005 compared with \$208 billion in 2004 (table 1), according to estimates from the Survey of Industrial Research and Development.¹ In inflation-adjusted (2000) dollars, 2005 R&D expenditures increased \$10.3 billion or 5.4% from 2004 levels. Funding from both the company's own and other nonfederal sources (hereafter, company or company and other funding) and from federal sources for R&D were higher in 2005 than in 2004. Company funding during 2005 amounted to \$204 billion in current-year dollars compared with \$188 billion during 2004, and federal funding amounted to \$22 billion during 2005 compared with \$20 billion during 2004. After adjusting for inflation, company-funded R&D increased 5.4%, and federally funded R&D increased 4.9%.

R&D Performance by Industrial Sector

In 2005, companies in manufacturing industries performed \$158 billion of R&D, which accounted for 70% of all industrial R&D performed in the United States; companies in nonmanufacturing industries performed \$68 billion of R&D (table 2). Manufacturers performed

\$143 billion of company-funded R&D and \$16 billion of federally funded industrial R&D; companies in the nonmanufacturing industries performed \$62 billion and \$6 billion, respectively. Other company and federally funded R&D costs by detailed industry are given in table 2 (see Data Notes for information on industry classification).

Sales and Employment of R&D Performers

Domestic net sales (see table 1 for definition) of companies that performed R&D in the United States were \$5.6 trillion in 2004 and \$6.1 trillion in 2005. The R&D-to-sales ratio was 3.7% in 2005, as it was in 2004. Domestic employment during 2005 was 16.0 million (table 3), compared with 14.8 million reported in 2004 (National Science Foundation 2007a). The number of full-time equivalent scientists and engineers who performed industrial R&D was 1.1 million in 2004 and 2005. Other sales and employment estimates by detailed industry are given in table 3.

R&D Funds and Company Size

Small-to-medium sized companies, those with fewer than 25,000 employees, performed 62% of industrial R&D in the United States during 2005 (table 4). More specifically, companies with at least 5 but fewer than 500 employees reported 9% of sales of R&D-performing firms, while performing 18% of all industrial R&D and employing 24% of the scientists and engineers who worked on R&D. Large firms with 25,000 or more

¹ *Company* is defined as a business organization of one or more establishments under common ownership or control. The Survey of Industrial Research and Development is conducted jointly by the National Science Foundation (NSF) and the U.S. Bureau of the Census. All estimates from the survey are subject to both sampling and nonsampling errors (see technical notes in the annual reports at <http://www.nsf.gov/statistics/industry/>).



TABLE 1. Funds expended for industrial R&D performance, by source of funds and size of company: 2004 and 2005

Selected characteristic	2004	2005	2004	2005
	Current \$millions		2000 constant \$millions	
Total industrial R&D performance	208,301	226,159	190,356	200,609
Source of funds				
Company and other nonfederal	188,035	204,250	171,836	181,175
Federal	20,266	21,909	18,520	19,434
Size of company (number of employees)				
5–24	6,295	7,373	5,753	6,540
25–49	5,906	7,488	5,397	6,642
50–99	6,456	7,144	5,900	6,337
100–249	11,045	10,327	10,093	9,160
250–499	8,380	8,149	7,658	7,228
500–999	10,821	13,992	9,889	12,411
1,000–4,999	31,475	34,969	28,763	31,018
5,000–9,999	18,191	18,170	16,624	16,117
10,000–24,999	31,208	33,564	28,519	29,772
25,000 or more	78,523	84,983	71,758	75,382
Domestic net sales ^a	5,601,729	6,119,133	5,119,147	5,427,843

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

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

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development: 2004 and 2005.

employees reported 42% of sales, performed 38% of all R&D, and employed 29% of R&D scientists and engineers. Other R&D costs and sales and employment estimates by size of company are given in table 4.

R&D Performance by State

During 2005, the top 10 states accounted for two-thirds of the industrial R&D performed in the United States. Companies in California, Michigan, Massachusetts, New Jersey, Texas, Washington, Illinois, New York, Pennsylvania, and Connecticut (listed by decreasing level) reported aggregate R&D expenditures of \$152 billion (table 5). California alone accounted for 22% of the U.S. industrial R&D total.

The types of companies that carry out R&D vary considerably among the top 10 states, reflecting regional specialization or clusters of industrial activity.

For example, the motor vehicles industry accounted for 74% of Michigan's industrial R&D in 2005, whereas it accounted for only 5% of the nation's total industrial R&D (National Science Foundation 2007b).

The computer and electronic products manufacturing industries accounted for 19% of the nation's total industrial R&D, but they accounted for a larger share of the industrial R&D in Massachusetts (41%), Texas (38%), Illinois (38%), and California (33%) in 2005. These states have clearly defined regional centers of high-technology research and manufacturing: Route 128 and Cambridge in Massachusetts; the Silicon Hills of Austin, Texas; Champaign County in Illinois; and Silicon Valley in California. Over 70% of R&D performed in the United States by computer and electronic products companies in 2005 was located in these four states, representing 14% of all industrial R&D nationwide.

TABLE 2. Funds for industrial R&D performed in the United States, by source, by industry: 2005
(Millions of dollars)

Industry	NAICS codes	All R&D	Federal	Company and other
All industries	21-23, 31-33, 42, 44-81	226,159	21,909	204,250
Manufacturing industries	31-33	158,190	15,635	142,555
Food	311	2,716	6	2,710
Textiles, apparel, and leather	313-16	816	5	811
Paper, printing, and support activities	322, 323	D	D	2,451
Petroleum and coal products	324	D	D	1,442
Chemicals	325	42,995	169	42,826
Basic chemicals	3251	2,277	98	2,179
Resin, synthetic rubber, fibers, and filament	3252	2,294	15	2,280
Pharmaceuticals and medicines	3254	34,839	41	34,798
Other chemicals	other 325	3,584	15	3,569
Plastics and rubber products	326	1,760	12	1,747
Fabricated metal products	332	1,375	52	1,323
Machinery	333	8,531	109	8,422
Computer and electronic products	334	D	D	42,463
Computers and peripheral equipment	3341	4,955	53	4,902
Communications equipment	3342	D	D	9,660
Semiconductor and other electronic components	3344	18,724	122	18,602
Navigational, measuring, electromedical, and control instruments	3345	15,204	6,879	8,325
Other computer and electronic products	other 334	997	23	974
Electrical equipment, appliances, and components	335	2,424	103	2,322
Transportation equipment	336	D	D	28,321
Motor vehicles, trailers, and parts	3361-63	D	D	16,025
Aerospace products and parts	3364	15,005	4,076	10,928
Other transportation equipment	other 336	D	D	1,368
Miscellaneous manufacturing	339	5,143	82	5,061
Medical equipment and supplies	3391	4,374	31	4,343
Other miscellaneous manufacturing	other 339	769	51	718
Other manufacturing	312, 321, 327, 331, 337	D	D	64,351
Nonmanufacturing industries	21-23, 42, 44-81	67,969	6,274	61,695
Wholesale trade	42	D	D	2,144
Retail trade	44, 45	D	D	1,285
Information	51	23,836	219	23,617
Publishing, including software	511	17,747	60	17,687
Telecommunications	517	2,539	0	2,539
Internet service and data processing providers	518	3,337	159	3,178
Other information	other 51	213	0	213
Finance, insurance, and real estate	52, 53	3,030	0	3,030
Professional, scientific, and technical services	54	32,021	5,839	26,181
Architectural, engineering, and related services	5413	4,687	2,239	2,448
Computer systems design and related services	5415	13,592	545	13,046
Scientific R&D services	5417	12,299	2,826	9,473
Other professional, scientific, and technical services	other 54	1,444	229	1,214
Health care services	621-23	989	7	981
Other nonmanufacturing	21-2, 48-9, 55-6, 61, 624, 71-2, 81	D	D	4,457

D = suppressed to avoid disclosure of confidential information.

NOTES: Detail may not add to total because of rounding. Excludes data for federally funded research and development centers.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development: 2005.

TABLE 3. Sales and employment for companies performing industrial R&D in the United States, by industry: 2005

Industry	NAICS codes	Domestic net	Domestic	R&D scientists
		sales	employment ^a	and engineers ^b
		\$millions	Thousands	
All industries	21-23, 31-33, 42, 44-81	6,119,133	16,032	1,097.7
Manufacturing industries	31-33	3,998,256	9,436	695.8
Food	311	374,342	995	11.8
Textiles, apparel, and leather	313-16	51,639	204	7.8 i
Paper, printing, and support activities	322, 323	159,608	421	D
Petroleum and coal products	324	404,317	164	D
Chemicals	325	624,344	1,074	118.0
Basic chemicals	3251	109,899	167	9.8
Resin, synthetic rubber, fibers, and filament	3252	132,934	110	8.4
Pharmaceuticals and medicines	3254	273,377	482	81.1
Other chemicals	other 325	108,134	314	18.7
Plastics and rubber products	326	90,176	377	11.0
Fabricated metal products	332	174,165	626	16.7
Machinery	333	230,941	832	59.6
Computer and electronic products	334	472,330	1,253	262.5
Computers and peripheral equipment	3341	91,010	158	33.1
Communications equipment	3342	69,115	155	50.4
Semiconductor and other electronic components	3344	176,054	444	92.4
Navigational, measuring, electromedical, and control instruments	3345	118,648	454	81.6 i
Other computer and electronic products	other 334	17,503	43	5.0
Electrical equipment, appliances, and components	335	101,398	321	17.9
Transportation equipment	336	957,051	1,972	135.0
Motor vehicles, trailers, and parts	3361-63	646,486	1,019	83.9 i
Aerospace products and parts	3364	227,271	639	41.5 i
Other transportation equipment	other 336	83,294	315	9.5
Miscellaneous manufacturing	339	83,103	338	21.7
Medical equipment and supplies	3391	56,661	220	16.1
Other miscellaneous manufacturing	other 339	26,442	118	5.6
Other manufacturing	312, 321, 327, 331, 337	274,842	859	D
Nonmanufacturing industries	21-23, 42, 44-81	2,120,877	6,596	401.9
Wholesale trade	42	107,485	247	19
Retail trade	44, 45	232,150	608	D
Information	51	445,489	1,493	134.2
Publishing, including software	511	103,609	381	98.7
Telecommunications	517	258,953	714	10.2
Internet service and data processing providers	518	36,493	149	23.8
Other information	other 51	46,434	249	1.5
Finance, insurance, and real estate	52, 53	580,380	1,265	30.2
Professional, scientific, and technical services	54	261,500	1,182	170.6
Architectural, engineering, and related services	5413	50,121	221	30.1
Computer systems design and related services	5415	136,376	660	90.3
Scientific R&D services	5417	34,516	129	42.7
Other professional, scientific, and technical services	other 54	40,487	172	7.6
Health care services	621-23	25,076	93	4.7
Other nonmanufacturing	21-2, 48-9, 55-6, 61, 624, 71-2, 81	468,797	1,708	D

D = suppressed to avoid disclosure of confidential information.

i = more than 50% of the value is imputed.

^a Data recorded on March 12, 2005, represent employment figures for the current year.

^b Data recorded in January 2006 represent employment figures for the previous year.

NOTES: Detail may not add to total because of rounding. Excludes data for federally funded research and development centers.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development: 2005.

The R&D of chemicals manufacturing companies is particularly prominent in New Jersey, Pennsylvania, and Connecticut, all of which host robust pharmaceutical and chemical industries. Together these three states represented over 40% of the nation's R&D in this sector in 2005.

The R&D services sector is even more concentrated geographically, with California and Massachusetts accounting for over 40% of R&D in this sector. This sector consists largely of biotechnology companies, contract research organizations, and early-stage technology firms. These companies maintain strong ties to the academic sector and often are located near large research universities.

The R&D performance by small companies (defined as having from 5 to 499 employees²) is also concentrated geographically. Nationally, small companies performed 18% of the nation's total industrial R&D in 2005, but in California, Massachusetts, and New York small companies performed between 19% and 22% of each state's industrial R&D. About 39% of the industrial R&D performed in the United States by small companies was performed in these three states.

Data Notes

Estimates in this *InfoBrief* were derived from the annual Survey of Industrial Research and Development. The survey is cosponsored by the National Science Foundation and the U.S. Census Bureau, and Census is the collection and tabulation agent for the survey. The survey is a nationally representative sample of all for-profit companies, publicly or privately held and with five or more employees that performed R&D within the 50 United States and the District of Columbia. Approximately 32,000 companies are surveyed each year and the overall response rate is approximately 80%.³ The primary focus of the survey is U.S. industry as a performer of research and development rather than as a source of funds. Beginning in 1989, the amount of federally funded R&D reported by performers began to diverge from the amount reported by federal agen-

cies. For 2005, federal agencies reported obligations of \$109.2 billion and outlays of \$100.3 billion in total R&D to all R&D performers and obligations of \$43.5 billion to industrial R&D performers. These totals compare with \$94.6 billion in federal funding reported by all performers of R&D and with \$22.0 billion reported by industrial R&D performers. 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 (National Research Council 2005).

Beginning in the late 1990s, increasingly large amounts of R&D were attributed to the wholesale trade industries, resulting from the payroll-based methodology used to assign industry classifications and the change from the standard industrial classification (SIC) system to the North American Industrial Classification System (NAICS) in 1999. Such classification artifacts were of particular concern for companies traditionally thought of as pharmaceutical or computer-manufacturing firms. As these firms increasingly marketed their own products and more of their payroll involved employees engaged in selling and distribution activities, the potential for the companies to be classified among the wholesale trade industries increased. To improve the relevance and usefulness of the industrial R&D statistics, NSF evaluated ways to ameliorate the negative effects of the industry classification methodology and classification system change. Beginning in 2004, in addition to firms originally assigned NAICS codes among the wholesale trade (NAICS 42) industries, firms in the information (NAICS 51); professional, scientific, and technical services (NAICS 54); and management of companies and enterprises (NAICS 55) industries using the payroll-based methodology were manually reviewed by NSF and Census. These firms were reclassified based on primary R&D activity, which in most cases corresponded to their primary products or service activities. The result was that most of the R&D previously attributed to NAICS 42 and 55 industries was redistributed. For detailed information, see National Science Foundation 2007c.

References

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² For most manufacturing industries, the U.S. Small Business Association defines a small company as having fewer than 500 employees. The Survey of Industrial Research and Development does not sample companies with fewer than five employees because of concerns about respondent burden.

³ For more detailed information about the survey sample and methodology, see: <http://www.nsf.gov/statistics/srvyindustry/>.

TABLE 4. Funds for industrial R&D, sales, and employment for companies performing industrial R&D in the United States, by company size: 2005

Company size (employees)	Funds					
	All R&D	Federal	Company and other	Domestic net sales	Domestic employment ^a	R&D scientists and engineers ^b
	\$millions				Thousands	
All companies	226,159	21,909	204,250	6,119,133	16,032	1,097.7
5-24	7,373	1,076	6,297	72,744	245	66.4
25-49	7,488	675	6,813	77,898	300	45.9
50-99	7,144	646	6,498	83,685	335	44.7
100-249	10,327	951	9,375	157,088	655	58.0
250-499	8,149	411	7,738	157,726	576	45.8
500-999	13,992	895	13,097	295,203	830	69.3
1,000-4,999	34,969	1,364	33,605	963,025	2,863	180.1
5,000-9,999	18,170	620	17,550	703,009	1,554	91.1
10,000-24,999	33,564	1,918	31,646	1,030,880	2,260	180.9
25,000 or more	84,983	13,352	71,631	2,577,876	6,413	315.6

^a Data recorded on March 12, 2005, represent employment figures for the current year.

^b Data recorded in January 2006 represent employment figures for the previous year.

NOTES: Detail may not add to total because of rounding. Excludes data for federally funded research and development centers.

SOURCE: National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2005.

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The full set of detailed tables from this survey will be available in the report *Survey of Industrial Research and Development, 2005* at <http://www.nsf.gov/statistics/industry/>. Individual detailed tables from the 2005 survey are available in advance of publication of the full report. For further information, contact

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TABLE 5. Funds for industrial R&D performed in the United States, by state, by source of funds: 2005

(Millions of dollars)

State	All R&D	Federal	Company and other	State	All R&D	Federal	Company and other
United States	226,159	21,909	204,250	Montana	77 i	6 i	71 i
Alabama	1,417	719	698	Nebraska	407	7 e	400
Alaska	32 e	2 e	30 e	Nevada	382	17 e	365
Arizona	2,980	269	2,711	New Hampshire	1,435	D	D
Arkansas	271	8 e	262	New Jersey	13,214	311	12,902
California	50,683	5,065 i	45,618	New Mexico	405	128	278
Colorado	4,299	131	4,168	New York	9,474	654	8,819
Connecticut	7,885	1,443	6,442	North Carolina	5,158	107	5,051
Delaware	1,511	21	1,490	North Dakota	104	D	D
District of Columbia	166	73	93 e	Ohio	5,900	455	5,445
Florida	4,164	1,190	2,974	Oklahoma	422	20	401
Georgia	2,282	56 e	2,226	Oregon	3,252	30	3,223
Hawaii	168	46	122	Pennsylvania	8,846	205 e	8,640
Idaho	642	7	635	Rhode Island	1,387 i	D	D
Illinois	9,712	205	9,506	South Carolina	1,402	38 i	1,364
Indiana	4,610 i	283	4,327 i	South Dakota	68	2 e	66
Iowa	1,039	10 e	1,029	Tennessee	1,246	96	1,150
Kansas	1,993 i	D	D	Texas	12,438	858	11,579
Kentucky	660	11 e	650	Utah	1,234	197	1,036
Louisiana	300	22	278	Vermont	360	22	338
Maine	350	20 i	331	Virginia	4,379	1,696 i	2,683
Maryland	3,706	1,254	2,452	Washington	9,736	181	9,555
Massachusetts	13,342	2,554 i	10,788	West Virginia	242	D	D
Michigan	16,752	204	16,548	Wisconsin	2,729	69	2,660
Minnesota	6,340	287	6,053	Wyoming	30	1 e	29
Mississippi	194	47	147	Undistributed funds ^a	3,731 i	96	3,636 i
Missouri	2,602	79	2,523				

D = data withheld to avoid disclosing operations of individual companies.

e = more than 50% of the cell value is imputed due to raking of state data.

i = more than 50% of the cell value is imputed.

^a Includes data reported on Form RD-1 not allocated to a specific state. Data reported on the Form RD-1A, the questionnaire sent to small companies or companies new to the survey, were allocated to the state in the address on the company's survey form, which is usually the company's headquarters.

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

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development: 2005.

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