National Patterns of Research and Development Resources: 2003

Special Report

Division of Science Resources Statistics
Directorate for Social, Behavioral, and Economic Sciences

National Science Foundation

February 2005

DIVISION OF SCIENCE RESOURCES STATISTICS

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CONTENTS

Page

Page

List of Sidebars

Page

LIST OF TABLES

LIST OF FIGURES

General Notes

The National Science Foundation (NSF) sponsors a series of surveys to collect information about the financial and human resources devoted to research and development (R&D). In this report, NSF survey data on various sectors of the U.S. economy—industry, government, and academia—and on selected nonprofit organizations are aggregated so that the components of the overall R&D effort are placed in a national context. Information presented in this report and other *National Patterns* reports includes the following:

- Level of R&D expenditures
- Sources of R&D funds
- Sector or organization performing R&D
- Character of work undertaken (i.e., whether it is basic research, applied research, or development)
- States in which R&D is undertaken in the United States
- International R&D comparisons

The national totals reported here incorporate data available from several NSF Division of Science Resources Statistics (SRS) surveys as of October 2003 as well as projections to cover the entire year.[1] This report, including the appendix tables, is available on the Internet at http://www.nsf.gov/statistics/natlpatterns/.

These notes introduce the main concepts used in the report. Important changes and revisions from previous *National Patterns* reports also are highlighted. More technical information as to how the various surveys' data are combined to produce national R&D estimates is presented in appendix A and in the forthcoming *National Patterns of Research and Development Resources: Methodology Report.*

Performer-Reporting Basis

SRS annually surveys Federal Government agencies, industry, and academia. Respondents in each sector indicate the amounts they spend on R&D in their own sector and the sources of these funds. National historical totals are based on data reported by performers because they are in the best position to (1) indicate how much they spent in the actual conduct of R&D in a given year, (2) classify their R&D by character of work, and (3) identify the sector of the economy in which their financing originated. The consistent use of performer reporting reduces the possibility of double-counting R&D expenditures and conforms to international standards and guidance.

There are exceptions to the use of performer-reported data. The last complete survey of the nonprofit sector was conducted in 1999 for activity undertaken in 1996 and 1997. Estimates of R&D performance by nonprofit organizations reported here are generally based on (1) Federal agency reporting of Federal funding of the nonprofit sector and (2) R&D performance trends in the other non-Federal sectors. Between 1973 and 1999, large R&D-performing nonprofit organizations were contacted periodically to inform NSF's estimation procedures.

In addition, NSF sponsors only occasional surveys of state government agencies; the last two surveys covered fiscal year (FY) 1987–88 and FY 1995–96. Consequently, the national R&D time-series totals exclude estimates of state agencies' intramural R&D performance. State funds for R&D performed and reported by other sectors of the economy, however, are included in the respective R&D performance totals.

One byproduct of the decision to use performer-reported data is that the federally funded R&D performance totals presented in *National Patterns* reports differ from the Federal R&D funding totals reported by the Federal agencies that provide the funds. One reason for these differences is that performers of R&D often expend Federal funds in a year other than the one in which the Federal Government provides *authorization*, *obligations*, or *outlays* (for definitions of these terms, see sidebar "Definitions of R&D" and appendix A). Differences between Federal R&D funding reported by performers and by funding agencies are documented in the sidebar "Tracking R&D: Gap Between Performer- and Source-Reported Expenditures."

Projections

Although respondents are continually given the opportunity to revise prior data, the R&D totals for 2001 reported here are considered actual expenditures. Data reported for 2002 and 2003 are preliminary, in the sense

[1]Data sources for this report are detailed in appendix A.

that 2002 data are based on preliminary reporting of information, and 2003 data are projections based on information available when this report was written.

For Federal agencies, preliminary estimates of obligations for R&D are available for FY 2002 and FY 2003, and budgetary data for FY 2004 are available in the Bush administration's 2004 budget proposal. These various sources of data are used to estimate Federal R&D performance for calendar years 2002 and 2003.

R&D performance estimates for 2002 and 2003 for the other sectors of the economy are derived on the basis of three types of information: (1) survey information submitted early by some of the responding institutions, allowing for a preliminary estimate of what the aggregate results will be once all survey responses are received; (2) responses by performers to questions about their future plans; and (3) statistical regression and time-series modeling techniques based on observed patterns of R&D expenditures by performers. The precise methodologies used for estimation are explained in the forthcoming *National Patterns of Research and Development Resources: Methodology Report*.

Calendar-Year Basis for All Data

Unless otherwise noted, this report presents all data, regardless of sector, in terms of calendar years. *National Patterns* reports before 1998 provided a combination of fiscal-year expenditures for governmental and academic R&D and calendar-year expenditures for industrial R&D and R&D performed by other nonprofit organizations. Aggregates of these amounts were then taken, reflecting neither precise fiscal-year nor calendar-year definitions but a general combination of both. Therefore, for greater consistency and clarity in measurement, and for ease of calculation (especially in adjustments for inflation), all R&D levels for all performers have since been converted to calendar years. However, detailed data for Federal agencies, federally funded research and development centers, and academic institutions refer to fiscal years, as do data on the budget authority of the Federal Government. The use of fiscal-year data is noted in the text.

HIGHLIGHTS

NATIONAL R&D TRENDS

- Research and development (R&D) expenditures in the United States are projected to reach $284 billion in 2003, up slightly from an estimated $276 billion in 2002.
- Industry performed a projected $194 billion of R&D in 2003, or 68 percent of the national total. Industry was also the largest source of R&D funding, paying for 63 percent of all R&D. Nearly all (98 percent) of these funds flowed to industry; the remainder financed R&D at universities, colleges, and nonprofit organizations.
- In the industrial sector in 2001, computer and electronic products manufacturing performed 24 percent ($47 billion) of all industrial R&D. The next largest industrial sector, transportation equipment, performed $26 billion in R&D in 2001. Nonmanufacturing industries associated with software and computer-related services performed between $24 billion and $25 billion of R&D in 2001.
- Universities and colleges performed a projected $40 billion of R&D in 2003, or 14 percent of the national total. However, universities and colleges performed the majority (55 percent) of all basic research.
- In 2001 California had the highest level of R&D expenditures among all states, $51 billion. However, the ratio of R&D to gross state product was highest in New Mexico at 7.1 percent compared with 3.8 percent in California.

FEDERAL R&D PERFORMANCE AND SUPPORT

- Federal R&D support expanded from $66 billion to a projected $85 billion between 2000 and 2003 as reported by performers of R&D. This growth increased the Federal R&D support share of total U.S. R&D from 25 to 30 percent. In contrast, Federal agencies and federally funded research and development centers performed only 13 percent of U.S. R&D in 2003.
- In fiscal year (FY) 2003 the Department of Defense is estimated to have obligated the most funds among Federal agencies for R&D support—$45 billion, or 46 percent of all Federal R&D obligations. The Department of Health and Human Services obligated the second largest amount in R&D support ($28 billion), followed by the National Aeronautics and Space Administration ($9 billion), the Department of Energy ($8 billion), and the National Science Foundation ($3 billion).
- The budget allocation for counterterrorism-related R&D increased dramatically between FY 2001 and FY 2003 from $0.6 to $2.7 billion. Most of this budget now falls under the aegis of the National Institutes of Health and the newly formed Department of Homeland Security.

INTERNATIONAL COMPARISONS OF NATIONAL R&D TRENDS

- The United States accounts for approximately 44 percent of total R&D expenditures in all Organisation for Economic Co-operation and Development (OECD) countries combined. R&D investments in the United States are 2.7 times greater than R&D investments made by Japan, the second largest performer. In 2000 the United States spent more on R&D activities than all other "group of seven" (G-7) countries (Canada, France, Germany, Italy, Japan, and the United Kingdom) combined.
- A noteworthy trend among G-7 and other OECD countries has been the relative decline in government R&D funding over the past 2 decades. In 2000 less than 30 percent of all OECD R&D funds were derived from government sources, down considerably from the 44 percent share reported in 1981. In aggregate terms, this change reflects a decline in industrial reliance on government funds for R&D performance.
- As a result of a worldwide slowing in R&D spending during the early 1990s, the latest ratio of R&D spending to gross domestic product (R&D/GDP)

for most G-7 countries is no higher now than it was a decade ago. The United States, devoting 2.7 percent of its GDP to R&D in 2001, ranked fifth among OECD countries during the 1996–2001 period. Sweden led OECD countries at 3.8 percent of its GDP devoted to R&D, followed by Finland (3.4 percent), Japan (3.0 percent), and Iceland (2.9 percent).

- As an indication of an overall pattern of increased university-firm interactions, the proportion of academic R&D funding from industry sources (for G-7 countries combined) climbed from 2.6 percent of the academic R&D total in 1981 to 5.2 percent in 1990 and to 6.0 percent in 1999.

INTRODUCTION

Research and development (R&D) is widely recognized as being vital to economic growth and social welfare, often resulting in benefits unimagined at the time it is initiated. The resources that various organizations devote to R&D and the ends to which they devote them influence both economic growth and international competitiveness. For this reason, the United States and many other nations collect extensive R&D expenditure data for study by analysts in a variety of fields.

Although often used as a proxy for the direction and rate of technological change, R&D expenditure data more directly measure the level of economic purchasing power devoted to R&D projects in lieu of other economic activities. Industrial (private sector) funding of R&D, for example, may be considered an indicator of how important R&D is to companies because companies could just as well devote those same funds to other business activities such as advertising. Similarly, government support for R&D reflects governmental and societal commitment to scientific and technological advancement, an objective that must compete for dollars against other functions supported by discretionary government spending. The same basic idea is true for the other sectors that fund R&D: universities, colleges, and other nonprofit organizations. In effect, R&D expenditures measure the perceived economic importance of R&D relative to all other economic activities.

Information about R&D's perceived relative value is extremely useful for economic decisionmaking. For example, an increase in R&D in a particular field of study may reflect an increase in demand for scientists and engineers to study and work in that field. An increase in R&D in a particular industrial sector could be among the first signs that the sector is about to expand with new lines of products or services. Of course, R&D data alone would not be enough to analyze accurately the future growth of a field of study or an industrial sector, but it may well be an important input into any such analysis. The National Science Foundation (NSF) publishes the R&D data in this report to facilitate useful analyses of the nation's economic and social conditions that ultimately lead to better-informed decisionmaking.

NATIONAL R&D TRENDS

In the mid- to late 1990s, R&D performance in the United States surged. In real terms (constant or inflation-adjusted dollars), total R&D performance grew 40.5 percent between 1994 and 2000 at an average annual real growth rate of 5.8 percent over the period (figure 1). NSF data indicate that this growth rate was not sustained in subsequent years. After adjusting for inflation, total R&D increased 1 percent between 2000 and 2001, declined a marginal amount between 2001 and 2002, and increased 1 percent between 2002 and 2003. Total 2003 R&D performance in the United States is projected to be $283.8 billion, up from an estimated $276.4 billion in 2002 and $274.2 billion in 2001. (See sidebar, "Definitions of R&D.")

Definitions of R&D

The National Science Foundation (NSF) uses the following definitions in its research and development surveys. They have been in place for several decades and generally are consistent with international definitions.

R&D. According to international guidelines for conducting research and development (R&D) surveys, R&D, also called research and experimental development, comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.

Basic research. The objective of basic research is to gain more comprehensive knowledge or understanding of the subject under study without specific applications in mind. In industry, basic research is defined as research that advances scientific knowledge but does not have specific immediate commercial objectives, although it may be performed in fields of present or potential commercial interest.

Applied research. The objective of applied research is to gain the knowledge or understanding to meet a specific, recognized need. In industry, applied research includes investigations to discover new scientific knowledge that hasspecific commercial objectives with respect to products, processes, or services.

Development. Development is the systematic use of the knowledge or understanding gained from research directed toward the production of useful materials, devices, systems, or methods, including the design and development of prototypes and processes.

R&D plant. R&D plant includes the acquisition of, construction of, major repairs to, or alterations in structures, works, equipment, facilities, or land for use in R&D activities.

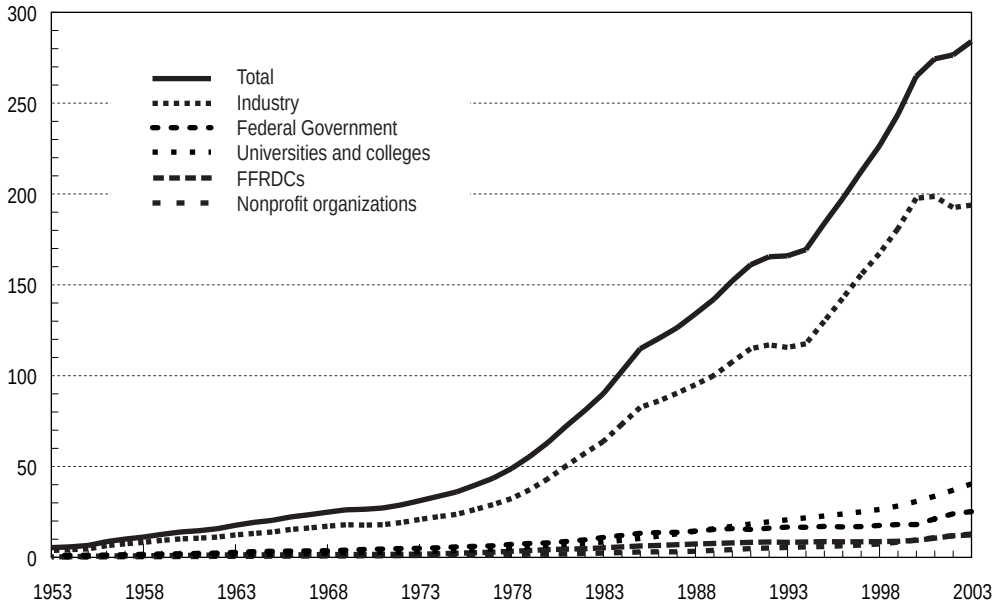
Budget authority. Budget authority is the authority provided by Federal law to incur financial obligations that will result in outlays.

Obligations. Federal obligations represent the dollar amounts for orders placed, contracts awarded, services received, and similar transactions during a given period, regardless of when funds were appropriated or payment was required.

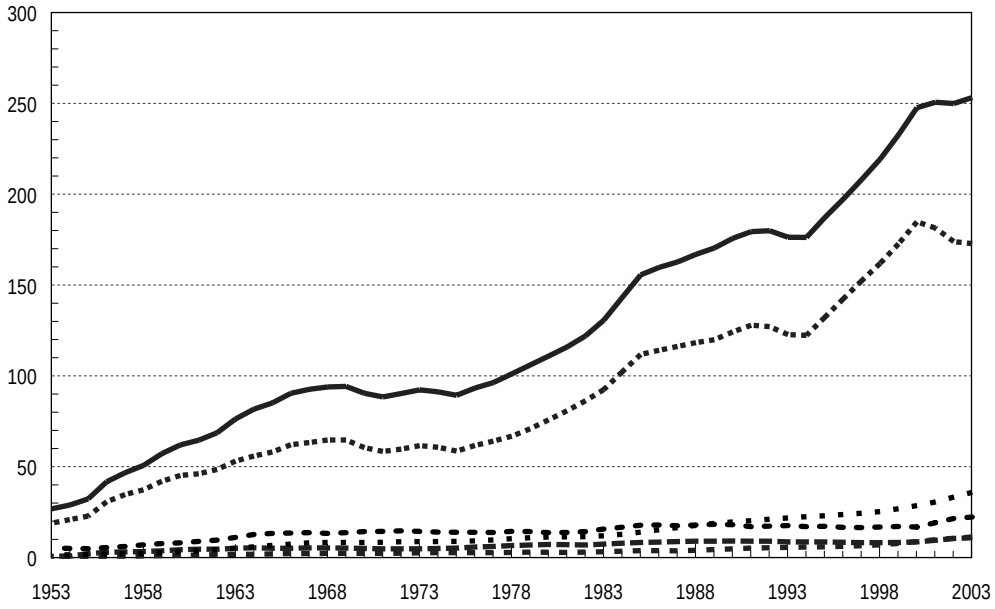
Outlays. Federal outlays represent the dollar amounts for checks issued and cash payments made during a given period, regardless of when funds were appropriated or obligated.

FIGURE 1. U.S. research and development performance, by performing sector: 1953–2003

Billions of current dollars



Billions of constant 1996 dollars



FFRDC federally funded research and development center

SOURCE: National Science Foundation, Division of Science Resources Statistics, *National Patterns of R&D Resources,* annual series. See appendix tables B-1 and B-21.

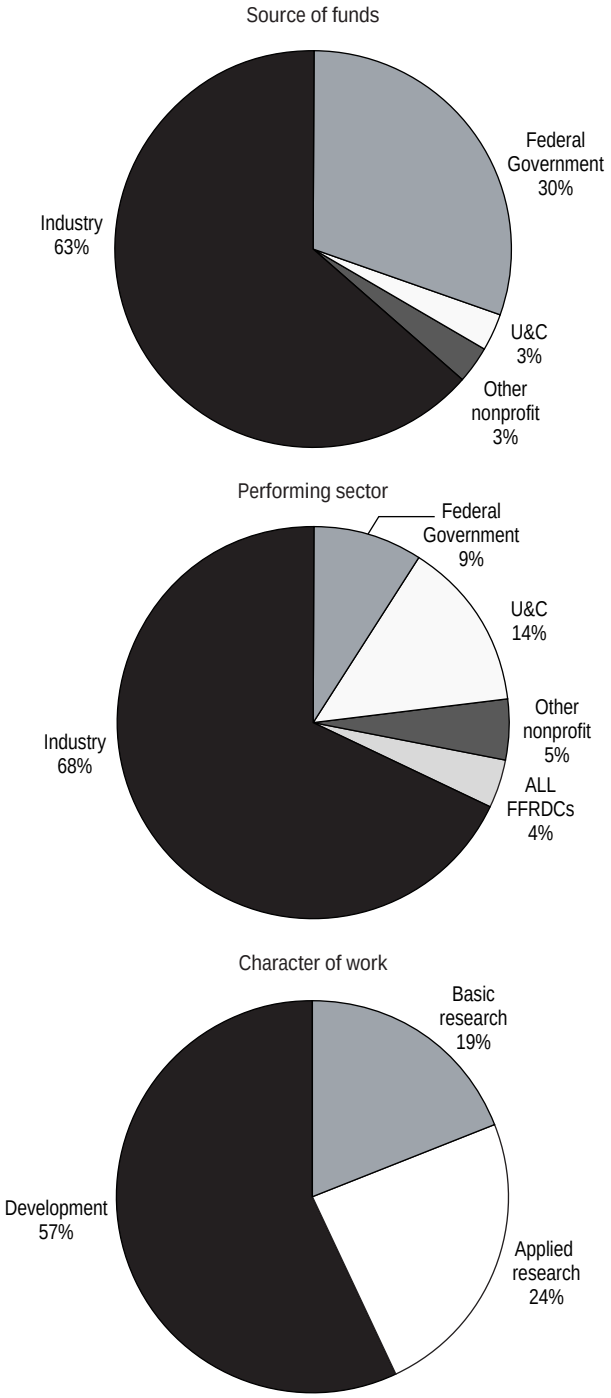
In comparison, gross domestic product (GDP), the main measure of the nation's total economic activity, grew in real terms by 3.8 percent per year between 1994 and 2000. R&D performance as a proportion of GDP rose from 2.40 percent in 1994 to 2.69 percent in 2000 as growth in R&D outpaced the growth of the overall economy. The ratio of R&D to GDP peaked in 2001 at 2.72 percent as the rate of economic growth from the late 1990s slowed. In the subsequent years, total R&D grew at a slower pace than the overall economy, resulting in R&D to GDP ratios of 2.65 percent in 2002 and 2.61 percent in 2003.[2]

Organizations that perform R&D often receive outside funding; conversely, organizations that fund R&D do not always perform all the R&D themselves. Therefore, it is useful to analyze R&D expenditure data in terms of who performed the R&D and who funded it.

Industry performs most of the nation's R&D and accounted for a projected 68.3 percent of total R&D performance in 2003.[3] Universities and colleges accounted for a projected 14.2 percent of national R&D performance in 2003, followed by the Federal Government (8.8 percent) and nonprofit institutions (4.5 percent).[4] All federally funded research and development centers (FFRDCs) combined are projected to have performed 4.3 percent of U.S. total R&D in 2003 (figures 1 and 2; table 1).

Private industry is also the largest source of R&D funding in the United States and provided a projected

FIGURE 2. Shares of U.S. research and development expenditures, by source of funds, performing sector, and character of work: 2003



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

NOTES: Figures are rounded to nearest whole number. National research and development expenditures were an estimated $284 billion in 2003.

SOURCE: National Science Foundation, Division of Science Resources Statistics, *National Patterns of R&D Resources,* annual series. See appendix tables B-1, B-3, B-5, and B-7.

[2]The estimated U.S. gross domestic product (GDP) for 2001, 2002, and 2003 in constant 1996 dollars is $9,215 billion, $9,440 billion, and $9,710 billion, respectively. See appendix table B-9.

[3]Unless otherwise noted, whenever a sector is mentioned, federally funded research and development centers (FFRDCs) are excluded. FFRDCs are R&D-performing organizations that are exclusively or substantially financed by the Federal Government either to meet a particular R&D objective or, in some instances, to provide major facilities at universities for research and associated training purposes. Each FFRDC is administered either by an industrial firm, a university, or a nonprofit institution. In some of the statistics provided in this report, FFRDCs are included as part of the sector that administers them and are so noted. In particular, statistics on the industrial sector often include industry-administered FFRDCs because for some of the statistics from the National Science Foundation (NSF) Survey of Industrial Research and Development before 2001 the FFRDC component cannot be reported separately.

[4]Recent methodological improvements have resulted in revisions from the amounts previously reported for total academic R&D expenditures. For more information, see M. Machen and B. Shackelford, *Academic R&D Spending Maintains Growth From All Major Sources in FY 2001,* NSF InfoBrief (Arlington, VA, 2003).

TABLE 1. U.S. research and development expenditures, by character of work, performing sector, and source of funds: 2003 (Projected)

Performing sector	Source of funds (millions of dollars)					Percent distribution of total expenditures
	Total	Industry	Federal Government	U&C	Other nonprofit institutions	
R&D	283,795	179,615	85,280	10,654	8,247	100.0
Industry	193,729	176,415	17,314	—	—	68.3
Industry-administered FFRDCs	2,383	—	2,383	—	—	0.8
Federal Government	24,959	—	24,959	—	—	8.8
U&C	40,262	2,123	24,499	10,654	2,986	14.2
U&C-administered FFRDCs	7,421	—	7,421	—	—	2.6
Other nonprofit institutions	12,661	1,077	6,323	—	5,261	4.5
Nonprofit-administered FFRDCs	2,381	—	2,381	—	—	0.8
Percent distribution by source	100.0	63.3	30.0	3.8	2.9	na
Basic research	54,103	9,020	32,712	7,380	4,990	100.0
Industry	7,725	6,952	773	—	—	14.3
Industry-administered FFRDCs	651	—	651	—	—	1.2
Federal Government	4,463	—	4,463	—	—	8.2
U&C	29,941	1,470	19,022	7,380	2,069	55.3
U&C-administered FFRDCs	3,625	—	3,625	—	—	6.7
Other nonprofit institutions	6,709	598	3,190	—	2,921	12.4
Nonprofit-administered FFRDCs	988	—	988	—	—	1.8
Percent distribution by source	100.0	16.7	60.5	13.6	9.2	na
Applied research	67,780	39,551	23,458	2,685	2,086	100.0
Industry	42,434	38,743	3,691	—	—	62.6
Industry-administered FFRDCs	1,040	—	1,040	—	—	1.5
Federal Government	8,837	—	8,837	—	—	13.0
U&C	8,927	535	4,954	2,685	753	13.2
U&C-administered FFRDCs	1,968	—	1,968	—	—	2.9
Other nonprofit institutions	4,215	273	2,609	—	1,333	6.2
Nonprofit-administered FFRDCs	359	—	359	—	—	0.5
Percent distribution by source	100.0	58.4	34.6	4.0	3.1	na
Development	161,911	131,042	29,109	589	1,171	100.0
Industry	143,569	130,719	12,850	—	—	88.7
Industry-administered FFRDCs	692	—	692	—	—	0.4
Federal Government	11,658	—	11,658	—	—	7.2
U&C	1,394	117	523	589	165	0.9
U&C-administered FFRDCs	1,828	—	1,828	—	—	1.1
Other nonprofit institutions	1,736	206	524	—	1,006	1.1
Nonprofit-administered FFRDCs	1,034	—	1,034	—	—	0.6
Percent distribution by source	100.0	80.9	18.0	0.4	0.7	na

na not applicable
— less than $0.5 million or less than 0.5 percent
FFRDC federally funded research and development center
R&D research and development
U&C universities and colleges

NOTES: State and local government support to industry is included in industry support for industry performance. State and local government support to U&C ($2,710 million in total R&D) is included in U&C support for U&C performance.

SOURCE: National Science Foundation, Division of Science Resources Statistics, *National Patterns of R&D Resources* (Arlington, VA, annual series). See appendix tables B-1, B-3, B-5, and B-7.

63.3 percent ($179.6 billion) of total R&D funding in 2003. Most of these funds (98.2 percent) flowed to industrial performers of R&D. The Federal Government provided the second largest share of R&D funding, 30.0 percent ($85.3 billion), with only 43.6 percent of these funds financing Federal labs and FFRDCs. The other sectors of the economy (i.e., state governments, universities and colleges, and nonprofit institutions) contributed the remaining 6.7 percent ($18.9 billion) (table 1).

Trends in R&D Performance

U.S. R&D has experienced largely uninterrupted growth over the past 50 years (figure 1). U.S. R&D performance grew in terms of current dollars each year between 1953 and 2003, even in the early 1990s when both Federal and industrial R&D funding slowed significantly[5] (figure 3). In the mid-1990s, substantial increases in industrial R&D, most notably in the computer and other information technology (IT) sectors and in small R&D-performing firms, ended a brief slowdown in national R&D growth.[6] Between 1994 and 2000, an 8.8 percent real annual growth rate in industrial support for R&D overshadowed a slight decline (–0.3 percent per year) in real Federal R&D support, resulting in overall real annual growth of 5.8 percent in U.S. R&D.

More recently, the growth of R&D investment in the United States has slowed. Preliminary data and projections indicate that although total R&D expenditures continued to rise through 2003 in current dollars, industrial R&D, which fueled the growth over the prior period, declined in 2002. This has occurred only two other times in the past 50 years—in 1970 and 1993. The business activities of many R&D-performing firms were curtailed following the stock market decline and subsequent economic slowdown of 2001 and 2002. The same sectors that saw impressive increases in the late 1990s experienced declines in sales, share prices, and R&D investment at the beginning of this decade. Economic indicators suggest modest growth in current dollar industrial R&D in 2003.

[5]These findings are based on performer-reported R&D levels. In recent years, substantial differences have been detected in data on federally financed R&D as reported by Federal funding agencies and by performers of the work (most notably, industrial firms and universities). This divergence in R&D totals is discussed in the sidebar "Tracking R&D: Gap Between Performer- and Source-Reported Expenditures."

[6]For most manufacturing industries, the U.S. Small Business Administration defines *small firm* as one with 500 or fewer employees. The share of company-financed R&D performed by these firms grew from 10 percent in 1990 to a peak of 20 percent in 1999.

Trends in Federal R&D Funding

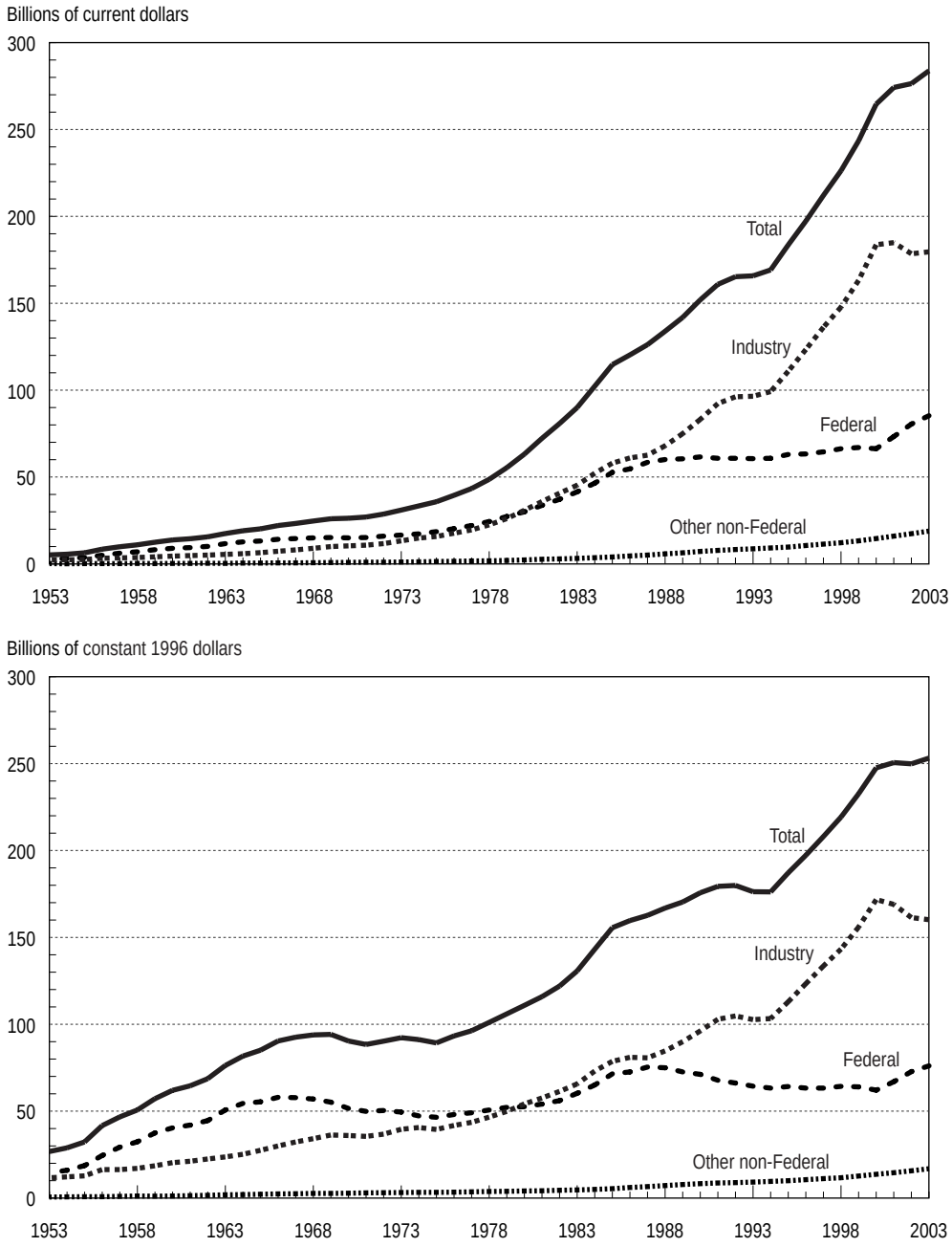
Increases in Federal R&D investment, particularly in the areas of defense, health, and counterterrorism, helped to offset languid industrial R&D performance in 2001, 2002, and 2003. These increases also reversed a decades-long trend in the shrinking share of Federal R&D funding as a percentage of the nation's total R&D (figure 4).

The Federal Government was once the main source of the nation's R&D funds, funding as much as 66.8 percent of all U.S. R&D in 1964. The Federal share first fell below 50 percent in 1979, and after 1987 it fell steadily, dropping from 46.3 percent in that year to 25.1 percent in 2000—the lowest it has ever been since the start of the time series in 1953. This sharp decline in the Federal Government share, however, should not be misinterpreted as a drastic decline in the actual amount of R&D funded (figure 3). Adjusting for inflation, Federal support decreased 18 percent from 1987 to 2000, although in nominal terms, Federal support grew from $58.5 billion to $66.3 billion during that period. Growth in industrial funding generally outpaced growth in Federal support, leading to the decline in Federal support as a proportion of the national total. The slowdown of industry's investment in R&D, as well as increases in Federal R&D funding in recent years, reversed this trend. Thus in 2003, the Federal share of R&D funding is projected to have grown to 30.0 percent.

Federal R&D Funding by National Objective

In 2003 the Federal Government funded over twice as much R&D as that performed by Federal agencies and FFRDCs. This support is projected to be $85.3 billion, reflecting a 7.0 percent average real increase per year since 2000. This funding supports a wide range of national objectives (also termed *budget functions*); is administered by many Federal agencies; and flows to R&D performers in all sectors, from industry to universities and colleges and to nonprofit organizations.

FIGURE 3. U.S. research and development funding, by source of funds: 1953–2003



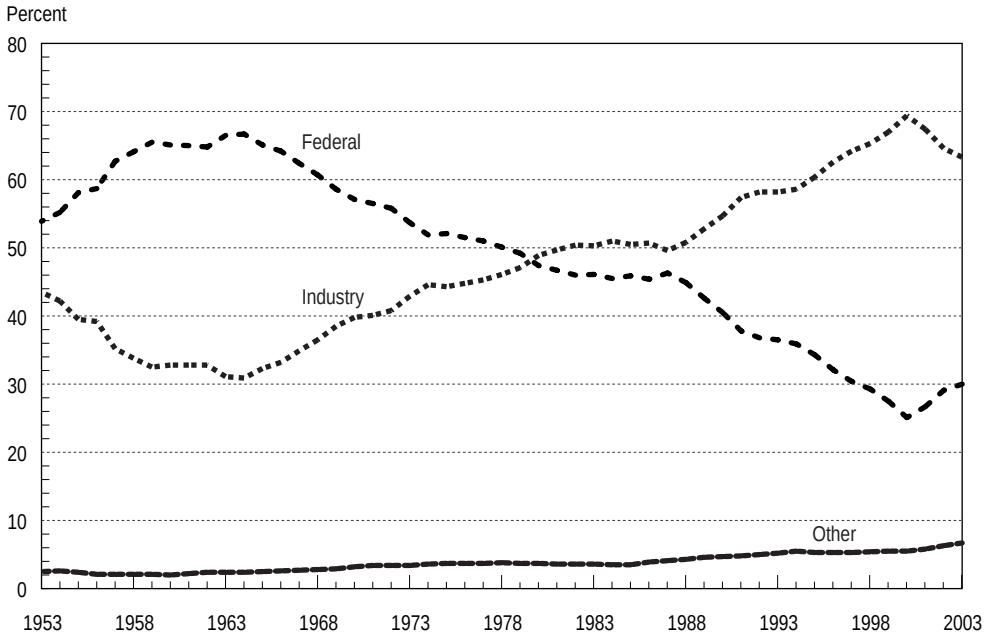
SOURCE: National Science Foundation, Division of Science Resources Statistics, *National Patterns of R&D Resources,* annual series. See appendix tables B-2 and B-22.

Defense-Related R&D. Defense-related R&D, as a proportion of the nation's total R&D, has shifted substantially. From 53.6 percent in 1959, it declined to a relative low of 24.2 percent in 1980, climbed to 31.7 percent by 1987, and, coinciding with the end of the cold war, fell substantially afterward, reaching a low of 13.5 percent in 2000 (figure 5).[7] Despite this dramatic decline relative to nondefense R&D, the absolute level of defense R&D in 2000 still exceeded that in any year from 1953 to 1982, after adjusting for inflation. In 2001, 2002, and 2003 defense-related R&D as a share of U.S. R&D began to grow again, reaching a projected 16.2 percent of the nation's total R&D in 2003.

In 1980 the Federal budget authority for defense-related R&D was roughly equal to that for nondefense R&D[8] (figure 6). Although the amount of defense-related R&D has fluctuated based on changing national security concerns over the past 20 years, nondefense R&D has exhibited fairly steady growth since 1983. For FY 2001 the budget authorities for defense R&D and for nondefense R&D had nearly reached parity at $45.7 and $41.0 billion, respectively. The terrorist attacks of September 11, 2001, dramatically reversed this trend and in the proposed FY 2004 budget, $66.8 billion is slated for defense-related R&D, and $51.2 billion is reserved for nondefense R&D. (See sidebar, "Federal R&D for Countering Terrorism.") These amounts reflect increases of 46.2 percent in defense-related R&D and 24.7 percent in nondefense R&D over the FY 2001 levels.

Civilian-Related R&D. R&D accounts for 13.4 percent of the FY 2004 Federal nondefense discretionary budget authority of $383.0 billion.[9] R&D is more prominent among defense activities, accounting for 16.7 percent of the $399.2 billion defense discretionary budget authority in FY 2004. However, over 90 percent of Federal basic research funding is for nondefense functions, accounting for a large part of the budgets of agencies with nondefense missions such as general science (NSF), health [National Institutes of Health (NIH)], and space research and technology [National Aeronautics and Space Administration (NASA)] (table 2, appendix table B-11). Because many different agencies

FIGURE 4. U.S. research and development expenditures, by source of funds: 1953–2003



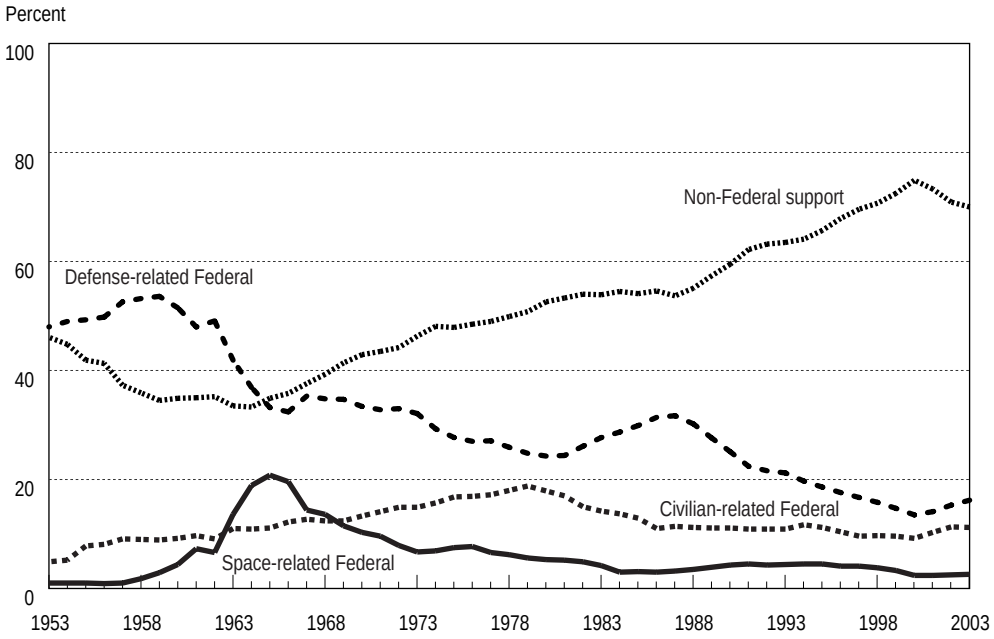
SOURCE: National Science Foundation, Division of Science Resources Statistics, *National Patterns of R&D Resources,* annual series. See appendix table B-2.

[7]These shares represent a distribution of performer-reported R&D data. They are distinct from the budget authority shares reported subsequently, which are based on the various functional categories constituting the Federal budget.

[8]R&D budget authority data represent a distribution of Federal source-reported data as opposed to performer-reported data.

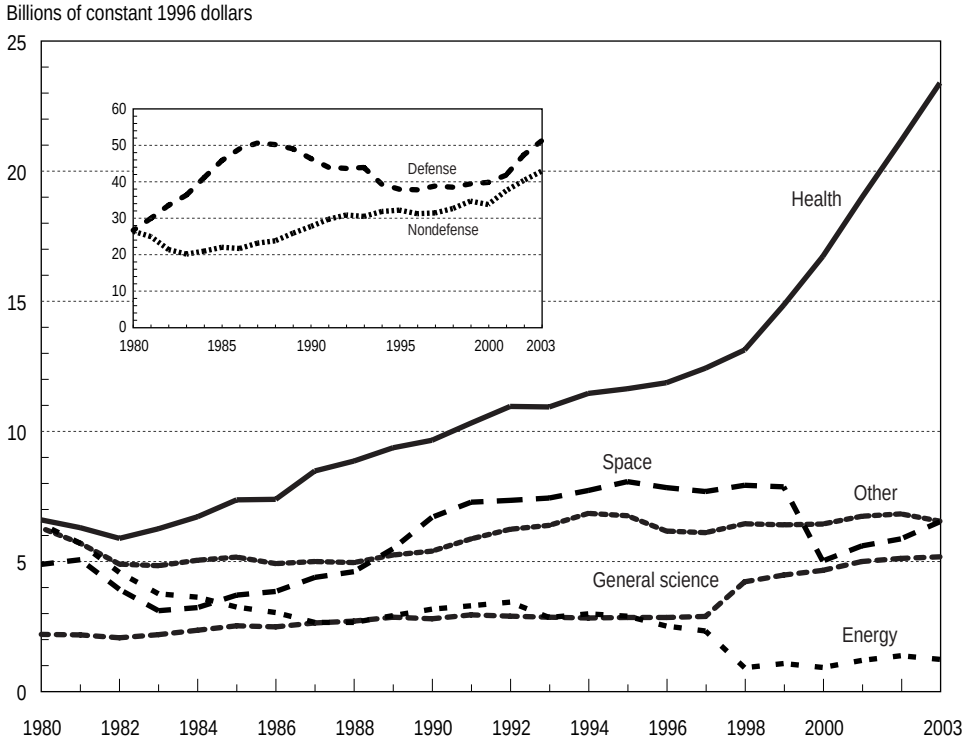
[9]Most of the $2.2 trillion Federal budget is reserved for mandatory items such as Social Security, Medicare, pension payments, and payments on the national debt. See appendix table B-13 for historical data on Federal outlays and R&D.

FIGURE 5. Federal and non-Federal share of U.S. research and development: 1953–2003



SOURCE: National Science Foundation, Division of Science Resources Statistics, unpublished tabulations, 2003. See appendix table B-10.

FIGURE 6. Federal research and development budget authority, by budget function: FY 1980–2003



NOTES: "Other" includes all nondefense functions not separately graphed, such as agriculture and transportation. 1998 increase in general science and decrease in energy and 2000 decrease in space were results of reclassification.

SOURCE: National Science Foundation, Division of Science Resources Statistics, *Federal R&D Funding by Budget Function: Fiscal Years 2001–2003* (Arlington, VA, 2002).

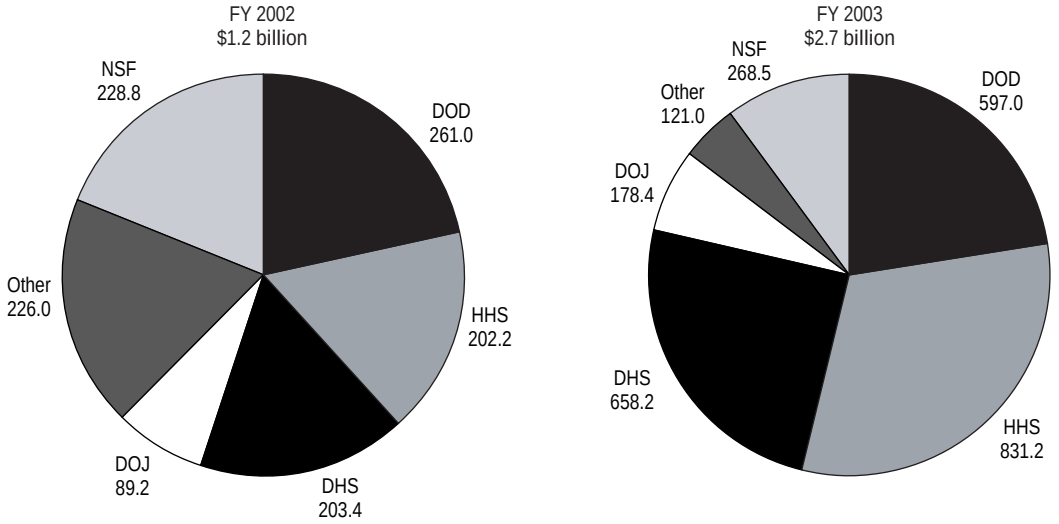
Federal R&D for Countering Terrorism

In fiscal year (FY) 2002, the Federal Government appropriated $44.4 billion for combating terrorism, $1.2 billion of which was R&D funding. As a point of reference, the total Federal budget for R&D activities to develop technologies to deter, prevent, or mitigate terrorist acts was less than half this amount ($511 million) in FY 2000. As figure 7 indicates, a large portion of the FY 2002 counterterrorism R&D was funded by the Department of Defense (DOD), most notably the Defense Advanced Research Projects Agency. The National Science Foundation was the next largest source of funds with over $200 million in research aimed at protecting critical infrastructure and key assets. The various agencies and offices that now constitute the Department of Homeland Security (DHS) had a combined R&D budget for combating terrorism of $200 million in FY 2002. Numerous other agencies, ranging from the Department of Health and Human Services (HHS) to the Department of Justice, supported counterterrorism R&D in FY 2002.

The Federal budget for counterterrorism R&D grew to almost $2.7 billion in the enacted FY 2003 budget. Almost a third of this R&D ($830 million) was requested for HHS, specifically for bioterrorism-related R&D at the National Institutes of Health (NIH). The budget for counterterrorism R&D programs in the agencies now within DHS more than tripled to $660 million. Counterterrorism R&D funded by DOD, with an emphasis on R&D to support war-fighting applications and counterbioterrorism, more than doubled in the FY 2003 budget.

Although the FY 2004 budget has not yet been enacted, the 225 percent increase in the budget for counterterrorism R&D between FY 2002 and FY 2003 appears to have been a one-time event. The FY 2004 budget proposes further increases in Federal R&D investment in the priority area of homeland security, particularly research against bioterrorism at NIH. However, the most prominent change from the FY 2003 budget is organizational rather than monetary. On January 24, 2003, DHS was officially established and the R&D programs of several agencies were consolidated under its management. The President's budget request reflects this consolidation and calls for a $1.0 billion R&D budget for the new department. Analysis by the Office of Management and Budget reports that $844 million of this amount is focused on R&D to combat terrorism, a fourfold increase over the enacted FY 2002 budget.

FIGURE 7. Federal research and development budget for combating terrorism, by agency: FY 2002 and 2003
(Millions of dollars)



DHS Department of Homeland Security component agencies; DOD Department of Defense; DOJ Department of Justice; HHS Department of Health and Human Services; NSF National Science Foundation

SOURCE: U.S. Office of Management and Budget, *Annual Report to Congress on Combating Terrorism* (Washington, DC, 2003).

TABLE 2. Budget authority for research and development, by Federal agency and character of work, proposed levels: FY 2004

Agency	Character of work (millions of dollars)				Percent R&D as share of discretionary budget
	R&D total	Basic research	Applied research and development	Discretionary budget authority	
All Federal Government	118,014	26,862	91,152	782,219	15.1
Department of Defense	62,672	1,309	61,363	379,898	16.5
Health and Human Services	28,108	14,804	13,304	66,195	42.5
National Institutes of Health	26,866	14,801	12,065	27,742	96.8
National Aeronautics and Space Administration	8,543	2,535	6,008	15,469	55.2
Department of Energy	7,559	2,593	4,966	23,376	32.3
National Science Foundation	3,690	3,486	204	5,481	67.3
Department of Agriculture	1,803	819	984	19,503	9.2
Department of Commerce	1,006	391	615	5,406	18.6
National Oceanic and Atmospheric Administration	675	312	363	3,325	20.3
National Institute for Standards and Technology	318	79	239	498	63.9
Department of the Interior	633	38	595	10,587	6.0
Department of Transportation	674	37	637	13,673	4.9
Environmental Protection Agency	607	90	517	7,627	8.0
Department of Veterans Affairs	822	495	327	28,057	2.9
Department of Education	275	1	274	53,137	0.5
Department of Homeland Security	836	47	789	26,697	3.1
International assistance programs	306	58	248	17,039	1.8
Smithsonian Institution	121	121	0	567	21.3
Tennessee Valley Authority	25	NA	25	NA	NA
Department of Labor	10	2	8	11,535	0.1
Nuclear Regulatory Commission	60	NA	60	626	9.6
Corps of Engineers	27	3	24	4,049	0.7
Department of Housing and Urban Development	51	NA	51	31,301	0.2
Department of Justice	106	33	73	17,697	0.6
Social Security Administration	30	NA	30	3,084	1.0
Postal Service	47	NA	47	NA	NA
Department of the Treasury	3	NA	3	11,397	0.0

NA not available

R&D research and development

NOTE: Details will not add to totals for discretionary budget authority because only R&D funding agencies are listed.

SOURCES: Intersociety Working Group, *AAAS Report XXVIII: Research and Development FY 2004* (Washington, DC, 2003); and U.S. Office of Management and Budget, *Budget of the United States Government, Fiscal Year 2004* (Washington, DC, 2003).

can support R&D programs with the same basic objective, it is useful to aggregate Federal R&D into budget functions to assess broad trends in national R&D priorities.

Space-related R&D as a percentage of total R&D reached a peak of 20.9 percent in 1965, during the height of the nation's efforts to surpass the Soviet Union in space exploration (figure 5). In terms of the nation's R&D performance, space-related R&D accounted for a projected 2.6 percent of total R&D in 2003.[10] The loss of the Space Shuttle Columbia and its crew of seven on February 1, 2003, has resulted in uncertainty as to the future focus and intensity of manned missions in the U.S. space-related R&D effort. In the President's FY 2004 budget, crafted before the disaster, 55.2 percent of NASA's $15.5 billion discretionary budget was reserved for R&D.

The most dramatic change in Federal R&D priorities over the past 20 years has been the growing importance of health-related R&D. As illustrated in figure 6, health-related R&D rose from representing roughly a fourth (27.6 percent) of the Federal nondefense R&D budget allocation in FY 1982 to more than half (54.5 percent) by FY 2003. Most of this growth occurred after 1998, when NIH's budget was set on a pace to double by 2003 (Meeks 2002).

In contrast to the steep growth in health-related R&D, the budget allocation for general science R&D has grown

[10]The steep drop in space-related R&D in fiscal year 2000, as depicted in figure 6, was the result of the National Aeronautics and Space Administration's reclassifying space station R&D to R&D plant.

relatively little in the past 20 years. In fact, the growth in general science R&D (figure 6) is more the result of a reclassification of several Department of Energy (DOE) programs from energy to general science in FY 1998 than the result of increased budget allocations. The formation of the Department of Homeland Security and the coincident reclassification of much of its formerly civilian R&D activities as defense R&D is a more recent example of how R&D budget function classifications can change when the mission or focus of funding agencies changes.

Federal R&D Funding by Performer and Field of Science or Engineering

Federal Funding to Academia. The Federal Government has long provided the largest share of R&D funds used by universities and colleges. In the early 1980s, Federal funds accounted for roughly two-thirds of the academic total. That share dropped to 57.7 percent in 2000 but is projected to rise to 60.8 percent in 2003. Although this share of funding has not changed much in recent years, the actual amount of funding in real terms increased on average 5.1 percent per year between 1985 and 1994, 3.4 percent per year between 1994 and 2000, and 9.8 percent per year between 2000 and 2003.

Federal Funding to Industry. The greatest fluctuation in Federal support as reported by R&D performers occurred in obligations to industry, ranging from a low of $10.4 billion (constant 1996 dollars) in 1955 (when the NSF time series began) to a high of $37.1 billion in 1987 (figure 8). Between 1998 and 2003, Federal funds for industrial R&D activities declined an annual average of 6.3 percent in real terms. Overall, the share of industry's R&D performance funded by the Federal Government has been steadily declining since its peak of 56.7 percent in 1959.[11]

The industries that report the greatest amount of Federal R&D funding include the computer and electronic products industry; the professional, scientific, and technical services industry; and the aerospace industry. Companies in these three industries accounted for 87 percent of all federally funded industrial R&D reported in 2001. In contrast, this same group accounted for only 37 percent of all company-financed R&D in 2001. Approximately half of the $7.9 billion of R&D performed by companies classified in the aerospace industry came from Federal sources in 2001. In comparison, companies classified in the pharmaceuticals and medicines industry reported no federally funded R&D in 2001, although they did and continue to benefit indirectly from the considerable amount of biomedical R&D funded by the Federal Government.

Federal Research Funding by Field

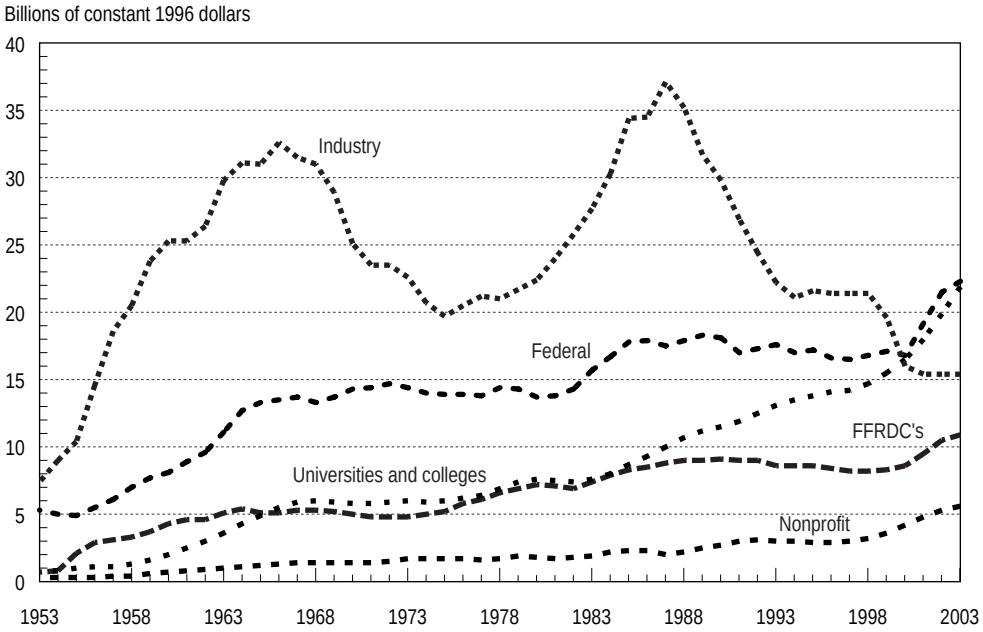
According to preliminary estimates, Federal obligations for research alone (excluding development) totaled $53.4 billion in FY 2003. Life sciences received the largest portion of this funding (53.7 percent, or $28.7 billion), most of which were provided by the Department of Health and Human Services (HHS), followed by engineering (17.2 percent), physical sciences (9.7 percent), environmental sciences (7.3 percent), and mathematics and computer sciences (5.4 percent) (figure 10). Social sciences, psychology, and all other sciences accounted for another 2.0, 1.8, and 3.0 percent, respectively.

HHS, primarily through NIH, provided the largest share (50.2 percent) of all Federal research obligations in FY 2003. The next largest contributor was the Department of Defense (DOD) (12.2 percent), providing substantial funding for research in engineering ($3.3 billion) and in mathematics and computer sciences ($1.1 billion). NASA provided 10.8 percent, primarily in the fields of engineering, environmental sciences, and physical sciences. DOE provided 10.1 percent, primarily in the fields of physical sciences and engineering. NSF provided 6.4 percent, contributing between $0.5 and $0.6 billion to each of the following fields: physical sciences, mathematics and computer sciences, engineering, environmental sciences, and life sciences.

Federal obligations for research have grown at different rates for different science and engineering (S&E) fields, reflecting changes in perceived public needs in those fields, changes in the national resources (e.g., scientists, equipment, and facilities) that have been built up in those fields over time, as well as differences in scientific opportunities across fields (appendix table B-14). Based on preliminary estimates for FY 2003, the major field of mathematics and computer sciences has experienced the highest rate of growth in Federal obligations for research, which was 7.8 percent per year

[11]Beginning in 1989, the amount of federally funded R&D reported by industry began to diverge from the amount reported by the Federal Government. For details on this discrepancy, see sidebar, "Tracking R&D: Gap Between Performer- and Source-Reported Expenditures." Detailed R&D data by source and performer for years prior to 1993 can be found in the online version of this report in table D.

FIGURE 8. Federal research and development support, by performing sector: 1953–2003



FFRDC federally funded research and development center

NOTES: Expenditures of industry FFRDCs for 1953–54 are included in industry. Expenditures of nonprofit FFRDCs for 1953–54 are included in nonprofit.

SOURCE: National Science Foundation, Division of Science Resources Statistics, *National Patterns of R&D Resources,* annual series. See appendix table B-1.

Tracking R&D: Gap Between Performer- and Source-Reported Expenditures

In many Organisation for Economic Co-operation and Development (OECD) countries, including the United States, total government R&D support figures reported by government agencies differ substantially from those reported by performers of R&D work. Consistent with international guidance and standards, most countries' national R&D expenditure totals and time series are based primarily on data reported by performers. This convention is preferred because performers are in the best position to indicate how much they spent conducting R&D in a given year and to identify the source of their funds. Although funding and performing series may be expected to differ for many reasons such as different bases used for reporting government obligations (fiscal year) and performance expenditures (calendar year), the gap between the two R&D series creates analytical challenges.

For the United States the reporting gap has become particularly acute over the past several years. In the mid-1980s performer-reported Federal R&D exceeded Federal reports by $3 billion to $4 billion annually (5–10 percent of the government total). This pattern reversed itself toward the end of the decade; in 1989 the government-reported R&D total exceeded performer reports by $1 billion. The gap subsequently grew to almost $13 billion by 2002. In other words, approximately 13 percent of the government total in 2002 was unaccounted for in performer surveys (figure 9). The difference in Federal R&D totals was primarily in DOD development funding of industry. For 2002, Federal agencies reported $34.2 billion in total R&D obligations to industrial performers, compared with $17.1 billion in Federal funding reported by industrial performers. Overall, industrywide estimates equal a 50 percent paper

Tracking R&D: Gap Between Performer- and Source-Reported Expenditures (Continued)

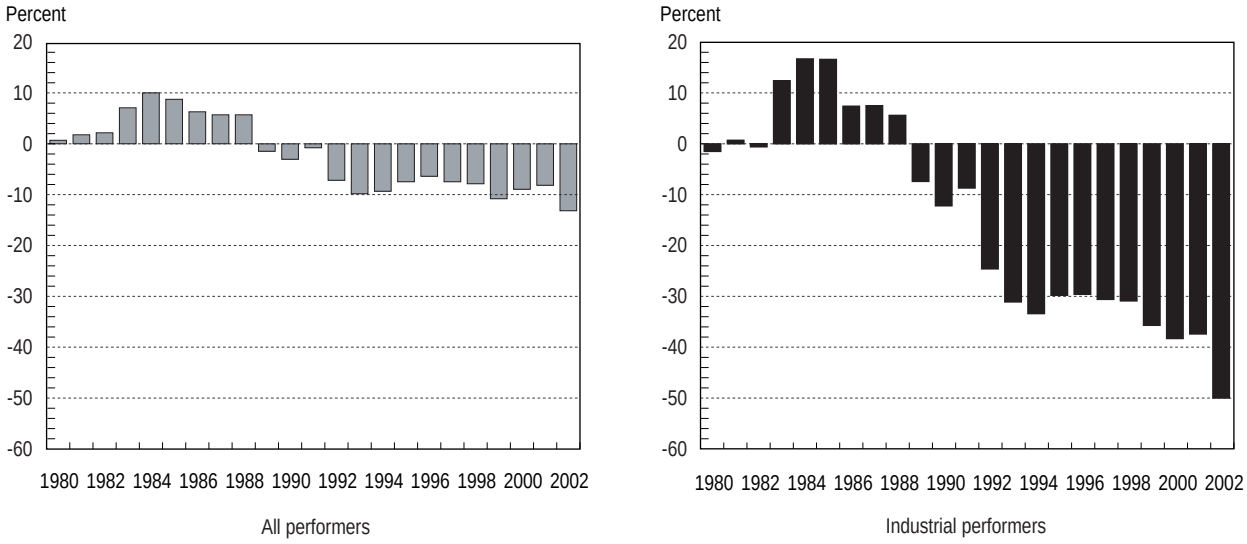
"loss" of federally reported 2002 R&D support (figure 9).

NSF has sponsored ongoing research and investigations into the possible causes for the data gap. Past studies have focused on the following aspects of the phenomenon:

- The relative prominence of similar divergences in the series in countries with large defense R&D expenditures
- Industry interpretations and financial treatment of Federal (particularly defense-related) R&D contracts
- Federal agency R&D data collection and reporting procedures

Each investigation resulted in useful insights into the issue, but conclusive explanations have yet to be identified. According to a U.S. General Accounting Office (GAO 2001, p. 2) investigation, "Because the gap is the result of comparing two dissimilar types of financial data [Federal obligations and performer expenditures], it does not necessarily reflect poor quality data, nor does it reflect whether performers are receiving or spending all the Federal R&D funds obligated to them. Thus, even if the data collection and reporting issues were addressed, a gap would still exist."

FIGURE 9. Difference in U.S. performer-reported and agency-reported Federal research and development: 1980–2002



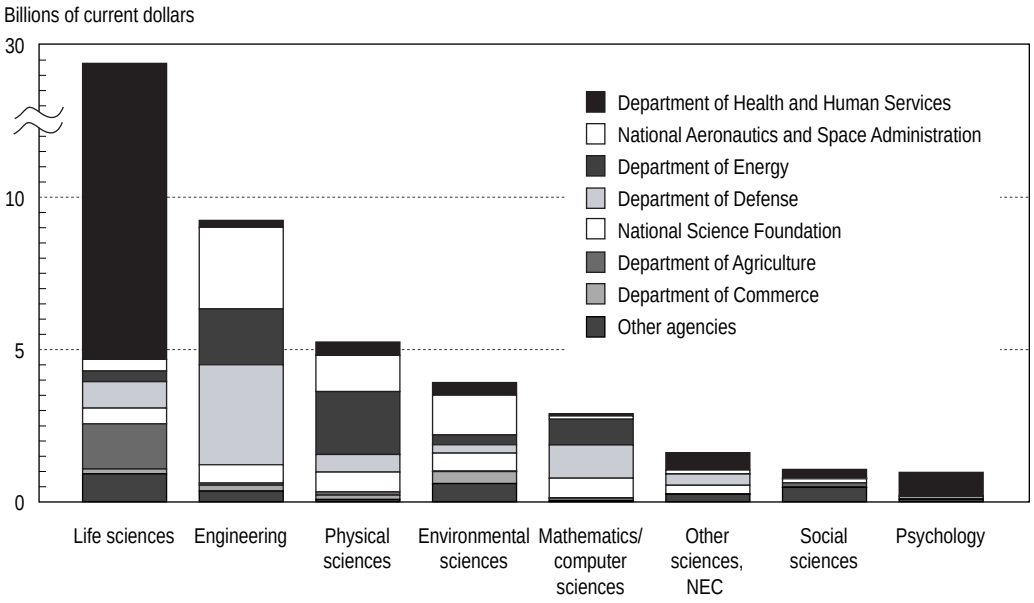
NOTE: Difference is defined as percentage of federally reported research and development (R&D), with a positive difference indicating that performer-reported R&D exceeds agency-reported R&D.

SOURCES: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), special tabulations, 2003; and NSF/SRS, *Federal Funds for Research and Development: Fiscal Years 2001, 2002, and 2003* (Arlington, VA, forthcoming).

in real terms between FY 1982 and FY 2003. Life sciences had the second highest rate (6.2 percent), followed by psychology (4.6 percent); environmental sciences (3.3 percent); social sciences, including anthropology, economics, political sciences, sociology, and other areas (2.3 percent); engineering (2.2 percent); and physical sciences (1.0 percent).

The trends in Federal support for these broad fields of research, however, may not reflect trends for the smaller fields that they contain. For example, within the broad field of mathematics and computer sciences, Federal support for research in mathematics grew 3.3 percent per year in real terms between FY 1982 and FY 2001, whereas support for research in computer

FIGURE 10. Federal obligations for research, by agency and major science and engineering field: FY 2003



NEC not elsewhere classified

SOURCE: National Science Foundation, Division of Science Resources Statistics, *Federal Funds for Research and Development: Fiscal Years 2001, 2002, and 2003,* forthcoming. See appendix table B-14.

sciences grew 10.9 percent per year.[12] Within life sciences during the same period, support for biological and agricultural research grew 6.0 percent per year, compared with research support for medical sciences, which grew 4.3 percent per year. Within the physical sciences, support for astronomy grew 2.7 percent per year, whereas support for physics declined 0.5 percent per year.

Caution should be employed when examining these trends in Federal support for detailed S&E fields because Federal agencies classify a significant amount of R&D only by major S&E field such as life sciences, physical sciences, or social sciences. In FY 2001, for example, 16.6 percent of the Federal research obligations classified by major S&E field were not subdivided into detailed fields. This was less pronounced in physical sciences and in mathematics and computer sciences, in which all but 7.6 percent of the research dollars were subdivided. It was most pronounced in engineering and social sciences, in which 27.3 and 63.9 percent, respectively, of the research obligations were not subdivided into detailed fields.

R&D BY FEDERAL AGENCY

The Federal agencies with the largest R&D expenditures vary considerably in terms of how their R&D budgets are spent.[13] Agency-reported data reveal remarkable diversity in terms of the character of the R&D, who performs the R&D, and how R&D is allocated to performers. These differences reflect the diverse missions, histories, and cultures of the agencies.

DOD. According to preliminary data provided by DOD before budget developments brought about by the war in Iraq, DOD obligated $45.0 billion, more than any other Federal agency, for R&D support in FY 2003. DOD's support represented 45.6 percent of all Federal R&D obligations. More than 85 percent of these funds ($38.5 billion) were spent on development, with

[12]For these subfields, the latest available data are for FY 2001.

[13]The data reported here on expected R&D obligations in FY 2003 were collected before recent budget negotiations and the formation of the Department of Homeland Security. See sidebar "Federal R&D for Countering Terrorism" for data on these recent developments.

$33.0 billion slated for major systems development.[14] Industrial firms are expected to have performed 65 percent of DOD-funded R&D in FY 2003. These firms accounted for an even greater share of development funds (71 percent). DOD's R&D obligations constituted more than 80 percent of all Federal R&D obligations to industry in FY 2003. Of DOD-funded R&D not performed by industry, government agencies and FFRDCs are expected to have performed 85 percent ($13.3 billion).

HHS. HHS, the primary source of Federal health-related R&D funding (largely through NIH), obligated the second largest amount for R&D in FY 2003 at $27.6 billion, most of which ($14.5 billion) was for basic research. In FY 2003 HHS is expected to have provided universities and colleges, the primary recipients of HHS funding, with $15.5 billion, or 67.4 percent, of all Federal R&D funds obligated to universities and colleges (table 3). HHS provided 75.6 percent ($4.7 billion) of all Federal R&D funds obligated to nonprofit institutions, with most of these funds going to large research hospitals such as Massachusetts General Hospital and the Dana-Farber Cancer Institute (NSF, 2002b).

NASA. The third largest agency in terms of R&D support is NASA, with R&D obligations expected to total $8.6 billion in FY 2003; 28.6 percent ($2.5 billion) was earmarked for basic research. Although not defense related, much of the development work sponsored by NASA relies on industrial performers similar to those funded by DOD. NASA is the second largest source of industrial R&D funds, an estimated $3.6 billion in FY 2003. Roughly 82 percent of NASA-funded R&D is performed either by industrial firms or in Federal agencies or FFRDCs. Academic and nonprofit institutions perform the remainder.

DOE. Of the large R&D-funding agencies, DOE relies the most on the R&D capabilities of FFRDCs, obligating 61.1 percent of its estimated $7.5 billion in FY 2003 R&D funding to FFRDCs. DOE is the largest funding source of the 36 FFRDCs, accounting for 61.2 percent of all Federal R&D obligations to FFRDCs in FY 2003.

NSF. NSF is the Federal Government's primary source of funding for general S&E R&D and is estimated to have funded $3.4 billion in R&D in FY 2003. Of these funds, 94.2 percent were for basic research. NSF is the second largest Federal source of R&D funds to universities and colleges and is expected to have provided $2.8 billion to academic researchers in FY 2003.

Other Agencies. DOD, HHS, NASA, DOE, and NSF are estimated to account for 93.4 percent of all Federal R&D obligations in FY 2003, with 93.9 percent of basic research, 85.6 percent of applied research, and 97.8 percent of development. Unlike those Federal agencies, the Department of Agriculture, the Department of Commerce, and the Department of the Interior obligate most of their R&D funds to mission-oriented R&D conducted in their own laboratories, which are run by the Agricultural Research Service, the National Institute for Standards and Technology, and the U.S. Geological Survey, respectively.

Trends in Non-Federal R&D Funding

R&D financing from non-Federal sources grew by 7.6 percent per year after inflation between 1980 and 1985, concurrent with gains in Federal R&D spending. This annual growth rate slowed to 3.3 percent between 1985 and 1994 but rose to 8.6 percent during the 1994–2000 period. More recently, between 2000 and 2003, non-Federal sources of R&D funding declined by a projected 1.5 percent per year in real terms.

As previously discussed, most non-Federal R&D support is provided by industry. Of the projected 2003 non-Federal support total ($199 billion), 90.5 percent ($180 billion) was company funded. Industry's share of national R&D funding first surpassed the Federal Government's in 1980, and it has remained higher ever since. From 1980 to 1985, industrial support for R&D, in real dollars, grew at an average annual rate of 7.7 percent. This growth was maintained through both the mild 1980 recession and the more severe 1982 recession (figure 3). Key factors behind increases in industrial R&D included a growing concern with international competition, especially in high-technology industries; the increasing technological sophistication of products, processes, and services; and general growth in defense-related industries such as electronics, aircraft, and missiles. Between 1985 and 1994, growth in R&D funding from industry was slower, averaging 3.1 percent

[14]The Department of Defense reports development obligations in two categories: *advanced technology development,* which is similar in nature to development funded by most other agencies, and *major systems development,* which includes demonstration and validation, engineering and manufacturing development, management and support, and operational systems development for major weapon systems.

TABLE 3. Estimated Federal research and development obligations, by performing sector and agency funding source: FY 2003

Character of work and performer	Total obligations (millions of dollars)	Primary funding source		Secondary funding source	
		Agency	Percent	Agency	Percent
All R&D	98,608	DOD	46	HHS	28
Federal intramural	24,558	DOD	51	HHS	21
Industrial firms	36,411	DOD	81	NASA	10
Industry-administered FFRDCs	1,478	DOE	71	HHS	19
Universities and colleges	23,055	HHS	67	NSF	12
Universities and college FFRDCs	4,835	DOE	58	NASA	29
Other nonprofit organizations	6,261	HHS	76	NASA	9
Nonprofit-administered FFRDCs	1,222	DOE	60	DOD	33
Basic research	25,977	HHS	56	NSF	12
Federal intramural	4,411	HHS	43	USDA	15
Industrial firms	1,446	NASA	38	HHS	31
Industry-administered FFRDCs	220	HHS	76	DOE	24
Universities and colleges	14,024	HHS	65	NSF	19
Universities and college FFRDCs	1,984	DOE	60	NASA	27
Other nonprofit organizations	3,153	HHS	85	NSF	7
Nonprofit-administered FFRDCs	571	DOE	93	HHS	5
Applied research	27,400	HHS	45	DOD	17
Federal intramural	8,799	HHS	37	DOD	22
Industrial firms	5,119	DOD	40	NASA	38
Industry-administered FFRDCs	762	DOE	80	HHS	15
Universities and colleges	8,205	HHS	78	DOD	6
Universities and college FFRDCs	1,494	DOE	87	NASA	5
Other nonprofit organizations	2,598	HHS	75	NASA	8
Nonprofit-administered FFRDCs	171	DOE	57	DOD	22
Development	45,231	DOD	85	NASA	6
Federal intramural	11,347	DOD	86	NASA	6
Industrial firms	29,846	DOD	91	NASA	3
Industry-administered FFRDCs	495	DOE	78	DOD	22
Universities and colleges	826	DOD	60	NASA	16
Universities and college FFRDCs	1,356	NASA	58	DOE	26
Other nonprofit organizations	510	NASA	35	DOD	25
Nonprofit-administered FFRDCs	481	DOD	76	DOE	23

DOD Department of Defense; DOE Department of Energy; FFRDC federally funded research and development center; HHS Department of Health and Human Services; NASA National Aeronautics and Space Administration; NSF National Science Foundation; R&D research and development; USDA Department of Agriculture

NOTE: Subtotals by performer do not add to total because state and local governments and foreign performers of R&D are included in the total but not shown separately.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Federal Funds for Research and Development, FY 2001, 2002, and 2003.

per year in real terms, but from 1994 to 2000 industrial R&D support grew in real terms by 8.8 percent per year. This rapid growth rate came to a halt following the downturn in both the market valuation and economic demand for technology in the first years of the 21st century. Between 2000 and 2003 industrial R&D support declined by a projected 2.3 percent per year in real terms.

R&D funding from other non-Federal sectors, namely, academic and other nonprofit institutions and state and local governments, has been more consistent over time, growing at an average annual rate of 6.4 percent between 1980 and 2003 after adjusting for inflation. Most of these funds went to research performed within the academic sector.

Trends in R&D by Character of Work

Because research and development encompasses a broad range of activities, it is helpful to disaggregate R&D expenditures into the traditional categories of basic research, applied research, and development. Despite the difficulties in classifying specific R&D projects, these categories are useful for characterizing the expected time

horizons, outputs, and types of investments associated with R&D expenditures.

In 2003 the United States performed a projected $54.1 billion of basic research, $67.8 billion of applied research, and $161.9 billion of development (table 1). As a share of all 2003 R&D expenditures, basic research represented 19.1 percent, applied research represented 23.9 percent, and development represented 57.1 percent.

Basic Research

In 2003 universities and colleges are projected to have performed 55.3 percent of basic research, more than any other sector (table 1; figure 11). The intellectual freedom and diversity of these institutions make them ideally suited to carry out basic research. Industry performed a projected 14.3 percent of U.S. basic research in 2003. Rather than serve an immediate market need, the basic research performed by a firm with industry funds serves to strengthen the innovative capacity of the firm by developing human capital and increasing the capability of the firm to absorb external scientific and technological knowledge.

The Federal Government has historically provided the majority of funding for basic research and is estimated to have provided 60.5 percent of basic research funding in 2003 (table 1; figure 11). Moreover, the Federal Government funded a projected 63.5 percent of the basic research performed by universities and colleges in 2003. Industry devoted an estimated 5.0 percent of its total R&D support to basic research in 2003, representing 16.7 percent of the national total. The reason for industry's relatively small contribution to basic research is that basic research generally involves the most uncertainty in terms of both the technical success and the commercial value of any of the three broad categories of R&D. The industries that invest the most in basic research are those whose new products and services are most directly linked to advances in science and engineering, such as the pharmaceuticals industry and the scientific R&D services industry.

Applied Research

U.S. applied research, which totaled a projected $67.8 billion in 2003, is performed largely by nonacademic institutions. Industrial performers accounted for 62.6 percent of all applied research, with the remainder largely performed by Federal laboratories and FFRDCs (17.9 percent). Industrial support accounts for 58.4 percent ($39.6 billion) of the 2003 total for applied research, and Federal support accounts for 34.6 percent ($23.5 billion). The Federal Government's investment in research has historically emphasized basic research over applied research, reflecting the belief that the private sector is less likely to invest in basic research. In 2003, Federal funding for applied research was 72 percent of that for basic research (table 1).

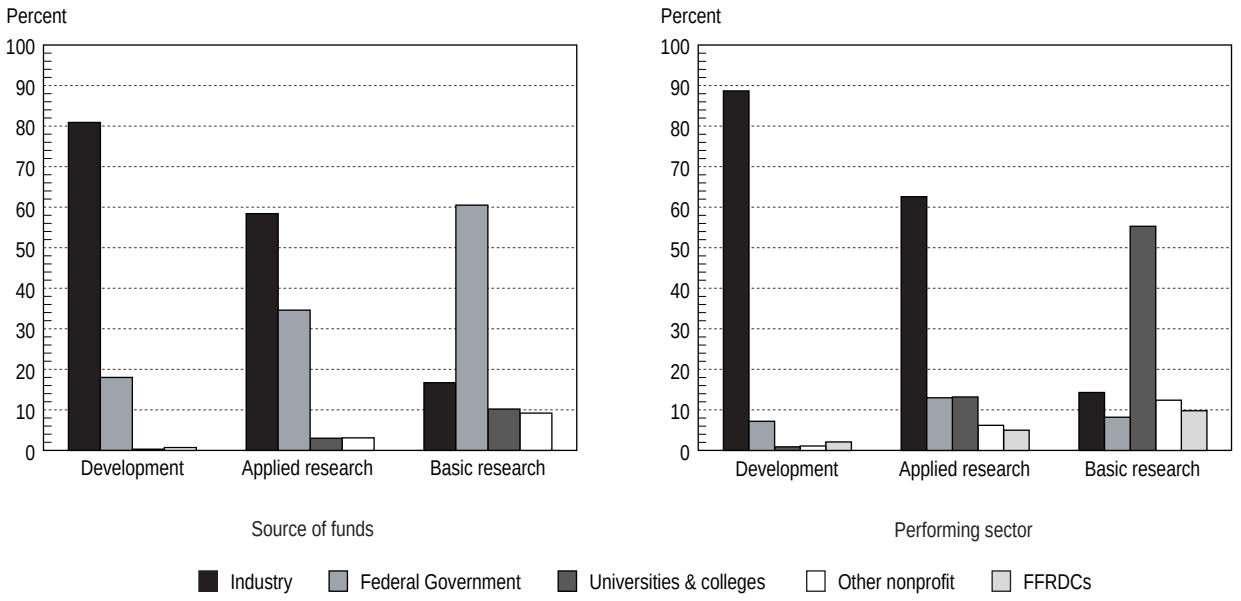
Within industry, applied research acts to refine and adapt existing scientific knowledge and technology into knowledge and techniques useful for creating or improving products, processes, or services. Examples of industries that perform a relatively large amount of applied research are the semiconductor industry and the biotechnology industry.

Development

Development expenditures totaled a projected $161.9 billion in 2003, representing the majority of U.S. R&D expenditures. The development of new and improved goods, services, and processes is dominated by industry, which performed 88.7 percent of all U.S. development in 2003. Federal laboratories and FFRDCs performed an estimated 9.4 percent of U.S. development; the remainder was performed by universities and colleges and nonprofit institutions.

Industry and the Federal Government together funded 98.9 percent of all development in 2003, with industry providing 80.9 percent and the Federal Government providing 18.0 percent (table 1). The Federal Government generally invests in the development of products for which it is the only consumer such as tactical nuclear weapons and space exploration vehicles. The Federal investment in development is dominated by DOD, which invests 85 percent of its R&D funds in development (figure 12).

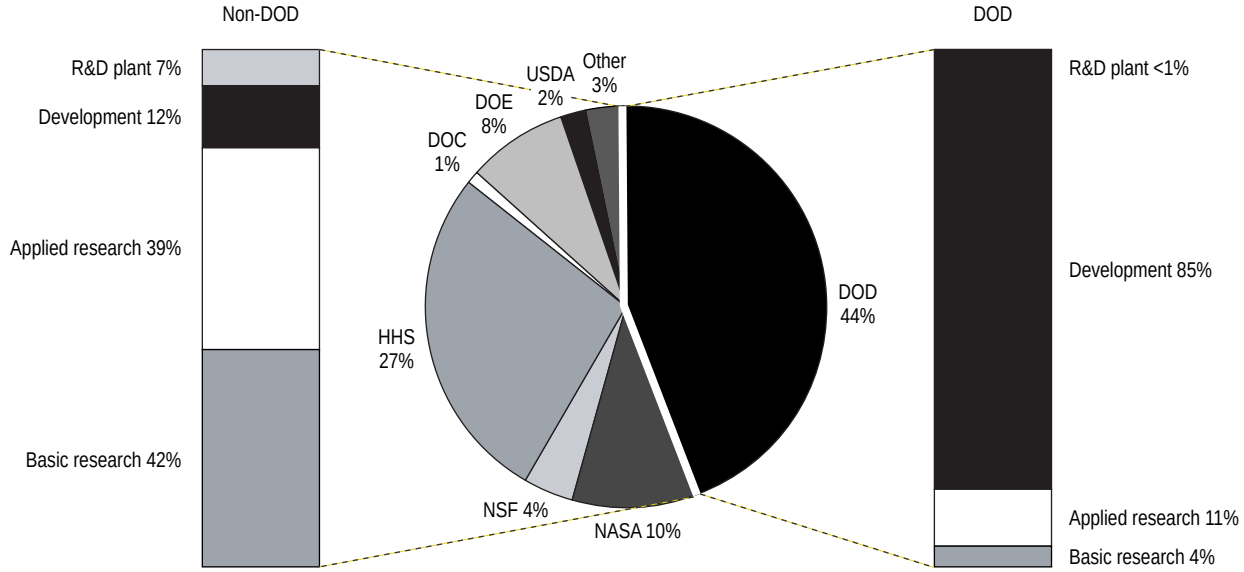
FIGURE 11. U.S. research and development expenditure, by source of funds, performing sector, and character of work: 2003



FFRDC federally funded research and development center

SOURCE: National Science Foundation, Division of Science Resources Statistics, *National Patterns of R&D Resources*, annual series.
See appendix tables B-1 through B-8.

FIGURE 12. Projected Federal obligations for research and development and research and development plant, by agency and character of work: FY 2003



DOC Department of Commerce; DOD Department of Defense; DOE Department of Energy; HHS Department of Health and Human Services; NSF National Science Foundation; NASA National Aeronautics and Space Administration; R&D research and development; USDA Department of Agriculture

NOTE: Percents may not sum to 100 because of rounding.

SOURCE: National Science Foundation, Division of Science Resources Statistics, *Federal Funds for Research and Development: Fiscal Years 2001, 2002, and 2003* (Arlington, VA, forthcoming).

Sectoral Composition of R&D Performance

Since the early 1980s, R&D performance in some sectors has grown much faster than in others. The industrial sector in particular has grown increasingly dominant (figure 1). In 1980, industry performed 68.4 percent of the nation's R&D, the academic sector performed 10.2 percent, laboratories within Federal agencies (Federal intramural R&D) performed 12.4 percent, and the nonprofit sector performed 2.6 percent. All FFRDCs combined performed 6.4 percent of the nation's R&D. Industry's defense-related R&D efforts accelerated in the early 1980s, and its share of R&D performance rose to 71.8 percent in 1985.

From 1985 to 1994, R&D performance grew by only 1.4 percent per year in real terms for all sectors combined. This growth was not evenly balanced across performing sectors, however. R&D performance at universities and colleges grew by 5.4 percent per year in real terms, compared with only 1.0 percent for industry, –0.5 percent for Federal intramural performance, 5.0 percent for nonprofit organizations, and 0.3 percent for all FFRDCs combined.

These growth rates changed dramatically from 1994 to 2000. Total R&D performance in real terms averaged 5.8 percent growth per year, which was substantially higher than in the earlier sluggish period. Yet, R&D performance at universities and colleges grew at a slower rate of 4.1 percent per year in real terms.[15] Industrial R&D expanded at a rate of 7.1 percent in real terms (despite a decline in company-reported Federal financing of R&D). Federal intramural performance decreased by 0.3 percent per year in real terms. Nonprofit organizations, according to current estimates, increased their R&D performance by 7.1 percent per year in real terms over the same 6-year period. Finally, R&D performance at all FFRDCs experienced essentially no change in real terms over this period.

Industry is projected to have performed 68.3 percent of the nation's total R&D in 2003 (table 1). The estimated $193.7 billion in industrial R&D performance represents a 2.2 percent average annual decrease in real terms from the 2000 level. Universities and colleges are projected to have performed 14.2 percent ($40.3 billion) of national R&D in 2003, representing an average annual increase of 7.9 percent in real terms over their R&D in 2000. The Federal Government is projected to have performed 8.8 percent ($25.0 billion) of U.S. R&D in 2003, an average annual increase in real terms of 9.9 percent over the 2000–2003 period. All FFRDCs combined performed a projected $12.2 billion of R&D in 2003, or 4.3 percent of the U.S. total. The nonprofit sector performed a projected $12.7 billion in 2003, or 4.5 percent of the U.S. total.

Industrial R&D by Industry, Firm Size, and R&D Intensity

As previously described, R&D performed by private industry reached a projected $193.7 billion in 2003 (table 1). This total represents a 2.2 percent average annual decline in real terms from the 2000 level of $197.5 billion. Most of this decline was in industry-financed R&D. Companies funded 91.1 percent ($176.4 billion) of their 2003 R&D performance, with the Federal Government funding nearly all the rest ($17.3 billion, or 8.9 percent, of the total). The federally funded share of industry's R&D performance total has fallen considerably from its most recent peak of 31.9 percent in 1987. For more than a decade the largest component of R&D in the United States has been performed by private industry through private industry's own funds. This component of U.S. R&D grew from 43 percent of total U.S. R&D in 1953 to a projected 62 percent in 2003.

R&D in Nonmanufacturing Industries

Until the 1980s, little attention was paid to R&D performed by nonmanufacturing companies largely because R&D activity in this sector was relatively small compared with the R&D operations of manufacturing companies. Before 1983, nonmanufacturing industries accounted for less than 5 percent of total industrial R&D performance (including industry-administered FFRDCs), but by 2001 (the most current year for detailed data on

[15]Recent methodological improvements in the estimation of total academic R&D have resulted in a break in the time series. Data for years before 1998 are slightly overstated compared with the data for later years. Had the same methodology been used for all years in the series, the average annual growth rate would have been closer to 4.3 percent per year in real terms from 1994 to 2000. See sidebar, "Academic Passed-Through Funds."

Academic Passed-Through Funds

The national R&D estimates presented in this report represent survey data that have been adjusted to eliminate double-counted funds. Only for the academic sector does surveyed R&D performance include research funds passed through or subcontracted to outside organizations. (Respondents in the other surveyed sectors are instructed to exclude R&D subcontracted to other organizations from their performance totals.) The amount of R&D funds passed through to subrecipients has grown from at least 3.8 percent of total academic R&D ($1.0 billion) in FY 1998 to at least 5.0 percent of total academic R&D ($1.6 billion) in FY 2001. Table 4 illustrates that a higher percentage of federally funded R&D dollars are passed through to subrecipients than non-Federal sources of funds. In FY 2001, 7.2 percent of all federally funded academic R&D was passed through to subrecipients as contrasted to 1.8 percent of all non-Federal sources of funds. It is unclear whether this difference is the result of Federal sources of funding explicitly encouraging cross-institution R&D collaboration.

Given the coverage of the Academic R&D Survey and the specific wording of its instructions, it is reasonable to assume that virtually all of the R&D expenditures that were reported as being passed to educational subrecipients were captured by the survey twice—once from the originating institutions and once from the subrecipient institutions. Thus to make the academic R&D data more comparable to that of other sectors, R&D reported as "passed through" to educational subrecipients has been netted out of academic R&D for FY 1998 and later years in this report.

TABLE 4. Academic research and development funds passed through to subrecipients: FY 1998–2001

	R&D expenditures (millions of dollars)				Passed-through expenditures as share of corresponding R&D total (percent)			
Source of funds	1998	1999	2000	2001	1998	1999	2000	2001
Total R&D	25,848	27,505	30,042	32,723	na	na	na	na
Federal R&D	15,145	16,071	17,508	19,191	na	na	na	na
Non-Federal R&D	10,703	11,434	12,534	13,532	na	na	na	na
Funds passed through to all subrecipients								
Total R&D	994	1,253	1,426	1,627	3.8	4.6	4.7	5.0
Federal R&D	846	1,027	1,205	1,380	5.6	6.4	6.9	7.2
Non-Federal R&D	148	226	221	247	1.4	2.0	1.8	1.8
Funds passed through to educational subrecipients								
Total R&D	479	572	705	793	1.9	2.1	2.3	2.4
Federal R&D	421	502	630	707	2.8	3.1	3.6	3.7
Non-Federal R&D	58	70	74	86	0.5	0.6	0.6	0.6

na not applicable
R&D research and development

NOTE: Data on passed-through funds are lower bound estimates because values were not imputed for nonrespondents. In addition, some respondents reporting total and Federal funds passed through did not break out these funds by subrecipient type (educational or other).

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 2001.

industrial R&D), they accounted for 39.2 percent.[16] In 2001, firms classified in nonmanufacturing industries performed $77.8 billion of R&D ($72.4 billion in funds provided by companies and other non-Federal sources and $5.4 billion in Federal support) (table 5). Of this amount, 79 percent ($56.9 billion) can be attributed to the following three groups of nonmanufacturing industries: trade, software and computer-related services,

[16]Beginning with the 2001 survey cycle, industry-administered FFRDCs were removed from the industrial R&D statistics. They are now separately surveyed and reported in the national statistics. This resulted in a relative increase in the share of R&D performed by nonmanufacturing industries. In 2000, when these FFRDCs were included in the industrial R&D totals, R&D performed by nonmanufacturing industries accounted for 37.8 percent of total industrial R&D.

and scientific R&D services.[17] An examination of these three groups of industries helps explain the dramatic growth in nonmanufacturing R&D over the past 2 decades.

R&D performance attributed to the trade industry reached $24.4 billion in 2001. Recent analysis of survey microdata revealed that only a fraction of this R&D was performed by companies whose primary business was wholesale or retail trade. As a consequence of assigning firms to one industry based on payroll data—the classification method used for the NSF Survey of Industrial Research and Development—some large companies were classified into an industry that was not closely related to its reported R&D activities.[18] Although imperfect, this classification scheme reasonably categorizes most companies into industries closely aligned with their primary business activities. Unfortunately, because the sale and marketing of goods and services is a trade activity, a large pharmaceutical firm or electronics manufacturer would be classified in the trade industry if the payroll associated with its sales and marketing efforts outweighed that of any other industrial activity in the company. (See sidebar, "Redistributing Trade R&D" for further discussion of this issue.)

Nonmanufacturing industries associated with software and computer-related services such as data processing and systems design performed approximately $24.0 billion of company-funded R&D in 2001.[19] As computing and IT became more powerful and ubiquitous over the past 2 decades, the demand for services associated with these technologies boomed. The R&D of companies providing these services also grew dramatically during this period. In 1987, when an upper bound estimate of software and other computer-related services R&D first became available, companies classified in the industry group "computer programming, data processing, other computer-related, engineering, architectural, and surveying services" performed $2.4 billion of company-funded R&D, or 3.8 percent of all company-funded industrial R&D. In 2001 the company-funded R&D of a comparable group of industries (excluding engineering and architectural services) was greater by a factor of 10 and accounted for 13.2 percent of all company-funded industrial R&D[20] (table 6). This trend in the growth of software and computer-related services R&D shows no sign of slowing. Despite essentially no growth in total company-funded, industry-performed R&D between 2000 and 2001, the company-funded R&D for this group of industries grew by 10 percent.

The R&D performed by companies in the scientific R&D services industry more than doubled in the 4 years between 1997 and 2001 from $7.0 to $14.2 billion.[21] The portion of this industry's R&D that was company-funded increased at an even faster pace, from $4.7 billion in 1997 to $10.9 billion in 2001. The scientific R&D services industry comprises companies that specialize in conducting R&D for other organizations, such as many biotechnology companies. (See sidebar, "Biotechnology R&D in Industry.") Although these companies and their R&D activities are classified as nonmanufacturing because they provide business services, many of the industries they serve are manufacturing industries. This implies that the R&D activities of a research firm that services a manufacturer would have been classified as R&D in manufacturing if the same research firm were a subsidiary of the manufacturer. Consequently, a growth in measured R&D in services may, in part, "reflect a more general pattern of industry's increasing reliance on outsourcing and contract R&D" (Jankowski 2001).

[17]"Trade" refers to both the wholesale and retail trade industries and is a distinct entry in the NSF industry R&D statistics, as is scientific R&D services. Software and computer-related services, however, is the sum of three distinct industries from the NSF statistics: software, other information, and computer systems design and related services.

[18]Details on how companies are assigned industry codes in the NSF Survey of Industrial Research and Development can be found on the NSF website (http://www.nsf.gov/sbe/srs/nsf02312/sectb.htm#frame).

[19]Although disclosure of Federal R&D funding prohibited the precise tabulation of total R&D performance for this industry, total R&D was between $24.5 billion and $24.6 billion.

[20]The introduction of a more refined industry classification scheme in 1999 allowed more detailed reporting in nonmanufacturing industries. For the cited 2001 statistic, the R&D of companies in software, other information, and computer systems design and related services industries were combined. These three industries provided the closest approximation to the broader category cited for earlier years without exceeding the coverage of the broader category.

[21]Despite the change of industry classification schemes in 1999, analysts have verified that data for the scientific R&D services industry are comparable over the period under discussion.

TABLE 5. Industrial research and development performance, by industry and source of funding: 2001

Industry	NAICS code	R&D funding (millions of dollars)			Percent of company-funded R&D
		Total	Federal Government	Company funded	
All industries	21–23, 31–33, 42, 44–81	198,505	16,899	181,606	100.0
Manufacturing	31–33	120,705	11,484	109,221	60.1
Food	311	1,819	0	1,818	1.0
Beverage and tobacco products	312	152	0	152	0.1
Textiles, apparel, and leather	313–16	D	D	255	0.1
Wood products	321	182	0	181	0.1
Paper, printing, and support activities	322, 323	D	D	2,664	1.5
Petroleum and coal products	324	D	D	1,057	0.6
Chemicals	325	17,892	180	17,713	9.8
Basic chemicals	3251	1,876	42	1,835	1.0
Resin, synthetic rubber, fibers, and filament	3252	D	D	2,745	1.5
Pharmaceuticals and medicines	3254	10,137	0	10,137	5.6
Other	325 (minus 3251–52, 3254)	D	D	2,996	1.6
Plastics and rubber products	326	D	D	2,245	1.2
Nonmetallic mineral products	327	990	11	978	0.5
Primary metals	331	485	6	479	0.3
Fabricated metal products	332	1,599	54	1,545	0.9
Machinery	333	6,404	67	6,337	3.5
Computer and electronic products	334	47,079	5,848	41,232	22.7
Computers and peripheral equipment	3341	D	D	3,165	1.7
Communications equipment	3342	15,507	298	15,209	8.4
Semiconductor and other electronic components	3344	14,358	148	14,210	7.8
Navigational, measuring, electromedical, and control instruments	3345	12,947	5,382	7,565	4.2
Other	334 (minus 3341–42, 3344–45)	D	D	1,083	0.6
Electrical equipment, appliances, and components	335	4,980	301	4,680	2.6
Transportation equipment	336	25,965	4,961	21,004	11.6
Motor vehicles, trailers, and parts	3361–63	D	D	16,089	8.9
Aerospace products and parts	3364	7,868	3,785	4,083	2.2
Other	336 (minus 3361–64)	D	D	832	0.5
Furniture and related products	337	301	0	301	0.2
Miscellaneous manufacturing	339	6,606	25	6,581	3.6
Medical equipment and supplies	3391	D	D	5,903	3.3
Other	339 (minus 3391)	D	D	678	0.4
Nonmanufacturing	21–23, 42, 44–81	77,799	5,415	72,384	39.9
Mining, extraction, and support activities	21	D	D	846	0.5
Utilities	22	133	19	114	0.1
Construction	23	320	1	320	0.2
Trade	42, 44, 45	24,372	88	24,284	13.4
Transportation and warehousing	48, 49	1,848	72	1,776	1.0
Information	51	D	D	17,259	9.5
Publishing	511	13,760	44	13,716	7.6
Newspaper, periodical, book, and database	5111	649	0	649	0.4
Software	5112	13,111	44	13,067	7.2
Broadcasting and telecommunications	513	D	D	1,270	0.7
Other	51 (minus 511, 513)	D	D	2,273	1.3
Finance, insurance, and real estate	52, 53	D	D	2,424	1.3
Professional, scientific, and technical services	54	27,704	5,065	22,640	12.5
Architectural, engineering, and related services	5413	3,386	1,021	2,365	1.3
Computer systems design and related services	5415	9,154	498	8,656	4.8
Scientific R&D services	5417	14,244	3,352	10,893	6.0
Other	54 (minus 5413, 5415, 5417)	920	194	726	0.4
Management of companies and enterprises	55	381	0	381	0.2
Health care services	621–23	1,149	29	1,120	0.6
Other	56, 61, 624, 71, 72, 81	1,259	38	1,221	0.7

D data withheld to avoid disclosing operations of individual companies; NAICS North American Industry Classification System; R&D research and development

NOTE: Manufacturing companies with fewer than 50 employees and nonmanufacturing companies with fewer than 15 employees were sampled separately without regard to industry classification to minimize year-to-year variation in survey estimates. However, estimates for companies in these groups are included with their respective NAICS classification for this table. Company funding includes all non-Federal funding.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development, 2001.

Redistributing Trade R&D

Ongoing investigations of the data underlying NSF's published R&D estimates for industry reveal that much of the R&D classified into the trade industry is an artifact of the automated industry classification methodology. Most of the R&D-performing companies with large amounts of payroll associated with retail or wholesale trade activities are in fact manufacturing firms that have integrated their supply chains and have brought their warehousing, sales, and marketing efforts in-house. Figure 13, which breaks the $24.4 billion into more detailed industry codes, helps clarify the activities of the R&D-performing companies currently classified in trade. Most of the R&D classified into the trade industry falls into three specific wholesale trade industries:

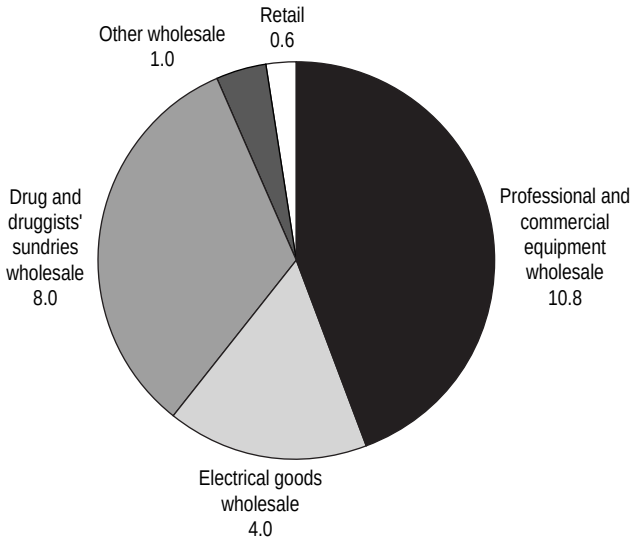
- **Professional and commercial equipment wholesalers [North American Industry Classification System (NAICS) 4214].** This industry comprises establishments primarily engaged in wholesaling photographic equipment and supplies; office, computer, and computer peripheral equipment; and medical, dental, hospital, ophthalmic, and other commercial and professional equipment and supplies. The computer and electronic products manufacturing industry (NAICS 334) manufactures these products.

- **Electrical good wholesalers (NAICS 4216).** This industry comprises establishments primarily engaged in wholesaling electrical apparatus and equipment, electrical appliances, televisions, and radios. The electrical equipment, appliances, and components manufacturing industry (NAICS 335) manufactures these products.

- **Drugs and druggists' sundries wholesalers (NAICS 4222).** This industry comprises establishments primarily engaged in wholesaling biological and medical products; botanical drugs and herbs; and pharmaceutical products intended for internal and external consumption in forms such as ampoules, tablets, capsules, vials, ointments, powders, solutions, and suspensions. The pharmaceuticals and medicines manufacturing industry (NAICS 3254) manufactures these products.

Using the assumption that the R&D reported in a trade industry is more closely aligned with the manufacturing of the product being sold than the trade activity itself, it is possible to redistribute almost all of the $24.4 billion of trade R&D into manufacturing industries. Figure 14 illustrates the effect of redistributing the $22.8 billion of R&D in the above three wholesale trade industries into their corresponding manufacturing industries. After the redistribution, the R&D within the computer and electronic products manufacturing industries exceeds all nonmanufacturing R&D combined.

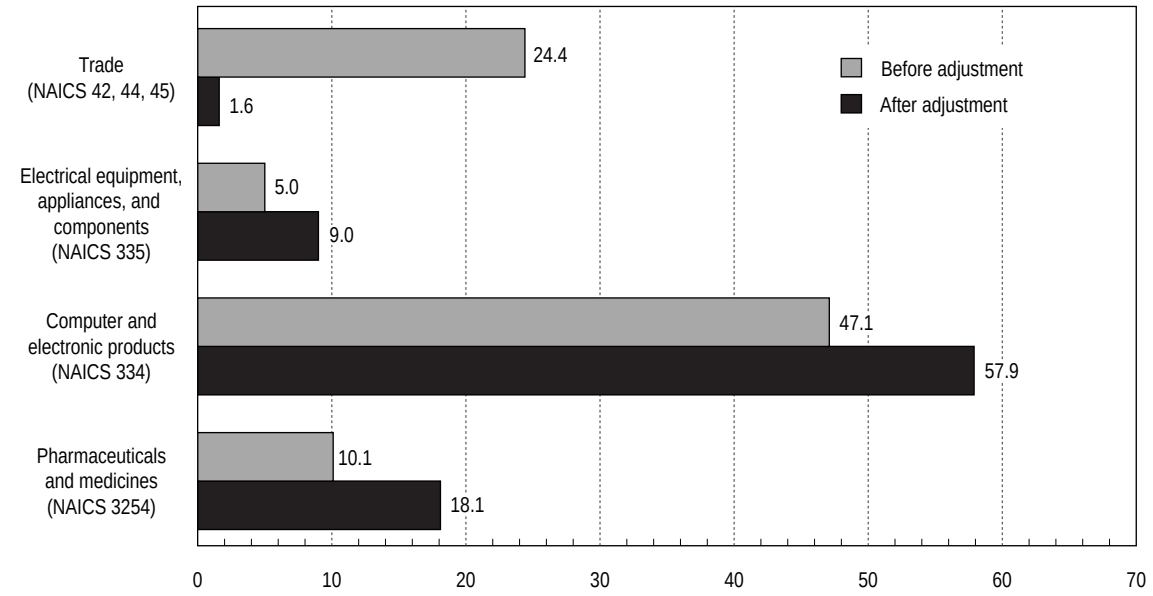
FIGURE 13. Trade industry research and development detail: 2001
(Billions of dollars)



SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development, 2003.

Redistributing Trade R&D (Continued)

FIGURE 14. Effect of redistributing trade research and development, by impacted industry: 2001
(Billions of dollars)



NAICS North American Industry Classification System

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development, 2003.

Although a great deal of R&D in the United States is related in some way to health care, companies specifically categorized in the health care services sector accounted for only 0.4 percent of all industrial R&D. In many industries, innovation often results from R&D performed in other industries. This is especially true with respect to health care where R&D in the pharmaceutical, scientific instrument, and software industries all play a role. This illustrates how R&D data disaggregated according to industrial categories (including the distinction between manufacturing and nonmanufacturing industries) may not always reflect the relative proportions of R&D devoted to particular types of scientific or engineering objectives or to particular fields of science or engineering.

R&D IN MANUFACTURING INDUSTRIES

Within the manufacturing industries, three groups dominate: computer and electronic products, transportation equipment, and chemicals (table 5). In 2001 computer and electronic products accounted for the largest amount of R&D performed among all industries at $47.1 billion, or 23.7 percent of all industrial R&D and 39.0 percent of all manufacturing R&D. For this subsector, industrial firms provided $41.2 billion in R&D support and the Federal Government funded the remainder. Reclassifying the R&D of *wholesalers* of computer and electronic products into manufacturing increases the R&D of this group of industries to $57.9 billion, or 29.2 percent of all industrial R&D. (See sidebar, "Redistributing Trade R&D.")

In 2001 transportation equipment accounted for the second most R&D performed in the manufacturing sector at $26.0 billion, or 13.1 percent of all industrial R&D. Of these expenditures, 19.1 percent was federally funded, primarily for R&D on aerospace products (planes, missiles, and space vehicles). In addition to aerospace products, this subsector includes a variety of other forms of transportation equipment, such as motor vehicles, ships, military armored vehicles, locomotives, and smaller vehicles such as motorcycles, bicycles, and snowmobiles.

TABLE 6. Estimated share of company-funded research and development and domestic net sales accounted for by computer-related services industries: 1987–2001
(Percent)

Year	Company-funded R&D	Domestic net sales
1987	3.8	1.4
1988	3.6	1.5
1989	3.4	1.4
1990	3.7	1.5
1991	3.6	1.6
1992	4.0	1.6
1993	8.2	1.5
1994	6.6	2.2
1995	8.8	3.3
1996	8.8	2.6
1997	9.1	2.5
1998	9.5	2.2
1999	10.7	2.6
2000	12.1	2.9
2001	13.2	3.5

R&D research and development

NOTES: Data before 1998 are for companies classified in Standard Industrial Classification (SIC) industries 737 (computer and data processing services) and 871 (engineering, architectural, and surveying services). For 1998 and later years, data are for companies classified in North American Industry Classification System (NAICS) industries 5112 (software), 51 (minus 511, 513) (other information), and 5415 (computer systems design and related services). Using SIC classification, the computer-related services share of company-funded R&D is 10.4 percent for 1998, indicating that SIC-based data are overestimates of actual computer-related services R&D and net sales.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development, 1987–2001.

In 2001 chemicals ranked third in R&D performed in the manufacturing subsector at $17.9 billion, approximately 1 percent of which was federally funded. In terms of R&D performance, the largest industry within the chemicals subsector is pharmaceuticals and medicines. In 2001 R&D performed by these companies accounted for 57 percent of non-Federal R&D funding in the chemicals subsector ($10.1 billion). Reclassifying the R&D of *wholesalers* of drugs and druggists' sundries into manufacturing increases the R&D of pharmaceuticals and medicines to $18.1 billion and the R&D of chemicals to $25.9 billion, or 13.0 percent of all industrial R&D. (See sidebar "Redistributing Trade R&D.")

Industrial R&D and Firm Size

Manufacturing R&D performers tend to be larger firms that perform more R&D on average than nonmanufacturing firms (table 8). As a share of the nation's GDP, manufacturing contributes less than 20 percent, but manufacturing industries account for 61 percent of total industrial R&D performance. Of the approximately 33,000 firms in the United States that performed R&D in 2001, 51 percent were in the manufacturing sector. Manufacturers dominate in terms of R&D performance largely because of the activities of the largest manufacturing firms. In 2001 the largest manufacturing firms (those with 25,000 or more employees) accounted for 49 percent of the R&D in the manufacturing sector, whereas nonmanufacturing firms in the same size category accounted for only 25 percent of total nonmanufacturing R&D.[22]

Among smaller R&D-performing firms (those with fewer than 500 employees), those in the nonmanufacturing sector conduct significantly more R&D than those in the manufacturing sector, both in aggregate and on a per-firm basis. These firms accounted for 12 percent of manufacturing R&D, 31 percent of nonmanufacturing R&D, and 19 percent of all industrial R&D in 2001.

Although R&D tends to be performed by large firms in the manufacturing sector and smaller firms in the nonmanufacturing sector, considerable variation can be found within each sector, depending on the type of industry. R&D tends to be conducted primarily by large firms in several industrial subsectors: aircraft and missiles; electrical equipment; professional and scientific instruments; transportation equipment (not including aircraft and missiles); and transportation and utilities, which are in the nonmanufacturing sector. In these same sectors, however, much of the economic activity occurs in large firms to begin with, so the observation that most of the R&D in these sectors is also conducted by large firms is not surprising.

R&D Intensity

In addition to absolute levels of and changes in R&D expenditures, another key indicator of industrial commitment to science and technology (S&T) is R&D intensity, a measure of R&D relative to production in a company, industry, or sector. For most firms, R&D is a discretionary expense in the sense that it is not directly related to short-term revenues. Since R&D does not directly generate revenue in the same way that production

[22]R&D performance is even more skewed toward companies with large R&D programs (total R&D of $100 million or more). The 243 firms in this category accounted for 73 percent of manufacturing R&D, 56 percent of nonmanufacturing R&D, and 67 percent of all industrial R&D in 2001.

Biotechnology R&D in Industry

Of particular interest to researchers, investors, and policymakers are the R&D activities of companies in emerging, fast-growing sectors of science and technology such as biotechnology. Unfortunately, the rapidly evolving and often multidisciplinary nature of these sectors makes them very difficult to track as unique industry categories. In 2001, for the first time, NSF collected data on industrial R&D for biotechnology and other select technology areas on its NSF Survey of Industrial Research and Development (only companies with estimated total R&D of at least $5 million in 2000 were asked to report R&D by technology area in 2001). Although many companies were unable or unwilling to report their R&D activities by technology area, the data reported reveal much about the structure of biotechnology R&D in the United States. As table 7 illustrates, the scientific R&D services industry accounted for slightly more than half of thereported $7.4 billion of biotechnology R&D. Many biotechnology firms that perform contract R&D for pharmaceutical companies are classified as part of this industry. Biotechnology R&D accounts for at least a quarter of all R&D in this industry and accounted for at least 3.7 percent of total U.S. industrial R&D in 2001. The $1.1 billion of biotechnology R&D reported in the trade industry is likely attributable to the activities of pharmaceutical firms, which devote considerable resources to marketing and selling their products. (See sidebar, "Redistributing Trade R&D.") Companies with fewer than 5,000 employees performed nearly three-fourths of the reported biotechnology R&D, whereas companies in this size bracket performed only 38 percent of total industrial R&D in 2001.

TABLE 7. Total research and development and estimated lower bound biotechnology research development, by industry and company size: 2001

Industry and size of company	R&D (millions of dollars)		Percent biotechnology/ total R&D
	Total	Biotechnology	
All industries	198,505	7,350	3.7
Manufacturing	120,705	2,193	1.8
Pharmaceuticals and medicines	10,137	1,882	18.6
Nonmanufacturing	77,799	5,157	6.6
Trade	24,372	1,104	4.5
Scientific R&D services	14,244	3,846	27.0
Company size (number employees)			
Total	198,505	7,350	3.7
5–24	4,828	0	0.0
25–49	3,750	118	3.1
50–99	8,202	398	4.9
100–249	12,916	869	6.7
250–499	8,702	533	6.1
500–999	10,564	1,300	12.3
1,000–4,999	26,748	2,155	8.1
5,000 or more	122,796	1,977	1.6

R&D research and development

NOTES: Details may not add to totals because of rounding. Data for biotechnology R&D are underestimated because no attempt was made to correct for item nonresponse. Counts of respondents suggest that actual figures could be much larger. Also, these totals exclude biotechnology R&D of firms whose total R&D was less than $5 million in 2000. These firms were not asked to report their biotechnology R&D separately on the 2001 survey form. This may be the main reason firms with 5–24 employees have no reported biotechnology R&D.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development, 2001.

TABLE 8. Funds for industry research and development performance and number of companies performing research and development in manufacturing and nonmanufacturing industries, by size of company: 2001

Company size (number of employees)	Funds (millions of dollars)			Number of companies		
	Total	Manufacturing	Nonmanufacturing	Total	Manufacturing	Nonmanufacturing
Total	198,505	120,705	77,799	33,263	16,817	16,446
5–25	4,828	973	3,855	14,681	5,802	8,879
25–49	3,750	1,123	2,627	5,036	2,013	3,023
50–99	8,202	3,924	4,278	5,030	3,209	1,820
100–249	12,916	4,817	8,099	4,261	2,817	1,444
250–499	8,702	3,345	5,357	1,504	1,040	464
500–999	10,564	5,290	5,273	1,194	851	343
1,000–4,999	26,748	15,828	10,919	1,039	755	284
5,000–9,999	17,487	10,918	6,569	244	164	80
10,000–24,999	27,065	15,647	11,418	156	97	60
25,000 or more	78,244	58,840	19,404	118	68	50

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development, 2001.

expenses do, companies can trim their R&D budgets when profits fall. Evidence suggests, however, that R&D enjoys some degree of immunity from belt-tightening endeavors, even when the economy is faltering, because of its crucial role in laying the foundation for future growth and competitiveness.

Many ways exist to measure R&D intensity; the one used most frequently is the ratio of company-funded R&D to net sales.[23] This statistic provides a way to gauge the relative importance of R&D across industries and among firms in the same industry. The industrial subsectors with the highest R&D intensities in 2001 were scientific R&D services (36.5 percent), software (19.3 percent), communications equipment (16.6 percent), and computer systems design and related services (16.5 percent). The R&D intensities of the professional, scientific, and technical services industries are particularly high because, as previously explained, much of the R&D reported by these companies also appears in their reported sales figures because the R&D activity is the product being sold. Industries with the lowest R&D intensities (0.5 percent or less) were food, broadcasting and telecommunications, and utilities (table 9). A decrease in the net sales of R&D-performing companies between 2000 and 2001 resulted in the ratio of R&D to sales for all industries increasing to 3.8 percent in 2001, up from 3.4 percent in 2000.

Although overall industrial R&D intensity increased between 2000 and 2001, the R&D intensity of very small companies (less than 100 employees) declined. These companies, on average, have much higher R&D-to-sales ratios than larger companies (table 9) because they include a large number of startups and young companies with less established revenue streams. Large, well-established companies often have reserves of cash and other liquid assets that allow them to maintain their R&D activities amid short-term economic downturns. Less mature companies, however, tend to be more reliant on outside investment and thus their expenditures on R&D are more likely to be cut in the event of a contraction in the economy or capital markets. This is one explanation for the divergence in the R&D intensities of very small companies and all other companies between 2000 and 2001.

Federal R&D Performance

Based on data from R&D performers, Federal agencies and FFRDCs performed a projected $37.1 billion of total U.S. R&D in 2003 (table 1), an average annual increase in real terms of 9.3 percent from the 2000 level of $27.1 billion.[24] Among individual agencies, DOD continued to perform the most intramural R&D and is expected to account for more than half of all Federal obligations for intramural R&D in the future. In FY 2003, DOD is expected to perform more than twice the R&D of the second largest R&D-performing agency,

[23] A similar measure of R&D intensity is the ratio of R&D to *value added* (sales minus the cost of materials). Value added is often used in studies of productivity because it allows analysts to focus on the economic output attributable to the specific industrial sector in question by subtracting materials produced in other sectors. For a discussion of the connection between R&D intensity and technological progress, see, for example, R. Nelson, "Modeling the connections in the cross section between technical progress and R&D intensity," *RAND Journal of Economics* 19(3) (Autumn 1988): 478–485.

[24] Federal intramural R&D obligations are interpreted as R&D performance expenditures for the purpose of this analysis.

TABLE 9. Company and other (non-Federal) research and development as share of net sales in companies performing research and development, by industry and company size: 2000, 2001
(Percent)

Industry and company size	2000	2001
Industry		
All industries	3.4	3.8
Manufacturing	3.3	3.6
Communications equipment	10.1	16.6
Semiconductor and other electronic components	7.4	10.5
Medical equipment and supplies	12.9	9.0
Pharmaceuticals and medicines	9.6	7.8
Computers and peripheral equipment	6.4	7.6
Navigational, measuring, electromedical, and control instruments	8.0	7.3
Resin, synthetic rubber, fibers, and filament	5.6	4.5
Machinery	3.8	4.2
Motor vehicles, trailers, and parts	3.2	3.5
Other chemicals	3.8	3.2
Aerospace products and parts	2.8	3.0
Electrical equipment, appliances, and components	2.2	2.9
Plastics and rubber products	1.4	2.9
Nonmetallic mineral products	1.8	2.3
Basic chemicals	2.3	2.2
Paper, printing, and support activities	1.6	2.1
Fabricated metal products	1.5	1.6
Furniture and related products	0.8	0.9
Primary metals	0.5	0.7
Food	0.4	0.5
Nonmanufacturing	3.8	4.0
Scientific R&D services	34.4	36.5
Software	20.4	19.3
Computer systems design and related services	15.8	16.5
Management of companies and enterprises	4.4	7.8
Trade	5.4	6.2
Architectural, engineering, and related services	7.3	5.2
Health care services	3.2	4.1
Newspaper, periodical, book, and database	2.0	2.7
Transportation and warehousing	0.3	2.4
Construction	1.8	1.4
Mining, extraction, and support activities	1.2	1.3
Finance, insurance, and real estate	1.2	0.7
Broadcasting and telecommunications	0.4	0.5
Utilities	0.1	0.0
Company size (number of employees)		
5–24	17.2	12.9
25–49	13.4	10.6
50–99	11.2	10.4
100–249	8.0	10.8
250–499	6.1	8.0
500–999	4.7	5.7
1,000–4,999	3.5	4.2
5,000–9,999	2.2	2.5
10,000–24,999	3.1	3.5
25,000 or more	2.9	3.0

R&D research and development

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development, 2001.

HHS, which performs most of its intramural R&D at NIH (table 10).

DOE sponsors the most FFRDCs of any agency—16 of the 36. These 16 FFRDCs performed a total of $8.7 billion of R&D in FY 2002, approximately three-fourths of all the R&D performed by FFRDCs (appendix table B-15). First established during World War II, FFRDCs are unique organizations that help the U.S. government meet special long-term research or development goals that cannot be met as effectively by in-house or contractor resources. The *Federal Register* states that an FFRDC is required "to operate in the public interest with objectivity and independence, to be free from organizational conflicts of interest, and to have full disclosure of its affairs to the sponsoring agency" (National Archives and Records Administration 1990). Total R&D performed by all FFRDCs (projected to be $12.2 billion in 2003) has grown at a real annual rate of 8.1 percent from its level of $9.2 billion in 2000 (appendix table B-1).

Besides performing R&D directly and funding R&D within other sectors as discussed earlier, the Federal Government also encourages R&D activity indirectly in the form of tax incentives. (See sidebar, "Federal R&D Tax Credit.")

TABLE 10. Federal research and development obligations, total, intramural, and federally funded research and development centers, by U.S. agency: FY 2003

Agency	Federal R&D obligations (millions of dollars)			Percent agency intramural or FFRDC R&D
	Total	Intramural[a] R&D	FFRDC R&D	
All Federal Government	98,608.1	24,557.7	7,534.6	32.5
Department of Defense	45,011.7	12,409.0	851.3	29.5
Department of Health and Human Services	27,551.1	5,162.4	403.9	20.2
National Aeronautics and Space Administration	8,598.3	2,149.6	1,405.3	41.3
Department of Energy	7,540.7	764.4	4,609.3	71.3
National Science Foundation	3,403.6	19.4	197.5	6.4
Department of Agriculture	1,984.3	1,367.2	0.0	68.9
Department of Commerce	1,064.5	838.0	2.9	79.0
Environmental Protection Agency	627.0	283.8	0.0	45.3
Department of Transportation	622.0	192.3	24.8	34.9
Department of the Interior	594.1	534.8	0.0	90.0
Department of Veterans Affairs	363.7	363.7	0.0	100.0
Department of Education	304.5	14.4	0.0	4.7
International Development Cooperation Agency	281.0	27.5	0.0	9.8
Department of Labor	176.8	154.9	0.0	87.6
Department of Justice	117.6	43.2	3.4	39.6
Smithsonian Institution	115.0	115.0	0.0	100.0
Department of the Treasury	80.4	64.4	0.0	80.1
Nuclear Regulatory Commission	68.0	18.7	36.1	80.6
Department of Housing and Urban Development	47.7	23.6	0.0	49.5
Social Security Administration	45.5	4.4	0.0	9.7
Library of Congress	3.5	2.5	0.0	71.4
Department of State	2.5	0.6	0.0	24.0
Federal Communications Commission	2.2	2.2	0.0	100.0
Federal Trade Commission	1.4	1.4	0.0	100.0
Appalachian Regional Commission	0.7	0.0	0.0	0.0
Broadcasting Board of Governors	0.1	0.1	0.0	100.0
National Archives and Records Administration	0.1	0.1	0.0	100.0

FFRDC federally funded research and development center
R&D research and development

[a] Intramural activities include actual intramural R&D performance and costs associated with planning and administration of both intramural and extramural programs by Federal personnel.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Federal Funds for Research and Development: FY 2001, 2002, and 2003.

Federal R&D Tax Credit

The Federal research and experimentation (R&E) tax credit was first established on a temporary basis in 1981 and has been renewed over ten times since through various tax legislation. It was last reinstated by the Tax Relief Extension Act of 1999 through June 30, 2004. As of this writing, legislation is pending to further extend the R&E credit.

A regular credit is provided for 20 percent of qualified research above a base amount based on the ratio of research expenses to gross receipts for 1984–88. Startup or younger companies follow different formulas. An alternative R&E credit is available for corporate fiscal years that began after June 30, 1996. Both the regular and the alternative R&E credits include provisions for basic research payments paid to qualified universities or scientific research organizations above a certain base-period amount.

In 1999 approximately 10,000 companies claimed $5.281 billion in R&E credits, about the same level as in 1998 (table 11). However, not all R&E claims are allowed because there is a limitation on the reduction of a company's total tax liability. In 1999, 267 companies claimed $540 million for basic research, about 10 percent of the total R&E credit. The 1999 basic research credits were 36 percent larger than those in 1998, but the number of claims declined by half.

R&E credits are tax expenditures or government revenue losses because of preferential provisions.

Table 11. Research and experimentation tax credit claims: 1990–99

Year	Billions of current dollars	Number of tax returns
1990	1.547	8,699
1991	1.585	9,001
1992	1.515	7,750
1993	1.857	9,933
1994	2.423	9,150
1995	1.422	7,877
1996	2.134	9,709
1997	4.398	10,668
1998	5.208	9,849
1999	5.281	10,020

SOURCE: U.S. Department of the Treasury, Internal Revenue Service, Statistics of Income, unpublished tabulations.

Tax expenditures from corporate income taxes relate mostly to cost recovery for certain investments, including research activities. One accounting method used to estimate the impact of a tax credit is called outlay-equivalent. This method converts R&E credits into data comparable to Federal R&D outlays.

According to this measure, tax credit claims in 1999 were equivalent to outlays of $2.625 billion, or 3.5 percent of direct Federal R&D outlays in 1999 (appendix table B-16). Although R&E claims data for tax year 2000 are not yet released, the credit generated an estimated outlay equivalent of $2.510 billion, or 3.4 percent, of Federal R&D outlays in 2000.

University and College R&D Performance

Universities and colleges performed a projected $40.3 billion of R&D in 2003, an average annual increase in real terms of 7.9 percent from the 2000 level of $30.6 billion. The Federal Government is the largest source of support for academic research in the United States, funding an estimated 60.8 percent ($24.5 billion) of academic R&D in 2003. The next largest source of support for academic R&D is university-own funds (19.7 percent in 2003) followed by nonprofit institutions (7.4 percent), state and local governments (6.7 percent), and industry (5.3 percent).

Although industrial firms provide only a small portion of the R&D funding at U.S. universities and colleges, their funding of academic research has grown faster than any other sector over the past 2 decades. Between 1980 and 2000, industry's funding of academic R&D grew at an average annual rate of 7.7 percent after adjusting for inflation, outpacing total academic R&D, which grew at an average annual rate of 4.7 percent over the same period. After adjusting for inflation, industry's funding of academic R&D declined at an average annual rate of 2.2 percent between 2000 and 2003, lessening at about the same rate as industry's R&D funding of industrial R&D.

Funding by Type of Institution

Although both public and private colleges and universities rely on the same funding sources for their R&D, the relative importance of those sources differs substantially for these two types of institutions (figure 15). For all public academic institutions combined, just over 9 percent of R&D funding in 2001 came from state and local governments, about 25 percent came from institutions, and about 52 percent came from the Federal Government. Private academic institutions received a much smaller portion of their R&D funding from state and local governments (about 2 percent) and institutional sources (about 10 percent) and a much larger share from the Federal Government (72 percent). The large difference in the role of institutional funds at public and private institutions is most likely due to a substantial amount of general-purpose state and local government funds that public institutions receive and decide to use for R&D (although data on such breakdowns are not collected). Both public and private institutions received approximately 7 percent of their respective R&D support from industry in 2001. Over the past 2 decades, the Federal share of support has declined, and the industry and institutional shares have increased for both public and private institutions.

Distribution of R&D Funds Across Academic Institutions

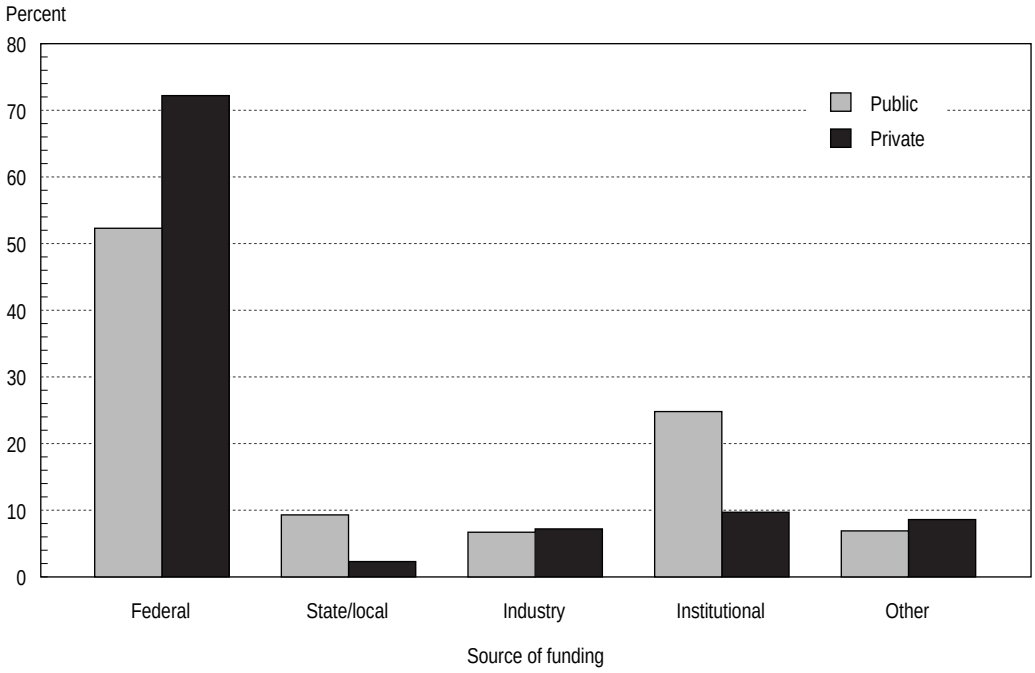
Most academic R&D is now, and has been historically, concentrated in relatively few of the 3,600 U.S. institutions of higher education.[25] The top 200 institutions ranked by total R&D expenditures accounted for about 96 percent of 2001 R&D expenditures. In 2001:

- The top 10 institutions spent 17 percent of total academic R&D funds ($5.5 billion).
- The top 20 institutions spent 30 percent ($9.8 billion).
- The top 50 spent 57 percent ($18.6 billion).
- The top 100 spent 80 percent ($26.3 billion).

The historic concentration of academic R&D funds diminished somewhat between the mid-1980s and mid-1990s but has remained relatively steady since then (figure 16). In 1985, the top 10 institutions received about

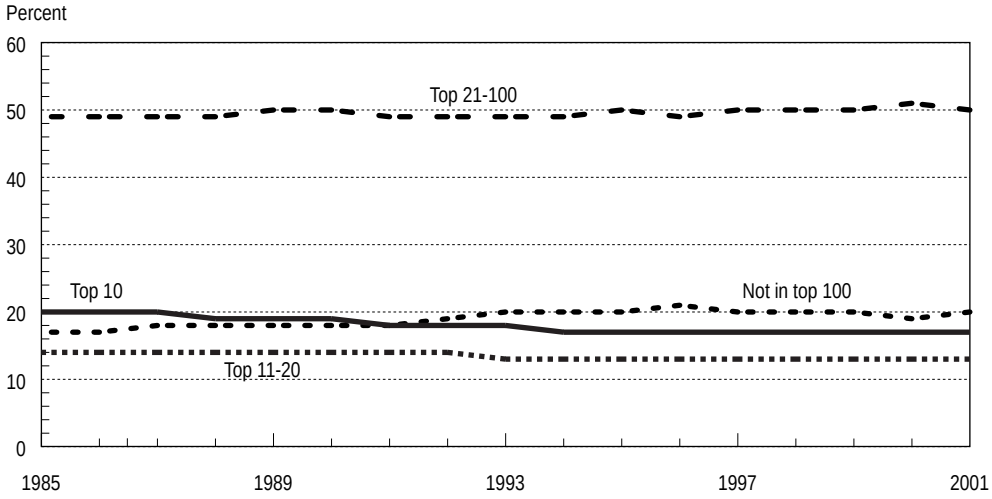
[25]The Carnegie Foundation for the Advancement of Teaching classified about 3,600 degree-granting institutions as higher education institutions in 1994.

FIGURE 15. Sources of research and development funding for public and private academic institutions: 2001



SOURCE: National Science Foundation, Division of Science Resources Statistics, *Academic Research and Development Expenditures: Fiscal Year 2001* (Arlington, VA, 2003).

FIGURE 16. Share of academic research and development of universities and colleges, by rank of academic research and development expenditures: 1985–2001



SOURCE: National Science Foundation, Division of Science Resources Statistics, A*cademic Science and Engineering R&D Expenditures: Fiscal Year 2001*, special tabulations.

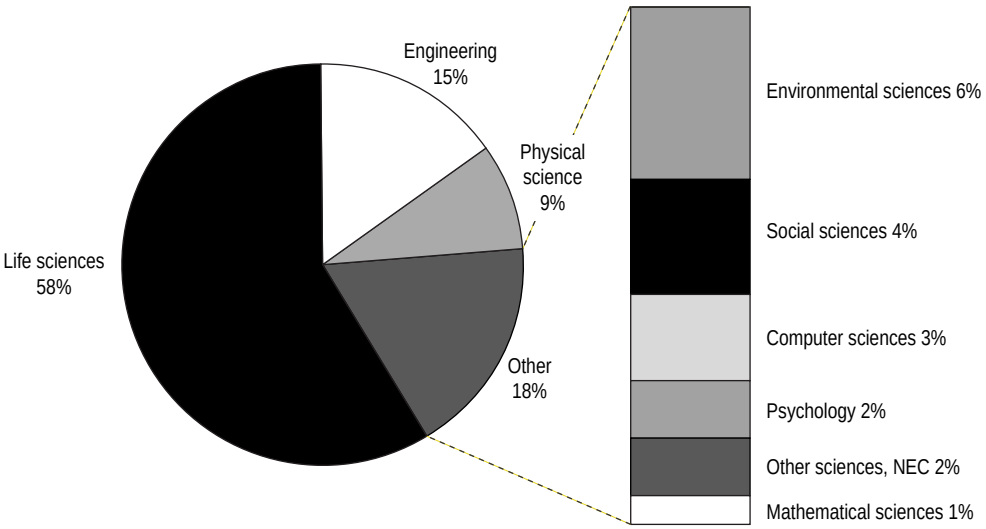
20 percent of the nation's total academic R&D expenditures and the top 11–20 institutions received 14 percent, compared with 17 and 13 percent, respectively, in 2001. The composition of the universities in the top 20 also fluctuated slightly from 1985 to 2001. There was almost no change in the share of the group of institutions ranked 21–100 during this period. The decline in the top 20 institutions' share was matched by an increase in the share of those institutions in the group that were not in the top 100. This group's share increased from 17 to 20 percent of total academic R&D funds, signifying a broadening of the base.

Funding by S&E Field

Many universities and colleges are able to report their total and federally financed R&D expenditures for separate fields of science and engineering. The majority of academic R&D expenditures are devoted to the life sciences (figure 17)—approximately four times the expenditures for the next largest field, engineering. Despite dramatic growth in Federal funding of R&D in the life sciences (particularly from NIH), Federal funding represents a smaller share of total R&D in this field than in many others. R&D in the physical sciences, mathematical sciences, and psychology, for example, show a higher concentration of Federal funding. The social sciences is the only group of fields that receives less than half of its funding from Federal sources (NSF, Division of Science Resources Statistics 2003).

Although there is no detailed information about the various non-Federal sources of academic R&D funding broken out by S&E field, it is possible to make some general observations. Agricultural sciences (a subset of life sciences) R&D, for example, is concentrated in public universities and colleges and receives most of its funding from non-Federal sources. It is fair to assume that most of this non-Federal funding comes from state and local governments and university-own funds. There also appears to be a correlation between industry funding and both medical sciences (a subset of life sciences) and engineering. Conversations with representatives of several large research universities confirmed that, at least for these schools, industry-funded R&D is concentrated in the fields of medical sciences and engineering.

FIGURE 17. Academic research and development, by field of science and engineering: FY 2001



NEC Not elsewhere classified

NOTE: Percents may not sum to 100 because of rounding.

SOURCE: National Science Foundation, Division of Science Resources Statistics, *Academic Research and Development Expenditures: Fiscal Year 2001* (Arlington, VA 2003).

R&D Performance by State

The latest data available on the state distribution of R&D performance are for 2001. R&D, like other economic activities, is concentrated in a handful of states. Patterns of R&D activities vary considerably among these top R&D-performing locations. In 2001 total U.S. R&D expenditures were $274 billion, of which $256 billion could be attributed to expenditures within individual states, with the remainder falling under an undistributed "other/unknown" category (appendix table B-17). These totals include R&D performed by industry, universities, Federal agencies, and nonprofit organizations.

Distribution of R&D Expenditures Among States

In 2001 the 20 highest-ranking states in R&D expenditures accounted for 85 percent of U.S. R&D expenditures, whereas the 20 lowest ranking states accounted for only 5 percent. The five states with the highest levels of R&D expenditures (in decreasing order of magnitude) were California, Michigan, Massachusetts, New York, and Texas, and they accounted for over 40 percent of the entire national effort. The top 10 states, which included New Jersey, Maryland, Pennsylvania, Illinois, and Washington (ranked 6th through 10th), accounted for almost two-thirds of U.S. R&D expenditures in 2001 (table 12). California alone accounted for one-fifth of the $256 billion U.S. R&D total, exceeding the next highest state by over a factor of three.[26]

[26]Reliability of the estimates of industrial R&D varies by state because the NSF Survey of Industrial Research and Development was not designed to produce estimates at that level of geographic detail in 2001. Rankings do not take into account the margin of error of estimates from sample surveys.

TABLE 12. Top 10 states in research and development performance, research and development by sector, and research and development as percentage of gross state product: 2001

			States with highest R&D performance, by sector			R&D intensity (highest R&D/GSP ratio)		
Rank	State	Total R&D[a] (millions of current dollars)	Industry[b]	U&C[c]	Federal Government and FFRDCs[d]	State	R&D/GSP (percent)	GSP (billions of current dollars)
1	California	50,959	California	California	Maryland	New Mexico	7.12	55.4
2	Michigan	15,533	Michigan	New York	California	Maryland	5.84	195.0
3	Massachusetts	14,665	Massachusetts	Texas	New Mexico	Massachusetts	5.10	287.8
4	New York	14,422	New York	Pennsylvania	Virginia	Michigan	4.85	320.5
5	Texas	12,722	New Jersey	Maryland	District of Columbia	Washington	4.65	223.0
6	New Jersey	11,392	Texas	Massachusetts	Ohio	Oregon	4.54	120.1
7	Maryland	11,379	Pennsylvania	Illinois	Alabama	Rhode Island	4.28	36.9
8	Pennsylvania	11,156	Washington	North Carolina	Illinois	District of Columbia	3.94	64.5
9	Illinois	10,472	Illinois	Michigan	Florida	California	3.75	1,359.3
10	Washington	10,372	Ohio	Florida	Massachusetts	Idaho	3.41	36.9

FFRDC federally funded research and development center; GSP gross state product; R&D research and development; U&C universities and colleges

[a] Includes in-state total R&D performance of industry, universities, Federal agencies, FFRDCs, and federally financed nonprofit R&D.

[b] Excludes R&D activities of industry-administered FFRDCs located within these states.

[c] Excludes R&D activities of university-administered FFRDCs located within these states.

[d] Includes costs associated with administration of intramural and extramural programs by Federal personnel and actual intramural performance.

NOTES: Reliability of estimates of industry R&D varies by state because the survey was not designed to make estimates based on geography. Rankings do not take into account margin of error of estimates from sample surveys.

SOURCES: National Science Foundation, Division of Science Resources Statistics, *National Patterns of R&D Resources* (Arlington, VA, annual series); and U.S. Bureau of Economic Analysis, U.S. Department of Commerce, http://www.bea.gov/bea/newsrel/gspnewsrelease.htm, 2003. See table B-17.

Ratio of R&D to Gross State Product

States vary significantly in the size of their economies because of differences in geographic location, population, land area, infrastructure, natural resources, and history. Consequently, state variations in R&D expenditure levels may simply reflect differences in economic size or the nature of their R&D efforts. One way to control for the size of each state's economy is to measure each state's R&D level as a percentage of its gross state product (GSP).[27] Like the ratio of industrial R&D to net sales, the proportion of a state's GSP devoted to R&D is an indicator of R&D intensity. New Mexico, one of the smaller states in terms of GSP, had the highest R&D/GSP of any state in 2001 (table 12), attributable to the activities of Los Alamos National Laboratory and Sandia National Laboratory, which together accounted for approximately three-fourths of the state's R&D. A list of states and corresponding R&D intensities can be found in appendix table B-17.

Sector Distribution of R&D Performance by State

Although leading states in total R&D tend to be well represented in each of the major R&D-performing sectors, the proportion of R&D performed in each of these sectors varies across states. States that are national leaders in total R&D performance are usually leaders in R&D performance by industrial sector, which is not surprising because industry-performed R&D accounts for 74 percent of the distributed U.S. total. University-performed R&D accounts for only 13 percent of the distributed U.S. total and is highly correlated with the total R&D performance in a state.

Federally performed and FFRDC R&D has less of a correlation with total R&D performance in a state.[28] Only 4 of the top 10 states ranked by Federal intramural and FFRDC R&D are among the top 10 states by total R&D: Maryland, California, Illinois, and Massachusetts. Maryland ranked first in Federal intramural and FFRDC R&D performance, followed by California, New Mexico, Virginia, and the District of Columbia. The inclusion of Maryland, Virginia, and the District of Columbia in the top five ranking reflects the concentration of Federal facilities and administrative offices within the national capital area. Alabama, Florida, and New Mexico rank among the highest in Federal intramural and FFRDC R&D because of their relatively high shares of Federal space- and defense-related R&D.

Industrial R&D in Top States

The types of companies performing R&D vary considerably among the 10 leading states in industrial R&D (table 13). This reflects regional specialization or clusters of industrial activity. For example, in Michigan manufacturing industries accounted for 93 percent of industrial R&D in 2001. This reflects a high concentration of transportation equipment manufacturers, which accounted for 78 percent of Michigan's industrial R&D in 2001, whereas this industry accounted for only 13 percent of the nation's total industrial R&D. Washington, having a high concentration of software R&D, has less of its industrial R&D concentrated in manufacturing industries than the nation as a whole. Over half the nation's software industry R&D is carried out by companies in California and Washington.

The computer and electronic products industry accounts for 24 percent of the nation's total industrial R&D but accounts for a larger share of the industrial R&D in Massachusetts (42 percent) and Texas (42 percent). These two states along with California perform over 40 percent of the nation's computer and electronic products R&D. These three states have clearly defined regional centers of high-technology research and manufacturing: Silicon Valley in California, Route 128 in Massachusetts, and the Silicon Hills of Austin in Texas.

[27]Gross state product (GSP) is often considered the state counterpart of the nation's GDP. GSP is estimated by summing the *value added* of each industry in a state. Value added for an industry is equivalent to its gross output (sales or receipts and other operating income, commodity taxes, and inventory change) minus its intermediate inputs (consumption of goods and services purchased from other U.S. industries or imported). U.S. Bureau of Economic Analysis, *Gross State Product by Industry for 2001: U.S. Economic Slowdown was Widespread* (Washington, DC, 2003). (See http://www.bea.gov/bea/newsrel/gspnewsrelease.htm.)

[28]Federally performed R&D includes costs associated with the administration of intramural and extramural programs by Federal personnel as well as actual intramural performance.

In addition, New York, New Jersey, and Pennsylvania, each home to robust chemical, including pharmaceutical, manufacturing industries, show much higher concentrations of R&D in these industries than the nation as a whole. Of course, other factors besides the location of industrial production also play a role in the location of industrial R&D activities. For example, industries tend to perform research near universities that conduct the same type of research, enabling them to benefit from local academic resources. This may explain why California and Massachusetts together account for over half of the nation's R&D in the scientific R&D services industry.

TABLE 13. Top 10 states in industry-performed research and development and share of research and development, by selected industries: 2001

State	Industry-performed R&D (millions of current dollars)	Share of state's industry-performed R&D (percent)				
		Manufacturing industries plus trade	Nonmanufacturing industries less trade	Computer and electronic products	Chemicals	Scientific R&D services
Total	198,505	73.1	26.9	23.7	9.0	7.2
California	40,430	63.6	36.4	25.9	3.5	15.6
Michigan	14,283	93.3	6.7	2.6	3.9	1.6
Massachusetts	11,240	68.9	31.1	41.5	7.1	13.8
New York	10,884	72.8	27.2	22.6	19.0	4.2
New Jersey	10,164	70.1	29.9	19.3	29.9	3.8
Texas	9,839	76.7	23.3	41.6	6.0	3.0
Pennsylvania	8,967	86.5	13.5	22.4	19.2	4.5
Washington	8,691	31.1	68.9	5.0	2.1	10.8
Illinois	8,232	89.0	11.0	38.2	16.3	1.0
Ohio	6,694	72.7	27.3	10.2	6.0	14.8
All other states	69,080	76.8	23.2	24.3	8.4	3.8

R&D research and development

NOTES: Reliability of estimates of industry R&D varies by state because the survey was not designed to make estimates based on geography. Rankings do not take into account margin of error of estimates from sample surveys. Details will not add to total because not all industries are shown.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Industrial Research and Development, 2001.

INTERNATIONAL R&D TRENDS AND COMPARISONS

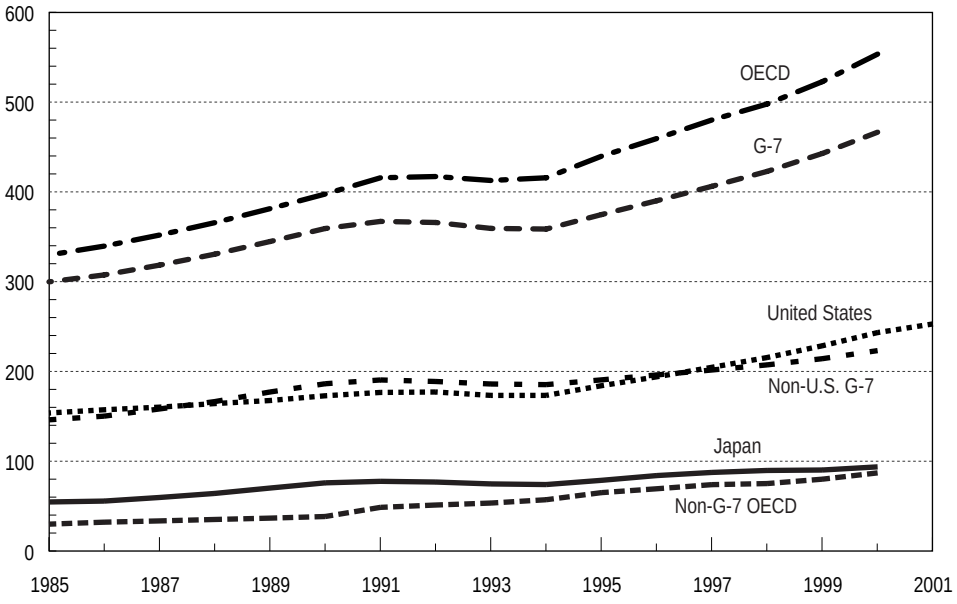
Worldwide R&D performance is concentrated in a few industrialized nations. Of the $603 billion in estimated 2000 R&D expenditures for the 30 member countries of the Organisation for Economic Co-operation and Development (OECD), fully 85 percent is expended in only 7 countries.[29] These estimates are based on reported R&D investments (for defense and civilian projects) converted to U.S. dollars with purchasing power parity (PPP) exchange rates.[30] (See sidebar, "Purchasing Power Parities: Preferred Exchange Rates for Converting International R&D Data.") R&D expenditures in the United States alone account for roughly 44 percent of all OECD member countries' combined R&D investments; R&D investments in the United States are 2.7 times greater than investments made in Japan, the second largest R&D-performing country. More money was spent on R&D activities in the United States in 2000 than in the rest of the "group of seven" (G-7) countries (Canada, France, Germany, Italy, Japan, and the United Kingdom) combined. (See figure 18 and appendix table B-18 for inflation-adjusted PPP R&D totals for OECD and G-7 countries.) South Korea is the only other country that accounted for a substantial share of the OECD total (3.1 percent in 2000, which was higher than expenditures in either Canada or Italy). In only four other countries (the Netherlands, Australia, Sweden, and Spain) did R&D expenditures exceed 1 percent of the OECD R&D total.[31]

[29]Current members of the Organisation for Economic Co-operation and Development (OECD) are Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States.

[30]Although purchasing power parities technically are not equivalent to R&D exchange rates, they better reflect differences in countries' research costs than do market exchange rates.

[31]Data for 2000 were unavailable for Sweden, but in 1999 it accounted for 1.4 percent of the OECD total (OECD 2002a).

FIGURE 18. U.S., G-7, and Organisation for Economic Co-operation and Development countries research and development expenditures: 1985–2001



OECD Organisation for Economic Co-operation and Development
PPP purchasing power parity

NOTES: Non-U.S. G-7 countries are Canada, France, Germany, Italy, Japan, and the United Kingdom. 2001 data not available for OECD, G-7, non-U.S. G-7, Japan, and non-G-7 OECD.

SOURCE: OECD, *Main Science and Technology Indicators* (Paris, 2002).

Although non-OECD countries also fund and perform R&D, most of these national R&D efforts are comparatively small. The few reported exceptions in 2000 were China and Russia, whose R&D expenditures totaled $50.3 and $10.6 billion (PPP dollars), respectively; nondefense R&D expenditures in Israel totaled $5.6 billion (PPP dollars) (OECD 2002a).[32] Among non-OECD members of Red Iberomericana de Indicadores de Ciencia y Tecnologia (RICYT), the largest R&D expenditures are reported for Brazil ($4.6 billion in U.S. dollars at market exchange rates in 1999), Argentina ($1.3 billion in 2000), Chile ($0.4 billion in 2000), and Colombia ($0.2 billion in 2000) (RICYT 2002). The combined R&D expenditures of these seven countries (approximately $73 billion) are equivalent to about 12 percent of the OECD total, and about two-thirds of this is from China alone.

In terms of relative shares, U.S. R&D expenditures in 1984 reached historical highs of 55 percent of the G-7 total and 47 percent of the OECD total.[33] As a proportion of the G-7 total, U.S. R&D expenditures declined steadily to a low of 48 percent in 1991 and then increased to 52 percent in 2000. (See figure 18 for actual expenditure totals.) The U.S. share of total OECD expenditures for R&D has increased similarly. By 1994 the U.S. share had dropped to 42 percent of the OECD R&D total, partly the result of several countries joining OECD (thereby increasing the OECD R&D totals). The U.S. share climbed back to 44 percent of the OECD total by 2000 as a result of robust R&D growth in the United States.

Most of the increase in the U.S. percentage of total G-7 R&D expenditures after the early 1990s initially resulted from a worldwide slowing in R&D performance that was more pronounced in other countries. Although U.S. R&D spending stagnated or declined for several years in the early to mid-1990s, the reduction in real R&D spending in most of the other large R&D-performing countries was more striking. In Japan, Germany, and Italy, inflation-adjusted R&D spending fell for 3 consecutive years (1992, 1993, and 1994) at a rate exceeding the similarly falling rate in the United States.[34] In the late 1990s, R&D spending rebounded in several G-7 countries and in the United States. Because annual R&D growth was generally stronger in the United States than elsewhere, however, the U.S. percentage of total G-7 R&D spending continued to increase. Although the slowdown in the technology market in 2001 and 2002 has had a global reach, it remains to be seen whether the sharp slowdown in U.S. R&D expenditures in 2001 and 2002 will be as pronounced internationally.

International R&D/GDP Comparisons

One of the first and now one of the more widely used indicators of a country's R&D intensity is the ratio of R&D spending to GDP. Economists often use the ratio of R&D expenditures to GDP to examine R&D in the context of a nation's overall economy. This ratio reflects the intensity of R&D activity in relation to other economic activity, and it is often interpreted as a relative measure of a nation's commitment to R&D.

Since 1953, the first year for which national R&D data are available, U.S. R&D expenditures as a percentage of GDP have ranged from a minimum of 1.36 percent (in 1953) to a maximum of 2.87 percent (in 1964) (figure 20). From 1994 to 2001, R&D outpaced growth of the general economy and the R&D/GDP ratio rose to 2.72. R&D expenditures subsequently slowed in relation to GDP. It is estimated that the amount of R&D performed in the United States equaled 2.65 percent of GDP in 2002, and 2.61 percent of GDP in 2003.[35]

Most of the growth over time in the R&D/GDP ratio can be attributed to increases in non-Federal R&D spending.[36] Nonfederally financed R&D, the majority of

[32] Data for defense-related R&D expenditures are not available for Israel.

[33] OECD maintains R&D expenditure data that can be categorized into three periods: (1) 1981 to the present (data are properly annotated and of good quality); (2) 1973 to 1980 (data are probably of reasonable quality, and some metadata are available); and (3) 1963 to 1972 [data are questionable for most OECD countries (with notable exceptions of the United States and Japan), many of which launched their first serious R&D surveys in the mid-1960s]. The analyses in this report are limited to data for 1981 and subsequent years.

[34] The United Kingdom similarly experienced 3 years of declining real R&D expenditures, but its slump took place in 1995, 1996, and 1997. The falling R&D totals in Germany were partly a result of specific and intentional policies to eliminate redundant and inefficient R&D activities and to integrate the R&D efforts of the former East Germany and West Germany into a united German system.

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

[36] Non-Federal sources of R&D tracked by NSF include industrial firms, universities and colleges, nonprofit institutions, and state and local governments.

Purchasing Power Parities: Preferred Exchange Rates for Converting International R&D Data

Comparisons of international R&D statistics are hampered because R&D expenditures are denominated in the performing country's currency. Two approaches are commonly used to normalize the data and facilitate aggregate R&D comparisons: (1) dividing R&D by GDP, which results in indicators of relative effort according to total economic activity and circumvents the problem of currency conversion, and (2) converting all foreign-denominated expenditures to a single currency, which results in indicators of absolute effort. The first method is a straightforward calculation that permits only gross national comparisons. The second method permits abolute-level comparisons and analyses of countries' sector- and field-specific R&D investments, but it entails choosing an appropriate currency conversion series.

Market Exchange Rates and Purchasing Power Parity Rates

Because (for all practical purposes) no widely accepted R&D-specific exchange rates exist, the choice is between market exchange rates (MERs) and purchasing power parities (PPPs). These rates are the only series consistently compiled and available for a large number of countries over an extended period of time.

Market Exchange Rates. At their best, MERs represent the relative value of currencies for goods and services that are traded across borders; that is, MERs measure a currency's relative international buying power. Sizable portions of most countries' economies do not engage in international activity, however, and major fluctuations in MERs greatly reduce their statistical utility. MERs also are vulnerable to a number of distortions, including currency speculation, political events such as wars or boycotts, and official currency intervention, which have little or nothing to do with changes in the relative prices of internationally traded goods.

PPP Rates. Because of the MER shortcomings described above, the alternative currency conversion series of PPPs was developed (Ward 1985). PPPs take into account the cost differences across countries of buying a similar basket of goods and services in numerous expenditure categories, including nontradables. The PPP basket is, therefore, representative of total GDP across countries. When the PPP formula is applied to current R&D expenditures of other major performers, such as Japan and Germany, the result is a substantially different estimate of total R&D spending than that given by MERs (figure 19). For example, Japan's R&D in 1998 totaled $91 billion based on PPPs and $116 billion based on MERs, and the German R&D expenditure was $45 billion on PPPs and $50 billion on MERs. (In comparison, the U.S. R&D expenditure was $226 billion in 1998.)

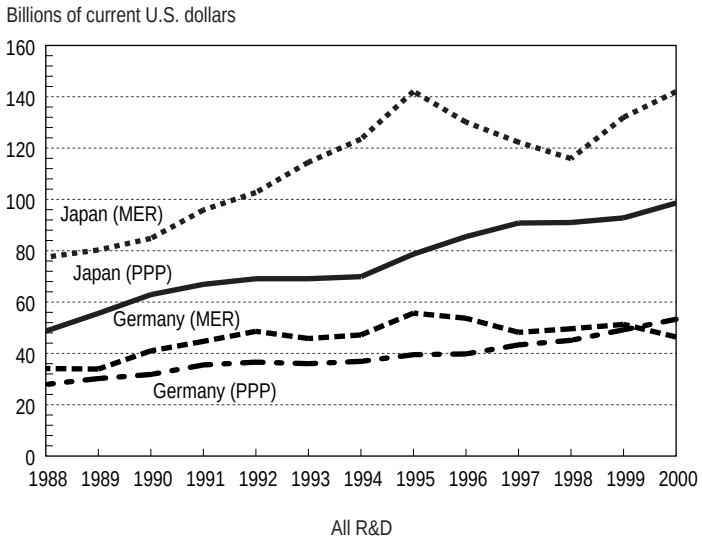
PPPs are the preferred international standard for calculating cross-country R&D comparisons wherever possible and are used in all official R&D tabulations of OECD. Unfortunately, they are not available for all countries and currencies. They are available for all OECD countries, however, and are therefore used in this report.

Exchange Rate Movement Effects

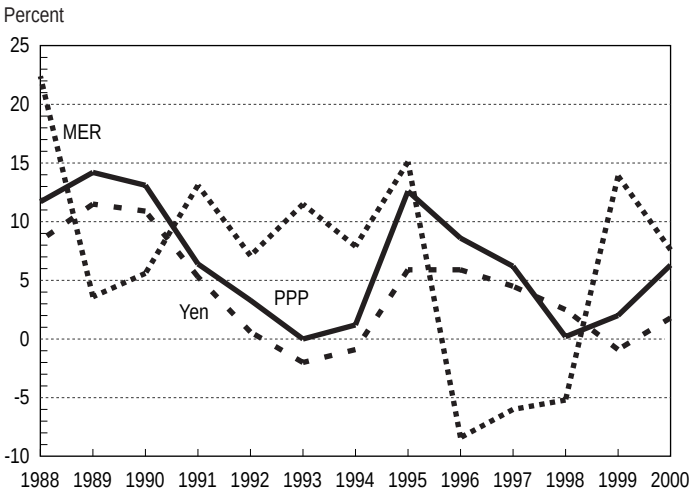
Although the goods and services included in the market basket used to calculate PPP rates differ from the major components of R&D costs—fixed assets as well as wages of scientists, engineers, and support personnel—they still result in a more suitable domestic price converter than one based on foreign trade flows. Exchange rate movements bear little relationship to changes in the cost of domestically performed R&D (figure 19). When annual changes in Japan's and Germany's R&D expenditures are converted to U.S. dollars with PPPs, they move in tandem with such funding denominated in their home currencies. Changes in dollar-denominated R&D expenditures converted with MERs exhibit wild fluctuations that are unrelated to the R&D purchasing power of those investments. MER calculations indicate that, between 1988 and 2000, German and Japanese R&D expenditures each increased twice by 15 percent or more. In reality, nominal R&D growth was only a fourth to a third of those rates in either country during this period. PPP conversions generally mirror the R&D changes denominated in these countries' home currencies.

Purchasing Power Parities: Preferred Exchange Rates for Converting International R&D Data (Continued)

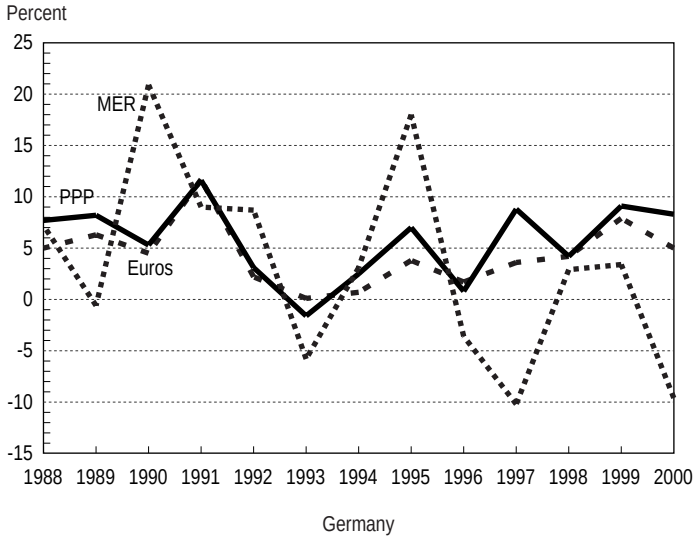
FIGURE 19. Research and development expenditures and annual changes in research and development estimates for Japan and Germany: 1988–2000



All R&D



Japan

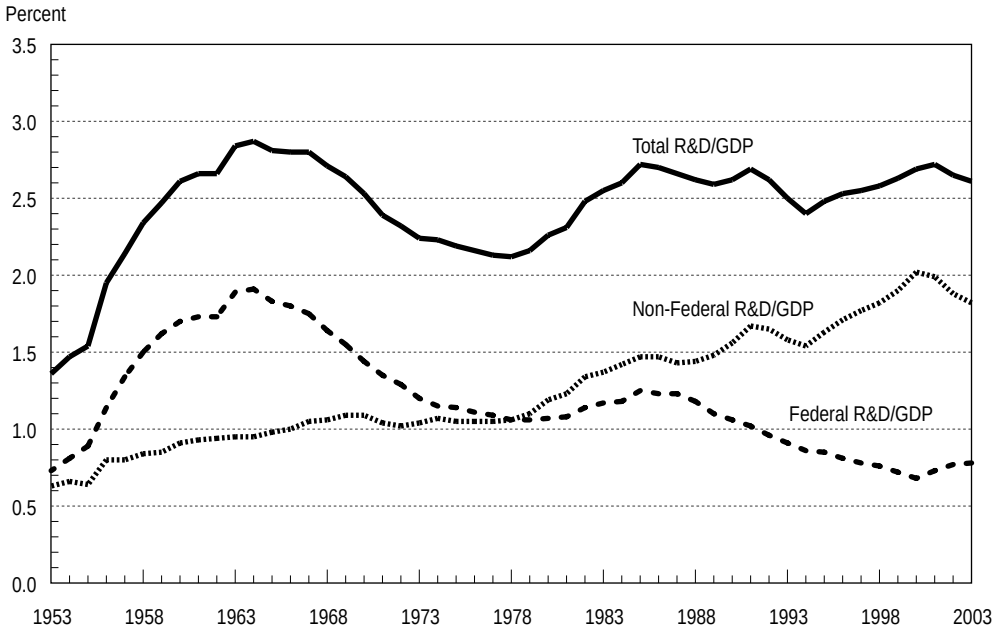


Germany

MER market exchange rate
PPP purchasing power parity
R&D research and development

SOURCE: Organisation for Economic Co-operation and Development, *Main Science and Technology Indicators* (Paris, 2002).

FIGURE 20. Research and development share of U.S. gross domestic product: 1953 2003



GDP gross domestic product
R&D research and development

SOURCE: National Science Foundation, Division of Science Resources Statistics, *National Patterns of R&D Resources*, annual series. See appendix table B-9.

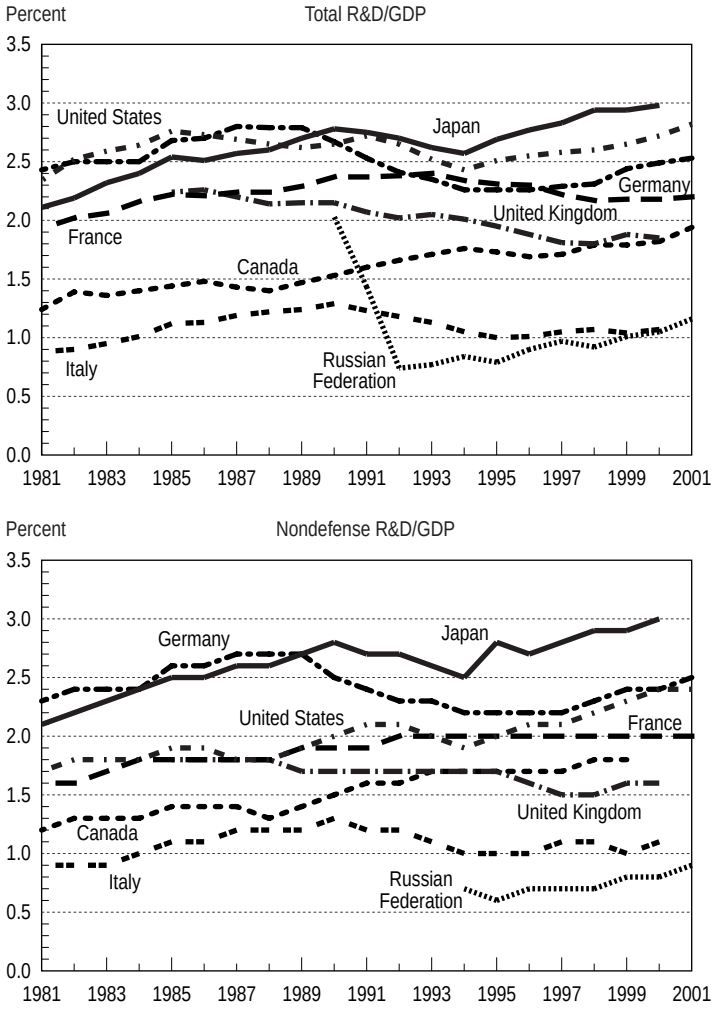
which is company financed, increased from 0.63 percent of GDP in 1953 to a projected 1.82 percent of GDP in 2003 (down from a high of 2.02 percent of GDP in 2000). The increase in nonfederally financed R&D as a percentage of GDP illustrated in figure 20 corresponds to an upward trend in R&D and technology intensive activities in the U.S. economy.

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

For many of the G-8 countries (that is, the G-7 countries plus Russia), the latest R&D/GDP ratio is no higher now than it was at the start of the 1990s, which ushered in a period of slow growth or decline in their overall R&D efforts (figure 21).[37] The United States and Japan reached 2.7 and 2.8 percent, respectively, in 1990–91. As a result of reduced or level spending by industry and government in both countries, the R&D/GDP ratios declined several tenths of a percentage point, to 2.4 and 2.6, respectively, in 1994 before rising again to 2.7 and 3.0 percent in 2000. Growth in industrial R&D accounted for much of the recovery in each of these countries. However, the steady increase in Japan's R&D/GDP ratio in 1994–2000 is also partially a result of anemic economic conditions overall: GDP fell in both 1998 and 1999 with only a marginal increase in 2000, so that even level R&D spending would have resulted in a slight increase in its R&D ratio.

[37]A country's R&D spending and therefore its R&D/GDP ratio is a function of several factors in addition to its commitment to supporting the R&D enterprise. Especially because the majority of R&D is performed by industry in each of these countries, the structure of industrial activity can be a major determinant of a country's R&D/GDP ratio. For example, economies with high concentrations in manufacturing (which traditionally have been more R&D intensive than nonmanufacturing or agricultural economies) have different patterns of R&D spending. See "Industrial Sector" for further discussion of such considerations.

FIGURE 21. Research and development share of gross domestic product for G-8 countries: 1981–2001



G-8 group of 8 countries
GDP gross domestic product
R&D research and development

NOTES: Total R&D/GDP data not available for Japan (2001), United Kingdom (2001), and Italy (2001). Nondefense R&D/GDP data not available for Japan (2001), United Kingdom (1982, 1984, and 2001), Italy (2001), and Canada (2000 and 2001).

SOURCE: Organisation for Economic Co-operation and Development, *Main Science and Technology Indicators,* 2002. See appendix tables B-18 and B-19.

Among the remaining six G-8 countries, three (Germany, Canada, and Russia) display recent increases in their economy's R&D/GDP ratio, and three (the United Kingdom, France, and Italy) report an R&D/GDP ratio that has remained stable or has declined. In Germany the R&D/GDP ratio fell from 2.8 percent at the end of the 1980s, before reunification, to 2.3 percent in 1994 before rising to 2.5 percent in 2001. Canada's R&D/GDP ratio also rose in the late 1990s from 1.7 percent in 1996 to 1.9 percent in 2001. The end of the cold war and collapse of the Soviet Union had a drastic effect on Russia's R&D intensity. R&D spending in Russia was estimated at 2.0 percent of GDP in 1990; that figure plummeted to 1.4 percent in 1991 and then tumbled further to 0.7 percent in 1992. Moreover, the severity of this R&D decline is masked somewhat: although the R&D share was falling, it also was a declining share of a declining GDP. By 1999 the R&D/GDP ratio in Russia had inched back to about 1.0 percent; it accelerated to 1.2 percent in 2001 as R&D performance in the country grew by more than 30 percent in real terms over those 2 years. In comparison, the R&D/GDP ratio slipped slightly in the United Kingdom in the late 1990s to 1.9 percent in 2000. Between 1997 and 2001, the R&D/GDP ratio fluctuated narrowly around 2.2 and 1.1 percent in France and Italy, respectively.

Overall, the United States ranked fifth among OECD countries in terms of reported R&D/GDP ratios (table 14). Israel (not an OECD member country), devoting 4.4 percent of its GDP to R&D, led all countries, followed by Sweden (3.8 percent), Finland (3.4 percent), Japan (3.0 percent), and Iceland (2.9 percent). Nations in Southern and Eastern Europe tend to have R&D/GDP ratios below 1.5 percent, whereas Nordic nations and those in Western Europe generally report R&D spending shares greater than 1.5 percent.

In practically all OECD countries, the business sector finances most of the R&D. However, OECD countries with relatively low R&D/GDP ratios tend to be relatively low-income countries, where government funding generally provides a larger proportion of the R&D support than it provides in countries with high R&D/

TABLE 14. Research and development share of gross domestic product, by country/economy

Country/economy	Percent	Country/economy	Percent
Total OECD (2000)	2.24	Italy (2000)	1.07
European Union (2000)	1.88	New Zealand (1999)	1.03
Israel (2001)	4.43	China (2000)	1.00
Sweden (1999)	3.78	Spain (2001)	0.97
Finland (2000)	3.37	Brazil (1999)	0.87
Japan (2000)	2.98	Cuba (2000)	0.82
Iceland (2001)	2.90	Hungary (2000)	0.80
United States (2001)	2.71	Portugal (1999)	0.76
Korea (2000)	2.65	Greece (1999)	0.67
Switzerland (2000)	2.64	Poland (2001)	0.67
Germany (2001)	2.53	Slovak Republic (2001)	0.65
France (2001)	2.20	Turkey (2000)	0.64
Singapore (2001)	2.11	Chile (2000)	0.54
Denmark (1999)	2.09	Mexico (1999)	0.43
Chinese Taipei (2000)	2.05	Argentina (2001)	0.42
Netherlands (2000)	1.97	Romania (2001)	0.40
Belgium (1999)	1.96	Panama (1999)	0.35
Canada (2001)	1.94	Bolivia (2000)	0.28
Austria (2001)	1.91	Costa Rica (1998)	0.27
United Kingdom (2000)	1.85	Uruguay (1999)	0.26
Australia (2000)	1.53	Colombia (2000)	0.24
Slovenia (2000)	1.52	Trinidad and Tobago (1997)	0.14
Norway (2001)	1.46	Nicaragua (1997)	0.13
Czech Republic (2001)	1.31	Ecuador (1998)	0.08
Ireland (1999)	1.21	El Salvador (1998)	0.08
Russian Federation (2001)	1.16	Peru (1999)	0.08

OECD Organisation for Economic Co-operation and Development

NOTES: Civilian research and development only for Israel and Taiwan. Year of data is shown in parentheses.

SOURCES: OECD, Main Science and Technology Indicators database, 2002; and Iberomerican Network of Science and Technology Indicators, *Principales Indicadores de Ciencia y Tecnologia Argentina 2001 (Buenos Aires, 2002).*

GDP ratios. Furthermore, the private sector in low-income countries often has a low concentration of high-technology industries, resulting in low overall R&D spending and therefore low R&D/GDP ratios. Indeed, a strong link exists between countries with high incomes that emphasize the production of high-technology goods and services and those that invest heavily in R&D activities. This highlights that R&D/GDP ratios are most useful when comparing countries with national S&T systems of comparable maturity and development.

Outside the European region, R&D spending has intensified considerably since the early 1990s. Several Asian countries, most notably South Korea and China, have been particularly aggressive in expanding their support for R&D and S&T-based development. In Latin America and the Pacific region, other non-OECD countries also have attempted to increase R&D investments substantially during the past several years. Even with recent gains, however, most non-European (non-OECD) countries invest a smaller share of their economic output in R&D than do OECD members (with the exception of Israel). All Latin American countries for which such data are available report R&D/GDP ratios below 1 percent (table 14). This distribution is consistent with broader indicators of economic growth and wealth. However, many of these countries also report additional S&T-related expenditures on human resources training and S&T infrastructure development that are not captured in R&D or R&D/GDP data (RICYT 2002).

Nondefense R&D Expenditures and R&D/GDP Ratios

Although the R&D intensities of many countries have changed little over the past decade, there have been significant changes in the composition of their R&D. One indicator of these changes is the relative increase in nondefense R&D. Although defense-related R&D does result in spillovers that produce social benefits, nondefense R&D is more directly oriented toward national scientific progress, standard-of-living improvements, economic competitiveness, and commercialization of research results. Indeed, conclusions about a country's relative standing may differ dramatically, depending on whether total R&D expenditures include or exclude defense-related expenditures; for some countries, the relative emphasis has shifted over time. Among G-8 countries, the inclusion of defense-related R&D has had little impact on R&D totals for Japan, Germany, Italy, and Canada, where defense-related R&D represents 5 percent or less of the national total. In other countries, defense has accounted for a more significant proportion of the national R&D effort, although this proportion has generally declined since the end of the cold war. Between 1988 and 2000, the defense share of the R&D total fell from 31 to 14 percent in the United States and fell from 19 to 8 percent in France. In the United Kingdom the defense share of R&D decreased marginally from 16 to 15 percent. Data over this entire period are not available for Russia, but in 2000 defense-related R&D accounted for an estimated 24 percent of total Russian R&D.

If current trends persist, the distinction between defense and nondefense R&D expenditures in international comparisons may become less important. In absolute dollar terms, nondefense R&D spending is still considerably larger in the United States than in other countries. In 2000 (the latest year for which comparable international R&D data are available for most OECD countries), U.S. nondefense R&D was more than twice that of Japan's and was close to the non-U.S. G-7 countries' combined nondefense R&D total (appendix table B-19).

In terms of R&D/GDP ratios, the relative position of the United States is somewhat less favorable when only nondefense R&D is included in the metric. Japan's nondefense R&D/GDP ratio (3.0 percent) exceeded the U.S. ratio (2.4 percent) in 2000, as it has for years (figure 21 and appendix table B-19). In 2001, Germany's nondefense R&D/GDP ratio (2.5 percent) slightly exceeded the U.S. ratio (2.4 percent). The 2001 nondefense ratio for France (2.0 percent) was below the U.S. ratio. In 1999–2000, ratios for the United Kingdom (1.6 percent in 2000), Canada (1.8 percent in 1999), and Italy (1.1 percent in 2000) were considerably lower than U.S. ratios. In 2001, the nondefense R&D/GDP ratio for Russia (0.9 percent) was less than half the U.S. ratio.

International R&D by Performer and Source of Funds

R&D performance patterns by sector are broadly similar across countries, but national sources of support differ considerably. In nearly all OECD countries, government has provided a declining share of all R&D funding during the past 2 decades, and the industrial share of R&D funding has increased considerably. The emphases of industrial R&D efforts, however, differ

across countries, as do governmental R&D priorities and academic S&E field research emphases, as described subsequently in this report.

Government and industry together account for roughly 80 percent or more of the R&D funding in each of the G-8 countries, although the respective contributions vary substantially across countries.[38] In recent years, the industrial sector provided 72 percent of R&D funds in Japan, 68 percent in the United States, 66 percent in Germany, 53 percent in France, 49 percent in the United Kingdom, and 42 percent in Canada[39] (figure 22). In Russia, industry provided approximately 34 percent of the nation's R&D funding. Government provided the largest share of Russia's R&D (57 percent), as it did in Italy in past years (more than 50 percent in 1999). In the remaining six countries, government was the second largest source of R&D funding, ranging from 20 percent (in Japan) to 39 percent (in France) of the total. In each of these eight countries, government provided the largest share of the funds used for academic R&D performance (appendix table B-20).

The industrial sector dominates R&D performance in each of the G-8 countries as well as in South Korea (figure 22). Industry's share of R&D performance for the 2000–2001 period ranged from 50 percent in Italy to more than 70 percent in the United States, Japan, Germany, Russia, and South Korea. During the same period, industry's share was between 57 and 66 percent in Canada, France, and the United Kingdom. Most of the industrial R&D in these countries was funded by industry. Government's share of funding for industrial R&D ranged from as little as 2 percent in Japan and Canada to 49 percent in Russia (appendix table B-20). In the other G-8 countries, government funded between 7 and 11 percent of industrial R&D.

Academic Sector

In many OECD countries, the academic sector is a distant second to industry in terms of national R&D performance. Among G-8 countries, universities accounted for as little as 5 percent of Russia's R&D total to more than 31 percent of Italy's.[40] For most of these countries, the government is now, and historically has been, the largest source of academic research funding. However, in each of the G-8 countries for which historical data exist (except Russia), the government's share has declined during the past 20 years, and industry's share has increased. Specifically, the government's share, including both direct government support for academic R&D and the R&D component of block grants to universities, has fallen by 8 percentage points or more in five of the G-7 countries since 1981 (except in France and Italy, where the government's share of academic R&D dipped by 6 and 2 percentage points, respectively).[41] In comparison, and as an indication of an overall pattern of increased university-firm interactions (often intended to promote the commercialization of university research), the proportion of academic R&D funded by industry for these seven countries combined climbed from 2.6 percent of the academic R&D total in 1981 to 5.2 percent in 1990 and to 6.0 percent in 1999. In Germany, more than 11 percent of university research was funded by industry in 2000 (table 15).

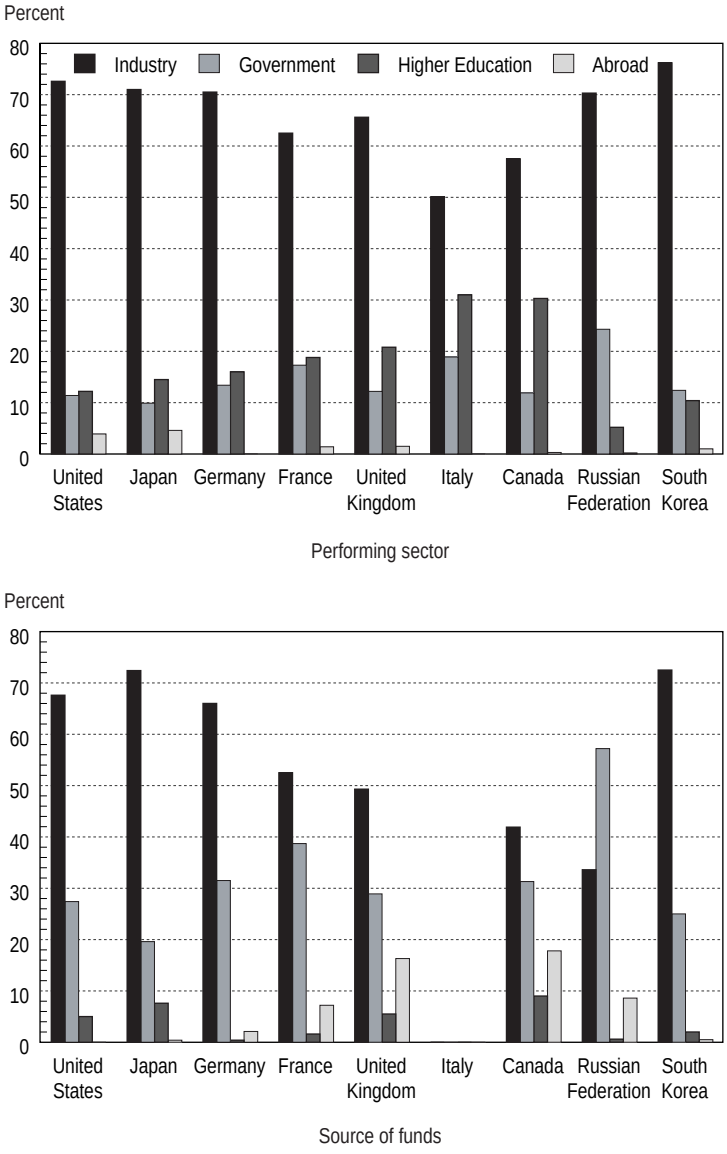
[38]In accordance with international standards, the following sectors are recognized sources of funding: all levels of government combined, business enterprises, higher education, private nonprofit organizations, and funds from abroad. Because data on foreign sources of R&D funding are unavailable for the United States, the figures reported for the share of industrial R&D funding in the United States includes funding from both foreign and domestic sources.

[39]Canada and the United Kingdom both report relatively large amounts of R&D funding from abroad, much of which originates from business enterprises. Therefore, industry's shares of R&D funding for these countries are particularly understated compared with that for the United States. Distribution of R&D by source of funds was not available for Italy for 2000. In earlier years, government sources accounted for more than half of Italy's R&D, industry accounted for more than 40 percent, and foreign sources funded the remainder.

[40]Country data are for 2000 or 2001 (appendix table B-20).

[41]Whereas general university funds (GUF) block grants are reported separately for Japan, Canada, and European countries, the United States does not have an equivalent GUF category. In the United States, funds to the university sector are distributed to address the objectives of the Federal agencies that provide the R&D funds. Nor is GUF equivalent to basic research. The treatment of GUF is one of the major areas of difficulty in making international R&D comparisons. In many countries, governments support academic research primarily through large block grants that are used at the discretion of each individual higher education institution to cover administrative, teaching, and research costs. Only the R&D component of GUF is included in national R&D statistics, but problems arise in identifying the amount of the R&D component and the objective of the research. Government GUF support is in addition to support provided in the form of earmarked, directed, or project-specific grants and contracts (funds for which specific socioeconomic categories can be assigned). In the United States, the Federal Government (although not necessarily state governments) is much more directly involved in choosing which academic research projects are supported than are national governments in Europe and elsewhere. In each of the European "group of seven" (G-7) countries, GUF accounts for 50 percent or more of total government R&D to universities and for roughly 45 percent of the Canadian government academic R&D support. Thus, these data indicate not only relative international funding priorities but also funding mechanisms and philosophies regarding the best methods for financing research.

FIGURE 22. Research and development expenditures for selected countries, by performing sector and source of funds: 2000 or 2001



NOTES: Separate data on foreign sources of research and development (R&D) funding are unavailable for the United States but are included in sector totals. In most other countries, "foreign sources of funding" is a distinct and separate funding category. For some countries (such as Canada), foreign firms are the source of a large amount of foreign R&D funding, which is reported as funding from abroad. In the United States, industrial R&D funding from foreign firms is reported as industry. Data for Japan, France, United Kingdom, and Italy are for 2000. Data for the United States, Germany, Canada, Russian Federation, and South Korea are for 2001. Recent data by source of funds were unavailable for Italy.

SOURCES: Organisation for Economic Co-operation and Development, unpublished tabulations, 2003; and National Science Foundation, Division of Science Resources Statistics, *National Patterns of R&D Resources,* annual series. See appendix table B-20.

TABLE 15. Academic research and development expenditures, by country and source of funds: 1981, 1990, and 2000
(Percent)

Country and source of funds	1981	1990	2000
Canada			
Government	78.8	75.0	59.9
Industry	4.1	5.0	8.9
Other	17.1	20.0	31.2
France			
Government	97.7	92.9	91.5
Industry	1.3	4.9	2.7
Other	1.0	2.2	5.8
Germany			
Government	98.2	92.1	85.9
Industry	1.8	7.9	11.6
Other	0.0	0.0	2.5
Italy[a]			
Government	96.2	96.7	94.4
Industry	2.7	2.4	4.8
Other	1.1	0.9	0.8
Japan			
Government	57.8	51.2	50.2
Industry	1.0	2.3	2.5
Other	41.2	46.5	47.3
United Kingdom			
Government	81.3	73.5	64.7
Industry	2.8	7.6	7.1
Other	15.9	18.9	28.2
United States			
Government	74.1	66.9	65.0
Industry	4.4	6.9	7.1
Other	21.5	26.2	27.9

[a] Italian data are for 1999.

SOURCES: Organisation for Economic Co-operation and Development, Science and Technology Statistics database, 2003; and National Science Foundation, Division of Science Resources Statistics, *National Patterns of R&D Resources* (Arlington, VA, annual series).

INDUSTRIAL SECTOR

Industrial firms account for the largest share of total R&D performance in each of the G-8 countries. However, the purposes to which the R&D is applied differ somewhat, depending on the overall industrial composition of each country's economy. Funding patterns for industrial R&D also differ from country to country, with respect to both domestic sources of funds as well as the relative proportion of foreign funding.

The structure of a country's industrial activity can be a major determinant of the level and change in industrial R&D spending. National variations in such spending can result from differences in absolute output, industrial structure, and R&D intensity. Countries with the same size economy could have vastly different R&D expenditure levels (and R&D/GDP ratios). Some nations have much higher concentrations of R&D-intensive industries such as pharmaceutical manufacture as opposed to food processing. And even individual firms in the same industries can devote substantial resources to specific R&D activities in one country and to other activities in another country. Table 16 shows recent distributions of industrial R&D performance in the G-7 countries, South Korea, and the European Union.

The sector distribution of U.S. industrial R&D performance is among the most widespread and diverse among OECD members. The accumulated knowledge stock, well-developed S&T infrastructure, and large domestic market in the United States have enabled it to invest and become globally competitive in numerous industries rather than just a few industries or niche technologies. In 2000 no one industrial sector accounted for more than 13 percent of total U.S. industrial R&D as detailed by the OECD in its ANBERD database (table 16). In comparison, most of the other countries displayed somewhat higher sector concentrations. For example, over one-fourth of total industrial R&D was concentrated in electronic equipment manufacturing in South Korea (37 percent) and Canada (29 percent). Indeed, the electronic equipment sector was the largest performer of industrial R&D in five of the eight countries shown and was the second largest performer of industrial R&D for the entire European Union. Among other manufacturing sectors, motor vehicles in Germany and pharmaceuticals in the United Kingdom accounted for 20 percent or more of total R&D performance.

One of the more significant trends in both U.S. and international industrial R&D activity has been the growth of R&D in the service sector. According to the internationally harmonized data in table 16, this sector accounted for 34 percent of total industrial R&D performance in the United States in 2000.[42] A number of other countries also reported substantial increases in their service sector R&D expenditures during the past 25 years. Among G-7 countries, nonmanufacturing shares of total industrial R&D increased about 5 percentage points in France and Italy and 13 percentage points in the United States, United Kingdom, and Canada from the early 1980s to the late 1990s (Jankowski 2001). In each of these countries, computer and related services account for a substantial share of the service R&D totals.

[42] As previously discussed, the recent growth in R&D in the U.S. trade industry reflects statistical procedures more than actual R&D activity in wholesale and retail trade companies. (See sidebar, "Redistributing Trade R&D.") The relatively high trade industry R&D for Canada (which, like the U.S., uses the North American Industry Classification System) is also likely the result of statistical procedures.

TABLE 16. Shares of industrial research and development, by industry sector for selected countries: 1999 or 2000

Industry	United States (2000)	Canada (2000)	Germany (2000)	France (1999)	Italy (2000)	Japan (2000)	United Kingdom (2000)	South Korea (2000)	European Union (1999)
	Billions of PPP dollars								
Total	199.5	9.0	37.4	19.2	7.4	69.7	17.8	14.1	101.7
	Percent distribution								
All business enterprise	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Manufacturing	64.9	67.3	91.3	85.7	79.9	95.0	80.2	83.7	84.3
Food, beverages, and tobacco	0.8	1.0	0.6	1.8	1.3	2.4	2.3	1.4	1.7
Textiles, fur, and leather	0.1	0.7	0.6	0.5	0.3	0.7	0.3	0.9	0.5
Wood, paper, printing, and publishing	1.6	1.3	0.4	0.4	0.3	1.1	0.3	0.4	0.7
Coke, refined petroleum products, and nuclear fuel	0.6	0.5	0.1	1.4	0.9	0.3	1.6	2.0	0.8
Chemicals (less pharmaceuticals)	4.2	1.4	10.9	6.1	5.1	8.1	5.9	4.7	NA
Pharmaceuticals	6.5	6.1	6.1	13.2	8.6	6.9	24.7	1.4	NA
Rubber and plastic products	0.8	0.4	1.7	2.8	1.8	2.4	0.5	1.4	1.7
Nonmetallic mineral products	0.4	0.1	1.2	1.3	0.3	1.6	0.4	0.5	0.9
Basic metals	0.3	1.4	0.7	1.4	0.4	2.8	0.5	1.3	1.0
Fabricated metal products	1.0	1.1	1.4	1.0	0.6	1.1	0.6	0.6	1.1
Machinery NEC	3.4	2.2	9.5	4.5	7.5	9.3	6.1	2.8	7.6
Office, accounting, and computing machinery	5.2	4.8	1.9	1.9	1.1	10.8	1.0	7.1	1.8
Electrical machinery	1.9	1.4	3.0	3.7	2.3	9.8	3.7	1.7	3.1
Electronic equipment (radio, television, and communications)	12.9	28.8	10.7	12.5	19.3	18.8	8.9	36.7	13.5
Instruments, watches, and clocks	9.6	1.3	4.9	6.7	2.9	4.5	4.2	1.0	4.6
Motor vehicles	9.3	1.9	29.6	13.4	15.4	12.4	7.5	14.3	16.1
Other transport equipment (less aerospace)	0.6	0.1	1.0	0.6	1.2	0.3	2.0	1.9	1.0
Aerospace	5.2	12.3	6.6	11.8	10.5	0.8	9.5	2.9	7.6
Furniture, other manufacturing NEC	0.4	0.6	0.5	0.8	0.2	0.9	0.2	0.8	0.5
Recycling	NA	NA	0.0	0.0	0.0	NA	0.0	0.0	NA
Electricity, gas, and water	0.1	1.6	0.3	2.5	0.2	0.9	1.4	1.8	NA
Construction	0.1	0.2	0.2	0.9	0.2	1.7	0.3	3.7	NA
Agriculture and mining	NA	NA	NA	NA	NA	NA	NA	NA	NA
Services	34.4	29.0	7.8	9.1	19.7	2.1	16.6	10.5	13.0
Wholesale, retail trade, motor vehicle repair, etc.	12.6	7.3	NA	0.0	0.4	NA	NA	0.3	NA
Hotels and restaurants	NA	NA	NA	0.0	0.0	NA	NA	0.0	NA
Transport and storage	0.1	0.2	NA	3.6	0.1	0.2	NA	0.5	NA
Communications	0.7	0.9	NA	NA	0.1	NA	5.9	3.6	NA
Financial intermediation (including insurance)	2.0	1.9	NA	NA	1.2	NA	NA	0.0	NA
Computer and related activities	7.4	6.2	NA	2.5	2.5	1.9	5.3	3.9	3.7
Research and development	7.0	10.5	2.5	NA	12.9	NA	3.7	0.3	NA
Other business activities NEC	NA	1.9	NA	3.0	2.2	NA	1.1	1.8	2.2
Community, social, and personal service activities, etc.	NA	NA	NA	NA	0.2	NA	0.1	0.2	NA

NA not available separately
NEC not elsewhere classified
PPP purchasing power parity

NOTES: Data for communications industry in United States include only telecommunications research and development. Data are for years listed under country names.

SOURCES: Organisation for Economic Co-operation and Development (OECD), ANBERD database, 2002; and OECD, *R&D Efforts in China, Israel, and Russia: Some Comparisons With OECD Countries* (Paris, 2000).

Furthermore, the service sector appears to be an important locus of industrial R&D activity in several countries, reflecting in part the growth in outsourcing and greater reliance on contract R&D in lieu of in-house performance, as well as intramural R&D in these industries.

According to national statistics for recent years, the service sector accounted for less than 10 percent of total industrial R&D performance in only three of the G-7 countries (Germany, France, and Japan). Among the countries listed in table 16, the service sector share ranged from as little as 2 percent in Japan to 34 percent in the United States. The latter figure, however, is partly the result of some manufacturing companies being classified into wholesale trade as discussed earlier in this report.

Most of the funding for industrial R&D in each of the G-7 countries is provided by industry itself. As is the situation for OECD countries overall, government financing accounts for a small and declining share of total industrial R&D performance within G-7 countries. (See "Government Sector.") Government financing shares ranged from as little as 2 percent of industrial R&D performance in Japan to 11 percent in Italy (appendix table B-20). In the United States in 2001, the Federal Government provided about 9 percent of the R&D funds used by industry, and the majority of that funding was obtained through DOD contracts. The role of foreign funding in R&D varied from country to country, accounting for as little as 0.6 percent of industrial R&D in Japan to as much as 31 percent in Canada in recent years. This foreign funding predominantly came from foreign corporations but also included funding from foreign governments and other foreign organizations.

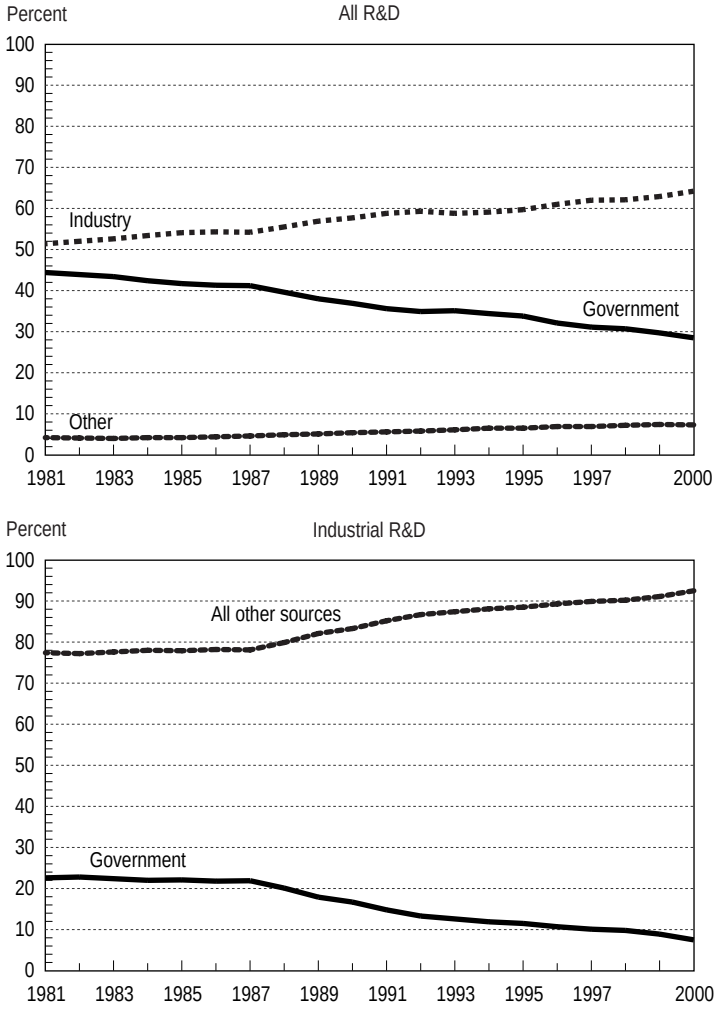
Government Sector

As in the United States, the role of the government as a performer of R&D has been shrinking internationally. The government sector accounted for 13 percent of the OECD R&D performance total as recently as 1995. This share fell to 10 percent of OECD members' combined R&D performance in 2000.

In most countries, including the United States, the government sector funds much more R&D than it performs, however a significant trend in the G-7 and other OECD countries has been a decline in government R&D funding relative to R&D funding from the private sector. In 2000, less than 30 percent of all R&D funds were derived from government sources, down considerably from the 44 percent share reported in 1981[43] (figure 23). Part of the relative decline reflects the effects of budgetary constraints, economic pressures, and changing priorities in government funding (such as the relative reduction in defense R&D in France and the United States). This trend also reflects the absolute growth in industrial R&D funding as a response to increasing international competitive pressures in the marketplace, irrespective of government R&D spending patterns. Both of these considerations are reflected in funding patterns for industrial R&D performance. In 1982, government provided 23 percent of the funds used by industry in conducting R&D within OECD countries, whereas by 2000 government's share of the industrial R&D total had fallen by almost two-thirds, to 8 percent of the total.

[43]Among all OECD countries, the government sector accounts for the highest funding share in Portugal (63 percent of its 2000 R&D total) and the lowest share in Japan (20 percent in 2000).

FIGURE 23. Sources of research and development expenditures in Organisation for Economic Co-operation and Development countries: 1981–2000



R&D research and development

SOURCE: Organisation for Economic Co-operation and Development, *Main Science and Technology Indicators* (Paris, 2002).

Appendix A

Technical Notes

Definitions of R&D and Its Components

Research and development (R&D is defined as "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications" (Organization for Economic Co-operation and Development 2002b, p. 30).

Character of Work

Total R&D comprises *basic research*, *applied research*, and *development*, defined as follows:

- ***Basic research.*** In the Federal, university, and nonprofit sectors, basic research is defined as research directed toward increases in the knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific application toward processes or products in mind. In the industrial sector, basic research is defined as "original investigations for the advancement of scientific knowledge . . . which do not have specific commercial objectives, although they may be in fields of present or potential interest to the reporting company."
- ***Applied research.*** In the Federal, university, and nonprofit sectors, applied research is defined as research directed toward gaining the "knowledge or understanding necessary for determining the means by which a recognized and specific need may be met." The definition of applied research is modified for the industrial sector to include "research projects which represent investigations directed to discovery of new scientific knowledge and which have specific commercial objectives with respect to either products or processes."
- ***Development.*** The National Science Foundation (NSF) survey definition of development is "the systematic use of the knowledge or understanding gained from research directed toward the production of useful materials, devices, systems or methods, including design and development of prototypes and processes." It excludes quality control, routine product testing, and production.

Fields of Science and Engineering

By definition, *R&D expenditures* consist of basic and applied research in the sciences (including medical sciences) and engineering as well as activities in development. The fields of study that are included depend, in part, on the economic sector that performs the R&D work. In particular, the Federal, university, and nonprofit sectors include data for the broad fields of physical sciences, environmental sciences, mathematical sciences, computer sciences, life sciences, psychology, social sciences, engineering, and an all inclusive "other sciences" category. Industry coverage is limited to the physical sciences, including related engineering and computer science R&D, and the biological sciences, including medicine but excluding psychology. Industrial R&D specifically excludes research in the social sciences.

Sectors of the Economy

Research and development is not limited to one sector of the economy. Presenting a national picture of R&D activity requires analyzing data from several sectors of the economy. The primary sectors analyzed in the *National Patterns of Research and Development Resources 2003* are the following:

- **Federal Government.** This sector consists of the agencies of the Federal Government.
- **Industry.** This sector consists of both manufacturing and nonmanufacturing companies. Manufacturing companies are reported by major industry groupings. Nonmanufacturing companies include those in mining, construction, transportation, communications, and selected service industries such as R&D laboratories and computer and data processing services. Industry's funding of industrial R&D includes all funds received from non-Federal sources (e.g., state and local governments).
- **Universities and colleges.** This sector consists of all institutions of higher education, both public and private. University funding of university R&D includes restricted or general funds that the institutions themselves have been free to allocate for research. Funds from the Federal Government,

industry, state governments, or other nonprofit institutions, which are supplied in the form of grants or contracts for R&D at a university, are credited to the appropriate source. For example, research contracts from industry are treated as university performance funded by industry. Funds given to the institution by industry for general educational purposes and used by the school—at its discretion—for research are treated as university performance financed with the university's own funds.

- **Other nonprofit institutions.** This sector consists of institutions that fall into two general categories: (1) organizations that are primarily granting in nature (i.e., private philanthropic foundations and voluntary health agencies) and (2) public and private organizations involved in performing R&D, such as research hospitals.
- **Federally funded research and development centers.** As the name suggests, federally funded research and development centers (FFRDCs) are organizations exclusively or substantially financed by the Federal Government to meet a particular R&D need or to provide major facilities for research and associated training purposes. Each center is administered by an industrial firm (industry FFRDC); an individual university or college or a university consortium (university FFRDC); or a nonprofit institution (nonprofit FFRDC).

U.S. R&D expenditures are often categorized according to the following concepts: (1) the economic sector in which the R&D work is actually performed, or the *performer*, for short; and (2) the sector from which funding for R&D originated, or the *source* (of funding), for short. Thus the source is where the money for R&D comes from, whereas the performer is where the money is actually last spent in the process of conducting R&D. Seven R&D-performing sectors are examined in the analysis of U.S. R&D: private industry, universities and colleges, Federal agencies, nonprofit institutions, industry FFRDCs, university FFRDCs, and nonprofit FFRDCs. Five R&D-funding sectors are included in the analysis of U.S. R&D: private industry, the Federal Government, universities and colleges, nonprofit institutions, and state and local governments. Separate data on R&D funding by state and local governments (or non-Federal government) are only available for the R&D performed by universities and colleges. Although state and local governments do perform R&D, the amount is small relative to the other sectors and has not been consistently tracked over time.

Defense/Space/Civilian Classifications

This report contains data on the estimated percentage distribution of total U.S. R&D performance by national objective and the reported distribution of Federal R&D authority by budget function. The performer-based U.S. shares differ from the Federal budget authority shares for several reasons. The U.S. shares are based on expenditures reported by performers, which often spend Federal R&D funds in a year other than the one in which the Federal Government provided authorization, obligations, or outlays. In addition, the two series are based on different concepts. For example, whereas in the U.S. series all of the National Aeronautics and Space Administration's (NASA's) R&D funds are considered expenditures for space R&D, the budget authority data are distributed according to the functional categories that constitute the Federal budget. Thus, NASA's R&D budget authorizations are distributed between the space research and technology function and the transportation function.

Defense R&D consists of R&D spending by the Department of Defense (DOD), defense-related atomic energy programs of the Department of Energy, and more recently some of the R&D performed under the aegis of Homeland Security. All DOD activities are classified as defense, although some activities have secondary objectives (for example, space). *Space R&D* consists of R&D spending by NASA. All industry-funded R&D, including expenditures by aerospace and electronic industries, is classified as *civilian R&D.*

Current Operating Costs

Funds used for R&D refer to *current operating costs.* These costs consist of both direct and indirect costs. They include salaries as well as fringe benefits, materials, supplies, and overhead. The R&D costs include depreciation, insofar as this information is available to respondents. Capital expenditures are excluded by definition in the surveys of the industrial and academic sectors. Under the accounting practices of some Federal agencies, obligations for capital items may be included.

For universities and colleges, R&D data are for separately budgeted expenditures only. Consequently, these data exclude that portion of salaries for research

time or other research expenses financed by funds not specifically earmarked for R&D from state and local governments and other non-Federal sources, including endowments.

Controlling for Inflation and Foreign Currency

In the tables and figures in this report, the term *current dollars* refers to dollar amounts measured and exchanged in the actual year, or years, in question. In contrast, *constant dollars* refers to dollar amounts normalized for inflation. For example, if the same dollar amount is reported for two different years and expressed in current dollars, then fewer actual goods and services could be purchased with that amount in the most recent year than in the earlier year, because of inflation. If the same amount is expressed in constant dollars, then it would be normalized for inflation in both years and, consequently, the same purchasing power would exist in each of the two years. Terms that are equivalent in meaning to *current* and *constant* dollars are, respectively, *nominal* and *real* dollars. These terms are also used to describe changes in dollar amounts over time. For instance, suppose a particular type of expenditure, when expressed in constant dollars, grew at a rate of 5 percent per year over a 10-year period. Such growth may be described as 5 percent growth *in real terms*, or equivalently, *real growth* of 5 percent, meaning the constant-dollar amounts grew at a 5 percent rate, whereas the current dollar amounts grew at a greater rate due to inflation.

In keeping with U.S. government and international standards, R&D trend data usually are deflated to 1996 constant dollars using the gross domestic product (GDP) implicit price deflator. (See appendix table B-9.) Because GDP deflators are calculated on an economy-wide rather than R&D-specific basis, their use more accurately reflects an "opportunity cost" criterion rather than a measure of cost changes in doing research. That is, the GDP deflator, when applied to R&D expenditure or funding data, reflects the value of R&D in terms of the amount of other goods and services that could have been purchased with the same amount of money. The constant dollar figures reported here thus should be interpreted as real resources forgone in engaging in R&D rather than in other activities such as consumption or physical investment.

Comparisons in this report of U.S. and international R&D expenditure data are based on reported R&D investments converted to U.S. dollars using *purchasing power parity* (PPP) exchange rates. PPP exchange rates are designed to reflect differences in the purchasing power of currencies, based on the quantity of currency needed to purchase equivalent quantities of actual goods and services in the countries in question. See sidebar, "Purchasing Power Parities: Preferred Exchange Rates for Converting International R&D Data."

Notes on Data Sources

Federal Government

Federal agency R&D obligations for *intramural performance* are treated as the equivalent of R&D expenditures in the *National Patterns* series. Intramural R&D performance by Federal agencies refers to work carried out directly by agency personnel. Federal obligations reported in this category are for activities performed by the reporting agency itself or represent funds that the agency transfers to another Federal agency for performance of work, as long as the ultimate performer is that agency or any other Federal agency.

As detailed in the *Federal Funds for Research and Development* series (hereafter, *Federal Funds*), R&D obligations for *intramural activities* cover costs associated not only with actual intramural R&D performance but also with the planning and administration by Federal personnel of intramural and extramural R&D programs [see NSF, Division of Science Resources Statistics (2002a)]. Intramural activities also include the costs of supplies and equipment that are procured for use in intramural R&D. For example, the purchase of saline solution that is used for intramural performance of R&D is reported as a part of the cost of intramural R&D.

In general, the universe of Federal agencies with R&D programs has been surveyed annually since 1953 for R&D performance and since 1963 for the distribution of R&D by character of work on the Survey of Federal Funds for Research and Development.

Industry

In general, the industrial sector has been surveyed annually since 1953 for its total R&D performance and since 1956 for the distribution by character of work. The

U.S. Bureau of the Census conducts the Survey of Research and Development in Industry for NSF. The target population of the survey is companies, whether U.S. or foreign-owned, that perform R&D in the United States and have more than five employees.

For the 2001 industrial R&D data (the most recent data incorporated into this report), the sample frame constructed for the survey included approximately 2 million companies. Of these, 3,010 known R&D-performing companies were surveyed and 21,956 other companies were selected for the sample.

Nonmanufacturing R&D. The enormous growth in nonmanufacturing industries is common knowledge. It should be noted, however, that some of this growth is the result of the methodology used to classify companies into industries as opposed to actual increases in nonmanufacturing R&D activity. (See the discussion of nonmanufacturing R&D in the main text and the sidebar, "Redistributing Trade R&D.")

Character-of-Work Revisions. Recent data quality reviews revealed that some companies were misreporting their R&D as 100 percent basic research. Followup calls confirmed that these cases were almost entirely the result of respondent error. To correct the aggregate character-of-work estimates, the R&D expenditures reported by these companies were reallocated for years 1998 through 2001. This resulted in a decrease in industrial R&D characterized as basic research for 1998 and subsequent years.

Universities and Colleges

R&D data for the academic sector are derived from NSF's Survey of Research and Development Expenditures at Universities and Colleges. For the fiscal year (FY) 2002 survey cycle (the latest data included in this report), a total of 626 institutions were included in this survey. These institutions have doctoral programs in science and engineering (S&E), are historically black colleges or universities that expend any amount of separately budgeted R&D in S&E, or are master's or bachelor's degree-granting institutions that expend at least $150,000 in separately budgeted R&D in S&E.

Recently, corrections from large respondents and a revised imputation procedure for academic basic research have resulted in a break in the data series beginning in FY 1998. The corrections and the revised imputation procedure resulted in a net increase for academic R&D classified as basic research.[44]

Other Nonprofit Institutions

The R&D activities of other nonprofit institutions have not been surveyed with the same frequency as other sectors. The most recent data used in this report are from NSF's Survey of Research and Development Funding and Performance by Nonprofit Organizations, Fiscal Years 1996 and 1997. Organizations covered by the survey included research institutes; university-affiliated hospitals; other voluntary nonprofit hospitals; professional and technical societies and academies of science and engineering; private foundations; science exhibitors; and trade associations, industrial consortia, and academic consortia.

Prior to this survey, the last R&D survey of nonprofit organizations collected data for 1973. Because of the paucity of data for the nonprofit sector, many of the figures for this sector presented in this report are NSF estimates.

FFRDCs

Beginning with FY 2001, R&D data for all 36 FFRDCs are collected as part of the Survey of Academic Research and Development Expenditures. Prior to FY 2001, R&D data for industry-administered FFRDCs were derived from the *R&D in Industry* report and data reported in the *Federal Funds* series were used for nonprofit-administered FFRDCs.

Data Analysis

Preliminary Data and Projection Procedures for 2002 and 2003

Preliminary R&D performance totals in *National Patterns* are calculated for each sector, by character of work and by source of funds from surveys and time-series extrapolation techniques, as follows:

- **Federal Government.** Projections for 2002 and 2003 are based on changes in intramural R&D obligations reported in *Federal Funds.* Data for 2003 are projections based in part on changes in intramural R&D represented in administration 2004 budget proposals.

[44]For more information, see M. Machen and B. Shackelford, *Academic R&D Spending Maintains Growth From All Major Sources in FY 2001,* NSF InfoBrief (Arlington, VA, 2003).

- **Industry.** Preliminary data for company-funded 2002 and 2003 performance are based on partial responses to the 2002 Survey of Industrial Research and Development and time-series forecasting methods.
- **Universities and colleges.** Preliminary data for 2002 and 2003 are based on university responses to the FY 2002 Academic R&D Survey and time-series forecasting models.
- **Other nonprofit institutions.** Preliminary tabulations for 2002 and 2003 are based on (1) Federal obligations reported in *Federal Funds* and (2) time-series-modeled extrapolations of recent trends in R&D performance and funding within the industrial and university sectors. (The method of estimation for these levels is provided in a forthcoming methodology report.)
- **FFRDCs.** Preliminary data for 2002 and 2003 are based on FFRDC responses to the FY 2002 Academic R&D Survey and expected Federal funding of FFRDC R&D reported in *Federal Funds* and the Bush administration's FY 2004 budget.

Use of Time-Series Data

Data presented in trend tables are assembled from the most recently completed survey cycles. Data for prior years are reviewed for consistency with the current year's responses and, when necessary, revised in consultation with survey respondents. In addition, changes in sample design or imputation methodologies can result in revisions to previously published data. For trend comparisons, the historical data contained in this report should be used rather than the data published in previous *National Patterns* volumes.

Geographic Distribution

This report contains information on the state distribution of R&D performance for 2001 (appendix table B-17). These data cover R&D performance by industry, academia, Federal agencies, and FFRDCs as well as the federally funded R&D activities of nonprofit institutions. These state-distributed data are meant to be indicative of general R&D patterns; they are not necessarily precise.

Supporting Data Sources on R&D Expenditures

National Science Foundation, Division of Science Resources Statistics. 2002. *Federal R&D Funding by Budget Function: Fiscal Years 2001–2003.* NSF 02-330. Arlington, VA.

Provides information on Federal R&D budget authority by Federal budget function as proposed in the administration's 2003 budget.

National Science Foundation, Division of Science Resources Statistics. Forthcoming. *Academic Research and Development Expenditures: Fiscal Year 2002.*

Detailed statistical tables cover academic R&D performance as reported in a survey of U.S. universities and all FFRDCs. Data include distribution by source of funds, performing institution, character of work, field of science, and geographic location.

National Science Foundation, Division of Science Resources Statistics. Forthcoming. *Federal Funds for Research and Development: Fiscal Years 2001, 2002, and 2003.*

Detailed statistical tables cover R&D (and R&D plant) funding levels for FY 2001–2003 as reported by all Federal agencies with R&D programs. Includes data by agency, performer, character of work, geographic distribution, and S&E field.

National Science Foundation, Division of Science Resources Statistics. Forthcoming. *Research and Development in Industry: 2001.*

Detailed statistical tables cover industrial R&D performance as reported in a sample survey of companies. Data include distribution by source of funds, industry classification, character of work, product field, geographic location, and company size as well as other tabulations.

Office of Management and Budget. 2003. *The Budget of the United States Government, Fiscal Year 2004.* Washington, DC.

Provides quantitative and qualitative information on R&D funding as proposed in the administration's 2004 budget.

APPENDIX B

DETAILED STATISTICAL TABLES

List of Tables

Table *Page*

TABLE B-1. U.S. research and development expenditures, by performing sector and source of funds: 1993–2003

Year[f]	Performing sector:	Total	Federal	Industry			Industry FFRDCs	U&C[a]						U&C FFRDCs	Other nonprofit institutions				Nonprofit FFRDCs[b]
	Funding sector:	Total	Federal	Total	Federal	Industry[c]	Federal	Total	Federal	Other government[d]	Industry	U&C	Nonprofit	Federal[e]	Total	Federal	Industry	Nonprofit	Federal
	Data column:[g]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]
		Millions of current dollars																	
1993		165,723	16,531	115,435	20,844	94,591	1,965	20,487	12,302	1,557	1,391	3,708	1,530	5,289	5,267	2,843	567	1,857	749
1994		169,195	16,355	117,392	20,261	97,131	2,202	21,595	12,987	1,622	1,456	3,937	1,594	5,294	5,599	2,911	617	2,071	758
1995		183,611	16,904	129,830	21,178	108,652	2,273	22,603	13,582	1,750	1,547	4,109	1,616	5,367	5,827	2,847	671	2,308	808
1996		197,330	16,585	142,371	21,356	121,015	2,297	23,702	14,073	1,860	1,671	4,434	1,665	5,395	6,209	2,906	730	2,574	772
1997		212,134	16,819	155,409	21,798	133,611	2,130	24,866	14,517	1,921	1,807	4,836	1,785	5,463	6,626	3,014	809	2,804	821
1998		226,321	17,362	167,102	22,086	145,016	2,078	26,151	15,147	1,970	1,947	5,168	1,919	5,559	7,225	3,281	880	3,064	843
1999		243,517	17,851	180,682	20,506	160,176	2,039	28,135	16,223	2,095	2,077	5,630	2,110	5,652	8,175	3,761	975	3,440	993
2000		264,634	17,917	197,548	17,127	180,421	2,000	30,566	17,637	2,238	2,165	6,211	2,316	5,742	9,404	4,447	1,103	3,854	1,465
2001		274,211	21,048	198,505	16,899	181,606	2,020	33,518	19,654	2,382	2,177	6,778	2,528	6,225	10,702	5,302	1,110	4,290	2,192
2002	preliminary	276,434	23,788	192,379	17,085	175,294	2,235	36,846	22,052	2,548	2,150	7,332	2,764	7,132	11,766	5,910	1,070	4,786	2,288
2003	preliminary	283,795	24,959	193,729	17,314	176,415	2,383	40,262	24,499	2,710	2,123	7,944	2,986	7,421	12,661	6,323	1,077	5,261	2,381
		[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]	[27]	[28]	[29]	[30]	[31]	[32]	[33]	[34]	[35]	[36]
		Millions of constant 1996 dollars																	
1993		176,207	17,576	122,738	22,163	100,575	2,089	21,783	13,080	1,655	1,479	3,943	1,627	5,624	5,601	3,023	603	1,975	796
1994		176,226	17,035	122,271	21,103	101,168	2,294	22,492	13,527	1,689	1,516	4,101	1,660	5,514	5,831	3,032	642	2,157	790
1995		187,168	17,231	132,345	21,588	110,756	2,317	23,041	13,845	1,784	1,577	4,188	1,647	5,471	5,940	2,902	684	2,353	823
1996		197,330	16,585	142,371	21,356	121,015	2,297	23,702	14,073	1,860	1,671	4,434	1,665	5,395	6,209	2,906	730	2,574	772
1997		208,076	16,497	152,436	21,381	131,055	2,089	24,391	14,239	1,885	1,773	4,744	1,751	5,358	6,500	2,956	793	2,750	805
1998		219,303	16,824	161,921	21,401	140,519	2,014	25,340	14,677	1,909	1,886	5,008	1,860	5,387	7,001	3,179	853	2,969	817
1999		232,697	17,058	172,653	19,594	153,059	1,948	26,885	15,503	2,002	1,985	5,380	2,016	5,401	7,812	3,594	932	3,287	949
2000		247,578	16,763	184,816	16,023	168,793	1,871	28,596	16,500	2,094	2,025	5,811	2,166	5,372	8,798	4,161	1,032	3,606	1,371
2001		250,614	19,237	181,423	15,445	165,978	1,847	30,634	17,963	2,177	1,989	6,195	2,310	5,690	9,781	4,846	1,015	3,921	2,003
2002	preliminary	249,903	21,505	173,915	15,445	158,470	2,021	33,310	19,935	2,304	1,943	6,628	2,499	6,447	10,637	5,343	967	4,326	2,069
2003	preliminary	253,161	22,264	172,817	15,445	157,372	2,126	35,916	21,854	2,417	1,894	7,087	2,664	6,620	11,294	5,641	961	4,693	2,124

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

[a] Adjustments have been made to university research and development (R&D) for 1998 and later years to eliminate double counting of funds passed through from one academic institution to another. Data for 1998 and later years are not directly comparable with data for 1997 and earlier years. For fiscal year (FY) 1998, $479 million in passed-through funds were reported. For FY 2003, $990 million in passed-through funds are estimated.

[b] Beginning in 2001, data for nonprofit FFRDCs are reported by FFRDCs. In prior years, data were collected from Federal agencies supporting FFRDCs.

[c] Industry sources of industry R&D expenditures include all non-Federal sources of industry R&D expenditures.

[d] Because of limitations in survey information, data on other government funding to other performers are not available and are consequently included in other sectors' support for their own R&D performance, e.g., other government support to nonprofits is included in nonprofit support for their own R&D.

[e] Includes all R&D expenditures of FFRDCs administered by academic institutions.

[f] Expenditure levels for academic and Federal Government performers are calendar-year approximations based on FY data. For Federal Government expenditures, approximation is equal to 75 percent of amount reported in same FY plus 25 percent of amount reported in subsequent FY. For academic expenditures, respective percentages are 50 and 50, because those FYs generally begin on July 1 instead of October 1.

[g] See historical database, table D, which is available in online version of this report at http://www.nsf.gov/sbe/srs/nprdr/start.htm, for full series of historical data arranged in same data columns defined in this and other tables.

NOTE: Technical notes explaining methodological issues of measurement will be provided in National Science Foundation, *The Methodology Underlying the Measurement of R&D Expenditures: 2003* (Arlington, VA, forthcoming). Data are based on annual reports by performers except for nonprofit sector. For trend comparisons, use only historical data reported here. Do not use data published earlier.

SOURCES: Data were derived from National Science Foundation, Division of Science Resources Statistics (NSF/SRS), *Research and Development in Industry 2001* (Arlington, VA, forthcoming); NSF/SRS, *Academic Research and Development Expenditures: Fiscal Year 2001* (Arlington, VA, 2003); NSF/SRS, *Federal Funds for Research and Development: Fiscal Years 2001, 2002, and 2003* (Arlington, VA, forthcoming); and NSF/SRS, Survey of Research and Development Funding and Performance by Nonprofit Organizations: FY 1996–97.

TABLE B-2. U.S. research and development expenditures, by source of funds and performing sector: 1993–2003

Year[f]	Funding sector:	Total	Federal								Industry				U&C	Nonprofit			Other government[a]
	Performing sector:	Total	Total	Federal	Industry	Industry FFRDCs	U&C[b]	U&C FFRDCs[c]	Non-profit	Nonprofit FFRDCs[d]	Total	Industry[e]	U&C[d]	Nonprofit	U&C[b]	Total	Non-profit	U&C[b]	U&C[b]
	Data column:[g]	[1]	[37]	[2]	[4]	[6]	[8]	[13]	[15]	[18]	[38]	[5]	[10]	[16]	[11]	[39]	[17]	[12]	[9]
											Millions of current dollars								
1993		165,723	60,581	16,531	20,844	1,965	12,302	5,289	2,843	749	96,549	94,591	1,391	567	3,708	3,387	1,857	1,530	1,557
1994		169,195	60,787	16,355	20,261	2,202	12,987	5,294	2,911	758	99,203	97,131	1,456	617	3,937	3,664	2,071	1,594	1,622
1995		183,611	62,965	16,904	21,178	2,273	13,582	5,367	2,847	808	110,870	108,652	1,547	671	4,109	3,924	2,308	1,616	1,750
1996		197,330	63,341	16,585	21,356	2,297	14,073	5,395	2,906	772	123,416	121,015	1,671	730	4,434	4,238	2,574	1,665	1,860
1997		212,134	64,548	16,819	21,798	2,130	14,517	5,463	3,014	821	136,227	133,611	1,807	809	4,836	4,589	2,804	1,785	1,921
1998		226,321	66,346	17,362	22,086	2,078	15,147	5,559	3,281	843	147,843	145,016	1,947	880	5,168	4,984	3,064	1,919	1,970
1999		243,517	67,015	17,851	20,506	2,039	16,223	5,652	3,761	993	163,229	160,176	2,077	975	5,630	5,549	3,440	2,110	2,095
2000		264,634	66,327	17,917	17,127	2,000	17,637	5,742	4,447	1,465	183,688	180,421	2,165	1,103	6,211	6,170	3,854	2,316	2,238
2001		274,211	73,341	21,048	16,899	2,020	19,654	6,225	5,302	2,192	184,892	181,606	2,177	1,110	6,778	6,818	4,290	2,528	2,382
2002 preliminary		276,434	80,490	23,788	17,085	2,235	22,052	7,132	5,910	2,288	178,514	175,294	2,150	1,070	7,332	7,550	4,786	2,764	2,548
2003 preliminary		283,795	85,279	24,959	17,314	2,383	24,499	7,421	6,323	2,381	179,615	176,415	2,123	1,077	7,944	8,247	5,261	2,986	2,710
		[19]	[40]	[20]	[22]	[24]	[26]	[31]	[33]	[36]	[41]	[23]	[28]	[34]	[29]	[42]	[35]	[30]	[27]
											Millions of constant 1996 dollars								
1993		176,207	64,414	17,576	22,163	2,089	13,080	5,624	3,023	796	102,657	100,575	1,479	603	3,943	3,601	1,975	1,627	1,655
1994		176,226	63,313	17,035	21,103	2,294	13,527	5,514	3,032	790	103,326	101,168	1,516	642	4,101	3,816	2,157	1,660	1,689
1995		187,168	64,184	17,231	21,588	2,317	13,845	5,471	2,902	823	113,017	110,756	1,577	684	4,188	4,000	2,353	1,647	1,784
1996		197,330	63,341	16,585	21,356	2,297	14,073	5,395	2,906	772	123,416	121,015	1,671	730	4,434	4,238	2,574	1,665	1,860
1997		208,076	63,313	16,497	21,381	2,089	14,239	5,358	2,956	805	133,622	131,055	1,773	793	4,744	4,501	2,750	1,751	1,885
1998		219,303	64,289	16,824	21,401	2,014	14,677	5,387	3,179	817	143,258	140,519	1,886	853	5,008	4,829	2,969	1,860	1,909
1999		232,697	64,037	17,058	19,594	1,948	15,503	5,401	3,594	949	155,976	153,059	1,985	932	5,380	5,303	3,287	2,016	2,002
2000		247,578	62,052	16,763	16,023	1,871	16,500	5,372	4,161	1,371	171,849	168,793	2,025	1,032	5,811	5,772	3,606	2,166	2,094
2001		250,614	67,030	19,237	15,445	1,847	17,963	5,690	4,846	2,003	168,982	165,978	1,989	1,015	6,195	6,231	3,921	2,310	2,177
2002 preliminary		249,903	72,765	21,505	15,445	2,021	19,935	6,447	5,343	2,069	161,381	158,470	1,943	967	6,628	6,825	4,326	2,499	2,304
2003 preliminary		253,161	76,074	22,264	15,445	2,126	21,854	6,620	5,641	2,124	160,227	157,372	1,894	961	7,087	7,357	4,693	2,664	2,417

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

[a] Because of limitations in survey information, data on other government funding to other performers are not available and are consequently included in other sectors' support for their own research and development (R&D) performance. For example, other government support to nonprofits is included in nonprofits' support for their own R&D.

[b] Adjustments have been made to university R&D for 1998 and later years to eliminate double counting of funds passed through from one academic institution to another. Data for 1998 and later years are not directly comparable with data for 1997 and earlier years. For fiscal year (FY) 1998, $479 million in passed-through funds were reported. For FY 2003, $990 million in passed-through through funds are estimated.

[c] Includes all R&D expenditures of FFRDCs administered by academic institutions.

[d] Beginning in 2001, data for nonprofit FFRDCs are reported by FFRDCs. In prior years, data were collected from Federal agencies supporting FFRDCs.

[e] Industry sources of industry R&D expenditures include all non-Federal sources of industry R&D expenditures.

[f] Expenditure levels for academic and Federal Government performers are calendar-year approximations based on FY data. For Federal Government expenditures, approximation is equal to 75 percent of amount reported in same FY plus 25 percent of amount reported in subsequent FY. For academic expenditures, the respective percentages are 50 and 50, because their FYs generally begin on July 1 instead of October 1.

[g] See historical database, table D, which is available in the online version of this report at http://www.nsf.gov/sbe/srs/nprdr/start.htm, for full series of historical data arranged in same data columns defined in this and other tables.

NOTE: Technical notes explaining methodological issues of measurement will be provided in National Science Foundation, *The Methodology Underlying the Measurement of R&D Expenditures: 2003* (Arlington, VA, forthcoming). Data are based on annual reports by performers except for nonprofit sector. For trend comparisons, use only historical data reported here. Do not use data published earlier.

SOURCES: Data were derived from National Science Foundation, Division of Science Resources Statistics (NSF/SRS), *Research and Development in Industry 2001* (Arlington, VA, forthcoming); NSF/SRS, *Academic Research and Development Expenditures: Fiscal Year 2001* (Arlington, VA, 2003)*; NSF/SRS, Federal Funds for Research and Development: Fiscal Years 2001, 2002, and 2003* (Arlington, VA, forthcoming)*;* and NSF/SRS, Survey of Research and Development Funding and Performance by Nonprofit Organizations: FY 1996–97.

TABLE B-3. U.S. basic research expenditures, by performing sector and source of funds: 1993–2003

Year[f]	Performing sector:	Total	Federal	Industry[a]			Industry FFRDCs	U&C[b]						U&C FFRDCs	Other nonprofit institutions				Nonprofit FFRDCs
	Funding sector:	Total	Federal	Total	Federal	Industry[c]	Federal	Total	Federal	Other government[d]	Industry	U&C	Nonprofit	Federal[e]	Total	Federal	Industry	Nonprofit	Federal
	Data column:[g]	[43]	[44]	[45]	[46]	[47]	[48]	[49]	[50]	[51]	[52]	[53]	[54]	[55]	[56]	[57]	[58]	[59]	[60]
		Millions of current dollars																	
1993		28,739	2,621	6,427	466	5,961	492	13,643	8,637	952	851	2,268	936	2,953	2,532	1,157	324	1,051	72
1994		29,644	2,547	6,514	436	6,078	503	14,393	9,135	991	889	2,405	973	2,934	2,678	1,137	356	1,186	75
1995		29,602	2,689	5,569	190	5,379	530	15,139	9,629	1,069	945	2,509	987	2,702	2,899	1,170	390	1,338	75
1996		32,790	2,680	7,498	650	6,848	708	16,033	10,087	1,148	1,032	2,738	1,028	2,606	3,187	1,248	428	1,510	79
1997		36,918	2,746	9,795	1,029	8,766	625	17,651	10,912	1,250	1,177	3,149	1,163	2,671	3,322	1,317	449	1,557	108
1998		35,256	3,003	5,853	1,002	4,851	568	19,309	11,875	1,331	1,315	3,491	1,296	2,660	3,651	1,461	489	1,701	213
1999		38,710	3,347	6,562	1,200	5,362	557	20,900	12,773	1,429	1,417	3,841	1,439	2,765	4,185	1,734	541	1,910	397
2000		42,321	3,765	6,945	928	6,017	547	22,726	13,836	1,539	1,488	4,271	1,592	2,873	4,852	2,099	612	2,140	616
2001		47,112	4,317	7,911	754	7,157	552	24,862	15,299	1,643	1,501	4,675	1,744	3,041	5,518	2,520	616	2,382	910
2002	preliminary	50,807	4,617	7,671	762	6,908	611	27,369	17,122	1,765	1,489	5,079	1,915	3,484	6,105	2,854	594	2,657	950
2003	preliminary	54,103	4,463	7,725	773	6,952	651	29,940	19,022	1,877	1,470	5,503	2,069	3,625	6,709	3,190	598	2,921	988
		[61]	[62]	[63]	[64]	[65]	[66]	[67]	[68]	[69]	[70]	[71]	[72]	[73]	[74]	[75]	[76]	[77]	[78]
		Millions of constant 1996 dollars																	
1993		30,557	2,787	6,834	495	6,338	523	14,506	9,183	1,012	905	2,411	995	3,140	2,692	1,230	344	1,117	77
1994		30,876	2,653	6,785	454	6,331	524	14,991	9,515	1,032	926	2,505	1,014	3,056	2,790	1,184	370	1,235	78
1995		30,176	2,741	5,677	194	5,483	540	15,432	9,815	1,089	963	2,558	1,006	2,754	2,955	1,193	398	1,364	77
1996		32,790	2,680	7,498	650	6,848	708	16,033	10,087	1,148	1,032	2,738	1,028	2,606	3,187	1,248	428	1,510	79
1997		36,212	2,693	9,608	1,009	8,598	613	17,313	10,704	1,226	1,155	3,088	1,140	2,620	3,259	1,291	440	1,527	106
1998		34,163	2,910	5,672	971	4,701	550	18,710	11,507	1,289	1,274	3,383	1,256	2,578	3,538	1,415	474	1,649	206
1999		36,990	3,198	6,271	1,147	5,124	533	19,971	12,206	1,366	1,354	3,670	1,376	2,642	3,999	1,657	517	1,825	379
2000		39,593	3,522	6,497	868	5,629	512	21,262	12,945	1,440	1,392	3,995	1,490	2,688	4,539	1,964	573	2,002	576
2001		43,058	3,945	7,230	689	6,541	505	22,723	13,983	1,502	1,372	4,273	1,594	2,780	5,043	2,303	563	2,177	832
2002	preliminary	45,931	4,174	6,934	689	6,245	552	24,742	15,479	1,596	1,346	4,591	1,731	3,150	5,519	2,580	537	2,402	859
2003	preliminary	48,263	3,982	6,891	689	6,202	581	26,709	16,968	1,674	1,312	4,909	1,845	3,234	5,985	2,846	534	2,606	882

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

[a] Character-of-work estimates for industry have been revised for 1998 and later years; hence these data are not directly comparable with data for 1997 and earlier years.

[b] Adjustments have been made to university research and development (R&D) for 1998 and later years to eliminate double counting of funds passed through from one academic institution to another. Character-of-work estimation procedure for university and college R&D also was revised for 1998 and later years; hence these data are not directly comparable with data for 1997 and earlier years.

[c] Industry sources of industry R&D expenditures include all non-Federal sources of industry R&D expenditures.

[d] Because of limitations in survey information, data on other government funding to other performers are not available and are consequently included in other sectors' support for their own R&D performance. For example, other government support to nonprofits is included in nonprofits' support for their own R&D.

[e] Includes all R&D expenditures of FFRDCs administered by academic institutions.

[f] 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 percent of amount reported in same fiscal year (FY) plus 25 percent of amount reported in subsequent FY. For academic expenditures, respective percentages are 50 and 50, because their FYs generally begin on July 1 instead of October 1.

[g] See historical database, table D, available in online version of this report at http://www.nsf.gov/sbe/srs/nprdr/start.htm, for full series of historical data arranged in same data columns defined in this and other tables.

NOTES: Technical notes explaining methodological issues of measurement will be provided in National Science Foundation, *The Methodology Underlying the Measurement of R&D Expenditures: 2003* (Arlington, VA, forthcoming). Data are based on annual reports by performers except for nonprofit sector. For trend comparisons, use only historical data reported here. Do not use data published earlier.

SOURCES: Data were derived from National Science Foundation, Division of Science Resources Statistics (NSF/SRS), *Research and Development in Industry 2001* (Arlington, VA, forthcoming); NSF/SRS, *Academic Research and Development Expenditures: Fiscal Year 2001* (Arlington, VA, 2003); NSF/SRS, *Federal Funds for Research and Development: Fiscal Years 2001, 2002, and 2003* (Arlington, VA, forthcoming); and NSF/SRS, Survey of Research and Development Funding and Performance by Nonprofit Organizations: FY 1996–97.

TABLE B-4. U.S. basic research expenditures, by source of funds and performing sector: 1993–2003

Year[e]	Funding sector:	Total	Federal								Industry				U&C	Nonprofit			Other government[a]
						Industry		U&C		Nonprofit									
	Performing sector:	Total	Total	Federal	Industry	FFRDCs	U&C[b]	FFRDCs[c]	Nonprofit	FFRDCs	Total	Industry[d]	U&C[d]	Nonprofit	U&C[b]	Total	Nonprofit	U&C[b]	U&C[b]
	Data column:[f]	[43]	[79]	[44]	[46]	[48]	[50]	[55]	[57]	[60]	[80]	[47]	[52]	[58]	[53]	[81]	[59]	[54]	[51]
											Millions of current dollars								
1993		28,739	16,400	2,621	466	492	8,637	2,953	1,157	72	7,136	5,961	851	324	2,268	1,987	1,051	936	952
1994		29,644	16,773	2,547	436	503	9,135	2,934	1,137	75	7,323	6,078	889	356	2,405	2,159	1,186	973	991
1995		29,602	17,030	2,689	190	530	9,629	2,702	1,170	75	6,714	5,379	945	390	2,509	2,325	1,338	987	1,069
1996		32,790	18,037	2,680	650	708	10,087	2,606	1,248	79	8,308	6,848	1,032	428	2,738	2,538	1,510	1,028	1,148
1997		36,918	19,394	2,746	1,029	625	10,912	2,671	1,317	108	10,392	8,766	1,177	449	3,149	2,719	1,557	1,163	1,250
1998		35,256	20,779	3,003	1,002	568	11,875	2,660	1,461	213	6,655	4,851	1,315	489	3,491	2,998	1,701	1,296	1,331
1999		38,710	22,770	3,347	1,200	557	12,773	2,765	1,734	397	7,320	5,362	1,417	541	3,841	3,349	1,910	1,439	1,429
2000		42,321	24,662	3,765	928	547	13,836	2,873	2,099	616	8,118	6,017	1,488	612	4,271	3,732	2,140	1,592	1,539
2001		47,112	27,393	4,317	754	552	15,299	3,041	2,520	910	9,274	7,157	1,501	616	4,675	4,126	2,382	1,744	1,643
2002	preliminary	50,807	30,400	4,617	762	611	17,122	3,484	2,854	950	8,992	6,908	1,489	594	5,079	4,572	2,657	1,915	1,765
2003	preliminary	54,103	32,713	4,463	773	651	19,022	3,625	3,190	988	9,021	6,952	1,470	598	5,503	4,989	2,921	2,069	1,877
		[61]	[82]	[62]	[64]	[66]	[68]	[73]	[75]	[78]	[83]	[65]	[70]	[76]	[71]	[84]	[77]	[72]	[69]
											Millions of constant 1996 dollars								
1993		30,557	17,438	2,787	495	523	9,183	3,140	1,230	77	7,587	6,338	905	344	2,411	2,112	1,117	995	1,012
1994		30,876	17,470	2,653	454	524	9,515	3,056	1,184	78	7,627	6,331	926	370	2,505	2,249	1,235	1,014	1,032
1995		30,176	17,359	2,741	194	540	9,815	2,754	1,193	77	6,844	5,483	963	398	2,558	2,370	1,364	1,006	1,089
1996		32,790	18,037	2,680	650	708	10,087	2,606	1,248	79	8,308	6,848	1,032	428	2,738	2,538	1,510	1,028	1,148
1997		36,212	19,023	2,693	1,009	613	10,704	2,620	1,291	106	10,193	8,598	1,155	440	3,088	2,667	1,527	1,140	1,226
1998		34,163	20,135	2,910	971	550	11,507	2,578	1,415	206	6,448	4,701	1,274	474	3,383	2,905	1,649	1,256	1,289
1999		36,990	21,759	3,198	1,147	533	12,206	2,642	1,657	379	6,995	5,124	1,354	517	3,670	3,200	1,825	1,376	1,366
2000		39,593	23,072	3,522	868	512	12,945	2,688	1,964	576	7,594	5,629	1,392	573	3,995	3,492	2,002	1,490	1,440
2001		43,058	25,036	3,945	689	505	13,983	2,780	2,303	832	8,476	6,541	1,372	563	4,273	3,771	2,177	1,594	1,502
2002	preliminary	45,931	27,482	4,174	689	552	15,479	3,150	2,580	859	8,129	6,245	1,346	537	4,591	4,133	2,402	1,731	1,596
2003	preliminary	48,263	29,182	3,982	689	581	16,968	3,234	2,846	882	8,047	6,202	1,312	534	4,909	4,451	2,606	1,845	1,674

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

[a] Because of limitations in survey information, data on other government funding to other performers are not available and are consequently included in other sectors' support for their own research and development (R&D) performance. For example, other government support to nonprofits is included in nonprofits' support for their own R&D.

[b] Adjustments have been made to university R&D for 1998 and later years to eliminate double counting of funds passed through from one academic institution to another. Character-of-work estimation procedure for university and college R&D also was revised for 1998 and later years; hence these data are not directly comparable with data for 1997 and earlier years.

[c] Includes all R&D expenditures of FFRDCs administered by academic institutions.

[d] Industry sources of industry R&D expenditures include all non-Federal sources of industry R&D expenditures. Character-of-work estimates for industry have been revised for 1998 and later years; hence these data are not directly comparable with data for 1997 and earlier years.

[e] 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 percent of amount reported in same fiscal year (FY) plus 25 percent of amount reported in subsequent FY. For academic expenditures, the respective percentages are 50 and 50, because their FYs generally begin on July 1 instead of October 1.

[f] See historical database, table D, which is available in online version of this report at http://www.nsf.gov/sbe/srs/nprdr/start.htm, for full series of historical data arranged in same data columns defined in this and other tables.

NOTES: Technical notes explaining methodological issues of measurement will be provided in National Science Foundation, *The Methodology Underlying the Measurement of R&D Expenditures: 2003* (Arlington, VA, forthcoming). Data are based on annual reports by performers except for nonprofit sector. For trend comparisons, use only historical data reported here. Do not use data published earlier.

SOURCES: Data were derived from National Science Foundation, Division of Science Resources Statistics (NSF/SRS), *Research and Development in Industry, 2001* (Arlington, VA, forthcoming); NSF/SRS, *Academic Research and Development Expenditures: Fiscal Year 2001* (Arlington, VA, 2003); NSF/SRS, *Federal Funds for Research and Development: Fiscal Years 2001, 2002, and 2003* (Arlington, VA, forthcoming); and NSF/SRS, Survey of Research and Development Funding and Performance by Nonprofit Organizations: FY 1996–97.

TABLE B-5. U.S. applied research expenditures, by performing sector and source of funds: 1993–2003

Year[f]	Performing sector:	Total	Federal	Industry[a]			Industry FFRDCs	U&C[b]						U&C FFRDCs	Other nonprofit institutions				Nonprofit FFRDCs
	Funding sector:	Total	Federal	Total	Federal	Industry[c]	Federal	Total	Federal	Other government[d]	Industry	U&C	Nonprofit	Federal[e]	Total	Federal	Industry	Nonprofit	Federal
	Data column:[g]	[85]	[86]	[87]	[88]	[89]	[90]	[91]	[92]	[93]	[94]	[95]	[96]	[97]	[98]	[99]	[100]	[101]	[102]
		Millions of current dollars																	
1993		37,280	4,838	24,251	4,295	19,956	435	5,146	2,539	496	443	1,181	487	962	1,544	900	148	497	103
1994		36,615	4,985	22,988	3,616	19,372	503	5,387	2,640	517	464	1,256	508	982	1,659	960	158	541	111
1995		40,932	4,952	26,919	3,164	23,755	535	5,655	2,775	559	494	1,311	516	1,050	1,692	934	170	589	129
1996		43,165	4,872	29,010	3,640	25,370	231	5,879	2,859	584	524	1,390	522	1,270	1,781	960	182	640	122
1997		46,542	4,997	32,430	2,648	29,782	213	5,511	2,549	551	517	1,384	510	1,337	1,926	1,011	205	711	128
1998		46,353	5,146	32,208	2,632	29,576	230	5,215	2,286	524	518	1,375	511	1,372	2,060	1,060	223	777	123
1999		51,865	5,530	36,418	3,109	33,309	274	5,843	2,740	546	542	1,467	550	1,251	2,419	1,300	247	872	130
2000		56,481	6,105	38,651	2,521	36,130	269	6,661	3,349	573	554	1,591	593	1,330	3,087	1,831	279	977	217
2001		64,401	7,164	43,486	3,603	39,883	916	7,366	3,839	606	554	1,724	643	1,548	3,570	2,202	281	1,087	351
2002 preliminary		65,559	8,083	42,140	3,643	38,497	955	8,146	4,418	642	542	1,848	697	1,938	3,933	2,448	271	1,213	365
2003 preliminary		67,780	8,837	42,434	3,691	38,743	1,040	8,927	4,954	683	535	2,002	753	1,968	4,215	2,609	273	1,333	359
		[103]	[104]	[105]	[106]	[107]	[108]	[109]	[110]	[111]	[112]	[113]	[114]	[115]	[116]	[117]	[118]	[119]	[120]
		Millions of constant 1996 dollars																	
1993		39,638	5,144	25,785	4,567	21,219	463	5,472	2,700	527	471	1,256	518	1,023	1,642	957	157	528	109
1994		38,136	5,192	23,943	3,766	20,177	524	5,611	2,750	539	484	1,308	530	1,022	1,728	999	165	563	116
1995		41,725	5,048	27,440	3,225	24,215	545	5,764	2,829	569	503	1,337	526	1,070	1,725	952	173	600	131
1996		43,165	4,872	29,010	3,640	25,370	231	5,879	2,859	584	524	1,390	522	1,270	1,781	960	182	640	122
1997		45,652	4,901	31,810	2,597	29,212	209	5,405	2,500	540	507	1,357	501	1,312	1,890	992	201	697	126
1998		44,915	4,986	31,209	2,550	28,659	223	5,053	2,215	508	502	1,333	495	1,329	1,996	1,027	216	752	119
1999		49,560	5,284	34,800	2,971	31,829	262	5,584	2,618	522	517	1,402	525	1,196	2,311	1,242	236	833	124
2000		52,841	5,712	36,160	2,359	33,801	251	6,232	3,133	536	519	1,489	555	1,244	2,888	1,713	261	914	203
2001		58,859	6,548	39,744	3,293	36,451	837	6,732	3,509	554	506	1,576	588	1,414	3,263	2,012	257	994	321
2002 preliminary		59,267	7,307	38,095	3,293	34,802	864	7,364	3,994	581	490	1,670	630	1,752	3,555	2,213	245	1,096	330
2003 preliminary		60,464	7,883	37,854	3,293	34,561	928	7,963	4,420	609	477	1,786	671	1,755	3,760	2,327	244	1,189	320

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

[a] Character-of-work estimates for industry have been revised for 1998 and later years; hence these data are not directly comparable with data for 1997 and earlier years.

[b] Adjustments have been made to university research and development (R&D) for 1998 and later years to eliminate double counting of funds passed through from one academic institution to another. Character-of-work estimation procedure for university and college R&D also was revised for 1998 and later years; hence these data are not directly comparable with data for 1997 and earlier years.

[c] Industry sources of industry R&D expenditures include all non-Federal sources of industry R&D expenditures.

[d] Because of limitations in survey information, data on other government funding to other performers are not available and are consequently included in other sectors' support for their own R&D performance. For example, other government support to nonprofits is included in nonprofits' support for their own R&D.

[e] Includes all R&D expenditures of FFRDCs administered by academic institutions.

[f] 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 percent of amount reported in same fiscal year (FY) plus 25 percent of amount reported in subsequent FY. For academic expenditures, respective percentages are 50 and 50, because their FYs generally begin on July 1 instead of October 1.

[g] See historical database, table D, which is available in online version of this report at http://www.nsf.gov/sbe/srs/nprdr/start.htm, for full series of historical data arranged in same data columns defined in this and other tables.

NOTES: Technical notes explaining methodological issues of measurement will be provided in National Science Foundation, *The Methodology Underlying the Measurement of R&D Expenditures: 2003* (Arlington, VA, forthcoming). Data are based on annual reports by performers except for nonprofit sector. For trend comparisons, use only historical data reported here. Do not use data published earlier.

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TABLE B-6. U.S. applied research expenditures, by source of funds and performing sectors: 1993–2003

Year[e]	Funding sector:	Total	Federal								Industry				U&C	Nonprofits			Other government[a]
	Performing sector:	Total	Total	Federal	Industry	Industry FFRDCs	U&C[b]	U&C FFRDCs[c]	Nonprofit	Nonprofit FFRDCs	Total	Industry[d]	U&C[d]	Nonprofit	U&C[b]	Total	Nonprofit	U&C[b]	U&C[b]
	Data column:[f]	[85]	[121]	[86]	[88]	[90]	[92]	[97]	[99]	[102]	[122]	[89]	[94]	[100]	[95]	[123]	[101]	[96]	[93]
											Millions of current dollars								
1993		37,280	14,089	4,838	4,295	435	2,539	962	900	103	20,547	19,956	443	148	1,181	984	497	487	496
1994		36,615	13,805	4,985	3,616	503	2,640	982	960	111	19,995	19,372	464	158	1,256	1,049	541	508	517
1995		40,932	13,463	4,952	3,164	535	2,775	1,050	934	129	24,418	23,755	494	170	1,311	1,104	589	516	559
1996		43,165	13,949	4,872	3,640	231	2,859	1,270	960	122	26,076	25,370	524	182	1,390	1,162	640	522	584
1997		46,542	12,888	4,997	2,648	213	2,549	1,337	1,011	128	30,504	29,782	517	205	1,384	1,221	711	510	551
1998		46,353	12,860	5,146	2,632	230	2,286	1,372	1,060	123	30,317	29,576	518	223	1,375	1,287	777	511	524
1999		51,865	14,332	5,530	3,109	274	2,740	1,251	1,300	130	34,098	33,309	542	247	1,467	1,421	872	550	546
2000		56,481	15,783	6,105	2,521	269	3,349	1,330	1,831	217	36,964	36,130	554	279	1,591	1,570	977	593	573
2001		64,401	19,623	7,164	3,603	916	3,839	1,548	2,202	351	40,718	39,883	554	281	1,724	1,730	1,087	643	606
2002	preliminary	65,559	21,849	8,083	3,643	955	4,418	1,938	2,448	365	39,310	38,497	542	271	1,848	1,909	1,213	697	642
2003	preliminary	67,780	23,458	8,837	3,691	1,040	4,954	1,968	2,609	359	39,551	38,743	535	273	2,002	2,086	1,333	753	683
		[103]	[124]	[104]	[106]	[108]	[110]	[115]	[117]	[120]	[125]	[107]	[112]	[118]	[113]	[126]	[119]	[114]	[111]
											Millions of constant 1996 dollars								
1993		39,638	14,980	5,144	4,567	463	2,700	1,023	957	109	21,847	21,219	471	157	1,256	1,047	528	518	527
1994		38,136	14,378	5,192	3,766	524	2,750	1,022	999	116	20,826	20,177	484	165	1,308	1,093	563	530	539
1995		41,725	13,724	5,048	3,225	545	2,829	1,070	952	131	24,891	24,215	503	173	1,337	1,126	600	526	569
1996		43,165	13,949	4,872	3,640	231	2,859	1,270	960	122	26,076	25,370	524	182	1,390	1,162	640	522	584
1997		45,652	12,641	4,901	2,597	209	2,500	1,312	992	126	29,920	29,212	507	201	1,357	1,197	697	501	540
1998		44,915	12,461	4,986	2,550	223	2,215	1,329	1,027	119	29,377	28,659	502	216	1,333	1,247	752	495	508
1999		49,560	13,695	5,284	2,971	262	2,618	1,196	1,242	124	32,583	31,829	517	236	1,402	1,358	833	525	522
2000		52,841	14,766	5,712	2,359	251	3,133	1,244	1,713	203	34,582	33,801	519	261	1,489	1,469	914	555	536
2001		58,859	17,934	6,548	3,293	837	3,509	1,414	2,012	321	37,214	36,451	506	257	1,576	1,581	994	588	554
2002	preliminary	59,267	19,752	7,307	3,293	864	3,994	1,752	2,213	330	35,537	34,802	490	245	1,670	1,726	1,096	630	581
2003	preliminary	60,464	20,926	7,883	3,293	928	4,420	1,755	2,327	320	35,282	34,561	477	244	1,786	1,861	1,189	671	609

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

[a] Because of limitations in survey information, data on other government funding to other performers are not available and are consequently included in other sectors' support for their own research and development (R&D) performance. For example, other government support to nonprofits is included in nonprofits' support for their own R&D.

[b] Adjustments have been made to university R&D for 1998 and later years to eliminate double counting of funds passed through from one academic institution to another. Character-of-work estimation procedure for university and college R&D also was revised for 1998 and later years; hence these data are not directly comparable with data for 1997 and earlier years.

[c] Includes all R&D expenditures of FFRDCs administered by academic institutions.

[d] Industry sources of industry R&D expenditures include all non-Federal sources of industry R&D expenditures. Character-of-work estimates for industry have been revised for 1998 and later years; hence these data are not directly comparable with data for 1997 and earlier years.

[e] 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 percent of amount reported in same fiscal (FY) plus 25 percent of amount reported in subsequent FY. For academic expenditures, respective percentages are 50 and 50, because their FYs generally begin on July 1 instead of October 1.

[f] See historical database, table D, which is available in online version of this report at http://www.nsf.gov/sbe/srs/nprdr/start.htm, for full series of historical data arranged in same data columns as defined in this and other tables.

NOTES: Technical notes explaining methodological issues of measurement will be provided in National Science Foundation, *The Methodology Underlying the Measurement of R&D Expenditures: 2003* (Arlington, VA, forthcoming). Data are based on annual reports by performers except for nonprofit sector. For trend comparisons, use only historical data reported here. Do not use data published earlier.

SOURCES: Data were derived from National Science Foundation, Division of Science Resources Statistics (NSF/SRS), *Research and Development in Industry, 2001* (Arlington, VA, forthcoming); NSF/SRS, *Academic Research and Development Expenditures: Fiscal Year 2001* (Arlington, VA, 2003); NSF/SRS, *Federal Funds for Research and Development: FY 2001, 2002, and 2003* (Arlington, VA, forthcoming); and NSF/SRS, Survey of Research and Development Funding and Performance by Nonprofit Organizations: FY 1996–97.

TABLE B-7. U.S. development expenditures, by performing sector and source of funds: 1993–2003

Year[f]	Performing sector:	Total	Federal	Industry[a]			Industry FFRDCs	U&C[b]						U&C FFRDCs	Other nonprofit institutions				Nonprofit FFRDCs
	Funding sector:	Total	Federal	Total	Federal	Industry[c]	Federal	Total	Federal	Other government[d]	Industry	U&C	Nonprofit	Federal[e]	Total	Federal	Industry	Nonprofit	Federal
	Data column:[g]	[127]	[128]	[129]	[130]	[131]	[132]	[133]	[134]	[135]	[136]	[137]	[138]	[139]	[140]	[141]	[142]	[143]	[144]
		Millions of current dollars																	
1993		99,704	9,071	84,757	16,083	68,674	1,038	1,698	1,126	109	97	259	107	1,374	1,191	787	95	309	574
1994		102,936	8,823	87,890	16,209	71,681	1,196	1,815	1,212	114	102	276	112	1,378	1,261	815	103	343	573
1995		113,077	9,262	97,342	17,824	79,518	1,208	1,810	1,178	123	108	288	113	1,616	1,236	744	111	381	603
1996		121,375	9,033	105,863	17,066	88,797	1,358	1,790	1,127	128	115	305	115	1,520	1,241	698	120	423	571
1997		128,674	9,077	113,184	18,121	95,063	1,292	1,705	1,055	121	113	304	112	1,454	1,378	687	155	536	585
1998		144,712	9,214	129,041	18,452	110,589	1,280	1,628	985	115	114	302	112	1,527	1,515	760	168	586	507
1999		152,941	8,974	137,701	16,196	121,505	1,208	1,392	711	120	119	322	121	1,636	1,570	726	187	658	467
2000		165,827	8,047	151,952	13,678	138,274	1,185	1,179	452	126	122	349	130	1,540	1,461	513	211	737	632
2001		162,698	9,567	147,108	12,542	134,566	552	1,290	516	133	122	378	141	1,636	1,614	581	212	821	931
2002 preliminary		160,068	11,088	142,569	12,680	129,889	669	1,331	512	141	119	406	153	1,710	1,728	608	205	916	974
2003 preliminary		161,911	11,658	143,569	12,850	130,719	692	1,395	523	150	117	439	165	1,828	1,736	524	206	1,006	1,034
		[145]	[146]	[147]	[148]	[149]	[150]	[151]	[152]	[153]	[154]	[155]	[156]	[157]	[158]	[159]	[160]	[161]	[162]
		Millions of constant 1996 dollars																	
1993		106,012	9,645	90,119	17,100	73,019	1,104	1,806	1,197	116	103	276	114	1,461	1,267	836	101	329	611
1994		107,214	9,190	91,543	16,883	74,660	1,246	1,890	1,262	118	106	287	116	1,436	1,314	849	107	358	596
1995		115,267	9,441	99,227	18,169	81,058	1,231	1,845	1,201	125	110	293	115	1,647	1,260	758	113	389	615
1996		121,375	9,033	105,863	17,066	88,797	1,358	1,790	1,127	128	115	305	115	1,520	1,241	698	120	423	571
1997		126,213	8,903	111,019	17,774	93,245	1,267	1,672	1,035	119	111	298	110	1,426	1,351	673	152	526	573
1998		140,225	8,928	125,040	17,880	107,160	1,240	1,578	955	112	110	293	109	1,480	1,468	736	163	568	491
1999		146,145	8,575	131,583	15,477	116,106	1,154	1,330	679	115	114	308	115	1,563	1,501	693	178	629	446
2000		155,140	7,529	142,159	12,796	129,362	1,108	1,103	423	118	114	327	122	1,440	1,367	480	197	690	591
2001		148,697	8,744	134,449	11,463	122,986	504	1,179	472	122	111	346	129	1,496	1,475	531	194	750	851
2002 preliminary		144,705	10,024	128,885	11,463	117,423	605	1,203	463	127	108	367	138	1,546	1,562	549	185	828	880
2003 preliminary		144,434	10,400	128,072	11,463	116,609	617	1,244	466	134	105	392	147	1,630	1,549	467	184	898	922

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

[a] Character-of-work estimates for industry have been revised for 1998 and later years; hence these data are not directly comparable with data for 1997 and earlier years.

[b] Adjustments have been made to university research and development (R&D) for 1998 and later years to eliminate double counting of funds passed through from one academic institution to another. Character-of-work estimation procedure for university and college R&D also was revised for 1998 and later years; hence these data are not directly comparable with data for 1997 and earlier years.

[c] Industry sources of industry R&D expenditures include all non-Federal sources of industry R&D expenditures.

[d] Because of limitations in survey information, data on other government funding to other performers are not available and are consequently included in other sectors' support for their own R&D performance. For example, other government support to nonprofits is included in nonprofits' support for their own R&D.

[e] Includes all R&D expenditures of FFRDCs administered by academic institutions.

[f] 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 percent of amount reported in same fiscal year (FY) plus 25 percent of amount reported in subsequent FY. For academic expenditures, respective percentages are 50 and 50, because their FYs generally begin on July 1 instead of October 1.

[g] See historical database, table D, which is available in online version of this report at http://www.nsf.gov/sbe/srs/nprdr/start.htm, for full series of historical data arranged in same data columns defined in this and other tables.

NOTES: Technical notes explaining methodological issues of measurement will be provided in National Science Foundation, *The Methodology Underlying the Measurement of R&D Expenditures: 2003* (Arlington, VA, forthcoming). Data are based on annual reports by performers except for nonprofit sector. For trend comparisons, use only historical data reported here. Do not use data published earlier.

SOURCES: Data were derived from National Science Foundation, Division of Science Resources Statistics (NSF/SRS), *Research and Development in Industry, 2001 (Arlington, VA, forthcoming); NSF/SRS, Academic Research and Development Expenditures: Fiscal Year 2001* (Arlington, VA, 2003); NSF/SRS, *Federal Funds for Research and Development: FY 2001, 2002, and 2003* (Arlington, VA, forthcoming); and NSF/SRS, Survey of Research and Development Funding and Performance by Nonprofit Organizations: FY 1996–97.

TABLE B-8. U.S. development expenditures, by source of funds and performing sector: 1993–2003

Year[e]	Funding sector:	Total	Federal								Industry				U&C	Nonprofit			Other government[a]
	Performing sector:	Total	Total	Federal	Industry	Industry FFRDCs	U&C[b]	U&C FFRDCs[c]	Nonprofit	Nonprofit FFRDCs	Total	Industry[d]	U&C[d]	Nonprofit	U&C[b]	Total	Nonprofit	U&C[b]	U&C[b]
	Data column:[f]	[127]	[163]	[128]	[130]	[132]	[134]	[139]	[141]	[144]	[164]	[131]	[136]	[142]	[137]	[165]	[143]	[138]	[135]
			Millions of current dollars																
1993		99,704	30,093	9,071	16,083	1,038	1,126	1,374	787	574	68,866	68,674	97	95	259	416	309	107	109
1994		102,936	30,209	8,823	16,209	1,196	1,212	1,378	815	573	71,886	71,681	102	103	276	455	343	112	114
1995		113,077	32,472	9,262	17,824	1,208	1,178	1,616	744	603	79,738	79,518	108	111	288	495	381	113	123
1996		121,375	31,355	9,033	17,066	1,358	1,127	1,520	698	571	89,032	88,797	115	120	305	538	423	115	128
1997		128,674	32,267	9,077	18,121	1,292	1,055	1,454	687	585	95,331	95,063	113	155	304	648	536	112	121
1998		144,712	32,707	9,214	18,452	1,280	985	1,527	760	507	110,871	110,589	114	168	302	698	586	112	115
1999		152,941	29,911	8,974	16,196	1,208	711	1,636	726	467	121,810	121,505	119	187	322	779	658	121	120
2000		165,827	25,878	8,047	13,678	1,185	452	1,540	513	632	138,607	138,274	122	211	349	868	737	130	126
2001		162,698	26,325	9,567	12,542	552	516	1,636	581	931	134,900	134,566	122	212	378	962	821	141	133
2002	preliminary	160,068	28,240	11,088	12,680	669	512	1,710	608	974	130,213	129,889	119	205	406	1,069	916	153	141
2003	preliminary	161,911	29,107	11,658	12,850	692	523	1,828	524	1,034	131,043	130,719	117	206	439	1,172	1,006	165	150
		[145]	[166]	[146]	[148]	[150]	[152]	[157]	[159]	[162]	[167]	[149]	[154]	[160]	[155]	[168]	[161]	[156]	[153]
			Millions of constant 1996 dollars																
1993		106,012	31,997	9,645	17,100	1,104	1,197	1,461	836	611	73,223	73,019	103	101	276	443	329	114	116
1994		107,214	31,464	9,190	16,883	1,246	1,262	1,436	849	596	74,873	74,660	106	107	287	474	358	116	118
1995		115,267	33,101	9,441	18,169	1,231	1,201	1,647	758	615	81,282	81,058	110	113	293	504	389	115	125
1996		121,375	31,355	9,033	17,066	1,358	1,127	1,520	698	571	89,032	88,797	115	120	305	538	423	115	128
1997		126,213	31,650	8,903	17,774	1,267	1,035	1,426	673	573	93,508	93,245	111	152	298	636	526	110	119
1998		140,225	31,693	8,928	17,880	1,240	955	1,480	736	491	107,433	107,160	110	163	293	677	568	109	112
1999		146,145	28,582	8,575	15,477	1,154	679	1,563	693	446	116,398	116,106	114	178	308	744	629	115	115
2000		155,140	24,210	7,529	12,796	1,108	423	1,440	480	591	129,673	129,362	114	197	327	812	690	122	118
2001		148,697	24,060	8,744	11,463	504	472	1,496	531	851	123,291	122,986	111	194	346	879	750	129	122
2002	preliminary	144,705	25,530	10,024	11,463	605	463	1,546	549	880	117,715	117,423	108	185	367	966	828	138	127
2003	preliminary	144,434	25,965	10,400	11,463	617	466	1,630	467	922	116,898	116,609	105	184	392	1,045	898	147	134

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

[a] Because of limitations in survey information, data on other government funding to other performers are not available and are consequently included in other sectors' support for their own research and development (R&D) performance. For example, other government support to nonprofits is included in nonprofits' support for their own R&D.

[b] Adjustments have been made to university R&D for 1998 and later years to eliminate double counting of funds passed through from one academic institution to another. Character-of-work estimation procedure for university and college R&D also was revised for 1998 and later years; hence these data are not directly comparable with data for 1997 and earlier years.

[c] Includes all R&D expenditures of FFRDCs administered by academic institutions.

[d] Industry sources of industry R&D expenditures include all non-Federal sources of industry R&D expenditures. Character-of-work estimates for industry have been revised for 1998 and later years; hence these data are not directly comparable with data for 1997 and earlier years.

[e] 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 percent of amount reported in same fiscal year (FY) plus 25 percent of amount reported in subsequent FY. For academic expenditures, respective percentages are 50 and 50, because their FYs generally begin on July 1 instead of October 1.

[f] See historical database, table D, which is available in online version of this report at http://www.nsf.gov/sbe/srs/nprdr/start.htm, for full series of historical data arranged in same data columns defined in this and other tables.

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TABLE B-9. Comparative measures of growth for gross domestic product and research and development (federally funded, non-Federal, and total): 1993–2003

	GDP			R&D				R&D/GDP (percent)		
Year / Data column:[a]	Billions of current dollars [169]	Implicit price deflator (1996 = 1.00) [170]	Billions of constant 1996 dollars [171]	Millions of current dollars [1]	Millions of constant 1996 dollars [19]	Federal support in millions of constant 1996 dollars [40]	Non-Federal support in millions of constant 1996 dollars [172]	Total [173]	Federal support [174]	Non-Federal support [175]
1993	6,642	0.9405	7,063	165,782	176,270	64,414	111,856	2.50	0.91	1.58
1994	7,054	0.9601	7,348	169,212	176,245	63,313	112,932	2.40	0.86	1.54
1995	7,401	0.9810	7,544	183,617	187,174	64,184	122,989	2.48	0.85	1.63
1996	7,813	1.0000	7,813	197,288	197,288	63,341	133,948	2.53	0.81	1.71
1997	8,318	1.0195	8,160	212,121	208,064	63,313	144,750	2.55	0.78	1.77
1998	8,782	1.0320	8,509	226,311	219,294	64,289	155,005	2.58	0.76	1.82
1999	9,274	1.0465	8,859	243,517	232,697	64,037	168,660	2.63	0.72	1.90
2000	9,825	1.0689	9,191	264,634	247,578	62,052	185,526	2.69	0.68	2.02
2001	10,082	1.0942	9,215	274,211	250,614	67,030	183,584	2.72	0.73	1.99
2002 preliminary	10,442	1.1062	9,440	276,434	249,903	72,765	177,138	2.65	0.77	1.88
2003 preliminary	10,884	1.1210	9,710	283,795	253,161	76,074	177,087	2.61	0.78	1.82

GDP gross domestic product

R&D research and development

[a] See historical database, table D, which is available in online version of this report at http://www.nsf.gov/sbe/srs/nprdr/start.htm, for full series of historical data arranged in same data columns defined in this and other tables.

SOURCES: Department of Commerce, Bureau of Economic Analysis, special tabulations (Washington, DC, 2003); Office of Management and Budget, special tabulations (Washington, DC, 2003); and National Science Foundation, Division of Science Resources Statistics, special tabulations (Arlington, VA, 2003).

TABLE B-10. Trends in Federal and non-Federal research and development expenditures as percentage of total research and development: 1953–2003

(Percent)

Year	Federal				Non-Federal
	Total	Defense related	Space related	Civilian related	
1953	53.9	48.0	1.0	4.9	46.1
1954	55.2	49.0	1.0	5.2	44.8
1955	58.1	49.3	1.0	7.8	41.9
1956	58.7	49.8	0.9	8.1	41.3
1957	62.7	52.6	1.0	9.1	37.3
1958	64.1	53.2	1.8	9.0	35.9
1959	65.5	53.6	2.9	8.9	34.5
1960	65.1	51.5	4.4	9.2	34.9
1961	65.0	48.0	7.3	9.7	35.0
1962	64.8	49.1	6.6	9.1	35.2
1963	66.5	41.9	13.6	11.0	33.5
1964	66.7	36.9	18.9	10.9	33.3
1965	65.1	33.2	20.8	11.1	34.9
1966	64.2	32.4	19.6	12.2	35.8
1967	62.4	35.3	14.4	12.7	37.6
1968	60.7	34.8	13.6	12.4	39.3
1969	58.6	34.7	11.5	12.4	41.4
1970	57.1	33.4	10.3	13.3	42.9
1971	56.5	32.8	9.6	14.1	43.5
1972	55.8	33.0	7.9	14.9	44.2
1973	53.7	32.1	6.7	14.9	46.3
1974	51.9	29.3	6.9	15.7	48.1
1975	52.1	27.7	7.5	16.8	47.9
1976	51.5	27.0	7.7	16.9	48.5
1977	51.0	27.1	6.6	17.2	49.0
1978	50.1	25.9	6.2	18.0	49.9
1979	49.2	24.8	5.6	18.8	50.8
1980	47.4	24.3	5.3	17.9	52.6
1981	46.7	24.4	5.2	17.0	53.3
1982	46.0	26.1	4.9	15.0	54.0
1983	46.1	27.7	4.2	14.2	53.9
1984	45.5	28.7	3.0	13.7	54.5
1985	45.9	29.9	3.1	12.9	54.1
1986	45.4	31.4	3.0	11.0	54.6
1987	46.3	31.7	3.2	11.4	53.7
1988	44.9	30.2	3.5	11.2	55.1
1989	42.6	27.6	3.9	11.1	57.4
1990	40.5	25.1	4.3	11.1	59.5
1991	37.8	22.4	4.5	10.9	62.2
1992	36.8	21.6	4.3	10.9	63.2
1993	36.5	21.2	4.4	10.9	63.5
1994	35.9	19.7	4.5	11.7	64.1
1995	34.3	18.6	4.5	11.2	65.7
1996	32.1	17.6	4.1	10.4	67.9
1997	30.4	16.7	4.1	9.6	69.6
1998	29.3	15.8	3.8	9.7	70.7
1999	27.5	14.7	3.3	9.6	72.5
2000	25.1	13.5	2.4	9.2	74.9
2001	26.7	14.1	2.4	10.3	73.3
2002 preliminary	29.1	15.3	2.5	11.3	70.9
2003 preliminary	30.0	16.2	2.6	11.2	70.0

NOTE: Details may not sum to totals because of rounding.

SOURCE: National Science Foundation, Division of Science Resources Statistics, unpublished tabulations (Arlington, VA, 2003).

TABLE B-11. Federal basic research budget authority, by budget function: FY 1996–2003

Budget function	1996	1997	1998	1999	2000	2001	2002	2003
	Millions of current dollars							
Total	14,442	14,961	15,523	17,433	19,470	21,376	23,635	25,499
Health	6,395	6,852	7,356	8,634	10,099	11,642	13,193	14,379
General science	2,662	2,753	4,121	4,464	4,722	5,187	5,398	5,649
Space research/technology	1,685	1,653	1,610	1,667	1,616	1,695	1,967	2,361
Energy	1,182	1,288	34	36	36	40	68	57
National defense	1,165	1,090	1,067	1,110	1,184	1,303	1,392	1,383
Agriculture	547	548	571	602	651	749	808	831
Transportation	456	420	411	358	542	17	13	25
Natural resources/environment	147	153	145	142	146	215	220	208
Education, training, employment, and social services	140	142	133	99	107	112	115	117
Commerce/housing credit	37	34	35	41	39	50	52	73
Veterans benefits/services	13	14	23	263	266	289	329	351
Administration of justice	12	13	16	18	20	27	27	25
International affairs	2	2	1	0	42	50	53	39
Community/regional development	0	0	0	0	0	0	0	0
General government	0	0	0	0	0	0	0	0
Income security	0	0	0	0	0	0	0	0
	Millions of constant FY 1996 dollars							
Total	14,442	14,675	15,014	16,644	18,213	19,544	21,146	22,411
Health	6,395	6,721	7,115	8,244	9,447	10,644	11,804	12,637
General science	2,662	2,700	3,985	4,262	4,417	4,743	4,830	4,965
Space research/technology	1,685	1,621	1,557	1,591	1,512	1,550	1,760	2,075
Energy	1,182	1,263	33	34	34	36	61	50
National defense	1,165	1,069	1,032	1,059	1,107	1,191	1,246	1,215
Agriculture	547	537	552	575	609	685	723	730
Transportation	456	412	398	342	507	16	12	22
Natural resources/environment	147	150	141	136	137	197	197	183
Education, training, employment, and social services	140	139	129	95	100	102	103	103
Commerce/housing credit	37	33	34	39	36	46	47	64
Veterans benefits/services	13	14	23	251	249	264	294	309
Administration of justice	12	13	15	17	19	25	24	22
International affairs	2	2	1	0	39	46	47	34
Community/regional development	0	0	0	0	0	0	0	0
General government	0	0	0	0	0	0	0	0
Income security	0	0	0	0	0	0	0	0

FY fiscal year

NOTE: Data for 1996–2001 are actual budget authority. Data for 2002 are preliminary estimates, and data for 2003 are proposed based on FY 2003 budget. Beginning in FY 1998, several Department of Energy programs were reclassified from energy to general science. Beginning in FY 1999, increase in Department of Veterans Affairs basic research total was a result of data reclassification.

SOURCE: National Science Foundation, Division of Science Resources Statistics, *Federal Research and Development Funding by Budget Function: Fiscal Years 2001–03, NSF 02-330* (Arlington, VA, 2002).

TABLE B-12. Federal research and development budget authority, by budget function: FY 1996–2003

Budget function	1996	1997	1998	1999	2000	2001	2002	2003
	Millions of current dollars							
Total	69,049	71,653	73,569	77,637	78,664	86,756	98,029	107,057
National defense	37,801	39,591	39,823	41,306	42,580	45,713	52,922	58,259
Health	11,867	12,670	13,576	15,553	17,869	20,758	23,654	26,615
Space research/technology	7,844	7,844	8,198	8,245	5,363	6,126	6,556	7,435
Energy	2,521	2,372	948	1,131	996	1,314	1,547	1,408
General science	2,846	2,944	4,360	4,690	4,977	5,468	5,717	5,890
Natural resources/environment	1,802	1,886	1,855	1,842	1,999	2,096	2,159	2,136
Transportation	1,795	1,785	1,833	1,725	1,636	1,640	1,696	1,554
Agriculture	1,176	1,203	1,249	1,288	1,426	1,657	1,703	1,703
Education, training, employment, and social services	331	373	444	403	418	411	417	484
International affairs	252	190	163	190	200	252	268	182
Veterans benefits/services	259	267	587	644	645	719	761	810
Commerce/housing credit	432	409	398	432	406	429	444	387
Community/regional development	50	48	42	59	46	54	48	48
Administration of justice	56	59	72	88	73	88	98	114
Income security	16	9	18	38	25	30	37	30
General government	2	2	2	3	6	3	3	3
	Millions of constant FY 1996 dollars							
Total	69,049	70,283	71,157	74,124	73,586	79,323	87,706	94,091
National defense	37,801	38,834	38,517	39,436	39,832	41,796	47,349	51,203
Health	11,867	12,428	13,131	14,849	16,715	18,980	21,163	23,392
Space research/technology	7,844	7,694	7,929	7,872	5,017	5,601	5,865	6,534
Energy	2,521	2,326	917	1,080	931	1,201	1,384	1,237
General science	2,846	2,888	4,217	4,477	4,655	4,999	5,115	5,177
Natural resources/environment	1,802	1,850	1,794	1,758	1,870	1,916	1,932	1,877
Transportation	1,795	1,751	1,773	1,647	1,531	1,499	1,517	1,365
Agriculture	1,176	1,180	1,208	1,230	1,334	1,515	1,524	1,497
Education, training, employment, and social services	331	366	429	385	391	376	373	425
International affairs	252	186	158	181	187	230	240	160
Veterans benefits/services	259	262	568	615	603	657	681	712
Commerce/housing credit	432	401	385	412	380	392	397	340
Community/regional development	50	47	41	56	43	49	43	42
Administration of justice	56	58	70	84	68	80	88	100
Income security	16	9	17	36	23	27	33	26
General government	2	2	2	3	6	3	3	3

FY fiscal year

NOTE: Data for 1996–2001 are actual budget authority. Data for 2002 are preliminary estimates, and data for 2003 are proposed based on FY 2003 budget. Beginning in FY 1998, several Department of Energy programs were reclassified from energy to general science. The decrease in space research and technology in FY 2000 is a result of National Aeronautics and Space Administration's reclassifying space station as a physical asset and transferring funding for program from research and development (R&D) to R&D plant.

SOURCE: National Science Foundation, Division of Science Resources Statistics, *Federal R&D Funding by Budget Function: Fiscal Years 2001–2003,* NSF 02-330 (Arlington, VA, 2002).

TABLE B-13. Trends in research and development and Federal outlays: FY 1970, 1980, 1990, 2000, 2002, and 2004

Composition of Federal outlays	1970	1980	1990	2000	2002	2004 (proposed)
	Billions of current dollars					
Federal outlays	195.6	590.9	1,253.1	1,788.7	2,011.0	2,229.4
Mandatory programs[a]	60.8	262.1	568.2	951.0	1,105.7	1,234.2
Net interest	14.4	52.5	184.3	223.0	171.0	176.4
Discretionary						
Defense	81.9	134.6	300.1	295.0	348.9	389.7
R&D	8.0	14.6	41.1	41.1	48.2	62.9
International	4.0	12.8	19.1	21.3	26.2	28.1
R&D	NA	NA	NA	NA	NA	NA
Domestic	34.4	128.9	181.4	298.5	359.3	401.0
R&D	7.1	15.6	22.7	32.9	39.7	49.2
Total	120.3	276.3	500.6	614.8	734.4	818.8
Total R&D	15.1	30.2	63.8	74.0	87.9	112.1
	Percent					
Federal outlays	100.0	100.0	100.0	100.0	100.0	100.0
Mandatory programs[a]	31.1	44.4	45.3	53.2	55.0	55.4
Net interest	7.4	8.9	14.7	12.5	8.5	7.9
Discretionary						
Defense	41.9	22.8	23.9	16.5	17.3	17.5
R&D	4.1	2.5	3.3	2.3	2.4	2.8
International	2.0	2.2	1.5	1.2	1.3	1.3
R&D	NA	NA	NA	NA	NA	NA
Domestic	17.6	21.8	14.5	16.7	17.9	18.0
R&D	3.6	2.6	1.8	1.8	2.0	2.2
Total	61.5	46.8	39.9	34.4	36.5	36.7
Total R&D	7.7	5.1	5.1	4.1	4.4	5.0
Total R&D/total discretionary	12.6	10.9	12.7	12.0	12.0	13.7
Defense	9.8	10.8	13.7	13.9	13.8	16.1
Domestic	20.6	12.1	12.5	11.0	11.0	12.3

NA not available

R&D research and development

[a] Includes Social Security, Medicare, Medicaid, and other programs.

SOURCE: U.S. Office of Management and Budget, *Historical Tables, Budget of the United States Government: Fiscal Year 2004* (Washington, DC, 2003).

TABLE B-14. Federal obligations for total research, by detailed science and engineering field: FY 1982–2003

(Millions of constant 1996 dollars)

Field	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
All fields	19,814.7	20,774.7	21,055.4	21,953.2	21,926.9	23,199.9	23,353.5	25,039.8	25,127.7	26,810.3	26,695.7
Life sciences, total	7,220.8	7,546.9	7,922.3	8,657.6	8,589.3	9,493.6	9,672.6	10,243.7	10,261.2	10,762.9	10,802.8
Biology and agricultural, total	4,278.5	4,466.4	4,673.9	5,109.9	5,130.6	5,636.2	5,726.8	6,053.3	6,017.9	6,261.6	6,140.8
Biology (excluding environmental)	3,163.9	3,360.3	3,602.9	3,926.7	3,977.4	4,528.6	4,610.2	4,803.1	4,816.5	4,986.4	4,834.4
Environmental biology	279.2	282.2	351.4	354.2	350.9	374.5	376.9	443.5	397.8	514.2	557.0
Agricultural	835.4	823.8	719.7	829.1	802.3	733.1	739.7	806.7	803.5	761.0	749.4
Medical sciences, total	2,697.8	2,809.4	2,969.9	3,222.9	3,136.3	3,446.0	3,682.7	3,885.8	3,930.7	3,870.6	4,261.9
Life sciences, NEC	244.5	271.2	278.5	324.8	322.3	411.5	263.1	304.6	312.7	630.6	400.0
Psychology, total	332.3	351.1	374.9	445.1	443.8	477.8	488.1	508.5	521.3	539.6	324.9
Biological aspects	90.7	92.1	113.6	124.1	119.7	127.1	131.9	146.9	151.8	156.8	37.7
Social aspects	149.3	152.6	151.5	194.4	190.7	199.8	187.1	180.8	206.3	220.9	110.0
Psychological sciences, NEC	92.4	106.4	109.8	126.7	133.4	150.9	169.3	180.8	163.3	162.0	177.2
Physical sciences, total	3,804.6	4,214.3	4,173.5	4,144.8	4,078.0	4,206.1	4,153.9	4,467.9	4,426.1	4,737.5	4,838.9
Astronomy	419.7	520.9	537.4	564.3	622.1	675.3	589.5	653.4	694.0	706.6	805.6
Chemistry	732.2	758.3	852.4	885.0	880.1	879.7	880.4	943.7	885.2	926.6	976.9
Physics	2,450.5	2,703.1	2,581.4	2,471.1	2,399.5	2,397.0	2,473.5	2,641.7	2,620.5	2,752.7	2,810.3
Physical sciences, NEC	202.2	232.0	202.3	224.2	176.2	254.2	210.5	229.0	226.6	351.6	246.0
Environmental sciences, total	1,747.3	1,823.6	1,793.5	1,910.1	1,968.8	1,954.7	2,012.3	2,138.2	2,526.6	2,404.7	2,406.4
Atmospheric sciences	647.9	671.5	610.2	661.3	692.7	715.0	736.0	709.0	898.8	897.9	836.4
Geological sciences	544.1	486.1	504.6	583.8	589.8	571.2	553.0	654.5	768.3	815.1	801.9
Oceanography	397.6	500.7	511.0	542.3	571.0	552.7	576.5	593.2	604.4	445.9	500.2
Environmental sciences, NEC	157.6	165.4	167.7	122.7	115.3	115.7	146.6	181.5	255.1	245.9	267.9
Mathematics and computer sciences, total	532.7	611.3	618.9	782.3	817.7	828.4	805.0	886.8	977.0	1,010.9	1,264.8
Mathematics	194.9	194.6	212.3	249.8	245.2	264.5	272.9	284.7	280.4	254.6	347.4
Computer sciences	260.0	312.8	301.5	381.4	401.8	385.1	366.5	439.6	653.2	654.3	841.3
Mathematics and computer sciences, NEC	77.6	104.1	105.1	151.0	170.7	178.8	165.7	162.5	43.3	101.9	76.2
Engineering, total	5,152.9	5,126.1	5,094.3	4,922.6	4,968.0	5,051.5	4,954.2	5,356.6	4,911.8	5,530.8	5,425.1
Aeronautical	1,127.8	1,196.0	1,209.4	1,004.2	1,030.6	1,048.0	1,004.0	1,189.9	1,077.4	1,136.7	953.3
Astronautical	442.3	468.6	557.8	577.9	700.1	807.7	720.5	816.8	675.0	730.5	687.2
Chemical	144.7	211.3	203.1	346.0	326.6	279.1	323.2	171.5	281.1	340.4	324.3
Civil	307.2	274.7	285.1	294.7	269.6	264.3	269.1	277.1	369.2	341.2	359.9
Electrical	931.5	896.2	885.6	852.9	896.1	1,016.8	915.5	1,016.6	743.8	816.4	827.3
Mechanical	306.1	388.3	267.8	363.3	314.2	302.0	301.5	310.4	311.8	375.3	367.6
Metallurgy and materials	470.3	484.6	479.5	597.6	591.3	468.1	571.9	628.2	644.4	795.0	792.7
Engineering, NEC	1,422.9	1,206.2	1,206.1	885.8	839.4	865.5	848.7	946.0	809.2	995.3	1,112.7
Social sciences, total	587.2	634.5	613.3	625.9	552.1	620.7	608.3	664.4	732.1	813.5	751.8
Anthropology	22.2	18.7	26.1	24.5	18.1	19.7	17.9	16.8	16.7	17.9	15.4
Economics	239.0	241.4	207.1	217.3	174.5	192.0	199.7	201.1	229.2	209.6	230.7
Political science	11.4	16.2	15.2	19.9	15.4	14.6	15.3	16.3	15.2	19.0	24.6
Sociology	79.1	98.8	98.7	90.5	89.0	95.7	102.4	113.5	135.0	205.8	88.0
Social sciences, NEC	235.4	259.4	266.4	273.9	255.1	298.7	273.0	316.9	336.0	361.2	393.3
Other sciences, NEC	436.7	467.0	464.6	464.8	509.3	566.8	659.3	773.7	771.3	1,010.5	881.1

See explanatory information and SOURCE at end of table.

TABLE B-14. Federal obligations for total research, by detailed science and engineering field: FY 1982–2003

(Millions of constant 1996 dollars)

Field	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002 preliminary	2003 preliminary
All fields	28,628.2	28,565.2	29,002.9	28,259.8	28,803.6	29,908.4	31,979.3	36,001.6	40,844.9	45,161.2	47,782.1
Life sciences, total	11,468.2	11,759.4	12,047.1	12,064.3	12,419.1	13,113.1	14,710.3	16,811.7	21,062.3	23,454.6	25,667.4
Biology and agricultural, total	6,450.9	6,359.9	6,530.5	6,629.9	6,418.8	6,841.9	7,676.1	11,580.8	12,895.0	NA	NA
Biology (excluding environmental)	5,099.4	4,945.6	5,023.9	5,309.9	5,218.4	5,519.5	6,178.5	10,050.7	11,308.8	NA	NA
Environmental biology	592.5	656.4	823.0	704.0	571.4	584.7	687.3	692.5	665.7	NA	NA
Agricultural	759.0	757.8	683.7	616.0	629.0	737.8	810.2	837.6	920.5	NA	NA
Medical sciences, total	4,689.0	5,066.8	5,071.6	4,973.4	5,426.9	5,799.7	6,487.1	4,177.3	6,015.4	NA	NA
Life sciences, NEC	328.2	332.7	445.0	461.1	573.4	471.4	547.1	1,053.6	2,151.9	NA	NA
Psychology, total	586.3	571.5	635.0	525.0	535.0	571.6	603.4	1,522.3	677.7	760.4	855.1
Biological aspects	39.6	50.1	60.0	62.8	56.7	40.2	17.2	7.7	12.4	NA	NA
Social aspects	143.4	121.7	159.4	83.4	94.9	94.3	63.5	52.4	54.6	NA	NA
Psychological sciences, NEC	403.2	399.5	415.6	378.8	383.4	437.1	522.6	1,462.2	610.7	NA	NA
Physical sciences, total	4,713.1	4,432.6	4,363.8	3,923.0	4,069.8	4,071.7	3,878.4	4,480.7	4,202.7	4,665.1	4,655.3
Astronomy	730.7	779.1	779.8	729.0	759.9	708.2	722.9	823.8	693.5	NA	NA
Chemistry	897.7	911.2	880.8	881.1	829.6	792.1	777.3	1,146.9	936.2	NA	NA
Physics	2,808.9	2,546.0	2,500.2	1,991.3	2,028.1	2,061.9	2,119.3	2,251.0	2,248.7	NA	NA
Physical sciences, NEC	276.0	196.2	203.2	321.6	452.2	509.4	258.9	258.9	324.2	NA	NA
Environmental sciences, total	2,777.1	2,957.7	2,911.5	3,019.7	2,987.4	2,961.6	2,952.4	3,115.2	2,970.3	3,325.3	3,472.2
Atmospheric sciences	1,047.7	1,141.1	1,158.3	1,085.7	1,142.0	1,135.9	1,122.2	1,033.4	1,017.2	NA	NA
Geological sciences	849.5	873.3	865.3	784.3	678.6	583.5	629.7	598.2	615.5	NA	NA
Oceanography	497.6	517.7	415.4	574.3	586.3	541.4	626.3	629.8	622.2	NA	NA
Environmental sciences, NEC	382.4	425.7	472.6	575.4	580.5	700.6	574.2	853.7	715.5	NA	NA
Mathematics and computer sciences, total	1,304.6	1,356.4	1,610.7	1,571.6	1,639.8	1,776.6	1,889.1	2,064.0	2,384.7	2,494.6	2,565.7
Mathematics	309.6	356.7	263.8	254.5	295.8	323.1	329.4	405.1	362.1	NA	NA
Computer sciences	879.5	865.2	1,034.2	1,119.8	1,240.5	1,352.8	1,446.1	1,553.1	1,847.8	NA	NA
Mathematics and computer sciences, NEC	115.5	134.5	312.7	197.3	103.5	100.6	113.7	105.8	174.8	NA	NA
Engineering, total	5,854.8	5,710.1	5,822.5	5,680.9	5,581.5	5,702.1	5,974.2	5,939.1	7,487.8	8,116.2	8,200.4
Aeronautical	1,270.1	1,274.2	1,273.3	1,249.4	1,326.8	1,544.1	1,535.4	1,369.9	2,219.8	NA	NA
Astronautical	525.9	520.1	557.4	526.6	584.9	610.4	591.9	481.9	687.6	NA	NA
Chemical	261.4	248.2	251.0	215.1	230.5	183.9	193.8	183.9	181.8	NA	NA
Civil	268.3	289.6	346.2	300.2	270.3	236.1	313.3	223.8	263.4	NA	NA
Electrical	938.5	773.0	771.4	669.7	610.3	618.3	666.4	697.0	812.7	NA	NA
Mechanical	497.1	394.0	420.7	294.0	249.7	241.4	229.3	270.7	291.6	NA	NA
Metallurgy and materials	740.7	887.2	831.6	989.0	844.2	763.2	751.6	859.2	987.3	NA	NA
Engineering, NEC	1,353.0	1,323.7	1,370.9	1,437.0	1,464.6	1,504.6	1,692.4	1,852.6	2,043.4	NA	NA
Social sciences, total	718.5	674.7	692.3	654.6	683.0	779.7	815.4	983.0	921.3	931.4	940.2
Anthropology	14.6	16.9	22.1	18.3	20.6	17.6	17.5	14.9	14.3	NA	NA
Economics	217.9	201.4	210.6	194.2	201.3	222.9	206.6	233.5	213.8	NA	NA
Political science	31.1	26.5	22.7	16.7	13.8	19.5	19.3	21.1	17.8	NA	NA
Sociology	81.7	71.0	48.8	41.2	25.4	97.5	79.9	84.8	87.2	NA	NA
Social sciences, NEC	373.2	358.9	387.9	384.2	422.0	422.1	492.2	628.7	588.3	NA	NA
Other sciences, NEC	1,205.7	1,103.0	919.8	820.7	888.0	932.1	1,156.1	1,085.7	1,138.0	1,413.7	1,425.7

NA not available

NEC not elsewhere classified

NOTE: Details may not add to totals because of rounding.

SOURCE: National Science Foundation, Division of Science Resources Statistics, *Federal Funds for Research and Development: Fiscal Years 2001, 2002, and 2003* (Arlington, VA, forthcoming).

TABLE B-15. Federally funded research and development center expenditures for research and development: FY 2001–02

(Thousands of dollars)

FFRDC	Total R&D FY 2001	Total R&D FY 2002	Administrator	Sponsoring agency	Location
All FFRDCs	10,071,218	11,536,424			
University-administered FFRDCs	5,944,112	7,069,245			
Ames Laboratory	22,916	23,416	Iowa State University of Science and Technology	Department of Energy	Ames, IA
Argonne National Laboratory	478,391	506,666	University of Chicago	Department of Energy	Argonne, IL
Ernest Orlando Lawrence Berkeley National Laboratory	408,487	467,461	University of California	Department of Energy	Berkeley, CA
Fermi National Accelerator Laboratory	310,928	313,556	Universities Research Association, Inc.	Department of Energy	Batavia, IL
Jet Propulsion Laboratory	1,355,463	1,435,039	California Institute of Technology	National Aeronautics and Space Administration	Pasadena, CA
Lawrence Livermore National Laboratory	1,090,875	1,227,111	University of California	Department of Energy	Livermore, CA
Lincoln Laboratory	380,200	451,200	Massachusetts Inst. of Technology	DOD, Department of the Air Force	Lexington, MA
Los Alamos National Laboratory	1,333,194	1,994,031	University of California	Department of Energy	Los Alamos, NM
National Astronomy and Ionosphere Center	10,986	12,295	Cornell University	National Science Foundation	Arecibo, PR
National Center for Atmospheric Research	119,846	157,173	University Corporation for Atmospheric Research	National Science Foundation	Boulder, CO
National Optical Astronomy Observatory	37,364	41,051	Association of Universities for Research in Astronomy, Inc.	National Science Foundation	Tucson, AZ
National Radio Astronomy Observatory	34,208	43,900	Associated Universities, Inc.	National Science Foundation	Green Bank, WV
Princeton Plasma Physics Laboratory	76,021	73,610	Princeton University	Department of Energy	Princeton, NJ
Software Engineering Institute	37,052	45,088	Carnegie Mellon University	DOD, Office of the Secretary of Defense	Pittsburgh, PA
Stanford Linear Accelerator Center	145,979	171,343	Leland Stanford, Jr. University	Department of Energy	Stanford, CA
Thomas Jefferson National Accelerator Facility	102,202	106,305	Southeastern Universities Research Association, Inc.	Department of Energy	Newport News, VA
Industry-administered FFRDCs	1,961,818	2,196,511			
Idaho National Engineering and Environmental	270,636	259,562	Bechtel BWXT Idaho, LLC	Department of Energy	Idaho Falls, ID
National Cancer Institute at Frederick	187,222	260,000	SAIC; Charles River Laboratories, Inc.; Data Management Services, Inc.	Department of Health and Human Services, National Institutes of Health	Frederick, MD
Sandia National Laboratory	1,416,796	1,583,347	Sandia Corporation, a subsidiary of Lockheed Martin Corporation	Department of Energy	Albuquerque, NM
Savannah River Technology	87,164	93,602	Westinghouse Savannah River Co.	Department of Energy	Aiken, SC
Nonprofit-administered FFRDCs	2,165,288	2,270,668			
Aerospace FFRDC	17,600	26,306	Aerospace Corporation	DOD, Department of the Air Force	El Segundo, CA
Arroyo Center	24,317	24,484	RAND Corporation	DOD, Department of the Army	Santa Monica, CA
Brookhaven National Laboratory	454,500	454,482	Brookhaven Science Associates, Inc.	Department of Energy	Upton, Long Island, NY
C3I FFRDC	29,458	31,163	MITRE Corporation	DOD, Office of the Secretary of Defense	Bedford, MA and McLean, VA
Center for Advanced Aviation System	5,683	6,256	MITRE Corporation	Department of Transportation, Federal Aviation Administration	McLean, VA
Center for Naval Analyses	69,102	72,712	The CNA Corporation	DOD, Department of the Navy	Alexandria, VA

See explanatory information and SOURCE at end of table

TABLE B-15. Federally funded research and development center expenditures for research and development: FY 2001–02

(Thousands of dollars)

FFRDC	Total R&D FY 2001	Total R&D FY 2002	Administrator	Sponsoring agency	Location
Center for Nuclear Waste Regulatory Analyses	14,977	16,398	Southwest Research Institute	Nuclear Regulatory Commission	San Antonio, TX
Institute for Defense Analyses Communications and Computing	43,100	45,296	Institute for Defense Analysis	National Security Agency	Alexandria, VA
Institute for Defense Analysis Studies	92,930	98,236	Institute for Defense Analysis	DOD, Office of the Secretary of Defense	Alexandria, VA
Internal Revenue Service (IRS) FFRDC	1,161	2,434	MITRE Corporation	Department of Treasury, Internal Revenue Service	McLean, VA
National Defense Research Institute	25,512	25,317	RAND Corporation	DOD, Office of the Secretary of Defense	Santa Monica, CA
National Renewable Energy Laboratory	207,230	197,438	Midwest Research Institute	Department of Energy	Golden, CO
Oak Ridge National Laboratory	581,046	620,329	UT-Battelle, LLC	Department of Energy	Oak Ridge, TN
Pacific Northwest National Laboratory	562,000	608,500	Battelle Memorial Institute	Department of Energy	Richland, WA
Project Air Force	29,361	32,439	RAND Corporation	DOD, Department of the Air Force	Santa Monica, CA
The Science and Technology Policy Institute	7,311	8,878	RAND Corporation	National Science Foundation	Washington, DC

DOD Department of Defense; FFRDC federally funded research and development center; FY fiscal year; R&D research and development

NOTE: More information about 36 FFRDCs can be found on National Science Foundation website, http://www.nsf.gov/sbe/srs/ffrdc/start.htm.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Academic Research and Development Expenditures: Fiscal Year 2002.

TABLE B-16. Budgetary impact of the Federal research and experimentation tax credit: FY 1981–2000
(Millions of dollars)

Year	Outlay equivalent cost of credit (current dollars)	Total Federal R&D outlays (current dollars)	Ratio of credit outlays/R&D outlays (percent)	Outlay equivalent cost of credit (constant 1996 dollars)[a]
1981	205	32,459	0.6	334
1982	640	34,391	1.9	974
1983	1,010	36,659	2.8	1,472
1984	3,360	39,691	8.5	4,723
1985	2,430	44,171	5.5	3,307
1986	2,295	50,609	4.5	3,049
1987	2,715	51,612	5.3	3,511
1988	1,240	54,739	2.3	1,553
1989	1,590	59,450	2.7	1,917
1990	1,625	62,135	2.6	1,888
1991	1,070	61,130	1.8	1,197
1992	1,850	62,934	2.9	2,017
1993	1,900	65,241	2.9	2,023
1994	2,110	66,151	3.2	2,199
1995	1,820	66,662	2.7	1,856
1996	1,245	66,142	1.9	1,245
1997	1,360	68,898	2.0	1,334
1998	3,270	70,632	4.6	3,163
1999	2,625	70,585	3.7	2,504
2000	2,510	69,807	3.6	2,349

R&D research and development

[a]Figures in constant dollars were obtained using fiscal-year gross domestic product implicit price deflators (1996 = 100).

NOTES: Outlay equivalent estimates are comparable to taxable outlay figures reported in budget. This allows for a comparison of resource cost of tax credit with cost of direct Federal R&D expenditure support. Tax expenditure estimates are prepared by U.S. Treasury Department, based on income tax law enacted as of December 31 of year for which expenditures are reported.

SOURCES: U.S. Office of Management and Budget, Budget of the United States Government (Washington, DC, annual series); and National Science Foundation, Division of Science Resources Statistics, Survey of Federal Funds for Research and Development, various years.

TABLE B-17. Research and development expenditure, by state, performing sector, and source of funds: 2001

(Millions of current dollars)

State:	Performing sector: / Funding sector:	All R&D	R&D Rank	Federal	Industry			FFRDCs	U&C[3]						U&C FFRDCs	Other nonprofit insti-tutions	Non-profit FFRDCs	GSP	GSP rank	R&D intensity[e]	
											Non-Federal			Non-profit							
				Federal	Total	Federal	Industry[b]	Total[c]	Total	Federal		Industry	U&C		Total[c]	Federal[d]	Total[c]			Percent	Rank
U.S. total		274,211	na	21,048	198,505	16,899	181,606	2,020	33,518	19,654	2,382	2,177	6,778	2,528	6,225	5,302	2,192	10,137,190		2.71	na
Alabama		2,251	27	870	905	176	729	0	445	313	5	22	85	21	0	30	0	121,490	25	1.85	27
Alaska		297	48	99	68	2	66	0	116	58	3	29	25	0	0	14	0	28,581	46	1.04	41
Arizona		3,048	23	235	2,257	232	2,025	0	501	266	14	30	170	21	37	18	0	160,687	23	1.90	26
Arkansas		451	43	52	254	5	249	0	141	64	37	8	23	9	0	4	0	67,913	34	0.66	47
California		50,959	1	2,259	40,430	3,648	36,782	0	4,422	2,527	255	262	954	423	3,001	750	97	1,359,265	1	3.75	9
Colorado		4,313	18	266	3,082	579	2,503	0	573	439	22	30	57	26	120	65	207	173,772	21	2.48	17
Connecticut		5,311	16	93	4,686	110	4,576	0	499	328	15	24	76	55	0	33	0	166,165	22	3.20	13
Delaware		1,316	34	3	1,232	10	1,222	0	80	44	5	5	17	10	0	1	0	40,509	42	3.25	12
District of Columbia		2,543	26	1,819	242	78	164	0	228	192	3	13	4	16	0	246	7	64,459	36	3.94	8
Florida		5,642	13	865	3,755	736	3,019	0	997	468	114	92	277	46	0	24	0	491,488	4	1.15	36
Georgia		3,236	22	310	1,912	57	1,855	0	989	473	79	97	297	44	0	25	0	299,874	10	1.08	38
Hawaii		358	47	70	93	14	79	0	157	98	33	7	19	0	0	38	0	43,710	40	0.82	45
Idaho		1,259	35	22	884	3	881	271	83	34	18	7	22	1	0	0	0	36,905	45	3.41	10
Illinois		10,472	9	79	8,232	749	7,483	0	1,281	742	83	59	312	86	789	91	0	475,541	5	2.20	22
Indiana		4,235	19	56	3,583	63	3,520	0	584	248	46	42	204	46	0	12	0	189,919	16	2.23	20
Iowa		1,324	33	40	817	21	796	0	440	219	60	35	104	22	23	5	0	90,942	30	1.46	32
Kansas		1,597	28	25	1,299	D	D	0	269	115	45	13	74	22	0	5	0	87,196	31	1.83	29
Kentucky		951	36	13	636	8	628	0	297	120	41	14	101	21	0	4	0	120,266	26	0.79	46
Louisiana		827	38	74	316	13	303	0	432	183	85	26	100	39	0	4	0	148,697	24	0.56	50
Maine		389	46	9	249	49	200	0	68	25	9	4	26	5	0	62	0	37,449	43	1.04	40
Maryland		11,379	7	5,435	3,682	1,119	2,563	187	1,645	1,196	60	72	211	106	0	430	0	195,007	15	5.84	2
Massachusetts		14,665	3	363	11,240	1,813	9,427	0	1,577	1,140	38	156	80	162	380	1,105	0	287,802	11	5.10	3
Michigan		15,533	2	119	14,283	117	14,166	0	1,107	622	67	66	278	75	0	24	0	320,470	9	4.85	4
Minnesota		5,010	17	33	4,355	207	4,148	0	469	268	59	27	82	34	0	153	0	188,050	17	2.66	16
Mississippi		650	39	181	219	7	212	0	242	146	39	8	48	1	0	8	0	67,125	35	0.97	43
Missouri		2,550	25	43	1,792	142	1,650	0	679	410	25	38	164	41	0	36	0	181,493	19	1.40	34
Montana		239	49	44	70	3	67	0	108	57	20	9	21	1	0	17	0	22,635	48	1.06	39
Nebraska		580	40	26	306	9	297	0	242	77	7	18	128	13	0	6	0	56,967	37	1.02	42
Nevada		444	44	34	290	8	282	0	116	69	10	5	28	4	0	4	0	79,220	32	0.56	49
New Hampshire		1,587	29	43	1,339	D	D	0	197	115	12	12	43	15	0	8	0	47,183	39	3.36	11
New Jersey		11,392	6	524	10,164	207	9,957	0	610	270	52	34	173	81	76	19	0	365,388	8	3.12	14
New Mexico		3,947	20	494	231	95	136	1,599	274	186	12	12	56	9	1,333	16	0	55,426	38	7.12	1
New York		14,422	4	271	10,884	994	9,890	0	2,476	1,566	128	130	414	239	0	337	455	826,488	2	1.75	30

See explanatory information and SOURCE at end of table.

TABLE B-17. Research and development expenditure, by state, performing sector, and source of funds: 2001

(Millions of current dollars)

State:	Performing sector: / Funding sector:	All R&D	R&D Rank	Federal	Industry			FFRDCs	U&C[3]						U&C FFRDCs	Other nonprofit insti-tutions	Non-profit FFRDCs	GSP	GSP rank	R&D intensity[e]	
					Total	Federal	Industry[b]	Total[c]	Total	Federal	Non-Federal	Industry	U&C	Non-profit	Total[c]	Federal[d]	Total[c]			Percent	Rank
North Carolina		5,825	12	441	4,138	70	4,068	0	1,137	655	121	168	153	41	0	109	0	275,615	12	2.11	24
North Dakota		461	42	28	347	1	346	0	85	31	1	6	42	4	0	2	0	19,005	51	2.43	18
Ohio		8,790	11	907	6,694	783	5,911	0	996	561	80	86	193	76	0	194	0	373,708	7	2.35	19
Oklahoma		872	37	54	543	14	529	0	255	96	41	17	88	13	0	20	0	93,855	29	0.93	44
Oregon		5,447	15	82	4,962	19	4,943	0	366	255	41	15	36	19	0	38	0	120,055	27	4.54	6
Pennsylvania		11,156	8	178	8,967	122	8,845	0	1,688	1,145	52	163	209	120	37	286	0	408,373	6	2.73	15
Rhode Island		1,579	30	254	1,134	D	D	0	143	102	6	2	30	4	0	49	0	36,939	44	4.28	7
South Carolina		1,447	32	55	921	17	904	87	361	169	30	23	131	8	0	22	0	115,204	28	1.26	35
South Dakota		141	50	21	87	2	85	0	32	16	9	0	4	3	0	1	0	24,251	47	0.58	48
Tennessee		2,651	24	101	1,503	154	1,349	0	423	265	44	22	57	36	0	43	581	182,515	18	1.45	33
Texas		12,722	5	527	9,839	185	9,654	0	2,244	1,231	228	177	369	240	0	97	15	763,874	3	1.67	31
Utah		1,495	31	82	1,069	168	901	0	338	213	21	15	55	34	0	5	0	70,409	33	2.12	23
Vermont		423	45	5	339	7	332	0	77	50	4	6	12	4	0	2	0	19,149	50	2.21	21
Virginia		5,544	14	1,540	2,957	680	2,277	0	611	345	70	50	110	37	102	93	241	273,070	13	2.03	25
Washington		10,372	10	179	8,691	555	8,136	0	707	489	19	48	129	23	0	233	562	222,950	14	4.65	5
West Virginia		466	41	111	211	6	205	0	79	36	3	7	29	5	34	31	0	42,368	41	1.10	37
Wisconsin		3,249	21	41	2,469	22	2,447	0	729	386	40	23	207	72	0	11	0	177,354	20	1.83	28
Wyoming		82	51	8	28	1	27	0	42	20	2	3	16	1	0	5	0	20,418	49	0.40	51
Other and unknown		9,950	na	47	9,819	785	9,034	0	71	50	5	2	13	1	11	13	0	NA	NA	NA	NA
Adjustment		8,364	na	1,520	0	0	0	(124)	795	463	67	(57)	225	98	281	454	27	NA	NA	NA	NA

na not applicable; D data withheld to avoid disclosing operations of individual companies; NA not available; FFRDC federally funded research and development center; GSP gross state product; R&D research and development; U&C universities and colleges

[a] Adjustments have been made to R&D expenditures reported by universities to eliminate double counting of funds passed through from one academic institution to another at national level. State-level university R&D data have not been adjusted to correct for this double counting.

[b] Industry sources of industry R&D expenditures include all non-Federal sources of industry R&D expenditures.

[c] Includes all R&D expenditures of FFRDCs; over 90 percent of these expenditures are federally funded.

[d] Other sources of support for nonprofit institutions were unavailable by state. For 2001, total nonprofit performance is estimated at $10.7 billion. Industry provided an estimated $1.1 billion to nonprofit sector, and nonprofit institutions provided an estimated $4.3 billion. These non-Federal support amounts are included in total R&D column for U.S total and in other and unknown. For these two columns, amounts under all R&D are greater than sum of components to right, because those components do not include non-Federal support to nonprofit organizations.

[e] R&D intensity is ratio of total R&D performed in a state to GSP.

NOTES: Industry R&D data refer to calendar years; other R&D data refer to fiscal years but may serve as approximations to calendar-year data. "Other and unknown" category reflects reported data that could not be assigned to a geographic location. "Adjustment" category reflects difference in state totals (and other and unknown) when reported on a fiscal-year basis and U.S. totals that have been adjusted to calendar-year estimates.

SOURCES: Data were derived from National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Survey of Industrial Research and Development, 2001; NSF/SRS, Survey of Research and Development Expenditures at Universities and Colleges: FY 2001; and NSF/SRS, Survey of Federal Funds for Research and Development: FY 2001. GSP data are from the U.S. Bureau of Economic Analysis, http://www.bea.gov/bea/regional/gsp.htm, 2003.

TABLE B-18. International research and development expenditures and research and development as percentage of gross domestic product, by selected country and for all Organisation for Economic Co-operation and Development countries: 1981–2001

Year	United States	Japan[a]	Germany[b]	France	United Kingdom	Italy	Canada	Russian Federation	Total OECD
	Billions of constant 1995 U.S. dollars[c]								
1981	114.5	39.7	27.8	17.4	18.2	7.7	6.0	NA	254.9
1982	120.5	42.6	28.4	18.7	NA	7.9	6.6	NA	267.4
1983	129.1	46.0	28.8	19.4	17.8	8.5	6.6	NA	281.9
1984	141.6	49.4	29.7	20.6	NA	9.2	7.2	NA	303.6
1985	153.7	54.6	32.5	21.5	19.2	10.5	7.8	NA	329.7
1986	157.3	55.6	33.5	21.9	20.1	10.9	8.2	NA	339.6
1987	160.2	59.6	35.3	22.8	20.5	11.8	8.2	NA	351.9
1988	164.2	64.1	36.5	23.8	21.0	12.5	8.5	NA	365.7
1989	167.6	70.1	37.9	25.4	21.5	13.1	9.1	NA	381.3
1990	172.9	75.9	38.3	27.0	21.7	13.9	9.5	28.4	397.6
1991	176.6	77.6	42.0	27.2	20.6	13.4	9.7	20.5	415.7
1992	177.1	76.8	40.9	27.7	20.2	13.1	10.1	8.6	417.1
1993	173.3	74.7	39.5	27.8	21.0	12.3	10.7	7.8	412.7
1994	173.3	74.0	38.8	27.6	21.5	11.8	11.6	7.4	415.7
1995	184.1	78.7	39.5	27.7	21.5	11.5	11.7	6.6	439.7
1996	194.0	84.0	39.7	27.9	21.2	11.7	11.6	7.4	459.4
1997	204.6	87.5	40.9	27.4	21.1	12.5	12.2	8.0	480.1
1998	215.5	89.7	42.1	27.7	21.6	12.9	13.3	7.2	497.9
1999	228.6	90.2	45.3	28.8	23.1	12.8	14.0	8.3	522.8
2000	243.3	93.7	47.7	29.9	23.4	13.5	15.0	9.4	553.5
2001	252.9	NA	48.6	30.7	NA	NA	16.2	10.9	NA
	Percent of GDP								
1981	2.34	2.11	2.43	1.93	2.38	0.88	1.24	NA	1.95
1982	2.52	2.19	2.50	2.02	NA	0.90	1.39	NA	2.05
1983	2.59	2.32	2.50	2.06	2.20	0.95	1.36	NA	2.10
1984	2.64	2.40	2.50	2.16	NA	1.01	1.40	NA	2.16
1985	2.76	2.54	2.68	2.22	2.24	1.12	1.44	NA	2.26
1986	2.73	2.51	2.70	2.21	2.26	1.13	1.48	NA	2.26
1987	2.69	2.57	2.80	2.24	2.20	1.19	1.43	NA	2.26
1988	2.65	2.60	2.79	2.24	2.14	1.22	1.40	NA	2.25
1989	2.62	2.70	2.79	2.29	2.15	1.24	1.47	NA	2.26
1990	2.65	2.78	2.67	2.37	2.15	1.29	1.53	2.03	2.29
1991	2.72	2.75	2.53	2.37	2.07	1.23	1.60	1.43	2.23
1992	2.65	2.70	2.41	2.38	2.02	1.18	1.66	0.74	2.19
1993	2.52	2.62	2.35	2.40	2.05	1.13	1.71	0.77	2.14
1994	2.43	2.57	2.26	2.34	2.01	1.05	1.76	0.84	2.09
1995	2.51	2.69	2.26	2.31	1.95	1.00	1.73	0.79	2.10
1996	2.55	2.77	2.26	2.30	1.88	1.01	1.69	0.90	2.13
1997	2.58	2.83	2.29	2.22	1.81	1.05	1.71	0.97	2.15
1998	2.60	2.94	2.31	2.17	1.80	1.07	1.79	0.92	2.17
1999	2.65	2.94	2.44	2.18	1.88	1.04	1.79	1.01	2.20
2000	2.72	2.98	2.49	2.18	1.85	1.07	1.82	1.05	2.24
2001	2.82	NA	2.53	2.20	NA	NA	1.94	1.16	NA

See explanatory information and SOURCE at end of table.

TABLE B-18. International research and development expenditures and research and development as percentage of gross domestic product, by selected country and for all Organisation for Economic Co-operation and Development countries: 1981–2001

Year	United States	Japan[a]	Germany[b]	France	United Kingdom	Italy	Canada	Russian Federation	Total OECD
	Billions of constant 1995 units of national currency[d]								
1981	114.5	6,739	28.6	17.1	11.9	6.1	7.1	NA	NA
1982	120.5	7,237	29.3	18.4	NA	6.4	7.7	NA	NA
1983	129.1	7,818	29.7	19.1	11.6	6.8	7.8	NA	NA
1984	141.6	8,387	30.6	20.3	NA	7.4	8.5	NA	NA
1985	153.7	9,281	33.5	21.2	12.6	8.4	9.2	NA	NA
1986	157.3	9,450	34.6	21.6	13.2	8.7	9.6	NA	NA
1987	160.2	10,121	36.4	22.5	13.4	9.4	9.7	NA	NA
1988	164.2	10,897	37.6	23.5	13.7	10.0	10.0	NA	NA
1989	167.6	11,918	39.0	25.0	14.1	10.5	10.8	NA	NA
1990	172.9	12,899	39.5	26.6	14.2	11.2	11.2	51.9	NA
1991	176.6	13,186	43.3	26.8	13.5	10.8	11.5	37.5	NA
1992	177.1	13,045	42.1	27.3	13.2	10.5	12.0	15.8	NA
1993	173.3	12,703	40.7	27.4	13.7	9.9	12.6	14.3	NA
1994	173.3	12,581	40.0	27.2	14.0	9.4	13.7	13.5	NA
1995	184.1	13,369	40.7	27.3	14.0	9.2	13.8	12.1	NA
1996	194.0	14,272	40.9	27.4	13.9	9.4	13.7	13.4	NA
1997	204.6	14,863	42.1	27.0	13.8	10.0	14.4	14.6	NA
1998	215.5	15,248	43.4	27.3	14.1	10.3	15.8	13.1	NA
1999	228.6	15,331	46.6	28.3	15.1	10.2	16.6	15.2	NA
2000	243.3	15,924	49.1	29.5	15.3	10.8	17.7	17.1	NA
2001	252.9	NA	50.1	30.2	NA	NA	19.1	19.9	NA

NA not available

GDP gross domestic product

OECD Organisation for Economic Co-operation and Development

[a] Data on Japanese research and development in 1996 and later years may not be consistent with data in earlier years because of changes in methodology.

[b] Data for 1981–90 are for West Germany.

[c] Conversions of foreign currencies to U.S. dollars are calculated with each country's GDP implicit price deflator and with OECD purchasing power parity exchange rates.

[d] Constant foreign currencies are based on deflation with each country's GDP implicit price deflator. Figures for Germany, France, and Italy are in euros.

SOURCE: OECD, *Main Science and Technology Indicators* (Paris, 2002).

TABLE B-19. International nondefense research and development expenditures and nondefense research and development as percentage of gross domestic product, by selected country: 1981–2001

Year	United States	Japan[a]	Germany[b]	France	United Kingdom	Italy	Canada
	Billions of constant 1995 U.S. dollars[c]						
1981	85	39	27	14	14	7	6
1982	86	42	27	15	NA	8	6
1983	90	46	28	16	14	8	6
1984	99	49	29	17	NA	9	7
1985	106	54	31	18	16	10	7
1986	108	55	32	18	16	10	8
1987	109	59	34	19	17	12	8
1988	114	64	35	19	18	12	8
1989	120	70	36	21	17	13	9
1990	128	75	37	22	17	14	9
1991	136	77	41	22	17	13	9
1992	138	76	39	23	17	13	10
1993	136	74	38	24	18	12	10
1994	138	73	37	23	18	12	11
1995	150	84	38	24	18	11	12
1996	160	83	38	24	18	12	11
1997	170	87	40	25	18	13	12
1998	182	89	41	25	18	13	13
1999	195	89	44	26	20	13	14
2000	210	93	47	28	20	14	NA
2001	218	NA	48	28	NA	NA	NA
	Percent of GDP						
1981	1.7	2.1	2.3	1.6	1.9	0.9	1.2
1982	1.8	2.2	2.4	1.6	NA	0.9	1.3
1983	1.8	2.3	2.4	1.7	1.7	0.9	1.3
1984	1.8	2.4	2.4	1.8	NA	1.0	1.3
1985	1.9	2.5	2.6	1.8	1.8	1.1	1.4
1986	1.9	2.5	2.6	1.8	1.8	1.1	1.4
1987	1.8	2.6	2.7	1.8	1.8	1.2	1.4
1988	1.8	2.6	2.7	1.8	1.8	1.2	1.3
1989	1.9	2.7	2.7	1.9	1.7	1.2	1.4
1990	2.0	2.8	2.5	1.9	1.7	1.3	1.5
1991	2.1	2.7	2.4	1.9	1.7	1.2	1.6
1992	2.1	2.7	2.3	2.0	1.7	1.2	1.6
1993	2.0	2.6	2.3	2.0	1.7	1.1	1.7
1994	1.9	2.5	2.2	2.0	1.7	1.0	1.7
1995	2.0	2.8	2.2	2.0	1.7	1.0	1.7
1996	2.1	2.7	2.2	2.0	1.6	1.0	1.7
1997	2.1	2.8	2.2	2.0	1.5	1.1	1.7
1998	2.2	2.9	2.3	2.0	1.5	1.1	1.8
1999	2.3	2.9	2.4	2.0	1.6	1.0	1.8
2000	2.4	3.0	2.4	2.0	1.6	1.1	NA
2001	2.4	NA	2.5	2.0	NA	NA	NA

NA not available; GDP gross domestic product; R&D research and development

[a] Data on Japanese R&D in 1996 and later years may not be consistent with data in earlier years because of changes in methodology.

[b] Data for 1981–90 are for West Germany.

[c] Nondefense R&D data are estimates. Nondefense R&D/GDP ratios are obtained directly from Organisation for Economic Co-operation and Development (OECD) reports or, for following countries and years, are estimated by National Science Foundation from OECD data: United States, for all years; Japan, for 1995 and later years; Germany, for 1990 and earlier years; United Kingdom, for 1981–84 and 1986–88; Italy, for 1986 and earlier years; and Canada, for 1990 and later years. Conversions of foreign currencies to U.S. dollars are calculated with OECD purchasing power parity exchange rates.

NOTE: Nondefense R&D/GDP ratio for Russian Federation was 1.2 in 1990, 0.6 in 1995, and 0.9 in 2001.

SOURCES: OECD, *Main Science and Technology Indicators* (Paris, 2002); and National Science Foundation, Division of Science Resources Statistics, special tabulations (Arlington, VA, 2003).

TABLE B-20. International research and development expenditures for selected countries, by performing sector and source of funds: 2000 or 2001

Country and R&D performer	Source of R&D funds						Percent
	Total	Industry	Government	Higher	Private	Abroad	
	Billions of yen						
Japan (2000)	15,304	11,083	2,997	1,049	111	64	100.0
Industry	10,860	10,606	184	—	8	62	71.0
Government	1,514	15	1,498	—	—	—	9.9
Higher education	2,224	56	1,115	1,048	4	1	14.5
Private nonprofit	707	407	199	—	99	2	4.6
Percent distribution, sources	100.0	72.4	19.6	6.9	0.7	0.4	na
	Millions of euros						
Germany (2001)	51,539	34,011	16,250	0	212	1,066	100.0
Industry	36,350	32,924	2,570	—	74	781	70.5
Government	6,923	152	6,492	—	138	142	13.4
Higher education	8,266	935	7,188	—	—	143	16.0
Private nonprofit	—	—	—	—	—	—	0.0
Percent distribution, sources	100.0	66.0	31.5	0.0	0.4	2.1	na
France (2000)	30,954	16,255	11,967	237	270	2,224	100.0
Industry	19,348	15,671	1,918	4	6	1,749	62.5
Government	5,361	359	4,673	10	9	311	17.3
Higher education	5,804	157	5,311	199	17	120	18.8
Private nonprofit	439	69	65	24	239	44	1.4
Percent distribution, sources	100.0	52.5	38.7	0.8	0.9	7.2	na
Italy (2000)	12,460	—	—	—	—	—	100.0
Industry	6,239	5,023	686	5	16	510	50.1
Government	2,356	40	2,199	3	25	91	18.9
Higher education	3,865	—	—	—	—	—	31.0
Private nonprofit	0	—	—	—	—	—	0.0
Percent distribution, sources	100.0	—	—	—	—	—	na
	Millions of pounds						
United Kingdom (2000)	17,544	8,648	5,069	158	815	2,854	100.0
Industry	11,510	8,023	1,014	—	3	2,470	65.6
Government	2,134	322	1,656	9	69	80	12.2
Higher education	3,645	259	2,358	147	598	283	20.8
Private nonprofit	255	44	42	2	146	21	1.5
Percent distribution, sources	100.0	49.3	28.9	0.9	4.6	16.3	na
	Millions of Canadian dollars						
Canada (2001)	20,828	8,726	6,513	1,386	489	3,714	100.0
Industry	11,973	8,030	291	—	—	3,652	57.5
Government	2,474	75	2,393	—	—	6	11.9
Higher education	6,313	609	3,803	1,386	460	55	30.3
Private nonprofit	68	12	26	—	29	1	0.3
Percent distribution, sources	100.0	41.9	31.3	6.7	2.3	17.8	na
	Billions of rubles						
Russian Federation (2001)	105,261	35,394	60,229	360	206	9,072	100.0
Industry	73,976	30,729	36,275	46	149	6,777	70.3
Government	25,580	3,167	20,398	17	8	1,991	24.3
Higher education	5,488	1,454	3,444	297	8	285	5.2
Private nonprofit	217	44	112	—	40	20	0.2
Percent distribution, sources	100.0	33.6	57.2	0.3	0.2	8.6	na

See explanatory information and SOURCE at end of table.

TABLE B-20. International research and development expenditures for selected countries, by performing sector and source of funds: 2000 or 2001

Country and R&D performer	Source of R&D funds						Percent
	Total	Industry	Government	Higher	Private	Abroad	
Korea (2001)	16,111	11,673	4,023	278	61	76	100.0
Industry	12,274	11,196	989	3	17	69	76.2
Government	1,991	160	1,819	1	9	2	12.4
Higher education	1,677	239	1,148	273	12	5	10.4
Private nonprofit	169	78	67	—	24	—	1.0
Percent distribution, sources	100.0	72.5	25.0	1.7	0.4	0.5	na
	Millions of U.S. dollars						
United States (2001)	274,211	184,892	75,723	6,778	6,818	—	100.0
Industry	198,505	181,606	16,899	—	—	—	72.4
Government	31,486	—	31,486	—	—	—	11.5
Higher education	33,518	2,177	22,036	6,778	2,528	—	12.2
Private nonprofit	10,702	1,110	5,302	—	4,290	—	3.9
Percent distribution, sources	100.0	67.4	27.6	2.5	2.5	—	na

— assumed negligible or not available

na not applicable

R&D research and development

SOURCE: Organisation for Economic Co-operation and Development, unpublished tabulations (Paris, 2003); and National Science *Foundation, Division of Science Resources Statistics, National Patterns of R&D Resources (Arlington, VA, annual series).*

TABLE B-21. U.S. research and development, by performing sector: 1953–2003

Year[c]	Data column:[d]	Total [1]	Federal [2]	Industry [3]	FFRDCs[a] [6]+[13]+[18]	U&C[b] [7]	Other nonprofit [14]	Total [19]	Federal [20]	Industry [21]	FFRDCs[a] [24]+[31]+[36]	U&C[b] [25]	Other nonprofit [32]
		Millions of current dollars						Millions of constant 1996 dollars					
1953		5,160	1,015	3,630	131	273	112	26,805	5,273	18,857	681	1,416	579
1954		5,621	963	4,070	161	301	127	28,912	4,951	20,936	826	1,548	651
1955		6,281	973	4,517	319	342	131	31,756	4,918	22,836	1,610	1,729	662
1956		8,500	1,130	6,272	561	391	146	41,565	5,528	30,670	2,743	1,912	711
1957		9,908	1,297	7,324	688	433	167	46,892	6,139	34,662	3,253	2,049	788
1958		10,915	1,507	8,066	657	491	195	50,439	6,962	37,274	3,034	2,269	901
1959		12,490	1,681	9,200	789	586	234	57,082	7,683	42,048	3,606	2,678	1,067
1960		13,711	1,801	10,032	910	705	264	61,790	8,115	45,210	4,101	3,175	1,190
1961		14,564	1,987	10,353	1,087	834	304	64,903	8,856	46,136	4,842	3,714	1,355
1962		15,636	2,188	11,037	1,056	993	363	68,761	9,620	48,536	4,644	4,365	1,596
1963		17,519	2,558	12,216	1,159	1,178	408	76,169	11,124	53,113	5,037	5,122	1,774
1964		19,103	2,965	13,049	1,297	1,375	417	81,846	12,705	55,908	5,557	5,889	1,787
1965		20,252	3,156	13,812	1,218	1,595	472	85,165	13,272	58,082	5,120	6,705	1,985
1966		22,072	3,308	15,193	1,217	1,818	537	90,236	13,523	62,114	4,974	7,433	2,193
1967		23,346	3,444	15,966	1,340	2,035	561	92,608	13,663	63,332	5,316	8,072	2,225
1968		24,666	3,497	17,014	1,372	2,187	596	93,788	13,297	64,692	5,217	8,316	2,266
1969		25,996	3,790	17,844	1,440	2,280	642	94,222	13,738	64,676	5,220	8,264	2,325
1970		26,271	4,154	17,594	1,430	2,418	677	90,404	14,294	60,544	4,919	8,319	2,328
1971		26,952	4,409	17,829	1,441	2,565	709	88,308	14,445	58,417	4,720	8,404	2,321
1972		28,740	4,676	19,004	1,533	2,757	771	90,321	14,694	59,723	4,818	8,664	2,421
1973		30,952	4,837	20,704	1,576	2,953	882	92,118	14,394	61,619	4,690	8,789	2,625
1974		33,359	5,132	22,239	1,784	3,216	988	91,095	14,015	60,729	4,872	8,781	2,698
1975		35,671	5,561	23,460	2,019	3,570	1,062	89,112	13,893	58,606	5,044	8,917	2,652
1976		39,435	5,890	26,107	2,401	3,899	1,139	93,227	13,925	61,719	5,675	9,216	2,692
1977		43,338	6,211	28,863	2,704	4,346	1,213	96,264	13,797	64,112	6,007	9,653	2,695
1978		48,719	6,962	32,222	3,187	4,996	1,353	101,014	14,435	66,809	6,605	10,358	2,806
1979		55,379	7,471	37,062	3,567	5,715	1,564	105,988	14,299	70,932	6,826	10,937	2,994
1980		63,213	7,831	43,228	4,058	6,455	1,641	110,822	13,728	75,785	7,115	11,317	2,877
1981		72,269	8,605	50,425	4,407	7,085	1,747	115,871	13,796	80,848	7,066	11,360	2,801
1982		80,783	9,501	57,166	4,553	7,603	1,961	121,937	14,342	86,288	6,871	11,475	2,960
1983		89,971	10,830	63,683	5,025	8,251	2,182	130,620	15,722	92,455	7,295	11,979	3,169
1984		102,251	11,916	73,061	5,607	9,154	2,513	143,128	16,679	102,269	7,849	12,813	3,518
1985		114,685	13,093	82,376	6,142	10,308	2,767	155,631	17,767	111,787	8,334	13,988	3,755
1986		120,569	13,504	85,932	6,402	11,540	2,882	159,686	17,932	114,104	8,500	15,323	3,826
1987		126,217	13,588	90,160	6,783	12,807	2,878	162,693	17,515	116,216	8,744	16,508	3,710
1988		133,880	14,342	94,893	7,213	14,220	3,213	166,912	17,881	118,306	8,992	17,728	4,005
1989		141,889	15,231	99,860	7,498	15,632	3,669	170,396	18,291	119,923	9,004	18,773	4,406

See explanatory information and SOURCE at end of table.

TABLE B-21. U.S. research and development, by performing sector: 1953–2003

Year[c]	Data column:[d]	Total [1]	Federal [2]	Industry [3]	FFRDCs[a] [6]+[13]+[18]	U&C[b] [7]	Other nonprofit [14]	Total [19]	Federal [20]	Industry [21]	FFRDCs[a] [24]+[31]+[36]	U&C[b] [25]	Other nonprofit [32]
		Millions of current dollars						Millions of constant 1996 dollars					
1990		151,990	15,671	107,404	7,853	16,936	4,126	175,690	18,115	124,152	9,077	19,577	4,769
1991		160,872	15,249	114,675	8,093	18,203	4,652	179,425	17,008	127,900	9,027	20,302	5,189
1992		165,347	15,853	116,757	8,360	19,385	4,993	180,038	17,261	127,131	9,102	21,107	5,436
1993		165,723	16,531	115,435	8,003	20,487	5,267	176,207	17,576	122,738	8,509	21,783	5,601
1994		169,195	16,355	117,392	8,254	21,595	5,599	176,226	17,035	122,271	8,598	22,492	5,831
1995		183,611	16,904	129,830	8,448	22,603	5,827	187,168	17,231	132,345	8,611	23,041	5,940
1996		197,330	16,585	142,371	8,464	23,702	6,209	197,330	16,585	142,371	8,464	23,702	6,209
1997		212,134	16,819	155,409	8,414	24,866	6,626	208,076	16,497	152,436	8,252	24,391	6,500
1998		226,321	17,362	167,102	8,480	26,151	7,225	219,303	16,824	161,921	8,218	25,340	7,001
1999		243,517	17,851	180,682	8,684	28,135	8,175	232,697	17,058	172,653	8,298	26,885	7,812
2000		264,634	17,917	197,548	9,207	30,566	9,404	247,578	16,763	184,816	8,614	28,596	8,798
2001		274,211	21,048	198,505	10,437	33,518	10,702	250,614	19,237	181,423	9,540	30,634	9,781
2002	preliminary	276,434	23,788	192,379	11,655	36,846	11,766	249,903	21,505	173,915	10,537	33,310	10,637
2003	preliminary	283,795	24,959	193,729	12,185	40,262	12,661	253,161	22,264	172,817	10,870	35,916	11,294

FFRDC federally funded research and development center

U&C universities and colleges

[a] Expenditures of industry FFRDCs for 1953–54 are included in industrial sector. Expenditures of nonprofit FFRDCs for 1953–54 are included in nonprofit sector.

[b] Adjustments have been made to university research and development for 1998 and later years to eliminate double counting of funds passed through from one academic institution to another. Data for 1998 and later years are not directly comparable with data for 1997 and earlier years. For fiscal year (FY) 1998, $479 million in passed-through funds were reported. For FY 2003, $990 million in passed-through funds are estimated.

[c] Expenditure levels for academic and Federal Government performers are calendar-year approximations based on FY data. For Federal Government expenditures starting in 1977, approximation is equal to 75 percent of amount reported in same FY plus 25 percent of amount reported in subsequent FY. For academic expenditures in all years and for Federal Government expenditures prior to 1977, respective percentages are 50 and 50, because those FYs (for most academic institutions and Federal Government before 1977) begin on July 1 instead of October 1.

[d] See historical database, table D, which is available in online version of this report at http://www.nsf.gov/sbe/srs/nprdr/start.htm, for complete series of historical data arranged in same data columns defined in this and other tables.

NOTES: Technical notes explaining methodological issues of measurement will be provided in NSF, *The Methodology Underlying the Measurement of R&D Expenditures: 2003* (Arlington, VA, forthcoming). Data are based on annual reports by performers except for nonprofit sector. For trend comparisons, use only historical data reported here. Do not use data published earlier.

SOURCES: Data were derived from National Science Foundation, Division of Science Resources Statistics (NSF/SRS), *Research and Development in Industry, 2001* (Arlington, VA, forthcoming); NSF/SRS, A*cademic Research and Development Expenditures: Fiscal Year 2001* (Arlington, VA, 2003); NSF/SRS, *Federal Funds for Research and Development: 'FY 2001, 2002, and 2003* (Arlington, VA, forthcoming); and NSF/SRS, Survey of Research and Development Funding and Performance by Nonprofit Organizations: FY 1996–97.

TABLE B-22. U.S. research and development funding sources, by funding sector: 1953–2003

Year[c]	Data column:[d]	Total [1]	Federal [37]	Industry [38]	U&C[a] [11]	Nonprofit [39]	Other government[b] [9]	Total [19]	Federal [40]	Industry [41]	U&C[a] [29]	Nonprofit [42]	Other government[b] [27]
		Millions of current dollars						Millions of constant 1996 dollars					
1953		5,160	2,783	2,247	37	55	40	26,805	14,455	11,670	190	286	205
1954		5,621	3,102	2,375	40	60	45	28,912	15,957	12,215	203	309	229
1955		6,281	3,603	2,522	42	64	50	31,756	18,217	12,750	212	324	253
1956		8,500	4,978	3,346	46	74	57	41,565	24,342	16,359	225	362	276
1957		9,908	6,233	3,470	51	91	64	46,892	29,497	16,420	241	431	303
1958		10,915	6,974	3,707	56	107	72	50,439	32,228	17,130	256	492	333
1959		12,490	8,167	4,065	61	117	81	57,082	37,327	18,576	279	532	368
1960		13,711	8,915	4,516	67	123	90	61,790	40,176	20,352	302	554	406
1961		14,564	9,484	4,757	75	148	101	64,903	42,265	21,199	332	660	448
1962		15,636	10,138	5,124	84	179	112	68,761	44,583	22,531	369	785	493
1963		17,519	11,645	5,456	96	197	125	76,169	50,632	23,720	417	857	543
1964		19,103	12,764	5,888	114	200	138	81,846	54,688	25,225	486	857	589
1965		20,252	13,194	6,549	136	225	150	85,165	55,482	27,538	572	944	629
1966		22,072	14,165	7,331	165	252	160	90,236	57,910	29,971	673	1,028	654
1967		23,346	14,563	8,146	200	271	168	92,608	57,766	32,311	791	1,073	666
1968		24,666	14,964	9,008	221	290	185	93,788	56,898	34,249	838	1,101	702
1969		25,996	15,228	10,011	233	316	208	94,222	55,195	36,283	845	1,145	754
1970		26,271	14,984	10,449	259	343	237	90,404	51,563	35,955	890	1,180	816
1971		26,952	15,210	10,824	290	366	262	88,308	49,837	35,465	949	1,199	858
1972		28,740	16,039	11,715	312	393	282	90,321	50,406	36,816	979	1,234	886
1973		30,952	16,587	13,299	343	422	302	92,118	49,366	39,579	1,021	1,254	897
1974		33,359	17,287	14,885	393	474	320	91,095	47,206	40,648	1,072	1,295	874
1975		35,671	18,533	15,824	432	534	348	89,112	46,299	39,531	1,078	1,335	869
1976		39,435	20,292	17,702	480	592	369	93,227	47,971	41,849	1,135	1,399	872
1977		43,338	22,071	19,642	569	662	394	96,264	49,026	43,629	1,263	1,472	875
1978		48,719	24,414	22,457	679	727	443	101,014	50,619	46,561	1,408	1,507	919
1979		55,379	27,225	26,097	785	791	482	105,988	52,105	49,946	1,502	1,513	922
1980		63,213	29,975	30,929	920	871	519	110,822	52,551	54,223	1,612	1,527	909
1981		72,269	33,715	35,948	1,058	967	581	115,871	54,057	57,637	1,696	1,550	932
1982		80,783	37,168	40,692	1,207	1,095	621	121,937	56,103	61,422	1,821	1,653	937
1983		89,971	41,472	45,264	1,357	1,220	658	130,620	60,209	65,714	1,969	1,772	955
1984		102,251	46,477	52,187	1,514	1,351	721	143,128	65,058	73,050	2,119	1,892	1,009
1985		114,685	52,655	57,962	1,743	1,491	834	155,631	71,455	78,656	2,365	2,023	1,131
1986		120,259	54,633	60,991	2,019	1,647	969	159,686	72,544	80,987	2,680	2,188	1,287
1987		126,217	58,466	62,576	2,262	1,849	1,065	162,693	75,363	80,660	2,916	2,383	1,372
1988		133,880	60,130	67,977	2,527	2,081	1,165	166,912	74,966	84,749	3,150	2,595	1,452
1989		141,889	60,463	74,966	2,852	2,333	1,274	170,396	72,611	90,028	3,425	2,802	1,530
1990		151,990	61,607	83,208	3,187	2,589	1,399	175,690	71,214	96,183	3,683	2,993	1,617
1991		160,872	60,780	92,300	3,457	2,852	1,483	179,425	67,789	102,945	3,856	3,181	1,653
1992		165,347	60,912	96,229	3,568	3,113	1,525	180,038	66,324	104,779	3,885	3,390	1,660
1993		165,723	60,522	96,549	3,708	3,387	1,557	176,207	64,351	102,657	3,943	3,601	1,655

See explanatory information and SOURCE at end of table.

TABLE B-22. U.S. research and development funding sources, by funding sector: 1953–2003

Year[c] Data column:[d]	Total [1]	Federal [37]	Industry [38]	U&C[a] [11]	Nonprofit [39]	Other government[b] [9]	Total [19]	Federal [40]	Industry [41]	U&C[a] [29]	Nonprofit [42]	Other government[b] [27]
	Millions of current dollars						Millions of constant 1996 dollars					
1994	169,195	60,769	99,203	3,937	3,664	1,622	176,226	63,294	103,326	4,101	3,816	1,689
1995	183,611	62,959	110,870	4,109	3,924	1,750	187,168	64,178	113,017	4,188	4,000	1,784
1996	197,330	63,383	123,416	4,434	4,238	1,860	197,330	63,383	123,416	4,434	4,238	1,860
1997	212,134	64,561	136,227	4,836	4,589	1,921	208,076	63,326	133,622	4,744	4,501	1,885
1998	226,321	66,356	147,843	5,168	4,984	1,970	219,303	64,298	143,258	5,008	4,829	1,909
1999	243,517	67,015	163,229	5,630	5,549	2,095	232,697	64,037	155,976	5,380	5,303	2,002
2000	264,634	66,327	183,688	6,211	6,170	2,238	247,578	62,052	171,849	5,811	5,772	2,094
2001	274,211	73,341	184,892	6,778	6,818	2,382	250,614	67,030	168,982	6,195	6,231	2,177
2002 preliminary	276,434	80,490	178,514	7,332	7,550	2,548	249,903	72,765	161,381	6,628	6,825	2,304
2003 preliminary	283,795	85,279	179,615	7,944	8,247	2,710	253,161	76,074	160,227	7,087	7,357	2,417

U&C universities and colleges

[a] Adjustments have been made to university research and development (R&D) for 1998 and later years to eliminate double counting of funds passed through from one academic institution to another. Data for 1998 and later years are not directly comparable with data for 1997 and earlier years. For fiscal year (FY) 1998, $479 million in passed-through funds were reported. For FY 2003, $990 million in passed-through funds are estimated.

[b] Because of limitations in survey information, data on other government funding to other performers are not available and are consequently included in other sectors' support for their own R&D performance. For example, other government support to nonprofits is included in nonprofits' support for their own R&D.

[c] Expenditure levels for academic and Federal Government performers are calendar-year approximations based on FY data. For Federal Government expenditures starting in 1977, approximation is equal to 75 percent of amount reported in same FY plus 25 percent of amount reported in subsequent FY. For academic expenditures in all years and Federal Government expenditures prior to 1977, respective percentages are 50 and 50, because those FYs (for most academic institutions and Federal Government before 1977) begin on July 1 instead of October 1.

[d] See historical database, table D, which is available in online version of this report at http://www.nsf.gov/sbe/srs/nprdr/start.htm, for complete series of historical data arranged in same data columns defined in this and other tables.

NOTES: Technical notes explaining methodological issues of measurement will be provided in NSF, *The Methodology Underlying the Measurement of R&D Expenditures: 2003* (Arlington, VA, forthcoming). Data are based on annual reports by performers except for nonprofit sector. For trend comparisons, use only historical data reported here. Do not use data published earlier.

SOURCES: Data were derived from National Science Foundation, Division of Science Resources Statistics (NSF/SRS), *Research and Development in Industry, 2001* (Arlington, VA, forthcoming); NSF/SRS, *Academic Research and Development Expenditures: Fiscal Year 2001* (Arlington, VA, 2003); NSF/SRS, *Federal Funds for Research and Development: FY 2001, 2002, and 2003* (Arlington, VA, forthcoming); and NSF/SRS, Survey of Research and Development Funding and Performance by Nonprofit Organizations: FY 1996–97.

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