InfoBrief
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Extramural R&D Funding by U.S.-Located Businesses Nears $30 Billion in 2011

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In 2011, U.S.-located companies spent $29.6 billion for extramural (purchased and collaborative) research and development performed by domestic and overseas organizations, according to statistics from the Business R&D and Innovation Survey (BRDIS). This amount includes contract or otherwise purchased R&D ($24.0 billion) and payments to R&D collaborators ($5.6 billion). Most of these extramural R&D expenditures involve domestic providers and partners.

The amount that U.S.-located companies pay to other U.S.-located organizations for extramural R&D has grown. In 2011, extramural R&D was more than 10% of the amount that companies based in the United States spent on their company-funded, company-performed U.S. R&D. Comparable estimates from the Survey of Industrial Research and Development put this ratio under 4% in 1991.[2] The growth in the relative size of domestic extramural R&D in the business sector is the result of differing rates of growth in total R&D spending among industries and of changes in the importance of external partners within industries.

Location and Type of Performers of Extramural R&D

Contractors and collaboration partners include other firms (e.g., industry partners, suppliers, or specialized firms) and other nonbusiness organizations (e.g., universities or government laboratories).[3] Motives for R&D activities with third parties include such technological and market factors as the need to complement internal capabilities and to share risks and costs. These benefits are often balanced against transactions costs, which can include negotiating the assignment of intellectual property and coordination costs across multiple and geographically dispersed parties (Hätönen and Eriksson 2009; Malerba and Vonortas 2009; Martinez-Noya, Garcia-Canal, and Guillen 2012).

Most of the 2011 extramural R&D ($25.3 billion, or 85%) was performed by U.S.-located organizations (table 1). Between 2009 and 2011, the share of extramural R&D expenditures paid for by U.S.-located firms and performed overseas has ranged from 11% to 24%.

In terms of the type of performer, 96% of the $29.6 billion in extramural R&D

TABLE 1. Extramural R&D paid for by U.S.-located firms, by location of performer: 2009–11

Year	Total (US$millions)	Performed in the United States		Performed outside the United States	
		Amount (US$millions)	Percent	Amount (US$millions)	Percent
2009	27,018	20,548	76	6,470	24
2010	29,216	26,032	89	3,184	11
2011	29,608	25,289	85	4,320	15

NOTES: The Business R&D and Innovation Survey collected extramural R&D paid for by all companies within the scope of the survey, but the detail on the types of recipients of this extramural R&D was only collected in the survey forms administered to large companies. This table uses extramural R&D detail collected from these companies to estimate details on the domestic extramural R&D for all companies. See Data Sources and Limitations for more details. Detail may not sum to total due to rounding.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics and U.S. Census Bureau, Business R&D and Innovation Survey.

was performed by other companies (located in the United States or overseas) in 2011. Additional details for 2010 (that were not collected for 2011) show that universities and colleges performed $1.0 billion (or 3%) of $29.2 billion in total extramural R&D funded by U.S.-located companies. Most of these funds were destined for domestic universities and colleges (table 2). For information on the relationships between businesses and universities in R&D, see NSF/NCSES (2013c).

TABLE 2. Extramural R&D paid for by U.S.-located firms, by type and location of performer: 2010
(Millions of U.S. dollars)

Performer location	Total	Companies	Universities and colleges	Other
Total	29,216	23,767	1,017	4,432
Performed in the United States	26,032	21,256	829	3,947
Performed overseas	3,184	2,511	188	485

NOTE: Other includes government agencies and other organizations.

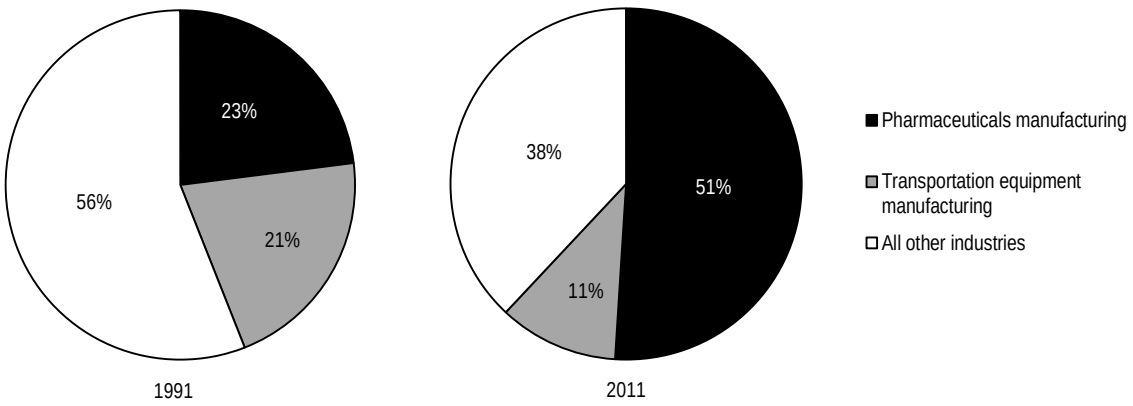
SOURCE: National Science Foundation, National Center for Science and Engineering Statistics and U.S. Census Bureau, Business R&D and Innovation Survey, 2010.

Industry Detail of Extramural R&D

The extent and evolution of R&D collaborative networks vary by industrial sectors. Two industry groups accounted for the majority of expenditures for domestic extramural R&D in 2011: pharmaceutical manufacturing (51%), and transportation equipment manufacturing (11%). These two industry groups were also the largest in terms of extramural R&D two decades earlier in 1991, but the pharmaceutical industry was much less dominant, accounting for 23% of domestic extramural R&D (figure 1). Expenditures for company-performed R&D grew much more rapidly in the pharmaceutical manufacturing industry than in the transportation manufacturing industries from 1991 to 2011. In 2011, pharmaceutical manufacturers accounted for 17% of company-funded, company-performed U.S. R&D, with transportation manufacturers accounting for only 8% of this R&D. In 1991, the pharmaceutical manufacturing industry accounted for 8% and the transportation manufacturing industries for 16% of company-performed U.S. R&D funded by company and other nonfederal sources.[4]

Just as pharmaceutical manufacturing's overall R&D spending grew during the past two decades, so too did its expenditures on extramural R&D increase in relation to its company-funded, company-performed U.S. R&D. In 2011, the ratio of extramural R&D to company-funded, company-performed U.S. R&D was 32% for the pharmaceutical industry and 14% for the transportation manufacturing industries. In

FIGURE 1. Share of domestic extramural R&D, by selected industry: 1991 and 2011



NOTES: Transportation equipment manufacturing data are for Standard Industrial Classification (SIC) code 37 in 1991 and North American Industrial Classification System (NAICS) code 336 in 2011. Pharmaceuticals manufacturing data are for SIC 283 in 1991 and NAICS 3254 in 2011.

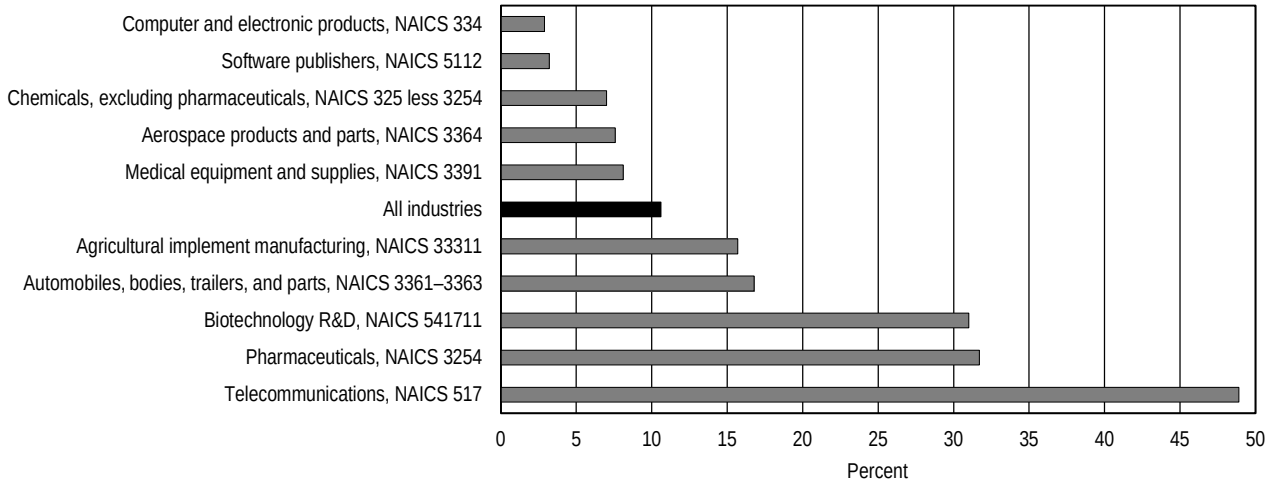
SOURCES: National Science Foundation, National Center for Science and Engineering Statistics and U.S. Census Bureau, Survey of Industrial Research and Development, 1991 and Business R&D and Innovation Survey, 2011.

1991, the amount that pharmaceutical manufacturing companies paid to other organizations located inside the United States for extramural R&D was 11% of the amount they spent on their company-performed U.S. R&D paid for by company and other nonfederal funds. The growth in extramural R&D expenditures by the pharmaceutical industry likely reflects, in part, the pharmaceutical industry's growing reliance on contract research organizations (CROs) as the cost and complexity of drug discovery have increased. CROs are employed by pharmaceutical companies to assist with all stages of the drug development pipeline, and CROs' participation in various aspects of clinical trials—the stages of drug development where compounds are tested in human volunteers—has grown substantially.[5] Analysis from the Tufts Center for the Study of Drug Development estimated the number of CROs to have grown from 800 in 2000 to more than 3,100 by 2011 (Getz et al. 2012). Also included in the pharmaceutical manufacturing industry's extramural R&D are payments made to collaborators, such as companies in the biotechnology R&D industry (Audretsch and Feldman 2003).

Compared with pharmaceutical manufacturing, another health care industry, medical equipment and supplies, reports much lower amounts of extramural R&D paid to U.S.-based organizations relative to its company-funded, company-performed U.S. R&D (figure 2).

The telecommunications services industry, biotechnology R&D industry, automobile and auto parts manufacturing industries, and agricultural equipment manufacturing industries report much higher amounts of extramural R&D expenditures relative to their company-funded, company-performed U.S. R&D. For the telecommunications services industry (consisting primarily of telecommunications service providers), the ratio of domestic extramural R&D to domestic company-funded, company-performed U.S. R&D was almost 50%, reflecting a dramatic increase in interfirm R&D partnerships in the industry (Campbell-Smith 2008). Industries with low amounts of extramural R&D paid to U.S.-based organizations relative to their company-funded, company-performed U.S. R&D include computer and electronic parts manufacturers and software publishers.

FIGURE 2. Ratio of business expenditures for domestic extramural R&D to domestic intramural R&D, by selected industry: 2011



NAICS = North American Industry Classification System.

NOTES: The Business R&D and Innovation Survey collected extramural R&D paid for by all companies within the scope of the survey, but the detail on the types of recipients of this extramural R&D was only collected in the survey forms administered to large companies. This figure uses extramural R&D detail collected from these companies to estimate details on domestic extramural R&D for all companies. Industry classification was based on the dominant business code for domestic R&D performance, where available. See Data Sources and Limitations for more details.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics and U.S. Census Bureau, Business R&D and Innovation Survey, 2011.

Data Sources and Limitations

The sample for BRDIS was selected to represent all for-profit companies with five or more domestic employees, publicly or privately held, that perform or fund R&D. The survey also captured information on companies whether or not they perform or fund R&D. For 2011, a total of 43,108 companies were sampled for BRDIS, representing 1,964,757 companies in the population. Statistics from the survey are subject to both sampling and nonsampling errors. Industry classification was based on the dominant business code for domestic R&D performance, where available. For companies that did not report business codes, the classification used for sampling was assigned.

BRDIS collected extramural R&D paid for by all companies within the scope of the survey, but details on the types of recipients of extramural R&D were only collected in the survey forms administered to large-R&D companies (those estimated to have performed $7 million or more of R&D in the United States in any of the 4 years preceding 2011). These large-R&D companies accounted for 93% of BRDIS's extramural R&D estimate. To make historical comparisons, this InfoBrief uses the detail collected from large-R&D companies to estimate characteristics of recipients of domestic extramural R&D for all companies. Furthermore, because of data limitations, recipients of domestic extramural R&D in 2009 are estimated from data on worldwide extramural R&D.

Some BRDIS extramural R&D data are reported in undistributed categories that are not assigned to either domestic or foreign performers. For the purpose of this InfoBrief, undistributed extramural R&D expenditures were allocated to U.S. and outside-the-U.S. performers using the U.S./non-U.S. distribution in reported data. For example, in 2011, 85% of detailed extramural R&D expenditures outside of undistributed categories were estimated to be performed by U.S.-located organizations. To determine the total extramural R&D performed in the United States, this InfoBrief estimates that 85% of the undistributed categories were also performed by U.S.-located organizations.

For full BRDIS statistics, see NSF/NCSES (2013a, 2013b) and http://www.nsf.gov/statistics/industry/.

Notes

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2. R&D statistics for 1991 include expenditures from companies' own funds as well as expenditures paid for by nonfederal customers and R&D collaboration partners. Statistics for 2011 include only expenditures from companies' own funds. Estimates for nonfederal funding of company extramural R&D (e.g., subcontracted R&D) are not available for 1991, but this funding likely contributes only a small amount to the differences in industry distributions presented here.

3. For U.S.-located companies that are foreign owned, their foreign parents are treated as external companies for purposes of extramural R&D expenditures in BRDIS.

4. Companies with fewer than 500 U.S. employees accounted for 18% of all extramural R&D in 2011. In 1991, only 3% of extramural R&D was estimated for companies with fewer than 500 U.S. employees.

5. Members of the Pharmaceutical Research and Manufacturers of America (PhRMA) reported spending $27.7 billion on phase 1–3 clinical trials in 2011 according to the 2013 PhRMA Annual Membership Survey. The market research company Thomson CenterWatch estimated that CROs played a substantial role in 64% of phase 1–3 clinical studies in 2003 as compared with 28% in 1993. See also Shuchman (2007).

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