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Basic Scientific and Engineering Research at U.S. Universities

AAU DATA & POLICY BRIEF

"Discovery," wrote William Press in a 2013 article in *Science*, "leads to technology and invention, which lead to new products, jobs, and industries."[1] Basic, curiosity-driven research continually expands the boundaries of knowledge across fields, providing insights that enrich our lives.[2] Such research helps drive the U.S. economy, enhances national security, and improves human health and wellbeing. Basic research conducted at universities also provides training for the nation's scientific and engineering workforce in business, manufacturing, government, and academia.

This brief looks at the funding and performance of basic research in the United States, which in 2012 totaled nearly $75 billion, with an emphasis on the role of universities. The data illustrate the importance of the long-standing partnership between universities and the federal government for the nation's basic research enterprise.

Who Funds the Nation's Basic Research?

The federal government has long been the largest funder of U.S. basic research (Figure 1), although its proportion has declined since peaking in the 1960s and 1970s, from 70.3% in 1980 to 52.6% in 2012 (Figure 2). Industry's proportion fell sharply through the 1960s and 1970s, increased in the 1980s, and has gone through peaks and valleys since. In 2012, industry funded 21.3% of U.S. basic research. The combined percentage funded by federal plus industry sources fell from 91.2% in

FIGURE 1 **FUNDERS OF U.S. BASIC RESEARCH (2012)**

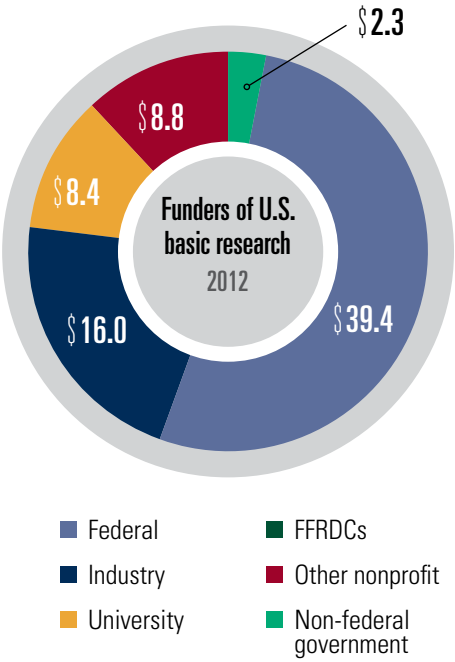
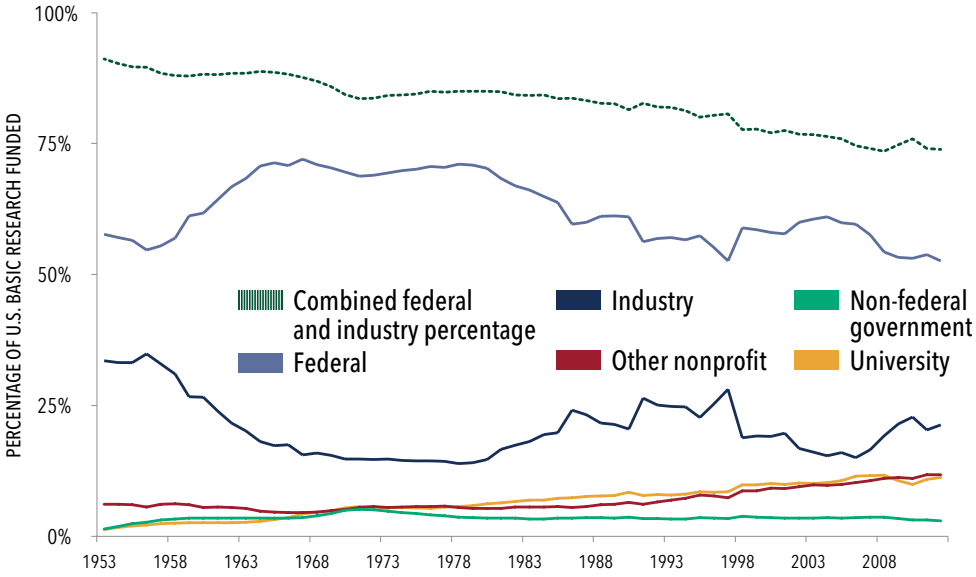
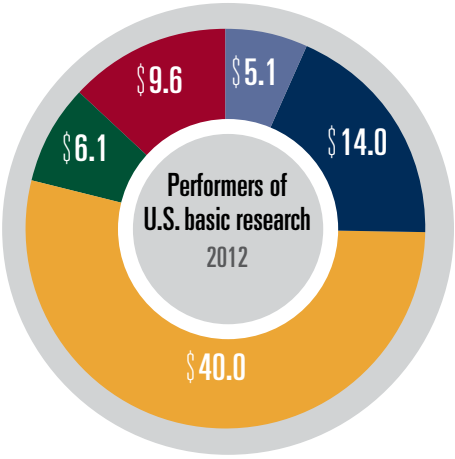


FIGURE 2 **WHO FUNDS THE NATION'S BASIC RESEARCH?**



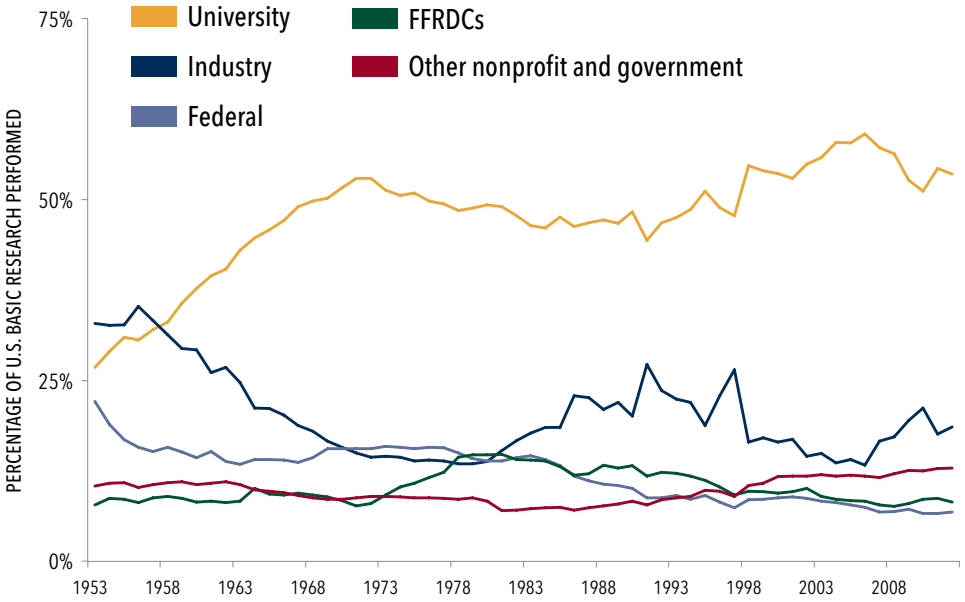
Source: National Science Foundation, National Center for Science and Engineering Statistics. 2013. National Patterns of R&D Resources: 2011–12 Data Update.

FIGURE 3 **PERFORMERS OF U.S. BASIC RESEARCH (2012)**



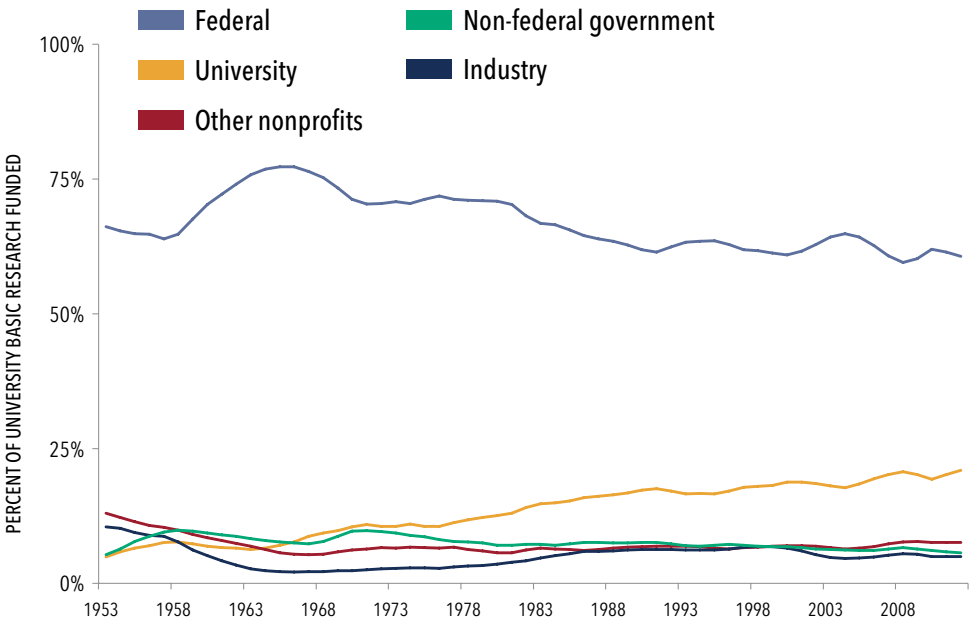
SOURCE: National Science Foundation, National Center for Science and Engineering Statistics. 2013. National Patterns of R&D Resources: 2011–12 Data Update. Dollars are in billions. Total basic research funding for 2012 was $74,849 in current dollars.

FIGURE 4 **WHO PERFORMS THE NATION'S BASIC RESEARCH?**



Source: National Science Foundation, National Center for Science and Engineering Statistics. 2013. National Patterns of R&D Resources: 2011–12 Data Update.

FIGURE 5 **WHO FUNDS BASIC RESEARCH PERFORMED AT UNIVERSITIES?**



Source: National Science Foundation, National Center for Science and Engineering Statistics. 2013. National Patterns of R&D Resources: 2011–12 Data Update.

1953 to 73.9% in 2012. The difference has been made up by universities and other non-profit organizations, which have both increased their shares. Universities, for example, have increased their share of U.S. basic research funding by a factor of eight. State and local governments have played a small but steady role funding basic research over the last 60 years.

Who Performs the Nation's Basic Research?

Over the last 60 years, universities have performed much of the nation's basic research (Figure 3), surpassing industry in the late 1950s and reaching more than 50% of the national total by 1970 (Figure 4). Each year since the late 1990s, universities have performed between 50% and 60% of U.S. basic research (53.5% in 2012). Industry is the second largest performer, though its share has declined from about one-third in the 1950s to between 15% and 20% each year since 2000 (18.6% in 2012). The federal government's share has also declined, from 22.1% in 1953 to 6.8% in 2012.[3] Performance by Federally-Funded Research and Development Centers (FFRDCs) has remained relatively flat at around 7% to 9%, although its percentage peaked slightly in the 1980s.[4] Other performers, including non-profits, have increased their share from the 1980s on, now performing 12.9%.

Who Funds Basic Research Performed at Universities?

The federal government remains by far the largest funder of basic research performed at U.S. universities (Figure 5). However, its share has steadily declined: from 77.3% (1965) to 60.7% (2012). During this same time period, the proportion of basic research performed at universities and supported by universities themselves tripled from 7.1% in 1965 to 21.0% in 2012. Other funders contribute steady but small percentages, including — for 2012 — other nonprofit organizations (7.6%), non-federal government (5.7%), and industry (5.0%). Industry has funded the smallest share of university basic

TABLE 1 **FEDERAL AGENCY (2014)**

Agency	Percentage of total federally-funded university basic research	Percentage of the agency's basic research funding that goes to universities	Percentage of the agency's total R&D funding that goes to universities for basic research
Department of Health and Human Services (largely NIH)	57.1%	57.5%	29.5%
National Science Foundation	25.4%	80.8%	72.2%
Department of Defense	7.5%	58.0%	1.9%
Department of Energy	4.2%	16.5%	7.1%
NASA	3.8%	19.2%	6.5%
Department of Agriculture	1.7%	30.5%	11.9%
Department of Homeland Security	0.3%	48.4%	7.0%
TOTAL	**100%**	**51.3%**	**13.0%**

TABLE 2 **BY DISCIPLINE (2014)**

Discipline	Percentage of total federally-funded university basic research	Percentage of federal basic research funding in that discipline going to universities	Percentage of total federal research funding (basic + applied) in that discipline going to universities for basic research
Life Sciences	55.9%	55.8%	28.9%
Physical Sciences	10.9%	36.6%	26.2%
Engineering	9.9%	43.6%	14.3%
Math & Computer Science	7.8%	64.5%	32.2%
Environmental Sciences	6.2%	40.0%	24.8%
Psychology	4.3%	63.7%	33.0%
Social Sciences	1.7%	69.0%	23.0%
Other sciences	3.2%	31.5%	16.0%
TOTAL	**100%**	**50.0%**	**25.4%**

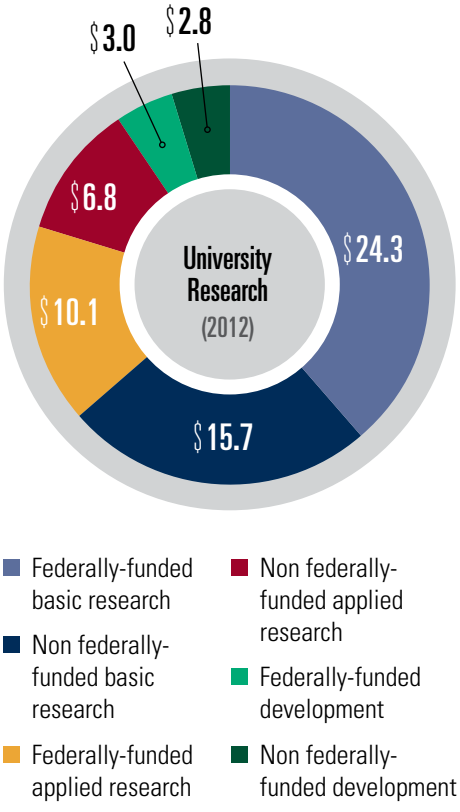
SOURCE: NSF Survey of Federal Funds for Research and Development

research since the late 1990s; industry itself performs more than 80% of the basic research it funds. While industry also funds university applied research and development, 62% of its total support for university research in 2012 was for basic research.

Federal Funds for University Basic Research by Agency

In 2014, as shown in Table 1, the majority of federal funds to perform basic research at universities (57.1%) came from the Department of Health & Human Services, almost exclusively the National Institutes of Health (NIH).[5] An additional 25.4% was from the National Science Foundation (NSF). Together, these two agencies provided 82.5% of federal support for basic research at universities. Some agencies obligate large portions of their total basic research budgets to universities: three of the seven agencies listed in Table 1 (NIH, NSF, Department of Defense) devote more than 50% of their basic research dollars to fund university research. Some agencies are overall more oriented toward university basic research than others in terms of their entire research and development

FIGURE 6 **BASIC RESEARCH IN THE CONTEXT OF ALL UNIVERSITY R&D**



SOURCE: National Science Foundation, National Center for Science and Engineering Statistics. 2013. National Patterns of R&D Resources: 2011–12 Data Update. Dollars are in billions.

(R&D) portfolios. For instance, university basic research constitutes 72.2% of NSF's R&D budget, but only 1.9% of the Department of Defense R&D budget.[6]

Federal Funds for University Basic Research by Discipline

More than half (55.9%) of 2013 federal funding for university basic research was for life sciences (Table 2). An additional 10.9% and 9.9% were devoted to physical sciences and engineering, respectively. Social sciences research was only 1.7% of federal funding for university basic research. Table 2 shows that universities receive a significant percentage of total federal money devoted to basic research across the disciplines. As expected, in more applied fields (e.g., engineering: 14.3% vs. physical sciences: 26.2%) a smaller percentage of overall research funding tends to be devoted to university basic research.[7]

Basic Research in the Context of All University R&D

In 2012, 64% of university research was basic research (Figure 6). Applied research constituted just over a quarter of university research (27%), while development was about 9% of university research. The federal government funded 60.8% of university basic research, 59.8% of university applied research, and 51.7% of university development. Overall, the federal government's share of university R&D was approximately 60% in 2012.

1 http://www.sciencemag.org/content/342/6160/817.full

2 Basic research has been defined as "systematic study directed toward fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind." http://www.nsf.gov/statistics/randdef/fedgov.cfm

3 This refers to intramural government research.

4 "FFRDCs are privately operated R&D organizations that are exclusively or substantially financed by the federal government. FFRDCs provide the sponsoring federal agencies with capabilities to meet special long-term R&D needs that cannot be met as effectively by existing in-house or contractor resources. They enable agencies to use private sector resources to accomplish tasks that are integral to the mission and operation of the sponsoring agency." http://www.nsf.gov/statistics/infbrief/nsf14308/

5 These data, as well as those for research by discipline, are based on obligations rather than expenditures.

6 The Department of Defense R&D budget includes items like testing and evaluation of weapons systems.

7 This includes basic and applied research. Development was not available by discipline.