Who Picks Up the Tab for Science?

For half a century, government funding of research edged upward. Times have changed.

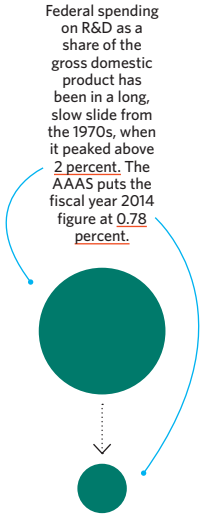
By Art Jahnke

Illustration by Oliver Munday

At BU, 80 percent of the roughly $350 million for sponsored research received in FY 2014 (down from a 2010 peak of $407 million) came from the federal government.

FINDING THE MONEY for scientific research used to be a lot more straightforward: people got it from people they knew. In the 1870s, when Alexander Graham Bell needed money to develop his "harmonic telegraph," he got much of it from the wealthy father of one of his students, 16-year-old Mabel Hubbard. Bell and Hubbard would eventually marry. Bell, who was at the time a professor of vocal physiology and elocution at Boston University's School of Oratory, even borrowed money from his (famous) assistant, Thomas Watson.

Throughout the ages, science has moved forward with boosts from many well-heeled patrons, from monarchs to millionaires. Galileo's heretical revelation that the Earth revolved around the sun would have been unlikely if not for his education at the University of Pisa, which was founded by Pope Clement VI, remembered even today as a devoted patron of the arts and learning. Four centuries after Clement, German universities adopted the notion that it was the academy's responsibility to advance the understanding of science, a conviction that we take for granted today. We also think that the government should pay for university research—and it does pay for the vast majority of it. But since government funding flatlined several years ago, scientists at BU and universities across the country are worried, very worried, not just about their research, but about the future of science in America.



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"The situation is serious," says Gerald Denis, a School of Medicine associate professor of pharmacology and medicine in the Cancer Research Center and a fellow of the Obesity Society. "The last few years of funding uncertainties have been deadly, and several investigators I know have lost their jobs because grants were terminated. Cancer cohorts have been lost, long-term studies decimated. Who will be around to make the next set of American medical discoveries and advances? This is no way to maintain international scientific leadership."

According to the American Association for the Advancement of Science (AAAS), Congressional cuts, along with the across-the-board reductions known as sequestration, from 2010 to 2013, resulted in the largest overall decrease in a three-year period since the end of the space race. Seen from a longer perspective, federal spending on R&D as a share of the gross domestic product has been in a long, slow slide from the 1970s, when it peaked above 2 percent. The AAAS puts the fiscal year 2014 figure at 0.78 percent.

Richard Myers, a MED professor of neurology and the author of more than 250 papers, says his funding "came to a screeching halt" in 2008. On those rare occasions when he is funded, he says, the money is likely to be reduced year after year until he ends up with just over half of what he requested. "I know what good science is," says Myers. "And that compromises the science."

Gloria Waters, vice president and associate provost for research, says finding funding sources other than the federal government has become "a top priority" of the University. Last spring, Waters' office launched a series of workshops designed to help researchers with such things as Humanities Proposal Writing and Working with Federal Agencies. Every one, she says, was "extremely well-attended," so well-attended that her office recently ramped up the program to include eight events per semester.

At BU, whose researchers study an enormous range of subjects, from the birth of frogs to the birth of planets, about 80 percent of the roughly $350 million for sponsored research received in FY 2014 (down from a 2010 peak of $407 million) came directly from the federal government, and another 10 percent originated in government grants and came to BU through other institutions, such as Harvard or MIT. About 45 percent of that money went to researchers at MED, where, according to Karen Antman, MED dean and Medical Campus provost, funding anxiety is at an all-time high. Antman says grants to the Medical Campus dropped $30 million in 2013 because of sequestration, although the money bounced back in 2014 when sequestration was put on hold. "These types of fluxes in research budgets produce a lot stress for faculty," she says.

Some observers of the funding dilemma take a more sanguine approach. One Washington insider, an expert on US research funding and a BU alum, who requested anonymity because of his position, says that "research and development funding generally does pretty well in the government's budget process," because the government branches agree it's important to stay competitive in science and technology. But looming over every budget decision, this expert says, is a broader debate about what the size of the government should be and how the government should spend its limited research budget.

In other words, some legislators wonder why the government should pay for so much university research. Waters offers some good reasons. She points out that the other likely source of research funding—industry—prefers to direct its money to projects that affect the bottom line. "Industry is focused on applied research that will result in the development of products with

immediate commercial application," she says. "But fundamental or basic research is needed in order to create the knowledge base that leads to more applied research. For example, in the area of medicine, specific treatments for many diseases cannot be developed until we know much more about the basic cellular and molecular changes involved in the development of the disease. Social science research has also played an extremely important role in addressing national security challenges. In a similar vein, scholarship in the humanities is critical to creating a broadly educated workforce and our ability to engage with other areas of the world."

The AAAS has the data to support Waters' concern about corporate research: 80 cents of every dollar that industry spends on R&D goes to development, and only 20 cents goes to basic and applied research, a ratio that is the polar opposite of that found in civilian science agencies.

Another argument for federal funding is the economic and cultural phenomenon known as Google, which was founded by two Stanford PhD students who were supported by a National Science Foundation (NSF) Graduate Fellowship. In 2013, in what could be called the trickle-up effect of federal funding, Google spent more than $8 billion on its own research projects, which include electric cars and balloon-distributed Wi-Fi. Another argument: the internet itself, without which there would be no Google, was developed with funds from the Department of Defense's DARPA (Defense Advanced Research Projects Agency), and the NSF, and it was based on research conducted at MIT, UCLA, and other academic laboratories.

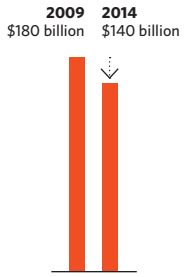
THE GOVERNMENT STEPS UP

Before World War II, government money for research was rare, and was mostly aimed at aeronautics and agriculture studies. So where did the money for basic science come from back then? As MIT historian and physicist David Kaiser wrote in *Nature*, science and technology research at American universities was historically funded by local industry, philanthropy, and universities themselves. That model leaped toward industry in 1919, when MIT created a division of industrial cooperation and research, essentially inviting corporations to pay for academic research. A decade later, according to Kaiser, more than a third of MIT faculty were working for corporate sponsors. All was good until the stock market crashed, taking with it 60 percent of the budgets for some departments. The crash also stanched the flow of funding from foundations.

ROBERT BACHRACH

Going Down

According to the American Association for the Advancement of Science, the federal government pays almost $140 billion a year for research and development, down from a 2010 peak of about $160 billion, in constant dollars. (In 2009, the American Recovery and Reinvestment Act added another $20 billion to the budget, for a total of about $180 billion for R&D.) Since the 2010 apex, cuts to discretionary spending have clipped R&D funds by 15.4 percent in inflation-adjusted spending, although nondefense R&D has declined only 4.9 percent.



Homer Alfred Neal, Tobin Smith, and Jennifer McCormick, authors of *Beyond Sputnik: US Science Policy in the 21st Century*, write that in 1931, total grants from American foundations amounted to $52.5 million. Three years later the figure was $34 million, and the devastation was lasting: as late as 1940 it was $10 million less than it had been in 1931.

In 1940, prewar concerns spurred President Franklin Delano Roosevelt to invent a new model of federal funding for science research and development—quickly. He created the National Defense Research Committee, which evolved into the Office of Scientific Research and Development (OSRD), a well-funded octopus whose projects would soon include wartime research on a variety of topics, from radar to malaria, as well as the Manhattan Project, code name for the World War II research and development project that produced the atomic bomb.

At BU, the first meaningful chunk of federal money for sponsored research, $160,000, arrived in 1946, when the Army moved an aerial reconnaissance lens-making operation from Harvard to what is now 111 Cummington Mall. The optics lab, known first as the BU Optical Laboratory and later as the BU Physical Research Laboratory, was headed by Duncan MacDonald (CAS'40, GRS'41,'44, Hon.'69). It employed more than 100 people, who developed distortion-free aerial cameras that were the eyes of U2 spy planes. In 1957, when MacDonald left BU to help found the Itek Corporation, he suggested that his new company take over the administration of the BU lab, but ethical concerns got in the way. Worried about a clash between the University's Christian pacifist tradition and classified military research, BU President Harold Case (STH'27, Hon.'67) turned down the collaboration. Itek later bought the lab, which was run for many years by BU veterans.

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In Washington, the wartime scramble to meet military needs was carved into policy when Roosevelt placed OSRD under the chairmanship of Vannevar Bush, a former MIT vice president and dean and president of the Carnegie Institute. Asked to design an apparatus that could fund science in the postwar years, Bush penned the historic report "Science: the endless frontier." He is now regarded as the architect of all government funding for university research.

In 1950, President Harry Truman created the National Science Foundation, charging it with developing a national policy for the promotion of basic research. For the next five and a half decades, the federal funding tap flowed with gradually increasing velocity, with a few marked leaps that coincided with perceived threats to the national security or economic angst. In 1957, for example, the year before the USSR launched Sputnik, the NSF budget was $40 million. In 1959, it was $134 million, and by 1968, Cold War concerns had shot it up to nearly $500 million. Other bursts attended the gas crisis of the 1970s, President Ronald Reagan's "Star Wars" Strategic Defense Initiative in 1983, a continuing concern about the health of baby boomers in the 1990s, and the 9/11 terrorist attack on the World Trade Center in 2001. (Money from that expansion helped pay for the National Emerging Infectious Diseases Laboratories on BU's Medical Campus.)

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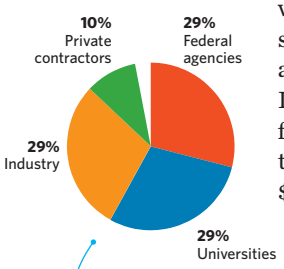
Who are the favorite children of federal funders? It depends on when you ask. From 1970 to 2012, spending in constant dollars on the social sciences remained essentially flat (and relatively minuscule), while money for the environmental sciences, other life sciences, and physical sciences increased slightly. The big winners since 1990 have been math and computer science, whose budgets have more than doubled, and engineering, which almost doubled. National Institutes of Health (NIH) biomedical science funding leaped from less than $10 billion in 1990 to about $30 billion in 2008, before dipping nearly $5 billion by last year.



Three-Way Split

According to the National Science Foundation, 29 percent of federal R&D money goes to universities, 29 percent goes to industry, and another 29 percent goes to researchers who work directly for federal agencies. About 10 percent goes to federally funded labs operated by private contractors.

ALTERNATE FUNDING: WHAT ALTERNATE FUNDING?

By 2006, the expansion of federal funding began to sputter, and the long-upward trend entered a faltering pattern of hops and dips, peaking, in constant dollars, in 2010. In July 2012, in an effort to raise BU's profile in the capital, the University opened a Washington-based Office of Federal Relations, and hired Jennifer Grodsky, who had previously been executive director of federal relations for the University of Southern California, to run it. Grodsky says the office "reads the tea leaves" about federal research priorities, to help faculty better respond to—and shape the direction of—funding opportunities.

While some fields of study do make out better than others, pain from the stalled funding has been generally distributed across disciplines and across the country, and in August 2013, BU President Robert A. Brown joined 186 leaders of other member universities of the Association of American Universities and the Association of Public and Land Grant Universities in signing a letter calling on Congress and the president to "reject unsound budget cuts and recommit to strong and sustained investments in research and education." The letter, sent jointly by the two associations, warned that without continued investment, US science and technology development could be outpaced by nations like China and Singapore.

Today, in the wake of sequestration and a great ideological divide in Congress, researchers have little reason to hope that federal spending will rise. And they don't.

"I think it will be flat or go down," says Ben Wolozin, a MED professor of pharmacology, who runs the Laboratory of Neurodegeneration. "I don't think funding will improve during my career."

Wolozin worries that the diminished funding will not affect just immediate projects, but will have a long-term impact on the number of people entering the field. And, he says, the roots of the cost-cutting sentiment extend far beyond Congress. "The average American citizen who doesn't do science believes that the NIH is not there to support scientists," he says. "They think it's there to solve problems and cure diseases, and you can argue that a competitive system is the best way to ensure that you have a good product."

Alice Cronin-Golomb, a CAS professor of psychological and brain sciences and director of the Vision and Cognition Laboratory and the Center for Clinical Biopsychology, blames the current distress on a "one-time bubble" that arose several years ago in the NIH budget. "That

brought more people into the system who were funded, but without sustaining that expansion in subsequent years." Cronin-Golomb says she is now "casting a much wider net for myself and for my graduate students.

"We are applying for funding from sources we would not have thought of before," she says. "But so far this has not been very successful—because everyone is doing it. I know many colleagues across the United States who are in the same position. I feel sorry for junior investigators who can't launch their programs, but also for senior investigators, because the senior ones not only conduct valuable research, but also train the next generation of graduate students and postdocs, providing their stipends from the research grants. Where will we be without that generation in a few years?"

Across the Charles River at Harvard, university data show a clear shift toward corporate and foundation funding. There, 75 percent of research is paid for by the government, corporate research funding has tripled, to $41 million, from 2006 to 2013, and foundation support has increased 50 percent, to $115 million. Harvard is now helping researchers set up meetings with big donors.

BU may soon follow suit. Waters and University Provost Jean Morrison are in the process of convening a task force of faculty, Waters says, "to address the questions of what our goals and mission should be with respect to collaboration with industry and what the optimal organization, structure, and staffing model for meeting these goals is." Currently, she says, "there are many different offices that deal with industry, and we are looking to see if we could be organized in ways that open up new research directions and educational and career development opportunities and establish new sources of sustainable funding."

Matt Hourihan, director of the AAAS R&D Budget and Policy Program, says the notion that corporate and foundation sponsors are waiting in the wings is a comforting one, but his association's research has found no evidence that it's true. So far, says Hourihan, the biggest increases have come from university coffers. "Industry contributions haven't increased appreciably, and I'm not sure we have a clear enough picture on the philanthropic front yet."

The experience of MED's Myers can provide an outline of that picture. As a member of the scientific advisory board of the American Parkinson Disease Association since 1995, he has been vetting grant requests to the association for many years. "These days," he says, "the number of applications is two to three times what it used to be, and the people who are applying are more senior. The number of people applying has gone up and the number of people we can fund has gone down."

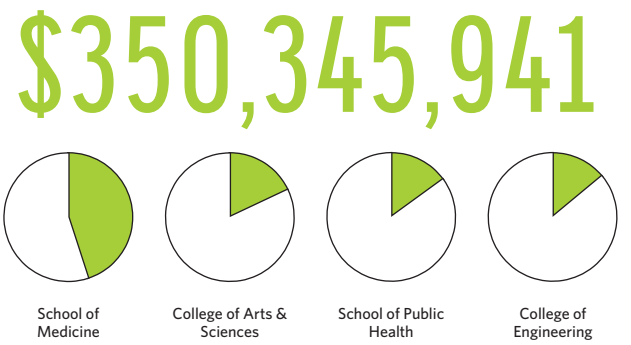
Myers' effort to fund a recent project involving proteomics and RNA sequencing led him to team up with a corporate partner, Proteostasis Therapeutics of Cambridge, Mass., and he was pleased with the outcome. "We worked on it collaboratively," Myers says. "We shared data. I think everybody is looking for a way to continue good science, and I think there is a growing appreciation that the private sector and academia could work together more than we have in the past."

That bit of good news may hearten some researchers, but the big picture is far from rosy. From his perspective in Washington, D.C., Hourihan says, he sees continued tightening of the discretionary budget and continued growth in federal entitlement programs competing for funds with research.

"Assuming that we continue with business as usual, there's very little chance we'll see any kind of significant increases in the science budget beyond the relatively modest gains of the last couple of years," he says. "If you want to increase science funding, then you've got to figure out where and how to decrease spending elsewhere, and that path gets you to tough choices very quickly." ■

Where the Money Goes at BU

In FY 2014, BU received $350,345,941 for sponsored research, with 44.6 percent of that ($156,087,093) going to the School of Medicine, a typical percentage for universities with medical schools and teaching hospitals. Other big winners were the College of Arts & Sciences, with 18 percent of the money, the School of Public Health, with 14.5 percent, and the College of Engineering, with 13.5 percent.



WEB EXTRA
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