Center for American Progress

Sequestering American Innovation

By Kwame Boadi December 9, 2013

The federal spending cuts brought on by sequestration—cuts that amount to $984 billion in indiscriminate, across-the-board federal program cuts over the next nine years—are putting our nation's long-term economic competitiveness at risk.[1] The cuts include roughly $85 billion in cuts to federal support of research and development, or R&D.[2] Sequestration is damaging numerous points along the R&D pipeline, including K-12 science, technology, engineering, and mathematics, or STEM, education; university STEM education; and the support of basic research. The federal government plays a critical role in promoting innovation through its support of R&D, but even before sequestration, the federal government's commitment to R&D investments had reached its lowest level in a decade.[3] As congressional leaders hammer out their long-term fiscal policy in the coming weeks, they must act to reverse this recent trend—and the first step must be repealing sequestration. In order to recommit to and stimulate R&D, however, the government must pursue new and greater investments.

What is the federal government's role in R&D?

Fiscal policy—particularly as it relates to the government's commitment in areas such as R&D—is inextricably linked to our nation's economic growth and global competitiveness. Economists believe that since World War II, anywhere from one-third to half of U.S. economic growth can be attributed to technological innovation, defined as the development and introduction of new tools, ideas, and processes that enhance productive capacity.[4] Much of this innovation is the product of basic research, which—in contrast to applied research—generally does not have immediately observable applications. It is this sort of basic research that has helped pave the way for groundbreaking economic developments such as the Internet, which began as a Defense Department-funded project, and the Human Genome Project—a joint project of the Department of Energy and the National Institutes of Health that has already generated economic output far in excess of the money devoted to it.[5]

In fiscal year 2013, the federal government invested approximately $124 billion in promoting R&D.[6] Fifty-two percent of this funding went toward defense R&D, which includes basic and applied research in areas such as satellite technology and advanced weaponry. The remaining 48 percent of federal R&D money went toward nondefense R&D. Nondefense R&D investment is comprised largely of funding for the National Institutes of Health, or NIH, which received 50 percent of all federal nondefense R&D money. The bulk of the remaining federal nondefense R&D money went to the Department of Energy, or DOE; the National Aeronautics and Space Administration, or NASA; and the National Science Foundation, or NSF.

Most federal R&D funding actually supports research conducted in universities and colleges, private industry, and nonprofit organizations, often through the awarding of research grants from agencies such as the NIH. Roughly one-third of federal research dollars goes to universities and colleges, one-third goes to private industry, and the remaining third is spent between the federal government and nonprofit organizations.[7]

Although it has declined as a share of gross domestic product, or GDP, U.S. R&D spending—including all public and private funding sources—has increased significantly over the past several decades. This increase, however, has come about largely as a result of dramatic increases in private-industry R&D spending. According to data from the NSF, in 1953, private industry funded 44 percent of R&D in the United States, compared to the federal government's 54 percent.[8] By 2010, private industry's share of R&D financing had increased to 61 percent, compared to the federal government's 31 percent.[9] Higher-education institutions and nonprofit organizations made up the bulk of the remaining R&D funding.

Many significant scientific discoveries and the resulting economic growth begin as mere kernels of thought from basic research—research that takes several years, if not decades to complete. Because the applied, or commercial, uses of such research may not become evident for a long time, no other entity in the United States is as well placed as the federal government to assume the short-term risks and uncertainty inherent in basic research over the long run. Although the federal government is no longer the largest supporter of R&D in terms of absolute expenditure, the nature of its investment in R&D remains critical to the overall national R&D ecosystem. In 2010, the federal government continued to provide the majority—53 percent—of the funding for basic research.[10] By comparison, private industry provided less than one-quarter of basic-research funding, while higher-education institutions and nonprofit organizations made up almost all of the remainder.

Private companies lack sufficient incentives to invest heavily in basic research because the standard profit motivation for investment is undermined by two important risks: the higher probability that a basic-research project will fail and the risk that even if a project is successful, the conceptual knowledge gleaned from it would be a useful input for the production of a variety of innovative products without compensation for the initial research. Thus, while industry's overall expenditure on R&D has increased dramatically, the percentage of that expenditure for basic research remained almost identical from 1953 to 2010, at roughly 7 percent.[11] The federal government, on the other hand, increased the percentage of its R&D budget for basic research from 10 percent to almost 33 percent over the same period.[12] Universities and colleges, which perform a majority of basic research in the United States, rely heavily upon support from the federal government for this task. In 2010, the federal government provided 60 percent of the R&D funding to higher-education institutions, while the institutions themselves provided 20 percent of their own funding.[13] The remaining 20 percent of the funding was split between industry, state and local governments, and nonprofit organizations.[14]

Historical pattern of federal R&D expenditure

For the past several decades, federal spending on R&D has increased steadily. From 1977 to 2010, federal R&D spending, adjusted for inflation, increased by an average annual rate of 2.9 percent per year.[15] Both defense R&D and nondefense R&D increased at roughly the same 2.9 percent annual rate, but much of the increase in defense R&D spending occurred in the 1980s and 2000s—two periods of significant military buildups, owing to the Cold War and the wars in Iraq and Afghanistan.

Although federal investment in R&D has increased historically in real terms, it has not kept pace with overall economic growth. As a percentage of GDP, annual federal spending on R&D averaged 0.97 percent of GDP from 1977 to 2010.[16] This figure increased greatly during the last throes of the Cold War in the 1980s, with R&D's share of GDP peaking at 1.19 percent in 1987. As the economy boomed during the 1990s, R&D spending as a percentage of GDP receded, reaching a low in 2000 of a little less than 0.78 percent.

According to data from the NSF, nonfederally funded research has increased considerably as a share of GDP, from 0.63 percent in 1953 to 1.93 percent in 2010, just below the all-time high of 2.02 percent in 2000.[17] In 2010, private-industry R&D financed 89 percent of nonfederally funded R&D, with universities and colleges, state and local governments, and nonprofit organizations making up the rest.[18]

Recent pattern of federal R&D expenditure

With the notable exception of the 2009 stimulus spending, federal funding for R&D has either remained stagnant or decreased during the past decade. Beginning around 2005, federal R&D spending began stagnating, and annual R&D spending growth was almost nonexistent from 2005 to 2008. Adjusted for inflation, federal R&D spending only increased by 0.7 percent annually between 2005 and 2008.[19] The federal government should have been increasing investments in R&D over the past three years in response, to make up for the lost time and opportunity of the preceding decade.

Instead, beginning in FY 2011, Congress began taking action to cut spending in the name of deficit reduction. This deficit reduction came primarily by way of the spending reductions in the 2011 Budget Control Act, or BCA. In addition to the BCA, reduced appropriation levels in the FY 2011 budget, the fiscal cliff deal reached on January 1, 2013, and the slowing growth in health care costs have contributed to a dramatic improvement in the long-term budget outlook. But many of these policies have come at a significant economic cost, as the economic growth the country has experienced since 2010 has not kept pace with projections from that time. A recent Center for American Progress analysis estimates that if the federal government had not adopted austerity policies, the U.S. economy would currently be growing at an average rate of 3.3 percent per year, as opposed to the 1.9 percent growth experienced since 2010.[20] Such a growth rate would have resulted in 2.5 million additional new jobs since January 2011.[21]

The yearly decrease in discretionary spending has had a significant negative impact on federal R&D investment. As a percentage of the overall economy, federal R&D spending decreased dramatically, from 0.99 percent in 2010 to 0.77 percent in 2013.[22] In fact, according to an analysis by the American Association for the Advancement of Science, even after setting aside the 2009 stimulus spending, federal R&D funding decreased by almost 7 percent from 2009 to 2012.[23]

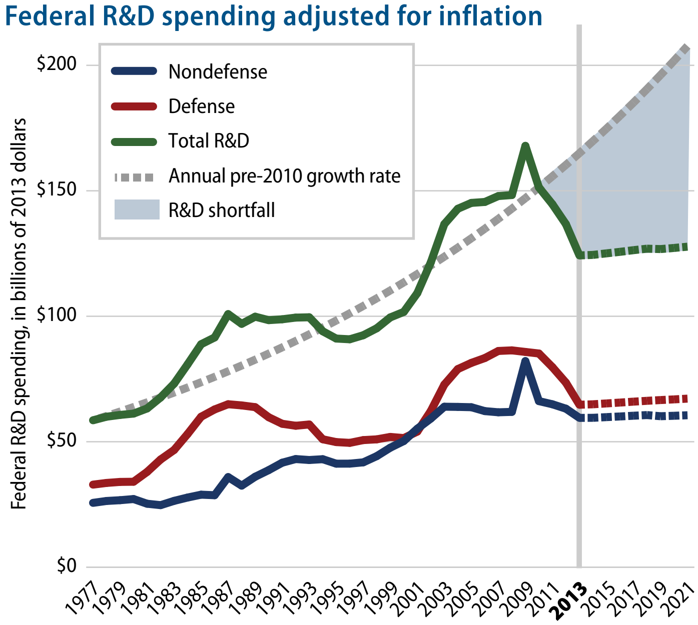
What is sequestration doing, and what will it do in the future?

Left unchecked, sequestration will greatly exacerbate the recent trend of decreasing federal R&D spending. On top of the recent pattern of underfunding R&D, sequestration further reduced R&D spending by roughly $9.7 billion in 2013.[24] If sequestration were to remain in place, federal R&D spending would be cut by $85 billion through FY 2021.[25] As a percentage of GDP, federally funded R&D would fall to 0.62 percent in FY 2021, the lowest level on record.[26] Under this scenario, through FY 2021 R&D funding for the NIH would be cut by approximately $20 billion, for the DOE by approximately $3 billion, for NASA by approximately $11 billion, and for the NSF by approximately $5 billion.

In addition to direct funding for R&D, sequestration is also reducing our ability to prepare the next generation of scientists and researchers for careers in R&D. Among other things, sequestration is reducing funding to the Department of Education by almost $2.5 billion in FY 2013.[27] According to a Senate Committee report from 2012, State Grants

FIGURE 1

Federal R&D spending adjusted for inflation

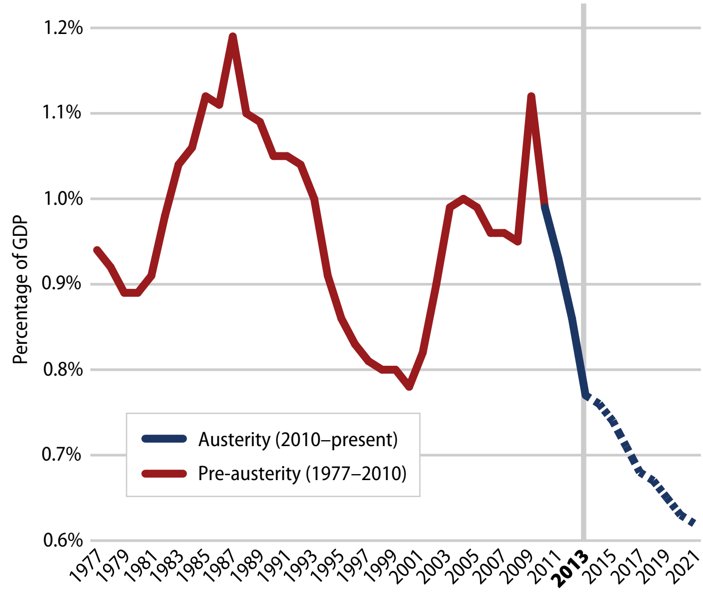


Source: See endnote 6.

for Career and Technical Education, which "[prepare] students for employment in high-demand fields such as healthcare, renewable energy, science, technology, engineering, and mathematics," was slated to be cut by about $56 million in FY 2013, resulting in about 700,000 fewer students served.[28] Additionally, Department of Education cuts reduced the Federal Work-Study Program by $51 million in FY 2013.[29] At the university level, sequestration reduced spending on the Federal Work-Study Program hundreds of thousands of students use to help pay for college by $51 million this year alone.[30] And even though Pell Grants—which provide funding to low-income undergraduates—were spared from cuts during the first year of sequestration, it is unclear if the program will be spared beyond the 2013-14 school year.[31]

FIGURE 2

Federal R&D spending as a share of GDP



Source: See endnote 6.

While the short-term effects of sequestration are real and significant, the most insidious and enduring effects will be felt over time because scientific discovery is cumulative. Just as R&D investments today will pay off down the road, missed opportunities in R&D support will be negatively magnified in the long run. According to Steven Warren, vice chancellor for research at the University of Kansas, "[Sequestration] is like a slow growing cancer."[32] Like a slow-growing cancer, the long-term consequences of sequestration, particularly in the area of federal investment in R&D, may not become readily apparent until their effects are too difficult to reverse. This means that simply restoring the $9.7 billion in R&D cuts in FY 2013 is not sufficient to put R&D back on the right track in FY 2014 and in subsequent years. Additional funding, over and above the amounts that have been cut, must be put toward R&D to make up for the time lost in FY 2013 and previous years.

For the sake of comparison, if in 2010 the federal government had simply allowed R&D spending to continue to grow at the same rate that it has historically, then in FY 2013, the federal government would have spent $165 billion on R&D, $41 billion more than was spent in FY 2013 under sequestration.[33] By the end of sequestration in FY 2021, the federal government would be spending $128 billion in R&D, a full $80 billion less than what it would have spent under its historical growth rate.[34]

Because the value of R&D capital depreciates over time, without continual replenishment of R&D investment, future innovative capacity decreases.[35] Hence, the concern among researchers across the country is that sequestration will create a "generational gap," according to Elias Zerhouni, former director of the National Institutes of Health.[36] Moreover, the lack of consistent federal support for R&D could lead future science and technology graduates—including those who come from abroad to obtain a university education—to take their talents elsewhere, to countries that display more of a commitment to scientific innovation. Almost one in five respondents to a recent American Society for Biochemistry and Molecular Biology survey indicated that they are considering moving their research abroad.[37]

Conclusion

Due to the technological innovation that it produces, scientific R&D is one of the main engines powering future economic growth. Although the federal government has supported innovation by investing an increasing amount of money in R&D over time, this investment has not kept pace with overall economic growth in recent years. Fiscal austerity policies that began in 2010 have negatively impacted the federal government's commitment to R&D, and sequestration is making an already dire situation worse. These policies have not only reduced our current scientific output but have also set the stage for weaker economic growth in the future. Given the federal government's singular role in supporting basic research, particularly the research conducted at American colleges and universities, it is critical that Congress reaffirm its commitment to scientific discovery by repealing sequestration and supporting new investments in R&D.

Kwame Boadi is a Policy Analyst at the Center for American Progress.

Endnotes

1 Office of Management and Budget, *OMB Report to the Congress on the Joint Committee Sequestration for Fiscal Year 2013* (Executive Office of the President, 2013), p. 3, Table 1.

2 Author's calculation is based on budget totals, including federal budget authority classified as subfunctions 251 (General Science and Basic Research); 252 (Space and Research Technology); 552 (Health Research and Training); and the "Research, Development, Test, and Evaluation" accounts within subfunction 051 (Department of Defense). R&D figures do not include funding for subfunction 053 (Atomic Energy Defense Activities), due to the inability to isolate R&D-specific funding at the account level for the Department of Energy's defense-related activities. Historical data for FY 1977 through FY 2012 come from the Office of Management and Budget. Projections for FY 2013 through FY 2021 are based on data from the Congressional Budget Office. Cut figures are derived by comparing an estimate of what the federal government would spend on R&D during sequestration against what the federal government would spend on R&D if it had maintained the FY 2012 presequestration spending levels for R&D through FY 2021.

3 American Association for the Advancement of Science, "Defense, Nondefense, and Total R&D, 1976–2014," available at http://www.aaas.org/spp/rd/guihist.shtml (last accessed November 2013).

4 Gordon Reikard, "Stimulating Economic Growth Through Technological Advance," AMSTATNEWS, March 1, 2011, available at http://magazine.amstat.org/blog/2011/03/01/econ-growthmar11/; Robert M. Solow, "Technical Change and the Aggregate Production Function," *The Review of Economics and Statistics* 39 (3) (1957): 312–320.

5 Gautam Naik, "Report Touts Economic Impact of Gene Project," *The Wall Street Journal*, May 11, 2011, available at http://online.wsj.com/article/SB10001424052748704681904576315253143162630.html.

6 Author's calculation is based on budget totals, including federal budget authority classified as subfunctions 251 (General Science and Basic Research); 252 (Space and Research Technology); 552 (Health Research and Training); and the "Research, Development, Test, and Evaluation" accounts within subfunction 051 (Department of Defense). R&D figures do not include funding for subfunction 053 (Atomic Energy Defense Activities), due to the inability to isolate R&D-specific funding at the account level for the Department of Energy's defense-related activities. Historical data for FY 1977 through FY 2012 come from the Office of Management and Budget. Projections for FY 2013 through FY 2021 are based on data from the Congressional Budget Office.

7 National Science Foundation, "National Patterns of R&D Resources: 2010–11 Data Update," available at http://www.nsf.gov/statistics/nsf13318/content.cfm?pub_id=4268&id=2#tab11 (last accessed November 2013).

8 Ibid.

9 Ibid.

10 Ibid.

11 Ibid.

12 Ibid.

13 Ibid.

14 Ibid.

15 See endnote 7.

16 Ibid.

17 National Science Foundation, "National Patterns of R&D Resources: 2010–11 Data Update."

18 Ibid.

19 See endnote 7.

20 Adam Hersh, "In a World Without Austerity…", Center for American Progress, October 4, 2013, available at http://www.americanprogress.org/issues/economy/news/2013/10/04/76305/in-a-world-without-austerity/.

21 Ibid.

22 See endnote 7.

23 American Association for the Advancement of Science, "R&D Budget and Policy Program," available at http://www.aaas.org/spp/rd/guihist.shtml (last accessed December 2013).

24 See endnote 7.

25 Ibid.

26 Ibid.

27 U.S. Department of Education, *Fiscal Year 2014 Budget Summary and Background Information* (U.S. Department of Education, 2013), Appendix 1.

28 Sen. Tom Harkin, "Under Threat: Sequestration's Impact on Nondefense Jobs and Services" (Washington: Senate Appropriations Subcommittee on Labor, Health and Human Services, Education, and Related Agencies, 2012), p. 61, available at http://www.harkin.senate.gov/documents/pdf/500ff3554f9ba.pdf. These figures represent an updated estimation of the committee's original figures. The committee's calculations were based on a sequester cut of 7.8 percent, but the American Taxpayer Relief Act reduced the FY 2013 sequester of nondefense programs to about 5 percent. Since the final sequester cut was approximately 64 percent of the committee's original estimate, the figures in this report are 64 percent of the figures calculated by the committee.

29 Kwame Boadi, "Sequestration Nation: Making College Less Accessible for Our Students," Center for American Progress, June 10, 2013, available at http://www.americanprogress.org/issues/economy/news/2013/06/10/65806/making-college-less-accessible-for-our-students/.

30 Ibid.

31 Federal Student Aid, "FY 2014 Sequestration Changes to the Title IV Student Aid Programs (Updated October 25, 2013), available at http://ifap.ed.gov/dpcletters/GEN1322.html (last accessed December 2013).

32 Sam Stein, "Sequestration Cuts to Research 'Like a Slowly Growing Cancer'," HuffPost Politics, July 10, 2013, available at http://www.huffingtonpost.com/2013/07/10/sequestration-cuts-research_n_3576030.html.

33 See endnote 7.

34 Ibid.

35 Justin Hicks and Robert Atkinson, "Eroding Our Foundation: Sequestration, R&D, Innovation and U.S. Economic Growth" (Washington: The Information Technology and Innovation Foundation, 2012); Ning Huang and Erwin Diewert, "Estimation of R&D Depreciation Rates: A Suggested Methodology and Preliminary Application" (Vancouver, BC: University of British Columbia Department of Economics, 2009).

36 Sarah Bacon, "Medical Research Cuts Have Immediate Health Effects," *The Atlantic*, April 17, 2013, available at http://www.theatlantic.com/health/archive/2013/04/medical-research-cuts-have-immediate-health-effects/275045/.

37 The American Society for Biochemistry and Molecular Biology, "Nondefense Discretionary Science 2013 Survey: Unlimited Potential, Vanishing Opportunity" (2013).