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# The High Return on Investment for Publicly Funded Research

Sean Pool and Jennifer Erickson December 10, 2012

Investing in innovation pays off.

The World Economic Forum, an international nongovernmental organization that assesses global business and socioeconomic policy, classified the United States in the 21st century as an "innovation-driven economy."[1] This means that the creation of new wealth depends not just on traditional inputs like natural resources, land, or labor—or on increasing the efficiency of existing capabilities. Rather, new wealth in an innovation-driven economy requires the discovery and development of new ideas to solve old problems; the seizing of new opportunities with technology and ingenuity.

But the importance of innovation is not measured simply in new inventions. Innovation also requires dissemination through market adoption and public acceptance. While the private sector has a key role to play in making innovation happen, government must provide three key public-good inputs that allow innovation to blossom: investments in human capital, infrastructure, and research.

January will bring deep budget cuts to all three of these critical innovation investments if President Barack Obama and Washington lawmakers don't avert the automatic spending cuts in the so-called fiscal showdown debate over how to reduce the deficit.

To be sure, deficit reduction is an important national priority, but as President Obama said in 2011, "Cutting the deficit by gutting our investments in innovation and education is like lightening an overloaded airplane by removing its engine. It may make you feel like you're flying high at first, but it won't take long before you feel the impact."[2]

The Center for American Progress has previously highlighted how investments in all three areas are critical to our competitiveness.[3] Today we'll take a closer look at one of these key innovation ingredients: research.

## Government research provides a high return on investment

To continue leading the world in innovation and welcoming the businesses and industries of the future, the United States must continue its long history of robust investments in research and development in the increasingly interconnected fields of physical sciences, computational sciences, life sciences, social sciences, and engineering.

The value of these investments is borne out by history. According to economists Charles Jones and John Williams of Stanford University, the National Bureau of Economic Research, and the Federal Reserve Bank of San Francisco, the return on investment for publicly funded scientific research and development is somewhere between 30 percent and 100 percent, or more.[4]

Consider just a few of the breakthrough innovations that have stemmed from government investments in research:

- **Department of Energy labs: 1943–present.** Founded in 1943 to address the need to mobilize our nation's scientific assets to support the war effort—including the Manhattan Project and development of radar—and then afterward to consolidate and repurpose our national investments in military research.

  **What we invested:** A few million dollars in the early 1940s, growing to about $5 billion, or 0.03 percent of GDP, in 2012.[5] (Note: The Department of Energy labs also receive funding from other government agencies outside the department, bringing the total spending of the system closer to $10 billion.)

  **What we got:** The optical digital recording technology behind all music, video, and data storage; fluorescent lights; communications and observation satellites; advanced batteries now used in electric cars; modern water-purification techniques that make drinking water safe for millions; supercomputers used by government, industry, and consumers every day; more resilient passenger jets; better cancer therapies; and the confirmation that it was an asteroid that killed the dinosaurs 65 million years ago.[6]

- **National Science Foundation: 1950–present.** Championed by Sen. Harley Kilgore of West Virginia, a New Deal politician and small-business man with a deep distrust of the laissez-faire attitude toward science and of large monopolies that at the time controlled much of the country's scientific enterprise. In response to these issues, the National Science Foundation was founded "to promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense."[7]

  **What we invested:** Just $3.5 million for its first full year of operation in 1952 (roughly $29 million in 2012 dollars), growing to $7 billion, or 0.05 percent of GDP, in 2012.[8]

**What we got:** Google, which was started by a couple of students working on a research project supported by the National Science Foundation, is today worth an estimated $250 billion and employs 54,000 people.[9] This alone would pay for nearly all the program's costs reaching back to its inception, but funding has also been instrumental in the development of new technologies and companies in nearly every major industry, including advanced electronics, computing, digital communications, environmental resource management, lasers, advanced manufacturing, clean energy, nanotechnology, biotechnology, and higher education.[10]

- **Defense Advanced Research Projects Agency, or DARPA: 1958–present.** Founded in response to the launch of Sputnik to ensure the United States had cutting-edge military technology, the Defense Advanced Research Projects Agency now operates as a small R&D team within the Department of Defense, delivering world-leading technology both on the battlefield (think stealth fighter jets) and off (think the Internet). Describing itself today as "one hundred geniuses connected by a travel agent,"[11] the agency continues to work with universities and teams across the country to push scientific boundaries, working on projects like a human exoskeleton and mobile robots capable of performing medical operations.

  **What we invested:** $246 million in the first appropriation in 1962.[12] In 2011 dollars: $1.6 billion. Investment has continued, reaching nearly $3 billion, or 0.02 percent of GDP, in 2012.[13]

  **What we got:** The team that would go on to pioneer technologies that brought us the Internet, the Global Positioning System,[14] and Siri.[15]

- **The Apollo Space Program: 1961–1969.** Two months after the Soviet Union put the first man in orbit, President John F. Kennedy announced the Apollo Space Program to a joint session of Congress, telling the nation, "No single space project in this period will be more impressive to mankind, or more important in the long-range exploration of space; and none will be so difficult or expensive to accomplish."[16] He was right. In fixing a national ambition and rallying resources behind it, the United States went from never having put a man in orbit to landing a team on the moon in less than a decade. At the height of Apollo's efforts, it employed 400,000 Americans and worked with 20,000 partnering institutions.[17]

  **What we invested:** $24 billion. In 2011 dollars: $150 billion.[18]

  **What we got:** Massive technological advancement and the start of huge opportunities for technology transfer, leading to more than 1,500 successful spinoffs related to areas as disparate as heart monitors, solar panels, and cordless innovation.[19] More recently, we've seen a fledgling private-sector American space industry with real growth potential, which in 2012 completed its first cargo delivery to the international space station.[20]

- **Human Genome Project: 1988–2003.** Started as a joint project between the Department of Energy and the National Institutes of Health, the Human Genome Project ultimately helped coordinate the work of scientists in countries around the world to map the human genome. In a joint telecast in 2000, President Bill Clinton and U.K. Prime Minister Tony Blair announced the first phase was complete, with a public working draft of the "genetic blueprint for human beings," ushering in a new era of medical and scientific advancement.[21]

  **What we invested:** $3.6 billion, or approximately 0.005 percent of GDP spread out over 15 years.[22] In 2011 dollars: roughly $5.7 billion in total.

  **What we got:** Critical tools to help identify, treat, and prevent causes of disease—and huge opportunities for the high-growth American biotechnology industry, which accounts for more than three-quarters of $1 trillion in economic output, or 5.4 percent of GDP, in 2010, and now depends heavily on these advances in genetics.[23]

## The future of federally funded research

While we have seen huge and tangible results from our research investments in the past, we are not making the level of investments we need to cultivate innovation in the 21st century. Our national investments in research and development as a percentage of discretionary public spending have fallen from a 17 percent high at the height of the space race in 1962 to about 9 percent today, reflecting a shift in priorities of our government.[24] The biggest decline has taken place in civilian research and development, which has dropped significantly as a proportion of both GDP and federal spending.

To make matters worse, the automatic budget cuts set to take effect January 1, 2012, would reduce research and development budgets by 8.4 percent on average. And independent analysis by the Aerospace Industries Association predicted that these cuts would put 31,000 physical, life, and social scientists across the country out of work, and reduce the success rate of science research grant applications at the National Science Foundation and National Institutes of Health from an average of about one-in-five to one-in-six.[25]

To ensure that the United States remains a leader in the 21st-century innovation economy, we need to double down on our investments in technology, the enabler of long-term efficiency gains and economic growth, and also change the way we think about the converging fields of science, technology, and business. Specifically, we must:

- Avert severe cuts to U.S. science research that would take effect under sequestration, and put key science agencies—such as the National Science Foundation, the Energy Department's Office of Science, and the National Institute of Standards and Technology—on a path that will see their budgets double by the end of the decade or sooner, like we did for the National Institutes of Health in the past decade

- Think more holistically about our national innovation ecosystem by taking steps to help universities and national laboratories—the two biggest performers of federally funded research—and engage with industry to help get good ideas out of the lab and into the market faster

- Reform our government systems to streamline the grant-making processes for technology, engineering, small business, and community- and region-based economic and workforce-development programs that support clusters of innovation and talent across the country

## Conclusion

At a time when economic success in the global market is determined more than ever by the pace of innovation, we cannot afford to reduce our investments in research. As the president said in his State of the Union speech last year, "In America, innovation doesn't just change our lives, it's how we make our living."[26] While innovation may be in our national DNA, we can't take it for granted.

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## Endnotes


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