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Five Free-Market Myths About Increasing Federal Research Funding

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When it comes to federal investment in science, the free-marketers' argument that the private sector can and will do most of the heavy lifting and that government can let federal support for R&D stagnate or even shrink is mistaken.

KEY TAKEAWAYS

- Members of Congress should be skeptical of free-market arguments that the federal government does not need to increase funding for research and development (R&D).
- Rather than displace private research funding, federal support for basic and applied research "crowds in" industry funding, because industry is able to build on the knowledge discoveries from publicly supported research.
- Because of externalities and other market failures, the private sector does not invest enough in R&D to maximize total economic welfare. Additional federal support is needed.
- While some federally funded research (such as the study of black holes) has little effect on productivity, most areas of federal research boost productivity.
- It is not the absolute amount of federally funded research that matters, it is funding as a share of GDP; and federal funding by that measure is falling.
- Federal funding on research creates jobs: An additional one-time $20 billion investment in research would create approximately 400,000 U.S. jobs for one year.

INTRODUCTION

Given the importance of innovation and advanced technology competitiveness to the U.S. economy, it is heartening to see recent congressional proposals, such as the Endless Frontier Act, that propose significantly increased federal funding for research and development (R&D) targeted at key national priorities. However, in considering budget proposals for significantly increased federal support, Congress will be confronted with an array of conflicting information; some of it wrong, much of it misleading.

In particular, conservatives committed to limited government have made a number of inaccurate claims about the impact of federal funding for scientific and engineering research. What is perhaps most surprising is that these statements are almost always offered as doctrine, and not backed up by scholarly evidence, perhaps because the scholarly evidence on the issue directly contradicts their claims.

To help clarify some of these claims, this report identifies and responds to five of the most common. The bottom line is it is clearly in the national interest for Congress to appropriate significantly more funding for scientific and engineering research.

MYTH 1: FEDERAL R&D "CROWDS OUT" PRIVATE R&D

Because of abiding faith in "free markets" and a commitment to limited government, many conservatives oppose increases in federal funding of science and engineering research. To justify their argument, many make the claim that this is not additive; that it simply crowds out private sector R&D funding, and we are left with the same amount of R&D as before. The Heritage Foundation has stated, "By attempting to force government-developed technologies into the market, the government diminishes the role of the entrepreneur and crowds out private-sector investment."[1]

In fact, the opposite is true: Federal support for basic and applied research is a complement to private research, because industry is able to build on the knowledge discoveries from publicly supported research, making their own research more productive and effective. These research results provide firms—large and small—with a common platform of basic knowledge, making their own research more productive and effective. In addition, government support for a promising line of research helps convince firms to boost their own efforts in these areas.

After reviewing over 60 academic articles on whether public sector R&D crowds out private sector investments, Cockburn and Henderson concluded:

> There are a number of econometric studies that, while imperfect and undoubtedly subject to improvement and revision, between them make a quite convincing case for a high rate of return to public science in this [life-sciences] industry. It is worth noting that there are, so far as we are aware, no systematic quantitative studies that have found a negative impact of public science.[2]

A working paper from the World Bank combs through recent evidence on government funding for R&D, and finds that government funding significantly increases R&D investment.[3] Although there is a large variation in the type of R&D funding examined, the study's methodologies, and the location of the studies, the results are clear: Government funding boosts R&D spending. The

paper tackles another important question as well: whether government spending "crowds out" private sector spending. The paper finds evidence of the opposite, however, with data that shows public funding actually incentivizes firms to invest more in R&D.[4]

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Another study finds that for every additional dollar of publicly funded research added to the stock of government R&D, it induces an additional 27 cents of private R&D investment. For the life sciences industry, Ehrlich found that a dollar of National Institutes of Health (NIH) support for research leads to an increase in private medical research of even greater levels, roughly 32 cents.[5] An Organization for Economic Cooperation and Development (OECD) study finds that "direct government funding of R&D performed by firms (either grants or procurement) has a positive effect on business financed R&D (one dollar given to firms results in 1.70 dollars of research on average)." Most other studies of the issue find similar results, with the effect differing from around 10 cents to 30 cents of additional R&D for every dollar of government funding for university or government laboratory research.

It is important to note that some of these studies show examinations of a period when federal R&D was more than double what it is today as a share of gross domestic product (GDP). And even then, federal funding crowded in private sector R&D investment. As such, the idea that the increases being proposed today in bills such as the Endless Frontier Act would crowd out private funding makes little sense.

MYTH 2: PRIVATE FIRMS HAVE ENOUGH INCENTIVES TO INVEST IN R&D

It is all well and good to support federal R&D, but many market fundamentalists argue that firms already have strong incentives to fund R&D. They therefore argue that increases in R&D, particularly to key technology areas related to U.S. industrial competitiveness, are not needed. Heritage Analyst Katie Tubb stated, "I would question why is it the role of the federal government to be funding science across the board. The private sector plays a huge role in supporting science."[6]

The question is not whether the private sector has incentives to invest in R&D; it clearly does. The question is whether those incentives are sufficient to maximize total economic welfare—and the answer to that is unequivocally no.

Economists have long attempted to measure the extent of spillovers from business R&D. As noted economist Zvi Griliches wrote:

> There has been a significant number of reasonably well-done studies all pointing in the same direction: R&D spillovers are present, their magnitude may be quite large, and social rates of return remain significantly above private rates.... The estimated social rates of return look, actually, surprisingly uniform in their indication of the importance of such spillovers.[7]

A 1998 study by Jones and Williams shows the social rate of return from R&D and concludes that the optimal level was at least two to four times actual investment.[8] The fact that some economists estimate a 7 percent private return and 30 percent social rate of return on R&D suggests the optimal level of R&D investment in the U.S. economy is three to four times larger than the total current level of private investment.[9] The overall social return from investment in information technology generally is over 80 percent.[10] When companies do basic research, the spillovers are even greater—as high as 150 percent.[11]

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Okubo and colleagues examined many different studies and concludes that the private return is 26 percent and the social return 66 percent.[12] Most recently, Bloom and Van Reenen examined the change in the rate of R&D spillovers; in other words the differential rate between private and social returns from R&D. The authors found that spillovers actually increased over the last 40 years, with the ratio of social to private returns increasing from a factor of three to four. As they wrote, "There is certainly no evidence that the need to subsidize R&D has diminished."[13] This underinvestment means, absent policies to raise the after-tax rate of private return from R&D closer to the rate of the public return (either through R&D tax incentives, direct funding of business R&D, or even support for government and university research that businesses can use), economic growth will be reduced, and the new innovations that will improve our lives will come about more slowly.

Economists Benjamin Jones and Lawrence Summers estimated that every dollar invested in innovation returns four dollars in social benefits. But these social returns compound as much as 2,000 percent (or $20 for every dollar invested) when considering health benefits, international spillovers, and if new firm creation drives the bulk of productivity gains that result from new ideas.[14] Another study uses firm-level data for Canadian businesses between 2000 and 2012 to estimate the economic impact of these positive spillovers, finding that they amount to an additional 33 percent return on investment in R&D, on average. This windfall for society comes above and beyond the profits firms themselves make from their innovations.[15]

MYTH 3: FEDERAL R&D DOESN'T BOOST PRODUCTIVITY GROWTH

Some free-market fundamentalists have dismissed the role of federal research spending, arguing that it has minimal impact on productivity. For example, in a *Wall Street Journal* op-ed titled "The Myth of Basic Science," Matt Ridley cited a U.S. Bureau of Labor Statistics (BLS) article as proof the return on investment from publicly financed R&D is near zero.[16] He wrote:

> In 2007, the economist Leo Sveikauskas of the U.S. Bureau of Labor Statistics concluded that returns from many forms of publicly financed R&D are near zero and that many elements of university and government research have very low returns, overwhelmingly contribute to economic growth only indirectly, if at all.

But what the BLS article is actually measuring is the impact of that R&D on the productivity of government agencies, which is in fact low.[17] After all, when NIH funds research to treat diabetes or cancer, the results do very little to make NIH workers more productive.

In fact, the BLS article concludes that "many advances arising from university or government research eventually have an important indirect effect on growth," and that "programs, especially those in which university scientists compete for grants, such as the National Science Foundation, the National Institutes of Health, some Department of Agriculture programs, and DARPA [Defense Advanced Research Projects Agency] in the Department of Defense, appear to have a remarkable record."[18]

Ridley also misled when he cited an OECD study on the sources of growth among its member countries in the 1970s, 1980s, and 1990s as evidence that "whereas privately funded research and development stimulated economic growth, publicly funded research had no economic impact whatsoever. None. This earthshaking result has never been challenged or debunked."[19]

Yet, the OECD study Ridley cites immediately qualifies that finding with: "[T]here are important interactions between public and private R&D activities as well as difficult-to-measure benefits from public R&D (e.g. defence, energy, health and university research) from the generation of basic knowledge that provides technology spillovers in the long run." Moreover, later, more comprehensive OECD studies find government-funded research does have a major effect on innovation and growth.[20]

Some federal R&D, such as the study of black holes, likely has little effect on productivity. But the real question is whether most areas of federal R&D expenditures have significant impacts on productivity, and the evidence clearly suggest the answer is yes.

This is not surprising, because virtually every scholarly study examining the issue finds the same thing. For example, Griliches concluded that federal R&D in industry has a positive effect on productivity, though less of an impact than privately financed research.[21] Likewise, Guellec and van Pottelsberghe de la Potterie found that government research expenditures, in addition to private R&D, contribute to the rate of economic growth.[22] Another study of the U.K. economy finds evidence of spillovers of private R&D and public R&D, with an estimated rate of return to public R&D of 20 percent.[23] Similarly, to compensate for this, the study examines the number of researchers in the public and private sectors between 1981 and 2017 across 20 OECD countries, finding that a doubling of private researchers increases productivity growth by 4.3 to 7.2 percent, while doubling public researchers increases productivity growth by 6.1 to 20.6 percent. Similarly, economist Dierk Herzer examined the number of researchers in the public and private sectors between 1981 and 2017 across 20 OECD countries, finding that a doubling of private researchers increases productivity growth by 4.3 to 7.2 percent, while doubling public researchers increases productivity growth by 6.1 to 20.6 percent.[24]

To be clear, some federal R&D, such as the study of black holes, likely has little effect on productivity. But the real question is whether most areas of federal R&D expenditures have significant impacts on productivity, and the evidence clearly suggest the answer is yes.

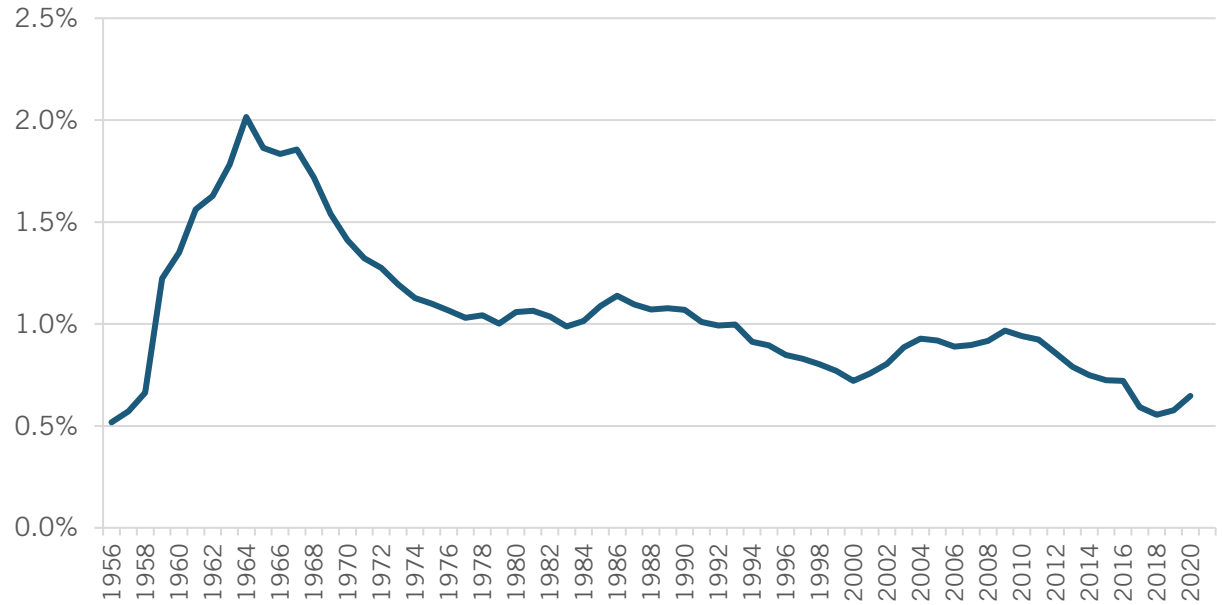
MYTH 4: FEDERAL R&D LEVELS ARE WHAT MATTERS, R&D SHARE OF GDP

Some have argued that the fact that federal R&D as a share of GDP has fallen is irrelevant and that all that matters is absolute amount. If the absolute funding levels have not fallen, all must be well.

Let's start with the data. The federal government spends approximately $125 billion per year in R&D for everything from agriculture to human health, national defense, manufacturing, and energy. Unfortunately, despite a modest uptick in the nominal value of federal support for R&D, the overall trend is a decline.

This is true in constant dollar spending. When controlling for inflation, according to the National Science Foundation the federal government spent 15 percent less on R&D in 2017 as it did in 2010.[25] As a share of GDP, the decline is much steeper. Indeed, in 22 of the 28 years from 1990 to 2018, federal R&D spending made up a smaller share of GDP than the year before, sinking to just 0.61 percent of GDP in 2018, the lowest level since 1955, according to the latest data from the National Science Foundation.

Figure 1: Federal R&D as a share of GDP



To understand just how far off the pace recent federal funding for research has been, figure 1 shows the recent fiscal year's funding levels would need to increase to match prior year R&D-to-GDP levels. To match levels of the 1980s, for example, funding today would need to increase by about 80 percent, or $100 billion per year.

There are two problems with the view that the United States doesn't need federal funding for research to stay at least constant with GDP growth. First, America is competing with China, which, as its economy grows, is funding vastly more R&D than three decades ago. The United States is in a commercial and military race with China, and that race is not about what it does relative to its past, but to China's present and future. Second, as Nick Bloom and colleagues have shown, the global productivity of R&D has fallen, in large part because the technical problems today are much more difficult than the ones half a century ago.[26] To take DARPA as an

example, its funding as a share of GDP has fallen by half, which means DARPA innovation outputs have likely fallen by at least three quarters relative to GDP. This means that if R&D doesn't at least keep up with GDP, there will continue to be less innovation every year.

MYTH 5: FEDERAL R&D CREATES RELATIVELY FEW JOBS

Some argue that in a time of high joblessness there is little point in funding R&D because it creates few jobs. To be sure, the principal goal of federal R&D is not to create jobs; it is to boost innovation, productivity and competitiveness, and national security. At the same time, however, it does create jobs. The Information Technology and Information Foundation (ITIF) estimated that an additional one-time $20 billion investment in research would create approximately 402,000 American jobs for one year. Our estimate projects that this level of funding would create or retain approximately 196,000 direct and indirect jobs.[27] Moreover, to the extent federal R&D supports commercial innovation, this too would lead to job creation. For example, Battelle Memorial Institute estimated that in 2010 the federally funded Human Genome Project supported the creation of over 360,000 jobs.[28]

CONCLUSION

Free market conservatives are right about a lot. It's important to limit the role of government in a number of areas, including ensuring it doesn't overregulate key parts of the economy. But when it comes to federal investment in science, the free-marketers' argument that the private sector can and will do most of the heavy lifting and that government can let federal support for R&D stagnate or even shrink is mistaken. That is a recipe for continued lags in innovation, productivity growth, national competitiveness, and national security.

About the Author

Robert D. Atkinson (@RobAtkinsonITIF) is the founder and president of ITIF. Atkinson's books include *Big Is Beautiful: Debunking the Myth of Small Business* (MIT, 2018), *Innovation Economics: The Race for Global Advantage* (Yale, 2012), *Supply-Side Follies: Why Conservative Economics Fails, Liberal Economics Falters, and Innovation Economics is the Answer* (Rowman Littlefield, 2007) and *The Past and Future of America's Economy: Long Waves of Innovation That Power Cycles of Growth* (Edward Elgar, 2005). Atkinson holds a Ph.D. in city and regional planning from the University of North Carolina, Chapel Hill.

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ENDNOTES

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