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Don't Be like China

Why the U.S. Government Should Cut Its Science Budget

By Terence Kealey

On April 9, 2021, President Biden unveiled plans to increase the U.S. government's science funding by some 20 percent over the next year.[1] These plans are likely to pass; not only did the U.S. House of Representatives Committee on Science, Space, and Technology introduce a bipartisan bill on March 26, 2021, to double the National Science Foundation's budget, but the majority of senators on both sides of the aisle are known to support the measures.[2] Meanwhile, the UK government also intends to double its funding of science. This measure also enjoys bipartisan support.

The U.S. and UK measures are popular because the two countries have identified a common enemy, namely China.[3] In the words of the ranking member of the House Science Committee, Frank Lucas (R-OK), the United States' leadership in science and technology "is being challenged now by the Chinese Communist Party."[4] The British government's *Integrated Review of Security, Defence, Development and Foreign Policy* of March 2021 justifies the UK becoming a "Science and Tech Superpower" in part by repeatedly invoking the growing technology of China, a country it describes as "repressive."[5] Yet, these government science initiatives will fail.

THE FEDERAL GOVERNMENT'S FUNDING OF RESEARCH

The United States rose to economic and technological dominance under scientific laissez faire, and though the federal government has long funded so-called mission research (Coast Survey, 1807; Surgeon General's Office, 1818; Army Medical Department, 1818; Depot of Charts and Instruments, 1830), it started to fund pure science only in 1950, when it established the National Science Foundation (NSF).

The blueprint for the NSF was provided by the prominent science administrator Vannevar Bush in his "linear" or "pipeline" model, which proposed that there were both military and market failures in pure science and that only if the government funded pure science would military and commercial technology flourish.[6]

On its launching of Sputnik in 1957, however, the USSR seemed to have overtaken the United States, which thus discredited the pipeline model, at least as a source of military technology. So, in 1958, the U.S. federal government inaugurated the Advanced Research Projects Agency (ARPA) on a different model: first, identify the technological goal and then fund the necessary research into science and technology.[7]

The federal government retained the NSF to correct for putative "market failure" within the economy, but it built up ARPA (later DARPA, or the Defense Advanced Research Projects Agency) as a vehicle for military technology research.

AUDITING THE GOVERNMENT FUNDING OF RESEARCH

Public choice theory predicts that government would advocate its funding of research, which indeed the U.S. federal government does—like all governments do. Yet, in their audits, government agencies have transcended publication

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bias, and (unexpectedly perhaps) they have emerged as the most effective discreditors of the idea. Here I consider the five most comprehensive and authoritative government audits, namely from

- the director of Defense Research and Engineering,
- the Congressional Budget Office (twice),
- the Organisation of Economic Co-operation and Development, and
- the U.S. Bureau of Labor Statistics.

The first formal audit of government-funded science came in 1969, when the Office of the Director of Defense Research and Engineering in Washington, DC, published *Project Hindsight* to analyze 700 research events that had led to the development of 20 weapons systems. *Hindsight* found that only two of those 700 events were in pure science. This finding massively discredited the pipeline model.[8]

Hindsight, however, did not protect ARPA, because by then ARPA's mission had crept away from its original goal-orientated vision, and it had moved back toward the pipeline model, and—in a classic example of producer capture—ARPA's scientists were doing a lot of pure science for its own sake. But in view of *Hindsight*'s findings, in 1969, Senator Mike Mansfield (D-MT) introduced an amendment to the Armed Forces Appropriation Authorization Act to strip ARPA of its pure science.[9]

At the time, Mansfield was widely condemned for destroying America's research, but his move instead rejuvenated it, because ARPA's newly redundant researchers streamed to the Xerox Palo Alto Research Center, or XeroxPARC, where they invented the mouse, the graphical user interface (windows, pop-up menus, the trash can), and the laser printer.[10] Indeed, they invented the first personal computer—the Xerox Alto. They also helped pioneer Ethernet networks and emails.

Famously, on reflecting on visiting XeroxPARC, Steve Jobs said, "I thought it was the best thing I'd ever seen in my life. . . . Within 10 minutes, it was obvious to me that all computers would work like this."[11] Jobs disclosed Xerox's advances to Bill Gates, and when the two men later quarreled over priority, Gates famously told Jobs, "We both had this rich neighbor named Xerox, and I broke into his house to steal the TV set and found out that you had already stolen it."[12]

So, it was in part because ARPA's pure science was closed that the United States pioneered today's high-tech revolution. This natural experiment teaches an important lesson in crowding out; had ARPA retained its budgets in pure science, its scientists would not have crowded into XeroxPARC.

The next audit came in 1991 when, in its *How Federal Spending for Infrastructure and Other Public Investments Affects the Economy*, the Congressional Budget Office (CBO) on reviewing the literature, found the following:

- the return to federal contract R&D [research and development] to be near zero and statistically insignificant;
- the general absence of statistical association between most federal contract R&D and productivity seems surprising, because a strong association exists between private R&D and productivity;
- the failure of production-function studies to find consistent positive effects of most federal contract R&D puzzles many observers; and
- given the difficulty of measuring economic returns to most federally funded R&D, claims of substantial economic benefits beyond contributions to agency missions should be viewed skeptically.[13]

The CBO performed a second audit in 1998, and in its *Economic Effects of Federal Spending on Infrastructure and Other Investments*, it found:

- aggregate statistical studies report that federal R&D does not enhance productivity substantially, if at all; and
- the returns to private R&D are high, those to federal R&D low to nonexistent.[14]

These were dramatic findings. In 2003, the Organisation of Economic Co-operation and Development, on using a completely different econometric methodology and on studying the growth rates of the 21 leading world economies between 1971 and 1998, found the following:

> The negative results for public R&D are surprising and deserve some qualification. Taken at face value they suggest publicly-funded R&D crowds out . . . private R&D. . . . Business-performed R&D . . . drives the positive association between total R&D intensity and output growth.[15]

In 2007, Leo Sveikauskas of the U.S. Bureau of Labor Statistics, on reviewing the scholarly literature on R&D, concluded:

> The overall rate of return to R&D is very large. . . . However, these returns apply only to privately financed R&D in industry.[16]

CROWDING OUT

These findings can be explained by crowding out, as was adumbrated by a 1998 CBO observation:

> Generally, the case studies have found that federal R&D spending contributes to the economy substantially in excess of its costs, but the aggregate statistical studies report that federal R&D does not enhance productivity substantially, if at all.[17]

That is, government subsidy for a company's science leads to greater output of that company. Or equally, government subsidy for a research program leads to successful research. However, it is *not* true that government subsidy for a nation's research leads to greater output of that nation.

As we have formally known for a century, scientific talent is distributed according to a power law (i.e., relatively few scientists matter, and the majority of scientists simply reinforce the paradigms of the handful of elite pioneers).[18] But those elite pioneers would prefer to be funded by the government rather than work for industry because government funding is distributed by peer review, and they are the elite peers who are doing the reviewing and the distributing.

So, the government funding of science is a mechanism that allows lead researchers to research as they wish. And their goals are not commercial but reputational: they are looking for fame.[19]

In industry, however, scientists are enjoined to work on projects that are of value to others, namely customers and investors. That does not preclude researchers from working in pure science, because—contrary to myth—industry's pure science budgets are large, and they account for some 7 percent of the sector's overall R&D budget.[20] Consequently, some companies publish as many research papers as do medium-sized universities.[21]

But when offered a choice, a distinguished scientist would rationally choose to work in the public sector rather than in the private sector. This is why academic scientists accept salaries that are around 30 percent smaller than in industry.[22] This has at least three deleterious consequences.

First, advances in research are best turned into new technology by the close collaboration of researchers and technologists, so if researchers are sequestered in universities, far from technologists in industry, then the translation of scientific discoveries into commercial advances must be inefficient.[23] Congress has long recognized the problem, and the Bayh-Dole Act of 1980 tried to break down some of the barriers between universities and companies, but its passage seems not to have markedly shifted the commercialization of academic science in America.[24] This suggests there is no ready compensation for the fundamental error of separating the institutions of science from the institutions of technology.

Second, this error is compounded by the fact that advances in pure science owe as much to advances in technology as vice versa, so pure science is itself damaged by being separated from industry.[25]

Finally, the lower quality of industrial researchers disincentivizes companies from investing in them because the returns are low. When governments fund academic science, therefore, they crowd out private money, because private funders get poor returns from their money, so they reduce their funding.

MORAL PANIC

The outbreak of the Cold War sparked a moral panic among U.S. policymakers, which was inflamed by the launch of Sputnik. As Lyndon B. Johnson recalled, on the night of the Soviet satellite's launch on October 4, 1957:

> Now, somehow, in some new way, the sky seemed almost alien. I also remember the profound shock of realizing that it might be possible for another nation to achieve technological superiority over this great country of ours.[26]

This moral panic was harnessed by lobbyists including the RAND Corporation, which commissioned two prominent economists, Richard Nelson and Ken Arrow, to publish influential papers that argued that governments needed to fund science to correct for market failure. As Martin Ricketts and I have shown in an earlier Cato Institute Economic Policy Brief, those arguments were fallacious: there is no market failure in science.[27] Nonetheless, the lobbying was highly effective, and U.S. government science budgets soared.

But those vast budgets achieved no useful effects, because not only was crowding out fueled, but neither the long-term rate of U.S. GDP per capita growth nor the long-term rate of U.S. growth in total factor productivity (TFP) accelerated.[28] Indeed, the long-term rate of TFP growth declined.[29]

Today, the Anglophonic world is engaged in another moral panic, and it is making the same mistakes it did 60 years ago. The reality in 1957 was that the USSR was an economic pygmy and that the United States' (and the

United Kingdom's) moral panic was disproportionate to the likelihood of the Russians overtaking Americans or Britons economically.[30] Today, China is also an economic pygmy, as its GDP per capita is only one-fourth of the United States' (in terms of purchasing power parity; even less, one-sixth, nominally), so an Anglophonic economic panic in the face of China is disproportionate.[31]

China's wealth and income *in toto*, of course, now challenge those of the United States', just as certain areas of Chinese technology now match those of the West, but though certain Chinese practices in acquiring Western technology have provoked fury in the United States and the United Kingdom, we need not worry that Beijing's support for research will empower China to overtake us economically. The Chinese government is as incompetent as any other: as judged by the numbers of patents granted for every unit of investment in R&D, private companies in China are three times more efficient than are state-owned enterprises.[32]

We are moving into a multipolar world, where—in addition to China and Russia—the United States will face the European Union and India as rivals. But when, of those rivals, only China and Russia are hostile—and when both are so weak per capita—the development of a multipolar world need not, in itself, occasion a U.S. Thucydides Research Trap.

There will always, of course, be a role in the United States for federally funded mission research, which has such a long and useful history. So, should President Biden, the U.S. House Science Committee, or any other branch of the federal government identify missions that need funding for geopolitical reasons (such as cybersecurity or the environment), then let such funding be made. But the idea that the federal government needs to fund science to correct for a putative market failure—one that does not exist—is not only misconceived but actually counterproductive. By pulling its best scientists out of industrial labs into government labs, the federal government will only accelerate the very economic decline it fears.

This can be illustrated with an anecdote about Katalin Karikó. Karikó was the University of Pennsylvania RNA researcher who, in 1995, was demoted to an adjunct position because she was failing in the competition to win research grants.[33] So she moved to the BioNTech company, where she not only created the Pfizer vaccine but also spurred Moderna to competitive imitation.

Had Biden and the U.S. House of Representatives Committee on Science, Space, and Technology had their way, Karikó would have stayed, well-funded, at the University of Pennsylvania. How many people might have died in 2020 and 2021 in consequence?

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