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U.S. Funding for University Research Continues to Slide

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The United States continues to fall further behind world leaders in funding for university research. To reverse course, it should increase support by $45 billion per year and provide stronger incentives for businesses to increase their investments.

KEY TAKEAWAYS

- Research universities play a critical role in generating innovation-based economic growth and driving U.S. global innovation leadership.
- According to the most recent OECD data, the United States has slid to 28th of 39 nations in government funding for university research as a share of GDP, with the 12 leading governments investing more than double the U.S. investment.
- Between 2011 and 2017, U.S. government funding for university research as a share of GDP fell by nearly a quarter—0.06 percentage points. On average, nations decreased 0.03 percent of GDP during that time.
- Congress should commit to increasing university research support by $45 billion per year, which would place the United States among the top seven nations in the world in funding for university research.
- Congress should also expand the energy-related collaborative research and experimentation tax credit to apply to any field of university research investment—not just energy research—made by businesses.

INTRODUCTION

In 2013, ITIF found that America is no longer—and nowhere near—the lead nation in terms of funding university research, despite boasting world-leading research universities that have been key to driving American technological supremacy since World War II. At that time, the United States ranked 24th out of 39 nations in government funding of university research as a share of gross domestic product (GDP). Since then, according to data provided by the Organization for Economic Cooperation and Development (OECD), the United States has slid to 28th in government funding, with the 12 leading governments investing more than double the U.S. level. Indeed, many nations are increasing investments in university research precisely because they understand the critical role research universities play in generating innovation-based economic growth, both through the training of scientists and engineers and the generation and transfer of knowledge.

Research drives innovation, and innovation drives long-run economic growth—creating jobs and improving living standards in the process. University-based research is of particular importance to innovation, as the early-stage research that is typically performed at universities serves to expand the knowledge pool from which the private sector draws ideas and innovation. America's failure to stay abreast—much less close the gap—with its economic competitors in university research funding hampers U.S. innovation and competitiveness. National economies increasingly compete on the basis of innovation, and in the "race for global innovation advantage," the United States will continue to trail countries that have made support for university research a key part of their national innovation strategies. While our public research universities used to be the envy of the world, many foreign universities have gained ground. Twenty years of underfunding by state governments have led to a decline in many public research universities' capabilities relative to private research universities.[1] And a long-term decline in federal funding for research and development (R&D) as a share of GDP, to the point federal funding levels fell to 1957 levels—when the Russians launched Sputnik—have also contributed to America's decline. And while U.S. research universities, both public and private, are still a key strength, absent increases in state and federal funding, their future strength is uncertain.[2]

If the United States is to regain some edge in the race for global innovation advantage, it will need to reverse these trends and significantly increase university research funding, while at the same time providing stronger incentives for businesses to invest in university research. To do that, Congress should commit to increasing university research support by $45 billion per year, which would place the United States among the top seven nations in the world. In addition, Congress should expand the energy-related collaborative research and experimentation tax credit to apply to any field of research investment—not just energy research—at universities made by businesses.

THE IMPORTANCE OF UNIVERSITY RESEARCH

In developed, knowledge-based economies, innovation powers long-run economic growth. For example, a study published by the U.K. National Endowment for Science, Technology and the Arts found that two-thirds of U.K. private-sector productivity growth between 2000 and 2007 was a result of innovation.[3] In a cross-country study, Klenow and Rodríguez-Clare found that more than 90 percent of the variation in the growth of income per worker was a result of

innovations that changed how capital was used.[4] Likewise, Hall and Jones studied 127 nations and found that how capital was used was 4.6 times more important in driving economic growth than how much capital a nation had.[5]

Innovation is also positively correlated to job growth in the mid to long term.[6] Innovation leads to job growth in three fundamental ways. First, it gives a nation's firms a first-mover advantage in new products and services, expanding exports and creating expansionary employment effects. In the United States, for example, growth in exports leads to twice as many jobs as an equivalent expansion of sales domestically.[7] Second, innovation's expansionary effects lead to a virtuous cycle of expanding employment. In the early to mid-1990s, increasing usage of information technology drove broad-based economic growth, creating hundreds of thousands of new jobs, which, in turn, led to additional job growth in supporting industries. Finally, when innovation leads to higher productivity, it also leads to increased wages and lower prices, both of which expand domestic economic activity and create jobs.[8]

Universities have taken on an even greater role in the American innovation system as many corporations have shut down or repurposed central research laboratories that used to conduct R&D.

Research performed outside the private sector is essential to the U.S. innovation system. Even with robust corporate R&D investment, the private sector alone does not invest at the levels society needs, in large part because firms do not capture all the benefits of innovation. Numerous studies suggest the rate of return society receives from corporate R&D and innovation activities is at least twice the estimated returns companies themselves receive.[9] For example, Tewksbury, Crandall, and Crane examined the rate of return of 20 prominent innovations and found a median private rate of 27 percent. However, the median social rate of return was a whopping 99 percent—almost four times higher.[10] Nordhaus estimated that inventors capture just 4 percent of the total social gains from their innovations; the rest spill over to other companies and society as a whole.[11] This differential between private and social returns means the optimal level of R&D investment for society—that which achieves the highest rate of economic growth—cannot be met by the private sector alone. Thus, without public investment, the rates of economic growth, job creation, and living-standard improvement are all lower than their potential. The university system plays a key role in filling the gap between the current levels of private R&D and that which is optimal for economic growth.

Over the last two decades, universities have taken on an even greater role in the American innovation system, as many corporations have shut down or repurposed central research laboratories that used to conduct R&D. For example, since its founding in 1925, Bell Labs (until 1995, a subsidiary of AT&T) made seminal scientific discoveries and created powerful new technologies that supported the world's most advanced and reliable telecommunications networks. AT&T was a regulated monopoly that conducted research because it still had profit incentives to lower costs and create new services. Its monopoly position allowed it to increase its returns on innovation by capturing for itself the benefits that would otherwise have spilled over to competitors within the telecommunications industry. But the foundational, generic research it conducted also spilled over to firms in other industries, which strengthened the entire economy. With the introduction of competition to the telecommunications industry in the 1980s and 1990s, Bell Labs was restructured to focus more on incremental technology improvements with

shorter-term payoffs. This is reflective of an overall shift in corporate R&D, with companies in the United States expanding their investments in development much more quickly than their investments in basic and applied research.[12] From 1991 to 2017, basic and applied research as a share of total corporate R&D funding conducted in the United States fell by 6.3 percentage points, while development saw its share increase by the same amount.[13]

This shift to shorter-term, less-fundamental R&D risks a shrinking of the knowledge pool from which firms draw the ideas and information necessary to conduct later-stage R&D, and ultimately bring innovations to the market. As U.S. companies have shifted their R&D activities upstream, universities have taken on a larger role in the innovation system. As of 2017, universities perform 47 percent of all basic research—up significantly from 38 percent in 1960, but lower than the 54 percent performed in 2011.[14] Moreover, universities are increasingly passing on these results to the private sector: Between 1991 and 2009, the number of patent applications filed by universities increased from 14 per institution to 68 per institution; licensing income increased from $1.9 million per institution to $13 million; and new start-ups formed as a result of university research increased from 212 in 1994 to 685 in 2009.[15] But without increased support from both the government and the private sector, this role is likely to diminish.

Overall, university research has large, beneficial impacts on U.S. economic growth. Mansfield found, in terms of its impact on product and process development in U.S. firms, the social rate of return from investment in academic research is at least 40 percent.[16] A study by the Science Coalition found that "companies spun out of research universities have a far greater success rate than other companies."[17] And a study by the Ratio Institute of Stockholm found that public university research spin-off companies have more patent applications and radical product innovations than similar non-spin-off firms—the study's authors find that these superior results can be explained by both research cooperation between the companies and universities, and colocation factors.[18] Indeed, university research has given the United States breakthrough companies such as Google, Medtronic, and iRobot.[19]

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The power of university R&D is apparent when we correlate the 2011 levels of R&D funding in this report with the competitiveness metrics ITIF published in 2011's *The Atlantic Century II*, which benchmarked the competitiveness of 36 countries around the world.[20] Government funding for university R&D has an extremely tight 0.70 correlation with countries' overall scores on *The Atlantic Century II*. Unsurprisingly, government funding is also tightly correlated with the number and prominence of a country's academic publication output (0.86), and with the per capita number of science and technology workers in a country (0.66). It is also tightly correlated with the level of GDP per working-age adult (0.71) and with the nation's overall labor productivity (0.59). As for business funding of university R&D, it has a smaller, although still substantial, correlation of 0.18 with countries' overall scores. It also shows substantial positive correlation with the countries' trade balance (0.21) and its level of labor productivity (0.28). While smaller than the correlation for government funding, this does not mean business funding

is insignificant: The level of business funding across countries is much smaller than government funding, and thus its impacts on countries' macro-competitiveness measures is likewise lower.

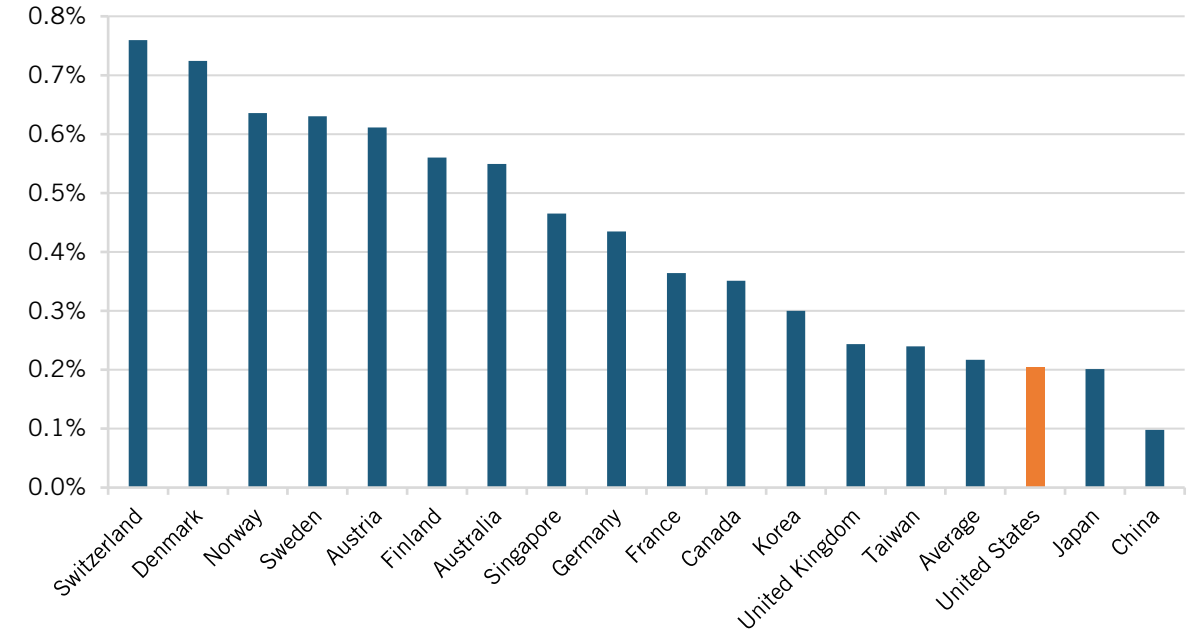
Despite the importance of this new, more synergistic relationship between research universities and innovation-based enterprises in the United States, some argue that government support for R&D does not really matter, and companies will pick up any slack from cuts in federal R&D. But, as previously noted, the exact opposite appears to be true, as U.S. companies have shifted funding away from basic and applied research. Moreover, publicly funded research is a complement to and not a substitute for private-sector research. A study by the RAND Corporation found that, in general, 1 additional dollar of public contract research added to the stock of government R&D induces an additional 27 cents in private R&D investment.[21] A Carnegie Mellon University study found that "public research is critical to industrial R&D in a small number of industries and importantly affects industrial R&D across much of the manufacturing sector."[22]

The development and expansion of major U.S. research universities, including the public land grant universities and other state universities, has played a key role in driving U.S. global innovation leadership. Indeed, it has become almost a matter of faith in economic and innovation policy circles to point to U.S. research universities as the secret weapon in the U.S. economic competitiveness arsenal. However, as the next section demonstrates, this widely held view reflects the past rather than the present.

BENCHMARKING U.S. GOVERNMENT FUNDING

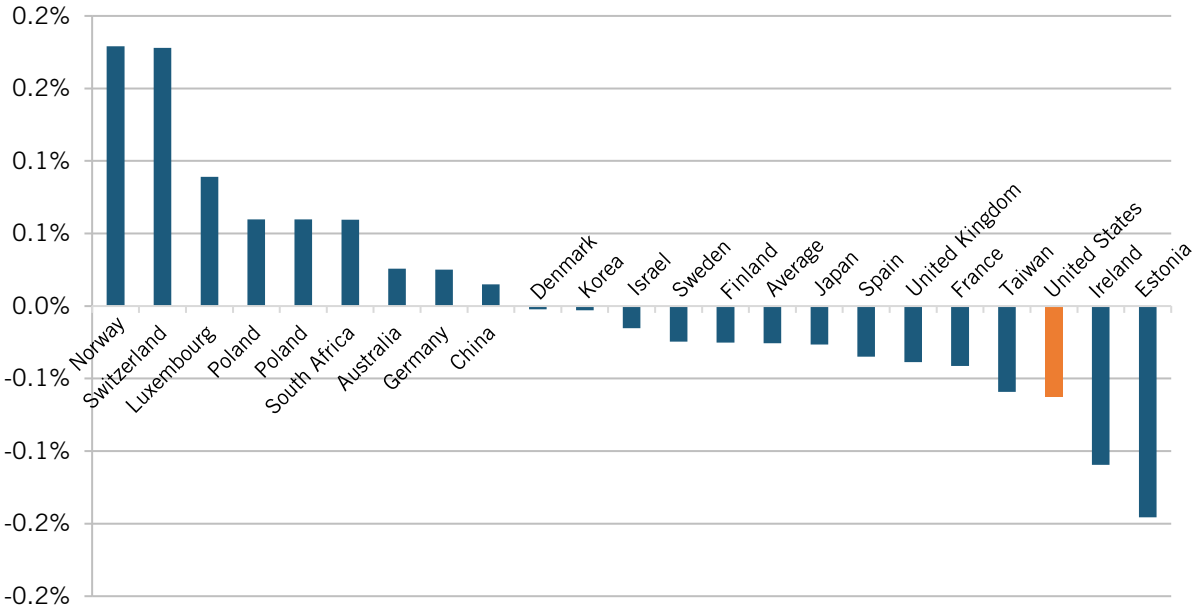
As of 2017, governments in the United States (state and federal) collectively invested 0.20 percent of GDP on university research, ranking 28th out of 39 nations.[23] For example, figure 1 shows the Swiss government invests over 3.7 times as much (0.76 percent) on funding university research as the United States, with Denmark just behind (0.72 percent). Germany (0.36 percent), France (0.43 percent), and the United Kingdom (0.24 percent) all out-invest the United States. U.S. governments fund at levels closer to East Asian countries: Although Korea (0.30 percent) and Taiwan (0.34 percent) out-invest the United States, the United States slightly out-invests Japan (0.20 percent) and invests at double the rate of China (0.10 percent), although Chinese funding is increasing. The exception to lower East Asian investment levels is, unsurprisingly, Singapore, which invests 0.47 percent of its GDP in university research. In all, 12 countries fund at more than 200 percent of U.S. levels, while 17 fund at more than 150 percent.

Figure 1: Government funding for university R&D as a share of GDP, 2017[24]



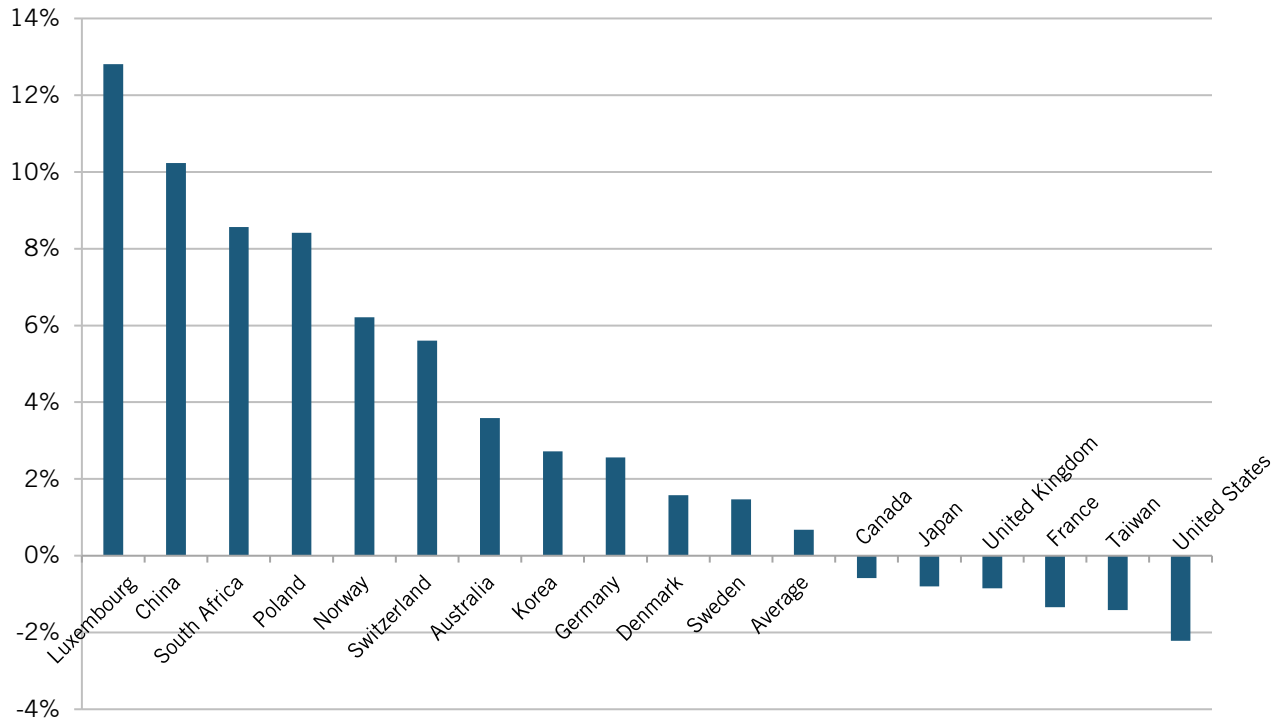
Between 2011 and 2017, U.S. government funding as a share of GDP fell by nearly a quarter (0.06 percentage points), causing the United States to be passed by Spain, Israel, Poland, and Luxembourg. Only 14 nations have increased their funding levels over this period, with an average decline of 0.03 percent of GDP. The U.S. decline is nearly unrivaled, ranking 37th, with only Ireland and Estonia seeing larger reductions in funding. Norwegian and Swiss governments each increased university R&D funding by 0.18 percent of GDP over this period, elevating them to third and first in the 2017 rankings, respectively. (See figure 2.)

Figure 2: Percentage-point change in government funding for university R&D as a share of GDP, 2011–2017[25]



Using constant purchasing-power parity (PPP) dollars, which analyze university R&D funding as a percentage change in dollar amounts rather than as a share of GDP, after adjusting those dollar amounts for differences in goods prices among countries and for changes in prices within those countries over time, the United States performs nearly as poorly. Between 2011 and 2017, U.S. government funding declined by 2.2 percent annually, ranking 34th, ahead of Argentina, Estonia, Mexico, Slovenia, and Romania, well below the average of an increase of 0.68 percent annually. (See figure 3.) In contrast, Luxembourg and China increased their funding by 12.8 and 10.2 percent per year, respectively.

Figure 3: Average annual percentage change in government funding for university R&D in constant PPP dollars, 2011–2017[26]



Collectively, the 39 governments increased university R&D funding by 4.2 percent in PPP terms between 2011 and 2017, which has been insufficient to keep up with economic growth, causing the average share of GDP to fall from 0.24 percent to 0.22 percent over this period. On its own, this is concerning. But the picture in the United States is far grimmer. While the United States' rank as a share of GDP has only slipped 4 places from 24th to 28th, its other ranks have plummeted, from 18th as a share of GDP growth from 2000 to 2011 to 37th in 2017. (See table 1.)

Table 1: Government funding for university R&D as a share of GDP[27]

2017 Level (GDP)			2011–2017 Change (GDP)			2011–2017 Annual Growth		
Country	**Share of GDP**	**Rank**	**Country**	**Pct. Point Change**	**Change Rank**	**Country**	**Avg. Annual Pct. Change**	**Rank**
Switzerland	0.76%	1	Norway	0.18%	1	Luxembourg	12.81%	1
Denmark	0.72%	2	Switzerland	0.18%	2	China	10.23%	2
Norway	0.64%	3	Luxembourg	0.09%	3	South Africa	8.56%	3
Sweden	0.63%	4	Poland	0.06%	4	Poland	8.42%	4
Austria	0.61%	5	South Africa	0.06%	5	Norway	6.21%	5
Finland	0.56%	6	Portugal	0.04%	6	Switzerland	5.60%	6
Australia	0.55%	7	Australia	0.03%	7	Iceland	4.01%	7
Iceland	0.54%	8	Austria	0.03%	8	Czech Republic	3.76%	8
Netherlands	0.47%	9	Czech Republic	0.03%	9	Australia	3.59%	9
Singapore	0.47%	10	Germany	0.03%	10	Slovak Republic	3.29%	10
Portugal	0.46%	11	Belgium	0.02%	11	Turkey	3.12%	11
Germany	0.43%	12	China	0.01%	12	Korea	2.72%	12
France	0.36%	13	Slovak Republic	0.01%	13	Germany	2.56%	13
Estonia	0.35%	14	Iceland	0.00%	14	Israel	2.41%	14
Canada	0.35%	15	Russia	-0.00%	15	Belgium	2.25%	15
Belgium	0.34%	16	Denmark	-0.00%	16	Portugal	2.08%	16
Israel	0.31%	17	Korea	-0.00%	17	Singapore	1.72%	17
Korea	0.30%	18	Netherlands	-0.01%	18	Austria	1.70%	18
Czech Republic	0.30%	19	Israel	-0.02%	19	Denmark	1.57%	19
Italy	0.29%	20	Italy	-0.02%	20	Sweden	1.47%	20
Poland	0.25%	21	Argentina	-0.02%	21	Russia	0.88%	21
United Kingdom	0.24%	22	Sweden	-0.02%	22	**Average**	**0.68%**	–
Taiwan	0.24%	23	Finland	-0.03%	23	Netherlands	0.36%	22
Luxembourg	0.24%	24	**Average**	**-0.03%**	–	New Zealand	0.29%	23
Spain	0.23%	25	Japan	-0.03%	24	Finland	-0.23%	24
Average	**0.22%**	–	Turkey	-0.03%	25	Canada	-0.58%	25
Ireland	0.21%	26	Spain	-0.03%	26	Japan	-0.80%	26

South Africa	0.21%	27	Romania	-0.04%	27	United Kingdom	-0.85%	27
United States	**0.20%**	**28**	New Zealand	-0.04%	28	Ireland	-0.92%	28
New Zealand	0.20%	29	United Kingdom	-0.04%	29	Spain	-1.25%	29
Japan	0.20%	30	Hungary	-0.04%	30	France	-1.34%	30
Turkey	0.18%	31	France	-0.04%	31	Chinese Taipei	-1.41%	31
Slovak Republic	0.18%	32	Mexico	-0.04%	32	Italy	-1.59%	32
Slovenia	0.15%	33	Slovenia	-0.06%	33	Hungary	-1.84%	33
Hungary	0.14%	34	Canada	-0.06%	34	**United States**	**-2.22%**	**34**
Argentina	0.13%	35	Taiwan	-0.06%	35	Argentina	-2.49%	35
Mexico	0.10%	36	Singapore	-0.06%	36	Estonia	-2.56%	36
China	0.10%	37	**United States**	**-0.06%**	**37**	Mexico	-4.00%	37
Russia	0.06%	38	Ireland	-0.11%	38	Slovenia	-5.30%	38
Romania	0.04%	39	Estonia	-0.15%	39	Romania	-8.67%	39

BENCHMARKING U.S. BUSINESS FUNDING OF UNIVERSITY RESEARCH

Some will argue that while other more "statist" nations must rely on government funding of university research, market-oriented United States relies more on business R&D. However, 16 of the 39 nations have public and private sectors that invest more in university research than those of the United States.

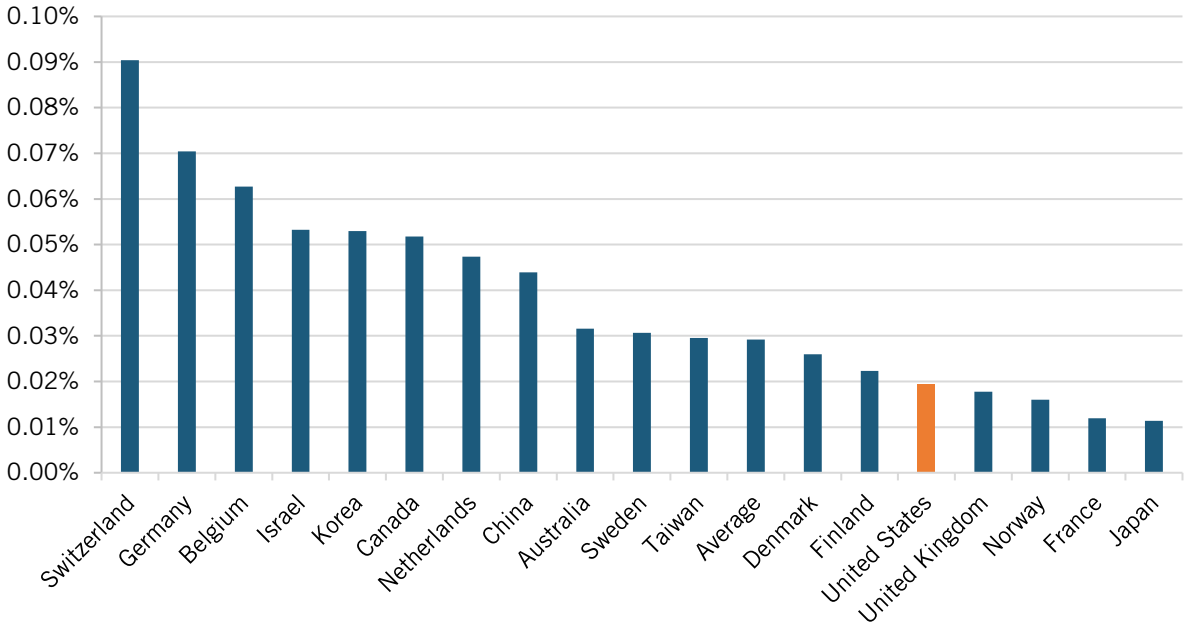
Some will also argue that even if the government does not fund university research at the same levels as other nations, our private sector will compensate for this gap. After all, they say, we are the nation that passed the Bayh-Dole Act to spur commercialization of university research, and we have more entrepreneurial faculty at our universities. However, there are two key problems with this rationale for our lagging government funding. First, even in the United States, government funding of university research exceeds business funding by an order of magnitude.[28] And second, even with these "policy innovations," the United States trails far behind other nations when it comes to business support of university research.

While businesses in the United States invested the equivalent of 0.019 percent of GDP on R&D at universities, businesses in Germany invested 0.070 percent–more than 3.5 times as much.

In 2017, the United States ranked 20th out of 39 countries in its level of business funding for university R&D as a share of GDP. While businesses in the United States invested the equivalent of 0.019 percent of GDP on R&D at universities, businesses in Germany, for example, invested 0.070 percent, more than 3.5 times as much—and Germany ranks second behind Switzerland, where companies invest more than 4.5 times as much as the United States. East Asian countries, including China, Korea, Singapore, and Taiwan, all outrank the United States with the sole exception of Japan, with 5th-ranked Korea receiving 0.053 percent of GDP from businesses,

and 8th-ranked China receiving 0.044 percent, each more than double the level of funding in the United States. (See figure 4.)

Figure 4: Business funding for university R&D as a share of GDP, 2017[29]



Since 2011, business funding of U.S. university R&D has grown by 0.001 percent of GDP, 55 percent higher than the average growth across the 39 countries—enough for the United States to rank 15th. Switzerland ranks first with a 0.024-percentage point increase in business funding as a share of GDP, nearly 17 times U.S. growth. (See figure 5.) Interestingly, China ranks 35th in growth relative to GDP, but 12th in annual PPP growth, falling 0.006 percentage points as a share of GDP, but increasing 5.0 percent in PPP terms—reflecting significant growth in business investment not having kept up with overall economic growth. In PPP terms, business funding in the United States grew 3.5 percent annually between 2011 and 2017, placing it 18th and just above the average of 3.4 percent. The Czech Republic and Luxembourg lead PPP growth, increasing by 31.9 and 26.3 percent annually, respectively, followed by Israel, Singapore, and Turkey, which each grew at above 10 percent annually. (See figure 6.)

Figure 5: Percentage-point change in business funding for university R&D as a share of GDP, 2011–2017[30]

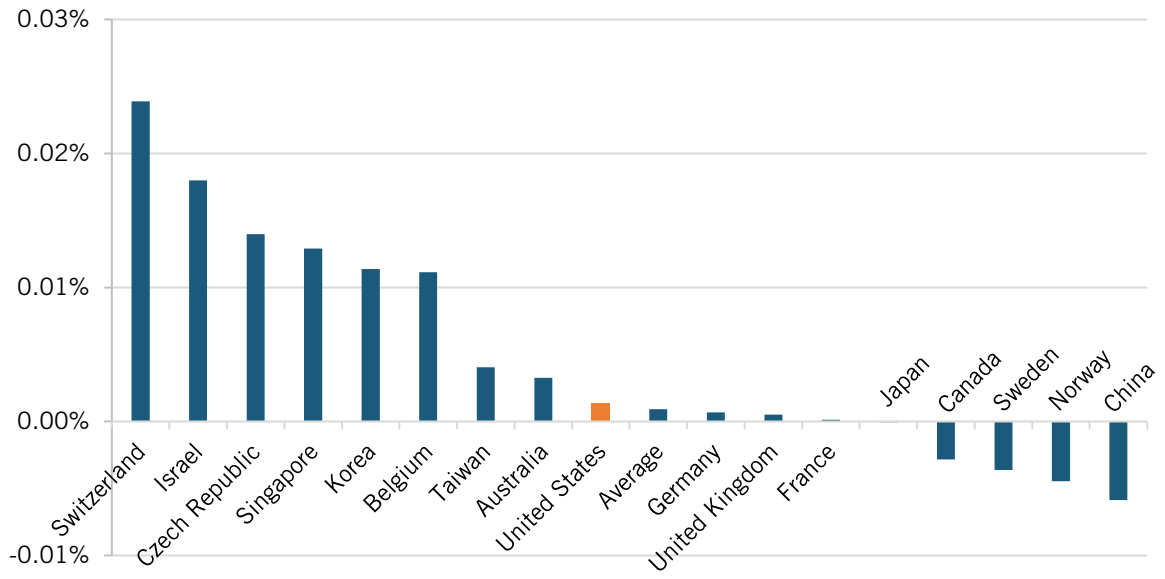
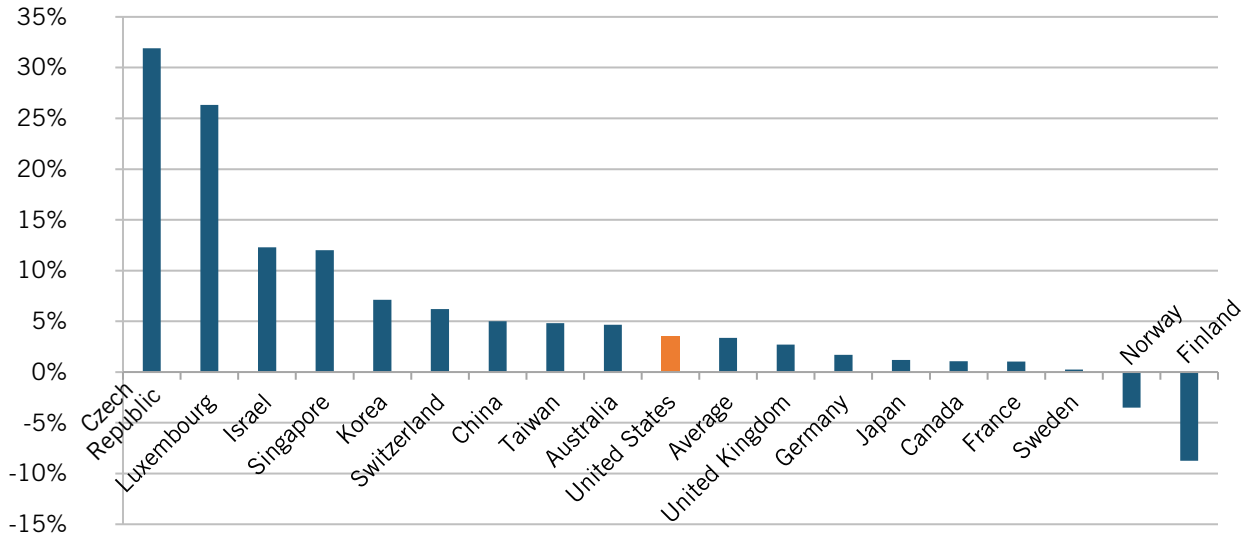


Figure 6: Average annual percentage-point change in business funding for university R&D in constant PPP dollars, 2011–2017[31]



While not rosy, the picture of U.S. business investment in university R&D has improved markedly since 2011. Although companies invest less than two-thirds the average share of GDP in U.S. universities, the U.S. rank has improved from 27th to 20th since 2011. Further, business investment growth is now slightly above average, improving from 31st for 2000–2011 to 15th for 2011–2017 as a share of GDP, and from 34th to 18th in PPP terms over the same periods. (See table 2.)

Table 2: Business funding for university R&D, 2011–2017[32]

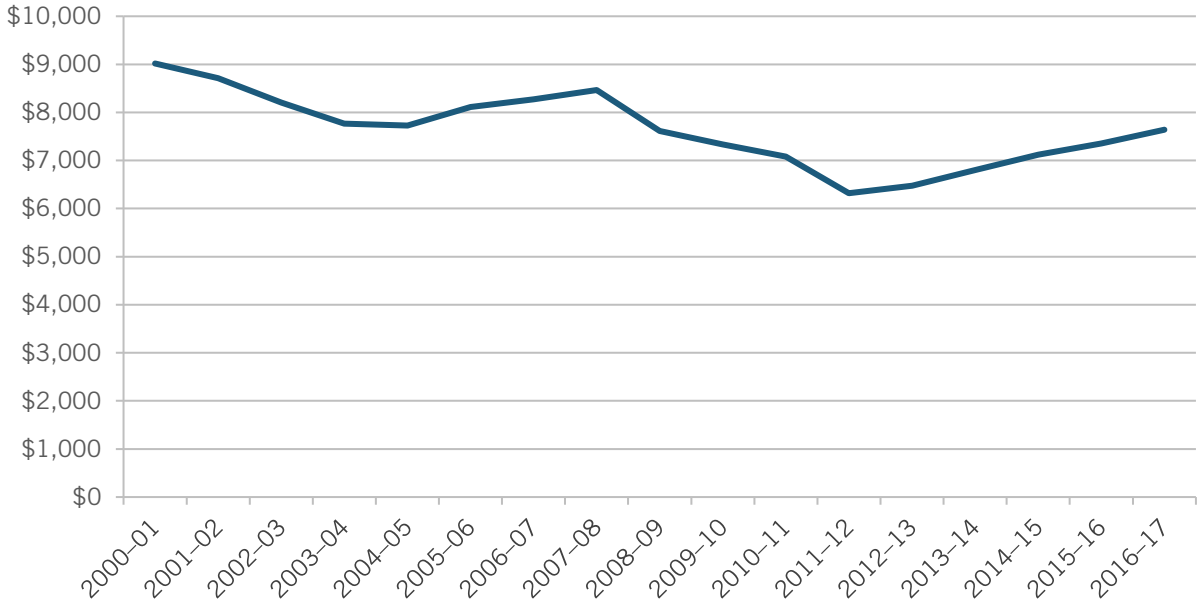
2017 Level			2011–2017 Change			2011–2017 Annual Growth		
Country	**Share of GDP**	**Rank**	**Country**	**Pct. Point Change**	**Change Rank**	**Country**	**Avg. Annual Pct. Change**	**Change Rank**
Switzerland	0.090%	1	Switzerland	0.024%	1	Czech Republic	31.9%	1
Germany	0.070%	2	Israel	0.018%	2	Luxembourg	26.3%	2
Belgium	0.063%	3	Czech Republic	0.014%	3	Israel	12.3%	3
Israel	0.053%	4	Singapore	0.013%	4	Singapore	12.0%	4
Korea	0.053%	5	Korea	0.011%	5	Turkey	10.7%	5
Canada	0.052%	6	Belgium	0.011%	6	Poland	9.3%	6
Netherlands	0.047%	7	Estonia	0.007%	7	Estonia	8.3%	7
China	0.044%	8	Russia	0.006%	8	Ireland	8.2%	8
Austria	0.038%	9	South Africa	0.004%	9	Korea	7.1%	9
Singapore	0.035%	10	Chinese Taipei	0.004%	10	Switzerland	6.2%	10
Australia	0.032%	11	Australia	0.003%	11	South Africa	6.2%	11
Sweden	0.031%	12	Austria	0.003%	12	China	5.0%	12
Estonia	0.030%	13	Poland	0.002%	13	Argentina	4.8%	13
Chinese Taipei	0.030%	14	Luxembourg	0.002%	14	Chinese Taipei	4.8%	14
Average	**0.029%**	–	United States	0.001%	**15**	Australia	4.6%	15
Russia	0.028%	15	Turkey	0.001%	16	Russia	4.5%	16
Denmark	0.026%	16	**Average**	**0.001%**	–	Belgium	4.5%	17
Slovenia	0.023%	17	Portugal	0.001%	17	**United States**	**3.5%**	**18**
Finland	0.022%	18	Germany	0.001%	18	**Average**	**3.4%**	–
South Africa	0.021%	19	United Kingdom	0.000%	19	United Kingdom	2.7%	19
United States	**0.019%**	**20**	Ireland	0.000%	20	Austria	2.5%	20
Czech Republic	0.018%	21	France	0.000%	21	New Zealand	2.1%	21
United Kingdom	0.018%	22	Argentina	0.000%	22	Germany	1.7%	22
Spain	0.017%	23	Japan	0.000%	23	Portugal	1.5%	23
Norway	0.016%	24	Italy	0.000%	24	Japan	1.2%	24
New Zealand	0.012%	25	Mexico	-0.001%	25	Canada	1.1%	25

France	0.012%	26	Netherlands	-0.003%	26	France	1.0%	26
Japan	0.011%	27	Canada	-0.003%	27	Sweden	0.2%	27
Hungary	0.011%	28	Romania	-0.003%	28	Netherlands	-0.3%	28
Portugal	0.011%	29	Slovak Republic	-0.004%	29	Italy	-0.8%	29
Poland	0.009%	30	Sweden	-0.004%	30	Denmark	-1.3%	30
Ireland	0.009%	31	New Zealand	-0.004%	31	Norway	-3.5%	31
Iceland	0.005%	32	Norway	-0.004%	32	Slovak Republic	-6.8%	32
Slovak Republic	0.005%	33	Denmark	-0.005%	33	Slovenia	-7.7%	33
Italy	0.004%	34	China	-0.006%	34	Spain	-8.1%	34
Turkey	0.004%	35	Iceland	-0.007%	35	Finland	-8.7%	35
Romania	0.003%	36	Slovenia	-0.013%	36	Romania	-9.0%	36
Luxembourg	0.003%	37	Spain	-0.013%	37	Iceland	-9.3%	37
Mexico	0.001%	38	Hungary	-0.016%	38	Mexico	-12.0%	38
Argentina	0.000%	39	Finland	-0.018%	39	Hungary	-12.0%	39

THE CAUSES BEHIND THE LOW U.S. RANK

What is behind the United States' poor performance? For government funding and business funding, the reasons differ. With regard to government funding for university R&D, until the budget "sequester" of 2013, the primary driver of the country's low rate of change was in fact not principally the federal government (although federal support for doctoral research fellowships has declined in recent years).[33] The more important cause of the decline was state governments. As a share of GDP, state government support for university R&D is 3 percentage points lower than it was in 1991, and only 2 percentage points higher than it was in 1970.[34] This matches the trend of declining state funding for higher education in general; when measured against the size of the institutions on a per-student basis, state funding for higher education, including university R&D, fell by 22 percent between 2000 and 2011. While it has improved since, growing by 8 percent between 2011 and 2017, funding is still 15 percent lower than it was in 2000. [35] (See figure 7.)

Figure 7: State and local appropriations for higher education per full-time equivalent student, 2000–2017 (in 2016 dollars)[36]



Today, however, the situation has changed. In January 2013, the automatic spending cuts imposed by the 2012 budget sequester went into effect, immediately cutting $8.7 billion from federal research budgets until September 2013, and $54 billion off the federal research budget over five years—a 7.9-percent reduction.[37] With 30 percent of federal R&D investment going to universities and university-run R&D centers, this has had a significant impact that has not been reversed—in fact, federal R&D funding for universities fell an additional 3.7 percent (controlling for inflation) between 2013 and 2017.[38]

The United States would need to invest an additional $29 billion per year to get to 15th place in government funding, $51 billion per year to get to 10th place, $80 billion to get to 5th place, and an additional $108 billion to match Switzerland in 1st place. ITIF recommends Congress increase funding for university research (through agencies such as the National Science Foundation, National Institutes of Health, Department of Defense, and Department of Energy) by at least $45 billion per year, which would bring the United States into 13th place.

With regard to business funding for university R&D, this is also a partial failure of policy. University researchers are not necessarily motivated to work on problems that are relevant to commercial needs, and thus business funding of university research encourages essential links between commerce and academia, orienting research toward topics and ideas that are more likely to increase productivity and create new businesses, products, and jobs. For example, a study of the pharmaceutical industry examined private-sector patents coauthored with at least one university researcher and found that the share of firms' patents coauthored with university researchers increased 1 percent, the number of patents per research dollar invested by firms increased between 4 and 7 percent.[39] The effectiveness of public-private collaborations is why at least 12 nations have established collaborative research tax credits that provide a more generous credit for business support for university research. France, Italy, Spain, the Netherlands, Canada, Japan and, recently, Belgium have all established some form of more-generous collaborative R&D

tax incentive for businesses that fund university research.[40] For example, France provides a 60-percent flat-tax credit for companies collaborating with universities. Italy and Spain provide a 40-percent, and 10-percent credit, respectively.[41] In the Canadian province of Quebec, businesses receive a refundable tax credit of 35 percent on 80 percent of all research expenditures at universities or public research centers, on top of a federal tax credit of up to 35 percent on all R&D expenditures.[42] In contrast, the U.S. R&D credit is actually *less generous* for firm-funded research at universities.[43]

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To address this, Congress should provide firms with a more generous credit for collaborative research conducted at universities (and at federal laboratories and research consortia). The Energy Policy Act of 2005 created a 20-percent flat credit for expenditures made to energy research consortia between at least one firm and a mix of four firms, universities, or federal laboratories. Thus, Congress could easily create an effective collaborative R&D tax credit by simply deleting the word "energy" from the legislative language and granting credit eligibility to collaborations between any and all businesses and universities (or federal laboratories).[44]

CONCLUSION

Given the importance of university research to the U.S. innovation system, and the primary role innovation plays in economic growth, competitiveness, and job creation, the data presented supports the view that the United States can no longer rest on its laurels and assume its universities will continue to lead the world only because they once did. The reason they led was no accident. It had nothing to do with the country's geography, culture, or even size. Instead, it had everything to do with the fact that after World War II, the United States, before any other nation, dramatically increased federal (and state) support for higher education generally, and higher education research specifically. Indeed, public-sector R&D investment in the United States as a share of GDP in the early 1960s was greater than public- and private-sector R&D of all nations combined.[45]

In a highly competitive globalized economy, relative decline *is* absolute decline. This report has presented one more piece of evidence of the U.S. innovation system not keeping up with global competition. It is therefore incumbent on policymakers to recognize the nature of the challenge and then implement policies that target the specific areas of deficiency, such as the underfunding of university research. Then, and only then, will the United States be able to restore its position as the global innovation leader.

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Robert D. Atkinson 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), 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, and a master's degree in urban and regional planning from the University of Oregon.

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About ITIF

The Information Technology and Innovation Foundation (ITIF) is a nonprofit, nonpartisan research and educational institute focusing on the intersection of technological innovation and public policy. Recognized as the world's leading science and technology think tank, ITIF's mission is to formulate and promote policy solutions that accelerate innovation and boost productivity to spur growth, opportunity, and progress.

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