University Research Funding: Still Lagging and Showing No Signs of Improvement

BY ROBERT D. ATKINSON AND LUKE A. STEWART | DECEMBER 2013

America is nowhere near the lead nation in terms of funding university research.

MIT. Stanford. Georgia Tech. The United States boasts world-leading research universities, and that leadership played a key role in driving American technological supremacy since World War II. Thus it will come as a surprise to many that America is no longer—and nowhere near—the lead nation in terms of funding university research. In fact, of 39 nations, the United States ranks just twenty-fourth in government funding and twenty-seventh in business funding as a share of gross domestic product, and, the leading seven nations invest more than double the U.S. level. Indeed, many nations are making substantial investments in university research precisely because they understand the critical role that 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. Our failure to increase these investments at rates comparable to our economic competitors 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, 20 years of underfunding by state governments have meant that many public research universities have fallen in their

capabilities relative to private research universities.[1] And while our research universities, public and private, are still a key strength, their future is uncertain given the large cuts in state higher education budgets and slow growth, and now outright decline, in federal support for university research.[2]

With the sequester and the continuing pressures on the federal budget, including the unwillingness to raise taxes on individuals and cut entitlements for seniors, the pressure to cut, rather than expand, university research will continue. 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 made at universities by businesses, not just energy R&D.

THE IMPORTANCE OF UNIVERSITY RESEARCH

In developed, knowledge-based economies, innovation powers long-run economic growth. For example, a study published by the UK National Endowment for Science, Technology and the Arts found that two-thirds of UK 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]

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 that society needs, in large part because firms do not capture all of the benefits of innovation. Numerous studies suggest that the rate of return that society receives from corporate R&D and innovation activities is at least twice the estimated returns that a company itself receives.[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 estimates that inventors capture just 4 percent of the total social gains

from their innovations; the rest spill over to other companies and to society as a whole.[11] This differential between private and social returns means that the level of R&D investment that is optimal 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 in the gap between the level of private R&D and the level that 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. Because so many of the benefits from its innovations spilled over to other firms and industries, the incentive to perform this kind of foundational, generic research was based in part on the fact that AT&T had significant market power and was a regulated monopoly. But 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 2011, basic and applied research as a share of total corporate R&D funding conducted in the United States fell by 7.9 percentage points, while development saw its share increase by the same amount.[13]

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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 to 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. Today, universities perform 52 percent of all basic research, compared to 38 percent in 1960.[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 per institution; and new startups 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. In terms of its impact on product and process development in U.S. firms, Mansfield finds the social rate of return from investment in academic research to be 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 recent 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 authors find that these superior results can be explained by research cooperation between the companies and universities, and by colocation factors.[18] Indeed, university research gave the United States breakthrough companies such as Google, Medtronic and iRobot.[19]

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 that 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 correlations with the countries' trade balance (0.21) and its level of labor productivity (0.28). While smaller than the correlations 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.

As U.S. companies have shifted their R&D activities upstream, universities have taken on a larger role in the innovation system.

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 that companies will pick up any slack from cuts in federal R&D. But, as noted above, 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, an 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 2011, governments in the United States (state and federal) collectively invested 0.28 percent of GDP on university research, ranking just twenty-fourth out of 39 nations.[23] (See Table 1) Moreover, the United States increasingly lags behind other nations in the rate of growth of funding. The United States ranked eighteenth in the rate of change between

2000 and 2011; and, from 2008 to 2011 it ranked twenty-second in rate of change. Overall, relative to the size of their economies, most foreign governments outpaced the U.S. state and federal governments combined.

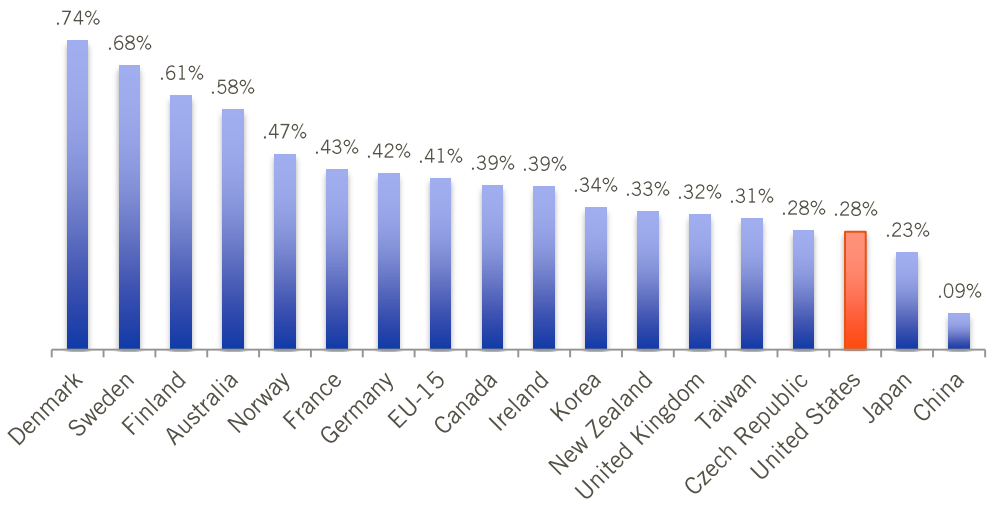

Figure 1: Government Funding for University R&D as a Share of GDP, 2011[24]

The Danish government, for example, invests over 2.5 times as much (0.74 percent) on funding university research as the United States, and Sweden is nearly the same (0.68 percent). (See Figure 1) France (0.43), Germany (0.42) and the United Kingdom (0.32) all out-invest the United States. The U.S. government funds at levels closer to East Asian countries: although Korea (0.34) and Taiwan (0.31) out-invest the United States, the United States out-invests Japan (0.23) and far out-invests China (0.09). The exception to lower East Asian investment levels is, unsurprisingly, Singapore, which invests 0.56 percent of its GDP in university research. In all, seven countries fund at more than 200 percent that of the United States, while 13 fund at more than 150 percent of the United States' level of funding. Furthermore, the closest economy of comparable size and development, the EU-15—an amalgam of Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and the United Kingdom, although excluding Greece due to insufficient data—also invests more than the United States.

The United States ranks only slightly better when it comes to its rate of change. As a share of GDP, since 2000 the United States has increased its government funding for university R&D by 0.08 percentage points, ranking just eighteenth out of the 39 countries studied. Some nations, however, have made major increases. For example, Denmark increased its funding by 0.34 percent of GDP while Australia increased funding by 0.21 percent. (See Figure 2) Furthermore, over the most recent period, from 2008 to 2011, the United States fell to twenty-second in the rate of change. Moreover, these data do not include the period of 2012 and 2013 when the U.S. budget sequester went into effect. Without cuts in federal support, it is virtually certain that the United States' rank will fall even farther in the years ahead.

2011 LEVEL			2000 – 2011 CHANGE			2008 – 2011 CHANGE		
Country	Share of GDP	Rank	Country	Pct. Point change	Change rank	Country	Pct. Point change	Change rank
Denmark	.74%	1	Denmark	+.34%	1	Denmark	+.11%	1
Sweden	.68%	2	Estonia	+.28%	2	Finland	+.09%	2
Switzerland	.65%	3	Portugal	+.26%	3	Luxembourg	+.09%	3
Austria	.62%	4	Ireland	+.23%	4	Switzerland	+.09%	4
Netherlands	.61%	5	Australia	+.21%	5	New Zealand	+.08%	5
Finland	.61%	6	Korea[25]	+.20%	6	Slovakia	+.08%	6
Australia	.58%	7	Switzerland	+.17%	7	Australia	+.08%	7
Singapore	.56%	8	Luxembourg	+.17%	8	Czech Republic	+.07%	8
Estonia	.52%	9	Singapore	+.16%	9	Estonia	+.07%	9
Portugal	.50%	10	Norway	+.15%	10	Netherlands	+.07%	10
Iceland	.49%	11	Iceland	+.14%	11	Singapore	+.06%	11
Norway	.47%	12	Czech Republic	+.13%	12	Argentina	+.06%	12
France	.43%	13	New Zealand	+.12%	13	Austria	+.06%	13
Germany	.42%	14	Slovakia	+.12%	14	Portugal	+.06%	14
EU-15[26]	.41%	–	Taiwan	+.11%	15	Germany	+.06%	15
Canada	.39%	15	Austria	+.10%	16	France	+.05%	16
Ireland	.39%	16	Finland	+.09%	17	Korea	+.05%	17
Korea	.34%	17	**United States**	**+.08%**	**18**	Sweden	+.05%	18
New Zealand	.33%	18	United Kingdom	+.08%	19	South Africa	+.05%	19
United Kingdom	.32%	19	Spain	+.08%	20	Slovenia	+.04%	20
Italy	.32%	20	Germany	+.08%	21	Ireland	+.04%	21
Belgium	.32%	21	EU-15[27]	+.08%	–	**United States**	**+.04%**	**22**
Taiwan	.31%	22	Canada	+.08%	22	EU-15[28]	+.04%	–
Czech Republic	.28%	23	Netherlands	+.07%	23	Poland	+.04%	23
United States	**.28%**	**24**	Argentina	+.07%	24	Belgium	+.02%	24
Spain	.27%	25	Romania	+.06%	25	Taiwan	+.02%	25
Israel[29]	.26%	26	France	+.06%	26	Japan	+.02%	26
Japan	.23%	27	Sweden	+.06%	27	Russia	+.02%	27
Slovenia	.21%	28	South Africa	+.06%	28	Turkey	+.02%	28
Argentina	.20%	29	Belgium	+.04%	29	Hungary	+.02%	29
Poland	.20%	30	China	+.04%	30	China	+.01%	30
South Africa	.19%	31	Russia	+.04%	31	Spain	+.01%	31
Hungary	.18%	32	Poland	+.02%	32	United Kingdom	+.00%	32
Luxembourg	.18%	33	Mexico	+.02%	33	Mexico	+.00%	33
Slovakia	.18%	34	Hungary	+.02%	34	Norway	-.01%	34
Turkey	.14%	35	Slovenia	+.02%	35	Italy	-.01%	35
Mexico	.09%	36	Italy	+.02%	36	Iceland	-.02%	36
China	.09%	37	Japan	+.01%	37	Israel	-.04%	37
Romania	.08%	38	Turkey	-.07%	38	Canada	-.04%	38
Russia	.07%	39	Israel	-.18%	39	Romania	-.06%	39

Table 1: Government Funding for University R&D as a Share of GDP[30]

2000 – 2011 CHANGE			2008 – 2011 CHANGE		
Country	Avg. annual pct. change	Rank	Country	Avg. annual pct. change	Rank
Luxembourg	50.2%	1	Luxembourg	30.1%	1
Romania	32.0%	2	Slovakia	23.6%	2
Slovakia	17.5%	3	Argentina	17.0%	3
China	17.2%	4	China	16.7%	4
Russia	13.5%	5	Russia	16.5%	5
Korea[31]	12.7%	6	Poland	10.9%	6
Estonia	12.1%	7	Singapore	10.6%	7
Ireland	12.0%	8	Czech Republic	10.0%	8
Czech Republic	9.5%	9	New Zealand	9.9%	9
Singapore	9.0%	10	South Africa	9.8%	10
Argentina	8.9%	11	Korea	8.3%	11
Taiwan	8.0%	12	Turkey	6.6%	12
Portugal	7.9%	13	Australia	6.1%	13
South Africa	7.6%	14	Taiwan	6.0%	14
Australia	7.2%	15	Slovenia	5.9%	15
Iceland	7.1%	16	Germany	5.7%	16
New Zealand	6.7%	17	Switzerland	5.4%	17
Denmark	6.6%	18	Denmark	5.4%	18
Norway	6.1%	19	**United States**	**5.3%**	**19**
Poland	5.5%	20	Finland	5.0%	20
Spain	5.2%	21	Sweden	4.9%	21
United States	**4.9%**	**22**	Austria	4.7%	22
Switzerland	4.6%	23	France	4.6%	23
United Kingdom	4.5%	24	Netherlands	4.5%	24
Canada	4.2%	25	Estonia	4.0%	25
Slovenia	4.1%	26	Portugal	3.6%	26
Mexico	3.6%	27	Belgium	3.2%	27
Hungary	3.5%	28	Ireland	3.0%	28
Finland	3.5%	29	Japan	2.6%	29
Austria	3.5%	30	Hungary	1.9%	30
Sweden	3.3%	31	Norway	1.2%	31
Germany	3.2%	32	United Kingdom	0.0%	32
Belgium	2.8%	33	Spain	-0.3%	33
France	2.6%	34	Iceland	-0.3%	34
Netherlands	2.6%	35	Israel	-0.8%	35
Turkey	1.9%	36	Italy	-2.2%	36
Japan	1.2%	37	Canada	-2.3%	37
Italy	0.9%	38	Mexico	-3.0%	38
Israel	-1.2%	39	Romania	-18.2%	39

Table 2: Constant PPP Dollar Changes in Government Funding[32]

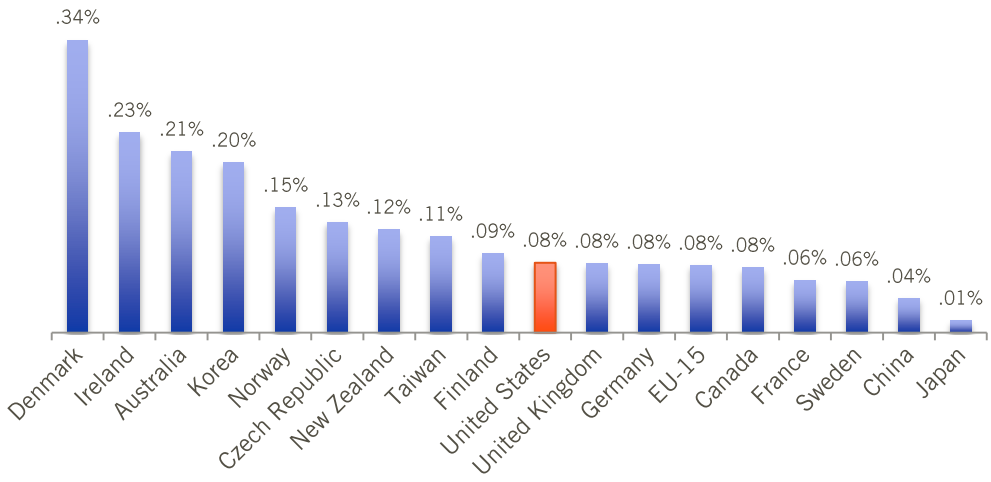

Figure 2: Percentage Point Change in Government Funding for University R&D as a Share of GDP, 2000–2011[33]

Seven countries fund at more than 200 percent that of the United States, while 13 countries fund at more than 150 percent of the United States' level of funding.

There is another way of measuring the rate of change in our university R&D funding, and this shows similarly poor results for the United States. (See Table 2) This measure uses "constant purchasing-power parity dollars," which means that, instead of analyzing growth as a share of GDP, we analyze it as a percentage change in dollar amounts, after adjusting those dollar amounts for differences in goods prices among countries and for changes in prices within those countries over time. On this measure, while the United States' rank is similar to the share of GDP rankings—twenty-second from 2000 to 2011, and nineteenth from 2008 to 2011—we now rank lower than larger economies such as China and Russia. From 2000 to 2011, the United States increased its government funding for university R&D by 4.9 percent per year. (Figure 3) In contrast, China increased its funding by 17.2 percent per year, ranking fourth, and Russia increased its funding by 13.5 percent per year, ranking fifth. On this measure, every East Asian country in our analysis, save Japan, outpaced the United States.

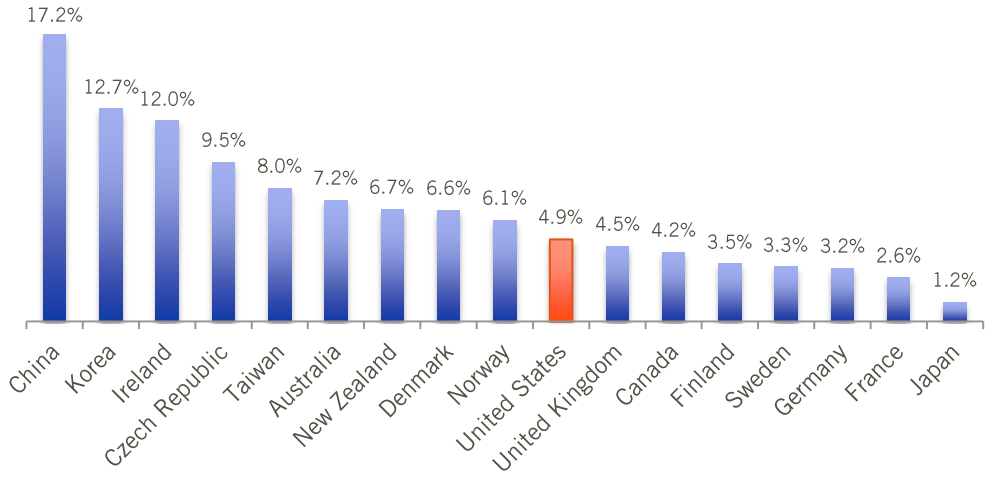

Figure 3: Average Annual Percentage Change in Government Funding for University R&D in Constant PPP Dollars, 2000–2011[34]

BENCHMARKING U.S. BUSINESS FUNDING

Some will argue that while other, more "statist" nations must rely on government funding of university research, the more market-oriented United States relies more on business R&D. However, 17 of the 39 nations have public and private sectors that both invest more in university research than those of the United States. As discussed, public R&D is a complement, rather than a substitute, for private R&D.

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.[35] And, second, even with these "policy innovations," the United States trails far behind other nations when it comes to business support of university research.

In four nations business invests more than twice as much as businesses in the United States on university R&D as a share of GDP.

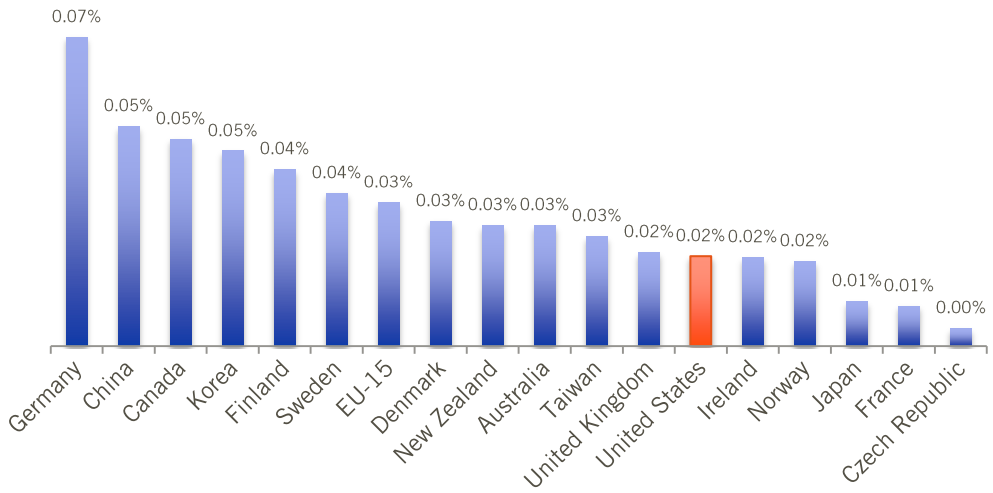

Figure 4: Business Funding for University R&D as a Share of GDP, 2011[36]

In 2011, the United States ranked twenty-seventh out of 39 countries in its level of business funding for university R&D as a share of GDP. (Table 3) While U.S. businesses invested the equivalent of 0.021 percent of GDP on R&D at universities, German companies, for example, invested 0.072 percent, nearly 3.5 times as much—and Germany ranks just third, behind Iceland and Switzerland. East Asian countries such as China, Korea and Taiwan all outrank the United States, with seventh-ranked China coming in at 0.051 percent, nearly 2.5 times that of the United States. Korean businesses invest 0.046 percent of GDP on university R&D, over twice as much as the United States. (See Figure 4—Japan is the sole East Asian exception.) Businesses in the EU-15 invest 0.034 percent of its GDP on university R&D, over 1.5 times that of the United States.[37]

2011 LEVEL			2000 – 2011 CHANGE			2008 – 2011 CHANGE		
Country	Share of GDP	Rank	Country	Pct. Point change	Change rank	Country	Pct. Point change	Change rank
Iceland	.087%	1	Switzerland	+.053%	1	Switzerland	+.034%	1
Switzerland	.082%	2	Iceland	+.040%	2	Mexico	+.018%	2
Germany	.072%	3	Mexico	+.031%	3	Singapore	+.014%	3
Turkey	.068%	4	Netherlands	+.030%	4	Slovenia	+.014%	4
Netherlands	.062%	5	Israel	+.029%	5	Turkey	+.013%	5
Israel[38]	.053%	6	China	+.026%	6	New Zealand	+.009%	6
China	.051%	7	Germany	+.026%	7	Netherlands	+.009%	7
Belgium	.051%	8	Denmark	+.020%	8	China	+.008%	8
Canada	.048%	9	Slovenia	+.019%	9	Ireland	+.008%	9
Korea	.046%	10	Austria	+.017%	10	Denmark	+.006%	10
Finland	.041%	11	Hungary	+.017%	11	South Africa	+.006%	11
Austria	.037%	12	Taiwan	+.016%	12	Belgium	+.006%	12
Slovenia	.037%	13	New Zealand	+.014%	13	Slovakia	+.005%	13
Sweden	.036%	14	Turkey	+.012%	14	Taiwan	+.005%	14
EU-15[39]	.034%	–	Spain	+.011%	15	Germany	+.004%	15
Mexico	.033%	15	Russia	+.011%	16	Russia	+.004%	16
Spain	.030%	16	Ireland	+.009%	17	Czech Republic	+.003%	17
Denmark	.029%	17	EU-15[40]	+.008%	–	Romania	+.002%	18
New Zealand	.028%	18	Finland	+.008%	18	EU-15[41]	+.002%	–
Australia	.028%	19	Slovakia	+.008%	19	Austria	+.002%	19
Hungary	.027%	20	Australia	+.007%	20	Korea	+.001%	20
South Africa	.026%	21	Korea[42]	+.005%	21	United Kingdom	+.000%	21
Taiwan	.026%	22	Belgium	+.004%	22	France	+.000%	22
Russia	.024%	23	Romania	+.004%	23	Italy	+.000%	23
Estonia	.023%	24	Czech Republic	+.002%	24	Luxembourg	-.000%	24
United Kingdom	.022%	25	Portugal	+.001%	25	Argentina	-.000%	25
Singapore	.021%	26	Argentina	+.000%	26	**United States**	**-.000%**	**26**
United States	**.021%**	**27**	Luxembourg	+.000%	27	Poland	-.001%	27
Ireland	.021%	28	Estonia	+.000%	28	Estonia	-.001%	28
Norway	.020%	29	Italy	-.000%	29	Norway	-.001%	29
Japan	.010%	30	Japan	-.000%	30	Portugal	-.001%	30
France	.009%	31	**United States**	**-.001%**	**31**	Japan	-.002%	31
Slovakia	.008%	32	France	-.002%	32	Spain	-.002%	32
Poland	.007%	33	Canada	-.002%	33	Sweden	-.003%	33
Romania	.007%	34	Norway	-.004%	34	Iceland	-.004%	34
Italy	.005%	35	United Kingdom	-.005%	35	Australia	-.004%	35
Czech Republic	.004%	36	Singapore	-.005%	36	Finland	-.005%	36
Portugal	.004%	37	Sweden	-.008%	37	Hungary	-.005%	37
Argentina	.001%	38	Poland	-.009%	38	Canada	-.006%	38
Luxembourg	.000%	39	South Africa	-.012%	39	Israel	-.009%	39

Table 3: Business Funding for University R&D as a Share of GDP[43]

2000 – 2011 CHANGE			2008 – 2011 CHANGE		
Country	Avg. annual pct. change	Rank	Country	Avg. annual pct. change	Rank
Mexico	122.1%	1	Singapore	66.0%	1
Slovakia	88.1%	2	Slovakia	54.0%	2
Argentina	37.0%	3	Czech Republic	43.1%	3
Luxembourg	30.9%	4	Mexico	27.8%	4
Hungary	19.1%	5	Switzerland	20.5%	5
China	18.3%	6	Slovenia	16.7%	6
Czech Republic	17.9%	7	China	16.7%	7
Denmark	16.6%	8	Ireland	16.2%	8
Romania	16.2%	9	Romania	14.8%	9
Taiwan	13.9%	10	New Zealand	13.2%	10
Singapore	13.8%	11	Taiwan	11.3%	11
Israel	12.6%	12	Denmark	10.0%	12
Switzerland	12.2%	13	South Africa	9.7%	13
Russia	11.7%	14	Turkey	8.4%	14
New Zealand	11.1%	15	Russia	7.5%	15
Slovenia	10.8%	16	Netherlands	5.8%	16
Ireland	10.2%	17	Belgium	4.7%	17
Iceland	10.1%	18	Korea	3.5%	18
Austria	8.0%	19	Austria	2.8%	19
Netherlands	7.7%	20	Germany	2.7%	20
Spain	7.2%	21	France	1.3%	21
Turkey	6.5%	22	Italy	0.8%	22
Portugal	5.7%	23	United Kingdom	0.3%	23
Australia	5.7%	24	Norway	0.1%	24
Korea[44]	5.6%	25	Iceland	-0.3%	25
Estonia	5.5%	26	**United States**	**-0.3%**	**26**
Germany	5.4%	27	Sweden	-0.3%	27
Poland	5.1%	28	Poland	-0.6%	28
South Africa	4.5%	29	Israel	-1.6%	29
Finland	4.2%	30	Argentina	-2.2%	30
Belgium	2.5%	31	Estonia	-2.6%	31
Canada	1.7%	32	Canada	-2.7%	32
France	1.5%	33	Australia	-3.3%	33
United States	**1.3%**	**34**	Spain	-3.5%	34
Norway	0.8%	35	Finland	-4.3%	35
Italy	0.8%	36	Japan	-5.7%	36
Sweden	0.5%	37	Hungary	-6.0%	37
Japan	0.4%	38	Portugal	-7.4%	38
United Kingdom	0.1%	39	Luxembourg	-15.3%	39

Table 4: Constant PPP Dollar Changes in Business Funding[45]

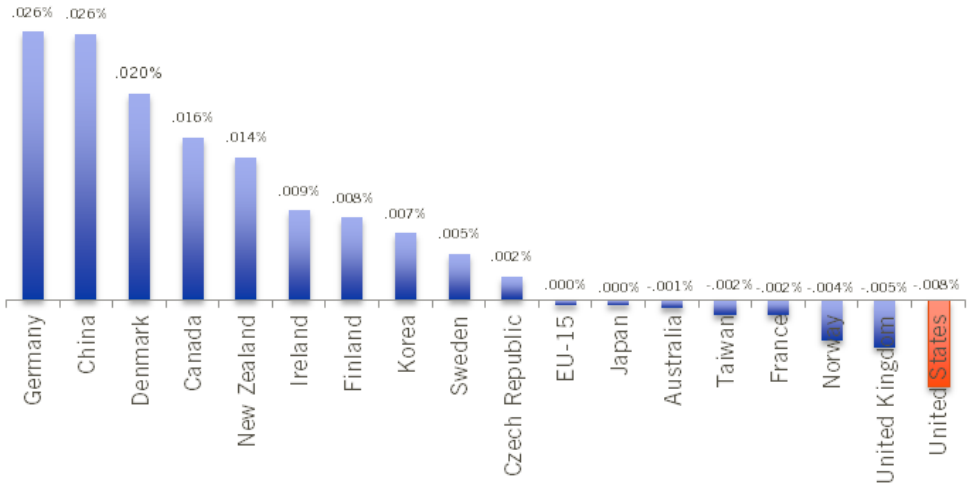

Figure 5: Percentage Point Change in Business Funding for University R&D as a Share of GDP, 2000–2011[46]

Not only is the level of U.S. business funding low relative to other nations, its growth rate is even lower. Using change in the share of GDP, the United States ranks thirty-first from 2000 to 2011, with business funding actually falling as a share of GDP. In constant PPP dollars, the United States ranks thirty-fourth in change from 2000 to 2011. (See Table 4) Indeed, competitor countries saw significant increases in business funding of university R&D in both measures (share of GDP and constant PPP). Germany, for example, saw a 0.026 percent GDP-share increase from 2000 and 2011, which translates to a 5.4 percent per year increase in PPP dollars. China did even better, posting a 0.026 percent GDP-share increase and an 18.3 percent per year PPP-dollar increase. Those numbers for the United States are -0.006 percent and 1.3 percent. (Figures 5 and 6)

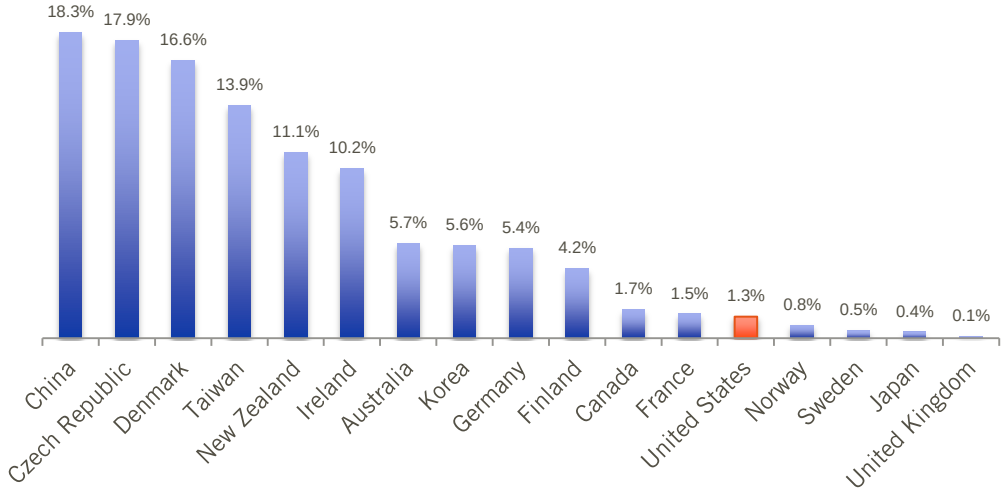

Figure 6. Average Annual Percentage Change in Business Funding for University R&D in Constant PPP Dollars, 2000–2011[47]

At first glance, the sole bright spot would appear to be that the United States has improved its ranking in business funding from 2008 to 2011: in share of GDP change, it rose from thirty-first to twenty-sixth place, and in PPP change, it rose from thirty-fourth to twenty-

sixth place. However, this barely qualifies as an improvement. The GDP-share change was slightly negative, and in PPP dollars the United States actually shrank its funding by 0.3 percent per year over the period.

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 our low rate of change was in fact not principally the federal government (although federal support for doctoral research fellowships has declined in recent years).[48] Federal investment in university R&D as a share of GDP has increased, albeit by a small amount, nearly every year over the past decade.[49] The more important cause of the decline was state governments. As a share of GDP, state government support for university R&D is at the same level as it was in 1991, and only 9 percent higher than it was in 1970.[50] 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, has fallen by over 30 percent over the past decade.[51] (Figure 7)

As a share of GDP, state government support for university R&D is at the same level it was in 1991.

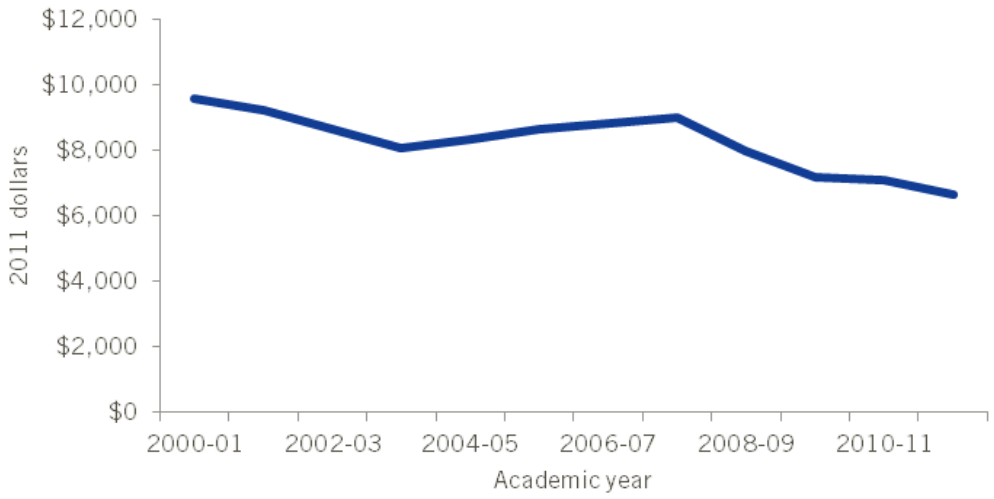

Figure 7: State Appropriations for Higher Education per Full-Time Equivalent Student, 2000–2012[52]

Today, however, the situation has changed. In January 2013, the automatic spending cuts imposed by the 2012 budget sequester went into effect. The sequester immediately cut $8.7 billion from federal research budgets until September 2013, and cut $54 billion off the federal research budget over five years—a 7.9 percent reduction.[53] With 33 percent of federal R&D investment going to universities and university-run R&D centers, this is having a significant impact—one that these rankings, which extend only until 2011, have not yet picked up.[54]

Excluding the effects of the sequestration, which will surely increase these dollar amounts, the United States would need to invest an additional $17 billion per year to get to fifteenth place in government funding, $33 billion per year to get to tenth place, $49 billion to get to fifth place, and an additional $69 billion to match Denmark in first place. ITIF recommends that Congress increase funding for university research (through agencies such

as the National Science Foundation, the National Institutes of Health, the Department of Defense, and Department of Energy) by at least $45 billion per year, which would bring the United States into seventh place.

With regard to business funding of 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, as the share of a firm's patents coauthored with university researchers increased by 1 percent, the number of patents per research dollar invested by the firm increased by between 4 percent and 7 percent.[55] 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.[56] For example, France provides a 60 percent flat tax credit for companies collaborating with universities. Italy provides a 40 percent credit and Spain provides a 10 percent credit.[57] 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 expenditure.[58] In contrast, the U.S. R&D credit is actually *less generous* for research that firms fund at universities.[59]

Congress should allow firms to take a flat credit of 20 percent for all collaborative research conducted at universities.

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 by granting credit eligibility to collaborations between any and all businesses and universities (or federal laboratories).[60]

CONCLUSION

Given the importance of university research to the U.S. innovation system, and the primary role that innovation plays in economic growth, competitiveness, and job creation, the data presented support the view that the United States can no longer rest on its laurels and assume that U.S. universities will continue to lead the world, just because they once did. The reason they led was no accident. It had nothing to do with our geography, our culture, or even our size. Instead, it had everything to do with the fact that after World War II, we, 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.[61]

As ITIF found in its 2011 report benchmarking overall U.S. competitiveness, *The Atlantic Century II*, the United States ranks fourth out of 44 countries in overall innovation-based competitiveness but second-to-last in the rate of change in competiveness over the last decade.[62] The conclusion is that, in a highly competitive globalized economy, relative decline *is* absolute decline, and this report presents one more piece of evidence that the U.S. innovation system is not keeping up with global competition. It is therefore incumbent upon policymakers to recognize the nature of the challenge and then to 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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The Information Technology and Innovation Foundation (ITIF) is a Washington, D.C.-based think tank at the cutting edge of designing innovation strategies and technology policies to create economic opportunities and improve quality of life in the United States and around the world. Founded in 2006, ITIF is a 501(c) 3 nonprofit, non-partisan organization that documents the beneficial role technology plays in our lives and provides pragmatic ideas for improving technology-driven productivity, boosting competitiveness, and meeting today's global challenges through innovation.

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