Industry Funding of University Research: Which States Lead?

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Industry funding of university research is an important component of U.S. academic research and industrial innovation, especially as federal funding for universities continues to decline and companies cut back on basic, intramural research. However, U.S. states vary dramatically on the extent to which their research universities attract industry support. In part, this is because of policy and administrative choices states and universities make. All states, but especially the laggards, would benefit from policies to attract more industry research funding, particularly as such funding appears to generate technology-based economic activity at the state level.

STATE RANKINGS ON INDUSTRY FUNDING OF UNIVERSITY RESEARCH

Before WWII, industry funded a significant share of university R&D. However, as federal research funding increased dramatically during and after the war, industry's share fell, to just around 3 percent in the 1970s. That percentage started to rise again in the late 1970s and early 1980s, in part due to the growth of more science-based industries, including information technology (IT) and biopharmaceuticals, but also because of federal and state policy changes. For example, the Bayh Dole Act in 1980 gave universities rights to intellectual property generated from federal funding, which spurred many universities to work more with industry. Separately, the National Science Foundation during the Reagan administration developed new industry partnership programs like the Engineering Research Center program, while many state governments developed university-industry research centers to grow technology-oriented businesses. Both of these types of initiatives spurred industry funding. As a result, the share of university research funded by industry increased from 4.9 percent in 1980 to a high of 7.4 percent in 1999. The share has fallen since then, even as federal funds have dropped overall. In 2016, industry funded just 5.9 percent of U.S. academic research.

This share varies considerably between states, however, from a high of 12.1 percent in North Carolina to just 1.7 percent in Nevada. As shown in table 1, the five leading states are North Carolina, Georgia, Kansas, Ohio, and Missouri. Leading states generally have strong research universities and at least a moderately robust advanced-industry economy with firms that benefit from more industrially relevant university research. In addition, many of the leading states, such as Georgia, North Carolina, Ohio, and Utah have long had robust state-supported technology-commercialization programs, such as the Georgia Research Alliance, which try to link industry and university research.[1]

The states where industry contributes less than 2 percent of all research funding are Nevada, Rhode Island, Nebraska, Hawaii, South Dakota, New Mexico, and Montana. Lagging states generally have lower-ranked, less-well-funded research universities and fewer technology-based firms.

Strong biomedical programs are associated with higher shares of industry funding because the life sciences industry is heavily dependent on scientific discoveries and is willing to fund university researchers doing cutting-edge work.

Table 1: Share of University Research Supported by Industry

North Carolina	12.1%	**Florida**	4.5%
Georgia	10.6%	**Michigan**	4.1%
Kansas	9.5%	**Arkansas**	3.9%
Ohio	8.7%	**New Hampshire**	3.9%
Missouri	8.6%	**Wyoming**	3.7%
Oklahoma	7.6%	**New Jersey**	3.7%
New York	7.5%	**Kentucky**	3.7%
Massachusetts	7.4%	**Minnesota**	3.6%
Utah	7.3%	**Washington**	3.5%
South Carolina	6.6%	**Maine**	3.4%
Texas	6.5%	**Alaska**	3.0%
California	6.4%	**Delaware**	3.0%
Alabama	6.4%	**Wisconsin**	3.0%
Connecticut	6.2%	**Idaho**	2.9%
Illinois	5.9%	**Vermont**	2.8%
Iowa	5.9%	**Maryland**	2.7%
Indiana	5.6%	**Arizona**	2.7%
Pennsylvania	5.5%	**West Virginia**	2.1%
Colorado	5.5%	**Montana**	1.9%
Virginia	5.4%	**New Mexico**	1.9%
Mississippi	5.3%	**South Dakota**	1.9%
North Dakota	4.8%	**Hawaii**	1.8%
Tennessee	4.8%	**Nebraska**	1.8%
Oregon	4.7%	**Rhode Island**	1.8%
Louisiana	4.6%	**Nevada**	1.7%
		U.S. Average	5.9%

When it comes to individual academic institutions, the gaps are even larger. Among the top 50 research universities (in terms of total research funding), the top 10 have on average five times more industrial support for university research than the bottom 10. (See table 2.) The leaders have either strong biomedical research programs (e.g., Duke; University of Alabama, Birmingham; University of Texas, MD Anderson; and University of Pennsylvania) or strong engineering programs (e.g., UT Austin, North Carolina State, Ohio State, and MIT), or in some cases both. Strong biomedical programs are associated with higher shares of industry funding because the life sciences industry is heavily dependent on scientific discoveries and is willing to fund university researchers doing cutting-edge work. Likewise, universities with strong engineering programs, particularly in computer science and electrical and mechanical engineering, are often able to obtain significant industry support because the research in these fields is often highly relevant to technology companies.

Table 2: Leading Universities Among the Top 50, by Industry Share of R&D Funding[2]

University	Overall Rank	Total Funding ($1,000s)	Industry Funding ($1,000s)	Industry Share
Duke	10	$1,055,778	$232,793	22.0%
MIT	14	$946,159	$159,451	16.9%
Ohio State	22	$818,464	$127,731	15.6%
North Carolina State	47	$489,918	$71,018	14.5%
Washington U., Saint Louis	28	$741,115	$84,182	11.4%
U. Texas, Austin	34	$621,692	$67,755	10.9%
U. Texas, MD Anderson Cancer Center	19	$852,095	$89,454	10.5%
Stanford	9	$1,066,269	$99,469	9.3%
U. Alabama, Birmingham	42	$537,825	$50,040	9.3%
University of Pennsylvania	3	$1,296,429	$116,812	9.0%

Nine of the 10 universities with the lowest share of industry research support among the top 50 are public universities. Two of them are in Maryland: Johns Hopkins (which receives the most total research funding) and University of Maryland (which receives the lowest share of industry funding of any of the top 50 research universities). Interestingly, none of these universities are in states with lagging technology-based economies. States like Maryland, Michigan, Pennsylvania, North Carolina, and Washington are anything but advanced-industry laggards, but for some reason these universities attract very little industry funding as a share of total funding.

Table 3: Lagging Universities Among the Top 50, by Industry Share of R&D Funding[3]

University	Overall Rank	Total Funding ($1,000s)	Industry Funding ($1,000s)	Industry Share
U. Maryland, College Park	41	539,388	6,345	1.2%
Michigan State	36	613,369	10,509	1.7%
U. Pittsburgh	17	889,793	16,701	1.9%
U. Wisconsin, Madison	6	1,157,680	23,930	2.1%
U. Colorado, Boulder	49	453,123	10,252	2.3%
U. Arizona	38	604,464	13,708	2.3%
Johns Hopkins	1	2,431,180	75,327	3.1%
U. North Carolina, Chapel Hill	11	1,045,338	33,748	3.2%
U. Washington, Seattle	5	1,277,679	43,396	3.4%
Arizona State	44	518,239	17,683	3.4%

States with higher shares of industry support for university R&D have strong research universities.

Of the top 220 universities that received more than $35 million in total research funding in 2016, the top three in terms of industry share of research funding were the Colorado School of Mines (23.9 percent), Wichita State University (50.3 percent), and SUNY Polytechnic Institute (53 percent). The Colorado School of Mines ranked third because its focus is on practical problems of interest to the mining industry. Wichita State's strong performance is in part because it is has built up a world-class aerospace engineering program to align with the needs of the local aerospace industry hub in Wichita.[4] And a key reason why SUNY leads the nation is because the state of New York and the Albany region have established, in partnership with the semiconductor industry, a world-class nanotechnology center related to semiconductors.[5]

IMPACTS AND POLICY ISSUES

Some might argue that leading states and universities are those with lower-quality research. But in fact, states with higher shares of industry support for university R&D have strong research universities. For example, there is a small positive correlation of 0.08 between industry funding and science and engineering output per $1 million of academic R&D. This suggests industry R&D is not a substitute for strong academic science quality. Interestingly, there is a small, negative correlation (-0.12) between total federal R&D funding (per worker) and industry share of R&D, suggesting that states that receive higher levels of federal funding may be less "hungry" to attract industry funding.

Some, especially on the left, decry industry funding of research university as somehow corrupting universities and turning them away from their "true" mission of knowledge discovery for its own sake.[6] However, as North Carolina State Professor Denis Gray has

documented, industry-university partnerships have no negative effects on academic freedom.[7] It is simply not the case that industry funding comes at the price of high-quality, independent research. If it did, then institutions such as Stanford and MIT should be worse than second-tier universities in their research quality, given how much money they receive from industry. In those and many other cases, high-quality, independent research attracts industry support. The key is not the independence or even the phase of research, but rather the orientation. Universities focused more on what Princeton Professor Donald Stokes termed "Pasteur's' quadrant" research—basic research directed at a specific challenge or problem—appear to be ones that are more likely to receive industry funding.[8]

Having strong industry funding of a state's university research looks like it pays off in economic benefits. There are modest positive correlations between the share of a state's university research supported by industry and its strength in key innovation variables such as high-tech startups (0.15), venture capital (0.28), high-tech jobs (0.14), and scientists and engineers (0.19).[9] Industry research funding is also associated with stronger university technology output, with a correlation of 0.26 between industry share and academic patents.[10] Moreover, interaction with industry as a STEM graduate student is associated with significantly greater likelihood of producing intellectual property (e.g., patents, invention disclosure, etc.).[11]

If states want to boost their technology economies one way to do that besides increased funding of university research is to establish policies specifically focused on spurring universities to be more focused attracting industry research funding.

There appears to be some positive relationship between state science and technology policy and the share of university research funded by industry. For example, there are small positive relationships between industry funding share and the presence of a state R&D tax credit (0.09), and between industry funding and state government agency R&D funding (0.08).[12]

Given the large federal budget deficit coupled with the ideologically driven political battles over domestic spending in Washington, as many Republicans focus on cutting spending while many Democrats focus on preserving and even expanding entitlement spending, the odds of the federal government increasing federal support for research universities any time soon is small. As such, if states want to boost their technology economies, one way to do that, besides increasing their own funding of university research, is to establish policies specifically focused on spurring universities to be more focused attracting industry funding. States should target university research funding increases to areas and programs linked to the technology needs and capabilities of in-state industries and firms. They should modify their state R&D tax credits to give firms a larger credit for funding academic research.[13] And they should tie a small portion of total higher education funding to how well individual universities do at obtaining industry funding for R&D, as some smaller nations, such as Sweden and Finland, have done. Institutions that do better would receive modest incentive rewards.

Finally, even with a political unwillingness to increase funding for research, federal science spending could be more targeted to better leverage industry funding. For example, existing NSF funds could be reprogramed to more industry-oriented programs, like the Industry-

University Center Research program and the Engineering Research Center program. Currently, for NSF, Congress, and the academic community as a whole, these kinds of industry-university partnership models are at best an afterthought and at worst an attack on the ivory tower model of STEM education. These attitudes need to change.

ENDNOTES

1. See: www.ssti.org for more information on state technology programs.
2. National Science Foundation, Science and Engineering Indicators, Table 5, Higher education R&D expenditures at higher education institutions in both survey populations, ranked by all R&D expenditures, by source of funds: FY 2016, https://ncsesdata.nsf.gov/herd/2016/html/HERD2016_DST_05.html, accessed December 20, 2017.
3. Ibid.
4. Wichita State University, Aerospace Engineering, http://www.wichita.edu/thisis/home/?u=aero_eng, accessed December 20, 2017.
5. SUNY Polytechnic Institute, Center for Semiconductor Research (CSR), https://sunypoly.edu/research/centers-programs/csr.html, accessed December 20, 2017.
6. Jennifer Washburn, *University, Inc.: The Corporate Corruption of Higher Education* (New York: Basic Books, 2006).
7. Denis O. Gray and S. George Walters, *Managing the Industry/University Cooperative Research Center* (Columbus, OH: Battelle Press, 1998), http://www.ncsu.edu/iucrc/PDFs/PurpleBook/FrontSection.pdf.
8. Donald E. Stokes, *Pasteur's Quadrant: Basic Science and Technological Innovation* (Washington, DC: Brookings Institution Press, 1997).
9. These variables were taken from: Robert D. Atkinson and John Wu, "The 2017 State New Economy Index" (Information Technology and Innovation Foundation, June 2017), https://itif.org/publications/2017/11/06/2017-state-new-economy-index. See also: John Wu and Robert D. Atkinson, "How Technology-Based Start-Ups Support U.S. Economic Growth" (Information Technology and Innovation Foundation, November 2017), https://www.itif.org/publications/2017/11/28/how-technology-based-start-ups-support-us-economic-growth.
10. National Science Board, *Science & Engineering Indicators 2016* (Arlington, VA: National Science Foundation, 2016), Table 8-48, "Academic Patents Awarded per 1,000 Science, Engineering, and Health Doctorate Holders in Academia," https://www.nsf.gov/statistics/2016/nsb20161/uploads/1/13/tt08-48.pdf.
11. Jennifer Shields Schneider, "A Multivariate Study of Graduate Student Satisfaction and Other Outcomes within Cooperative Research Centers" (Raleigh: North Carolina State University, 2007), http://www.lib.ncsu.edu/resolver/1840.16/52.
12. National Science Board, *Science & Engineering Indicators 2016* (Arlington, VA: National Science Foundation, 2016), Table 8-42, "State Agency R&D Expenditures per $1 Million of Gross Domestic Product," https://www.nsf.gov/statistics/2016/nsb20161/uploads/1/13/tt08-42.pdf.
13. Matthew Stepp and Robert D. Atkinson, "Creating a Collaborative R&D Tax Credit" (Information Technology and Innovation Foundation, June 2011), https://itif.org/publications/2011/06/09/creating-collaborative-rd-tax-credit.

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