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"Stim-Novation": Investing in Research to Spur Innovation and Boost Jobs[1]

BY DANIEL CASTRO AND ROB ATKINSON | JANUARY 27, 2009

The ideal fiscal stimulus measure not only creates jobs and drives economic activity in the short run but also boosts quality of life and economic growth in the medium and long run. Support for scientific research in the stimulus package accomplishes both goals.

Scientific research underpins the great technological advances of the past century, from mapping the human genome to the development of the Internet. Increased investment in scientific research, even if the increase is for only one or two years, will lead to long term payoffs in the form of more modern research infrastructure and laboratories, additional discoveries and innovation, and increased U.S. competitiveness.

Moreover, including substantial support for research in the stimulus package will create and retain a sizeable number of jobs, in a wide array of occupations, such as scientists, engineers, technicians, construction workers, and workers making scientific equipment. Spurring an additional $20 billion investment in our national research infrastructure will create or retain approximately 402,000 American jobs for one year.

Overview of U.S. Research and Development

Federal funding for research helps support private, university and federal laboratory research. Federal funds account for approximately 9 percent of R&D performed by industry. In addition, the federal government supports industrial research through the R&D tax credit. Scholarly research suggests that every federal dollar spent on the R&D credit spurs $1 to $2 of business R&D.

Federal funds account for an even larger share of the research efforts of colleges and universities, providing approximately 60 percent of R&D performed by colleges and universities.[2] In particular, the National Science Foundation (NSF) provides 20 percent of all federal dollars spent on basic research at American colleges and universities.[3]

Finally, much research also occurs in 36 federally-funded research and development centers (FFRDCs), laboratories that perform key mission-oriented research and increasingly play a role in spurring commercial innovations.[4] The targeted research performed at these institutions will continue to advance technological progress in important areas such as information technology, nanotechnology and environmental science.

Federal support for R&D overall is critical to innovation. As Fred Block and Matthew R. Keller found in a recent ITIF report (*Where Do Innovations Come From? Transformations in the U.S. National Innovation System, 1970–2006*) the lack of funding is cause for concern because the payoff for government support for research

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and development funding is considerable. Their analysis found that in 2006 only 11 of the 88 entities that produced award-winning innovations were not beneficiaries of federal funding.[5]

Unfortunately, as we have moved into an innovation-driven knowledge economy characterized by intense international competition, the United States has not kept pace with other countries in committing the same level of resources to research and development (R&D). In fact, U.S. R&D intensity (R&D as a percentage of GDP) trails many other nations.[6] Whereas U.S. total R&D investment represented an increasing share of world R&D investment from 1993 to approximately 1998, the U.S. share of world R&D investment has been receding since then.[7] The major reason for this slippage has been a slowdown in federal R&D investment since the mid-1990s, as total federal R&D spending grew at a sluggish 2.5 percent per year from 1994 to 2004—much lower than its long-term average of 3.5 percent growth from year 1953 to 2004.[8] Moreover, the United States is one of only a few nations where total investment in R&D as a share of GDP actually fell from 1992–2005, largely because of that decline in public R&D support.[9]

Moreover, there is disturbing evidence that our nation's research infrastructure—the equipment and facilities used for R&D—is also falling behind. If the United States is to regain its lead in the global innovation economy the nation's research infrastructure will have to be upgraded with state-of-the-art research equipment, such as DNA analysis equipment for cancer research, nanoengineering research facilities for new materials and systems, and supercomputers to create virtual reality environments. This research infrastructure shortfall is particularly acute for our nation's universities. As the National Science Board reports, "Over the past decade, the funding for academic research infrastructure has not kept pace with rapidly changing technology, expanding research opportunities, and increasing numbers of users."[10] Moreover, the trend since the Board issued its report has been in the wrong direction, with university research equipment expenditures falling 7 percent from 2003 to 2006 (in constant dollars).[11] In some fields the decline is even greater. For example, computer science investment in research equipment is down by over one-third while in life sciences it is down by 15 percent over this period. Because of this shortfall, the Board recommends that Congress appropriate an additional $2 billion per year to provide scientists and engineers with advanced tools, facilities, and cyber infrastructure.

While spurring investment in research as part of the stimulus package cannot make up for the nation's systemic shortfall in research funding, it can help close the gap, particularly in research infrastructure.

Investing in Research Can Play a Key Role in Economic Stimulus

Some economists believe that traditional measures such as tax cuts for individuals and businesses, funding for state and local government, and investment in traditional physical infrastructure are the best measures for spurring economic activity in a downturn. But providing support for research can play an equally, if not more effective role in spurring economic activity.

In part this is true because in the last two decades economic downturns have also impacted public and private organizations conducting research. In each of the last two downturns (1992-93 and 2001-02) total investment in R&D fell by over 2 percent, with industry funding declining even more. And the current recession is to see even more significant declines. Not surprisingly these declines in research funding lead to job losses for researchers and others employed in related fields. In the 1992-3 recession, unemployment of scientists and engineers went up significantly. For example, the unemployment rate for electrical engineers tripled, while the rate for computer scientists more than doubled. In the recession of 2001-02 the unemployment rate for electrical engineers increased to more than 5 times its rate of the late 1990s, while the unemployment rate for computer scientists increased by 3 times.[12] And while normally the increased unemployment rates for researchers in recessions is still lower than the overall unemployment rate, in the last recession this was not true for electrical engineers.

This suggests that efforts to increase research spending, even on a temporary basis, can reduce the number of researchers who become unemployed, leading to faster overall national recovery.

Estimate of the Impact of Investing $20B in Research Infrastructure

Including support for research in the stimulus package will lead to significant job creation. We estimate

TABLE 1: JOB ESTIMATE OF $20B INVESTMENT IN RESEARCH INFRASTRUCTURE

		INDUSTRY		
	TOTAL	SCIENTIFIC RESEARCH	EQUIPMENT	FACILITIES
DIRECT AND INDIRECT JOBS	**196,190**	97,345	27,270	71,575
INDUCED JOBS	**205,640**	119,595	32,340	53,705
DIRECT, INDIRECT AND INDUCED JOBS	**401,830**	216,940	59,610	125,280

that spurring an additional $20 billion investment in research would create approximately 402,000 American jobs for one year. We are not recommending or endorsing a specific level of investment, rather only demonstrating the impact that such an investment would have on employment. Our estimate projects that this level of funding would create or retain approximately 196,000 direct and indirect jobs. Direct jobs are those created specifically by new spending, such as hiring new researchers in federal laboratories or hiring contractors to renovate existing facilities. Indirect jobs are those created to supply the materials and other inputs to production, such as the manufacturers of components to scientific equipment. We also estimate an additional $20 billion per year would create or retain 206,000 induced jobs. Induced jobs are those created by newly employed (or retained) workers spending their paychecks, thus creating jobs in establishments such as restaurants and retail stores.

For the purpose of our analysis, we assume the following breakdown in spending: 50 percent of final funds go to fund research, 25 percent of funds go to purchases of new research equipment, and 25 percent of funds go to building and renovating research facilities.[13] Again, this allocation is not a recommendation, but merely used to illustrate the impact of such an investment. The economic stimulus packages outlined by the House Ways and Means Committee and the Senate Appropriations Committee offer a similar breakdown, although both lack sufficient detail to model exactly.[14]

ITIF calculates the projected employment numbers based on RIMS II final-demand employment multipliers provided by the U.S. Department of Commerce's Bureau of Economic Analysis. The employment multipliers provide an estimate of the national impact on jobs of increasing final-demand in various industries. For this calculation, ITIF breaks down spending into three categories: scientific research, equipment, and facilities. We assume approximately one-third of the funds spent on equipment is lost to imports.[15] We also assume no significant direct loss to imports for spending on facilities and research (i.e. we assume American workers are hired to build and renovate laboratories and grants are awarded to American researchers).

Many of the direct and indirect jobs would be created in scientific fields that employ high-skilled high-wage workers. The mean annual salary of life, physical and social science occupations is $62,020, with researchers working in the hard sciences earning significantly more, such as physicists ($99,000) and biochemists and biophysicists (85,290).[16] Research jobs are not limited, however, to only those with advanced degrees: science technicians (in the physical sciences) earn on average $53,000 annually. These workers operate and maintain much of the laboratory equipment and conduct much of the research. These jobs typically only require a bachelor's degree, an associate degree or completion of a two-year training program.[17] Jobs in the industries providing research equipment range from production jobs involved in making and assembling the equipment to back office jobs such as accounting, marketing and sales. Jobs would also be created in the construction industry, helping to employ out of work construction workers who formerly worked building residential housing. Jobs created from induced employment would likely reflect the average wages for the economy overall ($40,690).[18]

Funding for additional R&D would likely come from increasing the availability of competitive grants available for private, non-profit and college and university researchers. These funds could be awarded through the existing programs at government agencies to award competitive grants. Funds could also be allocated specifically to renovation and restoration projects, construction of new facilities and for specific scientific equipment. For example, NSF funds many of the critical investments in key scientific research equipment and instrumentation such as "giant optical and radio telescopes, Antarctic research sites, high-end computer facilities and ultra-high-speed connections, ships for ocean research, sensitive detectors of very subtle physical phenomena and gravitational wave observatories."[19] NSF also routinely "makes awards to universities and non-profit organizations to construct, manage, and operate large facility projects."[20]

Additional stimulus could also come from increased industry spending on R&D. Congress could spur additional industry investment in R&D by increasing the R&D tax credit, and in particular, by expanding the Alternative Simplified Credit (ASC).[21]

Conclusion

Spurring additional investment in research will modernize our nation's research laboratories and facilities, spur additional research, and provide an immediate boost in employment for our economy.

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Endnotes

1. "Stim-novation spending combines economic stimulus with measures that strengthen the economy's capacity for innovation." See Fred Block and Matthew Keller, "Building on Success: Reforming the U.S. Innovation System" UC Davis (December 1, 2008) <www.longviewinstitute.org/stimnovation2>.

2. "National Patterns of R&D Resources: 2007 Data Update, Table 1: U.S. research and development expenditures, by performing sector and source of funds: 1953-2007," *U.S. National Science Foundation* (November 2008) <www.nsf.gov/statistics/nsf08318/pdf/tab1.pdf> (accessed January 15, 2009).

3. "NSF at a Glance," *U.S. National Science Foundation* (2008) <nsf.gov/about/glance.jsp > (accessed on January 15, 2009).

4. Fred Block and Matthew R. Keller, *Where Do Innovations Come From? Transformations in the U.S. National Innovation System, 1970-2006* (Washington, D.C.: Information Technology and Innovation Foundation, July 2008) <www.itif.org/files/Where_do_innovations_come_from.pdf> (accessed January 15, 2009).

5. Ibid.

6. Stephen J. Ezell and Robert D. Atkinson, *RAND's Rose-Colored Glasses: How RAND's Report on U.S. Competitiveness in Science and Technology Gets it Wrong* (Washington D.C.: Information Technology and Innovation Foundation, September 2008): 11–13 < www.itif.org/index.php?id=174> (accessed January 15, 2009).

7. Stephen Ezell, "Benchmarking Foreign Innovation," *ScienceProgress* (2008): 35-46 <www.scienceprogress.org/wp-content/uploads/2009/01/issue2/ezell.pdf>.

8. Titus Galama and James Hosek, *U.S. Competitiveness in Science and Technology* (Santa Monica, California: RAND Corporation, 2008): 67.

9. Organization for Economic Co-operation and Development, *OECD Science Technology and Industry Scoreboard* 2005 (Paris: OECD 2005).

10. The National Science Board Website <www.nsf.gov/nsb/> (accessed October 27, 2008). Another indicator of this is that federal funding for R&D Plant is down to $3.6 billion in 2007 from $4.5 billion in 2000. (In constant 2000 dollars this equates to roughly $3.0 billion). Melissa Pollak, "Federal R&D Funding Down in FY 2007," *National Science Foundation* (Arlington, VA, February 2008) <www.nsf.gov/statistics/infbrief/nsf08303/nsf08303.pdf> (accessed October 28, 2008).

11. National Science Board, "Science and Engineering Indicators 2008: Volume 2: Appendix Tables," *National Science Foundation* (Arlington, VA, 2008) <www.nsf.gov/statistics/seind08/pdf_v2.htm>.

12. Ron Hira, "Offshore Outsourcing & Off-shoring of Technology Jobs: Impacts & Policy Dialogue," Presentation to AAAS S&T Policy Forum (April 23, 2004) <www.aaas.org/spp/rd/hira404.pdf> (accessed January 15, 2009).

13. "Approximately 25 percent of NSF's funding is directed toward research equipment and the construction, upgrade, and operation of research facilities." See "National Science Foundation" *U.S. Office of Management and Budget* (2004) <www.whitehouse.gov/omb/budget/fy2004/nsf.html> (accessed on January 15, 2009).

14. The executive summary of the House version of the American Recovery and Reinvestment Act lists "$10 billion for science facilities, research, and instrumentation." The more detailed proposal for "Scientific Research" totals approximately $12 billion. By our estimate, the proposal allocates 62 percent of funds to research grants, 5 percent to equipment and 33 percent to construction. However, specific detail on the allocation of these funds is not available, and likely a percentage of the funds allocated to research and construction would be spent on equipment (i.e. equipment bought by researchers or equipment bought to restore a laboratory).

    The plan also outlines spending for another $23 billion in related areas including, $20 billion for renovating and modernizing K-12 schools and higher education; $1 billion for education technology, including computer and science labs; and $2 billion for energy efficiency and renewable energy research grants.

    The American Recovery and Reinvestment Plan outlined by the Senate Appropriations Committee includes $19.5B for modernizing and improving energy efficiency of public schools and higher education facilities; $1.4B for NSF for grants and infrastructure; $1.5B for NASA research; $3.5B for NIH biomedical research; and $40B for the Department of Energy, with an unspecified portion going to research.

    For more details on the House plan see "Summary: American Recovery and Reinvestment" U.S. Congress, Committee on Appropriations (January 15, 2009) <appropriations.house.gov/pdf/PressSummary01-15-09.pdf>.

    For more details on the Senate plan see "Senate Appropriations Committee Releases Highlights of American Recovery and Reinvestment Plan" *U.S. Senate Committee on Appropriations* (January 23, 2009) <appropriations.senate.gov/News/2009_01_23_Senate_Appropriations_Committee_Releases_Highlights_of_American_Recovery_and_Reinvestment_Plan.pdf>.

15. This leakage factor was calculated using U.S. Bureau of Economic Analysis data to find the ratio of total import of goods to gross output of the manufacturing industry.

16. "May 2007 National Occupational Employment and Wage Estimates," *U.S. Bureau of Labor Statistics* (September 23, 2008) <www.bls.gov/oes/current/oes_nat.htm> (accessed January 25, 2009).

17. "Science Technicians" *U.S. Bureau of Labor Statistics* (December 18, 2007) <www.bls.gov/oco/ocos115.htm> (accessed January 25, 2009).

18. "May 2007 National Occupational Employment and Wage Estimates," *Bureau of Labor Statistics, U.S. Department of Commerce (September 23, 2008)* <www.bls.gov/oes/current/oes_nat.htm#b00-0000> (accessed January 25, 2009).

19. "NSF at a Glance" *U.S. National Science Foundation* (2008) <nsf.gov/about/glance.jsp> (accessed on January 15, 2009).

20. "National Science Foundation" *U.S. Office of Management and Budget* (2004) <www.whitehouse.gov/omb/budget/fy2004/nsf.html> (accessed on January 15, 2009).

21. For more information see Robert Atkinson, "Expanding the R&D Tax Credit to Drive Innovation" (Washington, D.C.: Information Technology and Innovation Foundation, 2007) <www.itif.org/files/ExpandR&D.pdf>.