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# Innovation in America: Opportunities and Obstacles

before the

**Commerce, Science, and Transportation**
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Madam Chair, Senator LeMieux, and members of the Committee, I appreciate the opportunity to appear before you to discuss the critical question of U.S. innovation and technology commercialization and what the federal government can do improve it.

I am the president of the Information Technology and Innovation Foundation. ITIF is a nonpartisan research and educational institute whose mission is to formulate and promote public policies to advance technological innovation and productivity. Recognizing the vital role of technology in ensuring American prosperity, ITIF focuses on innovation, productivity, and digital economy issues.

For over 50 years after WWII, the United States was the global innovation leader. However, in the last decade we have lost that lead and our rank appears to be rapidly slipping. The effects are seen in increased trade deficits, relatively lower increases in standards of living, higher unemployment, and even the severity of the current economic crisis.

While ultimately businesses and other organizations (e.g., universities) will have to take the lead in driving innovation, the federal government can and should take a much more proactive role. There are two key kinds of activities the federal government can take to spur innovation.

First, we need to better organize the federal government to support innovation. A key first step would be for Congress to charge the administration with the creation of a national competitiveness and innovation strategy. In addition, Congress should consider creating an Office of Innovation Review within OMB to review all proposed federal regulations for their impact on innovation. Finally, Congress should consider creating a new National Innovation Foundation that would house innovation-based programs now housed at agencies like NSF and NIST.

Second, it's time for federal agencies, and particularly NSF, to focus much more on commercialization and industry partnerships. NSF is almost exclusively focused on providing funding for scientific research to universities and makes little effort to ensure that these results are commercialized and lead to jobs in the United States. Congress can play a key role in spurring more industry partnerships and commercialization at universities and federal labs. First, as Congress increases science agency budgets, ITIF recommends that programs that focus specifically on industry partnerships and technology commercialization should receive a large share of the increases. Second, Congress should consider requiring NSF to tie funding to universities to the extent the latter work closely with industry and commercialize technology. Third, Congress should consider creating a new program to support university, state, and federal laboratory technology commercialization initiatives, funded by a small "tax" levied on federal research (the way SBIR and STTR are funded). Finally, we encourage Congress to expand R&D tax credit generally and also the scope of the current collaborative R&D credit.

We believe these steps would significantly increase technology innovation and related jobs in the United States. Moreover, these steps could be taken with almost no net negative budgetary impact..

**WHAT IS AT STAKE: WHY IS INNOVATION IMPORTANT?**

In recent years, a growing number of economists have come to see that it is not so much the accumulation of more capital that is the key to improving standards of living; rather it is innovation—the creation and adoption of new products, services, processes, and business models.[1] When economists Klenow and Rodriguez-Clare decomposed the cross-country differences in income per-worker into shares that could be attributed to physical capital, human capital, and total factor productivity, they found that more than 90 percent of the variation in the growth of income per worker was a result of how effectively capital is used (e.g. innovation).

Innovation is also essential if we are to create better jobs for all Americans. Properly conceived, innovation is not just about creating more jobs for engineers and managers in high technology industries. It is also about providing higher wage jobs for workers in manufacturing and "low-tech" services. Innovation also benefits not just the notable high-tech regions of the nation, but all regions.

The growth of international trade also makes it increasingly important for the United States to innovate. Low-wage nations can now more easily perform labor-intensive, difficult-to-automate work. Indeed, it has become difficult for the United States to compete in such industries as textiles and commodity metals. Notwithstanding the efforts of countries like China and India to compete in advanced technology industries, for the foreseeable future their competitive advantage should remain in more labor-intensive, less complex portions of the production process.

By contrast, the United States' primary source of competitive advantage should be in innovation-based activities that are less cost-sensitive. To illustrate, a software company can easily move routine programming jobs to India where wages are a fraction of U.S. levels. There is less economic incentive for moving advanced programming and computer science jobs there because innovation and quality are more important than cost in influencing the location of these jobs.

**THE UNITED STATES NO LONGER LEADS THE WORLD IN INNOVATION**

The combination of its policy and non-policy strengths, combined with policy and non-policy weaknesses in other nations, enabled the United States to lead the world in innovation for the rest of the century after WWII. However, changes at home and abroad have meant that while the United States continues to have many strengths we no longer lead the world in innovation. We see signs of this relative decline in a wide array of indicators. The decline began at least in the 1980s, with the United States' shares of worldwide R&D investment, U.S. patents, scientific publications, researchers, and science and engineering degrees falling from the mid-1980s to the beginning of this century. But given our strong overall lead, the declines were not enough to dethrone us from our number 1 position.

Yet, since then the U.S. has continued to lag on a number of key factors, including growth in corporate and government R&D, scientific and technical degrees and workers, venture capital, and creation of new firms. As ITIF documented in its report *The Atlantic Century*, from 2000 to 2009, the United States slipped from number 1 to number 6 in global innovation-based competitiveness, falling behind nations such as Singapore, Denmark, Sweden, and South Korea on a per-GDP basis. The reason is that all of the other 39 nations or region examined made faster progress than we did on a collection of 16 innovation competitiveness indicators.

We also see the evidence of our decline in our trade performance. The trade deficit represents perhaps the most visible manifestation of the global challenge. At 5 percent of GDP in 2008, the current account deficit is at extremely high levels both in absolute terms and relative to the size of our economy.[2] The traditional U.S. trade surplus in agricultural products is nearing zero and in high-technology products has turned negative. In fact, the United States has actually run a negative trade balance in high-technology goods since October 1995. Meanwhile, our surplus in services trade is small and only holding relatively steady.

We also see it in the decline in U.S. manufacturing output as a share of GDP. This has been overlooked by many economists because the national economic accounts that track manufacturing output provide a misleading picture of the health of U.S. manufacturing by overstating output, particularly in the computer and semiconductors industry. According to the Department of Commerce's Bureau of Economic Analysis, manufacturing output as a share of GDP has stayed somewhat constant between 1994 and 2008, at around 13.7 percent.[3] But drilling down to more detail causes a different, and more troubling picture to emerge. Over the last 25 years, the share of non-durable manufacturing output (e.g., sectors such as chemicals, paper, and food products) declined from around 7 percent of GDP in 1993 percent to 4.7 percent in 2008. The share of durables (e.g., sectors such as motor vehicles, wood products, and electronics), in contrast, increased to just over 9 percent in 2007, with a very slight decline in 2008, leading many to the rosy conclusion that while manufacturing employment may have declined, manufacturing output is still strong. But taking out computers and electronic products (NAICS code 334) shows a very different picture, with durable goods output share declining from 7 percent in 1998 to 5.3 percent in 2008. Overall manufacturing output minus computers and electronic products declined from 13 percent of GDP in 1998 to just 9.7 percent in 2008.

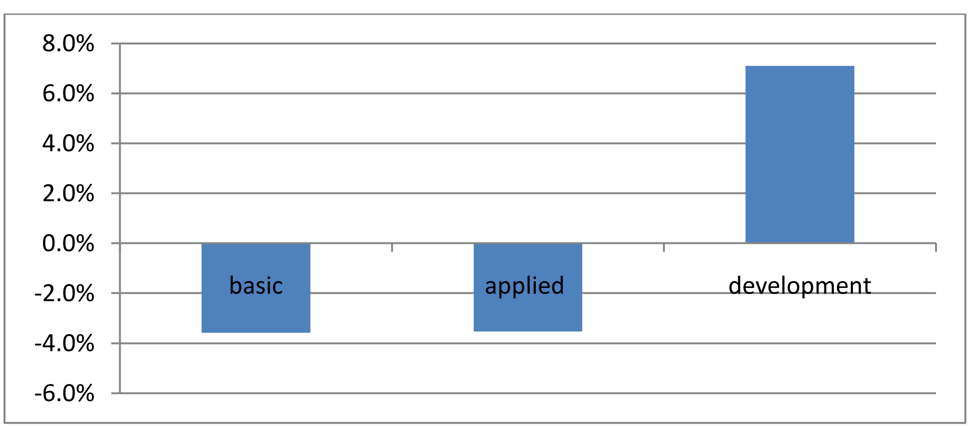
Defenders of the status quo will respond that the proper measure is overall manufacturing, not manufacturing minus computers. But does anyone really think that the real inflation-adjusted value added of computers and electronic products really doubled between 2003 and 2007, which is what the BEA numbers suggest? The problem is that BEA counts output of computers based on improvements in Moore's law and when processing power doubles every 18 months or so it counts that in the value-added. It also appears to understate the value of imports in this sector, thus imputing more domestic output to the sector than is warranted. But this clearly overstates output and provides an extremely misleading picture of the real health of the U.S. manufacturing sector. For those who want to play down the threat to the U.S. manufacturing (and export) base, these statistics provide reassuring, if false, comfort. In 2011, the United States is poised to cede its title as the world's leading manufacturer—a position it has held for the last 110 years—to China.[4]

## FACTORS CONTRIBUTING TO OUR RELATIVE DECLINE IN INNOVATION-BASED COMPETITIVENESS

There are a number of factors which have contributed to the United States' relative decline in innovation-based competitiveness. Many point to globalization. With the emergence of globalization and relatively faster growth in income of many nations, one would expect to see the global share of U.S. output fall. And it is certainly true that as some advanced nations began to catch up (in part by emulating and going beyond our policies) the U.S. share of global innovation output (e.g., R&D and patents) would also fall, although by less than overall economic output since the United States should actually be increasingly specializing in innovation-based activities as more routine-based production shifts offshore. But there was nothing preordained about the United States falling from number 1 in innovation competitiveness in 2000 to number 6 in 2009. The United States can and should remain the global innovation leader.

So what happened? As in explaining our success, non-policy and policy factors have played a role in our decline. There are a number of non-policy factors that appear to be at work. One key factor is the pressure from U.S. financial markets to prioritize increasing short-term returns to shareholders over growth or investments with longer-term payoffs, such as research and development and workforce training. Financial pressures have forced many U.S. firms to not only cut back on the growth of their research budgets, but to reallocate their research portfolios more toward product development efforts and away from longer term and more speculative basic and applied research. As Figure 1 shows, from 1991 to 2007, basic research as a share of corporate R&D conducted in the United States fell by 3.6 percentage points, while applied research fell by roughly the same amount, by 3.5 percentage points. In contrast, development's share increased by 7.1 percentage points. Moreover, corporate R&D as a share of GDP fell in the United States by 5 percent from 1999 to 2006, while in Europe and Japan it grew by 2 percent and 12 percent respectively. This has contributed to the U.S. share of global R&D falling from 39 percent in 1999 to 33 percent in 2007, while China's share increased fourfold.[5]

**Figure 1: Changes in the Shares of Corporate Basic and Applied Research and Development Between 1991 and 2007[6]**



It's not just corporations that are investing relatively less on riskier R&D. So too are venture capital firms. Venture capital has been a vital, and, at least initially, a distinctively American component of our national innovation system. In 2008, venture capital-funded companies accounted for 11 percent of private sector employment and represented the equivalent of 21 percent of U.S. GDP.[7] But venture investments are moving downstream as VCs focus on the most attractive later stage deals. In fact, while total venture capital funding for zero and first stage deals increased from 1996-2008, the share of total venture capital going to zero and first stage deals actually declined from 35 to 24 percent in the same time period.[8] This equals a market failure around risk, leading to underinvestment in early stage start-up deals, and also resulting in a gap between the completion of basic research and applied R&D. In addition, more recently, the level of venture capital activity has declined considerably in the current recession. In the first quarter of 2009, total U.S. venture capital investment plunged 60 percent as compared to the same period a year earlier.

Another concern is that U.S. firms are moving R&D offshore. R&D expenditures from U.S.-based multinationals in emerging Asian markets increased from 5 percent to 14 percent between 1995 and 2006.[9] And over the last decade, the share of U.S. corporate R&D sites in the United States has declined from 59 percent to 52 percent, while the share in China and India increased from 8 to 18 percent.[10] Taken together, it is clear that the U.S. private sector engine of innovation is not working as well as it used to.

One reason for these private sector challenges is that U.S. policy has not kept up to provide the support and incentives needed for private sector innovation. Among 36 nations, the United States ranked just 21st in the growth of government investment in R&D from 1999 to 2006, with a growth rate of just 20 percent the average of the other nations. Since the mid-1990s, total federal R&D investment 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 per year from 1953 to 2004.[11] To restore federal R&D support as a share of GDP to its 1993 level, we would have to increase federal R&D investment by 50 percent, or over $37 billion.

Indeed, 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.[12] Among OECD countries, the United States now ranks seventh in total R&D intensity, behind a list of countries including Japan, South Korea, Finland, and Sweden.[13] Moreover, the United States places only 22nd in the share of government GDP devoted to non-defense research.[14]

Federal investment in most of the programs that focus most directly on innovation promotion have also declined or grown more slowly than GDP. Funding for NSF's Partnerships for Innovation program has grown more slowly than GDP since the program began operating in 2000. NIST's Manufacturing Extension Partnership (MEP) is scheduled to receive $131.8 million in FY10, only 3 percent more (not adjusted for inflation) than it did in 1999. The America COMPETES Act abolished ATP and created a new Technology Innovation Program (TIP) with a substantially broader scope than ATP. However, the legislation did not match the broader scope with increased funding. TIP is slated to receive $140.5 million in 2010, slightly more than ATP received in 2005 but less than ATP received in any year between 1998 and 2004. Funding for NSF's Engineering Education Center programs, which includes NSF's Engineering Research Centers (ERCs) have declined by 11 percent since 2004.[15]

The Defense Advanced Research Projects Agency (DARPA) has played a key role historically in driving innovation. The Internet grew out of a DARPA initiative. However, over the last decade, DARPA funding as a share of GDP has declined by over 20 percent. Moreover, in recent years DARPA has shifted toward more short term, mission-oriented development.[16] Indeed, it is not an exaggeration to state that if DARPA were making the kinds of investments it makes today 30 years ago, the Internet never would have been developed.

Lack of adequate funding has also severely impacted agencies like the Patent and Trademark Office (PTO) and the Food and Drug Administration that are critical to enabling inventions become innovations in the marketplace. Both the PTO and the FDA used to be the envy of other nations around the globe for their effectiveness and efficiency. But the backlog at the PTO means that most patent applicants will wait many years before finding out if their invention is granted a patent. Likewise, there have been increases in delays at the FDA for drug and device approval and difficulties in upgrading the scientific expertise the FDA needs in order to expeditiously and effectively evaluate new drugs and biological submissions.[17] Likewise, the United States Office of the Trade Representative lacks the resources it needs to adequately go after rampant high-technology mercantilist practices other nations are engaged in to take market share away from U.S. technology companies.

Finally, while our public and private 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 capabilities relative to private research universities.[18] And while our research universities are still a key strength, their future is uncertain given the large cuts in state higher education budgets and slow growth in federal support for university research.

The declines have not just been in direct spending. Relative to other nations our R&D tax credit has become significantly less generous. In the early 1990s, the United States had the most generous R&D tax credit among 30 OECD nations. Now, because other nations have expanded their R&D incentives, U.S. rank has fallen to 18th.[19] And among 38 nations, it ranks 24th, now behind India, Brazil, and China (India's R&D tax credit is now four times that of the United States). The reason for this slippage is that the United States ranks just 21st out of 24 OECD countries assessed in rate of change in tax credit generosity between 1999 and 2008. Congress would need to increase the Alternative Simplified Credit (ASC) from 14 to 20 percent to reach 10th place and 47 percent to become the most generous of the OECD nations.[20]

Weaknesses in the U.S. innovation system don't simply stem from underfunding. The organization of efforts is often not optimal to driving innovation. Perhaps the most striking weakness is the fact that although there are a number of programs that help companies become more innovative or productive, there is no agency that has firm-level innovation as its sole mission. (In stark contrast to the litany of nations listed below who do have such an agency.) With a few important exceptions, U.S. innovation policy is at best a byproduct of federal programs whose main purpose lies elsewhere.

In addition, as the U.S. innovation system has spread out to all states and corners of the nation, the federal system has remained national in scope. Washington is often far removed from the firms and other institutions that drive innovation. This is particularly true for small and mid-sized firms. In contrast, state and local governments and metropolitan-level economic developers have a long track record of creating organizations that work more closely with firms. Unfortunately, most existing federal programs do not work through or in collaboration with state or local governments or regional organizations, which are often more flexible and less remote from production processes.[21] Federal program managers and policymakers all too often seem to assume that there is one uniform national economy in which regional agglomerations are at best a sideshow.

**WHAT CAN WE LEARN FROM OTHER NATIONS?**

Over the last 15 years, a large number of nations have woken up to the fact that they need to compete for internationally mobile innovation-based economic activities, and have put in place policies that reflect that determination, such as more generous R&D tax incentives and stronger government support for all stages of research. In contrast, the United States has lagged behind, believing that it needed to do little since it had long been the global innovation leader. As a result, U.S. firms are now competing against firms in a growing number of national economies in which their governments actively help them compete.

Many forward-thinking countries have made innovation-led economic development a centerpiece of their national economic strategies during the past decade. These nations know that moving up the value chain to more innovation-based economic activity is a key to boosting productivity, and that losing the competition can result in a relatively lower standard of living as economic resources shift to lower-value-added industries. These countries are implementing coordinated national innovation agendas that boost R&D funding, have introduced policy changes and government initiatives that more effectively transfer technologies from universities and government laboratories to the private sector for commercialization, and are ensuring that immigration policies support innovation. While many nations have taken the innovation challenge to heart and put in place a host of policies to spur innovation, the United States has done little, consequently falling behind in innovation policies and in innovation performance as well.

These innovation-support policies are crucial to national innovation competitiveness, as Professors Furman and Richard found in a study of the innovation capacity (an economy's potential for producing a stream of commercially relevant innovations) of twenty-three countries from 1978 to 1999.[22] Starting with 1978, they classify countries as either world-leading innovators (the United States, Germany, Japan), middle-tier (Great Britain, France, Australia), third-tier (Spain, Italy), or "emerging" innovators (Ireland, Taiwan) based on countries' patenting activity per capita, a proxy for commercialized innovations.

A number of these "emerging innovators"—among them Ireland, Finland, Singapore, South Korea, Denmark, and Taiwan, in particular—achieved remarkable increases in innovative output per capita, moving to the world's technological frontier and overtaking the innovative capacities of many mid- and third-tier countries, including France and Italy, whose economic conditions started off much more favorably in the early 1980s. Furman and Hayes conclude that the innovation leadership these countries achieved was based not only on the development of innovation-enhancing policies and infrastructure, such as strong IP protections, openness to trade, highly competitive markets, and strong industry clusters, but also a commitment to maintaining substantial financial and human capital investments in innovation.

**1. National Innovation Strategies**

Part of the United States' leadership slippage is attributable to the fact that over the past decade many of our competitors—from Great Britain and Finland to Japan and South Korea—have created national innovation and competitiveness strategies designed specifically to link science, technology, and innovation with economic growth.[23] As Annabelle Malins, British Consul General for the Southern U.S., commented recently, "The United Kingdom has made a conscientious decision to place innovation at the center of our country's economic growth strategy."[24] Where these countries have coherent, strategic game plans to compete and win in the highest value-added sectors of economic activity, the U.S. relies more on one-off policies that, while valuable and necessary, are all-too-often not tied to a coordinated strategy.

These nations are not content to let their government policies and actions influence innovation in a haphazard and uncoordinated way. They seek to develop strategies to assess their nation's weaknesses and strengths, examine the policies of other nations in order to learn from them, and assess and revise their own national policies in a broad array of areas that could influence innovation and competitiveness, including tax policy, regulation, direct science and technology programs and other areas (see Table 1).

It should be noted that these strategies seldom seek to "pick winners and losers" in the sense of picking individual firms to favor. Indeed, these strategies are a far cry from the strongly directive Japanese efforts, for example, of the 1980s. They do not try to decide the path of business innovation and then induce firms to follow that path. Instead, they exemplify the cooperative, facilitative government role that is needed to address the market failures that hamper the innovation process. And they seek to better align what government already does to ensure that it best supports innovation and competitiveness.

**Table 1: Selected Countries with a National Innovation Strategy and/or Foundation**

| Country | National Innovation Strategy | National Innovation Agency |
|---|---|---|
| Australia | Yes | Yes |
| Austria | Yes | Yes |
| Canada | Yes | No |
| China | Yes | No |
| Denmark | Yes | Yes |
| Finland | Yes | Yes |
| France | Yes | Yes |
| Germany | Yes | No (Yes at the Bundeslander level) |
| India | Yes | Yes |
| Ireland | Yes | Yes |
| Japan | Yes | Yes |
| Malaysia | Yes | Yes |
| The Netherlands | Yes | Yes |
| Portugal | Yes | Yes |
| Norway | Yes | Yes |
| Rwanda | Yes | No |
| Singapore | Yes | Yes |
| South Korea | Yes | Yes |
| Spain | Yes | Yes |
| Sweden | Yes | Yes |
| Thailand | Yes | Yes |

| | | |
|---|---|---|
| United Kingdom | Yes | Yes |
| United States | Yes | No |
| Uruguay | Yes | Yes |

**2. Civilian Technology and Innovation Promotion Agencies**

Many countries not only have innovation and competitiveness strategies, but also agencies specifically charged with spurring private sector innovation. In recent years, Finland, France, Iceland, Ireland, Australia, Japan, the Netherlands, New Zealand, Norway, South Korea, Canada, Germany, Taiwan, Switzerland and Great Britain have all either established or significantly expanded separate innovation promotion agencies (see Table 1). Many countries have launched such agencies only fairly recently. For example, India launched its National Innovation Foundation in 2000, Sweden introduced Vinnova in 2001, Thailand created a National Innovation Agency in 2003, the launched Senter Novem in 2004, and the United Kingdom launched its Department for Business, Innovation, and Skills in 2009.

All these countries have science- and university-support agencies similar to America's National Science Foundation, which largely fund basic research. But these countries realized that if they were to prosper in the highly competitive, technology-driven global economy, they needed specifically to promote technological innovation, particularly in small and mid-sized companies and in partnership with universities.

These countries' innovation agencies perform roles such as channeling R&D into specific technology or industry research areas; surveying the world to identify nascent technologies; building technology "roadmaps"; creating new knowledge pertaining to the methods, processes, and techniques of innovation; transferring knowledge from academia and government to the private sector; encouraging private-sector technology adoption; catalyzing industry-university research partnerships; supporting regional industry "technology clusters"; developing national innovation metrics; and championing innovation in the public sector.

Perhaps the most ambitious of these efforts is Tekes, Finland's National Agency for Technology and Innovation. In the last two decades, Finland has transformed itself from a largely natural resource-dependent economy to a world leader in technology, with Tekes a key player in the country's transformation. Affiliated with the Ministry of Employment and the Economy, Tekes funds many research projects in companies, multi-company partnerships, and business-university partnerships. With a budget of $560 million (in a country of only 5.2 million people), Tekes works in partnership with business and academia to identify key technology and application areas—including nano-sensors, ICT and broadband, health care, energy and the environment, services innovation, and manufacturing and minerals—that can drive the Finnish economy. Tekes also operates a number of overseas technology liaison offices that conduct "technology scanning," seeking out emerging technologies bearing on the competitiveness of Finnish industries, and sponsors foreign outreach efforts to help its domestic companies partner with foreign businesses and researchers.

One of the benefits of these programs is that they not only fund research projects but also facilitate networking and collaboration. For example, Tekes brings together in forums many of the key stakeholders in the research community. For each of its 22 technology areas there are networking groups of researchers. In addition, Tekes publishes a description of each project it funds. Through these processes, researchers learn more about research areas and gain opportunities to collaborate. Many agencies also work with industry on "roadmapping" exercises, whereby key participants (industry and academic researchers and government experts) identify technology challenges and key areas of need over the next decade. They then base their selection of research topic funding on the results of the roadmap exercise. The UK's Technology Strategy Board is funding over 600 collaborative business-university research projects which have been launched over the past two to three years. Like Tekes, it is also responsible for more than 20 industry- and technology-based knowledge transfer networks, with more being established.

In virtually all cases these nations have made an explicit decision not to place their innovation-promotion initiatives under the direct control of large government departments. Although most innovation-promotion agencies are affiliated with those departments, they usually have a substantial degree of independence. It is common for these agencies to have their own executive director and a governing board of representatives from industry, government, university, or other constituency groups. For example, Japan's government recently made a conscious choice to establish NEDO as an autonomous agency because it realized that MITI, as a large government bureaucracy, did not have the flexibility needed to manage such a program. NEDO is governed by a board of directors, with the Chair appointed by MITI and members from industry, universities, and other government agencies.

These nations also often invest considerable resources in these efforts. If the United States wanted to match Finland's outlays per dollar of GDP in innovation-promotion efforts, it would have to invest $34 billion per year. In fact, it invests around $3 billion per year, or 0.02 percent of GDP. While other nations invest less in their innovation-promotion agencies than Finland, they still invest considerably more than the United States. As a percent of their countries' GDPs, Sweden spends 0.07 percent, Japan 0.04 percent, and South Korea 0.03 percent on their innovation promotion agencies. To match these nations on a per-capita basis, the United Sates would have to invest $9 billion to match Sweden, $5.4 billion to match Japan, and $3.6 billion to match South Korea.[25] It is astounding that economies a fraction the size of the United States spend more on innovation promotion in *actual dollars,* let alone as a percentage of their economy.

This places U.S. industries and corporations operating alone at a disadvantage against foreign corporations that benefit from coordinated and enlightened national strategies among universities, governments, and industry collaborations to foster competitiveness. For example, the Japanese government has recognized advanced battery technology as a key driving force behind its competitiveness, and views battery technology as an issue of "national survival."[26] It is funding Lithium-ion battery research over the five-year period from October 2007 to October 2012 at $275 million (¥25 billion), and longer term has committed to a 20-year Li-ion battery research program. Germany's government will provide a total of €1.1 billion ($1.4 billion) over 10 years to applied research on automotive electronics, lithium ion batteries, lightweight construction, and other automotive applications.[27]

**3. Tax Incentives for Research and Development**

As noted above, many other nations have much more generous tax incentives for the private sector to invest in R&D. They do this not only to encourage existing companies to expand R&D, but to attract globally mobile R&D activity. But not only have these nations put in place more generous research incentives they have been more innovative in using incentives to spur research and innovation. For example, some countries, including Denmark and the Netherlands, have begun to extend R&D tax credits to cover process R&D activities, effectively extending the R&D tax credit from their goods to services industries as well. Other nations have more generous credits for companies investing in national laboratories or universities. For example, in France, companies funding research at national laboratories receive a 60 percent credit on every dollar invested. Denmark, Hungary, Norway, Spain, and the UK provide firms more generous tax incentives for collaborative R&D with public research institutions. Japan's R&D incentive for research expenditures companies make with universities and other research institutes is almost twice as generous as its regular credit.

Other nations are increasingly providing tax incentives to treat income received from patents more generously. For example, Belgium taxes income received from patents at a rate of 0 to 6.8 percent and Ireland at 0 percent. Switzerland has reduced corporate taxes on income from all intellectual property to between 1 and 3 percent. Just this year, the Netherlands expanded this incentive to include income derived from patents or R&D which is taxed at just 5 percent.[28]

**STEPS CONGRESS CAN TAKE TO BOOST U.S. INNOVATION AND COMPETITIVENESS**

The government's role in addressing the innovation economy is not to regulate business or to direct the path of technological development. We do not advocate a heavy-handed, government-driven industrial policy. Indeed, such a policy cannot be nimble enough to respond to the kinds of market failures that afflict the innovation process.

At the same time, though, we do not advocate simply "leaving it up the market" not only because the innovation economy is rife with market failures but also because U.S. firms are now in global competition with firms that have their government as an innovation partner. In this sense, government should be a facilitator that spurs firms to innovate in ways that serve the public interest. In short, while we believe that the private sector should lead in innovation, we also believe that in an era of globalized innovation and intensely competitive markets the federal government can and should play an important enabling role in supporting private sector innovation efforts.

As a core of this strategy, the federal government needs to invest significantly more in scientific research, commercialization, and innovation, including funding entities like the PTO and FDA that help support the innovation process. ITIF rejects the notion that in a time of fiscal constraint innovation investments should take their share of cuts, just like all other budget items. The reality is that investments in innovation are not like all other areas of the budget, most of which produce no or little additional economic activity and tax revenues. If structured properly federal investments in innovation (either through direct spending or tax incentives), can more than pay for themselves, not only in terms of jobs and economic growth, but also tax revenues.

However, given the current political climate that favors cutting the deficit over investing in America's future, I will focus my recommendations on activities that will have limited budgetary impact. If policies are crafted carefully, achieving greater levels of innovation and commercialization of R&D while recognizing budget limitations need not be mutually exclusive. Even in a time of budget constraints there are many pro-innovation policies Congress can pursue that will add little to the federal deficit (under its current static and short-term budgetary scoring system).

With this is mind, I offer the following set of innovation-enhancing policy proposals, each designed to be of low or no cost to the Treasury, but whose impact on enhancing U.S. innovation and competitiveness could be significant. These are organized into two areas: 1) changes in the structure of the federal government to better support innovation and 2) enacting policies to spur university-industry partnerships and technology commercialization.

Before going into detail on these, let me make it clear that we believe that there are a wide range of policies that can spur innovation and should be the focus on national innovation policy. Three in particular are worth mentioning here. First, high skill immigration reform to make it easier for the U.S. to attract and retain the best and the brightest from around the world is a key step Congress could take. As we recently noted, the old arguments that these highly skilled immigrants take jobs away from Americans or lower their wages are simply not true.[29] Second, Congress and the Administration need to do more to fight foreign "high-tech" mercantilism. As ITIF has shown, many nations are using an array of unfair trade practices, including standards; government procurement; anti-trust; intellectual property theft, including product counterfeiting; and other policies to systematically disadvantage U.S. technology companies in the global marketplace. U.S. trade policy needs to more aggressively go after these violations of the spirit and often the letter of the WTO.[30] Third, we need to expand our tax incentives for R&D. ITIF recently calculated that expanding the Alternative Simplified Credit from 14 percent to 20 percent would after several years created 162,000 jobs and actually lead to a net increase in federal tax revenues of $9 billion annually.

## I) RESTRUCTURE THE FEDERAL GOVERNMENT TO BETTER SUPPORT INNOVATION

The federal government plays a key role in innovation. To be most effective, federal policy should be aligned wherever possible to proactively support innovation. President Obama took an important step in this direction with the creation of the position of a Chief Technology Officer in the White House. But more needs to be done. ITIF suggests three key changes:

**1. Create a National Innovation and Competitiveness Strategy Modeled on the National Broadband Strategy.** The United States needs to create millions of new good-paying jobs over the next decade. If the United States wants to do this and be successful in the global economy, it is critical that the federal government develop a serious, in-depth, and analytically-based national competitiveness strategy. As noted above, we are one of the few nations without one. The last time the United States did anything similar was President Carter's Domestic Policy Review on Industrial Innovation in 1978 and President Reagan's 1984 Commission on Industrial Competitiveness**.** These efforts were extremely important in setting the stage for a number of important Congressional initiatives, including the R&D tax credit, the Bayh-Dole Act, the National Cooperative R&D Act, the Stevenson-Wydler Technology Innovation Act, and the Omnibus Trade and Competitiveness Act.

The American Recovery and Reinvestment Act charged the FCC with the development of a national broadband plan. The next America COMPETES Act should charge the Administration with the development of a national competitiveness strategy. Adequate funding should be provided to bring in an outside director with deep technical and policy knowledge and hire individuals with technical and business experience.

A national innovation strategy would provide an opportunity to engage in a comprehensive analysis of the key factors contributing to future U.S. competiveness. Legislation could require that the strategy focus on a number of broad issues, going more in depth on each. These should include assessing: 1) current U.S. competitiveness, including at the major industry level; 2) current business climate for competiveness (including tax and regulatory); 3) trade and trade policy issues; 4) education and training; 5) science and technology policy; 6) regional issues in competitiveness (including the role of state and local government and impacts on rural, urban and other regions); 7) measurement and data issues; and 8) proper organization of government to support a comprehensive innovation and competitiveness agenda.

**2. Form an Office of Innovation Review in OMB (i.e., an Office of Information and Regulatory Affairs for Innovation).** The relative absence of innovation from the agenda of many relevant federal agencies—as well as interagency processes such as the centralized cost-benefit review performed by the Office of Information and Regulatory Affairs (OIRA) within the Office of Management and Budget (OMB)—manifests the confluence of two regulatory challenges: first, the tendency of political actors to focus on short-term goals and consequences; and second, political actors' reluctance to threaten powerful incumbent actors. Courts, meanwhile, lack sufficient expertise and the ability to conduct the type of forward-looking policy planning that should be a hallmark of innovation policy.

To remedy these problems, we recommend that Congress create a White House Office of Innovation Review that would have the specific mission of being the "innovation champion" within these processes. OIR would be an entity that would be independent of existing federal agencies and that would have more than mere hortatory influence. It would have some authority to push agencies to act in a manner that either affirmatively promoted innovation or achieved a particular regulatory objective in a manner least damaging to innovation. OIR would operate efficiently by drawing upon, and feeding into, existing interagency processes within OIRA and other relevant White House offices (e.g., the Office of Science and Technology Policy). It is important to note that OIR would not be designed to thwart federal regulation; as a matter of fact, in some cases, the existence of OIR might lead to increased federal regulation (e.g., more Environmental Protection Agency regulations might pass muster under cost-benefit analysis if innovation-related effects were calculated).

Some might question the significance of this proposal. Isn't creating OIR a fairly small change to the system? Certainly adding OIR to the existing mix is a smaller change than jettisoning the existing substantive agencies in favor of a new agency with authority to regulate, and promote, innovation across all government agencies. But implementing this proposal will significantly change the regulatory environment. First, an entity focused on innovation would add an important new voice to the regulatory conversation. There would now be an entity speaking clearly and forthrightly on the centrality of innovation. Second, and more important, OIR would not merely have a voice: it would be able to remand agency actions that harm innovation. It would also have as part of its mission proposing regulation that benefits innovation. This is no small matter. Indeed, it would change the regulatory playing field overnight.

**3. Establish a National Innovation Foundation.** If Congress wanted to more effectively organize federal innovation implementation efforts, it could establish a National Innovation Foundation (NIF)—a new, nimble, lean, and collaborative entity devoted to supporting firms and other organizations in their innovative activities.[31] A National Innovation Foundation would:

- Catalyze industry-university research partnerships through national sector research grants.
- Expand regional innovation-promotion through state-level grants to fund activities like technology commercialization and entrepreneurial support.
- Encourage technology adoption by assisting small and mid-sized firms in taking on existing processes and organizational forms that they do not currently use.
- Support regional industry clusters with grants for cluster development.
- Emphasize performance and accountability by measuring and researching innovation, productivity, and the value-added to firms from NIF assistance.
- Champion innovation to promote innovation policy within the federal government and serve as an expert resource on innovation to other agencies.

By doing these things, NIF would address quite robustly each of the major flaws that weaken federal innovation policy. Creating NIF could be done in a budget neutral way by consolidating existing programs (with around $350 million in annual support). Because of its strong leveraging requirements from the private sector and state governments, NIF would lead to an expansion of overall national efforts devoted to innovation.

## II) SPUR UNIVERSITY INDUSTRY PARTNERSHIPS AND COMMERCIALIZATION

As companies have reduced their relative investment in basic and applied research, universities and federal laboratories have become more important to the U.S. innovation system. As Fred Bloch and Matthew Keller documented in a recent ITIF report, *Where Do Innovations Come From? Transformations in the U.S. National Innovation System, 1970-2006*, in 2006 76 of the 88 companies that produced award-winning innovations were beneficiaries of federal funding.[32] Today, the private sector increasingly relies upon partners in universities and federal laboratories when developing innovations. Indeed, universities are becoming more important players in the innovation process.

However, the current federal system for funding research pays too little attention to the commercialization of technology, and is still based on the linear model of research that assumes that basic research gets easily translated into commercial activity. In fact, the process is ripe with barriers, including institutional inertia, coordination and communication challenges, and lack of funding for proof of concept research and other "valley of death" activities.

Not surprisingly, many universities and federal labs underperform when it comes to working with industry and commercializing technologies. The major reason for this is that few universities and federal labs see commercialization and industry partnerships as a central part of their mission. In this context, the federal government can and should take a number of steps to support and incent universities and labs to more effectively commercialize technology. They can do this in a variety of ways.

**4) Focus Increases in Science Agency Budgets on Programs That Focus on Commercialization.** The National Science Foundation is fundamentally an agency which focuses on supporting university-based science, not on the transfer of these results to the marketplace. And this is reflected in part in the minimal levels of funding for NSF programs that seek to create partnerships with industry, such as the Engineering Research Center Program and other related programs. These partnership programs receive less than2 percent of the overall NSF budget.[33] Unless Congress specifically charges the NSF with focusing more on commercialization and significantly increases funds for the programs that have that as their mission, the NSF will continue to give these programs short shrift.

As such, we recommend that Congress not just simply expand science agency funding across the board within NSF, NIST, and DOE Office of Science (as is contemplated in the reauthorization of the COMPETES Act), but that Congress target a significant share of increased funding to the programs more focused on commercialization activities. In particular, COMPETES reauthorization should look to increase by a factor of four (over a period of three years) funding for NSF's Engineering Research Center program, the Industry/University Cooperative Research Centers (I/UCRC), Partnerships for Innovation, Grant Opportunities for Academic Liaison with Industry, and Advanced Technical Education (ATE) Program. These programs not only effectively leverage non-federal dollars (for example, I/UCRCs leverage 10 to 15 times the NSF investment), they effectively link universities and colleges to industry.

Some will object to such targeting, arguing that the funds should go to "basic" university research. But there is no reason why some share of university research cannot be oriented toward problems and technical areas that are more likely to have economic or social payoffs to the nation. Science analyst Donald Stokes has described three kinds of research: purely basic research (work inspired by the quest for understanding, not by potential use), purely applied (work motivated only by potential use), and strategic research (research that is inspired both by potential use and fundamental understanding).[34] One way to improve the link between economic goals and scientific research is to fund more strategic research in partnership with industry and universities.

**5) Tie Federal Research Awards to University Commercialization Results.**

Currently, NSF awards grants to universities solely on technical merit, not on whether the university is effective on transferring the results of that research into society and the economy. ITIF recommends that America COMPETES legislation include incentives for accountability. The legislation contemplates more dollars and more grants for private investigator scientific research; but we need greater accountability for results—a challenge we've had for more than 20 years. Many countries are experimenting with measures that would bring greater accountability to show results from government-funded scientific research. For example, in Sweden, 10 percent of regular research funds allocated by the national government to universities are distributed using performance indicators. Five percent of these funds are allocated based on the amount of external funding the institutions have been able to attract, with the other 5 percent based on the quality of scientific articles published by each institution (as determined through bibliometric measures such as the number of citations).[35] Finland has also started to base its university budgets on performance—25 percent of Finnish universities' research and research training budgets are based on "quality and efficacy" including the quality of scientific and international publications and the universities' ability to attract research investment from industry.[36]

One way to begin this process would be for Congress to charge NSF with using the criteria of the share of the university's research budget that is provided by industry when it makes awards to institutions (as opposed to individual scientists). Programs using this criteria might include the NSF Major Research Equipment and Facilities Construction Funding program, the Major Research Instrumentation program, and the Technology and Tools Funding program. If universities understand that their likelihood of receiving NSF grants is increased if they work more closely with industry, they will likely do so.

### 6) Create an SCNR (Spurring Commercialization of Our Nation's Research) Program to Support University, State, and Federal Laboratory Technology Commercialization Initiatives

In addition to using federal research funding as an incentive for universities to work more with industry, ITIF believes that the federal government should also provide funding to directly support commercialization activities. However, in an era of fiscal constraint adequate new funding may be difficult to obtain. As a result, Congress should consider establishing an automatic set-aside program taking a modest percentage of federal research budgets and allocating them to a technology commercialization fund. Currently the SBIR program allocates 2.5 percent of agency research budgets to small business research projects; the STTR program allocates 0.3 percent to universities or nonprofit research institutions that work in partnership with small businesses. If Congress allocated 0.15 percent of agency research budgets it would raise around $110 million per year to fund university, federal laboratory, and state government technology commercialization and innovation efforts. (The 0.15 percent share could either be added on top of the existing 2.8 percent allocation currently going to SBIR and STTR, or it could be taken from the SBIR share.)

This program would be different than the STTR program which funds small businesses working with universities.[37] We would recommend that half the funds would go to universities and federal laboratories that could use the funds to create a variety of different initiatives, including mentoring programs for researcher entrepreneurs, student entrepreneurship clubs and entrepreneurship curriculum, industry outreach programs, seed grants for researchers to develop commercialization plans, etc. The other half of funds would go to match state technology-based economic development (TBED) programs. Since the 1980s, when the United States first began to face global competitiveness challenges, all 50 states have established TBED programs. Republican and Democratic governors and legislators support these programs because they recognize that businesses will not always create enough high-productivity jobs in their states without government support. State and local governments now invest about $1.9 billion per year in TBED activities, a fraction of what they spend on industrial recruitment to convince firms to move from one state to another. States are a key partner in the U.S. innovation system, and the federal government needs to better support their technology commercialization efforts.

### 7. Expand the Scope of the Collaborative R&D Tax Credit

Increasingly, firms are collaborating with other firms or institutions in order to lower the cost of research and increase its effectiveness by maximizing idea flow and creativity. Indeed, a growing share of research is now conducted not only on the basis of strategic alliances and partnerships but also through ongoing networks of learning and innovation. Moreover, participation in research consortia has a positive impact on firms' own R&D expenditures and research productivity.[38] And OECD analysis shows that firms that collaborate on innovation spend more on innovation than those that do not, an indication that collaboration is more a means to extend the scope of a project or complement firms' competencies than simply a means to save on costs.[39]

Yet, most collaborative research, whether in partnership with a university, national laboratory, or industry consortium, is more basic and exploratory than research typically conducted by a single company. Moreover, the research results are usually shared, often through scientific publications. As a result, firms are less able to capture the benefits of collaborative research, leading them to under-invest in such research relative to socially optimal levels.[40] This risk of underinvestment is particularly true as the economy has become more competitive, and a reflection of this is the fact that for the first time since the data were collected in 1953, the percentage of U.S. academic R&D supported by industry declined over a six year period, from 2000 to 2006 (before experiencing a modest increase in 2007).[41] This may stem from the fact that university contracts are often undertaken as discretionary activities and are the first to be cut when revenues are down.[42]

ITIF urges Congress to provide a more generous incentive for collaborative research. As part of the Energy Policy Act of 2005, Congress created an energy research credit that allowed companies to claim a credit equal to 20 percent of the payments to qualified research consortia (consisting of five or more firms, universities, and federal laboratories) for energy research. To spur more collaborative research, Congress could allow firms to take a flat credit of 20 percent for all collaborative research conducted at universities, federal laboratories, and research consortia, not just that related to energy.

## CONCLUSION

For over half a century, the United States led the world in innovation on a per-GDP and per-capita basis. This leadership role not only enabled America to be the leading military power, it enabled us to be the leading economic power, with the resultant economic and social benefits that came with that. But now more than ever, the American standard of living depends on innovation. To be sure, companies are the engines of innovation and the United States has an outstanding market environment to fuel those engines. Yet firms and markets do not operate in a vacuum. By themselves they do not produce the level of innovation and productivity that a perfectly functioning market would. Even indirect public support of innovation in the form of basic research funding, R&D tax credits, and a strong patenting system, important as they are, are not enough to remedy the market failures from which the American innovation process suffers.

At a time when America's historic lead in innovation has evaporated and its relative innovation competitiveness continues to shrink, when more and more high-productivity industries are in play globally, and when other nations are using explicit public policies to foster innovation, the United States cannot afford to remain complacent. Relying solely on firms acting on their own will increasingly cause the United States to lose out in the global competition for high-value added technology and knowledge-intensive production. Congress has an opportunity to take steps now to stop and reverse this slide.

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