Dr. Robert D. Atkinson
President
Information Technology and Innovation Foundation

The Globalization of R&D and Innovation: How Do Companies Choose Where to Build R&D Facilities?

before the

Committee on Science and Technology
Subcommittee on Technology and Innovation
U.S. House of Representatives
October 4, 2007

Mr. Chairman, Mr. Gingrey, and members of the Committee, I appreciate the opportunity to appear before you today to discuss the issue of globalization of R&D and the factors that influence the location of U.S. R&D investments.

I am 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. I have studied and written extensively about the issues of offshoring, U.S. technology competitiveness, and the location decisions of technology-based firms.

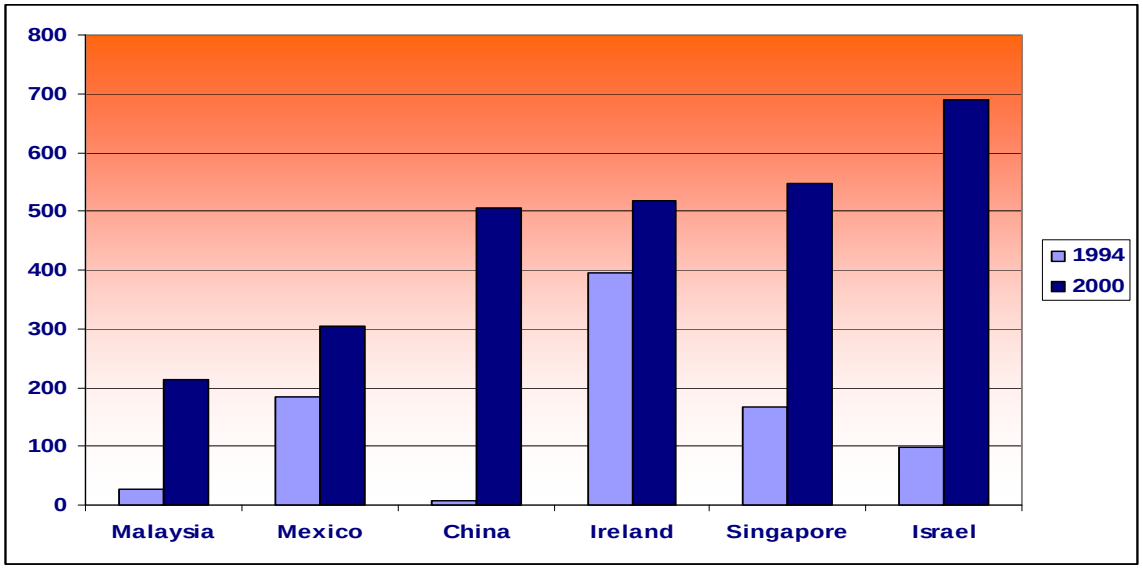
How Much R&D Is Being Offshored?

Until recently corporate R&D was generally not very mobile, certainly not in comparison to manufacturing. But in a "flat world" companies can increasingly locate R&D activities anywhere skilled researchers are located. Estimating the current and future magnitude of R&D offshoring, however, is difficult, in part because it is a relatively new process that is undergoing significant change.[1] Indeed, while the internationalization of R&D activities by U.S. multinational firms has been a growing phenomenon for the last two decades, the process appears to have accelerated in the last decade and shifted its locational focus from Western Europe to some lower cost nations, including Eastern Europe and Russia, China, and India. For example, most of the over 700 independent foreign R&D facilities in China have been established since 2000.[2] Eight of the top ten R&D-spending companies in the world have established R&D facilities in China.[3]

Yet, notwithstanding the newness of these trends, the evidence is fairly conclusive that R&D offshoring is increasing substantially. In the last decade the share of U.S. firms' R&D sites located in the United States declined from 59 percent to 52 percent, while the share in China and India increased from 8 to 18 percent.[4] According to a recent survey of U.S. R&D managers, over 60 percent of U.S. companies surveyed are investing in R&D in China, 50 percent in India, and 20 percent in Eastern Europe. Although 65 percent of U.S. companies are increasing their R&D investments in Asia, just 29 percent are doing so in higher-cost Western Europe – the traditional destination for U.S. corporate R&D.[5] From 1994 to 2003, R&D performed by U.S. firms outside the United States increased significantly in low-wage nations like Mexico, China, and Malaysia, and also in mid-wage nations like Ireland, Israel, and Singapore (see Figure 1).

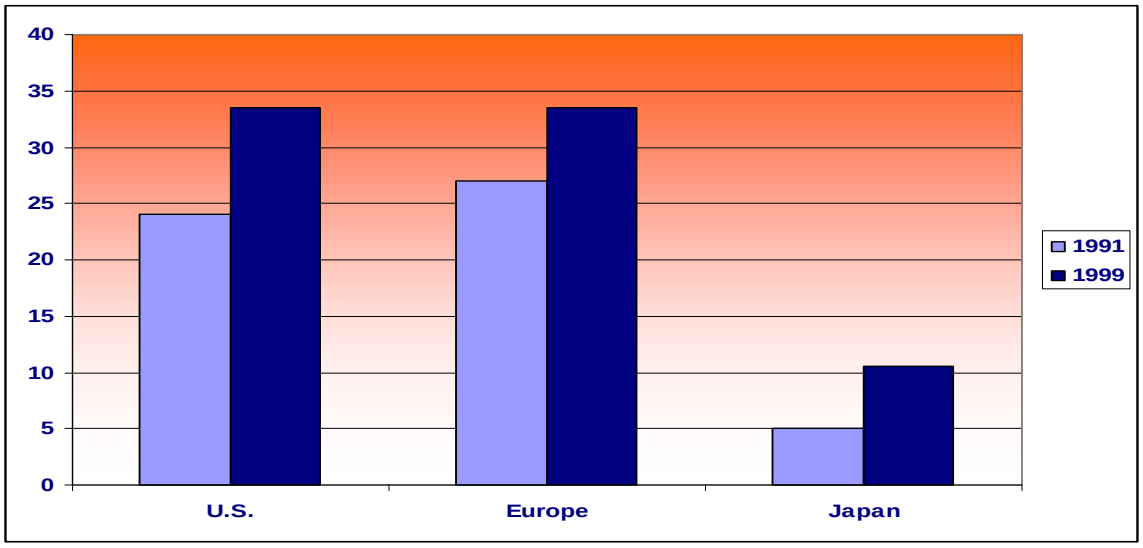
But it's not just large multinational firms that are offshoring R&D; small and mid-sized technology firms are as well. One study of California-based technology firms (80 percent of which had less than 500 employees) found that R&D was actually the most common activity offshored, with around 60 percent of firms reporting that they offshore R&D, which is about twice the rate of manufacturing offshoring and three times the rate of back office offshoring.[6]

Figure 1: R&D Performed Overseas by Majority-Owned Foreign Affiliates of U.S. Companies (in Millions)[7]



Moreover, not only are U.S. firms offshoring more R&D, but European and Japanese firms are as well. As Figure 2 demonstrates, the percentage of R&D conducted outside firms' home countries increased throughout the 1990s, even before the rapid increase in R&D offshoring to developing nations after 2000. The United Nations Conference on Trade and Development (UNCTAD) reports that of 1,773 greenfield R&D projects set up between 2002 and 2004, projects in developing nations by companies based in developed countries accounted for over half (953) of total projects, 70 percent of which were in China and India.[8]

Figure 2: Percentage of Total R&D Conducted by Firms Outside Their Home Region[9]

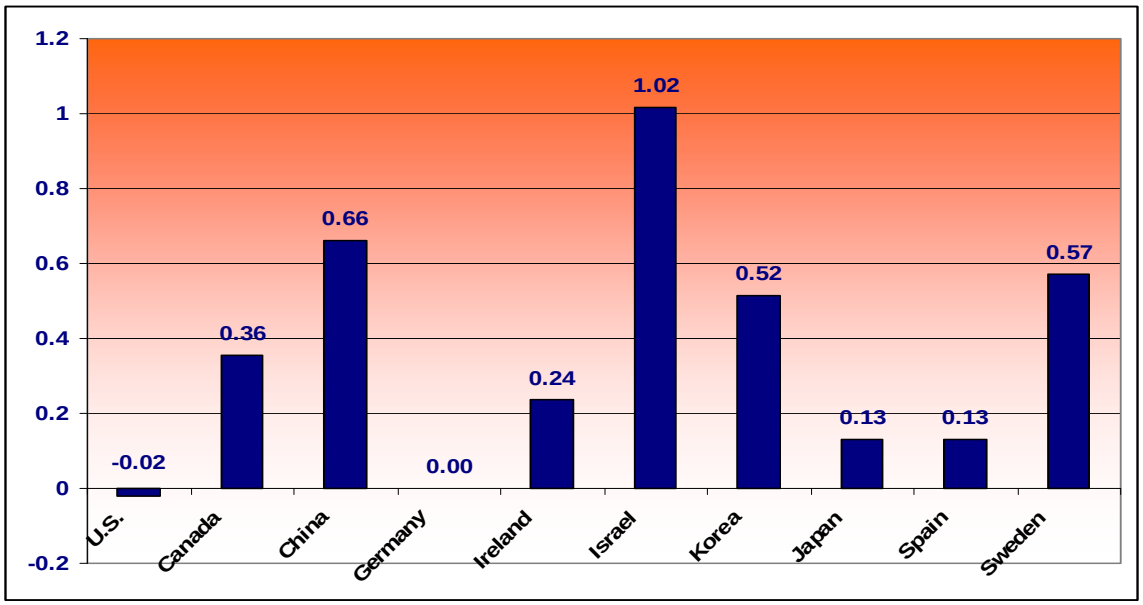


The Effects on Domestic R&D

There is considerable disagreement about the effect within the United States of these trends in R&D investments. It is certainly possible that offshoring of U.S. R&D will not affect the growth rate of R&D in the United States. If firms in most other nations are also globalizing their R&D they might in turn expand their R&D investments in the United States. To some extent this has happened, as multinational firms around the world have offshored a growing share of their R&D, some of it has come to the United States. But on net, however, it appears that in recent years more R&D has been offshored from the United States than has been insourced to us. One indicator of this trend is the fact that, between 1998 and 2003, investment in R&D by U.S. majority-owned affiliates increased twice as fast overseas as did total corporate R&D (U.S. firm and foreign firm) in the United States (52 percent vs. 26 percent).[10]

It's also possible that the expansion of offshored R&D by U.S. firms has no detrimental effect on the amount of their domestic R&D investments. U.S. firms that take advantage of lower cost R&D abroad may simply be expanding their overall R&D beyond what they would have done otherwise. However, it appears that this is not the case. Corporate-funded R&D as a share of GDP fell by 7 percent in the United States from 1999 to 2003, while in Europe it grew by 3 percent and in Japan by 9 percent and even faster growth rates in China and India.[42] From 2005 to 2007, R&D investment in the U.S. increased by 4.9 percent (PPP constant dollars) but increased in the rest of the world by almost twice that rate (8.7 percent).[11] Moreover, U.S. share of global R&D fell from 46 percent in 1986 to 37 percent in 2003.[12] Overall, while investments in R&D as a share of GDP actually fell for the United States from 1992 to 2002, they increased in most other nations, including Japan, Ireland, Canada, Korea, Sweden, China, and Israel. (see Figure 3).

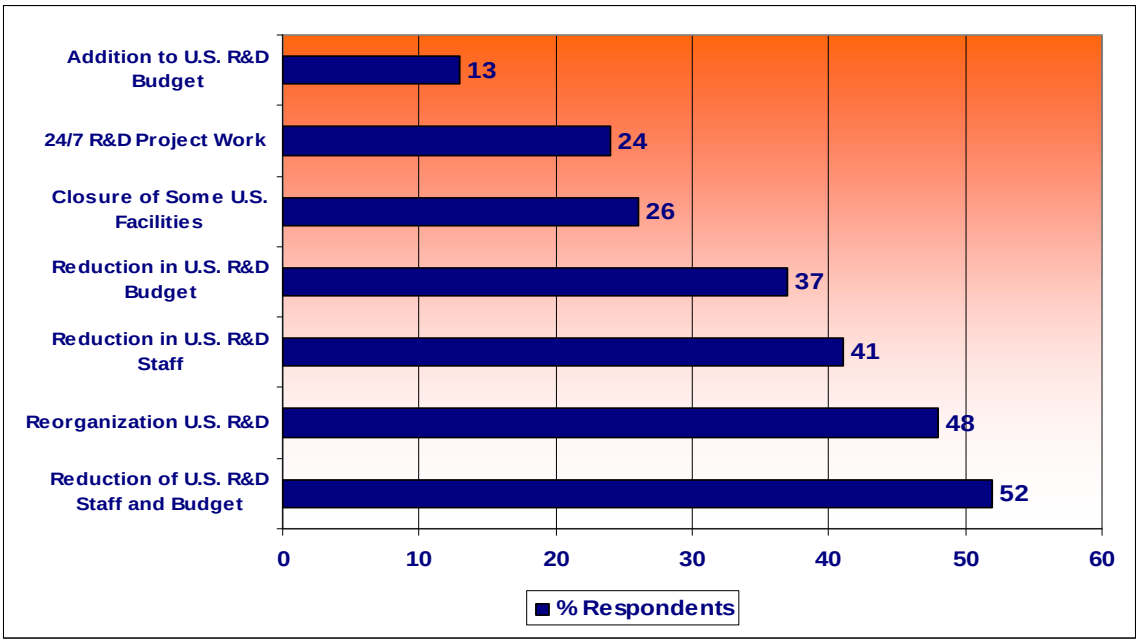
Figure 3: Percent Change in R&D/GDP Ratio, 1991-2003[13]



As the macro-level R&D investment data point to the substitution of foreign R&D for domestic, or at minimum to the fact that foreign R&D comes at the expense of a more robust expansion of domestic R&D. Survey data suggests similar conclusions. A survey of corporate research managers conducted by the Industrial Research Institute (IRI), the leading professional organization for corporate R&D managers, concluded that, "It is not surprising that two of the interrelated changes most often noted with respect to the effect on domestic [R&D] operations [from expansion of offshored R&D] are (1) a reduction in staff levels in domestic facilities, and (2) a reduction in domestic funding of R&D." [14] Indeed, IRI found that 52 percent of respondents reported that offshored R&D led to reductions in

domestic R&D spending or staff, with just 13 percent reporting that it led to increased U.S. staff (see Figure 4). Likewise, a 2005 survey of multinational firms conducted for the National Academy of Sciences found that 15 respondents expect to increase R&D employment in the United States over the next three years, whereas 23 expected a decrease. Almost 70 respondents expected an increase in R&D employment in China and over 40 in India, with no respondent expecting a decline in these countries.[15]

Figure 4: How Offshoring R&D Has Affected U.S. R&D Operations[16]



What Is Driving the Movement of R&D Offshore?

There appear to be a number of factors driving increased R&D offshoring. First, technology has made it possible for more work to be done at a distance. Researchers can be in close contact with others around the world through email, the Internet, and video teleconferencing. Second, other nations have woken up to the opportunities of attracting internationally mobile investment, including R&D facilities. Many developing nations have established the infrastructure, skilled workforce and business climate to become attractive locations for this kind of work. Indeed, many foreign governments, and their sub-national governmental units, are implementing exactly the same kinds of economic strategies that U.S. states have long practiced, including providing direct grants and tax waivers for establishing R&D facilities.

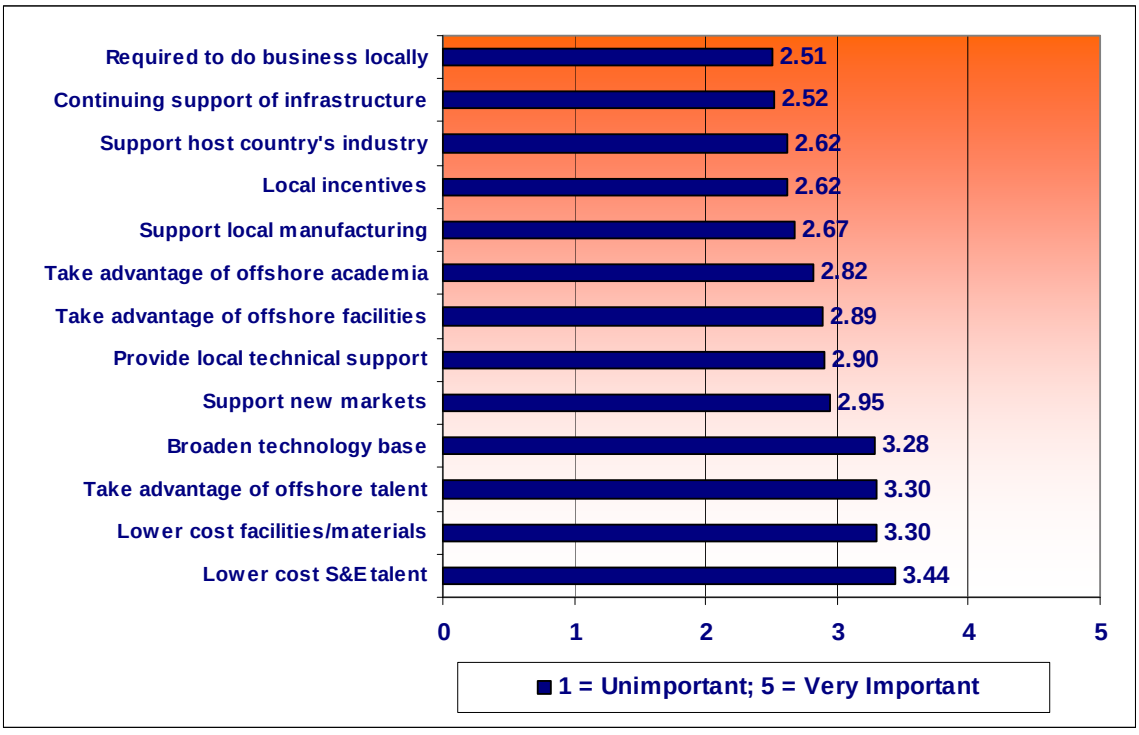
Most researchers agree that there are a number of motivations for U.S. firms to offshore R&D, including access to local markets, access to talent, and cost reduction. There is less consensus on which factors are the most important. Because R&D offshoring, particularly to developing nations such as China, India, and Russia, is new, there is relatively little research on the subject. However, some research has been done, but it yields conflicting answers. In part this is because the reasons firms offshore R&D vary according to a number of different factors, including the location, the type of R&D (e.g. more routine product development vs. more exploratory basic research), and the organizational form (in existing facilities; establishment of facilities that are specifically developed for the purpose of conducting R&D; or contracting with independent organizations for R&D). Moreover, the motivation for conducting R&D in other nations is changing. Traditionally, much overseas R&D was conducted to adapt products to foreign markets.[17] However, in the last decade, an increasing share of offshored R&D has been for the purpose of developing technology that can be used in the firm's global markets.

So what factors are most important in offshoring R&D from the United States? As might be expected, costs do not appear to be the driving factor for offshoring R&D to other developed nations. After all, R&D costs are generally not lower in Western Europe and Japan. There, factors such as access to markets, linkages to existing production facilities, and access to talent are the most important factors.

However, when it comes to offshoring to developing nations, it appears that cost reduction is the major driver. Indeed, this is what we would expect, given that salaries for R&D personnel in a nation like China are as low as 1/6th of those in the United States. In India the annual salary of an electronic circuit designer with a Master's degree and five years of experience is about $18,000, compared to $84,000 in the United States. Moreover, Indian engineers work about 450 hours a year more than their U.S. counterparts.[18]

A number of studies and surveys point to costs as the main driver. Booz Allen Hamilton found that when it comes to moving R&D to developing nations, access to a "low cost skills base" is a key driver for establishing new R&D sites.[19] A survey by the Industrial Research Institute agreed, finding that cost reduction is the most important factor in the decision to offshore R&D, with almost 39 percent of U.S. corporate respondents citing it as their most important consideration. Moreover, another 31 percent cited increased competitiveness, which could include cost reduction factors. When asked to assess the importance of individual factors important to the decision to offshore, lower cost S&E talent and lower cost facilities/materials were the two most important factors (see Figure 5).

Figure 5: Why U.S. Firms Outsource R&D[20]



A survey of California technology companies found a similar pattern. For foreign outsourcing (unaffiliated offshoring), cost reduction was the most important factor. For affiliated offshoring, costs and access to skilled labor were both important.[21] It appears that these factors are at work in other nations as well. A survey of Danish firms found that cost reduction was the major factor leading them to offshore R&D.[22]

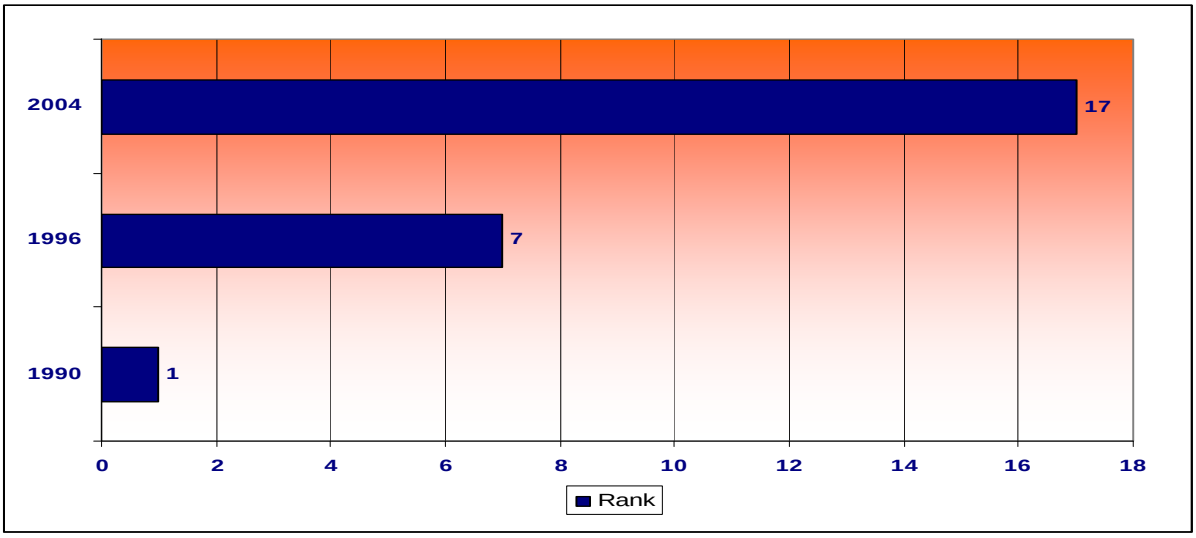
While most studies cite cost reduction as the most important driver in the decision to offshore R&D, particularly to developing nations, one widely cited and reported survey by Thursby and Thursby conducted for the National Academy of Sciences concluded that market growth potential and availability of skilled R&D workers, and not cost, are the top two factors that drive multinationals to offshore R&D to other nations.[23] Yet, there are several reasons to believe that this research study significantly underestimates the importance of cost. First, the study shows that low costs are more important to the location decisions for emerging countries than developed nations or relocation in the home nation. Second, the study asks firms to assess the importance of tax breaks and costs separately. But when making location decisions most firms consider these factors together. If the survey instrument had instead asked respondents to assess the importance of total costs, including tax breaks, it is likely that costs would have been reported as a more important driver.

Finally, and perhaps most importantly, it is not clear that availability of skills is the major driver of R&D offshoring. It seems more accurate to view the availability of R&D talent as a basic requirement of a site in order to be considered, but not a driver per se. In other words, firms will not move an R&D facility to a location where there is no technical talent, any more than a lumber and wood products firm would move to a region where there are no trees. Access to talent, as well as other basic necessities like electricity, water and telephone, is a requirement. Places with little or no access to these factors are simply not in the running. It doesn't matter how cheap the labor is or how big the incentives are, if a place doesn't have skilled researchers, R&D facilities will not locate there. So in a narrow sense, respondents may cite the availability of skills as an important factor. However, this is very different than saying that the availability of technical skills is the driver of the decision to offshore R&D. This is not to deny that sometimes firms locate R&D in particular regions because there is a concentration of particular types of scientific and technical talent there. But it's not clear that the major driver of firms going to China or India is the availability of skills.

Given that costs are the most important driver in offshoring R&D, particularly to developing nations, what role do incentives play? Costs are determined both by overall costs of doing business and by specific incentives. Generally, incentives are not listed as the most important factor in determining R&D location decisions. However, because they do contribute to the overall cost estimation firms undertake, they are a factor involved in decision-making. This is one reason why within the last decade many nations, including most of Southeast Asia and Europe, have made attracting and growing R&D a centerpiece of their national economic strategies. Their aggressive use of R&D tax incentives is just one indicator of that commitment. In 1990, the United States enjoyed the distinction of having the world's most generous tax treatment for research and development. However, because the generosity of the credit has been whittled away over the years, and other nations have forged ahead, by 2004 we had dropped to 17th most generous (see Figure 6).[24] For example, China provides a 150 percent deduction on R&D expenses (provided that R&D spending increased 10 percent over the prior year). Mexico offers a tax credit of 30 percent not only for all R&D expenses but also for equipment (which is not eligible for the credit in the United States). India provides a tax deduction of 125 percent of certain R&D expenses.[25] But nations use more targeted incentives as well. For example, China has established a large number of research parks and many advertise tax breaks for foreign companies locating there. Other R&D incentives include tax breaks on R&D labor, exemption from VAT taxes on equipment purchases, and subsidized research facilities.[26]

Many nations aggressively market their R&D tax policies to attract global research investments. Australia touts its generous R&D tax incentives in order to persuade multinational companies to invest there.[27] Ireland places ads in U.S. business magazines to market its attractiveness as a location for R&D facilities.[28] Not surprisingly the growth rate of R&D of U.S. foreign affiliates was higher in countries with tax-based R&D incentives than those without.[29]

Figure 6: U.S. Rank in Tax Generosity of R&D Among 30 OECD Nations, 2004[30]



There is one other factor that may lead firms to offshore R&D. In some nations, pressure from the national government for "technology transfer" have led some firms to establish R&D facilities there, in order to be able to access the domestic market to sell goods and services.[31] For example, China sometimes requires companies to establish a research institution, center, or lab for joint R&D in order to get approval for joint ventures. Since the WTO prohibits forced technology transfer, nations that have joined the WTO have discovered that they can avoid a WTO violation by "encouraging" technology transfer without formally requiring it. One way is for local government officials reviewing investment applications to make it clear that a quid-pro-quo deal is required for approval. Burying these deals in the fog of bureaucracy lets "mercantilist" countries hide their WTO violations that bring in more offshored R&D than they would otherwise receive.

Is R&D Offshoring Good or Bad for the U.S. Economy?

Not only is the extent and cause of R&D offshoring debated, so too is whether it is good or bad for the U.S. economy. There is a general consensus that R&D offshoring is beneficial to U.S. firms. Otherwise, why would they engage in it? Nonetheless, it is important to note that unless firms manage this process effectively, it's possible that they could lose valuable intellectual property to competitors. This could happen if other companies are able to gain access to the knowledge and then commercialize in direct competition. R&D offshoring could also benefits the U.S. economy if U.S. firms end up doing more R&D because of offshoring and are able to be more innovative and competitive than their rivals in other nations.

Yet, offsetting these potential gains are the potential losses to the U.S. economy of the direct and indirect economic activity related to R&D. There is no doubt that while offshoring, like trade in general, benefits the United States by lowering prices on a wide array of services, it is also true that it threatens particular workers and communities. It is hard to make a strong case that losing low-wage jobs to offshoring hurts the U.S. economy, since many laid-off workers are likely to move up to higher wage, higher-skilled jobs, especially if they receive the necessary support and retraining. However, if the jobs are higher wage – as are R&D jobs – then it is less clear how offshoring these jobs benefits the economy. It is unlikely that most of the laid off workers, or the workers not hired because the firm did not expand R&D in the United States, would find jobs at comparable incomes.

Moreover, the decline or otherwise slower growth of R&D investments is likely to mean fewer (or slower growth in) jobs for scientists and engineers.[32] This in turn could lead to fewer individuals choosing science, technology, engineering and math (STEM) careers, thereby exacerbating the trend

toward more offshoring of R&D, until a new lower equilibrium is established. Moreover, R&D jobs appear to be linked to production jobs. Indeed, there is a correlation between a nation's investment in R&D and the share of its total manufacturing exports that are high-tech.[33] As a result, offshored R&D could lead to less high-tech production.

Finally, there is considerable evidence that R&D activities generate positive spillovers and that these spillovers are geographically limited in scope.[34] For example, there is evidence that offshored R&D spurs domestic companies in the receiving nations to increase their R&D, thereby increasing the competitive challenge to U.S. firms.[35] This is one of the reasons for the renewed interest around the world in regional "clusters" of economic activity, particularly innovation-based economic activity. As a result, losing R&D means more than the loss of the actual R&D activities.

What Should Congress Do?

Congress has a key role to play in responding to this new challenge to the innovative position of the U.S. economy. However, one role it should not play is engaging in a debate about whether U.S. companies "should" be offshoring R&D or whether CEO's that offshore R&D are "Benedict Arnolds."[36] In the new global economy with hyper-competitive product and financial markets, companies that do not take advantage of appropriate offshore R&D opportunities will suffer in the marketplace and in equity markets. But going to the other extreme and doing little in response, hoping that "the market" will solve the problem is likely to be equally as unproductive.

Rather, Congress should focus on adopting the kinds of policies that will make the United States a place where companies – U.S. and foreign – want to increase their R&D investments. Making the environment and "ecosystem" for R&D the most vibrant and attractive in the world is a goal everyone should be able to agree on. There are four key steps Congress should consider:

- **Expand the R&D tax credit:** Perhaps the most straightforward and effective way to make the United States more attractive to internationally mobile R&D investment is to expand the R&D credit. Congress could start by doubling the credit's rate to 40 percent.[37] Doubling the credit would make an important statement that the United States is serious about keeping and growing research-based economic activities. In addition, Congress should also expand the Alternative Simplified Credit. Moreover, in order to spur more research partnerships between companies and American universities and federal laboratories, Congress should allow firms to take a flat credit of 40 percent for collaborative research conducted at universities, federal laboratories, and research consortia.

- **Create a National Innovation Foundation:** The federal government's traditional focus on basic science (principally through the National Science Foundation), agency-specific mission-oriented research, and managing a patent system is no longer sufficient to ensure that the United States remains the world leader in R&D and innovation. If the United States is going to meet the economic challenges of the future, the federal government will need to make the promotion of innovation a larger part of its national economic policy framework. Congress took an important step in that direction with the passage of the 2007 America COMPETES Act. But the challenge is neither modest nor fleeting and more needs to be done.

Other nations have come to that conclusion. In recent years many nations, including Finland, France, Iceland, Ireland, Japan, the Netherlands, New Zealand, Norway, South Korea, Sweden, Switzerland, and the United Kingdom have either established or significantly expanded separate technology- and innovation-promotion agencies. They 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 firms and in firms in partnership with universities.

It is time for the United States to do the same and create and fund a new National Innovation Foundation (NIF), with a core mission to boost innovation in businesses.[38] The NIF would work with businesses, state governments, universities, and other partners to help spur innovation. The NIF would operate a competitive Industry Research Alliance Challenge Grant program to match funding from consortia of businesses, businesses and universities, or businesses and national labs. The NIF would also operate a competitive grant program to increase state investments in innovation-based economic development activities. States would submit proposals to the NIF laying out their technology-based economic development (TBED) strategies and explaining how NIF support would enable them to do more and better. Qualifying projects would include a host of TBED activities, including technology commercialization centers, industry-university research centers, regional cluster development programs, regional skills alliances, and entrepreneurial support programs.

- **Ensure an Adequate Supply of Skilled Researchers:** While costs are a key driver in offshoring to developing nations, ensuring an adequate supply of STEM talent is an important factor in helping ensure that companies conduct more R&D in the United States. For if companies have difficulty in hiring skilled STEM workers, it will be that much more of a spur to look overseas. As a result, we need to not only work to expand the domestic supply of STEM talent but also expand the opportunities for talented foreigners to come to the United States and contribute their expertise. Congress took several steps toward the first goal in the recent America COMPETE Act, but these efforts need to be expanded and fully funded, including providing more funding for specialty math and high schools.[39]

But even with these efforts, it's important to note that at least for the short term, we won't be able to rely only on domestic supply alone. Policymakers around the world are also waking up to the fact that a key component of increasing domestic R&D is expanding the supply of individuals with STEM degrees. Yet at a time when many other nations are making it easier for talented immigrants to enter their country, either as students or workers, the United States is struggling to decide what to do.[40] We have sent out mixed messages to the rest of the world since September 11, 2001, and in the immigration debate of the past year, pragmatic discussion of skills was drowned out by heated rhetoric about other aspects of immigration. As a result, Congress should expand and reform the H-1B visa program. In particular, tighter oversight of the program may be required to ensure that employers, particularly foreign ones, are paying prevailing wages. Finally, immigration policy should make it easier for foreign students studying in STEM fields to attend school here and to gain a path to citizenship once they obtain their graduate degrees.

- **More Vigorously Combat other Nations' Efforts to Force U.S. Companies to Move R&D Offshore:** As noted above, some nations tie access to their markets to company investments in R&D in their nation. Even though these practices violate the letter or spirit of the WTO, they are popular tactics with some mercantilist countries to gain valuable technological know-how. Yet, it is one thing if a company wants to invest in R&D in other nations as part of its business strategy. It is quite another for it to be coerced into doing so in order to gain access to the market. The United States government, and in particular the United States Trade Representative (USTR), needs to be much more proactive in fighting these kind of high-tech mercantilist actions and ensure that governments do not pressure U.S. firms to move R&D offshore.

Conclusion

The U.S. economy still possesses enormous strengths and advantages in technology and innovation. However, the rise of offshore R&D threatens our technology leadership, particularly as there are few signs that, absent new public policies, this trend is not likely to abate any time soon. Ensuring continued technology leadership will require bold new policies to spur domestic R&D and innovation.

Notes:

1. Robert D. Atkinson, "Apocalypse Soon? Why Alan Blinder Gets it Wrong on Offshoring," (Washington, D.C.: The Information Technology and Innovation Foundation, 2006), <www.itif.org/index.php?id=64>.

2. Yifei Sun, Debin Du, and Li Huang, "Foreign R&D in Developing Countries: Empirical Evidence from Shanghai, China," *The China Review* 6.1 (spring, 2006), 67-91.

3. Magnus Karlsson, "International R&D Trends and Drivers," *The Internationalization of Corporate R&D*, ed. M. Karlsson, (Ostersund, Sweden: Swedish Institute for Growth Policy Studies, 2006), 55-88; <www.co-reach.org/input/document/documents/591.pdf>.

4. Booz Allen Hamilton and INSEAD, "Innovation: Is Global the Way Forward?" (2006): 3. <www.boozallen.com/media/file/Innovation_Is_Global_The_Way_Forward_v2.pdf>.

5. "2007 Global R&D Report: Changes in the R&D Community," *R&D Magazine,* (Battelle, Sep. 2006), 4; <www.rdmag.com/pdf/RD_GR2006.pdf>.

6. Ashok D. Bardhan and Dwight M. Jaffee, "Innovation, R&D and Offshoring," paper 1005 (Berkeley: Fisher Center for Real Estate & Urban Economics, 2005); <repositories.cdlib.org/cgi/viewcontent.cgi?article=1035&context=iber/fcreue>.

7. U.S. Bureau of Economic Analysis.

8. *World Investment Report 2005* (New York: United Nations Conference on Trade and Development, 2006) <www.unctad.org/en/docs/wir2005_en.pdf>.

9. Dan Breznitz, *Innovation and the State: Political Choice and Strategies for Growth in Israel, Taiwan, and Ireland* (New Haven: Yale University Press, 2007), 22.

10. Majority-owned foreign affiliates (MOFA), which are foreign business enterprises that are owned at least 50% by US parent(s). Source, U.S. Bureau of Economic Analysis.

11. "2007 Global R&D Report: Changes in the R&D Community," *R&D Magazine* (Battelle, Sep. 2006), <www.rdmag.com/pdf/RD_GR2006.pdf>.

12. Council on Competitiveness, *Competitiveness Index* (Washington: Council on Competitiveness, 2007), 67.

13. OCED S&T and industry outlook, 2004.

14. *R&D Magazine*, op. cit., p. G15; <www.rdmag.com/pdf/RD_GR2006.pdf>.

15. Jerry Thursby and Marie Thursby, *Here or There: A Survey of Factors in Multinational R&D Location* (Washington, D.C.: National Academy of Sciences, 2006), 12.

16. *R&D Magazine*, op. cit.m p. G15; <www.rdmag.com/pdf/RD_GR2006.pdf>.

17. Richard Florida, "The Globalization of R&D: Results of a Survey of Foreign-Affiliated R&D Laboratories in the USA," *Research Policy* 26.1 (1997), 85-103.

18. Raja M. Mitra, "India's Potential as a Global R&D Power," *The Internationalization of Corporate R&D*, ed. M. Karlsson, (Ostersund, Sweden: Swedish Institute for Growth Policy Studies, 2006), 267-306; <www.co-reach.org/input/document/documents/591.pdf>.

19. Booz Allen Hamilton and INSEAD, op. cit.

20. *R&D Magazine* (Battelle, Sep. 2006): G16; <www.rdmag.com/pdf/RD_GR2006.pdf>.

21. Bardhan and Jaffee, op. cit.

22. Peter Maskell, Torben Pedersen, Bent Petersen, and Jens Dick-Neilsen, "Learning Paths to Offshore Outsourcing – From Cost Reduction to Knowledge Seeking," *DRUID Working Papers 05-17* (Copenhagen: Copenhagen Business School, 2005).

23. Thursby and Thursby, op. cit.

24. Jacek Warda, "Tax Treatment of Investment in Intellectual Assets: An International Comparison," *OECD Science, Technology and Industry Working Papers 4* (Paris: OECD, 2006).

25. Anthony B. Billings, "Are U.S. Tax Incentives for Corporate R&D Likely to Motivate American Firms to Perform Research Abroad?" *Tax Executive* (Jul. 2003).

26. For example, see <www.cbw.com/business/invest/xian/policies.htm>.

27. Australian Government Department of Foreign Affairs and Trade, "Australia Now: Investing in Australia," <www.dfat.gov.au/facts/investing_in_australia.html>.

28. *Business Week*, 28 Aug. 2004.

29. Billings, op. cit.

30. OECD data including Jacek Warda, op. cit.

31. Julie A. Hedlund and Robert D. Atkinson , "The Rise of the New Mercantilists: Unfair Trade Practices in the Innovation Economy," (Washington, D.C.: The Information Technology and Innovation Foundation, 2007), <www.itif.org/index.php?id=51>.

32. Robert D. Atkinson, "Will We Build It and If We Do Will They Come: Is the U.S. Policy Response to the Competitiveness Challenge Adequate to the Task?" (Washington, DC: The Information Technology and Innovation Foundation, May 2006), <www.itif.org/index.php?id=62>.

33. Karolina Ekholm and Katerina Hakkala, "Location of R&D and High-Tech Production by Vertically Integrated Multinationals," *The Economic Journal* 117 (Mar., 2007), 512-543.

34. Adam B. Jaffe, Manuel Trajtenberg and Rebecca Henderson, "Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations," *The Quarterly Journal of Economics* 108.3 (Aug. 1993), 577-98.

35. Zhe Qu, Can Huang, Mingqian Zhang, and Yanyun Zhao, "R&D Offshoring and Technology Learning in Emerging Economies: Firm Level Evidence from the ICT Industry," *UNU-MERIT Working Paper Series 023* (United Nations University, Maastricht Economic and Social Research and Training Centre on Innovation and Technology, 2007).

36. Jim VandeHei, "Kerry Donors Include 'Benedict Arnolds,'" The Washington Post 26 Feb. 2004: A01; <www.washingtonpost.com/wp-dyn/articles/A6884-2004Feb25.html>.

37. The National Academy of Sciences' *Rising Above the Gathering Storm* report made a similar recommendation which was introduced into legislation by Senators Alexander (R-TN) and Bingaman (D-NM): Committee on Prospering in the Global Economy of the 21st Century, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (Washington, D.C.: The National Academy of Sciences, The National Academy of Engineering, and the Institute of Medicine, 2006); *PACE – Finance Act*, S. 2199

38. See Robert D. Atkinson and Howard Wial, "Boosting Productivity, Innovation, and Growth through a National Innovation Foundation," (Washington, D.C.: The Information Technology & Innovation Foundation and the Brookings Institution, forthcoming).

39. Robert D. Atkinson, Janet Hugo, Dennis Lundgren,. Martin J. Shapiro, and Jerald Thomas, "Addressing the STEM Challenge by Expanding Specialty Math and Science High Schools, "(Washington, D.C.: The Information Technology and Innovation Foundation, 2007), <www.itif.org/files/STEM.pdf>.

40. David M. Hart, "Global Flows of Talent: Benchmarking the United States," (Washington, D.C.: The Information Technology and Innovation Foundation, 2006), <www.itif.org/index.php?id=66>.