Testimony Prepared for the Hearing: The Globalization of R&D and Innovation

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By

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Globalization has provided many benefits to the US economy. My Peterson Institute colleagues, Gary Hufbauer et al, have estimated that the US is a trillion dollars richer today than it would have been if there had been no reduction in trade barriers after the end of World War II. [1] Many studies of productivity carried out at the McKinsey Global Institute have shown that productivity in an industry is enhanced when it is exposed to global competition, particularly competition against the world's leaders.[2] You have to compete against the best if you want to be the best. The Organization for Economic Cooperation and Development found that openness to international trade had provided an important stimulus to growth among the member countries of that organization.[3]

The United States benefits from globalization because it results in lower prices for US consumers, provides greater access to new technologies and business practices from around the world, allows US companies to take advantage of economies of scale, and because it forces companies to improve their own performance. One sign of the benefits of the open and competitive market in the US is the fact that productivity growth has been strong for the past ten years. From 1995 to 2006 output per hour in the non-farm business sector of the US economy has been nearly 2.9 percent a year, much faster than the pace achieved for 20 years prior to 1995 and faster than most other advanced economies.

At the same time, there are legitimate concerns about the impact of globalization on Americans. There is concern is over the impact of globalization on the skilled workforce and on the science and technology base of the US economy—the topic of this hearing. Strength in science and technology has been a key part of the success of the United States over its history. In addition there is concern over the huge trade and current account deficits and the slow growth of wages and incomes for lower skilled workers.

Scientific Research has Always been a Global Endeavor

The history of science tells us that major contributions have been made to scientific knowledge from countries and regions around the world. The United States came to the fore in scientific research during the 20th century, relying on its great universities and taking advantage of outstanding scientists and engineers that came to the US from the rest of the world. Today, the US remains unquestionably the global leader in science, judged by the size and quality of its research community and on the metric of Nobel prizes.

US leadership is not unchallenged, however. Other countries are determined to build up their own scientific research and are funding research projects. What are the lessons for US policy?

- Scientific research is not a zero-sum game. Scientific breakthroughs made around the world have benefited Americans and will do so in the future. One of the strengths of the US economy has been its ability to learn from developments made elsewhere and adapt them to the needs of the economy.

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[1] Scott Bradford, Gary Clyde Hufbauer, and Paul Grieco "The Payoff to America from Global Integration," in C. Fred Bergsten ed., *Foreign Economic Policy for the Next Decade*, Peterson Institute for International Economics, 2006.

[2] For a list of productivity studies see www.mckinsey.com/mgi

[3] OECD *Economic Policy Reforms: Going For Growth 2007*, Paris, 2007.

- Maintaining US strength in science depends heavily on embracing its global character. This means that trained scientists from around the world must be able to come to the United States and participate in the research being carried out here. It means that students from around the world must be allowed to come to US graduate schools and remain in this country for post-doc work.
- It is not just a matter of the number of visas granted. The treatment given to people applying to enter the US has sometimes been unpleasant in ways that do not materially assist our national security. Ultimately this will weaken our universities and our scientific base.
- Scientific research depends upon funding from the government and foundations because no private company finds it worthwhile to support large-scale research that does not provide it with proprietary returns. The US government does support scientific research and must continue to do so, even during periods of budget tightness. Moreover, the allocation of funds must be on the basis of the underlying science and technology. Allocating too large a share of scarce research dollars to celebrity diseases or big spectacular projects should be avoided.
- There is also a case for government support of pre-commercial technology development. This is research that is closer to commercial application than pure scientific study, but that is too broad and general for companies to do. There are areas of material science, for example, that fall into this category. This type of research must be carefully handled, however. Sometimes such projects continue too long because it is not easy to admit failure. Failure is part of research, but that means that projects must be turned off as well as turned on.

Off-shoring Services and Science and Technology

Historically, the United States has been a preferred location for employment in science and technology and has a robust comparative advantage in services. In 2006 the US ran a $72 billion surplus in services trade, despite the fact that goods trade was in a huge international deficit. As part of the $72 billion services surplus, the US ran a surplus of $35 billion in royalties and licenses, much of that coming from technology, as well as movies and other media. These figures in fact greatly understate the global revenues generated by technology activity in the US. US- and foreign-based multinational companies draw on the technological base they have developed through R&D and business development here in the US and use it in operations throughout the world. The returns come back as net income to US companies.

The US also runs a trade surplus in education reflecting the foreign students that are educated in US institutions. The only major service categories in which the US ran a deficit were insurance and transportation.

The very large trade deficits in manufactured goods experienced by the US have been the result largely of a value of the dollar that has made US production too expensive relative to other countries and the dollar has also hurt US services trade. The values of the Euro, the British pound, the Canadian dollar and other currencies have adjusted upwards and this has made the US a more competitive economy for locating production facilities and also R&D and other technology facilities. This should help to boost US employment in technology fields going forward. Some Asian currencies, notably the Chinese renminbi and the Japanese yen, remain undervalued, according to several of my Peterson Institute colleagues, and if these currencies adjust upwards in the future this will add to the desirability of the US as a location for high technology research, as well as tradable services more broadly.

On balance, the US service sector as a whole has sustained its position as a net exporter through a challenging overall environment for trade. Many countries around the world have off-shored their R&D and technology employment to the US, pharmaceutical R&D by US and European companies in New Jersey, for example.

This is not to downplay the competitive challenges now facing the US service sector and the pressure being felt by some mid-level occupational categories in the US. Table 1, prepared by the Peterson Institute's Jacob Kirkegaard, shows employment in a number of computer and technology related occupations, as well as employment in lower-skilled service occupations that are subject to relocation off-shore. The upper half of the table reveals that call-center type occupations and low-wage technology workers have experienced a substantial decline in employment, about 800,000 between 1999 and May 2006. This decline is in part the result of off-shoring, moving these jobs to lower-cost locations. Not all the employment decline is trade-related, however. Some of the largest declines are for data entry keyers and word processors and typists. These occupations have been heavily affected by changes in the technology itself, making it easier to read and transfer data electronically and allowing many white collar workers to enter their own documents or spreadsheets directly into the computer, bypassing the need for secretarial assistance.

This is an important point. The book by Frank Levy and Richard Murnane points out that the characteristics that make it possible to off shore a particular job also make it possible to automate that job.[4] This means that off shoring and automation are often alternatives. It is misleading to look at jobs that have "moved" to India and assume these jobs would have remained in the US. In many cases, the jobs would have been automated if there had not been the opportunity to buy the service overseas.

The lower part of the panel shows employment for mid-level workers and high-wage technology workers. The mid-level employment has risen nearly 52,000 and the high-wage workers have increased by about 428,000 between 1999 and 2006. Despite the impact of the technology crash in 2000-2001, and despite the impact of service sector off-shoring, employment in these job categories on average has increased substantially—by nearly 20 percent. Within the high-wage categories, however, there is one that stands out: computer programmers have seen a decline in employment of about 133,000. The decline in employment in this area comes because of the end of the tech boom, but also because many programming jobs have been re-located off-shore. The person who heard that programming was the way to ensure a good job and took some courses to learn the basics has found that the jobs are not there. Those that upgraded their programming and computer systems skills have been in demand.

The Economics of Service Sector Off-Shoring[5] One of the things that scare Americans is the idea that almost any job today could be off-shored. That is not true. A careful estimate has found that about 11 percent of all jobs could *theoretically* be carried out in a remote location. There are higher estimates around, but these do not take into account adequately some of the difficulties of performing tasks remotely, including the difficulty of complex, one-on-one interactions that are required in many operations.[6]

Even though 11 percent of employment is a lot smaller than some of the scare-numbers out there, it is still a very large number of jobs. Civilian employment in the US was about 146 million in 2006, so 11 percent would be over 16 million. But in fact the likely number of jobs that will be off shored over the next few years is much smaller than this. The main determinant of the number of jobs off shored is the extent to which US businesses judge that it is economic to do so. For some sectors the cost advantage from moving off shore is very small and not worth the risks involved. This is becoming increasingly true for off shoring to India, where wages are rising very rapidly for skilled workers. For many sectors it is not possible to

[4] Frank Levy and Richard J. Murnane, *The New Division of Labor: How Computers are Creating the Next Job Market,* 2005

[5] This section draws on *The Emerging Global Labor Market,* 2006, a study of the McKinsey Global Institute on which I was an advisor, see www.mckinsey.com/mgi.

[6] Alan Blinder in "Off-Shoring: The Next Industrial Revolution ," *Foreign Affairs,* March-April 2006, makes a rough estimate that 28 to 42 million jobs are susceptible to off-shoring. Blinder does not mention the possibility of service jobs that come to the US as a result of trade. J. Bradford Jensen and Lori Kletzer in "Tradable Ser vices: Understanding the Scope and Impact of Services Outsourcing," Peterson Institute, Working Paper 05-9, September 2005 use an original empirical approach and indicate a pretty large number of jobs that could theoretically be off-shored, although the authors believe only a fraction of this total are actually vulnerable.

disaggregate their value chains and move parts of them overseas because the business processes are just not suitable. Many small businesses do not have the scale to make off shoring worthwhile. For some sectors there are issues of regulation or intellectual property protection that preclude off shoring. On balance, it can be expected that no more than 4 million jobs will be off shored over the next five years, or about 2.7 percent of civilian employment in the US. Figure 1 illustrates the different factors that influence the off-shoring decisions companies make.

Overall, the growth of off-shoring is demand driven because there is an adequate supply of workers located in other countries that are qualified to perform the tasks that US companies will look for. There are a couple of important qualifications on the supply side, however. One of the arguments often used to argue that US jobs and wages are threatened is to claim that there are billions of new workers in the global labor market competing directly with American workers. This is not the case. After careful interviews with a number of companies, the McKinsey study found that the number of suitable workers available is much, much smaller. Based on educational qualifications alone there were about 33 million workers available in 2003, but after assessing their language skills and suitability and availability to work for multinational companies, the number dropped to about 4 million. The number of suitable workers is growing over time, of course, and so the overall supply will be more than adequate to meet the US demand of around 4 million over the next five years, but talking about billions of competing workers is just misleading.

The second qualification is that the number of suitable engineers, particularly software engineers, in the global economy may not be adequate to meet demand, leaving unmet engineering needs and/or rising relative wages for this group. Countries such as India and China are growing at an amazing pace and increasing their own demand for skilled workers. High tech in the US is a rapidly growing sector again. If demand growth exceeds current estimates there will be a shortage of trained workers globally.

Globalization and Technology: Evolving Models The nature of service sector off shoring is changing. Initially, companies took part of their value chain and sent it overseas—call centers or basic programming. What is happening now is that US companies are forming partnerships with companies in India and elsewhere. The new models have the following characteristics:

- **Co-operation** - both parties work together to achieve the goals of a common work force
- **Productivity and innovation** - drive for productivity gains and the centralizing of key processing capabilities
- **Transparency** - sharing both financial and operating details
- **Movement between operating models** - The client can move processes (and staff) between the operating models to meet changing business demands
- **Third party vendors** - May be deployed to perform specialist services
- **Multiple sites** – Operations across multiple physical centers and geographies

As is to be expected, the opening up of service activities to globalization has triggered a new round of interactions. The overseas suppliers of services are developing skills that allow them to work with US multinationals to increase productivity, the range of activities that can off shored and the different geographies that supply services. *As off-shoring matures as an activity, it takes on new roles which focus on improving productivity and efficiency in US operations, not just moving jobs.* Note also that leading Indian off-shoring companies are rapidly increasing their operations in the US and Europe. Many of the outsourced services being provided to US companies are being supplied by employees of outsourcing companies that are based in here in the US, creating American jobs.

The Shifting Mix of Jobs The US economy has sustained low rates of unemployment for the last twenty years and currently has an unemployment rate of 4.5 percent, so our economy can create jobs, indeed many companies report they have trouble recruiting workers. The challenge for the US labor market is that the distribution of wages has become much wider over time. How serious this problem is and the extent to which it is the result of trade or technology is a matter of controversy that I will not address here, but there is no question that the off-shoring process has resulted in a shift in the composition of employment. As we saw in Table 1, in computer and other occupations that have been subject to off-shore competition, there has been a decline in basic jobs and an increase in higher skill jobs, on balance. Although off-shoring is not large enough to be a main driver of the distribution of income in the US, it will contribute to some extent.

Policy Implications of Off-Shoring

- The most important features of the US economy that make it attractive as a location for science and technology production are the tremendous base of activity already in place; the favorable climate for business; the range of customers eager to make use of new technologies; and the flexibility of the economy that encourages business experimentation. Policy must make sure that these advantages stay in place. Efforts to regulate against off-shoring would discourage companies from locating science and technology jobs in the US and undermine the very jobs these efforts were attempting to save.
- One of the most acute problems facing the US, one that is likely to worsen over time, is the rising cost of health care. To the extent that support and technical jobs in this sector can be performed at lower cost overseas, this will help not only the fiscal deficit, but all Americans that use the health care system. Policymakers should encourage the use of the global economy to increase competitive pressure in the health care market and cut costs. It makes no sense to lament the fact that so many Americans lack health insurance and then stand in the way of measures that could lower health care costs by taking advantage of the global economy.
- The US is already a major exporter of services and could become a larger exporter if foreign markets were more open. The US has a lot to gain from trade negotiations that would open up service sectors around the world.
- Compared to most other advanced countries the US spends very little on worker training. Many companies report that they are unable to find skilled workers but many companies are unwilling to provide the training that would create the needed skills. Given the high rate of turnover in the US labor market that is not surprising because companies do not want to train someone only to see them move to a competitor. An important step that Congress could take to help US workers find better jobs and compete in the global market is to create financial incentives for companies to train workers, and financial penalties for companies that do not train. Our best companies today that do train their workers would benefit from such a policy.

Education, Globalization and the Science and Technology Workforce

We know that the American education system is not providing adequate skills to many Americans, skills that would allow them to get better jobs and that would increase the number of people that can work in R&D and technology jobs here in the US. This is a hard problem to fix, and part of the difficulty is that many students are unwilling to study technical subjects. We could help, however, by increasing opportunities and incentives. Higher education has become more expensive for low-income families because the value of government scholarships and awards has not kept pace with rising education costs. Congress could help solve this problem by providing additional grant money for students that lack the resources to attend.

Americans do respond to incentives. Many people, including myself, believe that it is in the interest of the economy as a whole to have an increase in the number of people educated in science and technology and hence a case for public support of science and technology education. Having a strong science and technology workforce based in the US helps generate good jobs and preserve our current strength in this area. Congress could add to the size of this workforce by providing more graduate scholarships in science and technology subjects that are available to US citizens and permanent residents. It is contradictory to talk about the need to protect our technology infrastructure if we are unwilling to pay the modest amounts needed to strengthen it directly.

Conclusions

Globalization is being blamed for problems that have been created by failures in other areas. The US does not save enough; job transitions are too costly because they can cause a loss of health insurance; workers that lose or leave jobs are not given adequate income or retraining support to help them find new jobs that are better than the ones they may have lost. Denmark has developed a system of "flexicurity" that gives them a flexible labor market but provides substantial but tough-minded support for workers. Most of the rest of Europe has income support but not enough flexibility. The US has flexibility but not enough support. The Danish model is not one that could be translated directly to the US, but there are lessons for the US here. Denmark has more people employed than does the US, relative to population, and sustains a lot of good jobs.

For a number of years the value of the US dollar against many currencies was out of line with the level that would allow US workers to compete effectively and exploit the underlying strength and productivity of the US economy—it is still out of line against some currencies. The most important way to make sure the US economy retains its strength as a center of technology jobs is to increase national saving and reduce our dependence on capital inflows from overseas, inflows that are the counterpart and enabler of our trade deficit. The Federal government has run very large cumulative budget deficits for many years. We need a fiscal policy in which there are budget surpluses during periods of full employment.

Trying to strengthen the R&D and technology jobs base of the US by subtle or overt protectionism is a mistake. The US is already an attractive location for these activities and it will become more attractive if we can take advantage of the global economy to reduce costs. In particular, Americans will be much better off if we can use the global economy to reduce the crushing costs of health care.

Table 1 Detailed US IT-Related Occupations 1999-May 2006

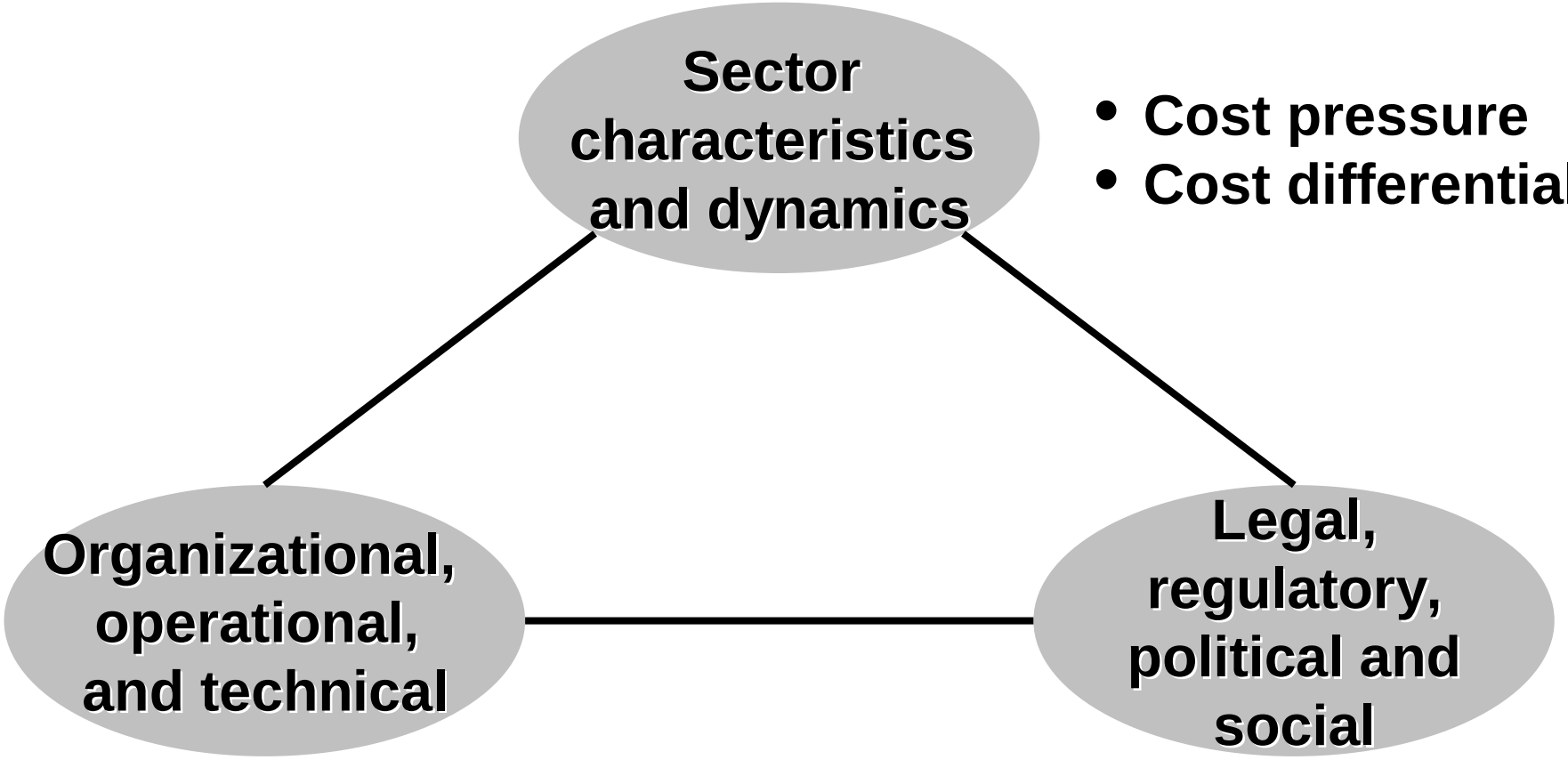
Occupations	1999	May-06	Total Change	Percentage Change	Annual Wage May 2006
Call-Center Occupations					
Telemarketers	485,650	385,700	-99,950	-20.6%	24,190
Telephone Operators	50,820	26,350	-24,470	-48.2%	32,710
Low-wage Technology Workers					
Switchboard operators, including answering service	248,570	172,060	-76,510	-30.8%	23,640
Computer operators	198,500	123,750	-74,750	-37.7%	35,010
Data entry keyers	520,220	295,650	-224,570	-43.2%	25,640
Word Processors and Typists	271,310	153,530	-117,780	-43.4%	30,540
Desktop Publishers	37,040	30,440	-6,600	-17.8%	36,120
Electrical and electronic equipment assemblers	387,430	211,460	-175,970	-45.4%	27,510
Semiconductor processors	42,110	41,520	-590	-1.4%	34,730
Total Call-Center and Low-Wage Tech. Workers	**2,241,650**	**1,440,460**	**-801,190**	**-35.7%**	**$ 27,227**
Mid-Level IT Workers					
Computer Support Specialists	462,840	514,460	51,620	11.2%	44,350
High-wage Technology Workers					
Computer and information scientists, research	26,280	27,650	1,370	5.2%	96,440
Computer programmers	*528,600*	396,020	-132,580	-25.1%	69,500
Computer software engineers, applications	287,600	472,520	184,920	64.3%	82,000
Computer software engineers, systems software	209,030	329,060	120,030	57.4%	87,250
Computer systems analysts	428,210	446,460	18,250	4.3%	72,230
Database administrators	101,460	109,840	8,380	8.3%	67,460
Network and computer systems administrators	204,680	289,520	84,840	41.5%	65,260
Network systems and data communications analysts	98,330	203,710	105,380	107.2%	67,460
Computer hardware engineers	60,420	74,480	14,060	23.3%	91,280
Electrical engineers	149,210	147,670	-1,540	-1.0%	78,900
Electronics engineers, except computer	106,830	131,880	25,050	23.4%	82,820
Total High-wage Tech. Workers	**2,200,650**	**2,628,810**	**428,160**	**19.5%**	**$ 75,819**

Source: Bureau of Labor Statistics CES Data, 1999, 2000, 2001, 2002, May 2003, November 2003, May 2004, November 2004, May 2005, and May 2006 National Occupational Employment and Wage Estimates

Source: Kirkegaard, Jacob F.

Figure 1:

FACTORS THAT INFLUENCE DEGREE OF ADOPTION



Source: McKinsey Global Institute, *The Emerging Global Labor Market*