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IT Offshoring and American Labor

William Aspray[1]

Abstract

This article presents an overview of the offshoring of information technology (IT), especially software and IT-enabled services, and its impacts on American labor. Topics include the history of offshoring politics in the United States, differences in attitudes between politicians and economists in their attitudes about the severity of the offshoring "problem," national differences in types of offshoring providers, technological and other drivers of offshoring, reasons to offshore, characteristics of work amenable to offshoring, the employment impact in the United States, political and educational responses to offshoring in the United States, and the roles of labor unions and big business.

Keywords

offshoring, information technology, educational responses, political responses, labor

This article addresses the offshoring of information technology (IT), especially software and IT-enabled services, from the United States over the past quarter century and the impacts it has had on American labor. The United States offshores more IT work than any other country, followed by the United Kingdom, Japan, and Germany. The findings here are drawn in large part from an international study of offshoring carried out by the Association for Computing Machinery, for which the author was the executive consultant and coeditor (Aspray, Mayadas, & Vardi, 2006). This article also draws on a rapidly growing literature on this subject that now numbers in the thousands (see, e.g., Arora & Gambardella, 2006; Aspray et al., 2006, bibliography; Atkinson, 2004; Bardhan, Jaffee, & Kroll, 2004; Carmel & Tjia, 2006; Dossani, 2007; Ferrell, 2006; Friedman, 2005; Hira & Hira, 2005; Koehler & Hagigh, 2004; Vashistha & Vashistha, 2006).

Offshoring is the term most commonly used in the United States in connection with the outsourcing of IT work. It is a fitting term for the United States, which typically

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reaches across water—for example, to India or China—when it sends software or IT-enabled service work to an outsourcing provider in another country. Contrast this to Germany, for example, which typically would send this kind of work to an Eastern European country such as the Czech Republic, where no crossing of a shoreline is involved.

When an American company outsources IT work, the provider company is most often located in the United States. But since the mid-1980s, and with increasing rapidity since the late 1990s, American companies have outsourced their work to providers outside the United States. This offshoring movement began in the mid-1980s with contracted programming services, typically provided by an Indian firm on site at the American company. Beginning in the late 1990s, one after another new kind of IT offshoring work was introduced, beginning with call centers and telemarketing centers, followed by business process outsourcing (e.g., routine back office work such as financial and accounting activities), so-called "knowledge process outsourcing" (a term that applies to a range of higher skill work efforts including background research for patents, animation, and ghostwriting), and most recently computing and software research and advanced development activities (Aspray et al., 2006, chap. 1, 5; Lewin & Couto, 2007). Thus, a wide range of jobs with significantly varying skill sets is part of this IT offshoring phenomenon. It is beyond the scope of this article to analyze the specific skills required for these jobs.

In the 1970s and 1980s, there was an increasing movement to Asia of hardware component (e.g., disk drives, circuit boards) and systems (e.g., personal computers, calculators) manufacture and assembly; and in recent years, this work has moved up the value scale to include component and system design and research (Aspray et al., 2006, chap. 1). However, this hardware offshoring developed earlier than and separately from the software and services offshoring, and so hardware offshoring is not considered in this article. Nor does this article address the more general offshoring of work, most notably including automobile and other manufacturing, from the United States to Asia and other parts of the world.

How Much Work Is Offshored, and What Is Its Labor Impact?

It is difficult to obtain good data about how much IT work is offshored and what its impact is on the American labor force (Aspray et al., 2006, chap. 2). Part of the problem is one of definitions. Some data sources include call center work, others only programming or some other particular type of offshored work. Some data sources track only work that is contracted outside the organization, whereas other data sets also include work that is moved from a U.S.-based company to a foreign subsidiary. It is hard to determine exactly why a person loses a job in an American company, so it is hard to determine when a job is lost to offshoring activity rather than, for example, to some sort of strategic reorganization of operations. For these and other reasons, the exact data one is seeking in the policy discussions of offshoring are hard to precisely define.

There are three major sources of data. The data from two of these sources, consultants and trade associations, can be problematic. Consultants commonly use data to

attract new business, so it enhances their business opportunities when they can use data to point to a crisis. Many scholars question the objectivity and reliability of the data from consulting firms, and these firms are generally unwilling to allow outsiders to review the methodologies by which they collect and analyze their data. Trade associations also often have a vested interest in a particular outcome to a particular political debate; moreover, their data typically come from their members, which may or may not be a representative sample.

The most commonly used data in studying offshoring are provided by governments and in particular by the U.S. federal government. The data collecting and analyzing agencies in the United States, such as the Bureau of Labor Statistics (BLS), the National Center for Education Statistics, and the Bureau of Economic Analysis, have a long tradition of careful, objective work. The federal government compels individual households and businesses to provide data, so that the data sets tend to be large and robust. The staff working for the federal agencies are typically highly trained professionals. There is a long history of federal data gathering and analysis being scientific, that is, independent from the whims of politics.

The problem with federal data is that they are collected in connection with some government policy or government management issues that arose in the past. It is expensive and time-consuming to collect and process data, and individuals and business owners do not like being compelled to provide data to the government, so the government is reluctant to collect new kinds of data when a new policy or management problem arises. Generally what happens is that one hopes to tease appropriate statistical analyses about the new issue out of existing data sets. When offshoring policy issues arose, government statisticians tried to use existing data sets to calculate both the number of U.S. jobs lost to offshoring and the amount of IT-based services trade sent from the United States to India. Independent analyses of these calculations show that the government analysis very significantly underestimated job loss and trade to India (U.S. Government Accountability Office, 2005). So how many jobs are being lost to offshoring? One well-regarded academic study suggests that approximately 200,000 U.S. IT jobs were lost in 2002 and perhaps twice that many in 2004 (Bronfenbrenner & Luce, 2004). Several studies show that the number of total jobs in the United States vulnerable to offshoring is in the 12 to 14 million range, but there is no reason to believe that all, or even most, of these jobs will be lost (Aspray et al., 2006, chap. 2; for independent analyses, see Blinder, 2007a; National Academy of Public Administration, 2006, 2007). There are also analyses of offshoring on particular local economies in the United States (Wial & Atkinson, 2007).

There has been somewhat more success in accurately determining the size of the U.S. IT workforce. The federal government collects two data sets that speak to this issue. Although these two data sets are completely independent, they show strikingly similar results. One data set is based on employers, who are surveyed about their workers and open positions (BLS Occupational Employment Survey). The other data set is based on households and the jobs held by members of the household (BLS Current Population Survey). Both of these data sets show that there was a drop off in IT jobs in the

United States in 2002 after the dot-com crash but that the numbers of jobs had returned by 2005 to a point that there were more IT jobs in the United States by the spring of 2005 than there were at the highest point in the dot-com boom era (1999). Since 2005, the number of IT jobs has continued to grow at a slow rate, with a more rapid increase in the most recent years.

The doom and gloom scenario that many people feared—of devastating job flight from the United States to India and China because of IT offshoring—has not occurred. Where there has been a sizable drop off is in the number of U.S. routine programming jobs. Other categories of IT jobs have not shown significant losses. These statistics are consistent with the argument that jobs requiring knowledge of the organization, knowledge of an application domain, or interaction with other people (either workers within the company or customers) are less likely to be offshored. The data are not definitive on these points, in part because some of the definitions of IT work categories have been changed over the past few years, so some of the shift in numbers may be because of redefinition of categories rather than actual trends; but if one totals up all the categories of IT workers, the trend is apparent in that the total number of IT jobs has been growing over the past several years (Murphy, 2008).

The BLS, like every other organization, is on much less firm ground when it projects employment trends into the future (say, over the next 10 years). It is impossible to foresee all the changes that might affect labor. An example that the federal government itself has given is illustrative. BLS projected in the 1970s that over the next 10 years there would be a large increase in the number of gas station attendants and bank tellers (Rosenthal, 1999). The agency did not foresee the role of automation on these two occupations, namely, self-pumping gas stations and ATMs. Despite the inherent limitations of projections, BLS builds sophisticated econometric models to try to make these projections, and its track record is fairly good. Its latest 10-year forecasts include several IT occupations among the 10 fastest growing occupations, competing closely in growth patterns only with jobs that take care of the aging U.S. population.

Some academic economic analysis adds credence to these BLS projections, especially the research of Catherine Mann (2003, 2004), senior fellow at the Peterson Institute of International Economics. Mann's historical economic analysis of the growth of productivity and job growth in the United States from the 1970s through the 1990s shows a strong positive correlation to the emergence of microcomputer hardware. She has also completed an analysis of future opportunities for software and service investment and argues that these investments will have an even more profound effect on productivity and job creation in the United States than did the introduction of inexpensive computer hardware. Her analysis by industry of IT investment identifies a number of sectors with underinvestment (construction, education, government services), and she argues that when this investment comes, there will be sizable positive effects on productivity and job growth. Her work strongly suggests that there is IT job growth ahead for the United States, just as the BLS projects.

Attitudes of Politicians and Economists

IT offshoring became a matter of national concern in the United States in November 2002, with the publication of a widely discussed report from the consulting firm Forrester Research that 3.3 million U.S. jobs would be lost by 2015 because of IT offshoring (Aspray et al., 2006, chap. 1). This continued to be a big issue throughout the 2004 U.S. presidential campaign. Almost every night on his business show on the CNN television network, Lou Dobbs excoriated greedy American executives who were willing to "export America." On the campaign trail, Democratic presidential candidate John Kerry repeatedly spoke of "Benedict Arnold" CEOs who were willing to send American jobs overseas.

Perhaps the difference in attitude between the politicians and economists on offshoring can best be seen in an episode in 2004 involving President Bush's chief economic advisor, Gregory Mankiw, who was quoted as saying that offshoring "is probably a plus for the economy in the long run"—no doubt following traditional economic thinking about the benefits of offshoring: companies can lower costs, bring products to market more quickly, and generally be more competitive if they add overseas workers to their extended employee pool. But especially in an election year when Michigan and Ohio, which had been subject to massive job losses in the automobile and other manufacturing sectors because of foreign trade, were swing states, it was not politically expedient to look beyond the short-term job losses to consider any long-term benefits of offshoring. The Democrats lambasted Mankiw's remarks, and President Bush had to go to some lengths to distance himself from these remarks and reassert his concern for American jobs. If one is to believe the politicians, offshoring causes loss of American jobs, harm to compensation levels of American workers, destruction of a career path for technical workers in America because the bottom rungs of the career ladder have been removed by having foreign workers fill those jobs, and reduction in national competitiveness and wealth.

Many economists disagree, arguing that offshoring will strengthen America in the long run, despite some possible short-term job losses, not only through more competitive companies but also by higher compensation to managers and shareholders through higher corporate earnings, more interesting jobs for workers who no longer have to carry out mundane tasks that are sent overseas, and long-term creation of more jobs than were lost because of the long-term success of more competitive American companies (Aspray et al., 2006, chap. 2; Drezner, 2004; for three contrary views, see Blinder, 2007b; Greider, 2007; Krugman, 2007). Politicians feared that the United States would lose its might in the high-tech world by ceding high-tech work to foreign workers. The economists did not generally share this concern, citing three arguments: first, a long history of nations doing well when the locus of production is geographically remote from the locus of innovation; second, tremendous advantages of the United States over other countries in remaining the center of innovation by having access to large pools of both talented IT workers and technically sophisticated users; and, third, the tremendous advantages that America holds in the international marketplace that enable it to

compete successfully in this high-tech arena—the best universities and research institutions, highly efficient capital markets, flexible labor markets, the largest consumer market, business-friendly immigration laws, and a deep managerial talent pool.

It is beyond the scope of this article to consider how politics in China and India shaped the emergence of skilled workforces, appropriate infrastructure, economic incentives, and policy environment that enabled them to become strong providers of offshore services. This topic is covered in Aspray et al. (2006, chap. 8).

National Differences in Types of Offshoring Providers

Many countries provide offshoring services to the United States, but these countries can be usefully organized into four categories (Aspray et al., 2006, chap. 3).

Cost and Capacity

These are countries, such as India and China, with a large supply of skilled workers trained in software or IT-enabled services and labor rates significantly lower than those in the United States. The term *labor arbitrage* is often used in connection with these countries, focusing on the opportunity of getting labor-intensive work done at lower cost; however, this low labor cost is only part of the advantage of these countries. These countries may also have labor pools available with skill sets not widely available in the United States. For example, in the late 1990s, the United States experienced a shortage of programmers familiar with "legacy" programming languages such as COBOL needed to update in-place computer systems in time to avoid the anticipated crashes associated with the Y2K problem. India rapidly trained a large number of COBOL programmers to fill this need.

Language Skills

Some countries, such as the Philippines and Costa Rica, have relatively large populations of workers fluent in both English and Spanish. Call centers and telemarketing centers serving the United States are often placed in these countries so as to serve America's two largest language populations. Francophone Africa, for example Morocco, plays a similar role for France.

Nearsourcing

Canada is one of the largest U.S. IT offshoring providers. There are many reasons for this. Although there is a wage advantage of doing IT work in Canada over the United States—on the order of 30%—it is not nearly as large as the wage advantage offered by China or India. However, American companies like working with Canadian providers for many additional reasons: a highly educated workforce, similarity of time zones that make business meetings between provider and supplier more convenient, relatively

short and less expensive travel if executives from the American company want to meet with their Canadian providers, Canadian understanding of American business practices and American culture, similarities in the legal and financial systems of the two countries, and wide fluency in English among Canadian workers. Nearsourcing is also a factor in the decision for companies in other countries where to send their work, for example, German companies sending work to the Czech Republic, where there is a large work force that speaks German.

Specialty Skills

Some countries attract offshore work because of the specialty skills they have to offer. The majority of security work (cryptography, information assurance, digital rights management, etc.) that U.S. firms offshore is sent to Israel, where a national concern about security issues has resulted in strong and sizable capabilities in its computer security industry. Similarly, much work that requires high levels of mathematical ability is offshored to Russia, where there is a legacy of highly trained mathematicians and physical scientists from the cold war era.

Technological, Business, and Other Drivers of Offshoring

A number of technological, business, and other factors have contributed to the rapid growth of offshoring over the past quarter century but in particular since the late 1990s. The following are the most important factors (Aspray et al., 2006, chap. 1).

Telecommunications Infrastructure

Since the late 1990s, there has been a massive increase in global telecommunications infrastructure, which is a critical enabler of offshoring. During the dot-com boom years of the late 1990s, up through 2001, various carriers competed to expand satellite and optical fiber networks to a point there was a major oversupply and costs collapsed. Totally unlike a decade earlier, by the early 2000s, India had ready access to both low-cost, high-bandwidth communication and cutting-edge telecommunications applications such as e-mail, fax, videoconferencing, and cell phones.

Changes in IT

IT that is used in the execution of offshore work has become commoditized over the past quarter century. This ranges from low-cost computer processing power and storage, to a small number of best-of-class business application programs (e.g., IBM and Oracle for database management, SAP for supply chain management), to standardized data format and networking protocols for moving data between client and provider. These commodifications in the IT infrastructure enable an offshore provider to acquire a small number of core technologies and amortize its costs over multiple clients. It

also simplifies the provider company's training because workers need to learn only a few core pieces of technology rather than many different proprietary systems.

Pace of Innovation

Some of the management literature (e.g., Bartel et al., 2005) shows that although the level of use of IT in an industry is not an indicator of likelihood to offshore, an increase in the pace of change in IT does lead to greater offshoring activity. The explanation seems to be that firms (especially those not in the IT sector itself) are more willing to invest in offshoring contracts than they are to sink fixed costs in IT likely to quickly become obsolete. The pace of IT change was particularly great during the dot-com years of the late 1990s and early 2000s, leading one to expect a growth of offshoring at that time.

The Downsized Corporation

Beginning in the 1970s, and accelerating in the 1980s and 1990s, American corporations began to downsize by shedding activities not regarded as core competencies. As IT systems became more standardized and commoditized, they were seen less as core competencies, making it easier to justify outsourcing IT activities, whether to a company down the street or in another country.

Other Business Drivers

During the past decade, a number of other business factors have driven more companies to offshore. One is the pressure to remain competitive with other companies that had begun to offshore to save on costs. Another was the existence of business champions for offshoring, for example, CEOs Jack Welch from General Electric and Carly Fiorina from Hewlett Packard, who were widely regarded as thought leaders in the business community.

Intermediaries

The earliest American companies to offshore were large companies, for example, General Electric and Citibank. The emergence of a new profession of offshoring brokers and consultants made it possible for smaller firms also to participate in offshoring. These intermediaries were able to help a company decide what work to offshore, where to set up offshore operations, and whether to contract for offshoring services or set up its own foreign subsidiary and were able to identify potential firms and employees to work with and manage the process.

Changes in the Work Process

Through reengineering and digitization of steps in the work process, it is possible to offshore many more kinds of software and service work than was otherwise possible.

Companies found that they could break work into tasks requiring different skill sets, some of which could be offshored even while other tasks, part of the same process, needed to remain in-house. Previously, if any single step in a process needed to be kept in-house, for example, because it involved specialized knowledge or required interaction with customers or vendors, the entire process was regarded as one that needed to remain in-house.

The Higher Education System

Most IT and IT-enabled work is of high skill, requiring an educated workforce. In the past two decades, India and China in particular but other developing nations as well have expanded their higher education systems to the extent that they are able to train large numbers of skilled IT workers. This educational advance has been made possible in part by the availability of low-cost computer systems for the classroom and standardized curricula developed by the professional societies such as the Association for Computing Machinery and the Institute of Electrical and Electronics Engineers.

Free Market World Economy

The marketplace has become much freer and more international since the Second World War. International agreements such as the General Agreement of Tariffs and Trade and increasing national participation in such international organizations as the World Trade Organization, together with the liberalization in the economies of developing nations such as India and China, have led to a much more international software market.

Immigration

The strong higher education system in the United States and its relatively open immigration system led many citizens of India and China to immigrate to the United States to pursue graduate degrees in technical fields and remain after graduation to work in the high-tech industries. Especially in Silicon Valley, communities of Indian (and, to a less extent, Chinese) high-tech entrepreneurs emerged, and these individuals were important go-betweens in establishing relations between American firms and Indian (and Chinese) offshoring providers (Varma, 2007).

Other Factors

Other factors have also enabled or driven offshoring. These include the use of English as the language of education and business in India, the similarity of the Indian accounting and legal systems to the British and American ones, the aging American population meaning the coming retirement of massive numbers of skilled technical workers, and the shortage of young people and especially of women and minorities entering into these technical occupations.

Reasons to Offshore

The most commonly cited reason for offshoring work, and often the principal motivation why a company *begins* to offshore work, is that the work will cost less because labor costs will be significantly lower in the country to which the work is sent than in the United States. However, this is by no means the only reason why IT work is offshored. There are at least nine principal reasons (Aspray et al., 2006, chap. 1, 4).

Reduced Costs and Increased Margins

In the investor-driven, globalized marketplace, companies are expected to use fewer resources to bring new products to market and to bring these products to market more quickly. Some subindustries of the software industry, such as software packages, are driven more by marketing and distribution capability than by labor costs, but most of the software subindustries (including customized programming, call centers, and IT-enabled accounting services) are highly sensitive to labor costs. Thus, the management of an American firm may find it attractive to send work to places such as India and China where the cost of labor is typically less than one fourth the cost of labor in the United States. There are significant overhead costs to doing the work in a different country, especially if the laws and culture are different, and there are also costs to set up a new operation; but in many cases it is financially rewarding for a U.S. company to establish operations in a low-wage country, either by contracting with a firm such as Wipro or Infosys or by establishing a wholly owned subsidiary there.

Access to Skills

Although the United States has the strongest higher education system in the world and does a good job at training technical workers, it does not have a monopoly on high-skilled technical workers. There are large numbers of workers with these skills in India, China, Russia, Israel, and several Eastern European countries, among others. In 1999, at the time of the Y2K problem, access to skills was the most important reason for offshoring IT work—more important than labor arbitrage. This pattern repeated itself in the next several years, when American companies looked overseas for Java programmers to enable them to compete during the height of the dot-com boom.

Experience

Sometimes, U.S. companies look overseas to find experience they cannot locate in their own companies or in the American labor market more generally. There are several types of experience sought. Sometimes it involves experience with a technology. For example, China and India each has more cell phones in use than the United States and each has an expanding wireless market, so it may be better for a U.S. firm to conduct its wireless R&D research in one of these countries. Another reason to look

overseas is experience with a particular scientific domain, such as Russia's strength in physics or Israel's strength in computer security. Sometimes U.S. companies look to workers in another country because they have familiarity with the culture or marketplace of a country the American firm would like to target with its products, and there is business advantage to be gained in designing these products with the local cultural values in mind.

Time Shifting and Time to Market

One of the most discussed opportunities presented by offshoring is time shifting, the use of offices in, say, three different places that are spaced evenly around the world so that each office can work a day shift and then pass the work on to the next office, which is just beginning its work day, so that work can continue around the clock, perhaps giving the American firm the advantage of early entry into a new market. It turns out that these kinds of virtual teams are not necessarily efficient and not easy to manage, so there has been less of this kind of work occurring than the press anticipated. Nevertheless, examples of time shifting do exist, for example, having medical tests read by experts in India overnight, so that the American doctors who ordered the tests will have the results available the morning after the tests were taken.

Market Access

Offshoring may give an American firm a foothold in a market it would like to serve with its products. This is especially attractive in China and India with their large and rapidly developing markets. Balasubramaniyan, the general manager of Wipro, one of the leading Indian offshoring firms, explains this point as follows:

> Offshoring also helps a company to be closer to its global customers, thereby providing appropriate offerings to its regional market and ensuring speedier problem resolution. Developers and support personnel in the relevant geographies have a better understanding of customers' needs, regulatory compliances and regional preferences, and can better implement the product or provide the service. (Balasubramaniyan & Guyer, 2004, p.)

Overflow Work

American firms that are reliant on contract work for most of their business often experience a feast or famine situation, in which they have too little or too much work for their permanent staff. Even larger firms, which may be better able to handle fluctuations in workload, are reluctant to gear up by hiring a large number of employees for a project that lasts only a year or two. Rather than create the disruption of hiring and firing large numbers of people, companies may elect to offshore some of their short-term project work.

Extending Venture Capital Money

Having learned lessons from the excesses of the dot-com era, venture capital firms have tried since 2001 to control the "burn rate" on the funds they provide to a start-up firm to better ensure that the venture capital will last long enough for the start-up firm to bring its first products to market. Venture capital firms now commonly require some of the technical work (research, development, and programming) to be carried out in low-wage environments. There are examples of companies in Silicon Valley where only the sales and marketing team, and the company management, are located in the United States (Dossani & Kenney, 2005).

Characteristics of Work Amenable to Offshoring

In a study for the U.S. Department of Commerce, John Sargent and Carol Ann Meares (2004) provided an excellent list of the characteristics work would need to have to be amenable to offshoring. Here is an edited version of their list:

- High wage differential for doing the work in the United States compared to in the supplier country
- High labor intensity of the work
- Clearly defined requirements, little nuance
- Repetitive tasks
- Rule-based decision making and problem solving
- Documented or easily transferred content and process knowledge
- Discrete, separable; low degree of interaction across different services, applications
- Low degree of personal interaction with end users or clients
- Stable applications with a minimum of "firefighting"
- Long projected useful life to amortize offshore set-up costs
- Low to medium business criticality
- Less time sensitive, longer transition periods
- Projects involve simple and standard hardware and software
- Digital, Internet enabled
- Low set-up barriers
- Low to medium technical complexity
- Not multidisciplinary
- Projects occur in a business areas in which offshoring is a broadly accepted concept
- Tightly defined work processes
- Stable process

As one can see from their list, it is a special kind of work that lends itself most readily to offshoring, so that American policy makers need not be worried that all kinds and manner of work are likely to be offshored.

American Responses to Offshoring

The national response to IT offshoring could take several forms. There could be labor actions such as strikes, slowdowns, or protests by American workers who have lost jobs or had their jobs threatened by offshoring. With the exception of some collective legal claims against the U.S. Department of Justice, as described below, there seem so far not to have been labor actions, as there have been to a minor extent in England and Scotland. There could also be boycotts by consumers against companies that offshore work or against their products, but there is no evidence of this happening either. What one does find are educational and policy responses. The educational response occurs through policy initiatives, but it also occurs through efforts of educational organizations to change their curricula to reflect the global marketplace, of local communities to enhance training for workers who have lost their jobs or whose jobs are threatened, of professional societies to provide continuing education programs to better prepare their members for a changing workplace, of society in general to find ways to prepare underrepresented groups such as women and minorities for full participation in the IT workforce, and of individuals themselves to take responsibility for their career preparation (American Association for the Advancement of Science, 2005).

The educational response is being attempted in a relatively uncoordinated fashion by many educational and professional organizations (Aspray et al., 2006, chap. 7). The goals are to make educational reforms that will better prepare American workers to have fulfilling, remunerative jobs in the context of a new international marketplace and to provide American companies with the skilled workforce that will enable the companies and the nation to be competitive.

Developing an educational response presents many hard challenges. There are dozens of different IT occupations, involving widely differing skill sets, for which to train people. Reform needs to happen in formal degree programs at every level of higher education—community college, bachelor's, master's, and doctoral. At the bachelor's level alone, there are several major types of degree programs (computer science, computer engineering, management information science, information systems). Many Americans are trained for IT careers not in traditional degree programs but instead in various kinds of for-profit or corporate universities or in various kinds of short courses and other training environments. There are multiple career paths to an IT career in America, with many people entering the field without any formal IT degree or training at all. Much of the power of computing today involves its application to some other domain of knowledge, so an educational response would have to consider the many different application domains. Universities are notorious for their deliberate pace of change, and they have a difficult time addressing the fast-moving world of offshoring. The federal government has a poor record of predicting national supply and demand numbers for the technical disciplines or of finding appropriately measured stimuli to match supply with demand. Educators are also understandably reluctant to change tried and true curricula that may serve well in producing a liberal arts education solely to meet a fleeting vocational demand. Moreover, offshoring itself is changing rapidly. No longer does it involve only low-skill programming and call center jobs; increasingly

higher value work, including research and advanced development jobs, is being off-shored. So how is the educator to respond with a new curriculum that meets these particular occupational needs in a timely fashion?

There have been at least the following six types of educational responses to off-shoring. One has been a movement to form "information schools" that adopt a highly interdisciplinary approach drawing on both the social sciences and technical disciplines to examine information in use. Approximately 40 schools have programs of this type, most of them created since 2000. Some are newly founded, whereas others have evolved from either computer science or library and information science programs. A second educational effort has been to make the traditional computer science curriculum more flexible to allow students to mix and match courses within some constraints so that students can customize their education. A leader in this effort has been Georgia Tech, with its Threads curriculum, under which each student takes a small core of common courses and then selects two of eight threads of concentration, such as media or computational modeling. A third approach being tried in many different ways at different institutions is to reduce the standard core of the computer science curriculum as it developed in the late 1960s and 1970s (emphasizing data structures, compilers, and programming languages) and add more application areas. A fourth approach is to find a new balance that allows the universities to continue to focus on giving their students foundational knowledge while at the same time teaching them marketable technical skills such as the most recent programming languages. A fifth approach is to provide a better rounded education to IT students by giving them training in global "soft" skills such as knowledge of the international IT market, foreign languages, better communication skills, teamwork skills for a multicultural and possibly geographically distributed environment, and training in the work cultures of other nations (National Leadership Council for Liberal Education and America's Promise, 2007). Finally, there is an effort to teach students to be creative and innovative, not just to cover specific technical content.

Some policy responses have focused on stimulating or enabling the educational responses mentioned above. However, there have also been policy responses in five other areas (Aspray et al., 2006, chap. 8). The earliest were protectionist measures. Protectionist legislation took the form of trade proscriptions, tariffs, privileging of national or state contractors in government bidding processes, and requiring workers on government-funded projects to be American citizens or green card holders. Although protectionist legislation was popular rhetoric at the time of the 2004 elections, it resulted in little policy change. The Commerce Clause of the Constitution reserves to the federal government the right to regulate trade with other countries, so it is probable that most of the state laws and executive decrees would have been ruled unconstitutional if challenged in court. Federal protectionist legislation would have likely broken international treaties to which the United States was a signatory, and there was also a real threat of retaliatory legislation from other countries.

The second policy area was not directly focused on offshoring but instead on leveling the international playing field for offshoring and other business. John Kerry in his

campaign speeches in the presidential election, for example, called for a change in tax law that closed a loophole that allowed U.S.-based multinationals to defer payments on overseas profits until they had offsetting losses. Senator Schumer and others pushed hard for fair currency valuation, in particular concerned that the Chinese were valuing their currency artificially low compared to the U.S. dollar as a means to attract business (Morrison & Labonte, 2008). Like protectionist legislation, these efforts did not generally lead to major policy changes and have had relatively little effect on offshoring practices, although they continue to be discussed by academics (Brookings Institution, 2007).

The third policy area has concerned visas for high-tech workers. The political debate has mostly been focused on the H-1B visa program, which provides temporary visas to highly skilled workers, but also to some extent on the L-1 visa program, which provides visas for intracompany transfers (Snyder, 2007). The debates have focused both on an insufficient number of visas and on the misuse of visas. In most years, the number of H-1B visas has been capped at 65,000 per year. In several years when the high-tech market was hot, for example, in the dot-com years, the allotment was used up very quickly—sometimes within a week of the opening of the new fiscal year—and companies had to wait almost an entire year before having access to another allotment of visas. Business pushed Congress to increase the number of H-1Bs, and Congress has done so on a temporary basis on several occasions. The labor unions argue, however, that there are qualified American workers available to do this work and that these visas are used by companies primarily to pay below the prevailing wage. Misuse of visas concerns not only this issue but also the fact that a majority of the visas go to the U.S. operations of Indian offshoring companies, which enables them to run their offshoring businesses, rather than to help American-based companies meet their skilled worker needs (Herbst, 2007, 2008; Hira, 2003). Debate over the H-1B program continues to this day (National Foundation for American Policy, 2008; Thibodeau, 2008).

Many progressives have pushed for a safety net for workers who lose their jobs because of offshoring because many of these workers face long-term unemployment or underemployment. The premise of such legislation is that we must expect some American jobs to be lost to offshoring, but we can help individuals and local communities that are the victims of this process (Kletzer, 2001, 2004). A number of ideas for helping workers have been proposed, including retraining programs, placement services, retention of pension and health benefits after job loss, extended unemployment insurance, wage insurance, mortgage payment insurance, income tax averaging to lower taxes while unemployed, and mandated early notification of workers when their jobs are going to be terminated. Most of these programs are expensive, which has been a significant problem in getting new legislation passed.

One of the interesting battles over worker safety nets has involved the Trade Adjustment Assistance Act (TAA), which was passed by Congress in 1962 and revised in 1974 as part of general trade reform. It extends unemployment benefits for workers who lose their jobs through foreign trade. The law had been written with manufacturing workers in mind, and it includes a section that restricts its application to workers who

"produce an article." When the Bush administration came into power, it interpreted the law as not applying to software workers because they do not produce "articles." Several class-action suits were filed against the Department of Labor challenging this interpretation. The U.S. Court of International Trade ruled in 2005 that the legislation did apply to software workers at Ericsson's plant in Brea, California, when work had been moved to a Canadian subsidiary. Software workers for Agilent Technologies in Roseville, California, and Colorado Springs, Colorado, whose work had been moved to India, China, and Scotland, were denied benefits by the Department of Labor in 2005, but the decision was reversed on appeal in 2006. With those two adverse rulings from the courts, the Department of Labor conceded that the TAA does apply to software workers. Nevertheless, the Bush administration opposed a bill, the Trade and Globalization Assistance Act of 2007, which died in committee, to reform the TAA legislation in a way that explicitly covered workers harmed by IT offshoring (Graham-Silverman, 2007; Montgomery, 2007).

The final policy area involves making the United States more competitive by increasing its ability to innovate. The idea is to pass legislation that will improve the innovation infrastructure for the United States to enable it to remain on top in the high-tech areas in the face of increased international competition. There have been many proposals, including some by industry and some by the professional science and engineering communities, but the most influential report—and the one that most proposed legislation has been based on—is the National Academies report *Rising Above the Gathering Storm* (National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2007; also see Council of Graduate Schools, 2007; Council on Competitiveness, n.d.; President's Council of Advisors on Science and Technology, 2007; Sigma Xi, 2007; Task Force on the Future of American Innovation, 2006; Wadhwa, Rissing, Saxenian, & Gereffi, 2007; Wadhwa, Saxenian, Rissing, & Gereffi, 2007; for an analysis of the effect of these bills on the workforce, see Hira, 2007; for a contrary view, see Galama & Hosek, 2007). Most of the proposed legislation calls for increased federal support for research and development, incentives and infrastructure improvements to increase the number of American students studying math and science, making it more attractive for foreign students and scientists to study and work in the United States, and improving the innovation culture in the federal research funding agencies (Finn, 2007; Harsha, 2007).

Political Players

So far, this article has addressed the policy initiatives but not described the political players. One might expect the major players to be the organizations representing big business and the labor unions; however, neither has been as active in these debates as one might expect. It has only been within the past decade that high-tech businesses, and Silicon Valley businesses in particular, have paid much attention to what happens in Washington (Miles, 2002). The three main players representing business interests in the offshoring debates have been the Technology CEO Council (formerly known as

the Computer Systems Policy Project) representing the CEOs of the large IT firms, TechNet representing in a bipartisan way Silicon Valley executives in the IT and biotech industries, and the Information Technology Association of America representing a large number of IT user companies. High on the policy agendas of these groups are higher caps on H-1B visas, a permanent federal research and development tax credit, increased federal funding for research and development, and more federal funding for technical education.

The labor unions have not generally been major participants in the offshoring policy battles. This is presumably because the software and services industries are not heavily unionized in the United States. The AFL-CIO played a minor role in the TAA reform battle mentioned above, but the union that has paid the most attention to offshoring issues has been the Communications Workers of America. They have been much more interested in challenging IBM's offshoring practices than they have in helping to craft federal legislation.

Sometimes, offshoring politics are not about Democrats versus Republicans or business versus labor. For the most part, safety net politics have been more aligned along regional than along party lines. For example, Rep. Jennifer Dunn (D-WA), herself a former IBM employee who represents many software workers in her district, has been a strong advocate in favor of a safety net for software workers. Meanwhile, representatives from Michigan and Ohio have generally been opposed to extending these benefits to software workers for fear that this will dilute TAA payments to laid-off factory workers.

Conclusions

IT offshoring of software and IT-enabled services from the United States has been underway since the mid-1980s, but it markedly advanced its pace in the late 1990s, and there is every reason to believe it will continue to grow in the coming years. The nature of the work offshored has evolved over time to include increasing amounts of higher value work such as research and development, without any diminishment in the amount of more routine work such as programming and operating call centers. This pattern is not unlike that in many other high-tech products and services, such as semiconductors, electronics, and computer hardware, for which there is an inadequate base of skilled workers within the United States to meet the production demand. In each of these areas, what began as routine, low-wage assembly work moved up the value chain over time to include advance manufacturing and component and product design. It may be that what differentiates software and IT-enabled services from these other product and service areas is the rapidity with which the changes occurred and the popular sense in America, not entirely founded, that IT work was more skilled than these other areas and hence more immune to offshoring. Indeed, all of these offshoring activities have involved increasingly skilled work requiring increasing numbers of highly skilled workers.

Economists and politicians disagree, and are likely to continue to disagree, about the benefits and dangers of offshoring to the American workforce and to national wealth

and competitiveness. Offshoring is more suited for certain kinds of work that has well-determined procedures and processes, can be carried out with standardized IT tools, and requires limited knowledge of other domains of expertise. It is clear that the original forecasts of the demise of the American IT workforce were much too gloomy, and in fact in the past several years IT has been a growth profession in the United States. There is also reason to believe that offshoring leads to more competitive positions for American companies, which redounds in greater national wealth. Although India is likely to continue as the principal destination for IT work from the United States, there will continue to be work sent to a number of other countries as well because of their competitive advantages such as proximity to the United States (Canada), language skills (Philippines), and specialized knowledge (Israel). The United States has experimented with many educational and policy responses to offshoring. It is clear that there are challenges in the implementation of either educational or political responses and that some of these response such as protectionism are unlikely to work. Nevertheless, there seems to be promise in some of the approaches that modernize the curriculum, provide better global soft skills, and improve national competitiveness by improving the innovative climate and welcoming talented workers from around the world.

Declaration of Conflicting Interests

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Bio

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