Number PB03-11 December 2003

International Economics Policy Briefs

Globalization of IT Services and White Collar Jobs: The Next Wave of Productivity Growth

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Overview

Businesses throughout the US economy continue to transform even after the technology boom has faded. The key sources of this continuing transformation are investment in the information technology (IT) package (hardware, software, and business-service applications) and reorientation of business activities and processes to use both information and technology effectively.

Globalized production of IT hardware led to lower prices during the 1990s, prompting IT investment and transformation. While IT was disruptive to businesses and workers alike, its influence on them and their successful response to that influence were key to higher trend productivity growth and the associated "trifecta" of faster income growth, lower inflation, and more employment.

Deeper transformation and wider diffusion of IT throughout the US economy will bring about a second wave of productivity growth. To that end, an international value chain should increasingly produce not only hardware but also software and services, which will lead to a decline in the prices of software and services, thus making the overall IT package affordable for more businesses. Moreover, the now less expensive imported software and services can be knit together by people in the United States who are close to the customer and can combine and tailor these inputs to the specific needs of businesses here.

The globalization of software and IT services means that some IT jobs will be done abroad. But as more sectors of the economy and more businesses use the IT packages in the United States, high-skill jobs to design and tailor IT packages will increase in the IT sector, and jobs demanding the skills to use these IT packages effectively will diffuse throughout the economy.

This policy brief concludes that:

• Globalization of IT hardware production is a model for the global evolution of IT services and software. Although technological change is the most important driver of IT price declines, globalized production and international trade made IT hardware some 10 to 30 percent less expensive than it otherwise would have been. These lower prices translated into higher productivity growth and an accumulated $230 billion in additional GDP (1995–2002). Real GDP growth might have averaged 0.3 percentage points less per year from 1995 to 2002, if globalized production of IT hardware had not occurred.

• As IT hardware prices have declined, the importance of IT services and software in the IT package has increased from 58 to 69 percent of IT spending in 1993 and 2001, respectively. Over the same period, growth in software and services spending at 12.5 percent overwhelmed growth in hardware spending at 6.7 percent. In the face of this demand, and enabled only since the mid-1990s by the Internet and standardization of methods, software and services are now beginning to be produced globally. Just as for IT hardware, globally integrated production of IT software and services will reduce these prices and make tailoring of business-specific packages affordable, which will promote further diffusion of IT use and transformation throughout the US economy.

• When some production of software and services is done abroad, some jobs will be done abroad too. Recent efforts to quantify IT-related and other white collar job loss "offshore" frequently use the peak of the economic and technology boom as the base for analysis, thus ignoring the business cycle, trend decline in manufacturing employment, dollar overvaluation, and technology bust. Cutting through the technology boom and peak of the business cycle and comparing end-1999 with October 2003, employment in architecture and engineering occupations is stable, that in computer and mathematical occupations is 6 percent higher and in business and financial occupations, 9 percent higher.

• Going forward, broader diffusion of IT throughout the economy points to even greater demand for workers with IT skills and proficiency. In the 1990s, investment in IT propelled job growth for workers with IT skills to twice the rate of job growth in the overall economy. Over the next decade, the Bureau of Labor Statistics (BLS) projects that job growth to 2010 in occupations requiring IT skills will be more than three times the rate of job growth in the overall economy.

• Globalization of software and services, enhanced IT use and transformation of activities in new sectors, and job creation are mutually dependent. Breaking the links, by limiting globalization of software and services or by restricting IT investment and transformation of activities or by having insufficient skilled workers at home, puts robust and sustainable US economic performance at risk.

IT and US Economic Performance: Past as Prologue

Researchers and the media alike have scrutinized IT's role in US economic performance—the dramatic gains in the second half of the 1990s, the recent recession, and the mixed signals in 2003. Researchers have agreed that investment in IT and transformation of business activities in response to IT investment accounted for half or more of the acceleration in labor productivity growth of the US economy between the first half of the 1990s and the second half through 2001 (Jorgenson and Stiroh 2000, Stiroh 2001). Overall, faster trend productivity growth supports higher sustainable GDP growth, higher living standards, and more jobs, although it does not eliminate the business cycle or its effect on output and jobs.

With respect to jobs and IT, two factors have supported superior US labor-market performance. First, as businesses integrate IT into their activities, price inflation slows. Thus policymakers can keep interest rates lower for longer without worrying that fast economic growth might lead to a price-wage spiral. This faster "speed limit" for the economy translates into more room for job growth. Indeed, the overall US unemployment rate fell below 4 percent in 2000 without generating inflationary pressures.

Deeper transformation and wider diffusion of IT throughout the US economy will bring about a second wave of productivity growth.

Second, when firms across the economy integrate IT into their operations, there is a substantial demand for workers with IT skills, ranging from basic IT literacy ("data entry keyers") to much more advanced IT skills (database administrators or computer software engineers).[1] Some of these jobs are at IT-producing firms, but more generally they are spread throughout the economy as businesses integrate IT into their activities. Through the economic boom of the 1990s, jobs that demanded IT skills

[1] See the classification of IT occupations in table A5.4 in *Digital Economy 2002*, US Department of Commerce.

(not just at IT-producing firms) increased by 22 percent, double the rate of job creation in the economy as a whole.

Globalized IT Production and Prices

What role did globalization play in the 1990s scenario? Globalization of production through trade and investment is important for IT's contributions to US economic success. Looking back, global integration of IT production accounts for perhaps 10 to 30 percent of the dramatic decline in IT hardware prices, which was key both for increased investment in IT capital and to release financial resources needed to transform activities within firms to use IT most effectively.

There are sufficiently detailed data on two specific products to examine the role of globalization in their price declines. For dynamic random access memory (DRAMs), squeezing margins between production cost and market price is an important factor in changing the pace of the overall trend decline in price (Aizcorbe 2001). (Technology fundamentally drives the trend decline.) Regression analysis confirms that when a gap opens between global capacity and actual production, the decline in DRAM prices accelerates. So, increased global capacity of foreign firms and foreign investment by US firms accelerate the decline in DRAM prices.[2] For personal computers (PC), cheaper semiconductors (including DRAM) explain about half the decline in PC prices.[3] In addition, regression analysis indicates that an increase in net imports of PCs is associated with a lowering of PC prices. Thus, globalized production and imports of PCs by US firms as well as foreign suppliers significantly reduce the price of this ubiquitous business tool.[4] Putting these estimates together, global integration of the IT hardware industry accounted for perhaps 10 to 30 percent of the decline in IT hardware prices.

Lower IT prices promote IT investment and transformation, which together support productivity and GDP growth. In this logic chain, how important is the global link? Taking the midpoint of the estimates, suppose IT prices fell 20 percent faster from 1995 to 2002 because production was globally integrated. These price declines supported additional investment in IT, which translates into productivity growth. Faster productivity growth supported higher GDP growth. All told, the calculations suggest that productivity growth might have been 2.5 percent instead of 2.8 percent for the 1995–2002 period and that annual real GDP growth might therefore have been 0.3 percentage points lower if global integration of IT production had not occurred. The potential difference in GDP growth for the seven-year period cumulates to a conservative $230 billion (and perhaps twice this amount).[5]

The Next Wave of Productivity Growth

Whereas productivity gains from intensive use of IT are clear, large segments of the US economy have not yet integrated IT fully into their business operations. Continuing to reduce the price and making the IT package easier to use and a better fit for the organization that buys it are necessary to

[2] Research suggests that squeezing margins between production cost and market price can account for an average of about 15 percent of the decline in prices, although the year-to-year range is huge—from no margin squeeze in some years (such 1995Q2 or 2000Q3) to squeezes of 20 or 30 percent in others (such as 1998Q3 and 2001Q3). Margins can narrow because of the business cycle (demand booms or falls) or because new facilities come on line and increase supply. For the specific type of DRAM, regression analysis confirms that when a gap opens between capacity and production (i.e., capacity utilization falls), the decline in DRAM prices accelerates. Based on the regression analysis, a 2.5 percentage point fall in capacity utilization (say from 87.5 to 85 percent) is associated with an acceleration of the pace of decline in DRAM prices from 2.5 percent (quarterly rate) to 10 percent (quarterly rate), as producers sell their product into looser supply-demand conditions at relatively lower prices.

[3] Detailed research on the relationship between the prices of PCs and semiconductors (DRAM as well as other types of chips) finds that about 40 to 60 percent of the decline in PC prices is due to the decline in semiconductor prices. About 30 percent of the semiconductors that go into a PC are DRAM (Aizcorbe, Flamm, and Khurshid 2002).

[4] Net imports of PCs averaged $200 million per quarter over the period, with a variation of about $50 million around that average. Regression analysis suggests that a $50 million increase in net imports of PCs is associated with a lowering of PC prices of about 10 percent in the quarter that more PCs entered the US market.

[5] Calculations are as follows: 'X' percent of price decline due to globalization (times) price elasticity of IT investment (equals) change in IT investment's contribution to productivity growth. Using the growth accounting framework adjusts GDP growth and translates into billions of dollars "gained" due to globalization of IT. To be conservative, only the relationship between lower prices and greater IT capital is calculated (the effect on productivity of so-called IT-capital deepening). However, there is a positive association between IT capital and total factor productivity, which together make up the principal components of labor productivity. Based on simple reckoning on the relative magnitude of IT capital deepening and total factor productivity growth, the ratio between the two could be 1:1. Thus, the magnitude of GDP growth accounted for by globalization of IT production could be twice the figures calculated here.

To put this figure into perspective, Kenneth Flamm (1997), using data from 1975–95, calculated a cumulative gain of $375 billion coming from falling semiconductor prices. His data covered the period before the pervasive use of IT throughout nontechnology sectors.

deepen and spread more widely the use of IT and the associated transformation of activities.

Making IT easier to use and a better fit for an organization comes in part from increasing the software and IT services components of the IT package. During the 1990s, the pattern of spending on the components of IT packages changed to increase the dominance of the market for software and particularly IT services. In 1993, spending on IT services and software was $115 billion whereas that on hardware was $81 billion. Over the course of the decade, the growth in spending on IT services and software combined was 12.5 percent (nearly twice the 6.7 percent growth rate seen in spending on IT hardware) to end in 2001 (year 1 postbubble) at $136 billion for IT hardware and $296 billion for IT services and software. Spending on services and software now dominates the US market, which is an incentive to both reduce costs and offer new products.[6] Globalization of production, enabled by the Internet, offers one way to do both.

An essential ingredient of the second wave of productivity growth coming from globalization of software and IT services is human capital in the United States.

Figure 1 shows the relationship between IT intensity and contribution to aggregate productivity growth in the United States by sector, along with the size of the sectors in terms of GDP. The sectors best known for their uptake of IT during the 1990s, including wholesale trade, securities and commodity brokers, depository institutions, and telecommunications are clearly identifiable. Retailing is the only notable example of a large sector that did not use IT particularly intensively in the sector as a whole but experienced above-average productivity growth.[7] Three other sectors stand out for being large, low IT intensive, and below average in terms of productivity: health services, construction, and the highly heterogeneous group of "other services" (figure 1).[8]

In addition, small and medium-sized enterprises (SMEs) generally have invested less in productivity-enhancing IT. The size and distribution of firms suggest that the sectors noted above (health and construction) have particularly high populations of SMEs, where IT investment per employee has been significantly less than at their large-firm counterparts and drastically less than in durable manufacturing, which has led the way in terms of IT investment, transformation, and productivity growth (table 1).

There is evidence that IT-based productivity gains can be had in these "lagging" sectors. IT applications in health services, for example, show dramatic results. Adverse drug events (ADEs) are the human face of productivity in the health sector.[9] Besides causing an estimated 372,000 preventable injuries and deaths per year, ADEs cost an extra annual $1.56 billion to $5.6 billion in hospital expenses per year.[10] Bar-coding of prescription medication and blood products, along with an electronic medical record system, could prevent more than 80,000 ADEs annually in the United States. IT also directly affects costs: Telemedicine improves patient recovery, decreases readmission, and reduces costs (by 80 percent) simply by allowing basic daily medical checks (weight, blood pressure, blood sugar, etc.) to be performed regularly at home and then transmitted to the central database by phone.

More generally, reasons ranging from cost to culture to regulatory constraints help explain why IT may be used less intensively in some sectors and

[6] This increasing dominance of software and services is characteristic of other industrial countries as well but is not observed in the emerging markets, where the demand for hardware is rising faster. See Mann with Kirkegaard (2003, table 1.1 and figure 1.2).

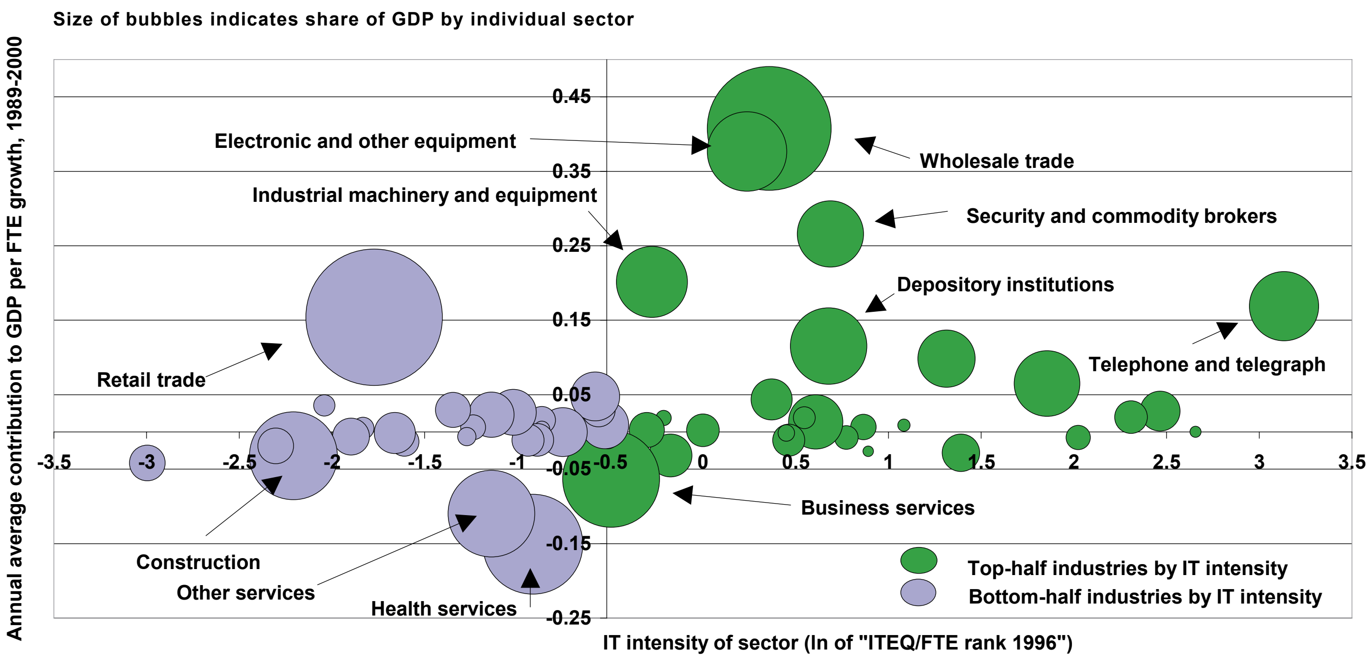
[7] Although the sector as a whole does not appear to use IT particularly intensively, research shows that much of the productivity gain in retailing comes from more productive establishments replacing less productive ones and that IT was an important factor underpinning the more productive establishments. See Foster, Haltiwanger, and Krizan (2002).

[8] The values of ITEQ/FTE, a measure of IT intensity (from *Digital Economy 2002*, table A4.4), have been converted to natural logarithm values to increase dispersion in figure 1. (ITEQ/FTE stands for information technology equipment/full time equivalent [worker].) A total of 55 industries, representing 78 percent of US GDP in 2000 are represented in figure 1. Remaining GDP is largely constituted by the real estate and government sectors for which no IT intensity estimates are available. In figure 1, the category "other services", consists of SIC categories 83 (social services), 84 (museums, art galleries, and botanical and zoological gardens), 86 (membership organizations), 87 (engineering, accounting, research, management, and related services), and 89 (services, not elsewhere classified).

[9] Adverse drug events (ADE) is the term used to describe injuries not caused by the underlying disease or condition of the patient but rather from the drug therapy incurred by the patient. Although hard to infer direct productivity implications of a reduction in ADE, fewer ADEs would, at a minimum, reduce the need for remedial action, which would raise the productivity of the sector.

[10] See Agency for Healthcare Research and Quality (2001) and McClellan (2003). All information originating from the Food and Drug Administration is from McClellan (2003).

Figure 1: IT intensity and contribution to GDP per FTE growth, 1989–2000



ITEQ/FTE = Information technology equipment/full-time equivalent (worker).

Source: Bureau of Economic Analysis, Department of Commerce, *Digital Economy 2002*, table A4.4.

Table 1: Capital expenditure per employee by industry sector and size of company, 1998

Sector/company size	Computer and peripherals (dollars)	Total equipment (dollars)	Share of total employment (percent)
Durable manufacturing			
Small and medium (0 to 499 employees)	942	4,562	38.5
Large (500+ employees)	1,463	20,291	61.5
Construction			
Small and medium	112	3,250	89.6
Large	493	3,731	10.4
Health			
Small and medium	231	1,284	43.1
Large	476	2,760	56.9

Source: US Department of Commerce, *Main Street In the Digital Age*, table 3.

by certain sizes of firms. Nascent globalization of software and services, if it takes the pattern of price declines that enable development of higher valued-added and sector-specific applications (as has been the case with globalization of IT hardware), could help vault these hurdles. The result would be IT diffusion to and more extensive transformation of sectors and firm sizes that have lagged in terms of productivity growth, as well as deeper integration of IT software and services into the sectors that have already enjoyed significant productivity gains based on hardware. The resulting second wave of productivity growth could be even greater than the one experienced in the 1990s.

Globalization of Software and Services and IT Job Loss

The advent of the Internet, standardization of methods, and creation of databases of information and knowledge enable the disaggregation of software and services into stages, which do not need to be done contiguously but can instead be done globally. While this may contribute positively to productivity growth via price declines, as detailed earlier, the specter of losing "white collar" IT jobs abroad looms large. Frequently cited projections indicate that millions of jobs will be lost to offshore workers. What these projections ignore is that the globalization of software and IT services, in conjunction with diffusion of IT to new sectors and businesses, will yield even stronger job demand in the United States for workers with IT proficiency and skills.

Even now, stories that report dramatic movement of jobs offshore need to be put into the current economic perspective. First, these citations frequently use the peak of the economy and technology boom as the base for their analysis, thus ignoring the business cycle, trend decline in manufacturing employment, dollar overvaluation, and technology bust.[11] Second, data on international trade do not corroborate the frequent citations but rather point to sustained international competitiveness of US service providers.

Table 2 shows developments in the US labor market from 1999 to October 2003. These data cut through the technology boom and peak of the business cycle but also clearly show the slow recovery in employment so far. Data confirm disproportionate and continuing employment losses in manufacturing (2.7 million or 16 percent since 1999), including production jobs in the IT sector. Among occupational categories, there similarly has been a trend decline in "management occupations," where 1.1 million jobs have disappeared since 1999 (a 14 percent decline). In contrast, employment in the private service–providing sector increased throughout the period and is 1.5 percent higher in October 2003 compared with 1999.

Employment in white collar occupations related to IT or deemed vulnerable to IT-enabled international trade, is stable and recovering (architecture and engineering occupations) or higher (computer and mathematical occupations is 6 percent higher and business and financial occupations, 9 percent higher) in October 2003 compared with 1999. Without a doubt there is offshore job activity, and the domestic labor market situation remains subdued, but job growth in many white collar occupations at home deemed particularly at risk to offshore operations is expanding, not contracting. (The full range of occupations categorized by the BLS is shown in the appendix table.)

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A second piece of evidence on the continued strength of the US services sector comes from international trade data (figure 2). The continued strong competitive showing of US net exports of services is particularly striking given the appreciation of the dollar from 1995 to 2002 and slow growth in the United States's major markets in the industrial

[11] There are no publicly available data on jobs "lost" to workers in foreign countries. Publicly available data show the number of people in occupations defined by occupational class and by sector. When the number of jobs falls in a particular cell of this matrix, there is no way to determine whether that job was regained in another cell of the matrix (different occupation or different sector) or whether this job no longer exists, either because the job has moved abroad or because technology has made it obsolete.

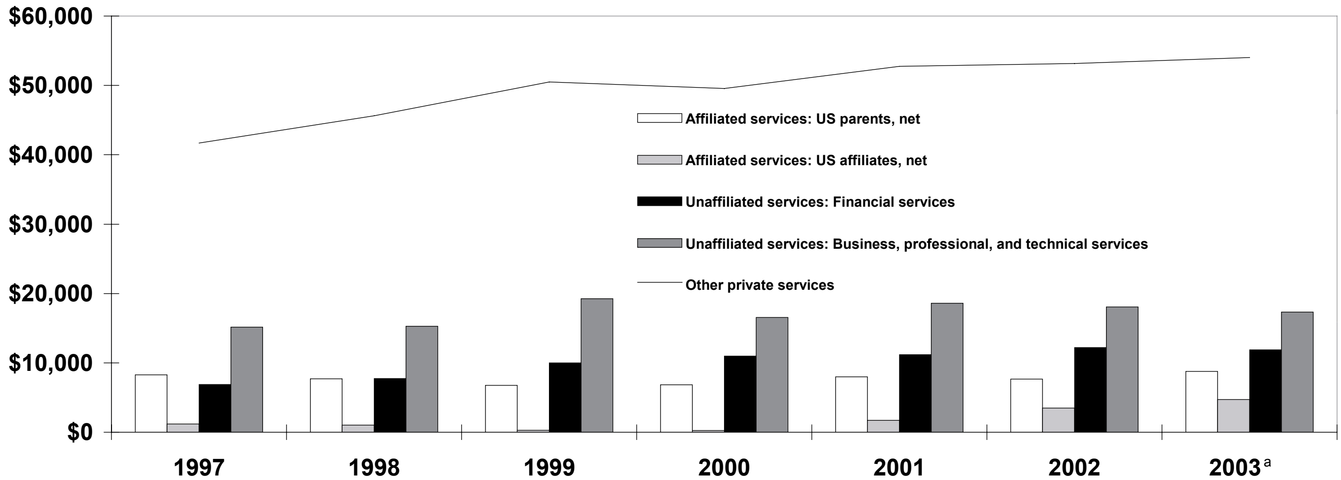
Table 2: The current employment situation (thousands of workers at end of period)

Sector/occupation	1999	2000	2001	2002	Current, October 2003 (P)
Total nonfarm private employment	109,972	111,639	109,302	108,642	108,644
Manufacturing	17,280	17,177	15,706	15,020	14,540
Private service providing	85,393	87,066	86,216	86,319	86,692
Total IT occupations[a]	6,136	6,383	6,061	5860	n.a.
of which					
Nonproduction	5,637	5,876	5,643	5492	n.a.
Production	499	507	418	368	n.a.
Management	8,063	7,783	7,212	7,092	6,940[b]
Business and financial	4,362	4,619	4,677	4,772	4,774[b]
Computer and mathematical	2,620	2,933	2,826	2,773	2,775[b]
Architecture and engineering	2,506	2,576	2,489	2,411	2,505[b]
Unemployment rate (16 years and above)					
Annual average (percent)	4.2	4.0	4.8	5.8	6.0[c]
End of period (percent)	4.0	3.9	5.8	6.0	6.0

n.a. = not available
(P) = Preliminary estimate.
a. IT occupations as defined by the US Department of Commerce in *Digital Economy* 2002, annual data.
b. The October 2003 number has been generated by using the rate of change from October 2002 to October 2003 in the unseasonally adjusted data from the BLS *Current Population Survey*, series LNU02032453 (management), LNU02032454 (business and finance), LNU02032455 (computer and mathematical) and LNU02032456 (architecture and engineering), which covers the same occupational categories but uses a different survey format than does the BLS *Annual Occupational Employment Survey*.
c. January to October 2003.

Source: Bureau of Labor Statistics, *Annual Occupational Employment Survey*, monthly current population and establishment data.

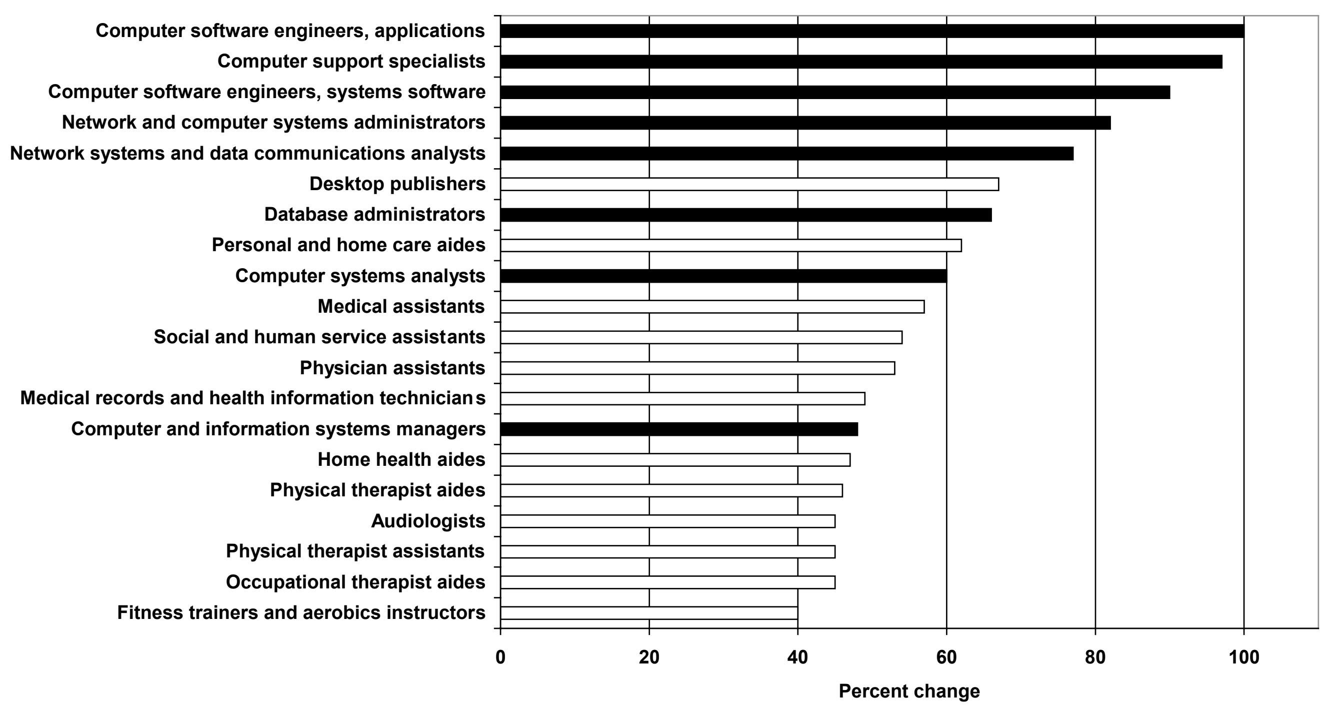
Figure 2: Balance of trade in US other private services trade categories (millions of dollars)



[a] Annualized from 2003 Q1 and Q2 seasonally adjusted data.

Source: Bureau of Economic Analysis, Department of Commerce, US International Transactions table 3, US private services transactions.

Figure 3: Percent change in employment in occupations projected to grow fastest, 2000–10



Note: Black bars are IT-related jobs as defined in *Digital Economy 2002*.
Source: Bureau of Labor Statistics, *Occupation Outlook Handbook*.

countries abroad. The trade surplus in other private services (OPS) increased from $42 billion in 1997 to about $50 billion in 2003Q1. OPS includes trade in services that might be vulnerable to being done abroad, including financial services and business, professional, and technical (BPT) services, both of which post strong positive net balances.

Moreover, examination of the "affiliated" trade category (i.e., intrafirm trade between parent and subsidiary) reveals that multinationals (both US and foreign) continue to do their headquarters' service activities in the United States. Even as US multinationals expand overseas, global integration of their activities has not yielded a fall in their "affiliated parent, net" balance. Even more striking, foreign multinationals with US subsidiaries are more prone to integrating their service transactions in the United States rather than at their headquarters abroad ("affiliated services: US affiliates, net").

What are the prospects going forward for jobs that demand IT skills, some of which increasingly could be done abroad as part of global integration of software and IT services? The BLS *Occupation Outlook Handbook* (OOH) details job projections (figure 3). Three of the 10 largest numerical increases in job categories (a total of about 1.2 million jobs of the projected 22 million in the US economy by 2010) are projected to be in computer-related occupations (computer support specialists, computer software applications engineers, and computer software system engineers). Among the top 20 occupations in terms of growth prospects projected by the BLS, 10 demand IT skills.[12] All of these are frequently cited in anecdotes as ripe for being sent abroad (software engineers, network administrators, desktop publishers, computer and information system managers). Considering all occupations projected to 2010 by BLS, 13 percent of the total number of jobs created in the economy will be IT-related, and the growth in these occupations will be 43 percent, compared with an economywide job growth rate of 13 percent.[13]

Not all job categories are projected to expand. Jobs for bank tellers, switchboard operators (including answering services), and telephone operators are all projected to shrink by 20,000 to 60,000 jobs each. But this contraction is as much due to automated teller machines and voice-answering technologies as due to jobs going offshore. Jobs for insurance claims clerks, word processors, and secretaries also are projected to drop; these could be candidates for offshore job creation, replacing jobs at home. What is notable about all these jobs is that they are at the low-wage, low-skill end of the job spectrum that currently demands IT skills.[14]

The point is not that no jobs will be done abroad but rather that higher-paid jobs demanding IT skills are projected to grow very quickly in the United States. Will US workers be prepared to make the move into those jobs? Right now, it is imperative that adjustment assistance be made available to the white collar workers hurt by international competition just as trade adjustment assistance aids those in the manufacturing sector. The new program of wage insurance will help some IT workers find new jobs but not necessarily those with white collar skills.[15]

A partnership between the private and public sectors and a real commitment to effective skill-building are crucial. For many years, tax policy has

An international value chain should increasingly produce not only hardware but also software and services, which will lead to a decline in the prices of software and services, thus making the overall IT package affordable for more businesses.

[12] Other important job categories in terms of magnitude of openings are registered nurses, retail salespeople, office clerks, general mangers, teachers, and laborers.

[13] How accurate have BLS projections of job growth been in the past? Evaluation of the projections in the 1988–2000 *Occupational Outlook Handbook* (OOH) is based on a six-category classification (centered around "about as fast as average" and ranging from "much faster than average" to "decline"). (As in the current OOH, each category is associated with specific percentage growth rates.) Of the 338 occupations evaluated, 187 had growth rates within one category of the projection category. There is even greater accuracy in the "extreme" categories of "much faster than average" and "decline," with projections being "within a few thousand workers or a few percentage points." See Alpert and Auyer (2003).

[14] See discussion of wage profile of job occupations in Kirkegaard (2003).

[15] As implemented in the trade promotion authority legislation, workers older than 50 years and earning less than $50,000 at their previous job can receive half of the difference between their old and new wage for up to two years. The objective of this program is to encourage workers to get back to work as soon as possible and for the new employer to provide on-the-job training, which has proven to be more effective that government-financed classroom training. The program is limited, however, by age as well as by type of job lost (only manufacturing jobs are covered). For more on wage insurance, see Kletzer and Litan (2002).

been used to promote capital investment through the investment tax credit. An essential ingredient to the second wave of productivity growth coming from globalization of software and IT services is human capital in the United States. The time has come to integrate *human capital* into investment tax credit policies. The US workforce needs the skills and adaptive capabilities to succeed in a global labor market, where fewer and fewer occupational categories can be shielded from foreign competition and where global competitors are spending even more on education relative to their income levels than is the United States.[16]

Globalization of software and services, enhanced IT use and transformation of activities in new sectors, and job creation are mutually dependent. Breaking the links will put the entire prospect for robust and sustainable US economic performance at risk.

Going forward, the globalization of software and IT services and the movement of some jobs abroad reduce the price of "components." (Software and services have components just as hardware does.) In the United States, the jobs will be to design, tailor, and implement IT packages for a broader range of industries and size of firms as well as to deepen the integration of IT into firms that already have it. Suppose that global integration of software and services yielded price declines of 20 percent (using the average of the results from the IT hardware research). Since the demand for software and IT services is more price elastic than for IT hardware, the potential increase in investment, productivity growth, and job creation from the globalization of IT services and software is even greater than that experienced in the 1990s from the globalization of IT hardware. Indeed, this second wave of productivity growth and the associated economywide gains *depend* on deeper integration of IT and transformation of more sectors of the US economy and the workers who can engender and partake of these changes.

Conclusion

Effective use of IT through investment and transformation of activities was key to US economic expansion during the 1990s. Globalization of IT hardware played an important role in that expansion. In order to return to the economic performance of the 1990s, the early IT adopters will have to deepen IT investment and transformation, and the process of IT investment and transformation will have to be extended to the sectors of the US economy that did not participate in the productivity growth of the 1990s—among them, health services, construction, and small and medium businesses.

The IT package has been increasingly weighted toward software and IT services rather than hardware. There is increasing incentive as well as need to provide more cost-effective and superior IT software and services. Part of delivering on that strategy involves a new wave of globalization of IT in software and services, which will contribute to the lowering of the prices of software and services. Globalization of software and services will entail some jobs being done abroad but will result in lower prices for the overall IT package. The resulting greater use of IT and transformation of activities throughout the economy will propel the United States toward a second wave of faster productivity growth that at the same time yields a greater demand for IT-related jobs spread throughout the economy.

In the end, globalization of software and services, enhanced IT use and transformation of activities in new sectors, and job creation are mutually dependent. Breaking the links, by limiting globalization of software and services or by restricting IT investment and transformation of activities or by having insufficient skilled workers at home, will put the entire prospect for robust and sustainable US economic performance at risk.

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[16] Research and data suggest that middle-income countries are investing relatively more in engineering and technical human capital than are rich countries (Sequeira 2003).

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Table A.1. Detailed data on occupations

BLS occupation code	BLS major occupational category	Number of workers 1999	2000	2001	2002
11-0000	*Management*	8,063,410	7,782,680	7,212,130	7,092,460
13-0000	*Business and financial operations*	4,361,980	4,619,270	4,676,690	4,772,120
15-0000	*Computer and mathematical*	2,620,080	2,932,810	2,825,820	2,772,620
17-0000	*Architecture and engineering*	2,506,380	2,575,620	2,489,040	2,411,260
19-0000	*Life, physical, and social science*	909,530	1,038,670	1,067,750	1,078,630
21-0000	Community and social services	1,404,540	1,469,000	1,523,940	1,576,980
23-0000	*Legal*	858,320	890,910	909,360	934,850
25-0000	Education, training, and library	7,344,830	7,450,860	7,658,800	7,772,470
27-0000	*Arts, design, entertainment, sports, and media*	1,551,600	1,513,420	1,508,730	1,503,680
29-0000	Healthcare practitioners and technical	6,001,950	6,041,210	6,118,880	6,185,020
31-0000	Healthcare support	2,970,780	3,039,430	3,123,160	3,173,400
33-0000	Protective service	2,958,730	3,009,070	2,958,050	2,993,490
35-0000	Food preparation and serving related	9,687,970	9,955,060	9,917,790	10,067,080
37-0000	Building and grounds cleaning and maintenance	4,274,200	4,318,070	4,275,660	4,262,880
39-0000	Personal care and service	2,556,920	2,700,510	2,801,640	2,919,280
41-0000	*Sales and related*	12,938,130	13,506,880	13,418,770	13,339,570
43-0000	*Office and administrative support*	22,562,480	22,936,140	22,798,460	22,754,570
45-0000	Farming, fishing, and forestry	463,360	460,700	453,010	451,140
47-0000	Construction and extraction	5,938,860	6,187,360	6,239,250	6,124,600
49-0000	Installation, maintenance, and repair	5,140,210	5,318,490	5,322,980	5,215,970
51-0000	Production	12,620,920	12,400,080	11,270,180	10,726,670
53-0000	Transportation and material moving	9,538,820	9,592,740	9,410,340	9,395,000
	Total economy	127,274,000	129,738,980	127,980,430	127,523,740

Note: Categories in italics represent occupations deemed by Forrester to be at risk of offshoring.
Source: Bureau of Labor Statistics (BLS), national employment and wage data from the *Occupational Employment Statistics* survey by occupation, 1999, 2000, 2001, and 2002.

Table A.1: Detailed data on occupations (continued)

Precent change			
1999–2000	**2000–01**	**2001–02**	**1999–2002**
–3.5	–7.3	–1.7	–12.0
5.9	1.2	2.0	9.4
11.9	–3.6	–1.9	5.8
2.8	–3.4	–3.1	–3.8
14.2	2.8	1.0	18.6
4.6	3.7	3.5	12.3
3.8	2.1	2.8	8.9
1.4	2.8	1.5	5.8
–2.5	–0.3	–0.3	–3.1
0.7	1.3	1.1	3.1
2.3	2.8	1.6	6.8
1.7	–1.7	1.2	1.2
2.8	–0.4	1.5	3.9
1.0	–1.0	–0.3	–0.3
5.6	3.7	4.2	14.2
4.4	–0.7	–0.6	3.1
1.7	–0.6	–0.2	0.9
–0.6	–1.7	–0.4	–2.6
4.2	0.8	–1.8	3.1
3.5	0.1	–2.0	1.5
–1.7	–9.1	–4.8	–15.0
0.6	–1.9	–0.2	–1.5
1.9	–1.4	–0.4	0.2