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Offshoring of Service Jobs*

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Abstract

Many previously-nontraded services have become tradable, or are expected to become so, as a result of technological advances in information technology. This situation has raised concerns about the future of jobs and workers' incomes in advanced countries, especially in the United States. However, a review of the U.S. evidence shows that the current extent of service offshoring is very modest in the United States, not only as a share of GDP but also in terms of its contribution to worker displacements. Service offshoring is currently a minor part of the overall international economic competition that the United States faces. Service offshoring appears to have been relatively intense for IT occupations, but the employment and wage trends in those occupations still compare favorably to U.S. averages. While offshoring might become much more significant in the future, a closer look at occupation details reveals that most U.S. service jobs are *not* suitable for performing remotely from abroad, even when some significant cultural and institutional barriers are ignored. In addition, a range of transaction and adjustment costs slow offshoring growth, and it would take a long time, possibly decades, for offshoring to attain its potential limits, although the available estimates of those limits and when they would be reached are very uncertain. This paper's assessment is that the share of existing jobs in the United States that have the possibility of exposure to competition from service offshoring is limited to 10 to 20 percent, and the impact will be sufficiently gradual to blend in with the ongoing ordinary structural changes in the U.S. economy.

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Keywords: Offshoring, Outsourcing, Service trade.

* The analysis and conclusions expressed in this paper are those of the author and should not be interpreted as those of the Central Bank of the Republic of Turkey, or of the U.S. Congressional Budget Office with which the author was affiliated when this paper was written.

1. Introduction

Many services that could not be performed in another country only a decade or two ago can now be performed from an offshore location where labor costs are much lower. Such movement of work, called *offshoring* or *outsourcing*, is now possible for many types of services, from computer programming to financial analysis to telemarketing.[1] While offshoring helps businesses lower costs and reduce the shortage of workers in some situations (as in the case of IT workers in the United States at the time of the Y2K problem), it has raised concerns about its effects on employment and wages in developed countries. Job losses in the manufacturing sector to lower-wage countries have long been common in advanced economies, but service jobs, which are by far a majority of the jobs in those countries, have also started to appear less secure from international competition.

This paper studies service offshoring in the case of an advanced economy, the United States. The paper discusses the magnitude of offshoring, the factors that drive it and slow it, and how it might have affected the IT sector (a particularly sensitive industry) in that country. The paper finds that service offshoring currently involves a very modest dollar amount compared to U.S. GDP. In fact, service offshoring from the United States to other countries appears to be less, at least in dollar terms, than service offshoring from other countries to the United States. Moreover, offshoring accounts for a very modest fraction of the economy-wide job turnover. While service offshoring is responsible for some worker displacements, it is not a leading driver of worker displacements in the U.S. economy, and it was not a leading reason for the slow job growth in the United States following the 2001 recession as some commentators claimed at the time.

While the extent of offshoring appears modest relative to the U.S. economy, offshoring can be concentrated in some occupations, and could result in below-average growth in earnings and employment in those occupations. The information technology (IT) sector has been suggested as an example of a sector that was particularly hurt by service offshoring. This paper confirms that service offshoring indeed appears to have been more intense than average for IT occupations, which have lost many jobs in the early 2000s. But those losses were mainly due to the collapse of the IT boom, not to offshoring. Moreover, in terms of employment and

[1] The term *offshoring* is preferred over *outsourcing* in this paper. Although *outsourcing* is used more frequently in the literature and in the media, it generates ambiguity in some contexts (see the discussion in Section 2).

wage trends between 1999 and 2004 (the beginning and end years of the available detailed occupational data at the time of the writing of this paper), those professions turn out to have done better on average than other U.S. occupations.

While the amount of service offshoring is modest today, it is growing rapidly, and may generate a more noticeable economic effect in the future, but that process is expected to be slow and gradual rather than disruptive. Most U.S. jobs cannot be performed remotely. The range of the estimates of the share of U.S. jobs that may be exposed to competition from service offshoring is roughly 10 to 20 percent. That range ignores many of the barriers to offshoring from linguistic, cultural, and institutional impediments, which would necessarily make the actual fraction of offshorable jobs smaller. However, that range does not take into account the possible future automation of current service jobs, which might make some services more suitable to offshoring and the actual fraction larger. On the whole, estimates for the future limits of offshoring are very uncertain.

The question of what those limits are is not an urgent one — those limits are expected to take a very long time to reach (in the order of decades). Service offshoring is emerging as another source of gradual structural change, which modern economies always experience continuously. The factors that slow the growth of offshoring include the difficulties related to the remote management of workers, costs of adjusting the workforce and (business processes) to suit offshoring, regulatory and institutional barriers, and the limits in the availability of workers in lower-wage countries with the necessary language and technical skills.

Section 2 discusses at length the terminological issues that arise in offshoring discussions. Section 3 offers a brief review of the reasons for the rise of service offshoring. Section 4 goes into a lengthy discussion regarding the amount of service offshoring in the United States, relying on existing research and various official and unofficial statistics. Section 5 discusses the amount of service offshoring in the information technology sector---an industry that is believed to be harmed disproportionately by service offshoring. Section 6 explores the future potential of service offshoring, reviewing the literature and presenting its own estimate. The data used in the empirical analysis throughout the paper is from 2006 and before, which is when the analysis for this paper was done.

2. Terminology

In this paper, service offshoring generally refers to the act of purchasing from abroad services that could be produced within the United States. While that sounds straightforward, terminological issues arise frequently in offshoring discussions. This section aims to clarify those issues.

Several times in the discussion below, a choice needs to be made as to whether a narrower or a wider definition would fit better for the service offshoring concept. This paper tends to opt for the wider definitions in those cases. That has two reasons. First, the available data are usually available only for the wider concept. Second, the leading conclusion in this paper, that the amount of service offshoring is currently modest, automatically holds for the narrower concept if it holds for the wider definition. Instead of switching back and forth between different definitions, this paper demonstrates conclusions primarily for the wider concept, which keeps the discussion simple and avoids the potential ambiguity in the summary statements.

(i) *'Outsourcing'* vs *'offshoring'*

Offshoring is preferred in this paper over the term *outsourcing* because the latter includes domestic transactions that are not of interest, while leaving out some offshore transactions that are of primary interest. *Outsourcing* means the purchase by a firm of a good or service that could be produced in-house from another firm, which may or may not be located in the same country. For example, a U.S. firm could be outsourcing to another firm within the United States — that would be *outsourcing*, but not *offshoring*. Conversely, many offshore movements of work are under the roof of the same multinational company—for example, from a U.S. firm to its subsidiary in India. Those transactions, which are of interest to this paper as they involve movement of jobs to lower-wage countries, would not necessarily be called *outsourcing*, because no party outside the firm is involved in the transaction (everything takes place within the same firm). But the term *offshoring* satisfactorily covers such transactions.

(ii) *Import substitutability as a criterion*

While offshoring constitutes a type of service import, not all service imports can be counted as offshoring. For example, it is a service import when an American tourist pays for a hotel stay while traveling in France, but that import would not be considered offshoring because a hotel room in the United States is not a close

substitute for one in France.[2] That example suggests that offshoring should include only service imports for which reasonable substitutes are available in the United States. In practice, that substitutability is often neither perfect nor zero, but is somewhere in between. For example, the American traveler in France might have vacationed within the United States instead. Nevertheless, tourism services are left out of offshoring because they are not relevant for popular offshoring concerns. Service imports that are left out of offshoring by that criterion include payments to other countries for usage of fiber optic cables, copyright royalties, purchases of insurance, tourism (spending by U.S. travelers abroad, as in the above example) and education (for example, tuition payments by U.S. students abroad). While it could be argued that there is some substitutability between domestic and foreign counterparts for at least some of those services, they would not be considered to have the potential to displace U.S. workers or prevent the creation of new U.S. jobs directly.

(iii) *Is it offshoring when the other country is not a low-wage one?*

The definition above does not specify whether the country that provides the offshored service is a developing or an advanced economy. Accordingly, sending work to Germany would be counted as offshoring by that measure. This is an area where the definition above has a disadvantage, because offshoring concerns are very often related to the competition from low-wage countries. Expensive labor in other advanced economies is not considered a challenge to U.S. workers. Therefore, it might have been preferable to limit the offshoring concept to cases where the service provider is a developing country; however, it is not always possible to identify the country of the trading partner in the data.

The country of the trading partner is identified in the data for some offshoring-related service imports — more specifically, for services that are imported from unaffiliated firms. Those data show that most of those imports come from advanced economies. Therefore, the extent of service offshoring reported in this paper (which includes service imports from those advanced economies) is likely to be significantly greater than what is relevant for the usual offshoring concerns about the challenge to U.S. service workers from lower-wage countries.[3] Nevertheless,

[2] As Blinder (2006) puts it, "if you vacation in Florida, you do not want the beachboy or the maid to be in China."

[3] That may be less of an issue in the future if BEA's current efforts to integrate data collection for affiliated and unaffiliated service trade produces more comparable data for those two types of transactions.

that wider definition, which is forced by the lack of detailed data, will not prove to be a problem, as the conclusion that the amount of offshoring is modest holds even for that wider concept.

(iv) *Offshoring with no displacements*

Moving production to another country requires laying off workers in many cases, but not always. For example, consider a firm that expands its back office jobs by hiring abroad rather than in the United States — that expansion would not displace U.S. workers, but it would be a case of offshoring as the firm substitutes production abroad for its production in the United States. The distinction between offshoring with and without displacements is worthwhile because displacements are costly. Displaced workers go through a period of unemployment, and may have to accept a new job at a lower wage than what they earned previously. However, for some other questions, tracking both types of offshoring could be important. For example, both types of offshoring in a given profession would affect the employment and earnings trends in that profession. Admittedly, offshoring is a term that many would reserve for cases that involve displacements (especially when it is used in the context of manufacturing), but this paper opts for the wider concept that does not require offshoring to involve displacements (An exception is the discussions in this paper regarding the data that are directly on displacements and the movement of work abroad).

(v) *Explicit decision by a firm to offshore is not a criterion*

If a U.S. firm (for example, a company specializing in call center operations) loses business to a foreign firm and, consequently, has to lay off its workers in the United States, that would be taken as a case of offshoring (consistent with the above definition), even if those layoffs are not the result of an explicit intention by the U.S. firm to offshore jobs.

(vi) *Suppose two workers abroad are now doing a service job that could be performed by one U.S. worker. Would that offshoring be considered as affecting one job or two?*

In this paper, that would count as one job. Given that this paper's focus is on how U.S. workers are affected, the number of affected U.S. jobs matters here more than the number of affected jobs abroad.

(vii) *'Insourcing'* vs *'onshoring'*

The opposite of offshoring—the movement of work from other countries to the United States—is called *onshoring* in this paper. An alternative word, *insourcing*, is probably used more frequently in the literature and media, but *onshoring* is preferred over *insourcing* for the same reason *offshoring* is preferred over *outsourcing* (see subsection (i) above).

3. What Drives Service Offshoring?

The leading driver of offshoring is that it creates opportunities to lower the cost of producing goods and services, thanks to the much lower cost of labor in developing countries.[4] Wage differences between developing countries and the United States have existed for a long time, but it has become possible to take advantage of them for production of services only in recent years, thanks to the rapid progress of IT technologies. The dot-com boom of the late 1990s may have contributed to the feasibility of offshoring by leading to substantial investments in fiber-optic cable installations around the world and in other IT technologies that reduced communication costs and thereby made offshoring of services less costly. Those developments changed the trade-off between costs and benefits of locating service jobs to remote locations, giving rise to offshoring.

In addition to benefiting from the low-cost labor of developing countries, offshoring also reduces costs in the same manner as domestic outsourcing does. Offshoring, as a form of outsourcing, helps firms concentrate on their main areas of expertise by enabling those firms to contract out their auxiliary tasks to specialized firms, which are likely to be more efficient at those tasks and hence would be able to do them at a lower cost.[5] Moreover, offshoring may open up new possibilities that might not have been feasible before, enabling firms to improve quality, designs, processes or service, to increase productivity (Siems, 2006; Mann, 2003),

[4] While labor costs are the primary incentive for offshoring, in the case of domestic outsourcing, leading sources of cost savings include the economies of scale in the provision of specialized services, and the flexibility in work force provided by temporary-employment agencies and outside suppliers in the face of volatile demand (see Houseman 2001, and Abraham and Taylor 1996). Those may be stronger incentives than the labor cost advantage of offshore labor, given that domestic outsourcing appears much more extensive than offshoring (for example, in the data presented in Amiti and Wei, 2005).

[5] Amiti and Wei (2005) estimate that those benefits accounted for about 11 percent of U.S. productivity growth in 1992-2000. While they report that figure as the benefit of service offshoring, their figure appears to mix the benefits of offshoring with those from domestic outsourcing. In their empirical work, domestic outsourcing is not distinguished from offshoring. Moreover, service offshoring in their data consists of an annual average increase of about 0.014 percentage points in the share of imported service inputs. That amount appears too small to account for 11 percent of U.S. productivity growth.

or to expand their businesses and sometimes also their employment.[6] *Business Week* (2006) interviews producers about the particular benefits that their firms derive from offshoring. The producers emphasize the advantages due to greater efficiency, better customer service, or the ability to provide a greater variety of products as the leading benefits, rather than simply "cost savings."

Some additional factors may have also contributed to the growth of offshoring. The increased outward orientation of some developing countries (especially India) is sometimes cited as a potential factor, although the concomitant rapid growth of domestic outsourcing of services suggests that technological changes have likely been more responsible than global developments.[7] Another example of a secondary factor is that offshoring permits night shifts in the United States to be covered by day-time workers on the other side of the globe.

4. The Amount of Service Offshoring in the United States

There are no comprehensive, direct data on key measures such as the total dollar value of imports and exports associated with service offshoring (or onshoring), the total number of displacements related to offshoring, or the number of jobs gained by onshoring. The available estimates are usually indirect and they do not always correspond to desired concept, or their accuracy may be questionable. Nevertheless, those data provide reasonably convincing clues about the amount of service offshoring for the economy as a whole.

The main data source on the dollar amount of service offshoring and onshoring is BEA's international service trade data—more specifically, the data on international trade in *business, professional, and technical* (BPT) *services*, which is the category where imports that are associated with service offshoring fall under. Estimates of the number of jobs involved in service offshoring come from the Bureau of Labor Statistics (BLS) as well as from academics, consultants, and interest groups.[8] It is

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[6] *Business Week* (2006) gives the example of a U.S. manufacturing company whose U.S. and Indian engineers collaborate twenty-four/seven. That collaboration reduced not only development and design costs but also cycle times, allowing the company to win orders it often had to miss due to engineering constraints. Those new orders consequently allowed the firm to expand its employment of production workers in the United States.

[7] Based on the data from the Census of Manufacturers, Bartel, Lach and Sicherman (2004) report that the ratio of purchased service inputs to value added rose from 4.25 percent in 1992 to 10.68 percent in 1997.

[8] BEA's data on employment by multinational corporations are also used in offshoring discussions, especially when they focus on the role of multinational corporations in offshoring. Those data are not as useful here because much of U.S. multinationals' offshore activity is directed to sales in markets outside the United States—only 11 percent of the total output of U.S. firms' foreign affiliates goes to the U.S. market (Landefeld and Mataloni, 2004). This means that, when a U.S. firm increases its employment and

important to note that the estimates of the numbers of offshored jobs solely focus on displacements due to offshoring and do not consider the number of jobs gained through onshoring.

Those data and estimates suggest that:

(i) Although both offshoring and onshoring of services have grown rapidly, the amounts of both are small compared to the size of the U.S. economy, and they appear to be mostly between advanced economies;

(ii) Service offshoring is responsible for only a small fraction of economy-wide displacements;

(iii) Service jobs account for a small fraction of layoffs that are associated with movement of work abroad or import competition;

(iv) Service offshoring may well be less than service onshoring;

(v) The amount of service offshoring is too little to have made a significant contribution to the slow growth of employment in the recovery that followed the 2001 recession (or the recession itself). Furthermore, service offshoring is likely to have increased less than onshoring did in those years, implying that service offshoring on net might have even made a (small) positive contribution to employment.

4.a. Data on International Trade in Business, Professional and Technical Services

Official data on service imports and exports show that the dollar amounts of service offshoring and onshoring are small relative to the size of the U.S. economy. While it is not possible to determine the number of workers involved in offshoring from its dollar amounts, those dollar amounts are small enough to support the

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production abroad, that is much more likely to increase sales abroad than to move U.S. production of that firm abroad. That is supported by the empirical finding that when a U.S. firm expands abroad, it also hires more workers in its U.S. location (Hanson, Mataloni, and Slaughter 2003), possibly because of the increased workload in domestic headquarters related to the expansion. However, that empirical finding has been challenged in the case of hiring in affiliates in developing countries (Harrison and McMillan, 2006). Moreover, that finding would not reduce concerns related to offshoring by itself because domestic expansion of the multinationals could be at the expense of their U.S. competitors, and those competitors could be reducing their U.S. employment. Similarly, evidence of rising employment of U.S. workers by foreign multinationals could be at the expense of greater decreases in employment by their U.S. competitors. Nevertheless, an interesting finding by Borga (2005) is that service imports by U.S. multinationals represent only a small part of the parent companies' total (domestic and international) purchases of goods and services — about 0.4 percent in 1994, declining to 0.2 percent in 2002.

conclusion that the impact of service offshoring on the economy has been very limited. Moreover, those data also suggest that U.S. offshoring activity is mostly (in dollar terms) with advanced economies, rather than with countries with significantly lower wages (such as India or China).

When a U.S. company offshores a service, the payments it makes to the firm in the other country are counted as a service import in the U.S. national accounts. While there is no category that corresponds directly to the service offshoring concept characterized in Section 2, the *business, professional and technical services* (BPT) category under service trade contains most of such imports, as explained in detail in Appendix A. However, the BPT category also contains some service imports that would not be considered as service offshoring, such as payments to lawyers for representation in another country's court, which are not close substitutes for U.S. jobs. (Therefore, the BPT data may overstate the magnitude of service offshoring by an unknown amount.) While that reduces the suitability of BPT imports as a measure of service offshoring, it does not affect the main conclusion of this section — that the amount of service offshoring is relatively small.

Table 1 shows that BPT imports are still small relative to U.S. GDP. For example, in 2004, BPT imports were USD 40.7 billion while U.S. GDP was USD 11.7 trillion — more than 250 times larger. BPT imports increased by USD 2.5 billion while U.S. GDP increased by USD 426 billion on average over the 1999-2003 period. The small size of the changes in exports and imports of BPT services relative to the change in GDP make service offshoring seem unlikely to be a significant contributor to employment changes in recent years.

Both BPT exports and imports amounts have grown much more rapidly than total U.S. exports and imports. In the 1997-2004 period, BPT exports grew 7.1 percent per year, faster than the total export growth rate of 3.0 percent. BPT imports grew at 10.0 percent per year, faster than the total import growth rate of 7.9 percent. However, because BPT imports remain much smaller than BPT exports, net BPT exports increased in most years. The United States was a net exporter of BPT services and those net exports grew over time.

However, the stronger growth in BPT imports than in exports in the 1997-2004 period should not be taken as a sign that offshoring will continue to grow faster than onshoring indefinitely. The faster BPT import growth likely reflects relatively

faster GDP growth in the United States than in its trading partners and the strength of the dollar — total U.S. export growth was also slower than total U.S. import growth, and by a much greater margin.

Table 1
Trade in Business, Professional and Technical Services
(Billions of dollars)

	Level					Change			memo:
	Exports		Imports		Net Exports	Exports	Imports	Net Exports	U.S. GDP
	Total	Un-affiliated	Total	Un-affiliated					
1992		11.7		3.2					6,337.8
1993		13.0		3.6					6,657.4
1994		15.3		4.0					7,072.2
1995		16.1		4.9					7,397.7
1996		19.5		5.7					7,816.8
1997	43.9	21.5	20.8	6.5	23.0				8,304.3
1998	45.3	22.7	22.0	7.5	23.3	1.5	1.2	0.2	8,747.0
1999	53.5	27.7	27.6	8.6	25.9	8.2	5.6	2.6	9,268.4
2000	54.3	25.3	29.1	9.1	25.2	0.8	1.5	-0.7	9,817.0
2001	58.9	28.2	30.4	9.5	28.5	4.6	1.3	3.3	10,128.0
2002	62.0	29.2	33.5	9.7	28.5	3.1	3.1	0.0	10,469.6
2003	66.6	31.5	37.5	11.4	29.1	4.5	4.0	0.5	10,971.3
2004	71.0	33.8	40.7	12.5	30.3	4.5	3.3	1.2	11,734.3
Avg change between 1999-2003						**3.3**	**2.5**	**0.8**	**425.7**

The BEA also provides some (limited) detail on the country of origin of BPT imports, and those data suggest that only a small fraction of BPT imports are from India,[9] the leading country of counterparty in offshoring transactions.[10] India is the primary destination for offshore movement of work because of its labor cost advantage and the English skills of its labor force. Of the reported USD 10.96 billion total unaffiliated BPT imports in 2003, only USD 0.42 billion was from India. Most of those imports came from other advanced economies. Those suggest

[9] Only imports from unaffiliated parties are reported by country of origin. According to GAO (2005), the BEA does not believe that firms report the country distribution of their service imports from affiliated parties reliably by type of service.

[10] Bronfenbrenner and Luce (2004) write that India is the largest destination for the white-collar shifts, with almost half of all shifts headed there in the first quarter of 2004 (p. 73). Separately, Gartner Inc. estimates that India commands USD 2 billion of the USD 3 billion global offshore BPO market, according to a CNN/Money article ("Is India's Outsourcing Honeymoon Over?" August 24, 2005, by Parija Bhatnagar).

that service offshoring to lower-wage countries may be much smaller than what is suggested by total BPT imports.

BEA's coverage of importers in its surveys may be incomplete, although the balance of evidence suggests that the missing importers are not likely to be important enough to alter any of the conclusions in this paper. The issue of missing importers became an issue in offshoring discussions because of a large discrepancy between the U.S. and Indian statistics regarding the amount of service imports from India—Indian estimates are several times larger. Nevertheless, a recent report by GAO (2005) shows that much of the discrepancy comes from the unorthodox conceptual or methodological approaches adopted in the Indian statistics (see Appendix A). It is not known precisely how much discrepancy those conceptual and methodological differences cause, but they are significant and could account for most (and possibly all) of the discrepancy. A discussion of this topic in the FAQ section of BEA's website explains this as follows: "Depending upon how one adjusts for important definitional differences, the gap between the U.S. and Indian estimates either entirely disappears or is substantially reduced." The GAO report also makes an attempt to identify possible undercounting in the BEA statistics, and finds that BEA's surveys leave out some importers who should have been included in BEA's list of surveyed firms. However, BEA's further work on those missing importers revealed no substantial imports of services that were not already being reported by BEA.[11] Furthermore, only a very large amount of undercounting would make a difference in the conclusions of this section, which appears to be unlikely.[12]

4.b. Mass Layoff Statistics (MLS)

The Mass Layoff Statistics (MLS) program is the primary vehicle that the Bureau of Labor Statistics (BLS) uses to collect information on the effect of offshoring on U.S. workers.[13] A "mass layoff" is a layoff that involves 50 or more

[11] According to the comment from the Department of Commerce, also included in the GAO (2005) report.

[12] As noted, conceptual and methodological differences account for the majority of the discrepancy between the U.S. and Indian statistics. However, those still leave a large residual unexplained discrepancy (possibly 150 percent of reported BPT imports). That residual could still be due to the other conceptual and methodological differences that were not quantified in the GAO report, but they could also be a result of true discrepancy. Nevertheless, even if all of that residual discrepancy is due to BEA's understatement and the reported BPT imports need to be multiplied by 2.5 to adjust for that, the conclusion that service offshoring has been modest relative to the U.S. economy would not change.

[13] In response to the "increasing interest in the impact on the U.S. economy of offshoring and outsourcing of work, ... the Mass Layoff Statistics program ... was determined [by the BLS] to be an appropriate vehicle for collecting information on this economic phenomenon," according to Brown and Siegel (2005).

workers within five-weeks or less. The MLS contain data on the number of workers involved in those layoffs, their sectors of employment, and the reasons for those layoffs, taken from a survey of employers. While the MLS survey goes back to 1992, questions that aim to investigate offshoring were added only recently and their answers are available at the time of this section's writing only for 2004. The MLS data are discussed in detail in Appendix B. Much of the discussion in this subsection and Appendix B relies on data only published in Brown and Siegel (2005), who are with the BLS, as well as some unpublished data that the authors kindly provided. The MLS data identify the reasons for layoffs, and this paper considers a layoff to be offshore-related when its reason is 'import competition', or when the reason is something else but the layoff involves 'movement of work' to an offshore location.

The MLS data show that only a small fraction of the mass layoffs in the private sector (service or non-service) involves movement of work abroad or import competition.[14] Those offshore-related work movements account only for about 3 percent of layoffs, and 5 percent of layoffs whose reason that this paper identifies as having a relatively permanent nature.[15] Moreover, less than a tenth of those offshore-related layoffs were in services, although those services employ the majority of the U.S. labor force. In contrast, manufacturing, which accounted for 26 percent of layoffs (and about 11 percent of total employment) accounted for more than 90 percent of those offshore-related layoffs. Manufacturing sectors contain many service jobs, such as those in IT-support or back-office services, and it is possible that some of the offshored jobs in manufacturing were actually in service occupations. Nevertheless, the above statistics are still very informative because they show that only a small fraction of offshore-related layoffs takes place in service sectors, despite the fact that those sectors constitute most of the U.S. economy and account for most of layoffs.

[14] While offshore-related layoffs are a small fraction of the total, that might not be sufficient to diminish the importance of such layoffs in overall displacements if offshore-related layoffs are much more costly for workers than average layoffs. But Kletzer's (2001a, p.78) findings suggest that this is not the case. In her study of manufacturing displacements, she finds that the distribution of earnings losses does not depend on the degree of import competition that the sectors face; 'trade-displaced' workers look little different from 'otherwise-displaced' workers.

[15] Those "relatively permanent" layoffs are about half of all layoffs, and leave out layoffs that are seasonal or due to factors that appear temporary (such as vacation, labor dispute, plant repair, etc). They also leave out layoffs whose reasons are not identified. Movement of work or import competition are reasons in a negligible fraction (0.2 percent) of those excluded layoffs (see Appendix B).

While those insights from the MLS are useful, four issues limit the suitability of the MLS data for understanding the magnitude of service offshoring. First, the MLS gives information on the sectoral distribution of layoffs, but not on the occupational distribution, obscuring whether separations involved service jobs or production jobs. (However, new data collection initiatives by the BLS are underway to solve this problem.) A second drawback is that, although the MLS data cover a very large sample of layoffs, that is not a representative sample of all layoffs. As mentioned, the MLS is restricted to layoffs from large firms (those with 50 or more employees) and mass layoffs within a short period of time (50 workers or more within five-weeks or less). It is not clear if and how the statistics of interest, such as the share of offshore-related layoffs in total layoffs, and the distribution of layoffs over industries, might differ in that sample from the whole population (see Appendix B). Nevertheless, the share of offshore-related displacements implied by the MLS does not appear inconsistent with the other available estimates, which are discussed in the next section.

Third, the MLS data excludes cases of offshoring that do not involve displacements. As explained briefly in Section 2, that is not a problem if the focus is on displacements, but offshoring could affect workers without displacing them. For example, offshoring could slow wage growth in some professions even for workers who are not displaced.[16] Therefore, the number of displacements likely understates the total number of workers affected by offshoring. Nevertheless, the information in the MLS is very useful for understanding what fraction of displacements is due to offshoring, and how those displacements are distributed between service and non-service sectors.

Fourth, some of the import-related layoffs covered by the MLS may be recorded under a different heading. By necessity, the MLS usually reports the proximate reasons for layoffs (such as business ownership change, contract cancellation, financial difficulty, model changeover) rather than the reasons that could be considered more comfortably as exogenous (such as changes in consumer preferences, changes in production technology, increasing import competition). Schultze (2004) writes that some layoffs may occur for reasons indirectly related to import competition even though they are not identified as such by employers (for example, bankruptcy may be the reported reason, but it may have been caused by

[16] Offshoring could also *enhance* real wage growth or reduce displacements in some other occupations, but concerns usually focus on the unfavorable effects of offshoring, rather than those favorable effects.

import competition, either directly or indirectly through loss of sales). Similarly, employers may fail to report some job relocations as movement of work. Those would mean that import competition or movement of work abroad might account for more than 3 percent of layoffs (and more than 5 percent of relatively-permanent layoffs).[17] Nevertheless, given that most of those layoffs were not in services, the conclusion that service offshoring accounts for a small fraction of layoffs appears safe.

4.c. Unofficial Estimates

In addition to those official data, various academics, consultants, and interest groups have estimated the numbers of jobs affected by offshoring. Naturally, the absence of direct, official counts of representative samples means that those private estimates have to rely on some strong assumptions, which may or may not be accurate. Furthermore, the methodologies behind the estimates are not always entirely transparent, and, not surprisingly, different studies find different results. However, they do not appear to contradict the conclusions drawn from the official data. The purpose of this section is not to describe or evaluate the methodologies adopted in those estimates, but rather to report some of their results.

A widely-cited estimate of service offshoring is by the consulting company Forrester Inc., which estimates the cumulative number of offshored jobs by 2005 at 830,000. Forrester estimates the rate of service offshoring at around 140,000 per year for the past five years and forecast 220,000 per year in the next five.[18] Another estimate is by Goldman Sachs (2003), at 100,000 to 167,000 a year between 2001 and 2003[19], and 180,000 to 360,000 "going forward."[20] Mark Zandi of Economy.com estimates service offshoring in the range of 140,000 to 250,000 per year between 2001 and 2005.[21] Blinder (2006) summarizes those and similar work by writing that "fragmentary studies indicate that well under a million service-

[17] It is worthwhile to note that the 5 percent finding is generally consistent with many other economists' finding that a small fraction of job churning is attributable to international trade (even when one includes manufacturing). However, the evidence does not always appear strong when one includes manufacturing. For example, it has been reported that only 2 percent of displacements are due to international trade (for example, Bernanke, 2004), but the estimate is obtained by dividing a numerator by a denominator that may not be compatible.

[18] Forrester estimates are taken from other citations, including Garner, 2004 and Mankiw, 2005. Their estimates are judgmental; the methodology involves Forrester's analysts assigning a rank from 1 to 5 to different occupations based on how rapidly they think jobs are likely to move offshore, according to Garner.

[19] As reported by Bernanke (2004).

[20] Mankiw (2005) reports that their estimate is 15,000 to 30,000 monthly.

[21] According to Stokes (2005).

sector jobs in the United States have been lost to offshoring to date." Blinder reminds that "a million jobs is less than two weeks' worth of normal gross job losses," highlighting the fact that those estimated numbers can account only for a small fraction of economy-wide job turnover.

As for offshoring of both service and manufacturing jobs, Bronfenbrenner and Luce (2004) estimate that jobs were offshored jobs at a rate of 406,000 a year, as of the first quarter of 2004. That estimate is based on announcements of offshored jobs that appeared in the media. The authors undertook an extensive effort, and collected those announcements in a database that contained "information on all production shifts announced or confirmed in the media during that period." The number is based on actual counts as well as the authors' estimate of the fraction of movement of work that their database may have missed. They make the judgmental assumption that their media tracking captures two-thirds of offshoring to Mexico and a third of those to other countries. That adjustment appears to make their estimate about twice as large as their actual count.

Another estimate on the effect of trade on displacements is by Kletzer (2005) who estimated it at the rate of 324,000 a year over the period 1979-01.[22] That is an earlier period than covered by most other estimates reported here—a period when the economy was smaller but somewhat more turbulent. A difference that may matter more than the time period is her methodology — she takes the average annual number of workers displaced in industries facing high import competition as her estimate.

The estimates of Kletzer and Bronfenbrenner and Luce, which are for offshoring in both service and non-service occupations, are not apparently inconsistent with the MLS data. While the MLS data show a far smaller number of offshore-related displacements (27,200 in 2004), that is only because the MLS data cover only a fraction—about a tenth—of all layoffs. When the figure 27,200 is projected to all separations in the United States, it yields an estimate of 280,000 (see Appendix B). That projection assumes that offshore-related layoffs (those involve the movement of work or are due to import competition) have the same frequency in layoffs in the MLS sample as in the whole population. The estimate 280,000 has a similar order of magnitude with the other estimates reported above—Bronfenbrenner and Luce's 406,000 (which was obtained by doubling the original count) and Kletzer's

[22] That is an update from an earlier estimate of 310,000 in Kletzer, 2001a, which may have been more frequently cited (for example, by Bernanke, 2005).

324,000. Those estimates for the number of layoffs due to offshoring, ranging from 280,000 to 406,000, are very small relative to the total number of layoffs and discharges in the U.S. economy, which were 18 million in 2004 (see Table 2).[23]

Table 2
Labor Market Turnover in 2004
(Millions of workers)

Net Hires	2
Hires	50
Total Separations	48
Layoffs and Discharges	18
Quits	26
Other Separations*	3
Memo:	
Labor Force	147
Private Sector Jobs	112

Source: BLS, Job Openings and Labor Turnover Survey (JOLTS).
* 'Other separations' include retirements and transfers to other locations.

A valuable piece of information documented by Bronfenbrenner and Luce is that, of the 48,400 job losses associated with movement of work abroad that they identified in the media, only 3,900 were to India (and some of those were nonservice jobs), while 24,400 were to Mexico and 8,300 were to China. Given the predominance of India in service offshoring, those numbers suggest that service offshoring is still far less prevalent than offshoring of manufacturing jobs, which accords with the observation in the MLS data that more than 90 percent of offshore-related layoffs were in manufacturing.

5. Offshoring and the Information Technology (IT) Sector

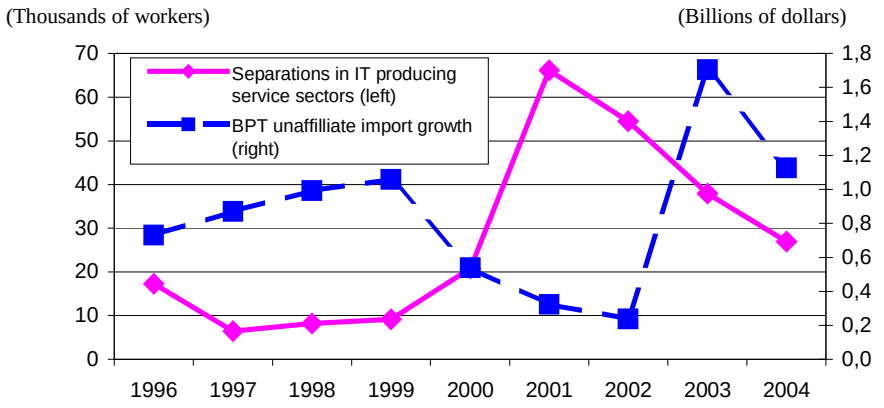
The impact of service offshoring could be concentrated in specific occupations, and the effect on those occupations could be significant even if the magnitude of service offshoring is small relative to GDP. Workers in those occupations would have to face not only an increased likelihood of displacement, but also significant earnings losses even if they continued to be employed. Information technology (IT) occupations have been given as a possible example, and service offshoring indeed appears to have been relatively intense in the IT sector. Nevertheless, this paper finds that the employment and wage trends in IT occupations generally compare

[23] There were 48 million separations in the private sector in 2004 (out of a total employment of 112 million in that year), but only 18 million of those 48 million were due to layoffs and discharges---26 million were due to quits, and 3 million for retirements and transfers to other locations. (Total employment increased by 2 million that year despite the 48 million separations because there were 50 million new hires.)

favorably to U.S. averages, concluding that those occupations have not been put at a great disadvantage relative to other occupations.

A difficult time for IT occupations was the early 2000s, when they experienced large employment losses. However, those difficulties were mainly due to the collapse of the IT boom. The rise and fall of IT employment and wages in the late 1990s and in early 2000s paralleled the technology boom and collapse. Figure 1 shows extended mass layoffs in IT-producing service industries and BPT unaffiliate imports (a measure of offshore outsourcing in services). The figure suggests that the rate of IT sector separations were not related to offshore outsourcing of services (as measured by BPT imports) — in fact, IT separations rose sharply in the early 2000s when BPT imports sharply fell.[24] That increase in IT separations rather coincided with the collapse of the IT boom. Figure 2 shows that the sharp rise in IT separations took place when IT investment (*business fixed investment in computer equipment and software*) collapsed, and those separations were quelled when IT investment recovered.

Figure 1. Offshore Service Outsourcing and IT Service Sector Layoffs



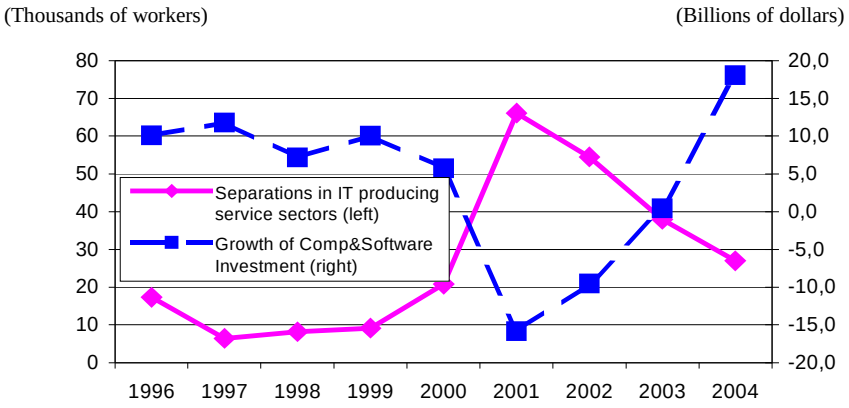
Source: Brown and Siegel (2005) and BEA.

When we look beyond the technology boom and bust, the general trends in IT employment and earnings are upward — they do not give the impression of a secular decline due to offshoring. As discussed in detail in Appendix C, IT

[24] The figure uses BPT service imports from unaffiliated parties (rather than total BPT service imports). That is because total BPT imports start in 1998—in order to be able to include the earlier years in the figure, only BPT unaffiliated imports were used. (The time path of that series is similar to the total in the period they overlap.)

occupations generally enjoyed faster employment and earnings growth between 1999 and 2004 than in the rest of the economy. However, that does not mean that offshoring has had no effect on IT occupations. The estimated number of offshored IT jobs is around 50,000, which is comparable to the average annual increase in the number of IT jobs in the 1994-2004 period, which was 60,000. While those estimates are uncertain, they suggest that offshoring cannot be dismissed as insignificant in those occupations — it is possible (if not likely) that those occupations would have done much better without offshoring, but offshoring pushed them down toward the U.S. average.

Figure 2. IT Investment Boom and Collapse, and IT Service Sector Layoffs



Source: Brown and Siegel (2005) and BEA.

Finally, while IT occupations generally did better than the U.S. average, there may be exceptions to that within specific IT occupations. For example, the share of *computer programmers* in total private employment went down from 0.40 percent to 0.30 percent between 1999 and 2004, a period when there was no decline in the overall IT sector either in terms of GDP or employment. However, offshoring was not the only factor in the decline in the number of *computer programmers* and it is not known how much of that decline is due to offshoring and how much to other factors.[25]

[25] The BLS web site explains those factors as follows: "Sophisticated computer software now has the capability to write basic code, eliminating the need for many programmers to do this routine work. The consolidation and centralization of systems and applications, developments in packaged software, advances in programming languages and tools, and the growing ability of users to design, write, and implement more of their own programs mean that more of the programming functions can be transferred from programmers to other types of information workers, such as computer software engineers."

6. The Future of Service Offshoring

In the medium term (over the next decade or so), service offshoring is likely to remain small relative to the U.S. economy (although it will maintain its rapid growth rate) according to available forecasts. A widely cited forecast by Forrester, 2004 puts the number of jobs that will be offshored at 3.4 million in 2015 (2.2 percent of CBO's civilian employment projection for that year), a relatively modest amount compared to the usual U.S. job market turnover—which entailed over 300 million jobs destroyed (but even more created) in the past 10 years.

Beyond the medium term, what are the eventual limits of service offshoring? The available though highly uncertain estimates for U.S. service jobs that could be done offshore range roughly from 10 to 20 percent of all (service and non-service) current U.S. jobs. Most jobs cannot be moved abroad because they require physical proximity (for example, many health-care occupations). Some other service jobs rely heavily on personal interaction with close cultural and social understanding (for example, social workers, managers, and some sales representatives and agents). Moreover, some authors also think that government jobs are unlikely to be offshored for political reasons (for example, Blinder, 2006). Nevertheless, that range may over- or understate the future of offshoring, as the underlying estimates are highly judgmental and leave out many important factors.

How long would it take for offshoring to reach its limits? While that is also highly uncertain, the available commentaries and forecasts suggest that it would take decades. Blinder, 2006 writes that "decades is ... the time frame that people should be thinking about." Forrester's above-mentioned forecast of a relatively modest amount (relative to the U.S. economy) for the next 10 years, and projections by the McKenzie Global Institute are also consistent with that view. Factors that slow the growth of offshoring include institutional barriers and adjustment and transaction costs.

6.a. Estimates of the Limits of Service Offshoring

This section reviews four different estimates for the number of U.S. service jobs that could be offshored. Table 3 shows those estimates (expressed as percent of *total* U.S. employment in service *and* non-service jobs) after some adjustments to enhance comparability, although some differences still remain in what the estimates exactly measure, as discussed below. A notable difference is that Jensen and Kletzer's estimate is based on tradability, which turns out to overstate

offshorability. Taking that difference into account, the studies suggest that *currently* — leaving out Blinder's conjecture that technological progress will make service jobs more offshorable than they are now — the limit of offshorable service jobs is roughly 10 to 20 percent of all U.S. jobs. Appendix D provides an independent estimate, which confirms that range.

Table 3
Estimates for Service Jobs that could be Performed Offshore, as Percent of Total U.S. Employment (Service and Non-service)

STUDY	ESTIMATE
Bardhan and Kroll (2003)	11
Van Welsum and Reif (2005)	15
Jensen and Kletzer (2005)	23 [a]
Taking into account possible future automation that might increase offshorability:	
Blinder (2006)	27 [b]

Notes: The estimates shown in the table assume government jobs are not offshorable. They do not cover offshoring in manufacturing and are only for *service* offshoring, but the fractions are expressed as a percent of *all* U.S. jobs — including jobs in manufacturing and other non-service sectors. These estimates may differ from the estimates reported in the original studies, reflecting some adjustments to make them more comparable. However, some differences still remain — see the text for more detail.
[a] A significant difference of Jensen and Kletzer's estimate from the others is that it measures tradability rather than offshorability.
[b] That is the mid point of the range that Blinder reports, which is 21 to 32 percent.

That range may under- or overestimate the future of offshoring. It appears understated compared to the range estimated by Blinder (2006), which is 21 to 32 percent, who assumes that future advances in automation will increase the number of jobs that can be performed remotely and make many more jobs suitable for offshoring. If some of the jobs that are done face-to-face today could become computerized and less personal in the future as Blinder conjectures, that would mean the other estimates (which do not take into account the possibility of such automation) may understate the future of offshoring.[26]

Nevertheless, the range of 10-20 percent may also overstate the future of offshoring. First, the estimates that underlie that range are not forecasts, but estimates for upper bounds that may never be reached. The methods behind them aim to find the fraction of jobs that may be performed remotely, but not all jobs that

[26] Atkinson (2006) finds Blinder's estimate of the range of at-risk jobs too large, believing that "jobs not at risk today are likely to not be at risk in the future," because the "core underlying technology is not likely to change in significant ways over the next 25 years (beyond getting cheaper and more powerful)." Blinder's conjecture relies on possible changes in the use of technology as well as changes in technologies other than telecommunications, both of which seem difficult to rule out.

can be performed remotely will be. U.S. manufacturing illustrates this well; most goods that are produced in the U.S. could be produced remotely, but U.S. manufacturing production was worth 75 percent of U.S. manufacturing purchases (as of 2003), employing about 11% of the workforce. The upper-bound estimates do not take into account many of the costs and barriers discussed below in Section 6.b, which will limit service offshoring. Moreover, those estimates do not account for the fact that increased service imports would increase the net U.S. demand for foreign currencies, lowering the value of the exchange value of the dollar. That, in turn, would reduce the attractiveness of service offshoring, and bolster U.S. competitiveness in world markets. If 10 or 20 percent of U.S. jobs were offshored, the resulting increase in imports would necessitate an equal increase in exports (barring an increase in net capital inflows), and the creation of new export jobs in the United States. Therefore, the estimates presented in this section should be interpreted as the percent of jobs whose nature allows them to be performed in another country, rather than estimates of percent of jobs that will actually be offshored.

Reasons for the Differences Among the Estimates Shown in Table 3

Blinder's estimate (shown in Table 3 as 27 percent, the mid point of his estimated range) is the highest, as he incorporates the possible future automation of jobs in his estimate. Blinder's estimate is for the number of current U.S. jobs in sectors "that will be susceptible to offshoring in the electronic future." Blinder does not give a precise breakdown of his estimate over sectors, but he provides a descriptive account of his thoughts regarding different sectors, and some of those remarks include possible future changes in the nature of offshorable jobs. The other estimates of offshorability are apparently based on the current nature of jobs.

Jensen and Kletzer's reported estimate is 39 percent, but that includes manufacturing and government jobs, and the estimate would be about 23 percent excluding those, and their estimate is not for offshorability but for an imperfectly estimated concept of "tradability." Jensen and Kletzer measure the tradability of a given sector based on the degree of geographic concentration of production in that sector. If production of a good or service is concentrated in a geographical area such as a state, either that good or service is tradable, or it is consumed more intensely in that state. Jensen and Kletzer's methodology judges, for example, *accommodation* as tradable, probably because it is concentrated in states such as Florida (and

tourism related services are indeed classified as tradable in the national accounts).[27] However, most jobs in *accommodation* are unsuitable for including in the concept of offshoring, as explained in Section 2 (and also by Blinder (2006)). Similarly, the *transportation and warehousing* sector is identified mostly as tradable by Jensen and Kletzer. In contrast, many *transportation and material moving* jobs are not offshorable because most of them entail activities such as driving. Jensen and Kletzer's method also identifies most jobs in *real estate and rental and leasing* as tradable, although most real estate jobs, from real estate managers to appraisers to sales agents, do not appear to be offshorable.

The third highest estimate is by Van Welsum and Reif, who estimate the limit at 18 percent (as of 2003), but their estimate would be 15 percent if they excluded government jobs, as many of the other estimates do. Van Welsum and Reif look at detailed CPS categories and identify some occupations as offshorable based on several criteria, including the intensive use of information technology. They then assume that all jobs in those occupations may be offshorable.

Bardhan and Kroll's (2003) estimate, 11 percent, is lower than the rest, but that appears to be partly because they exclude some jobs that might be offshorable. The authors "only take into account those occupations where at least some outsourcing has already taken placed or is being planned, according to business literature." Consequently, Bardhan and Kroll do not include, for example, *protective service occupations*, although some of those jobs (for example, guards monitoring cameras) could be performed remotely, at least in principal. This paper's assessment, which is detailed in Appendix D, is that including those occupations that Bardhan and Kroll leave out could increase their estimate to 15 percent, to the level of the estimate of Van Welsum and Reif.

Another difference between the approaches underlying those five estimates is whether they analyze jobs based on a breakdown over occupations or industries, although that does not appear to be a major source of difference between the final estimates. A breakdown over occupations allows assessing offshorability more directly than a breakdown over sectors. For example, the *truck transportation* industry employs 1.36 million workers, but at most 1.03 million of those workers are actually in *transportation and material moving* occupations (such as *truck*

[27] Jensen and Kletzer's approach relies on judgement less heavily than others, but it still requires a judgmental choice for the cutoff degree of tradability that divides the sectors into two groups as tradable and nontradable.

drivers). The remaining 0.33 million jobs are in other occupations that may or may not be offshorable, and whether they are or not can be decided better by looking at their respective occupations, which is not possible in a breakdown over industries. Two of the above five estimates (Bardhan and Kroll, VanWelsum and Reif) rely on a review of occupations, while two others (Blinder and McKinsey) review industries. Jensen and Kletzer analyze the data in both ways, but their preferred specification uses a breakdown over industries rather than occupations.[28]

6.b. Factors that Limit or Slow the Growth of Service Offshoring

There are important limitations on service offshoring. Some of those reduce the future limits of offshoring, but are not taken into account fully in the estimates discussed in Section 6.a. Some others slow the growth of offshoring, although they would not necessarily affect its limits.[29]

First, as mentioned, the estimates usually ignore many of the cultural, linguistic and institutional impediments to offshoring. Institutional barriers include "labor market regulations in the home country, such as high statutory severance awards; product market regulations in the home country that restricts, for example, where a service can be provided; and insufficient legal protection for intellectual property in offshore locations" (McKinsey, 2005b). Some of those barriers can be subtle. For example, radiologist positions are popularly assumed offshorable, but a reading of Levy, 2005 suggests that institutional factors greatly limit the offshorability of those positions. Levy reports that the offshored medical images are not "read by cheap foreign doctors," but by "radiologists who are U.S.-board-certified and credentialed in the hospital where the image was taken—a necessity if the firm is to acquire malpractice insurance." In addition to malpractice fears, the other limiting factors that Levy cites are "radiologists' professional power, insurance reimbursement regulations, and the cognitive structure of reading medical images that makes it difficult to monitor offshored work." According to McKinsey, 2005a,

[28] Jensen and Kletzer's results based on a breakdown of occupations are not intuitive. According to that breakdown, production jobs are generally not tradable, while construction jobs are. However, a review of those occupations suggest the reverse. While some production workers may not produce tradable goods (such as dry-cleaning workers), a majority of production jobs do (such as assemblers and machinists). Construction occupations consists of carpenters, cement masons, painters, plumbers, equipment operators and alike—which do not appear to be offshorable.

[29] Some of the limitations listed here should also slow the growth of domestic outsourcing. The latter is much more prevalent than offshoring, which suggests that the reasons related to offshore outsourcing have so far been more restrictive than the ones that apply both to domestic and offshore outsourcing.

management's unfamiliarity with or reluctance toward offshoring are also factors that limit offshoring.

Second, while wages are much lower between the United States and some other countries, actual cost savings tend to be much less than what those wage differentials might suggest, due to additional transaction costs arising from the remote management of work in another country.[30] Those costs make offshoring viable currently only for larger firms. Adjustment costs from changing the existing production processes and the profile of the workforce also reduce the overall cost savings from offshoring.

Third, the above estimates do not take into account the constraints in the supply of qualified workers in the host countries. Workers in many developing countries have lower levels of education than in the United States, and the same level of education might correspond to a lower level of skill. Language skills and cultural impediments can become even more significant without properly qualified workers. According to the estimates of McKinsey's, 2005b study on the labor supply in developing countries suitable for offshoring, qualified and available labor is less, and will stay less, in the medium term than their "theoretical maximum" (i.e., the limit that McKinsey estimates for offshoring).[31]

Finally, the rise of service offshoring took place at a time when the dollar was strong, foreign economies were weak, and the widening of the trade deficit was unprecedented. It is considered inevitable that the U.S. trade deficit will turn around and start narrowing eventually, likely accompanied by a fall in the dollar. A dollar depreciation would slow the growth of offshoring (as well as other imports) and enhance the growth of onshoring (and other U.S. exports).

6.c. Structural Change: A Constant in the U.S. Economy

Service offshoring may eventually become a much more important part of economic life in the United States than it is now, but U.S. occupations have undergone much greater structural changes in the past, without causing mass unemployment or decline in overall living standards. As Blinder notes, agriculture

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[30] "The math of looking only at salaries is just wrong. And it is a prevalent misconception,"says Joseph Feiman of Gartner Inc. (a research firm), as quoted in the New York Times article, "Offshore Jobs in Technology: Opportunity or Threat?", Dec 22, 2003. McKinsey, 2003 estimate the cost savings at 60 percent. While significant, that is smaller than what the wage differentials would suggest.

[31] But the demand-side costs are even more restrictive than qualified labor supply, according to McKinsey. McKinsey's forecast of realized service offshoring for 2008 is 1.2 percent of jobs, not only below their theoretical maximum of 9 percent, but also below their estimate of the qualified labor supply.

accounted for 14 percent of U.S. employment in 1947, but accounts for less than 2 percent today. According to calculations by Nordhaus (1994), under 30 percent of goods and services consumed today were variants of those produced at the beginning of the 20th century. "We travel in vehicles that were not yet invented that are powered by fuels not yet produced, communicate through devices not yet manufactured, enjoy cool air on the hottest days, are entertained by electronic wizardry that was not dreamed of and receive medical treatments that were unheard of." A more recent comparison by Parry (2004) shows that structural changes have continued in recent decades: "about a quarter of today's labor force is in jobs that did not even exist in 1967." That last observation portrays a structural change that has replaced about at least one million jobs a year on average.[32]

Those structural changes are driven by changes in technology, and the pace of technological change does not appear any slower now than in the past. It seems likely that the structure of U.S. occupations will be quite different in a few decades, whether offshoring proves to be important or not.

[32] The actual figure is probably more because even the remaining three quarters of jobs that managed not to disappear probably have a different nature now than they did in 1967. To the extent they are different now than before, the pace of structural change would be greater than this simple calculation suggests.

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Appendix A. Service Offshoring in BEA's Service Imports Data

This appendix discusses in detail the main issues related to the BEA's service imports data used in Section 2. Those data conceptually overlap with service offshoring fairly well. There are some potential differences but those are relatively minor, as discussed in Section A.1. Section A.2 discusses a concern regarding the accuracy of the data that arises from a mismatch between the statistics reported by the BEA and those reported by India. Those concerns do not appear to be important enough to overturn the conclusions drawn from those data in this paper.

A.1. Dissecting Service Imports: Which Categories Are Relevant for Offshoring Concerns?

Virtually all service imports relevant to service offshoring are in the *business, professional and technical services* (BPT) subcategory of *other private services.* All the main service imports categories other than *other private services* are unrelated to offshoring concerns. (U.S. services do not provide close substitutes for those, and they are not the type of imports that are subject to popular concerns.) Those categories are *travel*, *passenger fares*, *other transportation*, *royalties and license fees*, and two categories related to military and other government operations. Those together cover two-thirds of service imports. Within the *other private services* category, which accounts for the remaining one-third of service imports, the subcategories other than BPT are also generally unrelated to service offshoring. Those subcategories of *other private services* are *education*, *insurance*, *operational leasing*, *financial services* (fees and commissions on securities trading, fund management, etc), *telecommunications* (settlements between telecom companies, channel leasing etc—not Indian computer programmers' services), and *other services* (payments for embassy workers, rentals of motion pictures, etc.).

The coverage of the BPT category does not perfectly correspond to offshoring concerns, either. First, some imports included in BPT cannot be considered as service offshoring (such as payments to lawyers for representation in another country's court), which might make BPT imports an exaggerated measure of offshoring. (As mentioned before, that is not a problem for this main conclusion from this data set that the amount of service offshoring is small relative to the U.S. economy.) Second, the BPT category may exclude some imports that could be considered as offshoring: the subcategory *management and advisory services* is not under BPT but under the category of *financial services*, and contains activities some

of which could be considered offshoring, such as imports of advanced financial analysis services. However, the United States imports a small amount in that subcategory and exports much more than it imports. Imports of *management and advisory services* were USD 0.6 billion while exports were USD 7.4 billion in 2004.

A.2. Possible Undercounting of BPT Imports

A source of concern regarding the BPT data is the possible understatement in the U.S. data of BPT imports and, to a lesser extent, BPT exports. Those concerns arise from a major discrepancy between those data and the corresponding series published by India. GAO (2005) reports that the BEA's measures of BPT imports in 2003 from India is about one-twentieth of the measure reported by the Reserve Bank of India (USD 0.4 billion vs USD 8.7 billion). Indian statistics also show discrepancies with other developed country statistics. The Reserve Bank of India reports that India exported to the rest of the world USD 9.6 billion worth of computer and information services in 2002, while imports from India reported by the United States, the European Union, Japan and Canada in that year totaled only USD 0.3 billion (see Table 2.11 in OECD 2004).

A reason for the difference between the U.S. and Indian statistics is that country-by-country statistics that the BEA reports do not include imports from affiliated firms (i.e., from U.S. subsidiary or parent companies in India.)[33] In contrast, the Indian statistics count both affiliated and unaffiliated imports, which is a reason why the U.S. data should show a smaller amount. However, that difference is not likely to be large enough to explain the discrepancy fully. GAO (2005) reports that three-quarters of all U.S. imports of BPT services represented trade within multinational firms.[34] Consequently, once that conceptual difference is accounted for, the difference may decrease to 4- or 5- fold from the original 20-fold, but there would still remain a large discrepancy.

GAO (2005) shows that much of that remaining discrepancy might be accounted for by some methodological approaches adopted by India. First, Indian nationals working in the United States are included in the Indian data, but not in the U.S. data

[33] That is not the case for BPT totals reported in Table 1 — BPT exports and imports in that table cover trade with both affiliated and unaffiliated firms.

[34] That is consistent with the observation in the MLS data that 80 percent of the offshored jobs for which detailed information is available were within the same company (based on Table 4. in Brown and Siegel 2005). Bronfenbrenner and Luce (2004) find that a somewhat smaller percentage, 58 percent, of firms that shifted production abroad did so to a subsidiary company, although that statistics is not weighted by the size of the employment shifts, and it may not include shifts from a U.S. subsidiary to a parent company abroad.

unless those workers have been in the United States for less than a year. Indian officials estimate that this factor accounts for 40 to 50 percent of the remaining difference between the U.S. and Indian data, according to the GAO report. Second, India treats sales to U.S.-owned firms located outside the United States as exports to the United States. The GAO report does not give a specific estimate about the effect of that, but, according to the GAO report, "one high-level Indian official stated that it is likely a significant factor." Finally, some international trade that the BEA classifies (in accordance with international standard practices) as merchandise trade is included in Indian statistics as service trade. An example of those is software embedded on computer hardware. This inclusion on the Indian side is estimated by an Indian official to account for 10 to 15 percent of Indian exports (and a larger fraction of the discrepancy).[35]

The GAO report also identifies that BEA undercounts some imports, but those are not significant. GAO conducted a test of BEA's coverage of importing firms, by making a list of firms based on public sources and checking that list against BEA's list of surveyed importers. The BEA's list did indeed exclude some companies that should have been in the list. However, BEA's comment included in the report states that "BEA did not identify any company with substantial imports of services that were not already being reported to the BEA." The particular GAO test did not appear to have revealed a significant problem in the accuracy of the BPT import data reported by the BEA.

While GAO recommends more work to make sure that BEA's statistics cover all imports properly, the conclusion that the amount of service offshoring is small relative to overall GDP would be robust. Most of the discrepancy is established to be due to the difference in concepts used in Indian exports data, which may not always overlap with the standard international practice. Even if there is undercounting on the part of BEA, given that much of the difference is already accounted for, BEA is not likely to be leaving out more than 60 percent of BPT imports. While 60 percent would be a large degree of undercounting on the part of BEA (which the GAO report does not find evidence for), BPT imports that are reported in Table 1 are small enough that even multiplying them by 2.5 would not alter the conclusion they are small relative to U.S. GDP.[36]

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[35] The account of that difference here largely relies on GAO and BEA. For first-hand information on India's data on trade in services, see Reserve Bank of India (2005).

[36] However, the conclusion that the United States is a net exporter of BPT services would become less certain; BEA is less likely to undercount exporters because the exporters tend to be larger and are easier

Finally, it is possible that Indian statistics are also undercounting. However, the main source data for Indian statistics is NASSCOM, an Indian IT lobby (not a statistical agency itself), and the Indian firms have an incentive not to underreport—their data are used to qualify for certain tax incentives and infrastructure benefits (see GAO 2005). That incentive structure likely discourages underreporting.

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to identify. The lack of a perfect coverage is more likely to plague statistics on BPT imports more than those on BPT exports.

Appendix B. Offshoring in the Mass Layoff Statistics of the BLS

This appendix complements the discussion in Section 2.b, adding to its description of the MLS data and its discussion of what can be learned from them about offshoring. As mentioned in Section 2.b, much of the discussion here relies on the data published by Brown and Siegel, 2005.

B.1. *Possible Biases: the MLS Coverage May Be Unrepresentative of U.S. Layoffs*

The main drawback of the MLS data is that they cover only mass layoffs from relatively large firms, leaving out most layoffs and discharges. It is not clear how that sample selection affects the characteristics of interest — for example, it is not known whether the frequency of offshoring would be higher or lower in mass layoffs than in the layoffs that are left out.

As for the restriction related to the firm size, the MLS data sample leaves out firms that employ less than 50 workers. That restriction might result in an overstatement of offshoring as a reason for layoffs, as offshoring is less likely to be economical for small firms.[37] As for the restriction on the size and intensity of the layoffs, the MLS sample is restricted to layoffs that are concentrated in a short time period; it leaves out layoffs that involve less than 50 workers within a five-week period. That second restriction might result in an understatement of offshoring because firms may prefer to make adjustments associated with movement of work (MOW) more gradually than in other types of separations, whose reasons include company reorganization, bankruptcy, and contract cancellation or completion. On the whole, it is not clear if there is a net bias, and, if there is, in which direction it would go.

The first restriction, that firms employ 50 or more workers, makes the sample 44 percent smaller than otherwise (Brown and Siegel 2005). Adding the second restriction (that layoffs be concentrated within a short-period) reduces the sample by about 90 percent; the MLS recorded only 1.7 million separations in 2003, less than a tenth of the 18.6 million layoffs and discharges economy-wide recorded by the more comprehensive Job Openings and Labor Turnover (JOLTS) survey of the BLS. Those two observations suggest that the second restriction (that layoffs be

[37] The economies of scale in offshoring are mentioned in McKinsey (2005a), and in "*Offshoring Jobs: U.S. and Australian Debates"*, Research Brief by the Department of Parliamentary Services (Parliament of Australia), March 14, 2005.

concentrated within a short period with 50 or more workers) limits the sample somewhat more than the first restriction on the firm size.

Those restrictions may also affect the inferred distribution of offshoring by sector. For example, if manufacturing firms tend to be larger than those in service sectors, that would result in an over-representation of manufacturing in overall layoffs. However, manufacturing accounted for 26 percent of all separations, but 91 percent of the separations that involved movement of work abroad, and even a larger fraction of the separations due to import competition. It seems that if there is a bias from the MLS sample selection to the estimate of frequency of separations, that bias would affect both of those two estimates (26 percent and 91 percent) and would not explain why the latter is so much larger than the former.

B.2. Offshore-related Layoffs in the MLS Data

As mentioned in the text, when the reason for a given layoff is "import competition", or it is due to some other reason but involves movement of work abroad, that layoff is taken to be offshore-related. The MLS does not give a precise number for the separations that involve movement of work (MOW), but rather a range. Brown and Siegel (2005) write that the number of separations involving MOW (domestic or offshore) that the MLS data covered was in "a range of 55,122 to 73,217" in 2004.[38] In the analysis below and in Table B-1, the upper bound, 73,217, is assumed, which may have inflated the estimate of the number of offshored jobs. Detailed information on whether work moved domestically or internationally is available for only 52,400 MOW separations. Those show that 69 percent of the MOWs were domestic movements and 31 percent offshore.[39] The breakdown of the 73,217 MOWs into domestic and abroad is assumed to be also 61 percent and 39 percent, in the same proportion as in the 52,400 MOW separations for which the breakdown is known.

[38] The upper bound, 73,217, is the number of separations involved in all layoff events that involved a MOW, which consisted of 480 MOW actions and (presumably) an unreported number of non-MOW actions. The number of separated workers was specified in 382 of those 480 MOW actions, and those added up to 55,122. (For 52,443 of those 55,122 separations, it was further specified whether the destination was domestic or offshore, making the computation in the previous footnote possible.) The remaining 98 MOW actions for which the number of separations was not specified and the unknown number of non-MOW actions account for the difference between 73,217 and 55,122.

[39] Brown and Siegel (2005) report that, among 52,443 MOW separations for which detailed info is available (i.e., excluding separations with unassigned location), 16,917 (30.9 percent) moved abroad while 32,246 (69.1 percent) stayed within the United States.

There were a total of 1.5 million separations in 2004 covered by the MLS (see Table B-1). About two thirds of those were temporary in nature (separations lasting less than 31 days, separations due to vacation or seasonal reasons, etc), or their reasons were not reported (either by the employer or by the BLS). It is more appropriate to focus on the remaining half a million separations that are likely to have a relatively permanent nature and for which more complete reporting is available. Table B-2 shows that only 5.3 percent of those "relatively-permanent" separations involved movement of work abroad or import competition.

Table B-1
Reasons for Separations in Mass Layoff Statistics

	Total	MOW[a]
Total mass layoff initial claimants	1,464,164	
Separations lasting less than 31days	470,653	
"Extended" separations (lasting more than 31 days)	993,511	73,217
"Extended" but likely temporary, or reason not reported:	476,361	1,179
Seasonal work	334,380	-
Vacation period	17,612	-
Labor dispute	29,935	-
Material shortage	384	-
Weather-related	7,626	-
Plant or machine repair	2,811	-
Reason not reported	78,816	-
Model changeover	2,417	b
Not reported due to BLS disclosure standards	2,380	b
Extended separations that are relatively permanent	517,150	72,038
Bankruptcy	20,119	-
Business ownership change	30,376	3,805
Contract cancellation	18,398	1,362
Contract completed	170,192	621
Financial difficulty	43,220	6,517
Import competition	8,064	3,149
Product line discontinued	7,143	1,766
Reorganization within company	105,482	39,700
Slack work	76,643	3,476
Other	37,513	11,642

Notes:
a. MOW = Movement of work.
b. Does not meet BLS disclosure standards Dash represents zero.
Source: Brown and Siegel (2005). (The grouping of the reasons as "temporary" and "relatively permanent" is by this paper.)

Table B-2
Mass Layoff Statistics Data and Offshoring in 2004

	Total	Share
Extended separations that are relatively permanent	517,150	100.0
Involving MOW[a]	72,038	13.9
Involving MOW abroad[b]	22,249	4.3
Due to import competition	8,064	1.6
Involving MOW	3,149	0.6
Not involving MOW	4,915	1.0
Involving MOW abroad, or import competition	27,164	5.3

Notes:
a. MOW = Movement of work.
b. Assumes that separations for which detailed information is not available have the same rate of breakdown in terms of whether work moved abroad or domestically.
Source: Brown and Siegel (2005) and author's computations.

How permanent are those "relatively-permanent" separations? Davis et. al. (1996) report that "most jobs that vanish over a twelve-month interval fail to reopen at the same location within the following two years" (p.17) — once a job is destroyed, it is not created again for a substantially long time. While a "worker relocation" (or separation) is different from a "job destruction" (firm contraction or closing), much of worker relocations (possibly half) involve firm expansions and contractions.[40] Based on those, it seems likely that the "relatively-permanent" separations identified in Table B-2 have a significant overlap with firm expansions and contractions, and, therefore, are fairly long-lasting.

Going back to the 5.3 percent of separations that were due to import competition or MOW abroad, a great majority (90 percent) of them were in manufacturing, although manufacturing accounted for only 26 percent of the total extended separations in 2004. (Manufacturing accounted for 72 percent of MOWs, 91 percent of MOWs abroad, and even a larger fraction of separations arising from import competition.)

[40] Davis *et al.* (1996) estimate that, given the amounts of 'job reallocation' (job destruction or creation due to firm contractions/closings and expansions/openings) and their estimate of 'worker reallocation' (changes in workers' employment or jobs relative to a year ago) in the manufacturing sector, job reallocations and the ordinary life-cycle turnover (the turnover due to retirements and entry of new workers) together must account for at least 44 percent of worker reallocations. That is a lower bound that assumes each contraction or closing (or expansion or opening) results in no further reshuffling (for example, due to a chain of further quits as displaced workers displace other workers in firms that are not contracting). Such secondary waves would mean job creation and destruction accounts for a larger fraction of labor market turnover (Davis *et al*., 1996, pp.36-37). This finding is based on the manufacturing sector in the period 1972-1988. "Worker reallocations" consider employment changes relative to 12-month earlier, which implies that separations with short duration (such as those that last less than 31 days, or those due to seasonal, vacation, and repair reasons) are likely to be represented less often in worker reallocations than in the MLS.

What would the MLS data imply in terms of number of offshore-related displacements economy-wide? From Table B-2, offshore-related layoffs (layoffs that involve MOW abroad or import competition) accounted for 27,164, or 1.5 percent, of the total 1.5 million separations in the MLS. If that is projected to the 18.4 million layoffs and discharges in 2003 reported by JOLTS, that would amount to 280,000 displacements in a year, both in manufacturing and services.

Appendix C. Offshoring and the Information Technology (IT) Sector

IT occupations have been affected more by offshoring than most other occupations. When those occupations experienced significant employment losses in early 2000s, offshoring was cited as a possible cause. Offshoring may indeed have had a significant effect on IT occupations, in the sense that perhaps IT workers would have been significantly better off without offshoring. However, the main source of the employment loss in IT occupations in the early 2000s was the collapse of the IT boom of the late 1990s. Furthermore, when we look beyond the effect of the technology boom and its collapse, IT occupations as a whole are not in a disadvantaged situation relative to the U.S. average. Those occupations have seen faster wage and employment growth than the average, they have lower unemployment rates than the average, and they make above-average wages. However, looking more closely at individual IT occupations, *computer programmers* appear to be a group that may have been affected by offshoring.

Two occupations that are sometimes considered as IT are not included in IT in this Appendix. First, *data entry keyers* is not an IT occupation in the usual sense — it is an entry level occupation for low-skill workers, where next step is usually an administrative or clerical (i.e., non-IT) job. The other is *computer operators*, whose numbers are falling due to technical change (rather than offshoring) according to the BLS description for that profession.

C.1. The IT Sector Has Experienced A High Degree of Offshoring

Available estimates suggest that IT occupations have accounted for a disproportionately large share of offshoring compared to the size of IT services in the U.S. economy. Stokes (2005) cites Forrester Research's estimate that a quarter of all service offshoring is in the IT sectors. Bednarzik (2005) surveys several studies that estimate annual employment losses of around 50,000 jobs per year (between 34,000 and 65,000). Baily and Lawrence (2004) estimate that rate at 45,000 per year. Given the size of IT workforce, which is around 3 million and had an average growth of 60,000 jobs per year between 1994 and 2004, the offshoring of 50,000 jobs a year may very well have had a measurable impact on IT workers.

Those estimates mostly come from private consultant firms (an exception is the 65,000 estimate by Bhagwati et al, but that estimate is based on NASSCOM's estimate of the increase in personnel in India), and are highly uncertain. Nevertheless, official MLS data show that the IT sector has been more prone than

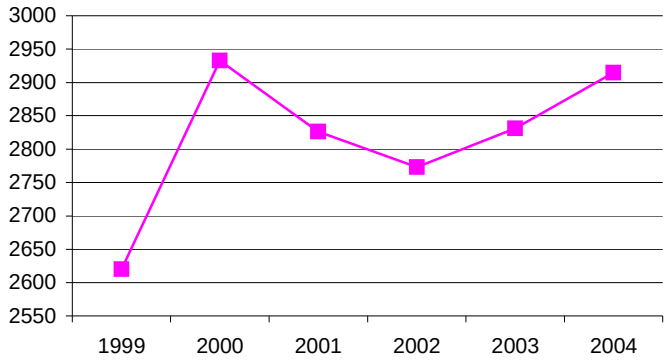
the average sector to layoffs associated with movement of work (within the United States or abroad). In 2004, movement of work was about three to four times as often in mass layoffs in IT-producing industries as in those in the overall nonfarm business sector— 25 percent vs. 7.4 percent.[41] (A breakdown of those percentages into movement abroad and movement within the United States is not available.)

C.2. Employment and Earnings in the IT Sector Have Grown Faster than U.S. Averages Since 1999

The number of jobs in *computer and mathematical occupations*, which were 97 percent computer, network and data related as of 2004 and cover most IT jobs, was 11 percent higher in 2004 than its 1999 level (see Figure 1). Total employment grew 4.3 percent over the same period.

Figure C-1. Employment in Computer and Mathematical Occupations

(Thousands of workers)



Source: BLS Occupational Employment Survey (http://www.bls.gov/oes/oes_dl.htm)

[41] This is based on the following data taken from Brown and Siegel (2005). They report that there were 993.5 thousand jobs lost in extended mass layoff episodes in the private nonfarm sector, of which 73.2 thousand took place in separations involving movement of work (Table B-1). In contrast, the IT-producing industries lost 40.4 thousand jobs, of which 10.3 thousand involved movement of work (Brown and Siegel, 2005, p.6).

Table C-1
IT Employment (thousands)

		Employment by years:					
		(Thousands of workers)					
occ_code	**occ_title**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
11-3021	**Computer and Information Systems Managers**	281	283	267	265	258	267
15-1011	**Computer and Information Scientists, Research**	26	26	26	24	24	25
15-1021	**Computer Programmers**	529	531	502	457	403	412
15-1031	**Computer Software Engineers, Applications**	288	375	362	357	411	426
15-1032	**Computer Software Engineers, Systems**	209	265	262	255	293	318
15-1041	**Computer Support Specialists**	463	523	493	479	481	489
15-1051	**Computer Systems Analysts**	428	463	448	468	486	489
15-1061	**Database Administrators**	101	108	104	102	98	97
15-1071	**Network and Computer Systems Administrators**	205	234	228	233	245	259
15-1081	**Network Systems and Data Communications Analysts**	98	119	126	133	156	169
17-2061	**Computer Hardware Engineers**	60	64	68	*67*	70	75
49-2011	**Computer, Automated Teller, and Office Machine Repairers**	130	142	144	135	143	141
43-9011	**Computer Operators**	199	186	178	173	150	141
43-9021	**Data Entry Keyers**	520	459	405	377	323	314
	ALL OCCUPATIONS	133,501	136,901	136,940	136,482	137,734	139,248
	IT Employment (Above occupations ex. data entry)	3,017	3,319	3,207	3,148	3,216	3,308
	IT Employment (Above occupations ex. data entry keyers and computer operators)	2,818	3,132	3,029	2,975	3,066	3,167

Source: Employment for detailed occupations are from the OES. Total employment numbers are from the household survey.

However, there are IT-related occupations that fall outside the *computer and mathematical occupations* category. The group of IT occupations can be chosen (or 'defined') in different ways, and different definitions can tell different stories. Rather than relying on a particular definition, a better insight can be obtained by looking at detailed IT-related occupation categories, which are shown in Table C-1 for the period 1999-2004.[42] Note that the table shows employment in IT occupations rather than in IT sectors, and that has an advantage because many IT employees work in non-IT sectors. (The table could be extended to earlier years if it used IT sectors instead of IT occupations. However, it would not be showing IT jobs, because IT sectors employ many non-IT workers and leave out IT workers who are employed in other sectors.)

The effect of the technology boom and bust is reflected in Table C-1 by the rise in IT employment from 1999 to 2000, and the fall between 2000 and 2002, in many of the detailed categories. Much of the variation in those years around the 2001 recession is apparently dominated by that technology boom. Focusing on the changes from 1999 to 2004 is helpful for looking beyond the effects of that boom and understanding what the trends in those occupations have been — and whether if those trends show any signs of adverse affects from offshoring. Those changes are shown in Table C-2, which sorts those IT-related occupations by their rate of employment growth from 1999 to 2004. However, it needs to be noted that 1999 was also a good year for the IT sector, and employment changes from 1999 to 2004 still contain an element of coming down from a peak due to the technology bust, which makes employment growth over the period lower than otherwise. (The data do not go back to before 1999, as the classification underlying those data, the Standard Occupational Classification (SOC) system, is relatively recent.) Table C-2 also shows the changes in wages in those occupations from 1999 to 2004 (both in levels and percentages) and the levels in 2004.

[42]The choice of detailed occupations in Table C-1 is based on Bednarzik, 2005, which is similar to that in Department of Commerce, 2003, except that Bednarzik excludes some occupations such as Engineering Managers and Electrical and Electronics Engineers. Those are occupations that have seen above-average employment and earnings growth in the period 1999 to 2004.

Table C-2
Changes in IT Employemt and Wages

		1999-2004 Change			2004 Level	
Occupation Code	Occupation Title	Employment [a]	[b]	Wages [a]	Employment [b]	Wages [c]
15-1081	**Network Systems and Data Communications Analysts**	72	71	2.6	169	$30.5
15-1032	**Computer Software Engineers, Systems Software**	52	109	4.4	318	$39.5
15-1031	**Computer Software Engineers, Applications**	48	138	3.3	426	$37.2
15-1071	**Network and Computer Systems Administrators**	27	55	4.2	259	$29.6
17-2061	**Computer Hardware Engineers**	24	14	4.6	75	$40.4
15-1051	**Computer Systems Analysts**	14	61	3.4	489	$32.9
49-2011	**Computer, Automated Teller, and Office Machine Repairers**	9	11	3.2	141	$17.6
15-1041	**Computer Support Specialists**	6	26	2.0	489	$21.0
15-1061	**Database Administrators**	-4	-5	3.8	97	$30.5
11-3021	**Computer and Information Systems Managers**	-5	-13	5.7	267	$47.2
15-1011	**Computer and Information Scientists, Research**	-6	-2	5.6	25	$42.3
15-1021	**Computer Programmers**	-22	-117	3.7	412	$31.7
43-9011	**Computer Operators**	-29	-58	3.1	141	$15.8
43-9021	**Data Entry Keyers**	-40	-207	3.0	314	$11.7
	ALL OCCUPATIONS	4.3	5,747	3.3	139,248	$17.8
	IT Employment (Above occupations excl. data entry)	9.7	291		3,167	
	IT Employment (Above occupations excl. data entry keyers and computer operators)	12.4	349		3,167	

Source: All the wage data are from the OES, except for the wage change figure for "all occupations", which is based on the change in ECI, Private Wages and Salaries (g:JECIWSP).
a. Percentage change, b. Thousands, c. Dollar per hour.

In Tables C-1 and C-2, two occupations are separated out at the end, and will be left out of much of the remaining discussion. The first one is *data entry keyers*. While that occupation is usually included in the information sector, it is very different than other IT sector occupations in several ways. The work of *data entry*

keyers does not appear to involve the high-level technical skills that are common for IT workers. That occupation, according to the BLS, is typically an entry level job for high school graduates. Accordingly, *data entry keyers* command much lower earnings than other IT workers, which is confirmed in the last column of Table C-2. The next step for workers who move on from that occupation is an administrative job not related to IT, "such as secretary, administrative assistant, or statistical clerk."

The second occupation that will be left out from most of the rest of the discussion are *computer operators*, who, unlike *data entry keyers*, are truly an IT occupation, but exhibit features similar to those of *data entry keyers*, such as lower earnings and lower-level of education than in other IT occupations,[43] and have had declining employment.[44] The BLS attributes the employment decline in *computer operators* to technological change.[45] Both in terms of the skill level of the occupation and the factors that drive the trends in it, the *computer operators* category does not appear likely to help understanding offshoring in IT occupations.

Table C-2 shows that employment in IT service occupations (excluding *data entry keyers* and *computer operators*) grew nearly three times faster than the national average (12.4 percent as opposed to 4.3 percent). However, employment in some IT occupations did not rise. There was a large fall in the number of *computer programmers*, and some declines in three other IT occupations. Those declines may be puzzling given that each of those four occupations enjoyed above-average wage growth (and starting with earnings levels that were already above average), but the reason for those conflicting signs may be compositional effects. Similarly, employment rose very strongly in the category of *network systems and data communications analysts*, but wage growth was not strong, which is suggestive of compositional change.

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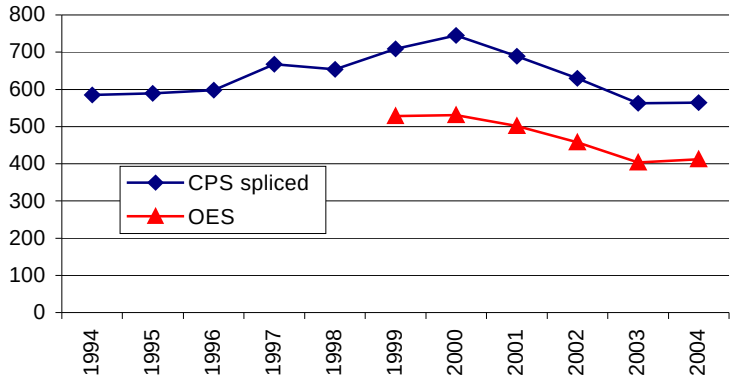
[43] "Computer operators usually receive on-the-job training," according to the description for that occupation at the BLS web site, although "the length of training varies with the job and the experience of the worker."

[44] Those two occupations saw employment falling not only from 1999 and 2004, but also in every year in that period, even between 1999 to 2000 when the other IT occupations were growing strongly. Despite that large employment decline, both occupations showed earnings growth similar to the economy-wide averages (3.0 and 3.1 percent vs 3.3 percent economy-wide). That above-average earnings growth could be due to compositional effects; if low-skill computer operators drop out due to automation while high-skill ones stay, average earnings in that category could rise even if each worker's earnings stayed the same.

[45] "Computer operators rank among the most rapidly declining occupations over the 2004-14 period because advances in technology are making many of the duties traditionally performed by computer operators obsolete," according to the BLS website.

Among those three occupations with falling employment, *computer programmers* may indeed have done worse than the average U.S. worker (in terms of employment opportunities and earnings), although it is not possible to determine that conclusively with the available data. One factor is that 1999 was close to the peak of the technology boom, and the employment decline in that occupation between 1999 and 2004 could be partly due to the collapse of that boom. Data from the CPS measure of that occupation, which goes back farther in time, confirms that intuition; some of the large decline between 1999 and 2004 was indeed due to the collapse of the IT boom (see Figure 2).[46] (It appears, though, that similar extensions for the other three occupations that lost employment would likely reverse the conclusion that they did so.) However, employment of *computer programmers* in 2004 was below its 1994 level, confirming the downward trend in employment in that occupation, at least relative to the rest of the economy. Furthermore, the BLS description acknowledges that downward trend, attributes it to technical change as well as offshoring, and forecasts it to continue in the future. However, it is not clear how much each of those two factors (offshoring and technical change) is responsible in that occupation's declining employment. Moreover, the growth of *computer programmers*' earnings was above-average over the period, which makes it difficult to reach a strong conclusion that *computer programmers* have had it worse than the average U.S. occupation in those years.

Figure C-2. Employment of Computer Programmers
(thousands of workers)



Source: BLS, the Current Population and Occupational Employment surveys.

[46] CPS measure uses a less exact survey on occupations, and is therefore not preferred although it goes further back in time.

Appendix D. An Assessment of the Limits of Service Offshoring

This section provides additional detail on this paper's assessment that a plausible range for the limits of service offshoring is 10 to 20 percent of current U.S. jobs. That assessment relies on an examination of the detailed occupations of the Occupational Employment Survey (OES), which details 803 occupations, covering all jobs except self-employed and household workers. (The OES sample size was 128 million workers in 2004, a year when civilian employment was 135 million.) The review of occupations is limited to the larger ones that employed more than 0.1 percent of workers. There were 212 such occupations, accounting for 83 percent of the total employment covered by the survey. There is no obvious bias in the excluded smaller occupations towards too much or too little offshorability. Altogether, about a fifth of jobs were left out of the analysis, either because they were in small occupations, or were self-employed or household jobs and therefore not included in the sample. Those excluded occupations are assumed to have the same rate of offshorability as the reviewed four-fifths of jobs, although many of those left-out jobs (such as those in lawyers' offices, dental practices, and small convenience stores) may not be offshorable.

For each of those 212 occupations, a judgmental estimate (with only one digit after the decimal) is made for the share of offshorable jobs for that occupation. For example, consider one of the largest detailed occupations, *retail salespersons*, which employed 3.2 percent of the work force in 2004. Most retail jobs require the employee work face-to-face with the customer, and therefore appear not suitable to be performed remotely. Although some retail work is done online and retail jobs in that segment are potentially offshorable, that share is minor. It could be argued that the online retail portion will become more pervasive over time, and thereby a larger share of retail sales jobs will become offshorable in the future. In fact, Blinder (2006) takes into account such possible increases in estimating the future limit of offshoring, resulting in a higher estimate than in here. However, such possible future increases are not taken into account in this section, as the estimate here aims to quantify the share of the *currently* existing U.S. jobs that could (in principle) be offshored. Consequently, it is assumed in the assessment that the share of offshorable jobs in the *retail salespersons* category is only 0.1 (10 percent), to account for the current small share of online retail sales jobs.

An important source of uncertainty here, of course, is the use of pure judgment in assessing the offshorability of individual occupations. Nevertheless, those

judgments may not be causing much uncertainty for the estimated aggregate share. To see why, consider the following exercise. The standard deviation of offshorable share in each occupation cannot be greater than 0.5, because 0.5 is the largest standard deviation that a random variable ranging between 0 and 1 can have. Assign that large value of uncertainty for a given occupation if the offshorable share in that occupation is estimated as 0.5 (50 percent). If the estimated share is closer to 0 or 1, that is a sign that *some* information is available about that occupation, and a standard deviation smaller than 0.5 would be warranted. Therefore, closer the estimated share for the occupation is to 0 or 1, assume a standard deviation that is closer to zero. For example, assume the standard deviation of 0.15 when the estimated share is 0 or 1 in a given occupation, and increase the assumed standard deviation linearly with the difference between the estimated share and 0.5. Thus, the assumed value of the standard deviation of the estimate for a given occupation would vary between 0.15 and 0.5. This uncertainty estimate can also be considered generous: when the estimated share is 0.2 or 0.8, the assumed standard deviation for that estimated share would be 0.29, the same as the standard deviation of a random variable distributed uniformly between 0 and 1. The latter would be the distribution for a random variable for which we know nothing except that it is a number in the unit interval. Given that the estimated share is 0.2 or 0.8 only when there is some idea about the occupation in question as to how suitable it is for offshoring, the assigned standard deviation can be considered generous. The individual standard deviations can then be used to calculate the uncertainty of the aggregate estimate. The foregoing is what is done to calculate the standard deviation of the final estimate, which yields the result that the 90 percent confidence band for the aggregate estimate the 10 to 20 percent.

Going back to the example from retail jobs, although further research could have been done into the nature of those jobs to obtain a better estimate, the foregoing analysis reveals that relying on the "law of large numbers" (that the percentage uncertainty in estimates for components round out to a lesser percentage uncertainty in total) produces a satisfying answer. For example, while the estimated number of offshorable jobs in *retail salespersons* is 413,000, the standard deviation of that estimate is 826,000, nearly twice as large as the estimate itself. However, in the aggregate, while the estimated number of offshorable jobs is 18.7 million, the standard deviation of that estimate is 2.7 million, about one-seventh of the estimate itself. Since the estimation covers a fairly large number of occupations, the law of large numbers ensures a reasonably tight distribution for the final estimate, as long

as the estimates of the offshorable share of jobs within occupations are not biased. In other words, it is not very important that the judgments for individual occupations are accurate, although it is important that those judgments are made without bias by the researcher doing the review.