4-1-2007

Outsourcing, Offshoring, and Productivity Measurement in U.S. Manufacturing

Susan N. Houseman
W.E. Upjohn Institute for Employment Research, houseman@upjohn.org

Upjohn Author(s) ORCID Identifier:
https://orcid.org/0000-0003-2657-8479

Upjohn Institute Working Paper No. 06-130

Published Version

In International Labour Review 146 (1-2): [61]-80

Citation

Houseman, Susan N. 2006. "Outsourcing, Offshoring, and Productivity Measurement in U.S. Manufacturing." Upjohn Institute Working Paper No. 06-130. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research. https://doi.org/10.17848/wp06-130

Outsourcing, Offshoring, and Productivity Measurement in U.S. Manufacturing

Upjohn Institute Staff Working Paper No. 06-130*

Susan Houseman
W. E. Upjohn Institute for Employment Research

June 2006
Revised September 2006
Revised April 2007

Abstract

I discuss reasons why manufacturing productivity statistics should be interpreted with caution in light of the recent growth of domestic and foreign outsourcing and offshoring. First, outsourcing and offshoring are poorly measured in U.S. statistics, and poor measurement may impart a significant bias to manufacturing and, where offshoring is involved, aggregate productivity statistics. Second, companies often outsource or offshore work to take advantage of cheap (relative to their output) labor, and such cost savings are counted as productivity gains, even in multifactor productivity calculations. This fact has potentially important implications for the interpretation of productivity statistics. Whether, for instance, productivity growth derives from a better-educated, more efficient U.S. workforce, from investment in capital equipment in U.S. establishments, or from the use of cheap foreign labor affects how productivity gains are distributed among workers and firms in the short term and undoubtedly matters for U.S. industrial competitiveness and living standards in the long term. Although it is impossible to fully assess the impact that mismeasurement and cost savings from outsourcing and offshoring have had on measured productivity growth in manufacturing, I point to several pieces of evidence that suggest it is significant, and I argue that these issues warrant serious attention.

I am grateful to Katharine Abraham, Mike Harper, Peter Meyer, Anne Polivka, Ken Ryder, Larry Summers, Lisa Usher, Robert Yuskavage, and seminar participants at the Federal Reserve Bank–Chicago for comments on an earlier draft of this paper, and to Mary Streitweisser and James Franklin for supplying detailed information on the construction of BEA's input-output estimates and their use in productivity calculations. Lillian Vesic-Petroic provided excellent research assistance. Any remaining errors as well as the views expressed in this piece are my own.

JEL Classification Codes: D24, D33, O47, J24

*A revised version of this paper will appear in *International Labour Review.*

Employment in U.S. manufacturing began declining steadily in the late 1990s, and the decline accelerated dramatically after 2000. Manufacturing employment was 19 percent lower in 2005 than in 1998, even though manufacturing output was 10 percent higher. One bright spot for U.S. manufacturing has been its extraordinary growth in productivity. The rate of productivity growth in U.S. manufacturing increased in the mid-1990s, greatly outpacing that in the services sector and accounting for most of the overall productivity growth in the U.S. economy. In a comparison with 14 other industrialized or newly industrialized countries, manufacturing productivity growth in the United States over the last decade was greater than that in all but two countries (BLS 2006, Table B). These strong productivity statistics have been taken to imply that what remains of U.S. manufacturing is highly competitive in international markets and provides a solid basis for improvement of American workers' living standards.

The drop in manufacturing employment coincided with an increase in outsourcing to domestic contractors, including staffing services, and an increase in outsourcing of materials and services inputs to foreign companies or affiliates, commonly known as offshoring. Outsourcing and offshoring might plausibly result in higher productivity. For instance, companies might use staffing agencies to more closely match worker use with actual production needs (Abraham 1990; Ono and Sullivan 2006) or outsource noncore functions to domestic or foreign contractors with greater expertise in these areas (Erickcek, Houseman, and Kalleberg 2003). Mann (2003) notes that the offshoring of much of the production in the IT sector resulted in lower prices of high tech equipment, which, she argues, stimulated the diffusion of high-tech equipment and the gains in productivity in the U.S. economy. Amiti and Wei (2004, 2006) also report evidence of a strong link between services offshoring and manufacturing productivity growth.

However, the coincidence of U.S. productivity growth with the growth of outsourcing and offshoring has also raised concerns that strong productivity growth since the mid-1990s, particularly in manufacturing, is misleading and its implications misinterpreted. Most analysis focuses on labor productivity measures, which in U.S. manufacturing are defined as constant dollar shipments divided by hours worked by manufacturing employees. When manufacturers outsource or offshore work, labor productivity increases directly because the outsourced or offshored labor used to produce the product is no longer employed in the manufacturing sector and hence is not counted in the denominator of the labor productivity equation. A 2004 study by the U.S. Bureau of Labor Statistics (BLS) sought to allay concerns that the accelerated growth in manufacturing labor productivity was being driven in a mechanical way by outsourcing and offshoring. It found that the contribution to manufacturing productivity growth from purchased services and materials-input purchases, which include domestic outsourcing and materials and services offshoring, actually declined over the 1990s. The study thus concluded that outsourcing and offshoring could account for none of the acceleration of productivity growth witnessed in the latter half of the decade (BLS 2004).

In this paper I raise questions about the conclusion of that study. I argue that even multifactor productivity measures, which were used in the BLS study and are designed to account for all inputs, should be interpreted with caution for two fundamental reasons. First, measurement of outsourcing and offshoring in U.S. statistics is poor. I present evidence that existing statistics greatly understate outsourcing by U.S. manufacturers to temporary help and related staffing agencies and thus may have missed much of manufacturers' extensive outsourcing to this sector in recent years. Recent government reports have raised similar concerns that data understate offshoring activities of U.S. companies because of the difficulty of accurately measuring the prices and quantities of imported inputs (GAO 2004; National Academy of Public Administration 2006).

Second, besides greatly complicating the measurement of inputs needed to compute productivity statistics, outsourcing and offshoring may significantly alter what is counted as a productivity gain. Companies often are motivated to outsource to domestic and foreign contractors or affiliates in order to exploit cheap (relative to their output) labor. Although such cost savings do not accord with common perceptions of what constitutes productivity improvements, they are recorded as productivity gains in multifactor productivity calculations. Such cost savings likely are increasingly being captured in productivity statistics, and, with the growth of materials and services offshoring, affect not just sector but also aggregate productivity statistics.

Yet, this source of productivity growth and its implications are rarely noted in the productivity literature.[1] The implications for who benefits from measured productivity growth are obvious and potentially important. While any cost savings from outsourcing and offshoring are counted as productivity gains, outsourcing and offshoring simultaneously place downward pressure on manufacturing workers' wages. Understanding the source of productivity gains is also important for understanding the implications of manufacturing productivity statistics for that sector as well as for the aggregate economy. Whether productivity growth derives, for instance, from better-educated U.S. workers working more efficiently, from U.S. companies investing in high-tech capital in U.S. establishments, or from U.S. companies offshoring materials and services inputs to exploit cheap foreign labor no doubt matters for the long-term competitiveness

[1]Slaughter (2002) links productivity growth in the high-tech sector to the growth of global production networks and notes the low cost of foreign labor as one source of productivity gains. He does not develop the implications of this point, however. I am unaware of other work discussing labor cost savings from materials and services offshoring as a source of measured productivity growth.

of the U.S. economy and living standards of American workers, albeit in ways that currently are poorly understood.

Although it is impossible to determine the extent to which mismeasurement of inputs and these types of labor cost savings from outsourcing and offshoring have contributed to the recent growth of measured manufacturing productivity, I point to several pieces of evidence indicating that these factors are significant: 1) apparent understatement of the contribution of manufacturers' outsourcing to the staffing sector in previous productivity statistics (Dey, Houseman, and Polivka 2006); 2) findings that services offshoring, which is likely to be significantly underestimated and associated with significant labor cost savings, accounts for a surprisingly large share of recent manufacturing multifactor productivity growth (Amiti and Wei 2006); and 3) the small high-tech sector, which pioneered the development of global production networks and outsourced much of the work performed domestically, accounted for about a third of multifactor productivity growth in the U.S. economy in the late 1990s. Together, this evidence makes a prima facie case that mismeasurement and labor cost savings from outsourcing and offshoring have significantly influenced measured manufacturing and, in the case of offshoring, aggregate productivity growth. These issues, I argue, warrant further study.

THE CONCEPT OF PRODUCTIVITY AND ITS MEASUREMENT

Productivity may increase because of an improvement in workers' efficiency: workers can produce more output with any given amount of other inputs. Reduction of slack time through more efficient assignment of workers to tasks is one example of how productivity may increase through this channel. Productivity may also increase because of technological improvements, typically embodied in capital equipment, which allow for the production of more output with any given amount of labor and other inputs. The rapid development of computer technology and associated automation, for instance, is widely believed to have fueled productivity growth in developed economies in recent years. Both sources of productivity growth accord with popular conceptions of what productivity improvements capture.

Although the broad concept of productivity is easy to understand, measuring productivity in a sector or in the aggregate economy is complex. Two types of productivity statistics are computed: labor productivity and multifactor productivity. Below, I discuss how these two productivity measures are constructed for the U.S. manufacturing sector.

Measurement of Labor Productivity in U.S. Manufacturing

Most analysis focuses on labor productivity, which in U.S. manufacturing is computed as

$$\frac{Q_t}{Q_0} \div \frac{L_t}{L_0}, \qquad (1)$$

where $\frac{Q_t}{Q_0}$ is the index of output in the current period (current period output divided by output in the base period) and $\frac{L_t}{L_0}$ is the index of labor in the current period (current period labor input divided by labor input in the base period). Output in the manufacturing sector is measured as the value of shipments, in constant dollars, from manufacturing establishments adjusted for inventory change and net of intra-industry shipments—i.e., shipments from one manufacturing establishment to another.[2] Labor input is measured as the simple sum of hours worked by employees of manufacturing establishments. The growth in labor productivity across periods, is computed as

[2] The output measure for U.S. manufacturing productivity statistics does not net out purchased material and services inputs, and thus it differs from the value-added concept of output used in the construction of U.S. aggregate business-sector labor productivity statistics. In the treatment of outsourced and offshored material and services inputs, the labor productivity measures for the aggregate economy are more analogous to the multifactor productivity measures discussed below.

(2) $$\ln\left(\frac{P_t}{P_{t-1}}\right) = \ln\left(\frac{Q_t}{Q_{t-1}}\right) - \ln\left(\frac{L_t}{L_{t-1}}\right).$$

Thus, the percent change in productivity over time equals the percent change in output less the percent change in labor input, measured by hours worked.[3]

This simple measure of labor productivity has well-recognized limitations that make it difficult to interpret. Increases in measured labor productivity may reflect the ability of workers to produce more with given amounts of other inputs, or they may reflect technological improvements—both of which accord with common conceptions of what drives labor productivity growth. Alternatively, increases in measured labor productivity may simply reflect the substitution of other inputs for labor. Of particular relevance to this paper, the outsourcing of labor to domestic contractors such as temporary help agencies or to foreign companies or affiliates will be measured as labor productivity gains rather than as the substitution of manufacturing labor for labor located in a different sector or in a different country.

Multifactor Productivity Measures (KLEMS)

Multifactor productivity measures are designed to address this shortcoming of labor productivity measures. KLEMS—which stands for capital (K), labor (L), energy (E), materials (M), and purchased business services (S)—is the multifactor productivity measure developed for U.S. manufacturing.[4] KLEMS measures of U.S. manufacturing productivity have been computed on an annual basis for the 1987-to-2004 time period. Conceptually, KLEMS measures

[3] Taking the natural logarithm of a ratio approximates the percent difference of the numerator from the denominator.

[4] The methodology used for computing multifactor productivity for the private business sector is somewhat different than that used for manufacturing. For a discussion of the methods and sources used in computing various multifactor productivity statistics, see BLS (1997).

not the change in labor productivity per se, but rather the change in productivity to all inputs used in the production process collectively. KLEMS is computed as

$$(3) \qquad \ln\left(\frac{A_t}{A_{t-1}}\right) = \ln\left(\frac{Q_t}{Q_{t-1}}\right) - \left[w_k\left(\ln\frac{K_t}{K_{t-1}}\right) + w_l\left(\ln\frac{L_t}{L_{t-1}}\right) + w_{ip}\left(\ln\frac{IP_t}{IP_{t-1}}\right)\right],$$

where $\ln\left(\frac{A_t}{A_{t-1}}\right)$ denotes the change in multifactor productivity. As with the manufacturing labor productivity measures, output in KLEMS, Q, is constant-dollar shipments net of inventory change and intraindustry shipments, and L is the summation of labor hours. The measure of capital input is based on the flow of services from capital equipment, structures, land, and inventories. Intermediate purchases (*IP*), which include material and energy inputs and purchased business services, are generally measured as current dollar values deflated by appropriate prices. To compute multifactor productivity, the various inputs—or in this case log changes to the inputs—must be aggregated in some way: labor hours must be aggregated with purchased material inputs (such as kilowatt hours of energy consumed), purchased business services, and so forth. The weights used in the multifactor productivity calculations—w_k, w_l, and w_{ip}—are computed as the average share of production costs in adjoining periods t and $t-1$. Thus, the percent change in multifactor productivity simply equals the percent change in output less a weighted average of the percent change in all inputs, where the weights represent the average factor shares in the two periods.

While the use of factor cost shares is an intuitively plausible way to weight the percent changes of separate categories of inputs, under certain stringent assumptions such an aggregation has a theoretical justification. These assumptions, taken from a simple general equilibrium model, include the supposition that all factors are paid their value marginal products—that is, the wage or payment made to an input factor reflects the value of output that an additional unit of the input would generate. As I argue below, however, productivity statistics capture a dynamic adjustment process for which such a simple general-equilibrium theoretical framework is likely to be particularly inapplicable and, where there is widespread substitution between input categories, complicate the interpretation of productivity statistics.

POTENTIAL PROBLEMS OUTSOURCING POSES FOR MULTIFACTOR PRODUCTIVITY MEASURES

Significant increases in outsourcing to domestic contractors or in offshoring parts of the production process to foreign companies or affiliates raise at least two concerns about multifactor productivity statistics in manufacturing. One is purely a measurement issue. The second is a more fundamental methodological issue concerning precisely what the productivity index measures.

Measurement Issues

Manufacturers that outsource functions reduce their own labor and capital inputs and increase purchased inputs. The accuracy of multifactor productivity measures requires that changes in purchased inputs be fully captured in the data. In the case of domestic and international outsourcing, however, these purchased inputs are not well measured. Collection of detailed data on inputs used by industries is difficult and expensive, and thus statistical agencies historically have focused their greatest resources on accurately measuring inputs deemed most important, like energy usage. Although the U.S. Bureau of Economic Analysis (BEA) generates input-output tables that provide a comprehensive set of estimates of commodity use for all industries, these estimates are only as good as the underlying survey data, which often are thin. The crudeness of certain input estimates would not matter for productivity calculations as long as little substitution to or from these inputs is occurring. However, the growth of domestic and foreign outsourcing has raised concerns that inaccurate measurement of these inputs results in inaccurate measurement of productivity growth in various sectors and, particularly where there is foreign outsourcing, inaccurate measurement of productivity growth for the aggregate economy.

Here I present direct evidence that an important component of domestic outsourcing by manufacturers—the use of employment services, composed primarily of temporary help and leased employees—has been greatly underestimated in the statistics that generate KLEMS measures, potentially leading to an overstatement of productivity growth in U.S. manufacturing. In addition, I review reasons why government statistics likely understate offshoring and thus overstate productivity estimates for sectors and the aggregate economy.

In constructing KLEMS productivity statistics, BLS bases its estimates of employment services input to manufacturing on benchmark input-output (I-O) tables constructed by the BEA every five years; the most recently available benchmark tables are for 1997.[5] In the 1997 benchmark I-O tables, the estimate of manufacturers' use of employment services was not based on direct evidence, but rather was imputed from data collected in the Business Expenses Survey (BES), which is administered to companies in the wholesale, retail, and services sectors. Companies completing the survey were asked to report their expenditures on contract labor, defined as "persons who are not on your payroll but are supplied through a contract with another company to perform specific jobs (e.g., temporary help, leased employees)." It was assumed that companies answering this question reported expenditures on six types of contract services—temporary help services, employee leasing services, security guards and patrol services, office administrative services, facility support services, and nonresidential building cleaning services—and thus these services were treated as a bundled commodity. Data on industry output in each of

[5] BLS estimates annual I-O tables from these five-year benchmarks. The 2002 benchmark I-O tables will be available in 2007.

these contract labor services industries came from the Economic Census and were aggregated to match the level of (assumed) commodity aggregation in the BES. The residual of the contract-labor services not accounted for by industries surveyed in the BES was imputed to industries not surveyed in the BES based on their output shares. To generate I-O estimates at a more disaggregated commodity level, it was assumed that industries utilized all contract labor services in the same proportion. For instance, if an industry was estimated to use 10 percent of all contract labor services, it was assumed to use 10 percent of each of the component contract services.

While such an imputation would result in imprecise estimates of manufacturers' expenditures on employment services, these estimates also may be biased for several reasons. Because evidence shows that manufacturers are disproportionately heavy users of staffing services, the assumption that industries not surveyed in the BES utilize all contract labor services in proportion to their output will result in an underestimate of staffing services for manufacturing. In addition, the BES data only provide information on expenditures. Output prices are estimated from input prices in user industries, which tend to overstate prices, understate quantities of inputs purchased, and hence overstate multifactor productivity growth (BLS 1996). Moreover, contract labor is not clearly defined in the BES and arguably could include a larger set of contract work than assumed in the construction of the BEA I-O tables. If this is the case, estimates of all contract labor services utilized by manufacturers would be systematically understated.

Available information indicates substantial bias in the imputation of the employment services input to manufacturing. Estimates from the five Contingent Worker Supplements to the Current Population Survey (CPS) show that 35–40 percent of temporary help agency workers were assigned to manufacturing in the 1995–2005 period; Dey, Houseman, and Polivka (2006) estimate that 27–33 percent of employment services workers were assigned to manufacturers over the 1989–2004 period. These figures contrast with the much lower estimates that only about 15 percent and 5 percent of employment services output was assigned as an input to the manufacturing sector in the 1992 and 1997 benchmark I-O tables, respectively. The large decline in the fraction of employment services output imputed to manufacturing is particularly striking given evidence that manufacturers greatly increased their utilization of these services during that period (Segal and Sullivan 1997; Dey, Houseman, and Polivka 2006).

Government data used to estimate offshoring activities come from several sources. U.S. trade statistics furnish detailed information on the importation of material goods, which BEA imputes to end users in its I-O tables. The BEA conducts benchmark and annual surveys of cross-border trade in services with unaffiliated foreigners. A separate BEA survey collects information on cross-border trade with affiliated foreigners. Reporting of service transactions with unaffiliated foreigners is only required if the transaction exceeds $1 million or with affiliated services if the affiliate’s assets, sales, or net income exceed $30 million, raising concerns that services offshoring is significantly understated (GAO 2004). Additional information about potential offshoring activities can be gleaned from data collected by the BEA on U.S. multinational companies, which report foreign direct investments and information on outsourced intermediate goods and services from domestic and foreign sources combined. Recent reports by the GAO (2004) and the National Academy of Public Administration (2006) have described gaps in data collection, benchmarking that occurs infrequently, and the lack of accurate price data with which to estimate the quantity of imported services. These and other factors detailed in the reports may contribute to unreliability and underestimates of goods and services offshoring.

Methodological Issues

> *Pick something to move offshore today . . . [In India you can get] quality work at 50 to 60% of the cost. That's two heads for the price of one.*
>
> —Microsoft senior vice-president Brian Valentine, quoted in Lazonick (forthcoming)

The second concern with the productivity estimates is more fundamental and relates to the construction of these numbers and what counts as a productivity gain. As noted above, the multifactor productivity calculation in Equation (3) can be derived from a simple general equilibrium model. For the multifactor productivity numbers generated from Equation (3) to have a clean theoretical interpretation, the assumptions of this general equilibrium model must hold, including the assumption that all factors are paid their marginal product and hence that differences in factor prices solely reflect differences in factor productivity.[6] Although such simplifying assumptions are perhaps necessary to construct a tractable model for the purposes of estimating aggregate productivity statistics, such a general equilibrium model arguably is ill-suited for capturing the dynamic adjustment process that intrinsically underlies productivity changes. The model's assumptions are not innocuous.

As the above quotation illustrates, an important reason manufacturers outsource or offshore work is to save on labor costs. Because of technical innovations, removal of barriers to trade, or some other market change, it may become profitable for companies to engage in factor

[6] The assumption that factors are paid their value marginal product, in turn, derives from assumptions that product, labor, and other input markets are perfectly competitive, that inputs are substitutable in the production process, and hence that these marginal values are observable. The model also assumes that the production process is characterized by constant returns to scale.

price arbitrage, exploiting differences in the cost of hiring labor across sectors within the country or across countries. A unionized company or a company with historically high labor costs may utilize a staffing agency to lower wages, benefits, workers' compensation, and other nonwage labor costs. This strategy is exemplified in recent agreements between the Ford Motor Company and its employees' union, the United Auto Workers, to utilize staffing agency workers at its plants to handle low-skilled work (McCracken 2007). Staffing agency workers earn a fraction of the wages and benefits of direct-hire unionized employees. The documented growth in imported material inputs and the offshoring of services is widely attributed to the lower costs of skilled and unskilled foreign labor and to technological changes and the removal of trade barriers, which allow companies to exploit these lower labor costs. If, for instance, a company substitutes lower-cost, but equally productive, contract (foreign or domestic) labor for its own employees, output per worker hour will not have changed from the company's perspective, but cost savings from the shift to contract labor will be counted as a net reduction in inputs used and thus a productivity gain (Equation [3]). This occurs because contract labor is treated as a separate input (*IP*) from employees hired directly by the company (*L*), and when the company substitutes contract for direct-hire labor, the increase in the cost share of contract labor (w_{ip}) does not match the reduction in the cost share of direct-hire labor (w_l).[7]

In practice, a company may lower costs by shifting to less productive but substantially lower-cost contract labor, and from the company's perspective output per worker hour would fall, but measured productivity in Equation (3) would rise. Such a case is nicely illustrated in a recent report by McKinsey & Company (2006), which compares the research and development

---

[7] Although this article pertains to manufacturing productivity, it is also the case that pure labor cost savings from offshoring are likewise measured as productivity gains in the value-added concept of labor productivity and in multifactor productivity measures for the aggregate economy.

costs that Cisco Systems, (the world's leading producer of networking equipment) incurs by developing switching routers through its own U.S.-based engineers with the costs incurred by outsourcing the research and development to a Chinese company, Huawei Net Engine. According to McKinsey & Company's estimates, the amount of work hours required by Huawei's engineers to develop the product is roughly double that required by Cisco engineers, but because labor costs of Chinese engineers are dramatically lower than those of American engineers, McKinsey estimates that the cost of R&D in China is about one-fifth that in the United States. If Cisco outsourced the R&D to China and actual work hours were measured as labor input, labor and multifactor productivity would fall. However, because Chinese contract labor is treated as a separate input and weighted by its cost share, multifactor productivity measures increase.

Institutional barriers or other types of adjustment costs typically would preclude the profit-maximizing firm from instantaneously shifting all of a particular type of labor input from direct-hire employees to lower-cost contract labor, even if this was the profit-maximizing outcome in the end. What we observe in practice is the shift in staffing patterns over time away from direct-hire employees toward contract labor. Note that even if one assumes, as is consistent with neoclassical economic assumptions, that the cost of using contract labor, including adjustment costs, equals its value marginal product for the "marginal" or last hired worker at each point in time, the shift in staffing patterns presumably would result in some cost savings to the firm; formally, the firm would realize labor cost savings on the "inframarginal" contract labor that it hires. And in Equation (3) such cost savings will be counted as a productivity gain because, in aggregating across inputs, direct-hire labor and contract labor are weighted by their cost shares, and the decline in the cost share of the former will exceed the rise in the cost share of the latter.

Should such cost savings be counted as productivity gains? As such gains are traditionally defined in manufacturing productivity statistics, the answer is probably no. Currently, the measurement of labor input in productivity statistics somewhat artificially depends on the legal status of the employment relationship. As noted above, a company could save money by outsourcing labor but use more labor hours to produce the same output. Particularly in the case of foreign outsourcing, however, one might argue that such cost savings represent a net gain in resources for the company, the sector, or the aggregate economy. For instance, the ability to exploit cheap (relative to workers' hourly output) foreign labor might be seen as a productivity gain that results from technical innovations that reduce transportation and communication costs, although imperfections in product and input markets and the transfer of technology and know-how resulting from trade may erode net gains to the economy as a whole.[8]

Even if it is desirable to measure outsourced labor as labor rather than as a separate intermediate input in productivity statistics, as a practical matter it would be difficult and in some cases impossible to do so. These different input categories must be aggregated, and the use of cost shares is a straightforward, intuitively plausible way to do so. It should be recognized, however, that current productivity measures include savings that result purely from lower hourly costs of outsourced labor, and that this fact has potentially important implications for the

[8] For instance, if workers who are displaced by offshoring experience significant unemployment spells or other costs in finding new jobs, and if those costs are not taken into account by companies in their decision to offshore tasks, the net gain to the American economy from offshoring would be less than the gain realized by the companies engaged in offshoring. Samuelson (2004) argues that over time free trade can result in a deterioration in a country's terms of trade and hence lower its welfare if the trade promotes technological and productivity gains among the country's trading partners. This type of logic is commonly used to argue that developed countries will not necessarily benefit from the globalization of production if such trade promotes skill development and technological progress in countries such as India and China. For a discussion of worker dislocation costs and a rebuttal to Samuelson's argument, see OECD (2006).

interpretation of measured productivity gains and how these gains are distributed among workers and capital.

THE EFFECTS OF OUTSOURCING ON PRODUCTIVITY MEASUREMENT IN MANUFACTURING: SOME SUGGESTIVE EVIDENCE

As is evident from the above discussion, the growth in outsourcing or offshoring likely will lead to an increase in measured productivity in manufacturing, even in the KLEMS multifactor productivity measures. Poor measurement of domestic and foreign outsourcing may result in systematic understatement of the amount of outsourcing that occurs in aggregate or in the manufacturing sector. Moreover, the use of factor cost shares to weight the growth of factor inputs implies that unless differences in factor payments solely reflect differences in the value added by these factors of production, an assumption that is particularly unrealistic in the case of domestic and foreign outsourcing, cost savings that result purely from the lower prices of outsourced labor will be counted as productivity gains. This fact has potentially important implications for the interpretation of productivity statistics. These effects on measured productivity would be of little concern if they were empirically small. Although I have no definitive information on the size of the effects, I present evidence that suggests they are significant and warrant serious attention.

The Contribution of Staffing Services Outsourcing to Manufacturing Productivity

The first piece of evidence pertains to the effect of manufacturing's outsourcing to employment services on manufacturing productivity estimates. Matthew Dey, Anne Polivka, and I have constructed annual estimates of workers from staffing agencies (the employment services industry) that were assigned to manufacturers from 1989 to 2004, using data from the

Occupational Employment Statistics (OES) program, the Current Employment Statistics (CES) program, and the Contingent Worker Supplements to the CPS (Dey, Houseman, and Polivka 2006). We estimate that the number of workers in the employment services sector grew from 419,000 in 1989 to a peak of more than 1.4 million in 2000. In relative terms, employment services workers added an estimated 2.3 percent to manufacturing employment in 1989 and an estimated 8.2 percent in 2000. From 2000 to 2001 employment services bore a disproportionate share of the employment reductions in manufacturing. Following 2001, staffing services assigned to manufacturing expanded while employment in manufacturing continued to decline sharply. As a result, we estimate that by 2004 employment services added 8.7 percent to manufacturing employment, although the number of employment services workers in manufacturing was still below its peak level of 2000. In other words, our estimates indicate that staffing services workers make up a significant and growing share of the dwindling number of manufacturing jobs remaining in the United States. These figures imply that it is important to accurately account for outsourcing to the staffing sector when computing multifactor productivity for manufacturing.

Using employment in manufacturing with and without adjustments for outsourcing to employment services, I estimate the contribution of this type of outsourcing to labor productivity in manufacturing. Specifically, I reestimate Equation (2) using employment estimates that include workers in employment services assigned to manufacturing as follows:

$$(4) \qquad \ln\left(\frac{P_t}{P_{t-1}}\right) = \ln\left(\frac{Q_t}{Q_{t-1}}\right) - \ln\left(\frac{AdjL_t}{AdjL_{t-1}}\right).$$

The difference in the rate of growth in measured labor productivity from Equation (2) and the rate of growth in the adjusted measure of labor productivity from Equation (4) shows the contribution of employment services outsourcing to productivity growth in manufacturing.

A couple of features of these estimates should be noted. First, because the OES data we use to generate estimates report number of workers, not hours worked, the labor productivity measures I compute pertain to output per worker, not output per hour, which is the more common labor productivity measure. Particularly over the time horizons that I am examining, changes in output per worker and output per hour in manufacturing are very similar. In addition, data from the CPS Contingent Worker Supplements indicate that the average number of weekly hours worked in the preceding week by temporary agency workers assigned to manufacturing is only slightly below the average number of weekly hours worked by direct-hire manufacturing workers in comparable occupations. Three occupations—production workers, laborers and helpers, and office and administrative workers—account for 75–80 percent of all staffing agency workers assigned to manufacturing. Within each of these occupations, temporary agency workers assigned to manufacturing worked an average of 8 percent fewer hours weekly than direct hires in manufacturing did. In some estimates reported below, I take into account differences in hours worked when computing adjusted labor productivity figures.[9]

[9] Specifically, I multiply the number of workers in a particular occupation assigned to manufacturing by the ratio of hours worked by temporary agency workers and direct-hire employees in a particular occupation category. For instance, if temporary agency production workers' hours were on average 0.92 that of direct-hire production workers' hours, I count each staffing agency production worker assigned to manufacturing as just 0.92 of a worker. Most of the difference in weekly hours between temporary agency and direct-hire workers employed in the same occupation probably stems from the fact that temporary agency workers are more likely to begin or terminate a job during the course of the week in which hours are measured. Because PEO workers are permanently assigned to an organization, their weekly hours should not differ from those of direct-hire workers, and hence the Table 1 figures that adjust for hours worked, if anything, probably overstate the importance of differences in hours worked between staffing agency workers and direct-hire employees in productivity calculations.

Second, productivity estimates are computed on fourth quarter, not annual, data to correspond with the timing of the OES survey.[10] Labor productivity growth can be sensitive to the endpoints used. For instance, because manufacturing was beginning to slow down by the fourth quarter of 2000, the estimates of labor productivity growth are lower when computed from fourth quarter 1995 to fourth quarter 2000 than when computed using annual data for the same years. For this reason, I report estimates over varying time periods to check the sensitivity of the findings to the endpoints used.

The three columns in the top panel of Table 1 display the annual growth rate in labor productivity (output per worker), the growth rate in labor productivity adjusting for the use of employment services workers, and the contribution of employment services outsourcing to manufacturing labor productivity growth. Over the 1990 to 2000 period, outsourcing to employment services accounted for about a half-percentage point of the growth in the labor productivity measure, or about 15 percent of that growth. The contribution of employment services to manufacturing productivity growth was larger during the latter part of the period than for the early part of the period, and this finding is robust to the endpoints used in the analysis. Adjusting for lower hours worked per week by staffing agency workers has little impact on the estimates and does not affect the qualitative nature of the findings. Note that although accounting for employment services workers generally results in a reduction in estimated manufacturing labor productivity growth rates, it results in a higher estimated productivity growth during the 2000–2001 downturn, reflecting the fact that temporary agency workers bore the brunt of adjustment to the recession.

[10] In the past, the OES was conducted each year in November. Since 2002, the OES has been conducted twice annually, once in March and once in November.

The bottom panel of Table 1 reproduces figures reported in BLS (2004), which are based on calculations from KLEMS. The three columns show reported labor productivity growth (output per hour), productivity growth adjusted for purchased business services, and the contribution of purchased services to the rate of labor productivity growth. The computations are based on annual rather than fourth-quarter data, and the definition of productivity is output per hour rather than output per worker. More important, the KLEMS estimates in the bottom panel adjust manufacturing labor productivity for all of purchased services, which include not only employment services but also services purchased from domestic contractors in other sectors and from offshoring. It is widely believed that during this period manufacturers increasingly adopted strategies to outsource and offshore, and hence, all else equal, the productivity adjustments for purchased services from KLEMS in the bottom panel should be greater than the adjustments based solely on outsourcing to employment services.

The numbers presented in the top and bottom panels of Table 1 portray inconsistent pictures of the role outsourcing played in manufacturing productivity growth during the 1990s. The KLEMS estimate of the contribution of all purchased services to productivity growth in the early 1990s is about the same as the estimated contribution of employment services by itself, reported in the top panel. More strikingly, in the latter half of the 1990s, the estimated contribution of purchased services from KLEMS is much lower than the estimated contribution of employment services alone. In addition, while the estimates in the top panel show a substantial increase in the contribution of employment services outsourcing to labor productivity growth in the 1990s, those in the bottom panel show a substantial decline.

The conclusion in BLS (2004)—that outsourcing and offshoring had minor effects on productivity growth in manufacturing and played no role in the acceleration of manufacturing labor productivity during the 1990s—simply is not supported by estimates based on data generated in Dey, Houseman, and Polivka (2006). It appears unlikely that differences in productivity concepts (output per worker vs. output per hour) and the time periods over which they are measured explain these inconsistencies. Rather, the low estimates of employment services output imputed to manufacturing in the BEA I-O tables used to generate the KLEMS figures suggest that the differences in the measurement of outsourcing are at least partly responsible for the discrepancies. As noted above, the share of the employment services imputed to the manufacturing industry was just 15 percent in the 1992 BEA I-O benchmark table, and it fell even further, to 5 percent, in the 1997 benchmark table. The extraordinarily low estimate of manufacturers' use of employment services in the 1997 I-O benchmark—at a time when all other data pointed to a large increase in manufacturers' outsourcing to the staffing industry—could help explain why BLS (2004) found that none of the acceleration in manufacturing labor productivity was attributable to outsourcing.

Figure 1 displays indices of employment and output in U.S. manufacturing from 1989 to 2004. The growing gap between the employment and output indexes measures the growth in simple labor productivity, defined as output per worker. A third line depicts manufacturing employment adjusted to take into account outsourcing to the staffing services sector, as reported in Dey, Houseman, and Polivka (2006). As is evident, outsourcing to staffing services can explain some of the phenomenal growth in U.S. labor productivity in the manufacturing sector, but by no means most of it. Other factors that potentially explain the remaining gap include technological improvements including automation, outsourcing to other domestic contractors, and offshoring of services and production of intermediate inputs. The remainder of the paper focuses on the potential contribution of the last category.

Evidence on the Contribution of Services Offshoring to Multifactor Productivity Growth: Real or Mismeasurement?

A recent study by Amiti and Wei (2006) found a strong association between offshoring of services and productivity growth. Amiti and Wei concluded that services offshoring accounted for 11–13 percent of the growth in manufacturing labor productivity from 1992 to 2000. They used a value-added concept of labor productivity that, in theory, netted out increased material and services inputs from offshoring on the labor productivity measure.

Although this study has data shortcomings acknowledged by the authors, the larger point is that in spite of the relatively low levels of services offshoring, the authors' estimates of imported services in manufacturing industries are strongly correlated with industry productivity growth. Offshoring genuinely may lead to some increased productivity among American workers through the channels suggested by the authors. One channel is through compositional effects in which production remaining in the United States focuses on tasks in which U.S. workers are more efficient. Another occurs through the importation of services that make American workers more efficient. But the surprisingly large estimated effects of services offshoring on manufacturing productivity raise concerns that measurement problems underlie the paper's findings. Because data understate the amount of services offshoring taking place with U.S. businesses and because recent expansion of services offshoring is motivated to a large degree by the lower wages of foreign labor, the large amount of manufacturing productivity growth that the authors attribute to services offshoring may, in part, be from picking up error in the measurement of manufacturing productivity and pure labor cost savings, not from the increased efficiency per se of American workers.

High Productivity Growth and Extensive Outsourcing and Offshoring in High-Tech Industries

> *"The personal computer on your desk today may have been designed in Taiwan and assembled in Mexico, with memory chips from South Korea, a motherboard from China, and a hard drive from Thailand."* (Agrawal, Farrell, and Remes 2003)

Of special concern is evidence that productivity growth in the 1990s was concentrated in the high-tech sector, a sector that pioneered outsourcing and offshoring practices. From 1990 to 2000, output per labor hour increased by 45 percent for all of manufacturing, while this simple labor productivity measure increased by 426 percent in computer and electronic product manufacturing. Moreover, labor productivity growth in the semiconductor and computer manufacturing industries far outpaced that in the rest of the computer and electronic product manufacturing sector. From 1990 to 2000, labor productivity increased by 961 percent in semiconductors and by an astounding 1,495 percent in computers. Since 2000, labor productivity in these two industries has continued to soar (Figure 2).

Multifactor productivity measures, which should net out increased inputs from outsourcing and offshoring, show a similar picture, with measured multifactor productivity growth in computer and electronic manufacturing dwarfing growth in manufacturing as a whole (Figure 3). Reflecting these facts, Oliner and Sichel (2000) show that much of aggregate labor productivity growth was attributable not only to the adoption of high-tech capital, which embodies the technological advances of computers and semiconductors, but also to productivity growth in the industries that produce computers and semiconductors. Oliner and Sichel estimate that production of computers and semiconductors accounted for 58 percent of multifactor productivity growth from 1991 to 1995, for 56 percent of multifactor productivity growth from 1996 to 1999, and for about 36 percent of the acceleration in the productivity growth between the early 1990s and the late 1990s.[11] Oliner and Sichel note that these percentages are extraordinary given the tiny share of current dollar output computers and semiconductors account for in the aggregate economy.

Schweitzer and Zaman (2006), justifying the concentration of productivity growth in these two industries, write that "advances in chip technology are widely acknowledged as having driven the dramatic productivity gains in the semiconductor sector and, in turn, the computer equipment sector." However, others have questioned whether the productivity gains in the production of high-tech equipment—as distinct from productivity gains that result from the use of computer and other high-tech equipment in other sectors—are exaggerated. Various factors could contribute to the high productivity numbers in high-tech industries. For example, the difficulty of accurately measuring output and prices in industries characterized by such rapid technological progress in the product produced has been much discussed and could result in substantial mismeasurement.[12] Here, I focus on the possible contributions of outsourcing and offshoring to the high productivity estimates in the IT sector.

Several case studies have documented the innovations in business strategy that originated in the IT sector, including the offshoring of the manufacturing process, the offshoring of services, and the extensive use of temporary help staffing and other contract workers for much of the work that remained in the United States (Ernst and O'Connor 1992; Hyde 2003; Lazonick forthcoming). Much of the actual manufacturing of computer equipment had been offshored by

[11] Similarly, according to BLS estimates, two manufacturing industries, Industrial and Commercial Machinery (SIC 35) and Electronic Machinery (SIC 36), accounted for 71 percent and 69 percent of multifactor productivity growth over the 1990–1995 and 1995–2000 periods, respectively, and almost half of the acceleration of productivity growth between the two periods. These estimates are from an unpublished BLS document dated October 21, 2004. Under the old SIC classification system, computer equipment manufacturers were grouped in SIC 35 and semiconductor equipment manufacturing was coded in SIC 36; now both form part of NAICS 334.

[12] See, for example, Aizorbe (2005); Aizcorbe, Oliner, and Sichel (2006); Basu et al. (2005); and Feenstra et al. (2005).

the early 1990s to developing countries in order to access cheap labor (Ernst and O'Connor 1992). Slaughter (2002) more generally discusses the growth of global production networks in high-tech industries. He presents evidence of the increase in the shares of inputs that were imported in various industries through the mid-1990s, though the import data distinguishing input from final goods production are limited. Several WTO agreements that reduced trade barriers in the high-tech sector and that coincided with the acceleration of productivity growth in that sector in the latter half of the 1990s should, if anything, have further stimulated global production networks.[13] In addition, employment remaining in this country was heavily outsourced to staffing agencies, other contract workers, and independent contractors (Hyde 2003). More recently, the high-tech sector took the lead in the offshoring of high-skilled jobs in order to access inexpensive skilled labor in developing countries, a development made possible by innovations in communications, in particular the Internet (Lazonick forthcoming).

During the 1990s output in the computer and electronic product manufacturing sector soared while measured labor hours in the sector remained flat. Since 2000, output has been flat, while labor hours have declined sharply. Little can be assessed from these figures about actual productivity growth, however, because so much of the labor input is not employed in this sector, but rather in other domestic industries and in foreign companies or affiliates. An accurate count of this labor and purchased materials input is critical to an accurate assessment of the sector's productivity growth. Yet, as detailed above, because measurement of outsourcing and offshoring is poor in U.S. statistics, it is possible that multifactor productivity growth in high-tech industries is significantly overstated. In addition, to the extent that expansion of the production of IT

[13] Slaughter (2002) provides a good discussion of the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights, the WTO Information Technology Agreement, and the WTO Basic Telecommunications Agreement. He makes a strong case that offshoring is in large part responsible for productivity gains in the U.S. IT sector. Slaughter mentions the role that lower foreign labor costs may have played in increasing measured productivity but does not develop the implications of this point.

equipment was occurring disproportionately in low-wage countries, cost savings or "gains from trade" from offshoring would be counted as productivity gains.[14] The fact that domestic prices were adjusted to reflect improvements in the quality of IT products, but import prices of intermediate IT inputs were not, further exacerbates the problem. Although any distortions from outsourcing and offshoring on productivity measurement in high-tech industries may have had little effect on the measurement of aggregate productivity growth, special investigation of this issue should be undertaken, particularly given this sector's role in driving recent productivity growth in the U.S. economy.

WHY UNDERSTANDING THE EFFECTS OF OUTSOURCING AND OFFSHORING ON MANUFACTURING PRODUCTIVITY GROWTH IS IMPORTANT

The manufacturing sector has accounted for much of the high productivity growth in the U.S. economy in the last decade. In addition, manufacturing, more than any other sector, is subject to pressures from international competition, and productivity growth is an important indicator of its global competitiveness. Accurately measuring and interpreting productivity in this key sector is arguably important in and of itself.

Any biases to manufacturing productivity statistics introduced by domestic outsourcing, however, likely will net out in aggregate productivity statistics: labor hours not counted in manufacturing will be counted in services and the two will cancel each other out (BLS 2004).[15]

---

[14] Feenstra, et al. (2006) also point to the extensive offshoring of the production of IT equipment as a possible culprit for the implausibly large productivity gains in the industry. They suggest that product price indexes used in the computation of productivity statistics are not adjusted quickly enough to account for exchange rate changes, and hence, gains from trade due to exchange rate changes may be counted as productivity gains. They find relatively little empirical support for their hypothesis, however.

[15] In a different twist on this theme, ten Raa and Wolff (2001) argue that manufacturing productivity growth may reflect the outsourcing of services, in which productivity growth is slower, and thus that the acceleration of productivity growth in U.S. manufacturing is simply an accounting phenomenon.

By implication, to the extent that economists and policymakers are focused on aggregate rather than on sector productivity figures, domestic outsourcing is not of major concern.[16]

Any overstatement of manufacturing productivity growth resulting from underestimates of offshored materials and services inputs clearly will not wash out in aggregate statistics. Moreover, companies are moving production and service jobs offshore in large part to exploit cheap (relative to their output) skilled and unskilled labor. In as much as lower hourly foreign labor costs are not matched by lower productivity, cost savings from offshoring will be counted as productivity gains. To the extent that offshoring is an important source of measured productivity growth in the economy, productivity statistics will, in part, be capturing cost savings or gains to trade but not improvements in the output of American labor and should be interpreted with caution.

While economic theory holds that improvement in a population's standard of living is directly tied to its productivity growth, one of the great puzzles of the American economy in recent years has been the fact that large productivity gains have not broadly benefited workers in the form of higher wages (Dew-Becker and Gordon 2005, Yellen 2006). A better understanding of what our productivity statistics actually measure potentially provides some answers to this puzzle. Although a number of economists have suggested that offshoring may partly explain why many Americans have not enjoyed real wage gains during this period of rapid productivity growth, a contribution of this paper is to suggest a direct link between productivity measurement, offshoring, and inequality. It is possible that because of poor measurement of imported intermediate inputs, especially services, productivity measures are inflated. Moreover, even

[16] One caveat to this conclusion is that labor input is not treated uniformly in aggregate multifactor productivity statistics. Rather, labor is treated as 1,008 separate inputs in the production process, with changes in each weighted according to its cost share. If the distribution of outsourced labor across these labor categories differs from that of the labor it displaces and if domestic contract labor has lower wages that are not fully matched by lower productivity, then domestic outsourcing by manufacturers will also inflate aggregate productivity statistics.

when offshored materials and services inputs are accurately measured, productivity improvements that result from offshoring may largely measure cost savings, not improvements to output per hour worked by American labor. Productivity trends may be an indicator not of how productive American workers are compared to foreign workers, but rather of how cost-uncompetitive many are vis-à-vis foreign labor. Although the productivity numbers may capture some net gains to the American economy from trade, there is no reason to believe that these gains will be broadly shared among workers. The very process of offshoring to cheap foreign labor places downward pressure on many domestic workers' wages and simultaneously increases measured productivity through cost savings.

The potential implications of this source of measured productivity gain are not purely distributional, however. Undoubtedly it matters for the long-term performance of the U.S. economy whether productivity improvements arise from smarter, more efficient American workers, from investment in capital equipment, or from the use of cheap foreign labor. While more accurate productivity statistics should be sought through improved measurement of imported materials and services inputs, research should also seek to measure the contribution of various factors—including pure cost savings from offshoring—to measured productivity gains. By so doing it can provide the basis for a better understanding of the relationship between productivity growth and economic performance at the sector and aggregate levels.

References

Abraham, Katharine G. 1990. "Restructuring the Employment Relationship: The Growth of Market-Mediated Work Arrangements." In *New Developments in the Labor Market: Toward a New Institutional Paradigm*, K.G. Abraham and R.B. McKersie, eds. Cambridge, MA: MIT Press, pp. 85–119.

Agrawal, Vivek, Diana Farrell, and Jaana K. Remes. 2003. "Offshoring and Beyond: Cheap Labor is the Beginning, Not the End." *McKinsey Quarterly.* 2003(4): 24–35.

Aizcorbe, Ana. 2005. "Moore's Law, Competition, and Intel's Productivity in the Mid-1990s," *American Economic Review* 95(2): 305–308.

Aizcorbe, Ana, Stephen D. Oliner, and Daniel E. Sichel. 2006. "Shifting Trends in Semiconductor Prices and the Pace of Technological Progress." Paper presented at the NBER Summer Institute 2006 "Conference on Research on Income and Wealth," held in Cambridge, MA, July 17–19. http://www.nber.org/confer/2006/si2006/prcr/oliner.pdf (accessed April 5, 2007).

Amiti, Mary and Shang-Jin Wei. 2004. "Fear of Oursourcing: Is It Justified?" NBER Working Paper No. 10808. Cambridge, MA: National Bureau of Economic Research.

———. 2006. "Service Offshoring and Productivity: Evidence from the United States." NBER Working Paper No. 11926. Cambridge, MA: National Bureau of Economic Research.

Basu, Susanto, John Fernald, Jonas Fisher, and Miles Kimball. 2005. "Sector Specific Technical Change," Paper presented at the NBER Summer Institute 2005 "Conference on Research on Income and Wealth," held in Cambridge, MA, July 25–26.

Bureau of Labor Statistics (BLS). 1996. "Inputs of Business Services." Unpublished document. Bureau of Labor Statistics, Washington, DC

———. 1997. *BLS Handbook of Methods,* BLS Bulletin 2490, April 1997, http://stats.bls.gov/opub/hom/homch10_a.htm and http://stats.bls.gov/opub/hom/homch11_a.htm

———.2004. "The Effect of Outsourcing and Offshoring on BLS Productivity Measures," March 26. http://www.bls.gov/lpc/lproffshoring.pdf.

———.2006. "International Comparisons of Manufacturing Productivity and Unit Labor Cost Trends, 2005." USDL 06-1655. News release, September 26. Washington, DC: Bureau of Labor Statistics. http://www.bls.gov/news.release/archives/prod4_09262006.pdf (accessed April 5, 2007).

Dew-Becker, Ian and Robert Gordon. 2005. "Where Did the Productivity Growth Go? Inflation Dynamics and the Distribution of Income." NBER Working Paper No. 11842. Cambridge, MA: National Bureau of Economic Research.

Dey, Matthew, Susan Houseman, and Anne Polivka. 2006. "Manufacturers' Outsourcing to Employment Services." Kalamazoo, MI: W.E. Upjohn Institute for Employment Research Staff Working Paper No. 07-132.

Erickcek, George, Susan Houseman, and Arne Kalleberg. 2003. "The Effects of Temporary Services and Contracting Out on Low-Skilled Workers: Evidence from Auto Suppliers, Hospitals, and Public Schools" In *Low-Wage American: How Employers are Reshaping Opportunity in the Workplace,* Eileen Appelbaum, Annette D. Bernhardt, and Richard J. Murnane (eds.),. New York: Russell Sage Foundation, pp. 368–406.

Ernst, Dieter and David O'Connor. 1992. *Competing in the Electronics Industry: The Experience of Newly Industrialising Economies*. Paris: Organization for Economic Cooperation and Development.

Feenstra,.Robert C. Reinsdorf, and Matthew J. Slaughter, and Michael Harper. 2005. "Terms of Trade Gains and U.S. Productivity Growth," Paper presented at NBER Summer Institute, 2005, "Conference on Research on Income and Wealth," held in Cambridge, MA, July 25–26.

———. 2006. "Effects of Terms of Trade Gains and Tariff Changes on the Measurement of U.S. Productivity Growth." Paper prepared for the 29th General Conference of the International Association for Research in Income and Wealth, held in Joensuu, Finland, August 20–26.

Government Accountability Office (GAO). 2004. *Current Government Data Provide Limited Insight into Offshoring of Services.* GAO-04-932. Washington, DC: Government Accountability Office.

Hyde, Alan. 2003. *Working in Silicon Valley.* Arkmonk, NY: M.E. Sharpe.

Lazonick, William. Forthcoming. "Globalization of the ICT Labor Force." In *The Oxford Handbook on ICTs*. Robin Mansell, Chrisanthi Avgerou, Danny Quah, and Roger Silverstone, eds. Oxford: Oxford University Press.

Mann, Catherine. 2003. "Globalization of IT Services and White Collar Jobs: The Next Wave of Productivity Growth." International Economics Policy Brief. No. PB03-1. Washington, DC: Peterson Institute for International Economics.

McCracken, Jeffrey. 2007. "Tough Talks: Desperate to Cut Costs, Ford Gets Union's Help; On Factory at a Time UAW Votes Givebacks Members Long Resisted." *Wall Street Journal*, March 2, A:1.

McKinsey & Company. 2006. "Creating and Capturing China Opportunities." Presentation made at China and India as Global Supply Points: A Business Opportunity Conference. May 23.

National Academy of Public Administration. 2006. *Off-Shoring: An Elusive Phenomenon.* A report prepared by the National Academy of Public Administration for the U.S. Congress and the Bureau of Economic Affairs, Washington, DC: National Academy of Public Administration.

Oliner, Stephen D. and Daniel E. Sichel. 2000. "The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?" *Journal of Economic Perspectives* 14(4): 3–22.

Ono, Yukako and Daniel G. Sullivan. 2006. "Manufacturing Plants' Use of Temporary Workers: An Analysis using Census Data." Federal Reserve Bank of Chicago Working Paper No. WP-06-24. Chicago: Federal Reserve Bank of Chicago.

Organisation for Economic Co-operation and Development (OECD). 2006. "The Share of Employment Potentially Affected by Offshoring—An Empirical Investigation." DSTI/ICCP/IE(2005)8/Final. Paris: Organisation for Economic Co-operation and Development.

Samuelson, Paul A. 2004. "Where Ricardo and Mill Rebut and Confirm Arguments of Mainstream Economists Supporting Globalization." *Journal of Economic Perspectives* 18 (3): 135–146.

Schweitzer, Mark and Saeed Zaman. 2006. "Are We Engineering Ourselves out of Manufacturing Jobs?" Federal Reserve Bank of Cleveland. *Economic Commentary* 2006(1): 1–4.

Segal, Lewis M., and Daniel G. Sullivan. 1997. "The Growth of Temporary Services Work." *Journal of Economic Perspectives* 11(2): 117–136.

.

Slaughter, Matthew J. 2002. *Technology, Trade, and Investment: The Public Opinion Disconnect.* Washington, DC: Emergency Committee for American Trade.

ten Raa, Thijs, and Edward N. Wolff. 2001. "Outsourcing of Services and the Productivity Recovery in U.S. Manufacturing in the 1980s and 1990s." *Journal of Productivity Analysis* 16(2): 149–165.

Yellen, Janet. 2006. Economic Inequality in the United States. *FRBSF Economic Letters*. No. 2006-33-34. San Francisco: Federal Reserve Bank of San Francisco.

Table 1: Comparison of Manufacturing Labor Productivity Growth Adjusted for Staffing Services to KLEMS Computations, 1990–2001

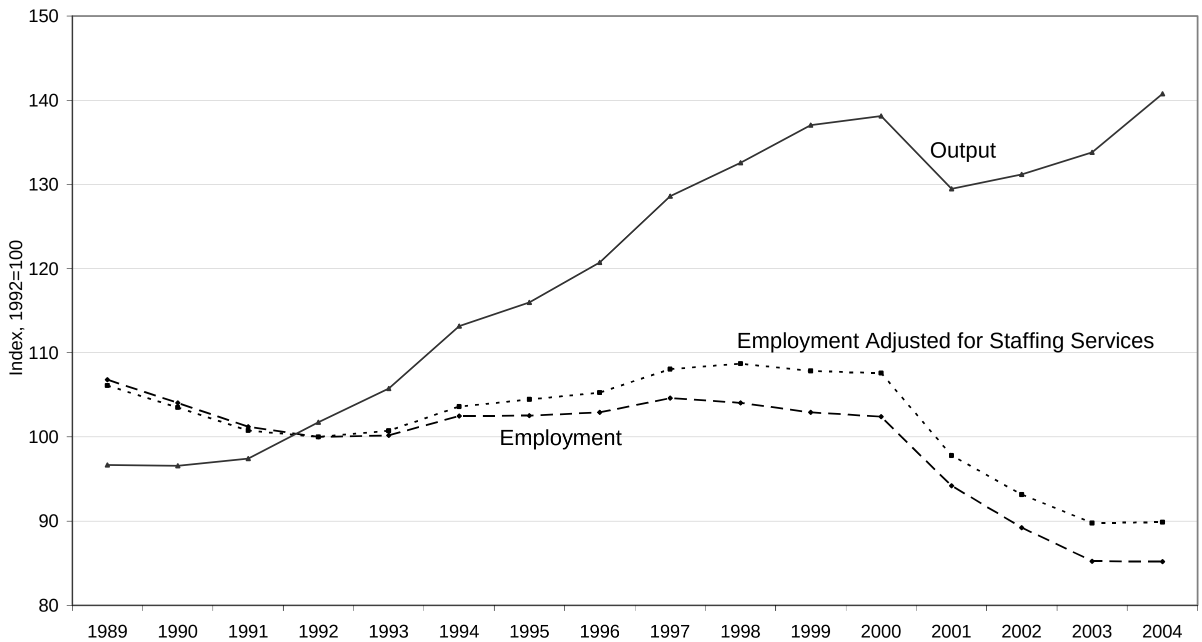
	Adjustments for employment services[a]		
Time period	Annual growth rate of labor productivity	Labor productivity adjusted for employment services	Contribution of employment services
1990–2000	3.71	3.17	0.55
1990–1995	3.96	3.48	0.48
1990–1995, adj. for hours[b]	3.96	3.52	0.44
1989–1995	3.72	3.30	0.42
1995–2000	3.52	2.90	0.61
1995–2000, adj. for hours[b]	3.52	2.95	0.57
1995–1999	4.07	3.37	0.70
2000–2001	2.14	3.33	−1.19

	Adjustments for all purchased services, based on KLEMS[c]		
Time period	Annual growth rate of labor productivity	Labor productivity adjusted for purchased services	Contribution of purchased services
1990–1995	3.3	2.8	0.5
1995–2000	4.1	3.9	0.2
2000–2001	1.2	1.6	−0.4

[a]Calculations are based on output per person, 4th quarter data, and only adjust for Employment Services.
[b]Adjusted labor productivity figures take into account fewer hours worked by Employment Services workers.
[c]KLEMS calculations are based on output per person, annual averages, and adjust for all purchased services.

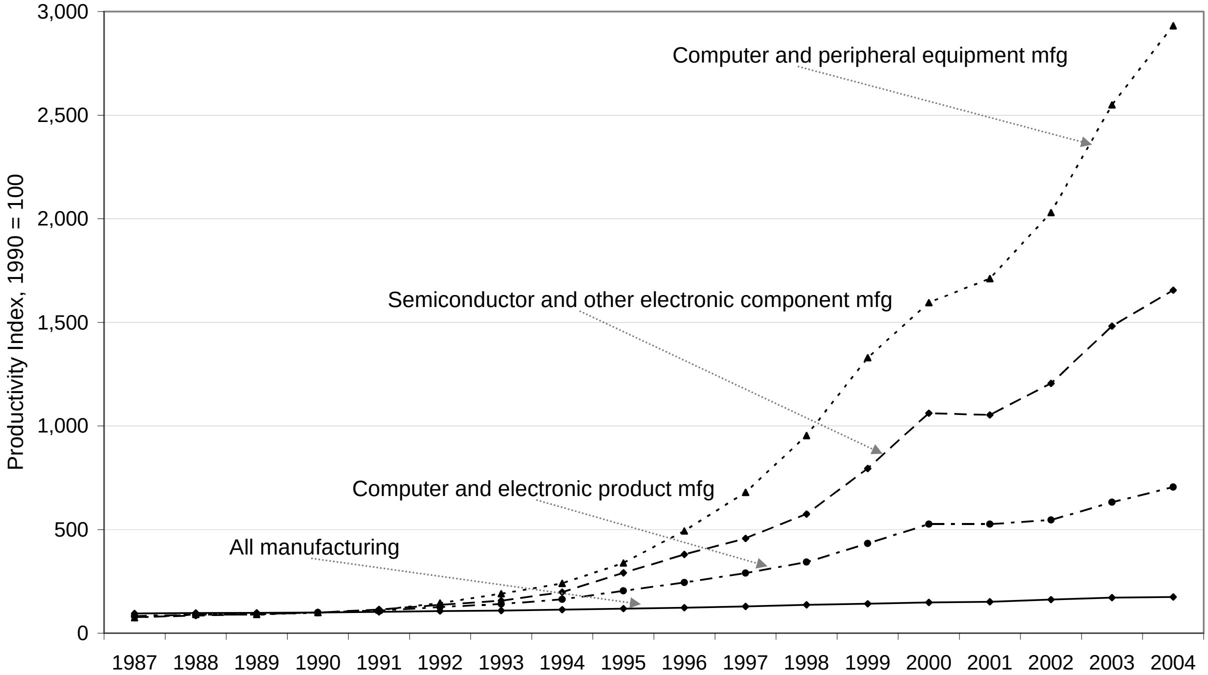
Sources: top panel: author's calculations using data from Dey, Houseman, and Polivka (2006); bottom panel: BLS (2004, Table 1).

Figure 1: Trends in U.S. Manufacturing Employment and Output (Indexes, 1992=100)



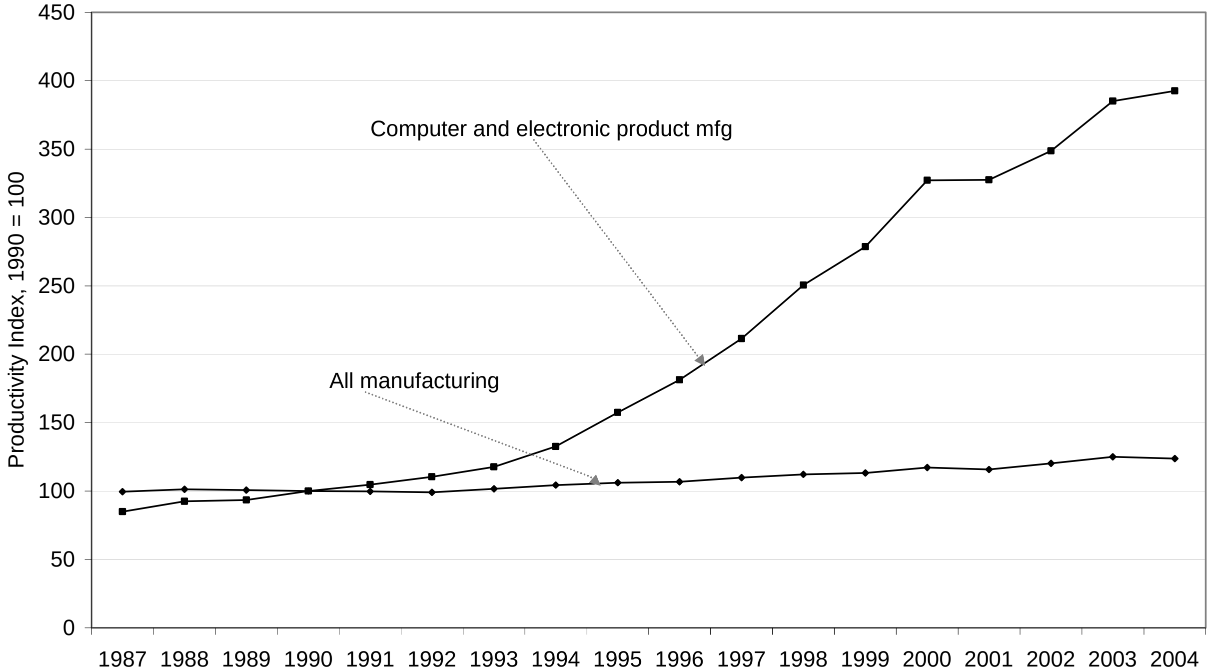
Sources: author calculations based on data from Dey, Houseman, and Polivka (2006) and U.S. Bureau of Labor Statistics

Figure 2: Labor Productivity, All Manufacturing and Computer and Electronic Equipment, 1987–2004 (Indexes 1990=100)



Source: author calculations based on data from U.S. Bureau of Labor Statistics

Figure 3: Multifactor Productivity, All Manufacturing Computer and Electronic Equipment, 1987–2004 (Indexes, 1990 = 100)



Source: author calcuations based on data from U.S. Bureau of Labor Statistics