What Happened to the Great US Job Machine?
The Role of Trade and Electronic Offshoring

By

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The authors are grateful to the editors and participants in the Panel meeting, and to Mac Destler, Jeffrey Frankel, Catherine Mann and Edwin Truman for helpful comments.

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"The loss of manufacturing jobs and hundreds of thousands of service jobs over the past few years, and the threat of the loss of millions more to offshore outsourcing, is a clear call to our business and political leaders that our trade policies simply are not working. At the least, not in the national interest."

Lou Dobbs "A home advantage for U.S. corporations" CNN Friday, August 27, 2004.

The business cycle downturn and recovery of the past few years has been an unusual one. In particular, payroll employment since the trough has been remarkably weak compared to previous recessions—a point illustrated Figure 1.1.[1] The decline of payroll employment from the peak in March 2001 to the trough in November of the same year was modest, but employment continued to fall for the next 21 months, ending up just over a million jobs below the trough before recovering. This contrasts with most previous recessions, where job growth following the trough was very strong. The most recent prior recession of 1990-91 was also characterized by relatively weak job performance for a period, as Figure 1.1 shows. But the jobs picture since 2001 has been much weaker even than that "jobless recovery."

In the press and in the minds of many Americans, much of the weakness in the labor market is blamed on foreign competition. As the quotation above indicates, there is uneasiness that manufacturing and service sector jobs have been, or will be, moved abroad. Partly because of technological change and partly because of trade agreements, so the argument goes, US workers now have to compete against a huge low-wage global labor pool and the sustained weakness in employment since 2000 is a sign that this is undermining the great US job machine.

Most economists dismiss these concerns as showing a misunderstanding of the functioning of international trade and the ability of the US economy to re-employ workers that have been displaced by trade. Indeed, over the long run, most economists would argue the US will have to reduce its trade deficit and this could create more opportunities for blue-collar workers in export industries. Similarly, the more services we import, the larger our exports of both goods and other services will have to be to pay for

[1] This now-familiar figure originated at the Council of Economic Advisers in the 1980s where it was given considerable play "for obvious reasons," as Michael Mussa has remarked—job growth after the early 80s recession was very strong indeed.

them. But economists' reassurances on this point have not carried a lot of weight in the popular debate or even at times in the policy debate.

Putting the role of trade in the US economy in perspective is not simply a matter of setting the record straight. Misperceptions by workers may discourage them from acquiring the skills they need in order to get good jobs. Misperceptions by voters and elected officials can lead to bad policies. In this paper, therefore, we take a more direct approach to putting trade and electronic offshoring concerns in the right perspective, by estimating the size of the first round job dislocation that trade and electronic offshoring may have caused between 2000 and 2003. [2] The approach used, and several assumptions made along the way, have the effect of exaggerating the impact on trade and offshoring on the US labor market. Nevertheless, the results show that weakness in US payroll employment since 2000 has not been caused by a flood of imports either of goods or services. The weakness of employment is primarily the result of inadequate growth of domestic demand in the presence of strong productivity growth. It should certainly not be attributed to any trade agreements the US may have signed.[3]

The paper also goes beyond this basic result in several ways and a summary of the additional findings is as follows: 1. To the extent that trade did cause a loss of manufacturing jobs it was the weakness of US exports after 2000 and not imports that was responsible. The share of imports in the US market actually declined. 2. The weakness in US exports was primarily the result of the effect of the high US dollar. The world market for manufactured exports continued to grow after 2000 but the US lost market share. 3. The impact of service sector offshoring to India 2000-2003 on US employment was very small when compared to the aggregate changes in service sector employment. 4. Focusing more narrowly, only on the US technology sector, there has been a loss of lower-level paid programming jobs, much of which could be attributed to

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[2] There has been considerable confusion created by the fact that people use the terms "Offshoring" and "Outsourcing" to refer to a wide variety of activities. In this paper, we use the term Electronic Offshoring to refer to imports of electronically transmitted services. For a discussion of these terms and one set of definition see Bhagwati, Jagdish, Arvind Panagariya and T.N. Srinivasan (2004) Journal of Economic Perspectives.

[3] The NAFTA in particular, has born the brunt of the allegations that trade agreements are responsible for high unemployment. Yet the NAFTA came into effect in 1995 and the subsequent five years saw very robust employment growth. So whatever the employment effects of the NAFTA may have been, it is simply implausible to blame it for unemployment in 2001.

offshoring to India. But the employment picture for computer service occupations as a whole has actually been surprisingly strong in the last few years, especially if you allow for the unsustainable domestic-demand-driven surge in employment in 2000. 5. Trade is also unlikely to be a major source of additional manufacturing jobs in the future: even if the US eliminates its merchandise trade deficit over the next decade, the net addition to manufacturing employment is likely to be modest. 6. Predictions have been made that over three million US service jobs will be offshored via information technology through 2015. Simulations from a macroeconomic model suggest offshoring of this magnitude is large enough to have appreciable effects on the macro economy. The nature of those effects depends crucially on the way the offshoring is modeled. If offshoring is modeled as a decline in the price at which the US can buy foreign services, then US GDP, real compensation of employees and real profits are all higher in 2015 as a result of the services offshoring. If offshoring is modeled simply as an increase in the quantity of services imports at today's prices, the welfare benefits are smaller because more exports are needed to pay for these. Nonetheless, again a relatively modest number of jobs are generated in manufacturing to produce these exports. All told therefore, our analysis suggests that trade is neither the major source of the current troubles facing manufacturing workers nor a potential solution to their problems in the future.

Section 1: The Pattern of Employment Change

This section uses industry and occupation data to review where in the economy jobs were lost and who lost them. We find that the job loss was overwhelmingly concentrated in the manufacturing sector. And that major service industries that had been consistent job creators over the 90s stopped creating jobs after 2000, indeed they lost significant numbers of jobs in some cases. The loss of manufacturing jobs and the erosion of the job-creating capabilities of private sector service industries and played into popular fears that trade and offshoring are driving the outcome.

Job Changes by Major Sector of the Economy. There are some limits to comparisons over time because of the changeover from the SIC to the NAICS industry classification and a major revision to the occupational classifications, but nevertheless the patterns in the available data are striking. Figure 1.2 shows changes in employment by broad industry grouping, showing the annual average employment changes from 1990 to 2000 and from 2000 to 2003 using the NAICS industry definitions and based on payroll data from establishments. The total decline in private sector employment after 2000 was at a rate of 880,000 a year or 2.64 million in total. Government employment rose, so the total decline in payroll employment was 1.86 million. Employment in the manufacturing sector has been very hard hit indeed. The decline was at a rate of over 900,000 a year, a total of 2.8 million over three years, more than the decline in total private sector employment. The sectors with the largest employment gains after 2000 were health and education (more the former than the latter) and the government sector.[4]

The other large sources of the post-2000 decline by industry were professional and business services and wholesale and retail trade, declining at rates of 223 thousand and 232 thousand jobs a year respectively. These two sectors' contribution to the overall swing in labor market conditions is even greater than is indicated by their post-2000 job losses. Unlike manufacturing, both sectors were large contributors to the job gains of the 1990s and they then flipped to large losses after 2000. If you take the "second derivative", and look at how large were the swings in employment performance before and after 2000, then manufacturing still remains the largest contributor to the shift in the employment picture, but professional and business services is close behind and wholesale and retail trade is large also.

The information sector also went from being a solid employment creator in the 1990s to an employment loser after 2000. This is a sector with many industries that are more about information (media, and publishing companies) than IT as such. This sector does include data processing services and telecom providers.

In summary, the shift in employment performance after 2000 was widespread across the major private sectors of the economy, as is to be expected in a general business cycle downturn. However, much of the action was in the three large sectors consisting of manufacturing, professional and business services and wholesale and retail trade.

[4] The education sector includes private schools, colleges and universities. The government sector includes employment in public schools, colleges and universities.

Manufacturing is notable for the very large job losses and the other two are notable because they went from big job gainers to job losers.[5]

Job Changes by Occupation. The BLS conducts an establishment survey that reports employment by occupation by industry (the Occupational Employment Statistics or OES data). These are not annual average data as the survey was on a once-a-year basis and then shifted to twice a year. Because of classification changes, consistent data are available only since 1999. Figure 1.3 shows the breakdown of the total job decline, effectively from the fourth quarter of 2000 to the second quarter of 2003. The total job loss in this survey is comparable to, although a bit smaller than, the job loss in the regular establishment survey. The median annual earnings of each group are shown on the chart.

The figure shows that by far the largest employment decline by occupation occurred among production workers. Given what happened in the manufacturing sector, this is not a great surprise. Most of the decline in production occupations occurred among production workers employed in the manufacturing sector—1.62 million out of 2.06 million—although there are also workers in production operations other industries. There was a decline of 437,000 production workers in private services, notably in administrative support and waste management, professional and technical services, and wholesale trade. There is a great deal of detail within the category of production workers, but no obvious pattern emerges, except to note that declines occurred pretty much across the board. The largest job decline was in team assemblers, followed by electrical and electronic equipment assemblers.

Somewhat surprisingly, the occupation that suffered the second largest number of job losses was managers—the highest paid occupational category. The biggest losses occurred for general and operational managers, chief executives, financial managers,

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[5] This summary does require one important qualification. Within the professional and business services sector, the two industries that had the largest employment gains prior to 2000 and the largest employment losses after 2000 were employment services and computer systems design and related services. Both of these sub industries provide intermediate services for other industries within the economy. The computer services sector we look at later. The biggest mover in the employment services industry is temporary help services, providing employees to a range of other industries. This sub-industry alone accounted for about a quarter of the job gains in the professional and business services sector and about 58 percent of the job losses. So the employment weakness was not quite as concentrated in three big sectors as appears from the industry employment data. Job losses in other industries were attributed back to the business services sector as temporary employees were released.

administrative services managers and human resource managers. Few categories showed gains and those that did were mostly education and social services managers and—surprise—legislators. The breakdown of job losses by managerial occupations by industry showed the largest number of losses in private services (713 thousand at a mean annual earnings of $174,000 in 2003) followed by manufacturing (334 thousand at $92,000).

Employment declines in the two broad occupational categories of managers and production workers account for more than 100 percent of the total job loss in this establishment data.[6] When the downturn hit, it seems that companies got rid of many of their production workers and managers. This is consistent with decisions to shut down operations and lines of business that were not longer profitable once the boom ended.[7]

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In Summary. The manufacturing sector is very involved in international trade. It is therefore not surprising that many found it plausible to assign imports a major role in the loss of production worker jobs between 2000 and 2003. Traditionally, business service activities have been overwhelmingly driven by domestic economic activity and seen as much less susceptible to cyclical fluctuations. But the change in the fortunes of well-paid workers in this sector during this period created an environment of uncertainty in which new trends could be seen as having highly ominous implications.

Section 2: The Impact of Trade on the Manufacturing Sector

"The recession has bludgeoned the nation's factories in the past three years, with a record 36 consecutive months of job losses totaling 2.7 million. Low demand at home

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[6] The total job loss in the OES occupational data is slightly smaller than the job loss over the same period from the payroll data over equivalent periods. The OES sample is from a separate survey with fewer respondents.

[7] There is a significant discrepancy between the occupational decomposition from the OES and CPS data sources. Based on the CPS, the sharp decline in the employment of managers evident in the OES establishment data does not appear; in fact there is a modest increase in employment in this occupation 2000-2003. The number of managers in the CPS is nearly twice as high in the CPS data as in OES. In part, this is because the self-employed and small farmers are often self-described as managers. Also there appears to have been significant "grade inflation" in the CPS data, as experienced sales clerks are described as assistant managers, for example. The drop in production worker employment, however, shows up strongly in both data sources. The CPS also shows a significant decline in administrative and office support jobs that is much less pronounced in the OES data.

and abroad, coupled with a flood of imports, have slowed production." Associated Press September 3 2003

In this section we make an estimate of the direct impact of trade on employment in US manufacturing between 2000 and 2003 using input-output tables. Before turning to that exercise we place the recent employment performance in historic perspective, explain why the manufacturing trade deficit has been viewed as an important causal factor, and use GDP data to show that the performance of exports -- rather than imports-- is the more important part of the recent employment story.

The share of total US employment in manufacturing has been declining for at least half a century. This is not unique to the US; it is typical of developed economies and even of many developing economies. The basic reason is that while the demand for the output of the manufacturing sector has grown about as rapidly as GDP, it has not grown fast enough to offset the relatively rapid productivity growth in the sector.[8] As a result the relative demand for manufacturing workers has declined.[9]

Some observers responded to the job loss in manufacturing by reminding people of the importance of relatively rapid manufacturing productivity growth, but between 2000 and 2003 this factor did not play a dominant role. Between 2000 and 2003 the share of manufacturing in non-farm payrolls fell from 13.1 to 11.1 percent -- a drop of fifteen percent. But the twelve percent increase in non-farm output per man-hour between 2000 and 2003 was only three percent less than the increase in manufacturing labor productivity. This leaves eighty percent (twelve of the fifteen percent) of the decline in the share attributable to other factors.[10]

Moreover, the concerns were more about absolute job loss rather than manufacturing's declining share. As Figure 2.1 illustrates, in the decade of the 90s, the

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[8] The demand for manufactured output depends on both the income and price elasticities. Rapid productivity growth could of course be associated with an increasing employment share in the sector if the demand for manufactured goods were sufficiently elastic. However, it turns out not to be. See Council of Economic Advisers, *Economic Report of the President*, 2004 for a discussion of this issue.

[9] The declining share of employment in manufacturing has not been associated with a declining share of real manufacturing GDP. Measured in chained 1996 dollars the share of manufacturing GDP in overall GDP declined from 17.25 percent in 2000 to 16.07 percent in 2002. After peaking at 17.59 in 1988 the share had declined to 15.8 in 1992.

[10] According to BLS estimates, between 2000 and 2003 output per hour in the non-farm business sector and in manufacturing increased by 11.7 and 14.8 percent respectively.

absolute level of employment in manufacturing remained fairly stable. In fact, between 1993 and 1998, manufacturing payrolls increased from 16.8 to 17.6 million and almost regained the 1989 peak of 18 million. They then declined modestly to 17.3 million by 2000. Thereafter, however, employment in the manufacturing sector fell precipitously. Between 2000 and 2003, payroll employment in manufacturing fell 16.2 percent – a drop that was the largest slump in manufacturing employment in postwar history.[11]

Table 2.1 lists the major 3-digit industries ranked by the size of their employment declines between 2000 and 2003. While the job losses were concentrated among producers of capital goods and apparel, every 3-digit industry saw its payrolls fall. The bursting of the high-tech boom resulted in the loss of more than half a million jobs in the industry producing computers and electronic products -- fully 29 percent of 2000 employment. Other large declines occurred in machinery (-312,000 – 21.5 percent) and fabricated metal products (-290,000 – 16.5 percent). Apparel and leather (-195,000 – 36 percent) and textile mill products (-166.2 thousand – 28.6 percent) were severely affected.

To many observers, trade was the obvious culprit for these job losses. The US has run increasing deficits in manufacturing trade since 1992. These deficits have been large and growing relative to the size of the sector. The declines have been particularly pronounced since 1997 when US exports stagnated in the aftermath of the Asian financial crisis while US imports increased rapidly as the economy boomed. As a result, between 1997 and 2000 the manufactured goods trade deficit more than doubled, rising from $136.4 to $317 billion. As indicated in Table 2.2, between 2000 and 2003 the trade balance in manufacturing declined by an additional $86.1 billion, predominantly because exports fell by $62.3 billion (-8.8 percent), although imports also increased. (by $23.6 billion – 2.3 percent).

Table 2.1 illustrates that between 2000 and 2003 the declining trade balances were widespread. Only one of the nineteen industries in manufacturing failed to experience a decline in the trade balance between 2000 and 2003 -- primary metals. The sectors with the largest declines were chemical products (-$15.3 billion), machinery (-$13 billion), Computers (-$8 billion), Apparel (-$8.0 billion) and Food (-$7.5 billion). Export

[11] The largest previous decline was from 19.4 to 17 million between 1979 and 1983.

performance was particularly weak: exports fell in 15 of the 19 industries. The largest percentage declines were in Apparel -27 percent (down $3 billion), Computers -24 percent (-$46 billion) and Motor Vehicles -20 percent (down $8 billion). Other large declines were in Machinery (down $15 billion) and Other Transportation (including aircraft) down $6.5 billion.

How do these deficits compare with overall manufacturing output? Figure 2.2 shows the manufacturing trade deficit expressed as a percentage of manufacturing output, with output measured in two different ways. The first measure is value added in the industry—the GDP that originates in the sector. On this basis, the trade deficit was equal to 28.3 percent of manufacturing output in 2003, up from 21.3 percent in 2000. The second measure is the gross output of the sector—how much manufacturing sells outside the sector—whether to US buyers or overseas.[12] On this basis, the trade deficit is not as large a factor in the manufacturing picture. The deficit equaled 15.6 percent of gross output in 2003, up from 11.9 percent in 2000.

While these comparisons give somewhat different results, the size of the deficit and its pervasiveness across sectors, make it easy for Americans to believe that trade played a major role in the manufacturing recession. In particular, as the quotation above suggests, many saw imports as the principle culprit. But let us examine whether the data support these views.

Let us focus on imports first. Changes in domestic spending will generally be reflected in changes in imports and thus imports tend to act as a stabilizer for domestic employment. When domestic spending falls or grows slowly, for example, some of the impact will occur abroad. Fewer US jobs would therefore be lost than if the economy were self-contained. Conversely, in the presence of imports, fewer domestic jobs will be created, when domestic demand grows rapidly. Thus one benchmark for imports is to consider whether or not they rise faster than domestic spending. In general, if imports were a major independent cause of job loss we might expect to see them rising faster than domestic spending; if they were simply responding to shifts in domestic spending, they

[12] This figure is estimated by the Bureau of Economic Analysis (BEA) by adding up the output of all manufacturing establishments and then estimating what fraction of that output consists of sales to other parts of the same sector. These intra-sector sales are then netted out and the remaining output consists of the gross output of the sector.

would rise at the same pace; if they acted to stabilize employment where spending was weak, they would rise more slowly than spending.

Table 2.3 provides a perspective on the role of goods in US GDP. It is important to note that these data measure final sales of goods. In addition to manufacturing value-added, therefore, they include distribution margins and primary commodity inputs, issues we will deal with later. Nonetheless, they provide important insights into this question. Between 2000 and 20003, measured in 2000 chain-weighted dollars, the volume of merchandise imports grew by 5.1 percent, a pace that was actually slower than US domestic spending on goods for consumption, investment and government spending which increased by 6.6 percent. In 2000 dollars, therefore, the share of imports in US domestic spending on goods actually *fell* from 32 to 31 percent. (In current dollars there was a slightly larger decline in the import share).

But the export story is different. Here, one benchmark is the share of exports in domestic goods output. Between 2000 and 2003, goods output *increased* by 3.8 percent, while the volume of merchandise exports actually *declined* by 8.2. This led to a decline in the share of goods exports in goods GDP from 23 to 20 percent. Thus these data suggest that falling exports detracted from employment and not that a rising share of imports led to disproportionate employment

While highly suggestive, measures such as these may fail to provide an accurate indication of the size of the trade effects on the manufacturing sector because they include value-added in other sectors.[13] Trade flows operate on the demand for labor in manufacturing in complex ways. First, manufactured exports are not all produced in the manufacturing sector, because manufactured goods embody value-added from other sectors, such as services and primary commodities. Second, trade in non-manufactured goods and services will embody manufactured goods, and third, goods produced in the US contain imported components. Ignoring this could lead to an overstatement of US employment due to exports, since some components are made abroad. Similarly,

[13] On the one hand, the ratio of the trade balance to value added will *overstate* the contribution of trade to manufacturing because the components in the numerator, measures of the value of manufactured trade, will also contain value contained in these products from other sectors i.e. primary commodity inputs and services. On the other hand, the ratio of the trade balance to gross output could *understate* the impact to the degree that the denominator includes the value of non-manufactured goods inputs.

displacement due to imports could be overstated, because imports may displace domestic products that themselves contain imported intermediates. In the analysis that follows, therefore, we try to account for these effects by linking trade flows with domestic production using input-output tables and by making adjustments to reflect imported components.

The Basic Relation Between Trade and Employment. We start by clarifying some basic relationships and concepts. In this analysis we are interested in the relative importance of trade and domestic use in US manufacturing employment shifts between 2000 and 2003. But in addition to these demand-side variables, manufacturing productivity growth plays a major role. In fact, we can decompose changes in employment into three elements (a) changes due to productivity, (b) changes due to trade (exports and imports) and (c) changes due to domestic use. Taking productivity as given, we can then ascribe employment changes to trade and domestic use.

Start from the identity:

$$V_i = Q_i / E_i \qquad (1)$$

Where value added per worker V equals production Q divided by employment E, and i denotes the ith industry. With lower case letters indicating rates of change, this gives (approximately)

$$e_i = q_i - v_i \qquad (2)$$

A second key identity links domestic production to trade and domestic use. We know that in an open economy Y = C+I+G+X-M. Gross Domestic Product Y equals Consumption (C) plus Investment (I) plus Government Expenditure (G) plus Exports(X) minus Imports (M), where all variables are in current dollars. Defining domestic use D as C+I+G we get the identity Y = D+X-M.

For each industry, therefore

$$Q_i = D_i + X_i - M_i \qquad (3)$$

Production Q (value added) in industry i reflects value added due to domestic use (D) plus value-added due to exports (X) minus value added attributable to imports (M). Note that in this formulation when we say that the production in an industry is “due to” domestic use and trade, we do not mean that it is due only to domestic use and trade in the products made by that industry. For example, when an automobile is exported from the United States, it will embody inputs such as steel, aluminum, computers and so forth that have been produced in other industries. The impact of exports from one industry on production in all other industries must therefore be correctly attributed. Similarly, when an import replaces a domestic product, it reduces the demand, not only in the industry in which the product is made but also in the sectors that produce inputs for the affected domestic product. A complete accounting of the role of trade and domestic demand should incorporate these indirect effects and this is what we do below

Equation 3 implies that

$$q_i = w_d.d_i + w_x.x_i - w_m.m_i \qquad (4)$$

The rate of change of output equals the weighted sum of the rates of change in value added due to domestic use and due to exports minus the weighted rate of change of value added due to imports. The weights reflect base year (year o) shares; i.e. $w_d = D_o/Q_o$, $w_x = X_o/Q_o$ and $w_m = M_o/Q_o$. Substituting equation (4) into equation (2) and using the fact that $w_d + w_x - w_m = 1$ gives

$$e_i = w_d(d_i - v_i) + w_x(x_i - v_i) - w_m(m_i - v_i) \qquad (5)$$

The percentage change in employment is equal to the weighted average of the changes in the differences between the growth rate of labor productivity and value added due to domestic use, value added due to exports and value added attributable to imports. This expression indicates, for example, that for employment due to exports to remain unchanged, the growth rate in value-added due to exports (x_i) must be equal to the growth rate in labor productivity (v_i). If value-added due to exports increases more slowly than productivity growth, exports will contribute negatively to employment. A similar relation holds for domestic demand, whose growth rate must exceed the growth of productivity if domestic demand is to contribute positively to employment.

Since imports enter negatively into equation (5), the opposite condition holds for imports. If the value-added attributable to imports increases less rapidly than productivity growth, this will contribute positively to domestic employment. Imports are assumed to displace employment in domestic import-competing industries. However, productivity is continually rising in these import-competing industries, which means that for a given level of imports, the number of jobs displaced goes down over time. It would take progressively fewer and fewer US workers to make a given quantity of manufactured goods being imported. Only if imports rise faster than productivity will the number of US jobs being displaced by imports rise over time

It is important to emphasize that equation 5 is an ex post identity where the elements in equation 5 are all endogenous variables. Decomposing employment changes using this identity provides an ex post accounting of the relative importance of these variables in shifting employment; it does not explain what has caused these variables to change. Productivity, trade flows and domestic demand are interrelated in complex ways. Their movements may reflect independent causes or inter-actions among them. For example, rapid US productivity growth could lead to relatively lower US prices, more US exports, fewer imports and more domestic use. However, rapid US productivity growth could also lead to higher US incomes and more demand for *both* domestic products and imports. Similarly, rapid increases in imports could stimulate domestic productivity growth, and increases in domestic demand could lead to more imports and fewer exports.

In addition it is dangerous to imply that increased imports and larger trade deficits necessarily come at the expense of domestic employment. The clearest way to see this is to imagine the economy is at full employment – as it was in 2000. If this is the case, it is not possible for domestic supply to meet the increased demand. The ability to trade allows the national spending to exceed national income so the increase in national spending leads to a larger trade deficit, but there is no job loss due to imports. Yet a mechanical decomposition might lead to the claim of jobs lost due to imports.

In sum, these estimates can be helpful in providing a perspective on the relative importance of domestic demand and trade in manufacturing employment. But it is important to be cautious in drawing causal implications from the results.

Our Approach. It is relatively straightforward to obtain measures of employment and labor productivity -- e_i and v_i in equation 5. The real work comes in estimating the changes due to exports (x_i) and imports (m_i). Once these are obtained, changes due to domestic use (d_i) can be derived as a residual. In this study, these effects due to trade are estimated using the summary 1997 input-output tables, the most recent that are available at a sufficiently disaggregated level. The total requirements version of this table lists over 130 industries by row and over 130 commodities by column. The values in the table are coefficients that indicate the gross output required from the industry at the beginning of the row per dollar of delivery to final use of the commodity at the top of the column. The coefficients reflect both direct and indirect requirements. For example, to produce an automobile will require a host of inputs – these are the direct requirements. But to produce these inputs, another set of inputs will be required, and in turn to produce the requirements for the inputs, more inputs will be required – the indirect requirements. The coefficients in the matrix capture all of these effects.

Going to the column for motor vehicles indicates for example that for each dollar of final demand for motor vehicles, the largest total requirement is output of 99 cents in the motor vehicle manufacturing industry. In addition, 53.3 cents of output is required from the industry titled "motor vehicle body, trailer and parts manufacturing", 13.8 cents from wholesale trade, 6.9 cents from electrical equipment manufacturing, 5.7 cents from plastics, and so on. All told 288 cents were required from the economy as a whole to produce a dollar's worth of motor vehicles delivered to final demand. To obtain our estimates, we go through five calculations.

(a) **Value-added.** First, since we are interested in estimating value-added by industry, we multiply the matrix coefficients by the 1997 ratio of value-added to gross output for each industry. This provides us with estimates of the direct and indirect value added required from each industry to produce a dollar of final demand. For motor vehicles for example the ratio of value-added to output was 0.156. Thus the 99 cents worth of final demand for motor vehicles was associated with 15.44 cents value added in motor vehicles.[14] .

(b) **Aggregation.** We have now obtained a matrix which estimates the direct and indirect requirements of domestic value added per dollar of final demand. However, the IO data are highly disaggregated. To make our work tractable and intelligible we then aggregate these coefficients into to provide estimates at the 3-digit NAICS level which, for example, divides manufacturing into 19 industries. We aggregate the columns to this

[14] IO= Total Requirement table
v= vector of the ratio of value added to gross output by industry.
va= vector of value added by industry (from the 1997 Use table)
go= vector of gross output (from the 1997Use table)

(1) IO
(2) v= va/go → v* IO

level by weighting the coefficients in the columns comprising parts of the 3-digit sector by the share of each commodity in the total commodity output of that sector.[15] We then sum the coefficients in the rows that make up each 3-digit industry. We now have a matrix that gives us direct and indirect value added at the 3-digit level.

(c)Value-added due to trade. Under the assumption that the inter-sectoral relationships between 2000 and 2003 are the same as those of 1997 we then use 3-digit NAICS trade data to estimate the value added in each two-digit manufacturing industry that is embodied in merchandise trade in 2000, 2002 and 2003. We obtain separate estimates for exports and imports.[16]

(d) **Correcting for imported components.** These value-added components are upper estimates of the effects due to exports and imports because the requirements table is derived under the assumption that all inputs are produced domestically. To account for imported components used as intermediate inputs we adjust the requirements by assuming that imported inputs are purchased in proportion to their share in the domestic market, where the domestic market is defined for each industry as the sum of gross output plus imports.[17] (We will also report our aggregate results without making this correction).

(e) **Employment.** The final step involves estimating the employment content of value-added. We assume that productivity in each US industry is the same whether the production is for export, or to replace imports or to serve domestic demand. This implies that the relative allocations of employment to exports, imports and domestic use, within each industry, are the same as the relative allocations of value-added.

Data on value added per employee for manufacturing industries are available for 2000 and 2002. To correspond to the trade data that is in current dollars we use current dollar value added per employee. Neither real nor nominal value added per employee are

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[15]If C_{ij} are the coefficients of the matrix V*IO we obtain C_{ik} where k includes all j in industry k. C_{ik} equals $(c_{i1}*go_{i1} + c_{j1}*go_{j1})/(go_{i1} + go_{j1})$ for each industry in k. We then obtain C_{lk} where l includes all industries i in l by summing the coefficients. This gives us the aggregated matrix at the 3-digit level IO3d

[16] X* IOtrg.= vaX (Total Value added of exports)
M* IOtrg= vaM (Total Value added of imports)

[17] adjvaX=vaX* (m/(go+m)) (Total Value added of exports adjusting by imported inputs)
and adjvaM = vaM* (m/(go+m)) (Total Value added of imports adjusting by imported inputs)

available by industry for 2003 and so we estimate the 2003 figure by multiplying the 2002 data by the growth in the industry-level industrial production index and the industry producer price index between 2002 and 2003.[18] Dividing industry value-added due to exports and imports by value-added per worker provides us with estimates of industry employment "due to" exports and imports. Finally we estimate employment due to domestic use as a residual—the difference between actual employment and employment due to trade

As well as the caveats given earlier, we note further that input-output coefficients allow for no substitution possibilities among inputs and no changes in input requirements over time. Furthermore, among products, the analysis assumes that final demands always substitute between particular imports and the output of the domestic industry that manufactures products similar to those imports rather than products of some other industry.

Results. Table 2.4 Reports a variety of output and trade measures for manufacturing, some of which have been derived using the analysis just detailed. These data reveal an interesting story. Trade plays an important role in manufacturing employment. In 2000, production for exports accounted for 3.43 million manufacturing jobs -- twenty percent of manufacturing employment. Each dollar of exports was associated with 48 cents of manufacturing value-added with the rest coming from imported inputs and other domestic sectors. Each million dollar's worth of exports, therefore, required 5.2 jobs in manufacturing. On average these jobs were associated with high levels of labor productivity. Output per employee engaged in export production was $91.7 thousand dollars, considerably higher than the $80.7 thousand in manufacturing as a whole and the $84.6 thousand if imports were replaced by domestic production.

Between 2000 and 2003 productivity growth in manufacturing was remarkably rapid. Our estimated measure of nominal value-added per employee increased by 15.3 percent over the three years just about the same as the official measure of (real) output per man-hour in manufacturing estimated by the Bureau of Labor Statistics. In 2000

[18] $VA_i2003 = VA_i\ 2002 *(1 + IP_i)(1+PP_i)$ Where VA_i2003 equals value added in industry i in 2003, IP_i equals percentage change in industrial production for industry i between 2002 and 2003, and PP_i equals percentage change in the producer price index for industry i between 2002 and 2003.

value-added per employee in US manufacturing was $80.7 thousand. By 2003 this had increased to $93.1 thousand. Had demand remained constant, manufacturing employment would have fallen by 2.64 million – a drop almost equal to the total loss of 2.7 million jobs between 2000 and 2003. Thus one way to interpret the data is that the decline is all "due to" domestic productivity growth. Taking output as given, productivity improvements caused all the job loss.

However, an alternative is to see how the domestic use and trade contributed to the decline, taking productivity growth as given. As equation 5 indicates, given productivity growth, a sufficient condition for constant aggregate employment would have been for value-added due to domestic demand, exports and imports would each have risen by 15.3 percent. Instead, value-added due to domestic demand and imports increased by just 0.3 percent and 2.4 percent respectively, while value added due to exports actually fell by 11.1 percent. The result was the precipitous 15.9 percent slump in employment.

Our estimates point to the failure of domestic demand growth to match productivity growth as the major source of the decline. We attribute 88 percent of the drop or some 2.54 million jobs to the slow growth in domestic demand. Only 12 percent, or some 314 thousand jobs, are attributed to "trade." While the employment decline attributable to exports played a major role -- accounting for 28 percent of drop or 742 thousand jobs, imports actually *offset* this fall by 429,000 and thus had a positive effect judged by this baseline. This positive effect arises because in 2003, partly because of rapid productivity growth and partly because of the slow growth of imports the manufactured job content of US imports (which have a negative impact on employment) was actually 8.8 percent lower than in 2000.[19]

Imports mitigated the job loss in manufacturing over the period 2000 to 2003, but this was not because of an exogenous downward shock to imports. There is no evidence that the US was suddenly able to compete more effectively against foreign producers. The slow growth of imports was because of the slow growth in overall US demand, which affected both domestic suppliers of manufactured goods and foreign suppliers.

[19] Between 2000 and 2003, value-added per employee due to exports and imports increased by 13.7 and 12.3 percent respectively, both somewhat slower than value-added in manufacturing as a whole.

In the above estimates we have adjusted the input-output coefficients to take account of imported inputs. This has the effect of reducing the estimated impact of trade flows by reducing the domestic value-added due to exports and by reducing the amount of domestic value-added due to imports. When we do not make these adjustments, therefore we get somewhat larger effects due to trade and thus smaller effects due to domestic demand, but qualitatively the results are the same. Using this approach, the net impact of trade on manufacturing job loss rises from 314 to 341 thousand.[20]

Table 2.5 presents the decomposition at a more disaggregated level. The first column again documents the very large shrinkage in manufacturing employment over this period, with the largest percentage declines experienced by apparel (-36.3 percent), Textiles (- 28.6) Computer and Electronic Products (-28.5) Primary metals (-24) and Electrical Equipment (-24). In all of these sectors domestic use was by a large measure the major source of the loss, ranging from 112 percent in the case of apparel (where trade actually had a positive impact!) to 87 percent of the decline in electrical equipment. The effects of sluggish domestic demand (and rapid productivity growth) were devastating for the Apparel sector. Together these induced a decline equal to 40.6 percent of 2000 employment. Large effects were also experienced by computers and electronic products (-28.7 percent); textiles (-24.2 percent); primary metals (-23.4 percent); and Electrical equipment (-20.2).

By contrast, the net losses due to trade in most industries were relatively small. The noteworthy exceptions were chemical products and plastics in which the employment losses due to trade were 17.1 and 10.9 percent of 2000 employment respectively. In all other sectors, however, net losses due to trade were fewer than 4.5 percent of 2000 employment. In both chemicals and plastics, the dominant source of the declines was exports. Losses due to exports in chemicals and plastics were equal to 15.9 and 10.5 percent of 2000 employment respectively. Employment due to exports also detracted from employment in computer products (down 14.8 percent) and primary metals (-8.2 percent) but imports actually helped stabilize employment in computers (15 percent), apparel (7.9) and primary metals (7.6 percent).

[20] Without the import correction, between 2000 and 2003 951 thousand jobs are lost due to exports and 611 thousand jobs are gained due to imports.

The final two columns of the Table present our estimates for each industry of the share of employment that depends on exports. In 2000 for manufacturing as a whole this share was 22.4 percent –almost a quarter of all jobs. Strikingly, the sector with the highest dependence is primary metals (ferrous and non-ferrous metals) in which 49.2 percent of all jobs depend on exports. This is undoubtedly a surprise to those in industries such as steel that focus on the direct impact of imports and ignore the powerful indirect effects that stem from the industries' dependence on US exports from metal- using sectors. Indeed the primary metals sector has become even more dependent on exports with this share rising to 54 percent in 2003, and as indicated in table 2.4, the negative influence on employment in primary metals came from the behavior of exports and not imports. Other sectors with a high dependence on exports in 2000 were computers (41.3 percent of employment), miscellaneous manufacturing (41.3 percent) machinery (30 percent) and other transportation (aircraft) (29.6 percent). Another interesting result here is that export related employment in textiles mills and products has increased from 24.4 to 30.1 percent.

Overall the results of this analysis are certainly at odds with the widespread perceptions that the bulk of job loss in US manufacturing is attributable to a rapid increase in outsourcing, particularly – in the case of manufacturing – to China and other developing countries. Instead they suggest that the behavior of imports was if anything a stabilizing factor and the weakness due to trade is attributable to the behavior of exports. Accordingly, we turn now to consider what might explain export behavior.

Section 3: Understanding the Weakness in US Exports

"Lackluster demand for U.S. exports has been another source of weakness in the manufacturing sector over the past three years. Exports have been depressed, in part due to slow growth in other major economies. Since the fourth quarter of 2000, the average annual rates of real GDP growth in the euro area and Japan have been less than half that of the United States. Industrial supplies and capital goods make up the bulk of U.S. goods exports.: *Economic Report of the President (2004) page 55.*

The previous section concluded that, on net, trade was not a major cause of the loss of manufacturing jobs, but that the weakness in exports, by itself, did account for a decline of 742,000 jobs in the sector. This section asks why US exports were weak.

As the quotation at the start of this section indicates, one obvious explanation for the decline in US manufactured exports 2000-2003 is that there was a world growth recession after 2000, and an outright recession in major markets, such as continental Europe. If the slowdown in the global economy were matched by a slowdown in global trade, then US exports would weaken even if the US were able to maintain its share of world trade.

Table 3.1 shows the rates growth or decline in US exports and non-US world exports for manufactured goods over the period 1990 to 2003.[21] The first column gives US exports and shows that measured in current dollars, they declined over the period 2000-2003, as we saw in the previous section. It is worth noting that they grew very rapidly in the 1990s. The second column shows non-US trade also measured in US dollars. On that basis, we see that the US actually increased its share of dollar world trade in the 1990s but then suffered a sharp decline in share 2000-03. World trade dipped only in 2001 and came back very strong indeed in 2003. The conclusion from column two is that world trade grew about as rapidly after 2000 as it did in the 1990s, indicating that the weakness with US exports was associated with a sharp decline in the US share of trade.

A problem with measuring non-US world trade in dollars is that the growth rates are sensitive to changes in the dollar. If the dollar rises against the euro, for example, the value of intra-European trade is pushed down and the growth rate of non-US world trade is reduced. Column 3 effectively measures non-US world trade in a basket of non-US major currencies.[22] This adjustment raises the estimate of world growth in the 1990s, raises it again in 2001, leaves it little changed in 2002 and lowers it sharply in 2003. It remains the case that non-US trade grows after 2000--indeed there is now no year in which it falls. The growth rate over the three-year period is lower, however, in column 3 than in column 2.

One way to avoid the question of which currency to use to measure the volume of world trade is to use estimates of trade volumes, calculated using unit value price

[21] The WTO provides data on world manufactured trade only through 2002. The growth rate for 2002-2003 is assumed to be the same as the growth in non-oil merchandise trade.
[22] The differences between columns 2 and 3 reflect the rates of change of the Federal Reserve's nominal index of major currencies over the years in question.

measures. There are some questions about the validity of the unit value prices used to create these volume measures, but leaving those concerns aside, the trade volume data from the United Nations Monthly Bulletin indicates that an index of the volume of US manufactured trade fell from 100 in 2000 to 86 by 2003. In contrast, the volume of European manufactured trade rose from 100 to 105 and the volume of all developed economies (including the US) rose from 100 to 101.

These different figures all suggest that while stronger economic growth in the rest of the world would certainly have increased US exports, it is a mistake to blame much of US export weakness on a general slowdown in world trade the reason emphasized by the CEA Report quoted above. US exports declined after 2000 while exports of the rest of the world grew. *The biggest export problem that the US faced after 2000 was the decline in its share of world trade*.

Understanding the Decline in the US Export Share after 2000. There are three distinct reasons why the US share of world manufactured trade may have declined. The first is that US exports may have been concentrated in commodities for which demand was growing relatively slowly. For example, US exports of IT goods rose rapidly in the 1990s but then the tech sector slumped. The second reason is that the US share may have fallen if US exports were going to countries that had particularly weak demand for imports. And finally, the US may have lost competitiveness against other suppliers to the world market.

There is a standard approach to decomposing the trade data into a term capturing first the effect of world trade growth and then the three sources of changes in the US share. This approach can be described as follows. [23]

V_{ij} = value of U.S. exports of commodity *i* to country *j* in period 1

V'_{ij} = value of U.S. exports of commodity *i* to country *j* in period 2.

$V = \sum_i \sum_j V_{ij}$ = total U.S. exports in period 1.

$V' = \sum_i \sum_j V'_{ij}$ = total U.S. exports in period 2.

[23] Richardson (1970, 1971) has made important contributions to the literature, while the discussion here is based on the exposition in Leamer and Stern (1970).

r = percentage increase in total world exports from period 1 to period 2

r_i = percentage increase in world exports of commodity *i* from period 1 to period 2

r_{ij} = percentage increase in world exports of commodity *i* to country *j* from period 1 to period 2.

As Leamer and Stern (1970) show, the change in U.S. exports from period 1 to period 2 can then be expressed as follows:

$$V' - V = \underbrace{rV}_{(1)} + \underbrace{\sum_i (r_i - r)(\sum_j V_{ij})}_{(2)} + \underbrace{\sum_i \sum_j (r_{ij} - r_i)V_{ij}}_{(3)} + \underbrace{\sum_i \sum_j (V'_{ij} - V_{ij} - r_{ij}V_{ij})}_{(4)}$$

This equation provides the four components described above. Term (1) reflects the change in U.S. exports that would occur if the U.S. simply maintained a constant share of world trade. Term (2) shows the extent to which U.S. trade changes as a result of the commodity composition of U.S. exports. Term (3) shows the extent to which U.S. trade changes as a result of the country/market composition of U.S. exports. Term (4) is then the "competitiveness" term, although, as a residual, this term also includes the effect of any additional factors not accounted for in the other terms.[24]

The data required to implement this decomposition were obtained from the United Nations commodity trade database (the COMTRADE data).[25] We carried out the decomposition of the decline in US merchandise trade for the period 2000 to 2003 to match the previous analysis of employment. Unfortunately, not all countries have reported to the UN for 2003, so that the trade of some countries is excluded from the analysis. One sign of this is that US merchandise exports shown below are about 18 percent smaller than the figure shown in Table 2.5. This does not appear to have a

[24] In our actual implementation of the decomposition we have made an adjustment to the standard model, in line with the approach used earlier. In the equations shown above, world trade includes exports from all countries including US exports. The "neutral baseline" underlying the first term of the decomposition is that the US will maintain a fixed share of total world trade. The problem with that approach is that if US exports fall, this lowers total world exports. So in this formulation, the drop in US exports is being attributed in part to the drop in US exports, a circularity we want to avoid. We therefore calculate non-US world trade, being the total exports of all countries except the US, and use this as the variable that reflect the changes in world demand by commodity or country or for total manufactured trade (this procedure affects the values of the r's).

[25] The data used in the version of this paper presented in the Panel meeting in September 2004 was different from that shown here and there are some resulting differences in findings. The UN COMTRADE data became available after the panel meeting.

significant impact on the findings, as we discuss shortly when exploring the robustness of the results.

The Drop in US Exports from 2000 to 2003. The results of the full four-level decomposition are shown in Table 3.2. US exports declined by $46.2 billion over this period, about 7.2 percent. Over the same period, however, non-US world merchandise trade expanded by 23.5 percent. If the US had maintained a constant share of non-US world, then US exports would also have risen by 23.5 percent (an increase of $151.7 billion rather than the actual decline of over $46 billion).

To what extent was this decline in export share the result of the particular commodities that the US sells in world markets? It was not a commodity problem at all. The overall commodity effect was very small and it actually helped the US a little. The commodity effect helped boost US exports by a trivial 0.6 percent (about $4 billion). The US sells some products, such as high-tech goods that did not grow in line with the overall growth in world trade, but it also sells commodities, such as auto parts, autos, medical products and aircraft (including military aircraft and helicopters), that grew more rapidly. Overall, the commodity effect was almost a wash.

To what extent was the decline in market share the result of the countries to which the US sells? This factor does account for a portion of the US export weakness. The market distribution effect can explain a drop of 7.2 percent in US exports ($46.2 billion).[26] This market composition factor is heavily attributable to the importance of US trade with Canada. The role of Brazil and Europe as destinations for US exports also contributed to US export weakness over the period. Trade with Mexico was a positive for US exports, however, and so was trade with China.

It is worth summarizing the combined effect of the first three terms in the decomposition. The basic finding is that the drop in US exports was not a result of a drop in non-US world trade—world trade continued to grow 2000-2003. Trade in the countries to which the US sells did not grow as strongly as overall world trade. This softens but does not change the basic conclusion that the drop in US exports was a result of a decline in the US share of trade. That drop in share was in part a reflection of the

[26] The fact that the country effect accounts for a 7.2 percent decline which is also the actual decline is coincidence and does not hold in any of the variations of the decomposition.

bursting of the high-tech bubble, but overall, the US was not trying to sell the wrong products.

That leaves the "competitiveness" term as the key factor that accounts for the drop in US exports. "Loss of Comptitiveness" is a vague term and could refer to a number of factors. Possibly it could reflect new structural changes in US exports: for example, the entry of new competitors such as China and/or India, an improvement in the relative quality of foreign goods or a change in the sourcing patterns of US multinationals away from the US to other foreign locations. However, such structural factors have been at work for some time, and seem unlikely to be the main reason for the rather abrupt shift from rapid export growth in the 1990s to export decline in 2001 and 2002.

It is important to recall that there is always random variation in any economic time series. The "competitiveness" term includes any residual effects not captured in the other terms of the decomposition, including measurement errors. US exports grew unusually rapidly in 2000, perhaps a carry over from export orders placed in the booming 90s. Some decline, at least in the growth of exports, may well have occurred even with unchanged economic conditions.

Finally, the competitiveness term may reflect the fact that US goods became relatively more expensive because of the behavior of the exchange rate. The dollar rose in the late 1990s and continued rising until early 2002. The lagged effect of the sharp rise in the dollar was a major reason for the export decline 2000-2003, as we will see shortly.

The results of the decomposition of the US export decline were tested for robustness as follows. As we noted earlier, the calculations in Table 3.2 cover 2000 to 2003 but omit some countries for which trade data are not available. A broader set of countries is in the COMTRADE database through 2002, so we repeated the decomposition exercise for the period 2000 to 2002 using all available countries and then only the countries for which data exists in 2003. Restricting the sample of countries made virtually no difference to the results of the decomposition for 2000 to 2002, and so we infer that the same restriction in 2003 has not distorted the findings. Second, we excluded various commodities from merchandise trade such as energy products and items such as gold and "returned goods." We also ran the decomposition for manufactured goods only. These variations again made very little difference to the results and so we have reported the findings for all merchandise trade in order to be comparable to the earlier employment calculations.

The Impact of the Dollar on US Exports. To explore the dollar impact quantitatively we used a rule-of-thumb framework, based on the results found in empirically estimated export equations.[27] We assume that 25 percent of the effect of a change in the real dollar index on US exports occurs in the year after the devaluation, another 50 percent occurs in the following year and the remaining 25 percent of impact is felt with a three-year lag. The elasticity of US exports to the dollar is assumed to be either 1.5 or 1.0.

We choose as our dollar index the real index of major currencies reported by the Federal Reserve Board. We use this index because it seems reasonable to assume that US exports compete primarily with the exports of other industrial countries. Table 3.3 shows the impact of the dollar on US merchandise exports 2000 to 2003 using the lag structure described above and the two alternative elasticities of demand for exports.

Column (1) shows again the actual values of US merchandise exports in 2000-2003, the same values reported in Section 2 that are based on the US trade figures. Column (2) shows what exports would have been if the rise in the dollar had not occurred (taking into account the lags). With and elasticity of 1.5, exports would have risen by $96.8 billion between 2000 and 2003, rather than falling by $54.8 billion. Column (3) shows the dollar impact of the rise in the dollar (it is column (2) minus column (1)), while column (4) expresses the impact of the dollar in terms of the percentage effect. Column (5) simply repeats the figures given in Section 2 of the paper, showing the jobsdue to exports, including the decline of 742,000 from 3.434 million in 2000 to 2.691 million in 2003. Column (6) recalculates these numbers in the event that the dollar had not changed over the period. Productivity was growing fast enough that the number of jobs due to exports would still have declined, but by just 183 thousand. As column (7) indicates, there would have been 559,000 additional jobs due to exports if the dollar had remained

[27] See for example, Houthakker and Magee (1969), Marquez (2002), Hooper, Johnson and Marquez (1998), Mann (1999, and Goldstein and Kahn (1985). While there are some outliers, most export equations fall within the range of 1 to 1.5 on the long run elasticity with a three-year lag. Most of the estimates are based on prices rather than on the exchange rate, so we are assuming 100 percent pass-through of the exchange rate by US exporters.

unchanged, according to this estimate. This would have eliminated loss of manufacturing jobs due to trade that we identified in Section 2.

An elasticity of exports to the dollar of 1.5 is a fairly high value. If the elasticity were smaller, the impact on exports and employment would be proportionally lower. The corresponding calculations are shown in the lower half of Table 3.3. According to column (7) there would have been an additional 361,000 jobs due to exports with an unchanged dollar and an elasticity of unity. Again, the job loss due to trade would have been eliminated.

Conclusions on the Reasons for the Weakness in US Exports. Based on the analysis in this section, we conclude that the current and lagged effect of the rising dollar was the key reason for the weakness in US exports after 2000. Stronger growth in world trade would have helped US exports, but the evidence presented here says that the main reason for US export weakness was a decline in the US share of world exports. The slump in trade in high-tech products lowered US exports after 2000, but this impact was largely offset by the relative strength of demand for the other goods that the US sells in world markets. When we presented this paper, a number of alternative explanations for the weakness of US exports were presented. One argument was that the US had lost competitiveness to China. A second was that US multinational firms were increasingly sourcing their exports from foreign countries. But our analysis suggests that the impact of the dollar is sufficient to account for most of the erosion in the US share in world markets and for the negative impact of trade on employment.

The competitiveness effect reported in Table 3.2 was $155.7 billion, but that was derived from a database that excluded some countries. Adjusting the figure to be comparable to Table 3.3, by simply scaling it up, indicates a competitiveness effect of $189.4 billion in 2003. With an elasticity of 1.5 for the exchange rate, the dollar rise can explain fully 80 percent of this term. It is by far the most compelling explanation of the weakness of US exports and hence the loss of manufacturing jobs due to trade.

While the dollar appears to explain US exports, we have not tried to determine what explains the dollar. One plausible explanation is that the rapid growth associated with the technology boom in the 1990s created investment opportunities that attracted capital to the US. When the boom subsided, however, the lagged effects of the strong dollar on US exports served to compound the difficulties facing US manufactures because of stagnant domestic demand. As private capital flows subsided after 2000, they were replaced to a large extent by foreign government purchases of US assets to keep the dollar high and reduce its rate of decline.

Section 4: The Impact of Service Sector Offshoring to India on US Jobs[28]

The development of the business services sector in India, geared heavily to exporting to the United States, has added a new layer of concern about the availability of good jobs in the US. The impact of trade on US manufacturing jobs has been a matter of debate for many years, and one popular response has been to talk up the benefits of education. Manual low-skill jobs in manufacturing are shifted overseas, but American workers can still earn high wages provided they increase their level of skill and education. The increase in the return to education over the past twenty years has reinforced this idea.

The rapid growth of service sector offshoring in India has rocked this conventional wisdom. With very large numbers of college-educated, English-speaking and highly motivated workers in India, with access to telecommunications capabilities, white-collar workers in the United States now feel threatened.

This section explores the extent to which the weakness in job creation in the US service sector 2000-2003 that was noted in the beginning of this paper can be attributed to the movement of service jobs to India. As was the case for the prior discussion of manufacturing job loss, we are well aware of the fact that in a full long-term general equilibrium analysis there is no reason why an expansion of trade should induce a loss of US jobs in the aggregate. But sizing the number of jobs that may have been shifted from the US to India is important to setting service sector offshoring in the right perspective.

Sizing the Impact of India Offshoring from the NASSCOM Data.[29] NASSCOM is an Indian trade association that tracks the newly emerging business services industry in

[28] There is now a large literature on the impact of offshoring, for example, Schultze (2004) Brainard (2004), Bhagwati et al. (2004), Farrell et al (2004), Baily and Farrell (2004), Atkinson (2004) and others too numerous to include.
[29] A description of NASSCOM and a variety of data are available on their website. This section uses information collected as part of the McKinsey Global Institute (2003) case study of India offshoring.

that country. They collect data from companies that provide IT services, such as computer programming, as well as other business services such as call centers and back office processing (for banks and insurance companies, for example). These latter activities are described as business process offshoring (BPO) or information technology enabled services (ITES).

The initial impetus to the development of this industry came in part from General Electric that saw the potential for cost savings based upon the availability of a skilled low-cost workforce. In past years, foreign companies operating in Inda, and even domestic companies, have faced substantial barriers as a result of a maze of regulations and a lack of infrastructure. Reliable electric power and telecommunications were not readily available and it took a good deal of time and persistence before GE was able to start offshoring. The first movers were foreign multinationals like GE and HSBC, but the industry has shifted over time so that local companies such as Daksh, Spectramind, Infosys and Wipro, have contribute to the growth in recent years. It remains the case, however, that two thirds of the industry consists of captive producers (owned by or affiliated with foreign multinationals, largely US and British companies).

NASSCOM reports its data on a fiscal year basis, ending in the first quarter of the year and Table 4.1 shows that over the period from the 2000/2001 fiscal year to the 2003/2004 fiscal year (ending respectively in the first quarters of 2001 and 2004) there was an increase in software employment in India of 200,000. Of this total, 134, 000 employees were involved in activities exported to the US. On the assumption that this work would have required the same number of employees in the US, that is that the productivity of the US and Indian industry is the same for these activities, then this involves a transfer of 134,000 US jobs.

Table 4.2 shows a comparable computation for business process offshoring. There was an increase in employment in India of 175,500 and 140,400 of these were in activities exported to the US. With the same assumption of one-for-one job transfer, this means that there was a loss of 140,400 US jobs in this service activity.

Vivek Agrawal of McKinsey worked extensively on that case study and has provided additional assistance since then.

The assumption of comparable productivity is a strong one. Based on the evidence of persons who have studied and visited the industry, the productivity differences are mixed. There is some evidence that call centers are more productive in India because they can attract higher quality employees (college graduates in India and high school graduates in the US). Also, the jobs are not well liked by US workers so that that turnover is very high in US call centers[30]--high turnover has a negative impact on productivity. On balance, however, it is likely that productivity would be higher in the US because the higher value-added programming tends to remain in the US, with more of the routine code development carried out in India. Thus the job loss estimates are probably above the actual job losses experienced.

This conclusion is reinforced by two additional and related factors. First, some of the tasks that moved to India would have been performed by automated information technology hardware in the US and not by workers—Voice Response Units replacing call center workers for example. Second, because the services being provided from India are cheaper than they would be when provided by the US, it is likely that the amount of services purchased by US customers is greater than if Indian offshoring were not available and that these services are performed in a more labor-intensive fashion.

Table 4.3 assesses the overall magnitude of service sector offshoring to India in relation to overall US service sector employment. Adding the software and business process employment together suggests that at most about 275,000 jobs moved to India over the three-year period 2000/2001 to 2003/2004. This equals an annual average change of about 91,500. For the workers that were displaced the costs of this increase in trade was substantial. But a job shift of this size is very small compared to the typical 2.1 million service jobs created every year over the decade of the 1990s and is even small compared to the net annual job increase of about 327,000 from 2000 to 2003.

The Relation between the NASSCOM Data and BEA's Services Trade Data. According to the Bureau of Economic Analysis, *total* US services trade with India is very small indeed and the US actually runs a surplus. Moreover, the level of total services imports from India actually declined between 2000 and 2002. Figure 4.1 shows the BEA data indicating that while service imports from India rose fairly strongly from 1995 to

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[30] See for example McKinsey Global Institute, 2003.

2000, more than doubling in current dollars from about $850 million to $1.90 billion, they subsequently fell back to $1.67 billion in 2002. Service exports have been consistently larger than imports according to BEA, and have grown very rapidly over time, especially after 1999. Exports in 2002 are reported as $3.21 billion.

There is no breakdown in the BEA data to indicate the nature of the services that are traded, but the discrepancy with the NASSCOM data is clear. Total services imports from India to the US in 2002 were only $1.67 billion, whereas IT and BPO exports from India to the US, according to NASSCOM, were around $6 billion in the same year.

There are several reasons why the BEA data may understate imports from India and why the NASSCOM data may overstate exports to the US. Most likely both errors are occurring. But before dissecting this discrepancy it is worth noting one important inference to be drawn from the BEA data that was missing from the earlier discussion. The US is not simply an importer of services; it is also a significant and growing exporter of services to India. As the Indian economy grows, it is likely that it will provide an increasing market for US services and contribute to job creation in service industries where the US has a comparative advantage. The analysis of offshoring given above leaves out this part of the employment effects of services trade between the US and India.

On the data differences: The BEA data are based on company surveys that may miss a lot of the recent offshoring, as these may be destined to sectors not traditionally covered well by surveys designed to pick international trade.[31] In particular, BEA misses much of the most important part of IT service imports from India, namely the "bundled services"—the software that is sold as part of the computer hardware purchased by end-use customers. BEA may also classify some service imports as goods imports (for example if the software is to be used in a packaged software product)[32]. In addition, since much of the activity in India is taking place in companies that are subsidiaries of US companies or affiliated with them, this gives these companies some discretion about where the disbursements are booked and at what price.

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[31] Inherently, it is easier for Indian statisticians to cover a limited number of IT services exporters via surveys, than it is for the BEA to cover the entire spectrum of potential IT services importers in the US economy, especially at a time when such imports may be going to new sectors.

[32] This problem is not large, however, as the US imports less than $10mn worth of "Records, Tapes and Discs SITC End-use Category 41220) a year.

In general, the data collection and analysis at BEA is very strong and the quality of the US trade data is better and more extensive than that available from most other countries. But BEA has limited resources and can only use the data available to it from existing surveys, which were not set up to monitor service sector offshoring from India. There is generally a large statistical discrepancy in the international accounts, so we know that not all international transactions are captured. The magnitude and time series pattern of the BEA data on services imports from India seem totally out of line with the rapid growth and development of the IT and BPO industries, located in India serving the US market, that is visible to Indians themselves and to journalists and researchers from the US.

The most important reason why the NASSCOM data may exaggerate India's exports is that a fraction of the software services provided by companies reporting to NASSCOM is provided by employees who are actually located in the US—thus, for example, programmers on assignment to the US and located in the US may be counted as Indian exports if they are working under a contract to a company based in India. NASSCOM itself states on its website that 40 percent of its IT activities are associated with personnel located at the customer's site. Steven Landefeld of BEA has noted that the payments made to these persons would not be counted as imports to the US, nor in his view, should they be.[33] If this view is correct we should scale back the numbers give earlier by 40 percent for the IT jobs—call center workers and other back office workers are located in India. The estimate of the software jobs transferred would drop from 134,000 over three years to 80,400.

We chose not to scale back the earlier estimates, however, for the following reasons. First, applying the 40 percent figure for Indian personnel located in the US seems inconsistent with US visa data reported by the Department of Homeland Security (or the Immigration and Naturalization Service). In particular, the number of Indians on H1B visas in the US was only 81,000 (47,500 in computer-related fields) in 2002, *and was lower than the level in 2000*. The number on L1 visas (inter-company transfers) was only 20,400 and had also fallen since 2000. On this evidence it seems that the number of Indians transferred to US companies has been falling since 2000 not rising, so it is very

[33] Based on an email written by Steven Landefeld April 7, 2004.

hard to attribute any of the *growth* in employment reported in the NASSCOM employment data to increases in persons working in the US. Perhaps the H1B and L1 visa data are missing a lot of people, but we know that entering the US has become much more difficult since September 2001. Either there are a lot of employees of Indian companies that have green cards or US citizenship or the 40 percent figure is wrong.[34]

The second point is that this paper is exploring the decline in US payroll employment. If there are Indian workers who are employed by establishments located in India and are assigned to projects located in US companies, then these workers will not show up on the US payroll survey.[35] They are not on the payroll of a US company. From the perspective of understanding US payroll employment, it is appropriate to count these jobs as having been offshored to Indian workers and companies, regardless of how their salaries either are or should be counted in the US balance of trade data.

Finally and most importantly, the purpose of this exercise is to show that the offshoring of service sector jobs to India, so far, has been small compared to the size of service sector employment in the US. If we use the NASSOM data, we may indeed be overstating the magnitude of offshoring, but so be it. The conclusion we draw will hold even more strongly. The NASSCOM data on the offshoring of services from the US provide an upper bound on the actual value of US service imports and the jobs that were previously performed in the US and are now being performed in India.

US Employment in Occupations Likely to have been Affected by Offshoring. Given the size of the service sector in the US it is not really a surprise to find that service sector offshoring to India so far has not been that big a deal. But it is certainly possible that the impact on the US labor market of the growth of the Indian industry has been larger for IT and IT -enabled occupations. Our conclusion is that: yes, offshoring to India was large enough to have had some impact on IT jobs in the US. However, we find that employment in the IT sector has actually been surprisingly strong in the past few years, especially if you allow for the unsustainable surge in employment in 2000.

[34] Thus far we have not been able to receive clarification from Nasscom about the validity of the 40 percent figure.
[35] This was confirmed by a phone conversation with BLS staff.

Table 4.4 uses data from the OES data described above, with a focus on the occupations that may have been affected by offshoring and looks at the employment patterns between 1999 and 2003.[36]

Looking first at the computer-related service occupations there was only a modest drop in total employment in this set of occupations—about 65,500 over the period 2000 to 2003 or about 2.5 percent.[37] Moreover, as Mann (2003) has pointed out, the employment decline after 2000 followed a huge technology boom in the late 1990s, culminating in a surge of employment and investment needed to resolve the Y2K problem. The employment levels reached in 2000 were not sustainable regardless of what happened to US services trade with India. As one sign of this, employment in computer occupations was actually over 230,000 higher in 2003 than it had been in 1999.[38] The short time period make it impossible to be sure of the trends, but the figures for 1999-2003 tentatively suggest an underlying upward trend of increased employment in computer occupations over the period, with 2000 as a temporary upward jump that was followed by a temporary downward adjustment.

The table does show some shift in the mix of employment within computer occupations. The biggest job losers were computer programmers and computer support personnel where about 103,000 jobs were lost 2000-2003. For computer support personnel, there was a large surge in employment between 1999 and 2000, strongly suggesting a Y2K effect. Employment in 2003 remained above the level in 1999.

For computer programmers, however, the decline in employment likely could have been the result of offshoring to India. Table 4.4 shows a decline of 99,090 in US computer programming jobs 2000 to 2003. Our estimate of IT jobs in India from Table 4.1 suggests that as many as 134,000 jobs were created in India serving the US. We note that our estimate of the shift of jobs to India is probably too high, but nevertheless these figures indicate the possibility that the loss of US programming jobs was the result of a movement of work to India.

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[36] The table is adapted from similar tables in Mann (2003) and Kirkegaard (2004). We have benefited from their analysis of high-tech employment.

[37] Note that this section does not include the production workers in the IT hardware industry. In Section 2 we showed that manufacturing employment in the computer and semiconductor industries fell very sharply after 2000.

[38] This dataset does not have figures prior to 1999.

The working out of comparative advantage within the computer programming sector, as trade with India became cheaper and easier, is that basic programming tasks were offshored, but the higher-end activities continued to expand in the US. Between 2000 and 2003 there were increases in the employment of computer software engineers (applications and systems) even as employment of computer programmers declined. The same statement holds even more strongly from 1999 to 2003.

In short, the availability of low-cost programming services from India surely has had an impact on the industry here in the US. Indeed we would expect it to do so as US customers benefit from the effects of the input price reduction generated by the availability of low-cost programmers.

The benefits from increased services trade will be reduced if it results in the permanent loss of US human capital. This would occur if trained programmers in the US were never re-employed or moved to jobs that did not make use of the programming skills they had acquired. Based on press accounts, there is anecdotal evidence showing that indeed some US workers have experienced such a loss of human capital. One press report described a worker who had lost his job in manufacturing, taken some computer programming courses and now was unable to find work in his new field—undoubtedly a very painful experience. While in part this is attributable to offshoring, there were also misperceptions in the late 90s about the sustainability of the technology boom.

In addition, the employment data in Table 4.4 suggest that overall loss of jobs in the sector was actually a relatively small phenomenon overall. Given the slump in the US technology sector and in the *domestic* demand for IT, it is actually very surprising that employment in computer occupations fell so little between 2000 and 2003 and remains well above the 1999 employment level.

Turning to the low-wage occupations that are IT-enabled, such as telemarketers, computer operators and word-processors, the table shows that these occupations experienced substantial employment declines—nearly 300,000 over the 2000 to 03 period and well over 400,000 from 1999 through 03. The declines occurred across the board in these occupations and some of these declines probably took place because the activities were shifted overseas. In other cases, however, the declines came about because of technology. For example, word processors have declined in part because most office workers now carry out that function themselves on PCs instead of using dictation or hand-written material. Computer operators are not needed in the same numbers because of the shift away from mainframes.

It is notable that the wage levels for these occupations are not very high—in the $10 to $15 an hour range. That is better than the minimum wage, certainly, but it would not be that difficult to replace such a job in most urban labor markets. Voluntary turnover rates are pretty high among positions at that level. We do not wish to minimize the personal cost faced by those whose jobs are shifted overseas, but to the extent that these jobs have been offshored, the labor market adjustment cost should not be very high.

Conclusions on the Extent of Offshoring to India. Even under assumptions that may overstate the extent of the offshoring of service sector jobs to India, we find that the importance of this phenomenon to the US labor market has been greatly exaggerated by the press and popular discussion of the issue. The numbers so far, suggest that the number of jobs transferred to India is tiny relative to employment in the US service sector. Looking more narrowly at computer occupations, we find that the net job loss for computer programmers in the US likely occurred because of offshoring. However, the surprising fact is how relatively well the computer services category of employment has done in recent years, given the weakness in the US domestic demand for technology services.

One response to this conclusion is to argue that maybe what has happened so far is minor, but in the future, the US labor market will be strongly adversely affected by the offshoring of service sector jobs in the future. We explore that possibility in the next section.

Section 5: The Impact of Expected Future Service Sector Offshoring

The debate over the effects of electronic offshoring in the long run has reflected a variety of concerns. First, will it make the US as a whole better off? Trade theory suggests several possibilities. First, to the degree that information technology lowers the cost of services the US imports, the impact will be positive: Some producers could be hurt but we know that when markets are competitive, the gains to consumers from lower priced imports outweigh the losses to producers.[39] Second, to the degree that information technology increases the range of services that are tradable, again welfare will be improved. We know that opening up a closed economy to trade improves welfare, and this is an analogous shift: sectors that were once self-sufficient now become tradable. Third, to the degree that the ability to outsource electronically allows foreigners to compete with US exports, this could reduce America's terms of trade, and thus reduce US welfare.[40] In addition to the impact on welfare, it is also of some interest to think about the impact electronic outsourcing on the structure of US employment. In particular, in the short run the US may be able to run bigger trade deficits, but over the long run the US will have to pay for the additional services in imports by exporting more goods and services or reducing imports of other goods and services. While outsourcing could mean fewer services jobs in some sectors, therefore, it could also mean more jobs in goods and services that are tradable. Indeed, scenarios with declines in the US terms of trade could mean more jobs in tradables than those in which the terms of trade improve.

The first issue is how large is outsourcing likely to be? While any forecast of the magnitude of service sector offshoring in the future is bound to be subject to great uncertainty, the most frequently quoted figures come from Forrester (2004), which suggest that 3.4 million US service jobs will be offshored by 2015 (to India and other countries). This study and the 3.4 million figure are used by those who argue that the offshoring of US service jobs is going to have major effects on the economy going forward, whether or not it has had major effects so far.

Forrester made their estimates by means of a series of company interviews both in the US and in India. They attempted to assess which US occupations were amenable to offshoring; the skills available overseas and the investments being made or planned to develop capabilities overseas.[41]

Forrester finds that 315,000 service jobs had been offshored by 2003 and that an additional 3.1 million jobs would move offshore by 2015—giving a total of 3.4 million by 2015, the Forrester headline number. By far the largest occupational category is office

[39] Bhagwati, Panagaryia, and Srnivasan (2004) point out, there is also the possibility that a whole new set of inputs could become available because of electronic outsourcing. In this case, all factors of production in the USA could gain.
[40] See Samuelson for an exploration of this effect.
[41] Forrester (2004) Page 4.

workers, accounting for nearly half of the jobs, but they suggest a range of possible employment categories could be offshored, including computer, business, management and sales workers, and also workers in architecture and life sciences (op. cit. p. 5).

The Forrester numbers have been criticized in part because it is intrinsically difficult or impossible to make such estimates. No one should bet the rent on the validity of the Forrester numbers, but they are sufficiently interesting for their implications to be explored. Moreover, in different simulation runs we used some alternative assumptions about the magnitude of offshoring. The results were roughly linear, so that someone who believes offshoring will be half as great or twice as great can, as a first approximation, halve or double the results reported here for the impact on the economy.

To formulate the simulations we worked with Ben Herzon and Joel Prakken of Macroeconomic Advisers (MA) to see how the level of offshoring predicted by Forrester would impact the economy.[42] The tricky part is to capture in a sensible fashion the impact of the "shock" to the economy provided by the rapid increase in service sector offshoring. We experimented with various approaches and we will report the two that, together, provide the most helpful insights. The impact of offshoring is inferred from the deviations of the "offshoring simulations" from MA's baseline simulation and that means that it worth starting out with a sense of what the baseline looks like.

The MA Baseline Scenario. MA's long-term simulations do not attempt to capture cyclical variations of the economy more than a few quarters out. This is standard practice for such forecasting models; for example, the CEA/OMB Administration forecasts and the CBO economic assumptions used for budget forecasting have the same property. The baseline simulation embodies an implicit Federal Reserve reaction function that ensures that, in the absence of shocks, the economy remains close to full employment, assumed to be at an unemployment rate of around 5.3 percent. The baseline used for this paper uses actual data through the first quarter of 2004 and does not reflect the increases in oil prices and the weakening of the US economy that occurred in mid-2004 (what Alan Greenspan has referred to as a "soft patch"). In the baseline, the US

[42] While we have benefited greatly from the assistance of MA, the resulting simulations should not be taken as a prediction by that organization of the future impact of offshoring.

economy continues its recovery from cyclical weakness and the unemployment rate falls to its target range by the end of 2004.

These characteristics of the baseline mean, together with the gradual smooth ramp up of offshoring that is built into the Forrester estimates, that for our purposes there is little significant information to be obtained from the quarter-to-quarter evolution of the economic variables. We compare the starting point of the baseline (in the first quarter of 2004) with the end point in the fourth quarter of 2015. The variables evolve relatively smoothly during the intermediate years.

When the MA model is run without adjustments, it predicts continuing large current account deficits for the US. However, MA's current thinking is that large current account deficits are not be sustainable going forward and that the dollar will decline substantially over the next ten years or so.[43] The baseline simulation therefore shows a gradual decline in the dollar exchange rate of around 21 percent and a reduction of the US current account deficit to around $100 billion—a half of one percent of the predicted 20 trillion current dollar GDP in 2015 Q4. The downward adjustment of the current account, accompanied by a shift from negative real net exports to positive net exports, is accomplished without imposing excessively high interest rates because there is assumed to be substantial reduction in the federal budget deficit over the same period. The baseline builds in a rather smooth resolution of the two big deficit problems facing today's economy.

Table 5.1 shows the values for a range of variables in the starting and ending quarters of the baseline and gives their growth rates when appropriate. Over the 11.75-year period, real GDP grows at 2.9 percent a year and inflation averages a bit under 2.0 percent a year. Payroll employment rises at 1.2 percent a year over the period and non-farm business labor productivity growth is at 2.3 percent a year. The decline in the dollar contributes to strong growth of real US merchandise exports, at a rate of 7.3 percent a year and real service export growth is similar. Since trend productivity growth in the manufacturing sector is lower than 7.3 percent a year, the implied growth of real exports

[43] It is notoriously difficult to model exchange rate determination econometrically and, in particular, it is very difficult to capture the downward pressure on the dollar that will likely come about (in part has come about) as dollar assets rise as a share of the portfolio of the rest of the world.

would contribute positively to manufacturing employment in this baseline simulation. The baseline simulation implies that trade will increase manufacturing employment going forward. Real non-petroleum imports are dampened by the fall in the dollar and grow at 5.6 percent a year. Real petroleum imports (not shown) grow even more slowly. Real service imports in the baseline are also dampened by the dollar decline and by rising prices and grow relatively slowly.

The baseline projections can be combined with our estimates of employment due to exports and imports in 2003 as reported in Table 2.4 to provide estimates of changes in employment due to trade between 2003 and 2015. To do this it is necessary to make an assumption about labor productivity growth in manufacturing associated with a 2.3 percent annual average growth rate for non-farm business. Fortunately, for our purposes it turns out that between 1992 and 2003, output per hour in non-farm business averaged 2.3 percent, a rate that is identical to that assumed in the baseline. Since output per man-hour in manufacturing between 1992 and 2003 averaged 3.9 percent, we assume that between 2003 and 2015 manufacturing productivity will again average 3.9 percent. This leads us to conclude that, in the baseline employment due to exports will increase by (7.3 – 3.9) i.e. 3.4 percent while employment due to imports will rise at (5.6 – 3.9 percent) i.e. 1.5 percent per year. This performance in merchandise trade will boost manufacturing employment by 316 thousand jobs by 2015.

Different people have different views about the future path of the US economy. Some have argued that there may have to be an economic crisis before the deficit problems are resolved. Terrorism or other shocks could disrupt economic growth. Others argue that large US current account and/or budget deficits can continue indefinitely. However, the MA baseline looks exactly right for the purpose here. We want to abstract from other economic issues and focus on the impact of offshoring. The extent to which service sector offshoring might interact with other shocks, we leave to others to determine.

The Macroeconomic Effect of Service Sector Offshoring: Adding More Imports. One simple way to model the impact of service offshoring is to impose on the model an increase in the demand for service imports. We asked MA to add-factor the service import equation up. Using the Forrester employment and US wage-cost numbers as a basis, we estimated what the increase in imports would be, with the assumption that the imported services would cost only 50 percent of the cost of supplying the equivalent services domestically.[44]

If the dollar is left unchanged the increase in imports translates into an increased current account deficit. We judged that a more neutral comparison with the baseline would be to impose an additional decline in the dollar as a result of the increased offshoring in order to keep current account the same as in the baseline.

Table 5.2 summarizes the results of this simulation. An increase in imports is an immediate negative to GDP in the model and in order to preserve employment this negative shock to demand has to be offset by Fed policy. Over time, however, the greater decline in the dollar stimulates exports and slows real imports. By the end of the simulation run, the dollar is down by 7.5 percent compared to the baseline and this has increased real merchandise exports and reduced real merchandise imports. The lower dollar has pushed inflation up a little and pushed up interest rates. With the higher interest rates, there is a slight reduction in productivity and real GDP is down very slightly by 2015. In this simulation, the increase in service imports has generated increased merchandise exports to help pay for the increased imports. This in turn has required a real devaluation of the dollar and thus a reduction in the US terms of trade. This also has employment consequences for manufacturing.

In Table 5.2, compared with the baseline, the value of exports increases by $137.1 billion or 6.7 percent, while the value of imports falls by 1.2 percent. We estimate that this shift would lead to an additional 335 thousand jobs in manufacturing in 2015. This highlights the fact that the once the current account is adjusted, the impact of increased spending on services imports, leads to increased employment in manufacturing.

In summary, this simulation run, modeled as a case where the US has, effectively, developed an increased taste for service imports, shows up as a modest negative for the economy--inflation, productivity and the terms of trade have all been negatively affected.

[44] The 50 percent figure is our estimate based on McKinsey Global Institute (2003). Thanks also to Sunil Patel of NASSCOM for comments. If anything, the cost would be somewhat less than 50 percent—in the 45-50 percent range. It is possible that the relative cost calculation would change over time as the foreign industry expands. However, Indian businesses are expanding their operations outside of their current region to avoid rising labor costs and other countries are investing in the infrastructure and language training that would allow them to enter the market.

The job displacement happens slowly, based on the Forrester assessment, and this allows Fed policy to maintain full employment. The MA model is a general equilibrium model and it predicts most of workers displaced from their jobs will find new ones. There is a predicted boost to manufacturing employment, although overall employment is essentially the same in this simulation run as it is in the baseline.

The Impact of Offshoring—A Decline in the Price of Service Imports. The previous simulation is a useful starting point, but it does not reflect the underlying economics of service sector offshoring. What is the underlying shock that is triggering the increased offshoring that Forrester is predicting? Presumably, it is that improved technology and infrastructure combined with capital and training has lowered the price that the US pays for service sector imports. As a result, the US buys more of them. For any given value of the dollar, the decline in import prices is an improvement in the US terms of trade.

US companies find they can produce the same level of sales or gross output with fewer domestic workers. Initially, their profitability rises as they sell at the same price domestically with reduced costs (they pay only 50 percent of the cost for the activities they offshore). Over time, competition works to lower prices and distributes the benefits back to consumers. The level of productivity will rise within the companies doing the offshoring. They buy more foreign inputs but they save labor and, since they have reduced costs, their productivity is higher. Productivity will rise for the US economy as a whole if the workers and capital displaced by the increased service imports are employed in activities that generate more than enough real output to pay for the increase in real service imports.

In order to capture this process, MA add-factored the price of service imports down by an amount large enough to induce an increase in the real quantity of service imports that, in turn, was large enough to displace the number of workers that Forrester predicts will be displaced. In the same quarter in which the increased offshoring takes place, there is a contemporaneous drop in payroll employment and a rise in productivity and corporate profits. Over time, domestic prices fall and Fed policy acts to restore employment. Domestic workers that are displaced are reabsorbed into the economy, according the normal dynamics built into the MA model.

Table 5.3 summarizes the results of the simulations. Offshoring in the magnitude suggested by Forrester is enough to contribute 0.2 percent a year to additional GDP growth and nearly 0.3 percent a year to non-farm business labor productivity. Real GDP is $384 billion higher by 2015. Total employment and unemployment are essentially the same as in the baseline. The inflation rate has been lowered by 0.25 percent a year, even though the dollar is down 4.8 percent.

As you would expect, real service imports are higher in this simulation, but in current dollars service imports are actually slightly lower. The fall in the price of imports has meant the US can buy more real imports for the same dollar cost. The decline in the dollar has partially offset the opening up of the low-cost offshoring opportunity.[45]

Table 5.3 shows that the values of merchandise exports and imports both rise – by 101.6 and 63.5 billion respectively relative to the baseline. In this scenario, manufacturing employment due to trade increases by 62 thousand jobs. In both simulations, therefore, we see that over the long run, more services imports implies more jobs in manufacturing.

The idea that offshoring could raise US productivity and hence US GDP is not a surprise. That is, after all what we expect to be the benefit of expanded trade. The magnitude of the increments to these variables is surprising—it is larger than we anticipated. It is not easy to determine how the structure of a large macro model plays out, but it seems that the reason why there is a "multiplier effect" of offshoring on real GDP is that the Fed follows a path of lower interest rates in this simulation. It does that because domestic labor is being released as a result of the job displacement and because inflation is lower as a result of the cheap service imports. In the MA model, the lower interest rates have a positive impact on domestic investment and this contributes to the growth in productivity and hence GDP.

Whether or not the magnitude of the impact on GDP that is predicted in this simulation is correct, the model is providing a valid lesson. The impact of offshoring that is being captured in the second run is basically the same as a trade opening, such as a

[45] The decline in the dollar has increased merchandise exports in these results. That is plausible enough, but was not a result that was robust across the different model runs. The MA model's price equations capture relative price effects between traded goods and services prices and the price of domestic production. Depending on the specification, these effects can eliminate the increase in merchandise exports.

reduction in tariffs and an expansion of real trade. There is a range of empirical evidence that supports the view that trade expansion results in higher GDP—see Cline (2004) for a summary of the evidence and references.

Wages and Profits. The simulations run on the MA model do not tell us about the distribution of wages across different types of worker, but they do make a prediction about total wages (compensation of employees) and profits. Table 5.4 gives the findings. The simulation in which the service import equation was add-factored up had a negative effect on the economy. Table 5.4 indicates that this negative effect is imposed on employees. Real compensation is reduced by nearly $160 billion by 2015, a reduction of 1.9 percent. Profits remain essentially unaffected in this simulation.

The simulation in which the price of imports is reduced had benefits to the economy and these are shared by labor and capital. Real compensation is increased by $209 billion and profits by $142 billion. The increase in profits represents a much larger percentage increase (11.4 percent) than the increase in compensation (2.5 percent). Offshoring has shifted the distribution of income towards profits. In this simulation, the initial impact of the offshoring is to increase profits and displace labor. Over time, competition and higher productivity result in lower prices and that is what increases real compensation. But higher profits are a persistent consequence of the ongoing process of offshoring. It is not a surprising result to find that if the US economy becomes more exposed to low-cost labor then this will shift the distribution of income towards capital. Employees as a whole are better off in this simulation, however.

Section 6: Conclusion

This paper started by pointing to the large and sustained drop in payroll employment that followed the end of the 1990s boom and has used a variety of evidence to suggest trade and offshoring were not major reasons for this decline. The weakness in US exports did contribute to the job loss, however.

So what is the explanation of the job weakness? Schulze (2004) has argued that the main cause is rapid productivity growth. We agree that rapid productivity may be playing some role, but it is a mistake to place too much emphasis on this factor as a fundamental cause.

In most textbooks, an increase in productivity implies an outward shift in the aggregate supply curve that results in a lower price level and a higher level of output, for any given aggregate demand schedule. There is no presumption that employment will fall; indeed to the extent that increased productivity results in a higher marginal product of labor and wages are sticky, there should be an increase in employment.

In addition to this, there have been two previous shifts in the productivity trend in the postwar US economy that can tell us how productivity affects aggregate employment. In the 1970s a decline in productivity growth combined with the additional adverse supply shock of rising food and energy prices resulted in a sharp recession with a higher price level and much lower employment. In that case, lower productivity growth contributed to higher inflation and to recession. In the second half of the 1990s an acceleration of productivity growth was followed by continued strong employment growth and the lowest unemployment rate of a generation. The more rapid growth of aggregate supply was more than balanced by growth in aggregate demand. And since faster productivity growth contributed to rising real incomes and a rising stock market, the increased supply was helping generate increased demand.

In sum, the two prior instances of changes in the trend rate of productivity growth (after 1973 and after 1995) do not support the hypothesis that faster aggregate productivity growth has caused lower employment. At the least, the 1990s show that faster productivity growth does not automatically generate weak employment.

Rapid productivity growth after 2000 did raise the bar, however. It meant that aggregate demand would have had to grow strongly in order to maintain employment growth and that did not occur. With strongly expansionary monetary and fiscal policies, the recession of 2001 was very mild and the employment drop was not unusual. The puzzle has been the failure of demand and employment to recover strongly enough after 2001. The reasons for this include the uncertainty resulting from 9/11 and the war in Iraq, the direct effect of higher oil prices, the over hang of high investment from the late 1990s, the weakness of the stock market (only partially offset by the recovery in 2003) and, as we emphasized in this paper, the lagged impact of the strong dollar in the aftermath of the Asian financial crisis. The drop in US capital goods investment, notably the decline in the demand for high-tech products, contributed to the weakness of manufacturing employment. Monetary and fiscal policies, though expansionary were not powerful enough to offset these negatives. Fiscal policy was more effective at increasing the budget deficit than at spurring demand. Monetary policy was about as expansionary as it could be and it certainly helped sustain housing and auto demand. But past history suggests that low interest rates may have a limited impact on aggregate demand in the presence of business and consumer uncertainty, especially given the lower bound on nominal interest rates.

We do not suggest the US economy is mired in perpetual job weakness, however. The economy has repeatedly demonstrated its ability to recover, and we expect aggregate demand and employment to increase going forward, barring a new oil shock or terrorist attack.

Since trade and offshoring were not the main reasons for the employment weakness, they should not be the focus of policies to restore employment. Since imports were not the reason for the job loss, there is not an employment case for trade restrictions to curtail imports.

The best trade-related remedy for manufacturing employment is a lower value of the US dollar and sustained recovery of the world economy. Since those outcomes are desirable for other reasons, it would be helpful to see them occur. In the late 1990s, when domestic demand in the United States was booming, the strong dollar helped relieve pressures on the US labor market by reducing exports and stimulating imports. It would certainly have been inadvisable and inflationary for the US to have reduced interest rates in an effort to weaken the dollar in 1999 and 2000. However, once the economy fell into a recession the lagged impact of the strong dollar contributed to labor market weakenss.

US policymakers have limited power to affect the dollar and the strength of the world economy. However, once the overall recovery is well established, a sustained effort to reduce the federal budget deficit would help lower interest rates, reduce the overvaluation of the dollar and would be good policy in any case. The best policies to ameliorate the adverse effects of job reallocation caused by trade are trade adjustment assistance programs and opportunities for workers to improve their skill levels.

Data Sources for Section 2.

A. **Output:**

- Output Data: 2000-2002 US manufacturing output (BEA)
  http://www.bea.doc.gov/bea/dn2/iedguide.htm#IIB.
  Se the README file to translate it to NIACS
- Industrial production data:
  http://www.federalreserve.gov/pubs/bulletin/2004/winter04_ip.pdf
- Producer Price Index. Industry Data
  http://data.bls.gov

B. **Input-Output:**

- 1997 I-O Industry-by-Commodities Total Requirements (3 digits) . Department of Commerce: Bureau of Economic Analysis.
  http://www.bea.doc.gov/bea/dn2/i-o_benchmark.htm

C. **Trade:**

- http://dataweb.usitc.gov/scripts/user_set.asp (imports and exports at 2, 3 and 4 digits NAICS desegregation)

D. **Employment**

- http://www.bls.gov/ces/home.htm

E. **Output:**

- Output Data: 2000-2002 US manufacturing output (BEA)
  http://www.bea.doc.gov/bea/dn2/iedguide.htm#IIB.
  Se the README file to translate it to NIACS
- Industrial production data:
  http://www.federalreserve.gov/pubs/bulletin/2004/winter04_ip.pdf
- Producer Price Index. Industry Data
  http://data.bls.gov

F. **Input-Output:**

- 1997 I-O Industry-by-Commodities Total Requirements (3 digits) . Department of Commerce: Bureau of Economic Analysis.

http://www.bea.doc.gov/bea/dn2/i-o_benchmark.htm

G. <u>Trade:</u>

- http://dataweb.usitc.gov/scripts/user_set.asp (imports and exports at 2, 3 and 4 digits NAICS desegregation)

H. <u>Employment</u>

- http://www.bls.gov/ces/home.htm

Figure 1.1: Total Non-Farm Payroll Employment, Months before and after Business Cycle Trough (Trough = Index Value 100)

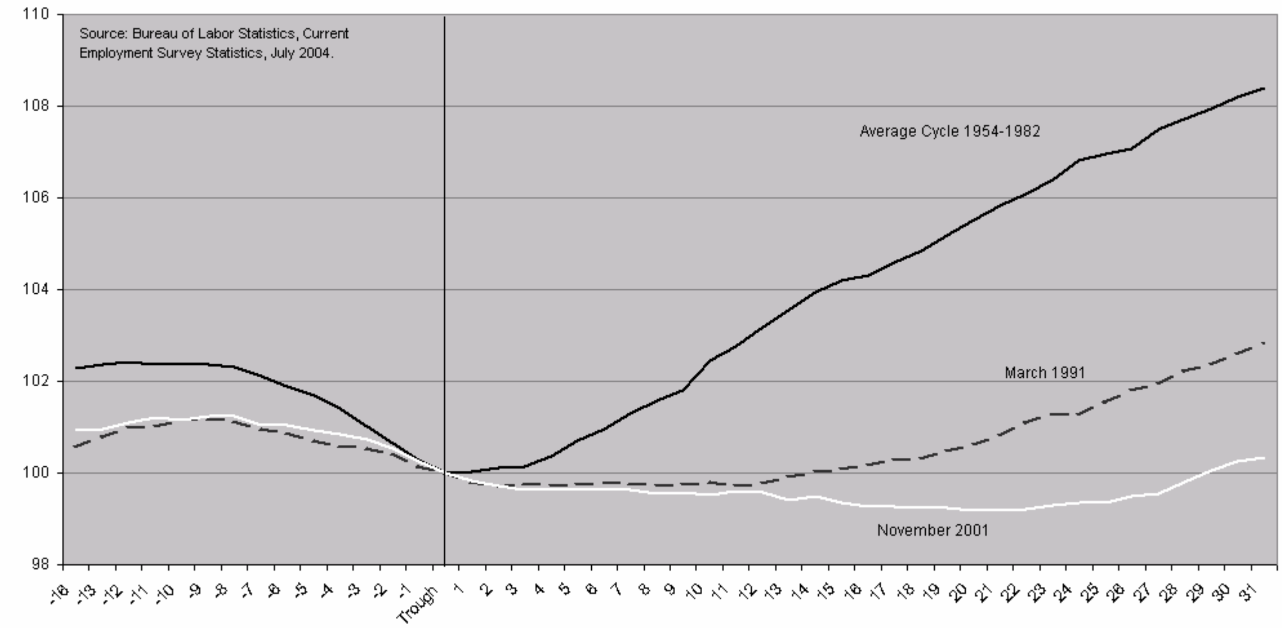

Figure 1.2: Average Annual Job Gains and Losses 1990-2000 and 2000-2003 by NAICS Super Sectors

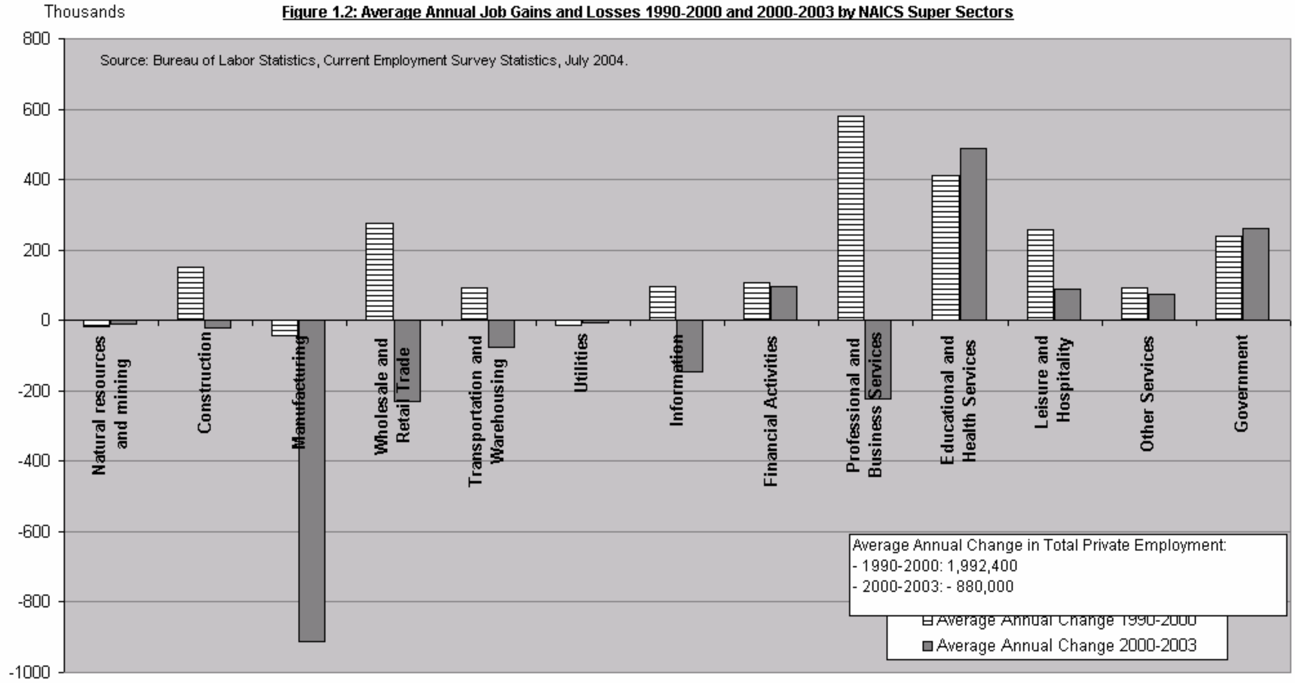

Figure 1.3: Job Change 2000-2003 by occupation sorted by annual median wage

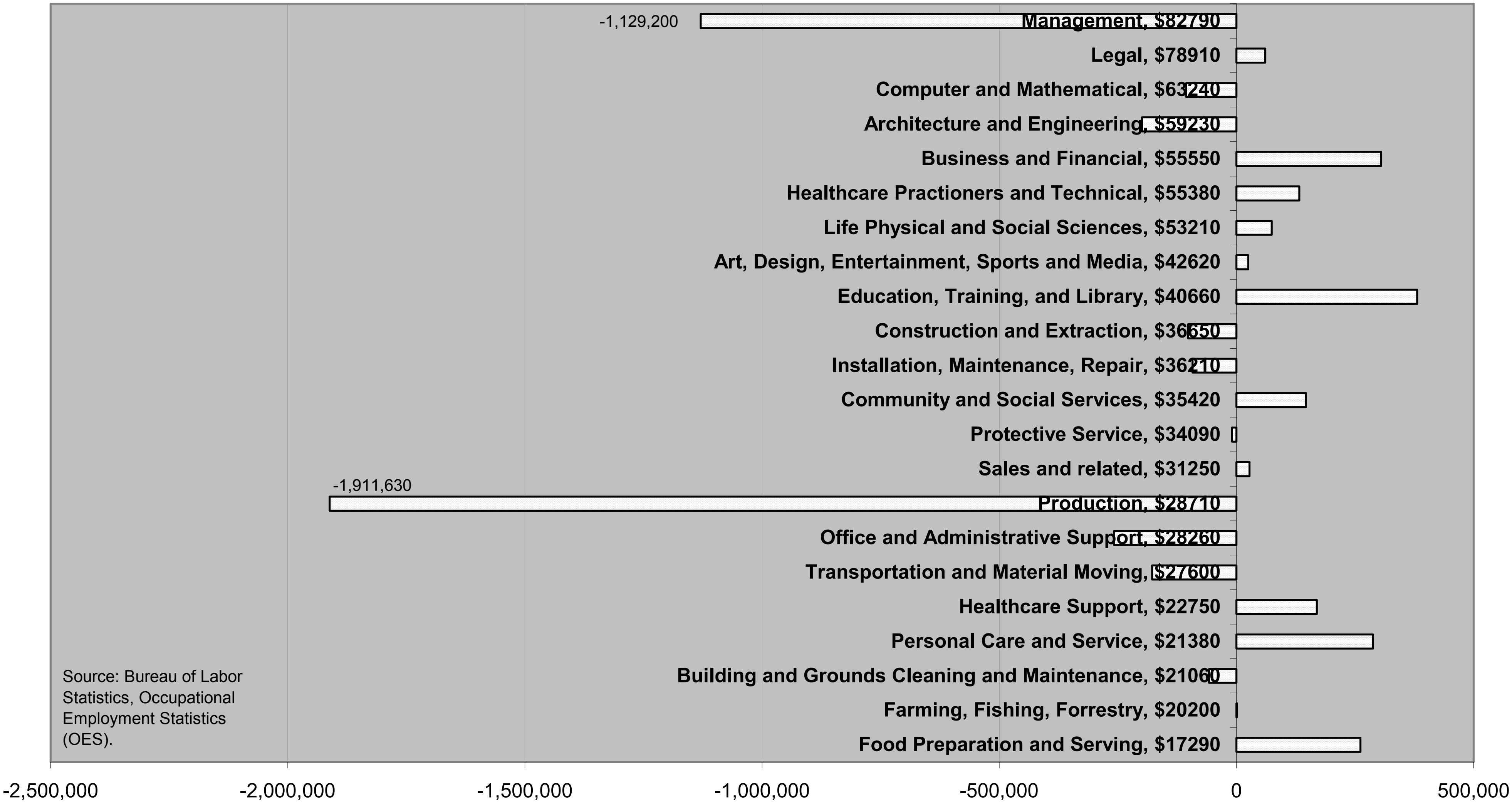

Figure 2.1: NAICS manufacturing employment thousands of workers, seasonally adjusted

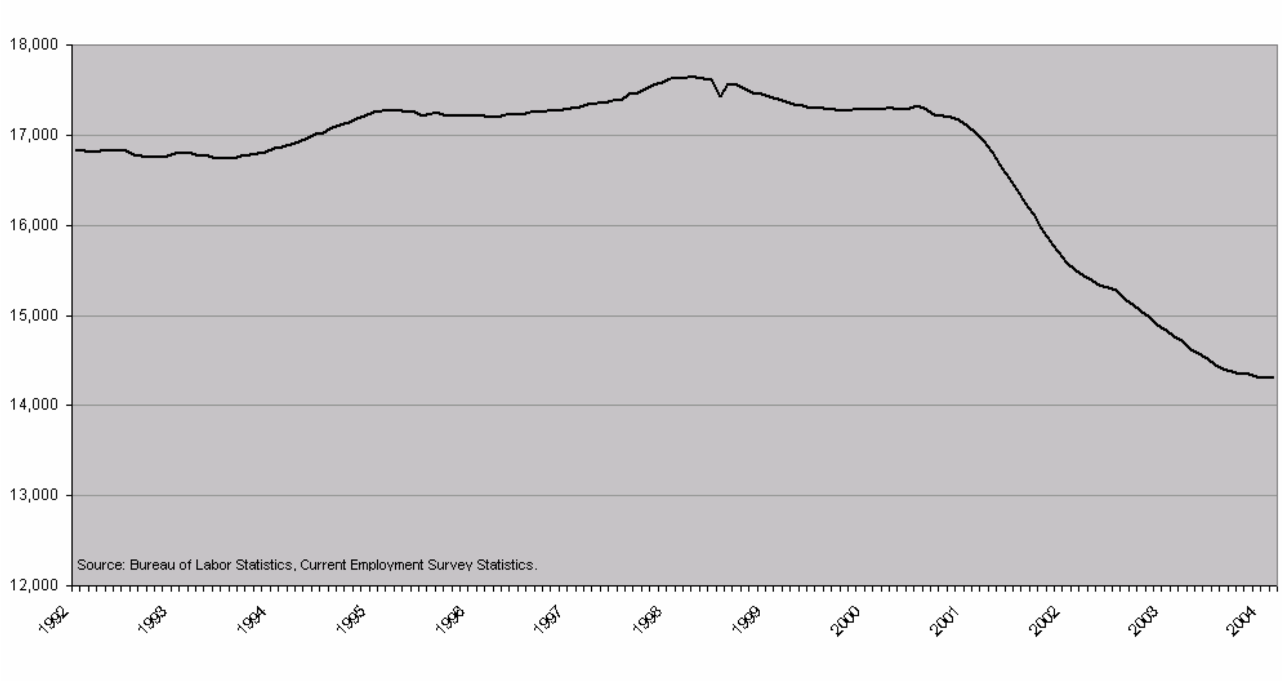

Table 2.1: Manufacturing Industries: Changes 2000-2003

	Employment 2000 (thousands)	Employment change (thousands)	Percent	%VA	%VA/E	%X	%M	Change in Trade Balance 2000-2003 (billions)
Computer and electronic products	1863.50	-531.30	-28.5	-13.54	20.95	-23.56	-15.16	-8.09
Machinery	1452.60	-312.20	-21.5	-9.53	15.23	-16.46	-2.26	-12.98
Fabricated metal products	1761.70	-290.50	-16.5	-11.66	5.78	-11.12	7.51	-4.67
Apparel and leather and allied products	537.00	-195.00	-36.3	-23.48	20.15	-27.20	5.88	-8.03
Textile mills and textile product mills	581.50	-166.20	-28.6	-23.47	7.15	2.01	15.74	-2.08
Motor vehicles, bodies and trailers, and parts	1283.46	-164.15	-12.8	3.12	18.25	-20.10	-6.82	-5.80
Primary metals	611.60	-147.00	-24.0	-20.79	4.27	-11.04	-22.78	7.62
Electrical equipment, appliances, and component:	587.70	-136.50	-23.2	-10.76	16.24	-15.23	6.68	-6.85
Plastics and rubber products	940.30	-134.50	-14.3	-7.09	8.42	-6.80	17.89	-4.34
Printing and related support activities	801.00	-130.90	-16.3	-9.25	8.48	-2.23	12.02	-0.62
Furniture and related products	676.10	-106.80	-15.8	-9.53	7.44	-15.82	25.82	-4.51
Other transportation equipment	737.74	-94.35	-12.8	-1.18	13.31	-13.39	1.47	-7.17
Paper products	599.30	-89.00	-14.9	-15.27	-0.49	-9.23	-3.48	-0.81
Miscellaneous manufacturing	734.10	-82.20	-11.2	-0.09	12.51	20.24	15.48	-3.83
Chemical products	975.20	-79.30	-8.1	8.18	17.76	13.40	36.28	-15.33
Nonmetallic mineral products	553.60	-66.10	-11.9	-3.06	10.09	-21.63	-2.61	-1.38
Food and beverage and tobacco products	1762.70	-58.10	-3.3	7.81	11.48	-0.42	26.65	-7.53
Wood products	593.50	-56.90	-9.6	2.35	13.20	-19.63	7.74	-2.18
Petroleum and coal products	122.10	-9.70	-7.9	-7.01	1.02	6.98	9.59	-1.81

Source: Bureau of Labor Statistics, Current Employment Survey Statistics; U.S. International Trade Commission; Bureau of Economic Analysis.

Table 2.2: Manufacturing in the Economy : 2000 - 2003

	2000	2003	change (2003-2000)	percent change
Output (billions)				
GDP	9817	10987.9		11.9
Manufacuring GDP	1426.2	1392.8		-2.3
Share	14.52786	12.67576		
Employment (millions)				
Non-Farm Payrolls	131.8	129.9	-1.9	-1.4
Manufacturing Payrolls	17.3	14.5	-2.8	-16.2
Share				
Productivity				
Manufacuring GDP/Employee	82.6	95.9		16.1
Manufacturing Output/Hour (bls)	134.2	154.6		15.2
Merchandise Trade (billions)*				
Exports	784.3	726.4	-57.9	-7.4
Imports	1243.5	1282	38.5	3.1
Balance	-459.2	-555.6	-96.4	21.0
Manufacturing Exports	707.2	644.9	-62.3	-8.8
Manufacturing Imports	1024.4	1048	23.6	2.3
Manufacturing Trade Balance	-317	-403.1	-86.1	27.2

Source: Bureau of Labor Statistics; Bureau of Economic Analysis; U.S. International Trade Commission. *Merchandise Trade data is from the National Income and Product Accounts (BEA), August 27, 2004 Revision.

Figure 2.2: Manufacturing Trade Deficit as a share of Manufacturing value added and gross output, 1989-2003

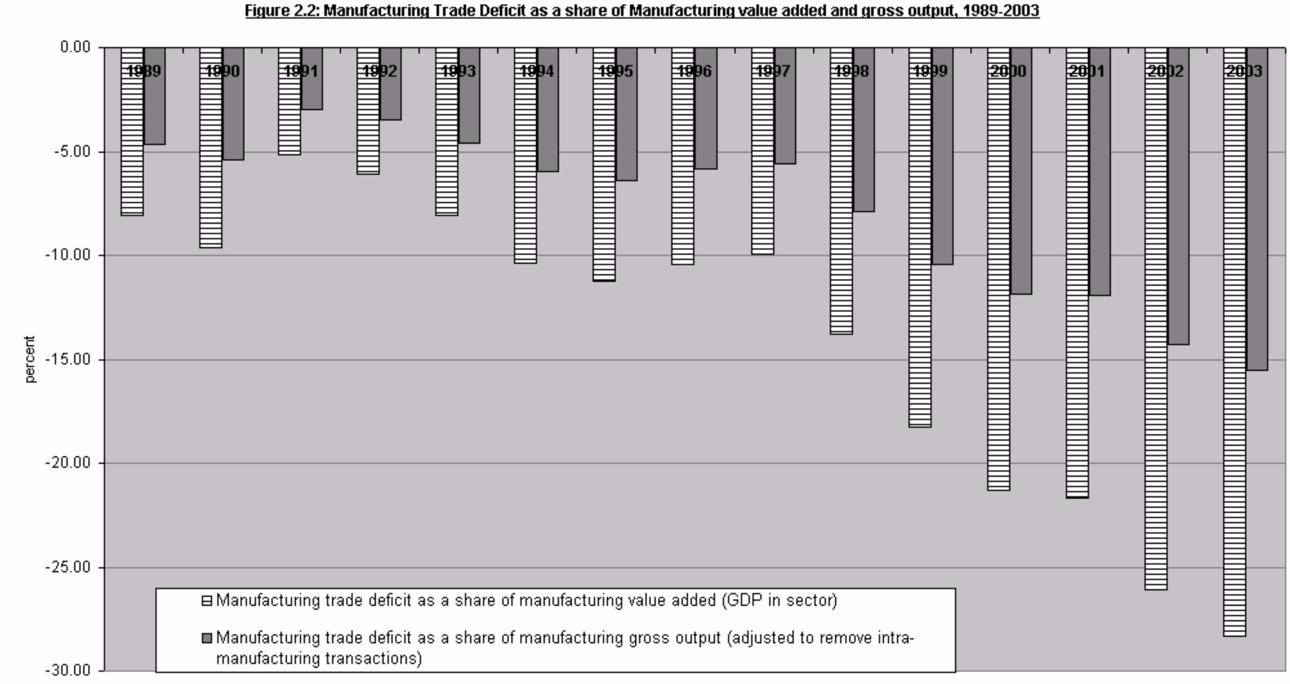

Table 2.3: Manufacturing: Sources of Employment Change
(millions)

	Total	Domestic Use	Trade	Exports	Imports
2000	17.175	18.685	-1.510	3.434	-4.944
2002	14.899	16.532	-1.633	2.739	-4.372
2003	14.324	16.148	-1.824	2.691	-4.515
2000-2003	-2.851	-2.537	-0.314	-0.742	0.429

Source: Bureau of Labor Statistics, Current Employment Survey Statistics; Bureau of Economic Analysis, Input-Output Tables; authors' calculations.

Table 2.4: Manufacturing Industry Employment: Sources of Change 2000 to 2003

	Employment 2000 (thousands)	Change 2000-2003 (thousands)	Change 2000-2003 (percent)	of which Domestic use	Trade	of which Exports	Imports	Employment Share due to Exports 2000	2004
Computer and electronic products	1863.5	-531.3	-28.5	-28.7	0.2	-14.8	15.0	41.3	37.0
Machinery	1452.6	-312.2	-21.5	-17.5	-4.0	-8.1	4.1	30.0	27.9
Fabricated metal products	1761.7	-290.5	-16.5	-13.5	-3.0	-3.6	0.6	20.7	20.4
Apparel and leather and allied products	537.0	-195.0	-36.3	-40.6	4.3	-3.6	7.9	9.6	9.4
Textile mills and textile product mills	581.5	-166.2	-28.6	-24.2	-4.4	-2.9	-1.6	24.4	30.1
Motor vehicles, bodies and trailers, and parts	1283.5	-164.1	-12.8	-11.6	-1.2	-2.8	1.7	9.0	7.1
Primary metals	611.6	-147.0	-24.0	-23.4	-0.6	-8.2	7.6	49.2	54.0
Electrical equipment, appliances, and component	587.7	-136.5	-23.2	-20.2	-3.0	-6.8	3.8	24.9	23.6
Plastics and rubber products	940.3	-134.5	-14.3	-3.4	-10.9	-10.5	-0.5	27.3	19.7
Printing and related support activities	801.0	-130.9	-16.3	-15.3	-1.1	-1.2	0.1	9.0	9.3
Furniture and related products	676.1	-106.8	-15.8	-11.9	-3.9	-0.9	-3.0	4.3	4.1
Other transportation equipment	737.7	-94.4	-12.8	-8.7	-4.1	-7.0	2.9	29.6	25.9
Paper products	599.3	-89.0	-14.9	-12.6	-2.3	-1.5	-0.8	20.5	22.3
Miscellaneous manufacturing	734.1	-82.2	-11.2	-11.2	0.0	0.7	-0.7	15.7	18.5
Chemical products	975.2	-79.3	-8.1	9.0	-17.1	-15.9	-1.2	41.3	27.6
Nonmetallic mineral products	553.6	-66.1	-11.9	-10.7	-1.2	-3.4	2.2	13.7	11.7
Food and beverage and tobacco products	1762.7	-58.1	-3.3	-1.7	-1.6	-0.8	-0.8	8.0	7.5
Wood products	593.5	-56.9	-9.6	-8.1	-1.5	-2.5	1.0	10.6	9.0
Petroleum and coal products	122.1	-9.7	-7.9	-4.2	-3.8	-0.1	-3.7	22.7	24.6
Total Manufacturing	17174.7	-2850.7	-16.6	-13.4	-3.2	-5.8	2.6	22.4	20.0

Source: Bureau of Labor Statistics, Current Employment Survey Statistics; Bureau of Economic Analysis, Input-Output Tables; authors' calculations.

Table 2.5: National Income Accounts: Goods Output

		2000	2003	2004	% Change 2003/2000
2000 chain-weighted dollars (billions)					
A.	GDP	9817.00	10381.30	10697.5	5.7
B.	Goods GDP	3449.30	3581.80	3784.8	3.8
C.	Merchandise Imports	1243.50	1307.30	1394.1	5.1
D.	Merchandise Exports	784.30	721.70	767.2	-8.0
E. (B+C-D)	Domestic Use (C+I+G)	3908.50	4167.40	4411.70	6.6
F. (C/E)	Import share of US Goods Market	0.318	0.314	0.316	-1.4
G. (D/B)	Export share of US Production	0.227	0.201	0.203	-11.4
Current dollars (billions)					
A.	GDP	9817.00	11004	11557.85	12.1
B.	Goods GDP	3449.30	3564.5	3779.4	3.3
C.	Merchandise Imports	1243.50	1282	1435.7	3.1
D.	Merchandise Exports	784.30	726.4	800.4	-7.4
E. (B+C-D)	Domestic Use (C+I+G)	3908.50	4120.10	4414.70	5.4
F. (C/E)	Import share of US Goods Market	0.318	0.311	0.325	-2.2
G. (D/B)	Export share of US Production	0.227	0.204	0.212	-10.4

Source: Bureau of Economic Analysis, National Income and Product Accounts, last revised August 27, 2004.

Table 3.1: Growth in U.S. and Non-U.S. World Manufactured Trade

(compound annual growth rates)

(in percent)	U.S. Manufactured Exports in USD	Non U.S. World Manufactured Exports in USD	Non U.S. World Manufactured Exports in Major Currencies
1990-1995	9.16	9.13	7.53
1995-2000	7.58	4.44	8.62
2000-2001	-7.17	-3.18	2.61
2001-2002	-5.59	5.83	4.21
2002-2003	3.11	16.32	2.12
2000-2003	-3.32	6.02	2.98

Source: WTO, U.S. ITC, Federal Reserve Board; Authors' calculations.

Table 3.2: Sources of U.S. Merchandise Export Decline 2000-2003

	billions of dollars	percentage of 2000 exports
U.S. Exports in 2000	645.881	n.a.
U.S. Exports in 2003	599.653	n.a.
Decline	-46.227	-7.2
Impact of Non-US World Trade Growth with Constant U.S. Share	151.690	23.5
Impact due to commodity distribution	3.975	0.6
Impact due to country distribution	-46.202	-7.2
Residual "competitiveness" effect	-155.691	-24.1

Source: United Nations COMTRADE data

Table 3.3 Impact of the Dollar on U.S. Merchandise Exports and U.S. Manufacturing Jobs due to Exports

Elasticity equal to 1.5

	U.S. Merchandise Exports, bil. dollars (1)	U.S. Merchandise Exports with Unchanged dollar, bil. dollars (2)	Dollar Impact on Exports, bil. dollars (3)	Dollar Impact (percent of column 2) (4)	U.S. Manufacturing Jobs due to Exports, millions (5)	U.S. Manufacturing Jobs due to Exports with Unchanged Dollar, millions (6)	Dollar Impact on Manufacturing Jobs due to exports, millions (7)
2000	784.3	784.3	-	-	3.434	3.434	-
2001	731.2	762.9	-31.7	-4.2	n.a.	n.a.	n.a.
2002	697.3	784.1	-86.8	-11.1	2.739	3.080	-0.341
2003	729.5	881.1	-151.6	-17.2	2.691	3.250	-0.559

Source: Data U.S. ITC, Bureau of Economic Analysis, Federal Reserve Board; Authors' calculations.

Elasticity equal to 1.0

	U.S. Merchandise Exports, bil. dollars (1)	U.S. Merchandise Exports with Unchanged dollar, bil. dollars (2)	Dollar Impact on Exports, bil. dollars (3)	Dollar Impact (percent of column 2) (4)	U.S. Manufacturing Jobs due to Exports, millions (5)	U.S. Manufacturing Jobs due to Exports with Unchanged Dollar, millions (6)	Dollar Impact on Manufacturing Jobs due to exports, millions (7)
2000	784.3	784.3	-	-	3.434	3.434	-
2001	731.2	752.2	-21.0	-2.8	n.a.	n.a.	n.a.
2002	697.3	754.0	-56.7	-7.5	2.739	2.961	-0.223
2003	729.5	827.3	-97.8	-11.8	2.691	3.052	-0.361

Source: Data U.S. ITC, Bureau of Economic Analysis, Federal Reserve Board; Authors' calculations.

Table 4.1: Software Jobs Lost to India

	2001/2002 - 2003/2004
Increase in Software Employment in India	200,000
Involved in Exports to the U.S.	134,000
U.S. employment loss, assuming one-for-one job transfer	**134,000**

Source: Nasscom, Authors' calculations.

Table 4.2: The Impact of Business Process Offshoring of Jobs to India

	2001/2002 - 2003/2004
Increase in business process offshoring employment in India	175,500
Involved in Exports to the U.S.	140,400
U.S. employment loss, assuming one-for-one job transfer	**140,400**

Source: Nasscom, Authors' calculations.

Table 4.3: Offshoring to India in Relation to Total Service Sector Employment

Total service sector jobs offshored to India 2001/2002 - 2003/2004		274,400
Average annual change		**91,467**
Average annual change in U.S. service sector employment		
	1990 to 2000	**2,137,200**
	2000 to 2003	**327,100**

Source: Previous Calculations; Bureau of Labor Statistics

Figure 4.1: Private Services Trade with India (millions USD)

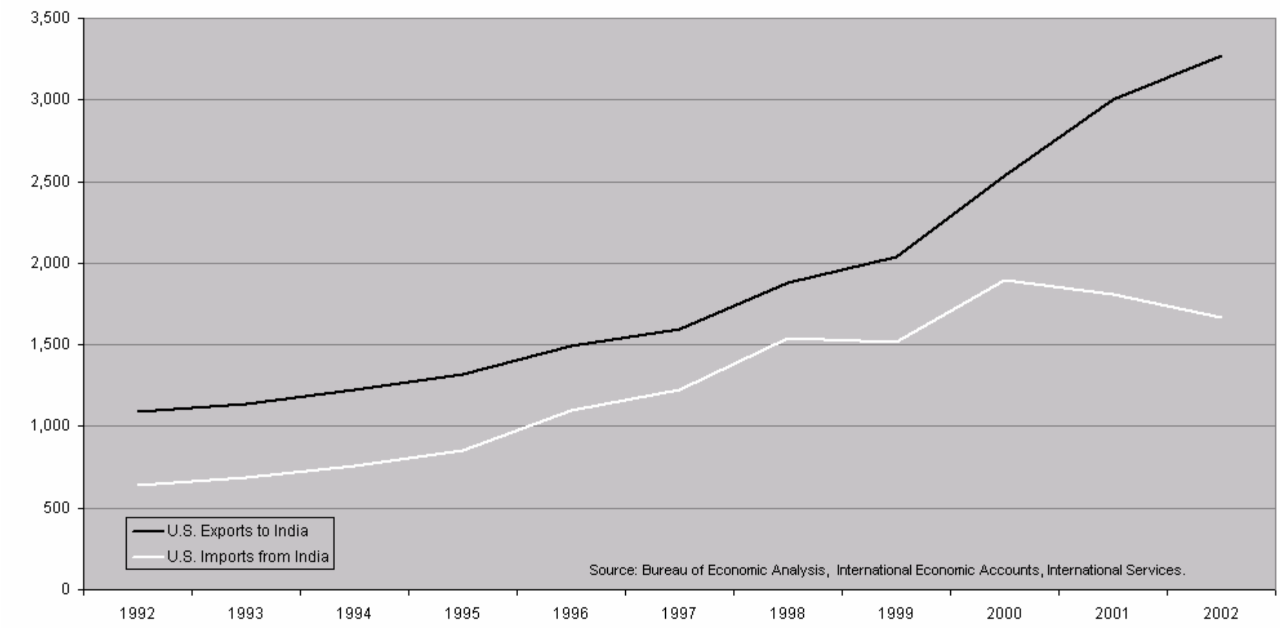

Table 4.4: Change in Employment for Computer and Low-Wage IT-Enabled Technology Occupations, 1999-2003 (employment in thousands)

SOC Code	Occupational Category	1999	2000	2003	Change 1999 to 2003	Change 2000 to 2003	Share of Sub-Group Employment in 2003 (in percent)	Annual Average Wage 2003
	Computer occupations							
15-1011	Computer and Information Scientists, Research	26,280	25,800	23,210	-3,070	-2,590	0.90	84,530
15-1021	Computer Programmers	528,600	530,730	431,640	-96,960	-99,090	16.75	64,510
15-1031	Computer Software Engineers, Applications	287,600	374,640	392,140	104,540	17,500	15.21	75,750
15-1032	Computer Software Engineers, Systems Software	209,030	264,610	285,760	76,730	21,150	11.09	78,400
15-1041	Computer Support Specialists	462,840	522,570	482,990	20,150	-39,580	18.74	42,640
15-1051	Computer Systems Analysts	428,210	463,300	474,780	46,570	11,480	18.42	66,180
15-1061	Database Administrators	101,460	108,000	100,890	-570	-7,110	3.91	61,440
15-1071	Network and Computer Systems Administrators	204,680	234,040	237,980	33,300	3,940	9.23	59,140
15-1081	Network Systems and Data Communications Analysts	98,330	119,220	148,030	49,700	28,810	5.74	62,060
TOTAL For Computer occupations		**2,347,030**	**2,642,910**	**2,577,420**	**230,390**	**-65,490**		**66,072**
	Low-Wage IT-Enabled occupations							
41-9041	Telemarketers	485,650	461,890	404,150	-81,500	-57,740	27.91	22,590
43-2011	Switchboard Operators, Including Answering Service	248,570	243,100	217,700	-30,870	-25,400	15.03	22,230
43-2021	Telephone Operators	50,820	52,150	45,310	-5,510	-6,840	3.13	29,770
43-9011	Computer Operators	198,500	186,460	160,170	-38,330	-26,290	11.06	31,870
43-9021	Data Entry Keyers	520,220	458,720	339,010	-181,210	-119,710	23.41	23,590
43-9022	Word Processors and Typists	271,310	257,020	191,180	-80,130	-65,840	13.20	28,400
43-9071	Office Machine Operators, Except Computer	101,490	86,380	90,470	-11,020	4,090	6.25	23,760
TOTAL For Low-Wage IT-Enabled occupations		**1,876,560**	**1,745,720**	**1,447,990**	**-428,570**	**-297,730**		**26,030**
TOTAL		**4,223,590**	**4,388,630**	**4,025,410**	**-198,180**	**-363,220**		**46,051**

Source: Bureau of Labor Statistics, Occupational Employment Statistics, 1999-May 2003.

Table 5.1 Baseline Scenario

	Real GDP, bil. chained 2000 USD	Nominal GDP, bil. current USD	Chain Price PCE, 2000 = 100	Unemployment Rate, percent	Employment, Private Nonfarm Business, mil.	Output per hour, NFB, chained 2000 USD	Federal Funds Rate, percent	10-year Treasury Bond, percent
2004Q1	10716.0	11459.6	106.6	5.63	108.3	45.80	1.00	4.02
2015Q4	14986.1	19679.2	134.0	5.28	120.7	59.77	6.33	7.11
Compound Annual Growth Rate (percent)	2.90	4.71	1.97	n.a.	0.93	2.29	n.a	n.a.

	Nominal Exchange Rate, Trade-weighted 35-Country Index (1997=100)	Current Account Balance, bil. current USD	Net Exports of Goods and Services, bil. chained 2000 USD	Nonfarm Merchandise Exports, bil. chained 2000 USD	Merchandise Exports, bil. current USD	Exports, Services, bil. chained 2000 USD	Imports, Merchandise, Nonpetroleum, bil. chained 2000 USD	Merchandise Imports, bil. current USD	Imports, Services, bil. chained 2000 USD	Imports, Services, bil. current USD
2004Q1	113.30	-575.7	-525.2	717.9	788.3	330.6	1244.7	1384.5	243.1	278.4
2015Q4	96.94	-99.0	210.7	1642.9	2040.5	736.2	1807.1	2508.3	260.8	456.3
Compound Annual Growth Rate (percent)	n.a.	n.a.	n.a.	7.30	8.43	7.05	3.22	5.19	0.60	4.29

Source: Authors' simulations using Macroeconomic Advisers' model.

Table 5.2: Impact of Offshoring -- Adding Additional Service Imports

	Real GDP, bil. chained 2000 USD	Nominal GDP, bil. current USD	Chain Price PCE, 2000 = 100	Unemployment Rate, percent	Employment, Private Nonfarm Business, mil.	Output per hour, NFB, chained 2000 USD	Federal Funds Rate, percent	10-year Treasury Bond, percent
2015Q4	14895.7	19535.2	134.8	5.3	120.6	59.4	6.9	7.56
Difference with Baseline	-90.4	-144.0	0.9	0.1	-0.1	-0.4	0.6	0.45
Compound Annual Growth Rate, 2004Q1-2015Q4 (percent)	2.84	4.64	2.02	n.a.	0.92	2.24	n.a.	n.a.

	Nominal Exchange Rate, Trade-weighted 35-Country Index (1997=100)	Current Account Balance, bil. current USD	Net Exports of Goods and Services, bil. chained 2000 USD	Nonfarm Merchandise Exports, bil. chained 2000 USD	Merchandise Exports, bil. current USD	Exports, Services, bil. chained 2000 USD	Imports, Merchandise, Nonpetroleum, bil. chained 2000 USD	Merchandise Imports, bil. current USD	Imports, Services, bil. chained 2000 USD	Imports, Services, bil. current USD
2015Q4	89.4	-97.7	331.1	1686.0	2177.7	738.9	1649.6	2477.9	334.7	630.8
Difference with Baseline	-7.5	1.3	120.4	43.1	137.1	2.7	-157.4	-30.4	73.9	174.5
Compound Annual Growth Rate, 2004Q1-2015Q4 (percent)	n.a.	n.a.	n.a.	7.54	9.03	7.09	2.43	5.08	2.76	7.21

Source: Authors' simulations using Macroeconomic Advisers' model.

Table 5.3: Impact of Offshoring -- Reduction in the Price of Service Imports

	Real GDP, bil. chained 2000 USD	Nominal GDP, bil. current USD	Chain Price PCE, 2000 = 100	Unemployment Rate, percent	Employment, Private Nonfarm Business, mil.	Output per hour, NFB, chained 2000 USD	Federal Funds Rate, percent	10-year Treasury Bond, percent
2015Q4	15369.9	19687.5	130.2	5.3	120.7	61.7	5.3	6.36
Difference with Baseline	383.8	8.3	-3.7	0.0	0.0	1.9	-1.0	-0.75
Compound Annual Growth Rate, 2004Q1-2015Q4 (percent)	3.12	4.71	1.72	n.a.	0.93	2.57	15.27	3.98

	Nominal Exchange Rate, Trade-weighted 35-Country Index (1997=100)	Current Account Balance, bil. current USD	Net Exports of Goods and Services, bil. chained 2000 USD	Nonfarm Merchandise Exports, bil. chained 2000 USD	Merchandise Exports, bil. current USD	Exports, Services, bil. chained 2000 USD	Imports, Merchandise, Nonpetroleum, bil. chained 2000 USD	Merchandise Imports, bil. current USD	Imports, Services, bil. chained 2000 USD	Imports, Services, bil. current USD
2015Q4	93.2	-98.5	190.5	1721.6	2142.2	764.1	1824.5	2571.7	350.6	449.4
Difference with Baseline	-3.7	0.6	-20.2	78.7	101.6	27.9	17.4	63.5	89.8	-6.9
Compound Annual Growth Rate, 2004Q1-2015Q4 (percent)	n.a.	n.a.	n.a.	7.73	8.88	7.39	3.31	5.41	3.17	4.16

Source: Authors' simulations using Macroeconomic Advisers' model.

Table 5.4 Real Compensation of Employees and Corporate Profits

	Compensation of Employees, billions 2000 USD	Difference with Baseline	Corporate Profits, billions 2000 USD	Difference with Baseline
Baseline	8458.2	n.a.	1247.5	n.a.
Additional Service Imports Added	8298.7	-159.5	1249.4	1.9
Price of Service Imports Reduced	8667.4	209.2	1389.2	141.7

Source: Authors' simulations using Macroeconomic Advisers' model.

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