# Manufacturing Productivity and the Shifting US, China, and Global Job Scenes—1990 to 2005

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## ***Executive Summary***

***Summary of Section I Results****: Manufacturing productivity growth from 1990 to 2004 should have taken away 7.5 million of the 17.7 million manufacturing jobs that existed in the US in 1990, while GDP growth should have added back (at the new productivity levels of 2004) 5.7 million manufacturing jobs—for a net loss of 1.8 million. In fact, the US economy lost 3.3 million manufacturing jobs during that period, implying that structural and competitive factors shifted 1.5 million of the GDP-growth-implied jobs from the manufacturing sector to other sectors of the US economy. I applied this same "Job Shift Analysis" to the sub-periods 1990-1995, 1995-2000, and 2000-2004 and found striking differences between those intervals in terms of manufacturing employment changes (and job quality changes—Section II). For one thing, more than 80% of the manufacturing job losses by the US economy since 1990 occurred after 2000. I find that 100% of the (3.0 million) manufacturing jobs lost since 2000 were lost to manufacturing productivity growth and that 100% of the (1.8 million) jobs that should have been added back by GDP growth in the US after 2000 were shifted to other sectors of the US economy than manufacturing.*

***Summary of Section II Results.*** *I analyzed job changes in 12 private sectors (including manufacturing) over the period January 1990 to January 2005. An "Index of Job Quality Change" was constructed to help analyze those shifts, where an index value above 1.0 implies that the net jobs added are higher-pay than the average private sector job in the US, while an index below 1.0 implies the opposite. I found important differences amongst the three sub-periods. The index for 1990-1995 was 0.95; the index for 1995-2000 was 1.03; and for 2000-2005 the index was a shocking 0.16. The contrast between 1995-2000 and 2000-2005 is remarkable. In the earlier of these two sub-periods more than 12.8 million net private sector jobs were added in the US economy (plus 1.2 million in government), with 47,000 of those being in manufacturing (at $16.14/hr) and 3.7 million being in Professional and Business Services (at $17.46/hr, compared to the 2005 private industry average hourly compensation of $15.67). During the 2000-2005 sub-period, in contrast, only 1.7 million net jobs were added by the economy (with 1.1 million of those being in government and 0.599 million in the private sector), including a 3.0 million job net decline in manufacturing employment and the largest net employment gains occurring in Education and Health Services (2.2 million jobs at $16.16/hr) and in Leisure and Hospitality (0.97 million jobs at $8.91/hr.).*

***Summary of Section III Results.*** *I estimate global manufacturing employment to have been between 150 million and 200 million workers in 2002, with those numbers reflecting a global decline of 20-30 million manufacturing employees in 2002 compared to 1995. I also estimate that China employed between one-fourth and one-half of that global total. Meanwhile, China's manufacturing productivity growth, estimated at 60% between 1995 and 2002, should have cost China 37 million manufacturing jobs over that period, while China's even more rapid GDP growth should have added back 42 million jobs, for a net addition of 5 million manufacturing jobs. Yet, Bannister (2004) reports that China actually lost17 million manufacturing jobs between 1995 and 2002—net job losses that approximated the total US manufacturing employment during that time frame. This suggests that competitive and structural factors were having a profound impact on China's economy between 1995 and 2002, much as competitive and structural factors were affecting manufacturing and overall employment in the US.*

***Section IV—Conclusions.*** *While certain US manufacturers might compete globally in coming years, manufacturing is not likely to contribute to net job creation in the US the way it did at mid-century. I expect two factors to continue to reduce manufacturing employment globally: (a) Manufacturing productivity growth, and (b) Structural changes in demand away from goods and towards services, at the margin. Current trends reduce global manufacturing employment so rapidly that only two kinds of countries will be able to make GDP Growth-induced and Competitive gains sufficient to offset the Productivity Factor and the Structural changes: (1) Small countries such as Ireland and Canada, and (2) Emerging market economies with "unlimited supplies of surplus labour" coming out of agriculture and out of very inefficient (often state-controlled) manufacturing industries and, thus, having very low opportunity costs.*

***Section V—Epilogue.*** *Markets and systems of markets in both the 'real' and 'financial' sectors have globalized at rapid rates in the past ten years. Yet, much of the analysis of trade, financial flows and macroeconomic phenomena continues to be conducted in national or—at best—bilateral terms. Analysts who attempt to take a global perspective find themselves "cobbling together" pieces of data to get a look at the entire, interrelated global picture. In this new world of globalized markets and open-economy macroeconomic theorizing, we need new datasets that reflect global economic relations. The appropriate organizations to provide such global datasets are the IMF, the World Bank, and the UN agencies. I would like to see such datasets become important parts of the work programs of these organizations.*

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Are US manufacturing jobs leaving for China? Or are they simply disappearing? These are not idle questions. Since 1990, the US economy has lost more than 3 million jobs in the manufacturing sector—even as the nation's real Gross Domestic Product (GDP) grew by more than 55%. Meanwhile, China's exports to the US were increasing many times over as that nation followed the export-led growth strategy successfully pursued decades before by much smaller nations from that region of the world.

In this paper, I argue that one must be careful in seeing a one-to-one relationship between China's export growth and US job losses in manufacturing. No doubt, there is some relationship (particularly after 2000). But it is not one-to-one. The emergence of China as the world's low-cost manufacturing center is part of a broader story of restructuring that is occurring in the manufacturing sector globally. That restructuring process is triggering massive change that is showing up in productivity growth—and manufacturing employment declines—globally as well as in the US.

In following sections of this paper, I present data and calculations to buttress the argument that US manufacturing job losses arise from three, interacting factors and that those three factors are having similar effect on manufacturing employment in other countries as well: (1) Productivity growth in the manufacturing sector, (2) Growth in GDP and in personal consumption expenditures that favor service consumption over goods consumption at the margin, and (3) De-integration, de-centralization, and re-organization of manufacturing production processes. The third of these—global re-organization of production processes—is related to the argument that jobs are leaving for other countries; but the actual process that is at play here is vastly different from those envisioned in the urban legends that make up much of the popular discourse on trade and jobs.

The topic of global production re-organization in manufacturing has generated extensive literatures in a number of disciplines, including in management, in economics,

and in industrial engineering. Within economics, bodies of related research have developed around "cluster theory", around "vertical specialization" within international trade theory, and around extensions of the New Trade Theory into the New Economic Geography.[1] These bodies of research combine to analyze production processes that are seen to be

a) De-integrating out of large-scale, vertically-integrated plants and into 'supply chains' or (in Michael Porter's terminology, 'value chains') composed of clusters of nearby firms combined with far-flung suppliers benefiting from reductions in spatial frictions associated with 'globalization'.[2]

b) Integrating these supply chains across international borders, with national specialization shifting from 'horizontal' specialization in particular industries to 'vertical' specialization in particular processes or steps in production processes across a broad range of industries (with LDCs specializing in vertical tasks involving low-cost labor—e.g., assembly—and with developed countries specializing in tasks involving highly-educated labor and/or intellectual property protection).

c) Competitive advantage based on external economies (of agglomeration and localization) that are associated with supply chain organization beginning to gain equal footing with comparative advantage of old trade theory.

This re-organization of production is an important factor in the rapid rates of productivity growth in manufacturing—my first emphasis in the calculations that follow—that are having dramatic impact on manufacturing employment, both in the US and in the broader, global economy. One aspect of this is the actual increase in output per worker that results at the firm level when the entire supply chain becomes more

[1] I deal with this subject in much greater detail in the forthcoming book, *The Rise of Market-Based Society: Technology, Institutions, and the Choice of Market over Hierarchy.* My colleague John Mittelstaedt and I have studied the impact of the external economies of localization and agglomeration upon firm propensity to export. Working Papers from this work can be found at the Center for International Trade website.

[2] Documented in William A. Ward, Madhusudan Bhattarai and Pei Huang, "The New Economics of Distance: Long Term Trends in Indexes of Spatial Friction." Departmental Working Paper WP020299, Clemson University Department of Agricultural and Applied Economics (February 2, 1999). http://cherokee.agecon.clemson.edu/wp020299.pdf

efficiently organized. This reduces overall employment in the production of manufactured goods. A second aspect that is tricky to calculate from secondary data is the transfer of workers FROM integrated manufacturing firms TO services firms as the integrated manufacturer de-integrates into a supply chain cluster. Workers who are "service producers" within the manufacturing sector become "service producers" within the service sector, as they or their employer end up selling back to the manufacturing sector firm the very same service the worker used to produce from within the previously-integrated firm. Thus, one part of the reported decline in manufacturing employment is not a decline at all but, rather, a reclassification arising out of the de-aggregation of the production process. The analysis that I conduct in this paper does not separate out the phantom "manufacturing job losses" represented by such reclassification of workers between sectors.

In Section I, a simple technique I will call "Job Shift Analysis" is used to analyze changes in manufacturing employment in the United States. Job Shift Analysis divides manufacturing employment changes into three categories: (a) Productivity Factor, (b) GDP Growth Factor, and (c) Structural & Competitive Factor. As a side-show to my general argument in this paper, I develop in Section II an "Index of Job Quality Change" to assess the qualitative impact of the Structural and Competitive shifts in jobs occurring in the US economy over the period January 1990 to January 2005. As I said above, this section does not capture the impact of sectoral reclassification of jobs. What it captures, instead, is the change in weighted average pay scales of workers as manufacturing experience net job losses over time and as other sectors experience net increases in employment. As I show in Section II, these changes were positive in the 1995-2000 period but highly adverse in the 2000-2005 period.

Then I look in Section III at changes in manufacturing productivity and employment in other major countries and compare their experiences with those of the US. My look at global manufacturing in Section III includes an application of Job Shift Analysis to manufacturing employment in China for the period 1995-2002. I then draw conclusions in Section IV about what is actually happening to manufacturing employment globally and about the implications for the future of manufacturing as a source of job creation in the US. In Section V, the "Epilogue" I make the case for

international organizations compiling and providing to researchers datasets appropriate for a globalized microeconomy and in which open economy macroeconomic analysis increasingly is the object of the work of researchers and policy analysts.

## Section I. Application of Job Shift Analysis to US Manufacturing Employment

A good place to start with manufacturing job gains (losses) in the US is to look at the period from 1979 to 1st Quarter 2005—i.e., starting from the point in history at which US manufacturing employment reached its all-time peak at more than 19 million jobs (Table 1), only to trend downwards to just over 14 million jobs by April of 2005—a 25% drop in 25 years. Keep in mind that Table 1 also shows manufacturing output in the US almost doubling between 1979 and the end of 2004, and real GDP (i.e., after adjusting for the effects of inflation) growing by 115%.

**Table 1. Manufacturing Employment, Manufacturing Output, and Real GDP in the USA—1979 to early 2005**

| Year | Mfg Employment 1/ (000) | Index of Mfg Output 1/ (1997=100) | Real GDP ($000) 2/ (2000 price level) |
|---|---|---|---|
| 1979 | 19,426 | 60.4 | 5,173 |
| 1980 | 18,733 | 58.2 | 5,162 |
| 1985 | 17,819 | 65.1 | 6,054 |
| 1990 | 17,695 | 75.0 | 7,112 |
| 1995 | 17,241 | 88.1 | 8,032 |
| 2000 | 17,263 | 117.3 | 9,817 |
| 2001 | 16,441 | 112.3 | 9,891 |
| 2002 | 15,259 | 111.9 | 10,074 |
| 2003 | 14,510 | 111.9 | 10,381 |
| 2004 | 14,329 | 117.2 | 10,841 |
| 2005 (1st Qtr) | 14,258(p) | 120.5 | 11,078 (p) |

**Source**: 1/ US Bureau of Labor Statistics; 2/ Bureau of Economic Analysis.

Now let's shift our focus to the period from 1990 to 2004, when the major buildup in China trade occurred. During these most recent 14 years, the US lost 3.3 million manufacturing jobs (Table 1). Meanwhile, total output in manufacturing in the US was increasing by more than 50% (i.e., the index went from 75.0 to 117.0), and output per worker in manufacturing was increasing by 73% (i.e., the index of output per

worker in US manufacturing went from 100.00 to 173.34; see Table 2, below). To better understand these changes, I apply "Job Shift Analysis", a simple technique patterned after shift-share analysis.

**Job Shift Analysis of US Manufacturing Employment Losses 1990-2004**

In the Job Shift Analysis model, we are trying to address four sets of changes that are affecting manufacturing job growth/decline in a country (in the present paper, for the USA in Section I and for China in Section III):

1. Static job losses in the manufacturing sector from productivity growth;
2. Implied, potential manufacturing job gains from GDP growth;
3. Manufacturing job losses from structural changes such as the shift to producing less labor-intensive goods, the increasing demand for services relative to goods, and the related shift of existing jobs and of GDP-induced job growth to other sectors of the economy;
4. Gains (losses) of jobs due to competitive manufacturing advantages (disadvantages) experienced by the home country.

Competitive advantages in a particular manufactured good can arise from a number of sources, only some of which are directly related to labor. These non-labor advantages can include intellectual property attributes and the protections that one national environment (such as the US) provides compared to another national environment (such as China or Argentina). They can entail access to final markets, such as—for example—BMW's desire to assemble automobiles within the country representing its most important final market. They can include external economies of agglomeration or of localization (in the contemporary vernacular, "clustering") arising from the presence of supply chain partners and other related firms. Likewise, advantages can grow out of traditional advantage such as access to important natural resources. One such "natural resource" can be labor related—e.g., productive and/or inexpensive workers, or a particularly-educated workforce (including innovative and creative people). And, finally, all such advantages as these can both enjoy and enhance the advantages provided by a favorable rate of exchange for the national currency.

Labor-based competitive advantages on the cost side (much the objective of data collection and analysis efforts feeding off of the US Department of Labor's Foreign

Labor Statistics web site http://www.bls.gov/fls/home.htm, from which I take part of my data for this paper) derive from the interplay between the following components: (1) Output per hour by manufacturing workers; (2) Total worker costs per hour, denominated in the local currency; and (3) The effective exchange rate between the local currency and foreign exchange (often normalized into US Dollars). Together, these are the components of the labor cost per unit of manufacturing output stated in the common denominator of US Dollars.

As we discuss again later, productivity can have a negative, direct effect on labor employment. And productivity can simultaneously have a positive, indirect effect—subject, of course, to what is happening with local wage costs denominated in the local currency and the exchange rate that links local costs to the global economy. Because technology spreads rapidly in a globalized manufacturing economy, it is possible for every nation to be affected by the direct effect which acts to reduce the overall number of manufacturing workers needed. With the competitiveness factor, on the other hand, there will be both gainers and losers. With rapid productivity growth, only a very few countries will be able to overcome the employment reducing effects with sufficient competitive gains to make up for those effects. It is my judgment that, generally, the "winners" in manufacturing job creation/retention will fall into two categories: (1) Small countries with productive and well-managed economies; and (2) Previously-inefficient national economies in which market liberalization is making available large numbers of workers at very low opportunity cost.

With Job Shift Analysis, we can divide the US manufacturing job gains and losses over time into three groups: (1) Job gains (losses) one would expect from productivity growth; (2) Job gains (losses) one would expect from growth in GDP; and (3) A residual category intended to capture job gains (losses) from the combination of structural and competitive changes outlined above and not included in the first two parts of the Job Shift Analysis calculation. As I demonstrate below, this paper's application of Job Shift Analysis suggests that productivity growth in manufacturing dominates the overall manufacturing job losses by the US during the period 1990-2005.

**Table 2. Index of Output per Worker in Manufacturing in the US—1990 to 2005 (January to January)**

| Year | Manufacturing Productivity Index (1990=100) |
|---|---|
| 1990 | 100.00 |
| 1995 | 118.06 |
| 2000 | 144.29 |
| 2001 | 146.46 |
| 2002 | 157.13 |
| 2003 | 164.96 |
| 2004 | 173.34 |
| 2005 | 182.92 |

**Source**: US Bureau of Labor Statistics.

We start by asking the simple question: "Given the productivity growth from 1990 to 2004, how many manufacturing workers would be needed in 2004 to produce the same output as 1990?" We can use this simple question to calculate the "Productivity Factor" effect on job growth (loss) during the period:

**Productivity Factor = 17.695 x (100.00/173.34) – 17.695 = – 7.5 mil. jobs**

What this first calculation tells us is that, in static terms, the US lost 7.5 million jobs to productivity growth during the period 1990-2004. This amounted to more than 40% of the manufacturing jobs that existed in the US in 1990.

If the US economy of 2004 otherwise looked just like the US economy of 1990, that would be fine. But in that interim, GDP grew by 56% (the same rate as the growth in manufacturing output during that same period, incidentally). Based on the 56% growth in GDP, the economy should have added back 5.7 million manufacturing jobs (based on the 'new' manufacturing productivity levels of 2004):

**GDP Growth Factor = (17.695 – 7.5) x 0.56 = + 5.7 mil. jobs**

In other words, after the effect of productivity growth, we should have had (17.695 million – 7.5 million = 10.2 million) manufacturing jobs to supply the 1990 level of US manufacturing output. Growth of 56% in GDP should have added back (at the new productivity levels) by a factor of (10.2 million x 0.56 = 5.7 million). Combine the

GDP growth effect with the job losses from productivity growth and you get a net loss of –1.8 million manufacturing jobs:

GDP Growth Factor – Productivity Growth Factor = (5.7 – 7.5) = – 1.8 mil jobs

The above calculation tells us that during this 14-year period, GDP did not grow sufficiently to add back the manufacturing jobs in the US that were lost to productivity growth during that same period. But the actual job losses were greater than the 1.8 million calculated above, raising the question of what happened to the other 1.5 million (of the 3.3 million) manufacturing jobs that were lost from 1990-2004? In this analysis, I attribute those losses to Competitive and Structural Factors affecting the US economy.

**Competitive & Structural Factors = – 3.3 million – (– 1.8 million) = – 1.5 million jobs**

One of these competitive and structural factors recognized by others, of course, is the changing composition of Personal Consumption Expenditures (PCE) in the GDP. Table 3 shows a continuing and long-developing shift in the balance of PCE from expenditures on "goods" to expenditures on "services". This shifting balance would affect manufacturing employment adversely, since the manufacturing sector produces the bulk of the goods that go into that part of the PCE accounting. Because of the shifting balance in PCE, one should not expect all of GDP growth effect to go straight into creating new manufacturing jobs, since 'services' production and consumption in the GDP accounts grew faster than 'goods' production and consumption in those same accounts.

**Table 3. Personal Consumption Expenditures for "Goods" versus "Services" in the National Income and Product Accounts of the United States—1950 to 2004**

| Year | Goods | Services |
|---|---|---|
| 1950 | 67.1% | 32.9% |
| 1960 | 59.1% | 40.9% |
| 1970 | 55.1% | 44.9% |
| 1980 | 51.8% | 48.2% |
| 1990 | 44.9% | 55.1% |
| 2000 | 41.7% | 58.3% |
| 2004 | 41.0% | 59.1% |

**Source**: National Income and Product Accounts, 1950 to 2004. Bureau of Economic Analysis.

Still another matter is the competitive effect of growing global manufacturing competition. Just as in the Shift-Share Analysis alluded to in passing, above, it is possible to gain an increasing share of jobs with an overall sector or industry that actually is in secular decline globally.

Had the US manufacturers been gaining significant global competitive advantage during the period we are analyzing, we might have seen net positive numbers resulting from our Competitive and Structural Factor calculation.[3] We did not, so we might surmise that the US did not secure sufficient competitive gains during full period 1990-2004 to make up for the net manufacturing job losses shown for the sum or our Productivity and GDP Growth Factor calculations. Of course, the global competitiveness of US manufacturers is more complicated than worker productivity alone (including negotiated wage agreements, taxation, and exchange rate issues as well, for example).

Meanwhile, compare the United States economy's 1.5 million manufacturing job losses from competitive and structural factors to the 7.5 million lost to productivity growth. From this comparison, I conclude that, during the period 1990 to early-2005, US manufacturing productivity growth cost the US several times more manufacturing jobs than all other factors combined—including global competition.

[3] Indeed, there is some evidence from our calculations of US competitive gains in the late-1990s that disappears or goes the other way after 2000.

**Job Shift Analysis of US Employment Changes 2000-2005**

Before we go on to look at other issues such as manufacturing sector trends in other countries, let us refine our Job Shift Analysis to look at the period from 2000 to early-2005, the period during which 83% of the overall US job losses in manufacturing alluded to above occurred. This particular application of Job Shift Analysis reveals some striking outcomes on the interplay between productivity growth and economic adjustments in the US economy.

Using the same data tables and Job Shift Analysis algorithms as previously, we get the following results:

**Productivity Growth Factor (2000 to 2005): – 3.005 million jobs**

**GDP Growth Factor (2000 to 2005): + 1.831 million jobs**

**Total Actual Job Gains or Losses (2000 to 2005): – 3.005 million jobs**

**Competitive & Structural Factor (2000 to 2005): – 1.831 million jobs**

This application of Job Shift Analysis tells us something very interesting about the period after 2000, because the actual job losses in manufacturing during that period match up closely with losses we would have expected from productivity growth alone.[4]

In addition to being a period of rapidly rising manufacturing exports by China, the 2000-2005 interval also was a period of particularly high productivity growth in manufacturing in the US (and, as we show in Section III, in the larger world as well—See Table 2 and Table 9). According to this second application of Job Shift Analysis, 100% of the US manufacturing job losses from the base point of 2000 were due to productivity growth. Meanwhile, 100% of the GDP Growth Factor went into creating income and jobs in OTHER sectors of the US economy (i.e., other than manufacturing) after 2000. Thus, the period 2000-2005 was a period that was particularly marked by competitive and structural adjustments in the US economy.

Meanwhile, during the post-2000 period, US GDP rose by about 13%. And the US index of manufacturing output shown in Table 1 that stood at 117.3 in 2000 was back

[4] Further buttressing confidence in our calculation is the fact that the Index of Manufacturing Output (Table 1) stood at about the same level at the end of 2004 as in 2000 (more on this point below).

again to 117 (after declining in 2001-2003 and then rising again through 2004). Productivity growth in that period took away three million manufacturing jobs—the number of manufacturing jobs actually lost in the period. The GDP Growth Factor should have created 1.831 million new jobs—but they were not in manufacturing[5]. So, where were they?

## Section II. Index of Job Quality Changes in the US

Table 4 shows that the job losses in the US economy between 2000 and early 2005 occurred in manufacturing (about 3 million jobs), in "information" (434,000), in wholesale trade (279,000), in retail trade (134,000), in transport and warehousing (50,000), and in utilities (31,000). Meanwhile, 2.2 million net jobs were developing in education and health services, 1.1 million in government (presumably paralleling the overall average of two-thirds of them being in local government), and almost a million in Leisure and Hospitality. All-in-all, the Bureau of Labor Statistics recorded net job growth of 1.7 million in the US economy as counterpart to the GDP growth of 13% between 2000 and early-2005. This suggests that the two largest employment substitutes for manufacturing jobs lost during 2000-2005 were (a) Education and Health Services, and (b) Government. Take Government out of the job accounts, and fewer than 0.6 million private sector net new jobs were created in the US after January 2000 (Therefore, the application of the term "jobless recovery" following the recovery from the 2001 economic downturn). US GDP grew by 13% after 2000, and the US civilian workforce grew by about 3.3% (i.e., from 142.6 million in 2000 to 147.4 million in 2004, according to BLS data). However, US civilian employment grew less than one-half of one percent (i.e., 600,000 divided by 137 million) during that period.

[5] Appendix Table 1 shows actual net job creation overall in the US economy during 2000-2005 (January to January) of 1.7 million jobs, very close to the 1.831 million jobs that our Job Shift Analysis suggested should have developed outside of manufacturing but within the overall US economy.

**Table 4. US Job Gains and Losses by Sector (January to January), 1990 to 2005**

| | Jobs Gained (Lost) in '000s | | |
|---|---|---|---|
| **Sector** | **2000-2005** | **1995-2000** | **1990-1995** |
| Government | 1,129 | 1,162 | 1,211 |
| Education & Health Services | 2,214 | 1,836 | 2,321 |
| Financial Activities | 472 | 853 | 230 |
| Information | (434) | 766 | 110 |
| Leisure & Hospitality | 971 | 1,305 | 985 |
| Other Services | 305 | 619 | 301 |
| Professional and Business Services | 222 | 3,723 | 1,778 |
| Transport and Warehousing | (50) | 569 | 348 |
| Utilities | (31) | (68) | (61) |
| Wholesale Trade | (279) | 581 | 87 |
| Retail Trade | (134) | 1,347 | 520 |
| Construction | 329 | 1,534 | (186) |
| Natural Resources and Mining | 13 | (59) | (110) |
| Manufacturing | (2,999) | 47 | (516) |
| **Total** | **1,728** | **14,215** | **7,018** |

**Source**: Calculated in Appendix Table 1. Data from USDOL, BLS.

To see how the pattern of job gains and losses affected the overall quality of net new employment created in the US economy from January 2000 to January 2005, I created an "Index of Job Quality Change" in which job changes in each (private) sector were multiplied by the average hourly compensation for that respective sector, and the sum of these products was then divided by the product of total private sector job change multiplied by the private sector average hourly compensation (for January 2005, as reported by BLS). I then calculated the Index for each of the intervals we have been analyzing and present the Index calculation for the post-2000 period in Table 5. In Table 6, the results of calculations of the Index of Job Quality Changes for the 1990-1995 and the 1995-2000 periods also are presented.

**Table 5. US Private Sector Worker Average Hourly Compensation (January 2005) and Calculation of Index of Job Quality Change for 2000-2005 Period**

| Private Sector Category | Net Jobs 2000-2005 (in '000s) | Hourly Compensation in 2005 | Sector Product in Index |
|---|---|---|---|
| Education & Health Services | 2,214 | $16.16 | 35,778 |
| Financial Activities | 472 | $17.53 | 8,274 |
| Information | (434) | $21.42 | (9,296) |
| Leisure & Hospitality | 971 | $8.91 | 8,652 |
| Other Services | 305 | $13.98 | 4,264 |
| Professional and Business Services | 222 | $17.46 | 3,876 |
| Transport and Warehousing | (50) | $16.43 | (822) |
| Utilities | (31) | $25.62 | (794) |
| Wholesale Trade | (279) | $17.66 | (4,927) |
| Retail Trade | (134) | $12.08 | (1,619) |
| Construction | 329 | $19.23 | 6,327 |
| Natural Resources and Mining | 13 | $18.08 | 235 |
| Manufacturing | (2,999) | $16.14 | (48,404) |
| **Sum of the Sector Products** | | | **1,544** |
| **Total Private** | **599** | **$15.67** | **9,386** |

**Index of Job Quality Change (2000-2005): (1,544/9,386) = 0.16**

The Index of Job Quality Changes for the periods 1990-1995 and 1995-2000 presented in Table 6 show striking differences between these two earlier intervals versus the post-2000 period results that were calculated in Table 5. Indeed, the positive job quality performance of the 1995-2000 period (Index of 1.03) stands in stark contrast to the very negative job quality performance of the US economy after 2000 (Index of 0.16). Driving this dramatic change in my Index for 1995-2000 versus the Index for 2000-2005 was the decline in relative importance of newly-tradable services such as Professional and Business Services and the increase in relative importance of less-tradable services such as Education and Health Services, and Leisure and Hospitality between these two periods. This suggests to me two things: (1) The importance of the "sectoral reallocation" modeling that is being done by a number of analysts, particularly in conjunction with the Chicago Fed;[6] and (2) The importance of broadening that work to include global data and

[6] See the papers and related citations in *Economic Perspectives*, Federal Reserve Bank of Chicago, Vol. 28, No. 2, (2nd Quarter 2004).

analysis on employment change. My Section III should make clear the importance of this second suggestion.

**Table 6. Index of Job Quality Change for Five-Year Intervals During 1990-2005**

| Interval | Index of Job Quality Change |
|---|---|
| 1990-1995 | 0.95 |
| 1995-2000 | 1.03 |
| 2000-2005 | 0.16 |
| **1990-2005** | **0.97** |

**Source**: Author's calculations from data in Tables 4 and 5.

## Section III. Manufacturing in China and the Rest of the World

Let us begin Section III with a look at the World Bank's World Development Indicators 2005 data on "Industry" employment as a percent of total employment for the most industrialized of the Bank's member countries. From the WDI 2005 data, we see a dramatic shift in the proportion of workers employed in **industry** *versus* **services** in the middle- and high-income countries during the decade ending in 2000-2002. In the middle-income countries, the proportion of workers employed in industry declined by a third during that decade, while in the high-income countries the proportion declined by half (Table 7).

**Table 7. Employment by Economic Activity, High-Income and Upper-Middle-Income Countries (1990-1992 and 2000-2002)**

| | 1990-1992 | | 2000-2002 | |
|---|---|---|---|---|
| | **Male** | **Female** | **Male** | **Female** |
| **Upper Middle Income Countries** | | | | |
| Agriculture (1) | 22% | 17% | 8% | 8% |
| Industry (2) | 32% | 32% | 22% | 19% |
| Services (3) | 46% | 51% | 70% | 73% |
| **High Income Countries** | | | | |
| Agriculture (1) | 6% | 4% | 4% | 3% |
| Industry (2) | 38% | 35% | 19% | 15% |
| Services(3) | 55% | 60% | 76% | 82% |
| **United States of America** | | | | |
| Agriculture (1) | 4% | 3% | 1% | 1% |
| Industry (2) | 33% | 32% | 14% | 12% |
| Services (3) | 62% | 65% | 85% | 87% |

**Source**: World Bank, World Development Indicators 2005.

(1) Agriculture, forestry, hunting and fishing are included in "agriculture".
(2) Manufacturing, mining, and construction are included in "industry".
(3) Transportation, communication, public utilities, trade, finance, public administration, private household services, and miscellaneous services are included in "services".

From the notes to Table 7, you can see that "Industry" includes more than "manufacturing" alone, though manufacturing is the dominant sector in that category. To examine more closely what was happening to manufacturing employment, *per se*, in the closest competitor economies of the US between 1990 and 2004, we look to data compiled by the US Department of Labor and summarized in Table 8, below (For comparative data going back to 1960, see Appendix Table 3).

**Table 8. Manufacturing as Percent of Total Civilian Employment, Ten Countries, 1990 and 2004**

| Country | % Employed in Mfg in 1990 | % Employed in Mfg in 2004 |
|---|---|---|
| United States | 18.0% | 11.8% |
| Canada | 15.7% | 14.4% |
| Australia | 15.0% | 11.3% |
| Japan | 24.3% | 18.3% |
| France | 21.0% | 16.3%* |
| Germany | 31.6% | 22.7% |
| Italy | 22.6% | 21.8% |
| Netherlands | 19.1% | 14.0%** |
| Sweden | 22.3% | 14.9%* |
| United Kingdom | 22.3% | 14.9%* |

Note: * Indicates 2003 data, while ** indicates 2002 data.

**Source**: "Comparative Civilian Labor Force Statistics, 10 Countries, 1960-2004". US Department of Labor, Bureau of Labor Statistics, Office of Productivity and Technology (May 13, 2005). http://www.bls.gov/fls/flslforc.pdf

Manufacturing as a percent of total civilian employment declined in every country presented in Table 8. The two smallest percentage declines occurred in Canada and in Italy and for two very different reasons. Canada seems to have experienced some competitive gains in manufacturing employment (a point to which we turn below), while Italy slowed somewhat the decline in its own manufacturing employment by creating distortions that leave the country with an unemployment rate (8.1% in 2004) that stands above the OECD average.[7] Italy's policy experiments seem also to be reflected in its productivity growth in comparison to other countries profiled in Table 9, (the lowest productivity growth amongst the countries covered).

In addition to the productivity growth shown for the countries in Table 9, Judith Bannister[8] suggests that manufacturing productivity grew by about 60% in China between 1995 and 2001. In Table 10, we reproduce Bannister's estimates of changes in

[7] "In addition, the share of unemployed individuals who have been seeking work for longer than one year is among the highest in the OECD, at about 50 per cent", according to the OECD's Employment Outlook 2005.

[8] Judith Bannister, "Manufacturing Employment and Compensation in China" (December 2004). Consultant's report to US Department of Labor, Bureau of Labor Statistics.

manufacturing employment in China from 1978 through 2002. Note the large difference between Bannister's manufacturing employment estimates for China compared to those reported by the ILO and shown in Appendix Table 4. In both data sets, major declines in manufacturing employment in China are reported between 1995 and 2002.

**Table 9. Productivity Growth and Employment Change in Manufacturing in Fourteen Countries, 1992-2003**

| Country | % Growth In Output per Worker In Manufacturing (1992-2003) | % Change in Employment In Manufacturing (1992-2003) |
|---|---|---|
| Canada | 34.5 | +1.1% |
| Australia | 42.0 | -25.7% |
| Japan | 54.3 | -25.7% |
| Korea | 155.3 | -11.8% |
| Taiwan | 76.1 | -2.7% |
| Belgium | 44.0 | -16.8% |
| Denmark | 36.0 | -12.6% |
| France | 58.0 | -10.9% |
| Germany | 35.1 | -21.0% |
| Italy | 10.9 | -2.9% |
| Netherlands (*1990-2002) | 35.2* | -12.7% |
| Norway | 13.5 | -1.5% |
| Sweden | 101.5 | -3.6% |
| United Kingdom | 34.9 | -18.1% |

**Source**: Bureau of Labor Statistics, US Department of Labor. ftp://ftp.bls.gov/pub/special.requests/ForeignLabor/prodsuppt01.txt

Table 9 juxtaposes data on manufacturing productivity and manufacturing employment changes for fourteen countries between 1992 and 2003. In all of the reporting countries, except Canada, productivity growth was associated with employment decline.

Meanwhile, Bannister's estimate of productivity growth (60%) and employment decline (from 98 million down to 80 million jobs) in manufacturing in China (Table 10) between 1995 and 2002 are consistent with the results for the other fourteen countries shown in Table 9. They are also consistent with the results for the US that were presented in Section I of this paper.

## Table 10. Reported Manufacturing Employment in China (Urban and Rural), 1978-2002

| Year | China Manufacturing Employment (millions) | Urban Manufacturing Employment (millions) | Rural Manufacturing Employment (millions) | Index of Manufacturing Employment (1992=100) |
|---|---|---|---|---|
| 1978 | 53.32 | 17.34 | 35.98 | 58.55 |
| 1980 | 58.99 | 19.42 | 39.57 | 64.78 |
| 1985 | 74.12 | 27.41 | 46.71 | 81.40 |
| 1986 | 80.19 | 31.39 | 48.80 | 88.06 |
| 1987 | 83.59 | 32.97 | 50.62 | 91.80 |
| 1988 | 86.52 | 34.13 | 52.39 | 95.01 |
| 1989 | 85.47 | 32.56 | 52.91 | 93.86 |
| 1990 | 86.24 | 32.29 | 53.95 | 94.71 |
| 1991 | 88.39 | 32.68 | 55.71 | 97.07 |
| 1992 | 91.06 | 34.68 | 56.38 | 100.00 |
| 1993 | 92.95 | 36.59 | 56.36 | 102.08 |
| 1994 | 96.13 | 38.49 | 57.64 | 105.57 |
| 1995 | 98.03 | 39.71 | 58.32 | 107.65 |
| 1996 | 97.63 | 40.19 | 57.44 | 107.22 |
| 1997 | 96.12 | 40.32 | 55.80 | 105.56 |
| 1998 | 83.19 | 39.29 | 43.90 | 91.36 |
| 1999 | 81.09 | 39.53 | 41.56 | 89.05 |
| 2000 | 80.43 | 41.09 | 39.34 | 88.33 |
| 2001 | 80.83 | 42.96 | 37.87 | 88.77 |
| 2002 | 83.07 | 45.06 | 38.01 | 91.23 |

"Prepared by Judith Bannister. These Figures refer to the mainland provinces of the PRC not including Hong Kong, Macao, or Taiwan. These data are from China's annual yearend reporting system, not from census data and not adjusted to agree with census data. The column on 'Derived urban manufacturing employment' is calculated from national manufacturing employment minus rural manufacturing employment."

**Source**: This table is reproduced with little alteration from the report by Judith Bannister, "Manufacturing Employment and Compensation in China" (December 2004). Consultant's report to US Department of Labor, Bureau of Labor Statistics. Bannister reports her sources as "China NBS & Labour, 2003, pp. 8, 10, 13, 16, 21, 23-26, 171, 473."

The fact that China's manufacturing employment did not decline by 37.5% (i.e., one minus the reciprocal of 1.60) suggests that there were GDP Growth and/or Competitive and Structural effects upon manufacturing employment in China during the period 1995-2002 that had some degree of offsetting effect. Productivity Growth should have reduced China's manufacturing employment from 98 million workers in 1995 down to 61 million workers by 2002. However, Bannister reports that China's manufacturing employment declined "only" to 80 million workers in 2002 (before recovering a bit to 83

million by 2003). This suggests that China's GDP Growth, and Competitive and Structural Factors combined to offset the Productivity Factor effects by an amount equivalent to 19 million manufacturing jobs.

With an average annual GDP growth[9] rate of 7.8%, the GDP Growth Factor for China should have added back an astounding 42 million manufacturing jobs between 1995 and 2002 (based on Bannister's data). Yet, as we already indicated, the country added back "only" 19 million manufacturing jobs. What happened to the remaining 23 million jobs that one would have expected from this combination of manufacturing productivity growth and GDP growth between 1995 and 2002? According to our Job Shift Analysis model, we attribute the difference to Competitive and Structural changes in China's economy.

Because China is such a large part of the global manufacturing picture, the absolute magnitude of the numbers in our China Job Shift Analysis is astonishing. The 17 million manufacturing jobs that Bannister's data indicate were actually lost by China during 1995-2002 are equivalent to the total US manufacturing employment at that time.

Pulling together national manufacturing employment data from the ILO and other sources, I estimate that global manufacturing employment totaled between 150 million and 200 million workers in 2002, with China employing somewhere between one-fourth and one-half the global total (within these totals, China employed more than 80 million, the EU-25 approximately 30 million, and Japan and the US together about 25 million).[10]

If we assume a global average manufacturing productivity growth of 30% between 1995 and 2002 (i.e., half that estimated for China), then the global economy might have lost as many as 60 million manufacturing jobs to productivity growth during that period. Assuming global GDP growth of approximately the same amount adding

[9] Justin Yifu Liu, "Is China's Growth Real and Sustainable?" China Center for Economic Research, Peking University. Working Paper No. E2004003 (February 26, 2004). http://www.ccer.edu.cn/download/3024-1.pdf

[10] Note that ILO data in Appendix Table 4 show manufacturing employment in China as "only" 29 million, while Bannister (2004) shows reported manufacturing employment in China to be more than 80 million workers (out of a workforce estimated in WDI 2004 to be 770 million). Likewise, ILO data in Appendix Table 4 also show "only" 6.68 million manufacturing workers in India, which would amount to about 1.4% of that country's estimated workforce of 470 million. I conclude that ILO data seem to undercount actual employment in a number of important cases.

some jobs back combined with a pattern of structural changes similar to those affecting the US and Chinese economies, one might expect global experience to be something like that of the US and China (except, of course, that the "competitive" effect nets out on the global level). Such intuitive calculations would suggest net manufacturing job losses globally in the 20 million job range. Can we find the numbers to test that intuition?

I have used Appendix Table 4 to cobble together estimates of global manufacturing employment for 1995 and for 2002 (using ILO data as the building blocks). In between my 1995 and 2002 global manufacturing employment estimates shown in Appendix Table 4, I calculate a global net loss of 23 million manufacturing jobs. From that and related data and calculations, I fudge that calculation with the statement that the global economy seems to have experienced net manufacturing job losses between 20 million and 30 million during the period 1995 to 2002.

A bit of a rebound in manufacturing output has occurred as the post-2001 recovery has taken hold, as reflected, for example, in the US Index of Manufacturing Output shown in Table 1 (and in additional data released after I compiled my data tables for this paper). However, no comparable rebound is reflected in the manufacturing employment index numbers shown for the fourteen countries profiled in Appendix Table 2 (nor in ensuing employment data releases).

We all would like to know what has actually happened to manufacturing employment globally since 2002—particularly in light of the fact that the US economy lost another million manufacturing jobs after that date. But I simply do not have the data at this point in time (July 2005) to render a global estimate beyond 2002. Judith Bannister's data suggest that China might have regained two million manufacturing jobs between 2002 and 2003 (and others suggest that more competitive job gains followed in 2004 and 2005). Still, I do not expect that a global rebound of more than 5 million manufacturing jobs occurred after 2002. Therefore, I estimate that the global economy lost, at a minimum, 15 million 25 million net manufacturing jobs between 1995 and 2005.

## Section IV. Conclusions

The evidence I am able to assemble suggests that manufacturing productivity is growing rapidly on a global basis—not just in the US. Sure, Italy amongst the industrial countries did not show high levels of productivity growth in recent years. And we don't have manufacturing productivity numbers for the least developed of the world's countries. But we do have data for the countries that make up more than half of the manufacturing output and manufacturing employment in the global economy—China, the EU-25, and the remaining OECD countries. With few exceptions, they show dramatic increases in manufacturing productivity and depressing losses in manufacturing jobs between 1995 and 2002—even in the face of often-gratifying levels of GDP growth.

Data I am able to assemble suggest that global manufacturing employment was between 150 million and 200 million workers in 2002, with one-fourth to one-half of those being in China. My estimates lead me to believe that global manufacturing employment was 20-30 million lower in 2002 than in 1995. The economic recovery after 2001 probably added back no more than 5 million jobs after 2002, with far greater than half of those add-backs apparently occurring in China. Thus, in the ten years 1995-2005, the global economy appears to have suffered net losses of 15-25 million manufacturing jobs. This is significant when one considers that US manufacturing job losses during that period amounted to about 2 million and that China's manufacturing job losses during the period appeared to be significantly greater than total US manufacturing employment at the beginning of 2005.

I conclude that manufacturing productivity growth and structural shifts in demand are so great in the global economy that only two kinds of countries will be able to add net new manufacturing jobs in the second five years of the 21st century: (1) Small countries who can achieve competitive gains at a sufficient rate to make up for productivity growth and structural change, and (2) Emerging market countries undergoing substantial market liberalization and, thus, having access to large amounts of resources (particularly labor) with very low opportunity costs.

As many other analysts already have pointed out, manufacturing will not be the job creator in the early years of the 21st century in the US that it was during much of the

20th century. In addition "manufacturing competitiveness" is not likely to mean the same thing as "job creation" in coming years, as much of that competitiveness will require cost reductions (read 'labor reduction') and switching to production of higher valued products that do not entail much labor per unit of output. The era of job creation through "industrialization" (i.e., manufacturing) in the US appears to be over. Again, as others have suggested, we must now find new ways to achieve employment and income growth. Not just because we are in the US—a high-income country with a powerful currency. But also because we are part of a broader economy in which dramatic manufacturing productivity growth and structural changes in demand and in production organization are global—not just national phenomena. On the academic research side, our models must begin to reflect these realities, and (as the BLS is beginning to do) we must focus greater attention to building the global datasets that we will need to accomplish such changes.

## Section V. Epilogue

I end this paper with an appeal for the multilateral organizations to commit themselves to the task of providing researchers and policy analysts with datasets capable of reflecting the full extent of global economic relations. As I wrestled in this paper with the simple model that I have dubbed "Job Shift Analysis", I really wanted to do a standard shift-share analysis particularly for the USA but also for a number of countries, using a global dataset made up of fungible national data. As I was beginning thinking about this paper, Ben Bernanke was making a speech (March 2005) in which he argued that developing countries as a group had emerged as net exporters and that, as a result, savings were now flowing in the opposite direction compared to preceding decades. He could say this from cobbled-together data that (like my own cobbling in this paper) had a large measurement error associated with it. Nevertheless, because the change he was chronicling was much larger than the huge error that remained in the summary data, it proved to be a valuable exercise that helped all of our thinking on the US trade deficit and on US and international interest rates.

While there is widespread recognition that we now face a globalized and deeply interrelated economy, much of the analysis from which we build our understanding of that economy continues to use national datasets and to look at national or—at best—bi-lateral economic relations. Using national datasets alone and listening to others who

were doing the same thing, I was finding it difficult to understand what the factory and the company level managers were saying about the globalization process that was/is leading to massive restructuring of their supply chains. I finally concluded that I could not really understand those adjustments until I had some understanding of what was happening at the aggregate, global level. I don't think I am the only person experiencing this problem. All of us could do better analysis, if we had addable data that were (decently) consistent country-to-country and country-to-globe.

I know that lot of work is required to make one country's data series comparable to and addable with those of another country. The OECD has put a lot of resources into creating comparable datasets between its member countries. The Foreign Labor Statistics group at the US Department of Labor continues to work hard at comparing labor and employment data between the US and other countries. And the Growth and Development Centre at Groningen University in the Netherlands has expended tremendous energy and resources in developing international comparisons of productivity. It is hard work, requiring lots of resources.

So, who should provide these globally-addable data? The usual suspects are the International Monetary Fund for macroeconomic data and the World Bank for global microeconomic data. I would be pleased if the annual edition of World Development Indicators, for example, would routinely provide the capacity to get global sums for every measure in that dataset. Country-by-country index numbers are fine for some kinds of work. But for many types of analysis, there is no real substitute for raw numbers that can be added up globally.

## Appendix Table 1. Employment by Sector in US, 1990 to 2005 (January data, in thousands of employees)

| Year (Jan) | Educ. & Health Services | Finan. Activities | Gov. | Infrmtn | Leisure & Hosptlty | Other Servcs | Prof & Bus Servcs | Transp. &Whsng | Utilities | Whlsle Trade | Retail Trade | Constrctn | Natural Res & Mining | Mfg. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1990 | 10,695 | 6,537 | 18,118 | 2,663 | 8,766 | 4,163 | 10,579 | 3,413 | 733 | 5,242 | 13,252 | 4,974 | 748 | 17,648 | 107,531 |
| 1991 | 11,254 | 6,561 | 18,439 | 2,688 | 8,763 | 4,216 | 10,573 | 3,451 | 735 | 5,177 | 13,065 | 4,530 | 745 | 17,184 | 107,381 |
| 1992 | 11,699 | 6,462 | 18,641 | 2,632 | 8,817 | 4,169 | 10,575 | 3,409 | 730 | 5,109 | 12,786 | 4,235 | 693 | 16,703 | 106,660 |
| 1993 | 12,032 | 6,561 | 18,839 | 2,648 | 9,026 | 4,254 | 11,033 | 3,480 | 713 | 5,031 | 12,846 | 4,233 | 664 | 16,661 | 108,021 |
| 1994 | 12,494 | 6,790 | 19,087 | 2,690 | 9,388 | 4,306 | 11,560 | 3,578 | 697 | 5,111 | 13,150 | 4,500 | 657 | 16,722 | 110,730 |
| 1995 | 13,016 | 6,767 | 19,329 | 2,773 | 9,751 | 4,464 | 12,357 | 3,761 | 672 | 5,329 | 13,772 | 4,788 | 638 | 17,132 | 114,549 |
| 1996 | 13,391 | 6,826 | 19,377 | 2,874 | 9,994 | 4,563 | 12,827 | 3,852 | 650 | 5,426 | 13,924 | 4,907 | 620 | 17,084 | 116,315 |
| 1997 | 13,822 | 7,013 | 19,506 | 2,999 | 10,275 | 4,691 | 13,577 | 3,945 | 624 | 5,545 | 14,223 | 5,232 | 632 | 17,184 | 119,268 |
| 1998 | 14,195 | 7,276 | 19,688 | 3,144 | 10,445 | 4,852 | 14,507 | 4,057 | 613 | 5,713 | 14,452 | 5,544 | 645 | 17,511 | 122,642 |
| 1999 | 14,547 | 7,549 | 19,995 | 3,293 | 10,720 | 4,977 | 15,246 | 4,196 | 608 | 5,790 | 14,701 | 5,912 | 603 | 17,325 | 125,462 |
| 2000 | 14,852 | 7,620 | 20,491 | 3,539 | 11,056 | 5,083 | 16,080 | 4,330 | 604 | 5,910 | 15,119 | 6,322 | 579 | 17,179 | 128,764 |
| 2001 | 15,255 | 7,700 | 20,753 | 3,697 | 11,328 | 5,140 | 16,479 | 4,404 | 598 | 5,816 | 15,284 | 6,394 | 592 | 16,993 | 130,433 |
| 2002 | 15,854 | 7,784 | 21,299 | 3,482 | 11,385 | 5,281 | 15,695 | 4,177 | 597 | 5,643 | 14,981 | 6,363 | 585 | 15,475 | 128,601 |
| 2003 | 16,325 | 7,866 | 21,542 | 3,249 | 11,568 | 5,336 | 15,568 | 4,177 | 585 | 5,582 | 14,855 | 6,293 | 559 | 14,744 | 128,249 |
| 2004 | 16,665 | 7,932 | 21,443 | 3,125 | 11,760 | 5,341 | 15,773 | 4,166 | 568 | 5,574 | 14,857 | 6,431 | 559 | 14,171 | 128,365 |
| 2005 | 17,066 | 8,092 | 21,620 | 3,105 | 12,027 | 5,388 | 16,302 | 4,280 | 573 | 5,631 | 14,985 | 6,651 | 592 | 14,180 | 130,492 |
| **CHANGE**: | | | | | | | | | | | | | | | |
| **1990 to 2005** | **6,371** | **1,555** | **3,502** | **442** | **3,261** | **1,225** | **5,723** | **867** | **(160)** | **389** | **1,733** | **1,677** | **(156)** | **(3,468)** | **22,961** |
| **1990 to 1995** | 2,321 | 230 | 1,211 | 110 | 985 | 301 | 1,778 | 348 | (61) | 87 | 520 | (186) | (110) | (516) | 7,018 |
| **1995 to 2000** | 1,836 | 853 | 1,162 | 766 | 1,305 | 619 | 3,723 | 569 | (68) | 581 | 1,347 | 1,534 | (59) | 47 | 14,215 |
| **2000 to 2005** | 2,214 | 472 | 1,129 | (434) | 971 | 305 | 222 | (50) | (31) | (279) | (134) | 329 | 13 | (2,999) | 1,728 |

**Source**: US Department of Labor, Bureau of Labor Statistics

**Appendix Table 2A. Index of Manufacturing Employment, Selected Countries (1992=100)**

| Year | USA | Canada | Australia | Japan | Korea | Taiwan |
|---|---|---|---|---|---|---|
| 1979 | 115.5 | 115.7 | 130.8 | 87.1 | NA | 81.4 |
| 1980 | 111.5 | 115.1 | 131.4 | 88.8 | NA | 84.5 |
| 1985 | 105.8 | 106.8 | 116.2 | 93.7 | 80.3 | 103.8 |
| 1990 | 105.4 | 113.2 | 113.4 | 97.5 | 104.2 | 101.4 |
| 1991 | 101.7 | 104.1 | 105.7 | 99.8 | 102.4 | 99.5 |
| 1992 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1993 | 100.1 | 99.1 | 97.6 | 96.8 | 97.3 | 99.6 |
| 1994 | 101.5 | 100.9 | 101.5 | 93.6 | 98.5 | 101.4 |
| 1995 | 102.8 | 104.8 | 100.8 | 90.1 | 99.9 | 99.9 |
| 1996 | 102.6 | 106.6 | 97.6 | 89.3 | 98.3 | 98.1 |
| 1997 | 103.7 | 110.0 | 98.6 | 89.1 | 92.6 | 99.2 |
| 1998 | 104.6 | 111.5 | 98.6 | 85.5 | 79.7 | 99.4 |
| 1999 | 103.0 | 113.6 | 96.3 | 83.2 | 80.8 | 100.0 |
| 2000 | 102.5 | 118.2 | 95.3 | 81.7 | 88.1 | 102.1 |
| 2001 | 97.8 | 116.5 | 92.1 | 79.6 | 92.7 | 97.4 |
| 2002 | 90.6 | 114.9 | 93.1 | 75.8 | 91.5 | 95.7 |
| 2003 | 86.4 | 115.5 | 91.3 | 74.3 | 88.2 | 97.3 |
| 2004* | 83.0 | 113.5 | 87.3 | 72.5 | 90.5 | 99.3 |
| 2005* | 83.1 | 113.7 | - | 71.3 | 90.5 | 101.8 |
| # Jobs in 2003 (000s)** | 14,744 | 2,260 | 1,096 | 11,850 | 4,144 | 2,327 |

**Appendix Table 2B. Index of Manufacturing Employment, Selected Countries (1992=100)**

| Year | Belgium | Denmark | France | Germany | Former West Germany |
|---|---|---|---|---|---|
| 1979 | 121.8 | 110.1 | 126.0 | NA | 101.2 |
| 1980 | 119.3 | 107.4 | 124.7 | NA | 102.2 |
| 1985 | 104.0 | 109.5 | 109.9 | NA | 94.9 |
| 1990 | 102.5 | 104.7 | 105.2 | NA | 100.3 |
| 1991 | 101.5 | 102.7 | 103.5 | 108.0 | 101.8 |
| 1992 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1993 | 96.1 | 96.8 | 95.2 | 93.0 | 94.0 |
| 1994 | 92.5 | 95.8 | 92.7 | 88.2 | 89.3 |
| 1995 | 91.9 | 98.6 | 92.8 | 86.2 | 87.3 |
| 1996 | 90.6 | 94.9 | 91.9 | 83.8 | 84.6 |
| 1997 | 89.3 | 92.9 | 90.9 | 82.6 | 82.6 |
| 1998 | 89.5 | 94.5 | 91.0 | 82.9 | 82.4 |
| 1999 | 88.4 | 96.0 | 90.7 | 82.0 | NA |
| 2000 | 88.9 | 94.5 | 91.6 | 82.7 | NA |
| 2001 | 89.6 | 93.3 | 92.7 | 83.0 | NA |
| 2002 | 86.0 | 90.2 | 91.1 | 81.2 | NA |
| 2003 | 83.2 | 87.4 | 89.1 | 79.0 | NA |
| # Jobs in 2003 (000's)** | NA | NA | NA | NA | NA |

**Appendix Table 2C. Index of Manufacturing Employment, Selected Countries (1992=100)**

| Year | Italy | Netherlands | Norway | Sweden | UK |
|---|---|---|---|---|---|
| 1979 | 114.2 | 108.9 | 134.0 | 131.0 | 158.7 |
| 1980 | 115.7 | 107.4 | 134.2 | 130.9 | 150.9 |
| 1985 | 102.1 | 94.9 | 120.5 | 122.0 | 120.0 |
| 1990 | 103.7 | 100.0 | 105.2 | 117.2 | 115.0 |
| 1991 | 103.2 | 100.7 | 101.9 | 109.9 | 106.3 |
| 1992 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1993 | 97.0 | 95.9 | 101.8 | 92.6 | 97.1 |
| 1994 | 95.9 | 92.4 | 104.5 | 92.6 | 98.2 |
| 1995 | 95.8 | 92.1 | 107.0 | 98.0 | 100.9 |
| 1996 | 94.9 | 91.1 | 108.7 | 97.7 | 101.6 |
| 1997 | 94.9 | 92.2 | 113.3 | 96.6 | 101.8 |
| 1998 | 96.8 | 93.1 | 114.7 | 98.4 | 101.3 |
| 1999 | 96.3 | 93.1 | 110.2 | 98.0 | 97.1 |
| 2000 | 96.1 | 93.1 | 107.5 | 98.1 | 94.1 |
| 2001 | 96.1 | 92.7 | 104.5 | 99.2 | 89.7 |
| 2002 | 96.9 | 90.0 | 103.3 | 96.4 | 85.7 |
| 2003 | 97.1 | 87.3 | 98.5 | 93.8 | 81.9 |
| 2004* | 96.6 | | 92.2 | 92.5 | 80.1 |
| 2005* | | | 90.2 | | |
| # Jobs in 2003 (000's)** | 5,144 | NA | 281 | 720 | 3,455 |

**Source**: US Department of Labor, Bureau of Labor Statistics (Foreign Labor Statistics home page).

* Projected from ILO employment data, where available. http://laborsta.ilo.org/cgi-bin/brokerv8.exe

** Jobs in 2003 from ILO LABORSTA Internet, http://laborsta.ilo.org/. Note that ILO data on manufacturing employment does not always match up with data from national or other international labour agencies. See Appendix Table 3 for an alternative statement of relative manufacturing employment levels in European Union countries.

## Appendix Table 3. Percent Manufacturing of Total Civilian Employment for 10 Countries, 1960-2004 (Approximating U.S. Concepts by Economic Sector)

| Year | United States (1) | Canada (1) | Australia | Japan | France | Germany | Italy (6) | Nether-lands | Sweden | United Kingdom |
|---|---|---|---|---|---|---|---|---|---|---|
| 1960 | 26.1 | 24.7 | NA | 21.7 | 28.2 | 34.4 | 24.0 | 29.0 | 31.6 | 36.0 |
| 1965 | 27.0 * | 23.8 | 26.2 | 24.8 | 27.5 | 36.0 | 25.5 | 28.6 | 32.6 | 35.0 |
| 1970 | 26.4 | 22.3 | 24.4 | 27.4 | 27.5 | 39.5 | 27.7 | 26.8 | 27.7 | 34.7 |
| 1975 | 22.7 | 20.2 | 21.3 | 26.1 | 27.8 | NA | 28.0 | 24.5 | 28.1 | 31.0 |
| 1980 | 22.1 | 18.9 | 19.4 | 25.0 | 25.8 | 34.0 | 26.9 | 21.3 | 24.3 | 28.3 |
| 1985 | 19.5 | 16.5 | 16.8 | 25.3 | 23.2 | 32.3 | 23.2 | 19.5 | 22.6 | 24.6 |
| 1990 | 18.0 * | 15.7 | 15.0 | 24.3 | 21.0 * | 31.6 | 22.6 | 19.1 | 21.0 | 22.3 |
| 1991 | 17.5 | 14.8 | 14.4 | 24.6 | 20.7 | 30.7 * | 22.1 * | 18.3 | 19.9 | 21.7 |
| 1992 | 17.0 | 14.3 | 14.3 | 24.6 | 20.1 | 29.5 | 22.0 | 18.2 * | 18.9 | 21.2 * |
| 1993 | 16.4 | 14.0 | 14.1 | 23.9 | 19.4 | 28.1 | 24.1 * | 17.7 | 18.3 | 21.0 |
| 1994 | 16.4 * | 14.0 | 14.1 | 23.4 | 18.9 | 26.6 | 24.2 | 16.7 | 18.2 | 19.2 |
| 1995 | 16.4 | 14.4 | 13.6 | 22.7 | 18.7 | 25.2 | 24.1 | 16.4 | 19.0 | 19.1 |
| 1996 | 16.2 | 14.4 | 13.4 | 22.5 | 18.5 | 24.3 | 23.8 | 15.9 | 19.3 | 19.4 |
| 1997 | 16.1 * | 14.7 | 13.5 | 22.2 | 18.2 | 24.0 | 23.5 | 15.7 | 19.3 | 18.8 |
| 1998 | 15.8 * | 15.0 | 12.8 | 21.4 | 17.9 | 24.1 | 23.7 | 15.2 | 19.1 | 18.6 |
| 1999 | 15.0 * | 15.3 | 12.2 | 21.0 | 17.5 | 23.8 * | 23.4 | 15.0 | 18.5 | 17.9 |
| 2000 | 14.4 * | 15.3 | 12.6 | 20.7 | 17.2 | 23.9 | 22.9 | 15.0 | 18.0 | 17.2 |
| 2001 | 13.5 | 14.9 | 12.0 | 20.2 | 17.1 | 23.7 | 22.4 | 14.5 | 17.5 | 16.5 |
| 2002 | 12.6 | 15.0 | 11.9 | 19.1 | 16.7 | 23.5 | 22.2 | 14.0 | 16.8 | 15.7 |
| 2003 | 12.3 * | 14.6 | 11.4 | 18.8 | 16.3 | 23.1 | 22.1 | NA | 16.2 | 14.9 |
| 2004 | 11.8 * | 14.4 | 11.3 | 18.3 | NA | 22.7 | 21.8 | NA | 16.0 | NA |

**Source**: "Comparative Civilian Labor Force Statistics, 10 Countries, 1960-2004". US Department of Labor, Bureau of Labor Statistics, Office of Productivity and Technology (May 13, 2005). http://www.bls.gov/fls/flslforc.pdf

NA=Not Available

(1) Data for 2000 forward for the United States and for 1976 forward for Canada are shown based on the 2002 North American Industry Classification System (NAICS).

(2) Because of rounding, sub totals may not add to totals.

(3) Agriculture, forestry, hunting and fishing are included in "agriculture".

(4) Manufacturing, mining and construction are included in "industry".

(5) Prior to 1993 public utilities are included in "industry".

(6) For 1993 forward some mining is included in "manufacturing".

(7) Transportation, communication, public utilities, trade, finance, public administration, private household services, and miscellaneous services are included in "services".

* Indicates a break in series.

## Appendix Table 4a. Manufacturing Employment in 1995 and 2002 Reported by ILO (Africa and Americas)

| REGION/Country | Manufacturing Employment In 2002 ('000) | Year if other than 2002 | Manufacturing Employment in 1995 ('000) | Year if other than 1995 |
|---|---|---|---|---|
| **AFRICA*** | | | | |
| Algeria | 189.6 | 2000 | 373.8 | |
| Botswana | 29.8 | | 24.0 | |
| Egypt | 1,163.0 | 2000 | 1,163.0 | |
| Kenya | 214.5 | 1997 | 204.8 | |
| Mauritania | 2.2 | 2000 | 1.4 | |
| Mauritius | 111.0 | | 110.4 | |
| Morocco | 506.9 | 2000 | 451.8 | |
| South Africa | 1,261.0 | | 1,438.0 | |
| Swaziland | 16.0 | 1996 | 16.0 | |
| Tunisia | 294.2 | 2000 | 273.6 | |
| Zimbabwe | 137.7 | | 185.9 | |
| | | | | |
| **AMERICAS** | | | | |
| Argentina | 746.6 | | 669.7 | |
| Barbados | 5.4 | 1993 | 5.4 | 1993 |
| Bermuda | 1.1 | | 1.1 | 1994 |
| Brazil | 5,255.9 | 2001 | 4,939.0 | 1996 |
| Canada | 2,231.4 | | 1,854.8 | |
| Colombia | 458.7 | 1999 | 576.0 | |
| Costa Rica | 167.3 | 2003 | 147.0 | 1996 |
| Ecuador | 279.3 | | 279.3 | 2002 |
| El Salvador | | | 65.1 | 1994 |
| Mexico | 5,652.5 | 2001 | 4,168.3 | |
| Panama | 43.2 | 2001 | 41.9 | 1994 |
| Peru | 352.2 | | 550.0 | 1996 |
| Puerto Rico | 95.7 | | 120.0 | 1994 |
| USA | 16,399.5 | | 18,524.0 | |
| Virgin Islands | 2.5 | 2000 | 2.5 | |

Appendix Table 4 continued next page.

## Appendix Table 4b. Manufacturing Employment in 1995 and 2002 Reported by ILO (Asia and Oceania)

| REGION/Country | Manufacturing Employment In 2002 ('000) | Year if other than 2002 | Manufacturing Employment in 1995 ('000) | Year if other than 1995 |
|---|---|---|---|---|
| **ASIA** | | | | |
| Azerbaijan | 106.1 | | 295.9 | |
| China | 29,070.0 | | 45,384.0 | 1994 |
| Cyprus | 30.8 | | 30.8 | 2002 |
| Hong Kong | 184.5 | | 375.8 | |
| India | 6,683.0 | 1999 | 6,767.0 | |
| Indonesia | 4,467.0 | 2001 | 4,123.6 | 1998 |
| Iraq | 109.3 | 2001 | 111.2 | 1998 |
| Israel | 329.4 | | 329.4 | 2002 |
| Japan | 11,190.0 | 2003 | 12,674.4 | Calculated |
| Jordan | 97.0 | | 100.0 | |
| Kazakhstan | 577.0 | 1999 | 645.0 | |
| Kuwait | 67.7 | 2000 | 62.1 | |
| Lebanon | 78.0 | 1998 | 103.0 | 1994 |
| Macau | 40.7 | 1999 | 42.0 | |
| Malaysia | | | 1,222.1 | 1994 |
| Philippines | 903.0 | 1995 | 903.0 | |
| Saudi Arabia | 326.0 | 2001 | 222.9 | |
| Sri Lanka | 250.8 | | 263.9 | |
| Syria | 37.7 | 2000 | 314.0 | |
| Taiwan | 2,314.2 | | 2,409.8 | |
| United Arab Emirates | 193.7 | 2001 | 95.8 | |
| West Bank & Gaza | 38.7 | | 39.9 | 1996 |
| Yemen | 78.7 | 1999 | 78.7 | 1999 |
| | | | | |
| **OCEANIA** | | | | |
| Australia | 1,109.2 | | 1,040.5 | |
| Fiji | 29.2 | 1998 | 24.4 | 1993 |
| New Zealand | 257.3 | | 256.2 | |

Appendix Table 4 continued next page.

## Appendix Table 4c. Manufacturing Employment in 1995 and 2002 Reported by ILO (Europe, and Global Total)

| REGION/Country | Manufacturing Employment In 2002 ('000) | Year if other than 2002 | Manufacturing Employment in 1995 ('000) | Year if other than 1995 |
|---|---|---|---|---|
| **EUROPE** | | | | |
| Austria | 711.8 | | 711.8 | 2002 |
| Belgium | 697.2 | | 644.8 | |
| Bulgaria | 653.8 | 1995 | 653.8 | 1995 |
| Croatia | 306.9 | 1996 | 338.4 | |
| Czech Republic | 1,216.0 | | 1,332.0 | |
| Denmark | 440.8 | | 496.2 | |
| Estonia | 97.1 | 1994 | 97.1 | 1994 |
| Finland | 436.0 | | 403.0 | |
| France | 3,855.6 | | 4,121.0 | 1994 |
| Germany | 8,080.0 | | 8,499.0 | |
| Greece | 396.5 | | 397.6 | |
| Hungary | 746.3 | | 860.3 | 1992 |
| Iceland | 20.0 | | 20.7 | |
| Ireland | 260.5 | | 229.2 | |
| Italy | 4,103.0 | | 4,027.0 | |
| Latvia | 147.0 | | 153.0 | 1997 |
| Lithuania | 221.7 | | 279.7 | |
| Macedonia | 96.0 | 2001 | 120.0 | |
| Malta | 26.8 | 1999 | 31.1 | |
| Moldova | 156.0 | 1995 | 156.0 | 1995 |
| Netherlands | 985.3 | Calculated | 1,017.0 | 1994 |
| Norway | 281.0 | | 300.0 | |
| Poland | 2,220.8 | | 2,615.5 | |
| Portugal | 918.3 | | 858.2 | |
| Romania | 1,593.4 | | 2,191.7 | |
| Russia | 12,517.0 | | 13,181.0 | |
| San Marino | 5.9 | | 4.4 | |
| Serbia & Montenegro | 647.4 | 2001 | 800.7 | |
| Slovakia | 549.2 | | 556.0 | |
| Slovenia | 269.0 | | 297.0 | |
| Spain | 2,653.7 | | 2,045.2 | |
| Sweden | 676.0 | | 716.0 | |
| Switzerland | 689.3 | | 737.9 | |
| Turkey | 3,034.0 | | 3,034.0 | 2002 |
| Ukraine | 2,321.0 | 2001 | 2,321.0 | 2001 |
| United Kingdom | 3,627.0 | | 4,072.0 | |
| **GLOBALTOTAL** | **149,843.5** | | **172,421.4** | |

**Source**: International Labor Organization (http://laborsta.ilo.org/).
"Calculated" indicates data calculated using index of manufacturing employment data from Appendix Table 2.