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10 Issues in Measurement and International Comparison of Output Growth in Manufacturing

Robert Z. Lawrence

10.1 Introduction

Estimates of manufacturing output are crucial for several issues of concern to policymakers. They are frequently used to draw inferences about the health of the U.S. industrial base and U.S. international competitiveness. Taken at face value, the official data suggest that U.S. manufacturing performance during the 1980s was reasonably good. These data show that:

1. Despite the emergence of a large trade deficit in the 1980s, manufacturing output has retained its share in real U.S. GNP. This conclusion suggests that fears of deindustrialization in the United States have been exaggerated. While U.S. manufacturing firms may have lost domestic market share and may have had relatively sluggish export growth in the first half of the 1980s, apparently the domestic demand for goods grew rapidly enough to enable them on the whole to expand production as rapidly as overall GNP.

2. Output per manhour in U.S. manufacturing grew at a 3.3 percent annual rate between 1979 and 1988. This pace is similar to the 3.2 percent growth rate recorded between 1960 and 1973 and suggests that U.S. manufacturing, unlike the service sector, successfully reversed the productivity slowdown of the 1970s. The performance of manufacturing suggests that U.S. policymakers concerned about aggregate productivity growth should pay much more attention to the service sector, where productivity growth rates have not recovered.

3. The 3.3 percent growth rate of output per manhour in U.S. manufacturing between 1979 and 1988 places the U.S. in the middle of the pack in man-

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ufacturing productivity growth among industrial countries. This is a marked improvement compared to the 1960s and 1970s, when U.S. productivity growth in manufacturing was the slowest of the industrial nations. In particular, while U.S. output-per-manhour growth still lags that of Japan, in recent years this gap has narrowed. This evidence suggests that much of the earlier differences between the United States and the rest of the world reflected an inevitable catch-up phenomenon, rather than a fundamental flaw in U.S. performance.

4. When this productivity performance is combined with modest increases in compensation per manhour in U.S. manufacturing and the decline in the U.S. dollar, it shows there has been a marked improvement in relative unit labor costs since 1985. Indeed, purchasing power estimates suggest today that manufacturing unit labor costs are considerably lower in the United States than in any other major industrial country. Researchers relying on these data argue that with sufficient time, U.S. manufacturing will be highly competitive at current exchange rates (Hooper and Larin 1988).

10.1.1 Criticisms

The validity of the manufacturing output data, and thus of these inferences about the health of the U.S. manufacturing sector, has been called into question. In particular, questions have been raised about the accuracy of the Gross Product Originating (GPO) series, which is commonly used to measure output in the manufacturing sector. Lawrence Mishel has argued that the data overstate manufacturing growth on several counts.

1. *Alternative Measures.* Mishel argues that the GPO measure is inconsistent with alternative measures of manufacturing output (Mishel 1988, 1989). Mishel shows (1988, p. 25) that between 1982 and 1985, real gross output in manufacturing increased almost 10 percent less than GPO (24.5 percent versus 14.8 percent). He suggests this is suspicious. In the 1980s, U.S. manufacturers increasingly sourced components abroad. With less value added at home, he believes gross output measures should grow more rapidly than value-added measures. But the data suggest otherwise.

Mishel also finds support for the view that the value added is overstated from input-output (I-O) data. In particular, he points out that between 1977 and 1981 manufacturing output growth measured by the GPO series was nearly double the growth implied by the I-O data for these years. He suggests this outcome resulted from difficulties in assigning output to specific sectors during a period in which the sectoral composition of corporations were in a continual state of flux. Mishel argues that manufacturing value-added growth will have to be revised downwards if it is to track the benchmark from the I-O series.

Mishel is also critical of the major downward adjustments—"the fudge factors"—made by BEA to manufacturing output in 1972 and 1973 to make their estimates consistent with the rest of the GNP accounts. The official data indicate that, measured in 1982 dollars, in 1973 the share of manufacturing in GNP was 22.6 percent. Removing the downward adjustment would raise this share to over 24 percent in 1973. Mishel notes that without these adjustments manufacturing GPO would grow much more slowly between 1972 and 1979.

2. *Purchased materials and services.* The GNP input deflators for materials and services (except for crude petroleum) exclude import prices (Mishel 1988, p. 25). If import prices decline relative to domestic prices but domestic prices are used to deflate all inputs, the result is an understatement of the growth in inputs and thus an overstatement of the growth in value added. Since import prices declined relative to domestic prices between 1979 and 1985, according to BEA, which has accepted this point, this could reduce manufacturing growth, "perhaps by half a percentage point or more per year" (BEA 1988, pp. 132–33).

A related issue concerns the measurement of services inputs. Many believe manufacturing activities have increasingly been outsourced to the services sector. Mishel argues that prices of services used as manufacturing inputs are overstated because the deflators BEA uses for some service sector input into manufacturing fail to take account of productivity increases. This overstates service prices, understates service quantities and thus biases upward value added in manufacturing. The BEA estimates an overstatement of purchased services prices by one percent would lead to a 0.3 percent overstatement of manufacturing value-added growth in the 1975–85 period. (BEA 1988).

3. *Computer Prices.* Edward Denison (1989) has raised questions about the hedonic price measures for computers now used in the National Income and Product Accounts (NIPA). Denison advocates measuring capital goods output by labor inputs. He prefers picking up the impact of technology improvement in final goods output rather than in capital inputs, and he argues that the current practice leads to a significant overstatement of manufacturing output growth.[1] Denison estimates that the treatment of computers has raised the growth rate in manufacturing output per manhour by 1.02 percent annually between 1979 and 1986. Instead of the 3.48 percent annual growth in output per manhour actually recorded, without the extraordinary treatment of computers the rate would be 2.46 percent per year. Manufacturing output per manhour should be marked down accordingly.

A second issue, highlighted by Baily and Gordon (1988) relates to the index number problem which stems from using fixed base-period price weights for products like computers whose relative price has declined rapidly. They estimate that using current-year share weights for computers lowers the growth of output of producer's durable equipment between 1979 and 1987 from 2.64 to 2.20 percent. Mishel points out that the use of hedonic indexes

1. For a rejection of Denison's views, see *Survey of Current Business* (July 1989).

for inputs such as semiconductors would further lower estimates of computer output by raising input and import measures, although presumably hedonic measures would also raise estimates of semiconductor output growth.

10.1.2 Implications

Taken together, these criticisms raise doubts about the manufacturing output data. The problems they point to all suggest that U.S. manufacturing output growth has been overstated. Mishel estimates that taking account of the criticisms that are quantifiable leads to a downward revision in annual manufacturing value-added growth to 1.42 percent, rather than the official 1.94 percent, between 1973 and 1979, and to 0.91 percent rather than 2.04 percent annually, between 1979 and 1985 (Mishel 1989; p. 40).

These adjustments clearly could be important. Between 1980 and 1985, for example, accepting Mishel's estimates, the rise in U.S. unit labor costs would have been 7 percent more than estimated by Hooper and Larin (1988). Accordingly, the failure of the U.S. trade balance to respond to the incentives of allegedly lower U.S. unit labor costs would be less of a puzzle (Hooper 1988). Annual labor productivity growth in manufacturing between 1979 and 1985 would be 2.23 percent—a slower pace than in the period 1950 to 1973—compared with the official estimate of 3.38 percent.

It is noteworthy that while Mishel marks down the growth in labor productivity growth since 1973, his adjustments for the period 1985 to 1987 are minor. He would mark the output growth of manufacturing down by just 0.15 percent. Indeed, while the computer deflation issues remains, relative import prices were rising over this period, and thus the manufacturing output estimates are biased downwards rather than upwards. Between 1985 and 1988, output per manhour in U.S. manufacturing increased at an average annual rate of 3.7 percent. This suggests the labor productivity growth rates for manufacturing since 1985 *have* improved greatly over their performance between 1973 and 1979. *Between 1985 and 1988, the recovery in manufacturing labor productivity has been real.*[2]

In this paper, I will deal primarily with the objections to the measurement of manufacturing output that involve international issues, in particular the questions of outsourcing of imports and the deflation of imported inputs. I will argue that with the exception of the computer price deflation question, the case that manufacturing output growth has been seriously overstated has not been proved. I will show that even when chain-weighted prices are used to take care of the computer weighting problem, manufacturing output grew as rapidly as GNP in the 1980s. At the same time, however, I will argue that the manufacturing output estimates should be used with great caution and that

2. This does not mean, however, that aggregate U.S. productivity growth has fully recovered. Between 1985 and 1988, output per hour in the business sector grew 1.8 percent annually (a full percentage point below the pace between 1960 and 1973).

the estimates at even more disaggregated levels leave much to be desired. I will suggest that the data we have available are deficient in coverage and above all in their lack of timeliness. Major structural changes could take place in the United States, but not become fully apparent in the data for many years.

10.2 Alternative Measures

The Census, BEA, and input-output measures of nominal manufacturing value added are reported in table 10.1. Between 1972 and 1980 the Census measure grew more rapidly than the BEA measure. But since 1981 the relationship has reversed, and the GNP value-added measure has outpaced the Census measure. Mishel believes the GNP output numbers have become increasingly inaccurate because they are derived in part from data available only on an enterprise basis. He argues that the basis for assigning such data to particular sectors is outdated since it reflects classifications most recently revised in 1972 (Mishel 1988, p. 39).[3]

The critical feature of these data is that they all present a very similar picture of nominal value added in manufacturing. To be sure, the three different measures deviate in some years, and choosing these years as endpoints can exaggerate their differences. But over longer periods of time, their growth rates seem quite similar. As shown in table 10.1, between 1972 and 1977 and between 1977 and 1987 all three measures have similar growth rates. The differences arise between 1977 and 1980 when the Census measure grows more rapidly than the GNP measure and in 1981, 1985, and 1986 when the BEA measure grows more rapidly. But it is hard to see how differences in classification have led to a systematic overstatement in GNP value-added growth.[4]

Mishel found that between 1977 and 1981, the input-output data showed slower growth in manufacturing than the GNP. This is borne out by the calculations reported in table 10.1. However, as also reported in table 10.1, by 1983 the two series had converged. Accordingly, after 1977, the GNP series for value added matches the Census series in its growth through 1986 and the input-output series for growth through 1983. The shipments series in the Census and I-O data are virtually identical in 1977, 1981, and 1983.

In sum, this examination does not bear out the charge that the Census and I-O data suggest BEA has made serious classification errors.

Mishel is also concerned by the reported growth in the ratio of real value

3. The BEA and Census measures are conceptually different, since the Census data include purchased services. But Mishel argues the growth in purchased services is not a major reason behind the measured differences in the series growth after 1979. He points out that current-dollar service sector inputs accounted for only 9 percent of gross output in 1972 and have increased only slightly since then.

4. The Census cautions that the data after 1982 are not strictly comparable with the data prior to 1982 because prior to 1982, respondents were allowed to report their inventories using any generally accepted accounting method. See, for example, *Annual Survey of Manufactures* (1985).

Table 10.1 **Alternative Measures of Nominal Manufacturing Output**

	Value Added			Value Added (1977 = 100)			Ratios (1977 = 100)		Shipments	
Year	GNP	I-O	Census	GNP	I-O	Census	GNP/I-O	GNP/Census	I-O	Census
1987	854.00			1.84						
1986	820.00		1,035.00	1.76		1.77		1.00		2,280.00
1985	796.00		1,000.00	1.71		1.71		1.00		2,280.00
1984	767.00		983.00	1.65		1.68		0.98		2,253.00
1983	683.00	708.00	882.00	1.47	1.47	1.51	1.00	0.97	2,056.00	2,045.00
1982	635.00		824.00	1.37	1.34	1.41		0.97		1,960.00
1981	643.00	643.00	838.00	1.38	1.34	1.43	0.97	0.97	2,018.00	2,017.00
1980	581.00		774.00	1.25		1.32		0.94		1,853.00
1979	562.00		748.00	1.21		1.28		0.95		1,727.00
1977	465.00	481.00	585.00	1.00		1.00	1.00	1.00	1,359.00	1,358.00
1972	293.00		354.00	0.63		0.61		1.04		757.00

Sources: Bureau of Economic Analysis, *Survey of Current Business;* Bureau of Labor Statistics, input-output table diskettes; Bureau of the Census, *Annual Survey of Manufactures*.

added to shipments in the 1980s. He believes this growth is inconsistent with the widespread view of increased outsourcing. If producers now import products once made at home, Mishel argues this should be expected to raise the ratio of shipments to value added. However, in principle this is not correct. Shipments reflect both the value of imported inputs and the double counting of inputs shipped between domestic firms in partially finished form. Foreign outsourcing will raise the value of the former, but it will also reduce the value of the latter. If for example, General Motors makes auto parts in one plant and ships them to another for painting and to a third for final assembly, these parts will show up three times in the shipments data. If GM simply imports painted parts, the parts will show up only when embodied in the final product. Mishel implies that increased outsourcing should raise the ratio of shipments to value added. In fact, however, increased outsourcing has an ambiguous impact on the ratio of shipments to value added.

Mishel compares the real gross output growth rates with those of value added at a disaggregated level. He finds that between 1979 and 1986, the decline in the ratio of gross output to value added is widespread. It occurred in 15 industries accounting for 81.8 percent of gross output. But he also shows that the same phenomenon occurred in 15 industries accounting for 57.3 percent of output between 1973 and 1979. The data might be capturing a growing and widespread tendency to economize on inputs, rather than errors in input measures.

10.3 Deflation

When estimating real value added in manufacturing, BEA uses domestic producer prices (where available) to deflate manufacturing inputs. In fact of course, many inputs are actually imported. According to Mishel, the use of inappropriate deflators is another major reason for the overstatement of growth in the real GPO series.

But it is important to be careful about the years over which inadequate deflation presents a problem. According to BEA, the use of the inappropriate import deflators resulted in an overstatement of value-added growth in manufacturing of 0.5 percent per year between 1979 and 1985 (BEA 1988). During periods of dollar depreciation in the 1970s and after 1985, however, the bias was in the opposite direction. Indeed, between 1985 and 1988 almost all of the relative decline in import prices of the early 1980s was reversed. Moreover, according to BEA, "taking account of import prices would have little effect on manufacturing growth from 1972 to 1985, because prices of imported materials grew at about the same rate as prices of domestically produced materials" (BEA 1988, p. 132).

Mishel's study divides the period 1979 to 1985 in two. He finds that between 1979 and 1982 the series grew by similar amounts; constant dollar output measured by gross output declined by 11.1 percent, whereas the constant dollar GPO series declined 9.0 percent. It is in the recovery phase, between 1982 and 1985, that the two series differed; the gross output series rose only 14.8 percent, while the GPO series increases 24.5 percent. Thus, what he terms the value added intensity puzzle is essentially a feature of the subperiod 1982 to 1985, rather than of the period 1979 to 1985 as a whole. Indeed, this is precisely the timing one would expect if increased foreign sourcing is behind the puzzle, since it was during this period that imports grew especially strongly.

It seems reasonable to assume that imports of homogeneous primary commodities will have prices similar to domestically produced commodities. But this need not be the case with imported inputs of semifinished manufacturing components. Accordingly, the bias will stem mainly from the failure to use the correct deflators for imports that are classified as manufactured goods.

It should also be noted that domestic producer prices will miss the *first* use of an imported input in the production process, but will capture accurately the prices of products which embody imports. For example, if imported steel is used to make automobile axles, the prices of inputs into axles will be mismeasured, but when the axles are used to produce automobiles, their prices will be measured accurately.

To estimate how large a bias is introduced into the real value-added measures, a price series for imported inputs is required. The published price series that are readily available are reported in table 10.2. One series that by its name appears ideal for this purpose is the end-use, fixed-weight import price series for industrial supplies and materials. But it is unclear what domestic price series should be used. Between 1980 and 1987, the end-use import price series for imports of nonfuel industrial supplies rose 4 percent *more* than the producer price series for nonfuel crude materials, but it rose about 13 percent *less* than the producer price index for manufacturing materials and components.

Nonetheless, the comparison with the PPI for manufacturing materials suggests that most of the decline in relative import prices took place between 1980 and 1982 (and not during the subperiod 1982 to 1985, in which the value-added intensity puzzle appears. Between 1982 and 1987, the end-use import price series for nonfuel industrial supplies increased at the same rate as the PPI for manufacturing materials and components.[5]

Unfortunately, the concept of industrial supplies is not entirely appropriate for use in this context. The industrial supplies end-use category neglects the manufacturing inputs that are included in the end-use categories for capital

5. The end-use categories for *finished* goods present a similar picture. In 1987 the relative prices of imported consumer goods were back to their 1980 levels; relative imported automobile prices were about 10 percent above their 1980 levels, but relative imported capital goods prices remained 26 percent below their 1980 levels. The major declines in relative import prices appear to have taken place in 1981 and 1982. Even capital goods had returned to their 1982 relative levels by 1987. Of course, these categories may cover up rather large compositional differences.

Table 10.2 Producer and Import Price Series

	Producer Prices		Import Prices	Ratios	
Year	Manufacturing Materials & Components (1)	Nonfuel, Nonfood Crude Materials (2)	Nonfuel Industrial Supplies (3)	PPI Components (1)/(3)	PPI Crude (2)/(3)
1980	92	92	103	0.89	0.89
1981	99	110	104	0.95	1.06
1982	100	100	100	1.00	1.00
1983	101	99	95	1.06	1.04
1984	104	101	94	1.11	1.07
1985	103	94	87	1.18	1.08
1986	102	76	90	1.13	0.84
1987	105	89	104	1.01	0.86

Note: Import price series for fixed-weights end-use.

goods and automotive products. There are, therefore, no readily available import price aggregates that are suitable for the purpose at hand. Indeed, it would be extremely useful to a user of the import data if an import price series for manufacturing components was available.

Since there is no such series available, I have tried to construct one. However, even at the disaggregated 2-digit SIC code level, a complete set of import price data by industry is not available for the period under consideration. BLS has now completed the task of producing such data, but its coverage in the early 1980s was spotty.

Nonetheless I have tried to get a quantitative estimate of the problem by using the price series that are available. I have used the 1983 input-output table to obtain a system of weights for this purpose. I-O table 1 indicates the use of commodities by industries. By assuming that imports were used in the same proportions as domestic output, I can estimate the share of manufactured imports used as inputs in manufacturing.

Table 10.3 reports the ratios of domestic PPIs to import prices at several points in the 1980s. For June 1981, price data were available on industries accounting for 44 percent of 1983 manufacturing imported inputs. The weighted average of available PPI/import price ratios in 1981 was 16 percent below the 1985 levels. (That is, the weighted ratio had a value of 0.84 where 1985 = 1.0; in other words, relative import prices were 19 percent above their 1985 levels.) After rising to a peak in 1985, by the end of 1987 these relative prices had returned to their levels of June 1981. Over the period 1981 to 1987, therefore, the impact of these imported prices appears to have washed out. By 1987, relative PPIs in sectors accounting for 67 percent of all manufacturing inputs were 9 percent lower than in December 1982. PPIs in sectors

Table 10.3 **Ratios of Industry Producer Price to Import Price Index (1985 = 1)**

SIC Code	(1) RPPI June 1981	(2) RPPI Dec 1982	(3) RPPI Dec 1983	(4) RPPI Dec 1986	(5) RPPI Dec 1987	1987/1981 (5)/(1)	1987/1982 (4)/(1)	1987/1983 (4)/(2)
20	0.95	0.99	0.97	1.00	0.95	1.01	0.96	0.97
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	1.01	1.00	0.89	0.82	0.00	0.82	0.82
23	0.94	1.02	1.04	0.99	0.93	0.94	0.91	0.89
24	0.96	0.97	0.97	0.93	0.96	1.01	0.99	0.98
25	0.85	0.94	0.98	0.91	0.87	1.00	0.93	0.89
26	0.80	0.96	0.99	1.01	0.96	1.14	1.01	0.98
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.92	0.95	0.95	0.94	0.00	1.02	0.99
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.88	0.97	0.99	0.92	0.90	0.97	0.92	0.91
31	0.87	0.93	0.96	0.99	0.86	0.97	0.92	0.89
32	0.85	0.92	0.95	0.87	0.86	0.95	0.94	0.91
33	0.82	0.94	0.94	0.96	0.93	1.12	0.98	0.98
34	0.00	0.00	0.00	0.89	0.85	0.00	0.00	0.00
35	0.81	0.93	0.94	0.86	0.78	0.92	0.83	0.82
36	0.00	0.00	0.91	0.94	0.88	0.00	0.00	0.97
37	0.00	1.04	1.01	0.90	0.83	0.83	0.80	0.82
38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.92	0.92	0.92	0.87	0.00	0.94	0.94
Weighted ratio	0.84	0.97	0.96	0.93	0.88	0.98	0.91	0.92
Percent of inputs covered	44	67	86	95	95	44	67	86

Source: Bureau of Labor Statistics.
Note: Weights of imported manufactured goods inputs derived using 1983 input-output table. RPPI = Ratio of domestic producer price index to import prices.

accounting for 86 percent of all levels were 8 percent lower than in December 1983.

Real value added is estimated by the double-deflation method. The series on outputs and inputs are deflated separately, and real value added is estimated from their difference. Using the 1983 I-O table, I estimate that imported manufactured inputs accounted for $79 billion of the total $1347 billion inputs into manufacturing. Manufacturing value added was $708 billion. Using an imports-input price index which was 10 percent too high would lead to an upward bias in estimated value added equal to $(.10 \times 79)/708$, or 1.1 percent. Between 1982 and 1985 relative import prices declined by 19 percent. Using the parameters discussed above suggests the bias to growth over this period would have been about 2.1 percent.

But in fact, the ratio of manufactured imports to shipments *increased* considerably between 1983 and 1986. Thus the 1983 value may underestimate the bias introduced to later years. I have used the shipments and import data for 1986 to estimate the value of imported manufacturing inputs that would be used in the 1983 output mix given the 1986 import-to-shipments ratios. This analysis indicates that given the rise in the ratio of imports to shipments between 1983 and 1986, the 1983 mix of products would have been produced using $108 billion of manufactured imports rather than $78 billion. This suggests that by 1986 a 10 percent import price bias would have resulted in a 1.5 percent overstatement of output. Given the 19 percent relative price increase, a bias of 2.9 percent in growth would have resulted.

These numbers are meant to be illustrative rather than accurate. They are based only on partial information about the price series. But they do suggest that the use of inappropriate deflators is unlikely to be the full explanation for the difference of almost 10 percent between the growth of the GPO and gross output series between 1982 and 1985. The data could be capturing reality rather than measurement error.

It should also be noted that most of the bias would have taken place in growth estimates between 1982 and 1983. By December 1982, relative import prices were only 3 percent above their 1985 levels. Thus, the downward bias in growth after 1982 would have been relatively minor. Moreover, by 1987 relative import prices had returned to their 1982 levels. Accordingly, inappropriate deflators are a minor factor in estimates for GPO growth between 1982 and 1987 measured in 1982 dollars.

In sum, this analysis does not suggest that major differences in price changes between domestic and imported products exerted an important downward bias on the manufacturing output measures between 1982 and 1987, and indeed, according to BEA itself, no bias was present over the period 1972 to 1985. The bias, may however, have been present in the early 1980s. The analysis also suggests that at most about 3 of the 10 percentage-point difference in growth between the GPO and gross-output series between 1982 and 1985 could be due to inappropriate import deflators.

BEA estimates that ignoring import prices biased the growth estimates of manufacturing output upward by 0.5 percent per year between 1979 and 1985. Assuming all of this took place between 1982 and 1985, it would amount to 3 percent—an estimate quite close to the one I have obtained. Even if we add in the additional 0.3 percent per year Mishel believes is attributable to the overstatement of services input prices (1989, p. 40), we could explain only about 4 percentage points of the value-added intensity puzzle.

10.3.1 Computers

Denison's objections to the procedures used to deflate computers raise fundamental issues.[6] His suggestions are appropriate for a measure which seeks to ensure that technological innovations appear in the residual rather than as inputs. However, from the standpoint of appraising sectoral productivity, it seems more appropriate to ensure that improvements in computers are ascribed to the sector producing them. The points made by Baily and Gordon (1988) about the weighting scheme used for measuring output is, however, relevant. The use of the 1982 implicit deflators leads to an overstatement of real manufacturing output growth after 1982.

Table 10.4 reports an estimate of manufacturing real output growth using a chain-weighting method for calculating growth. In each year, manufacturing output growth is calculated as the weighted average of growth in SIC 35, the 2-digit category which includes computers, and the growth in the rest of manufacturing, where the weights are the shares of each series in nominal manufacturing output in the previous year. This method indicates that between 1979 and 1987 manufacturing output increased by 18 percent, in contrast to the 20.4 percent rise in the NIPA accounts. Over the period 1979 to 1987, therefore, this effect reduced manufacturing growth by 0.26 percent per year. Almost all of the reduction took place between 1984 and 1987, the growth for which is overstated by an average of 0.53 percent per year.

The weighting scheme also affects estimates of overall GNP growth. Table 10.5 reports the growth in real GNP estimated by deflating the annual growth in nominal GNP by the chain-weighted deflator for GNP published by BEA. Between 1979 and 1987 this reduces the estimated GNP growth from 20.7 to 19.7 percent. Between 1979 and 1987 the share of the chain-weighted estimate of manufacturing growth in (chain-weighted) GNP declines by 1.1 percent. Specifically, taking account of the impact of the weighting of computers implies that instead of similar 21.8 percent shares of manufacturing in real GNP in 1979 and 1987, the share of manufacturing in GNP would (barely) decline from 21.8 to 21.5 percent.

6. For a more extensive discussion of the impact of computer deflation methods on trade flows, see the paper by Ellen Meade, chapter 2 in this volume.

Table 10.4 **Percentage Growth Rates for Manufacturing**

Year	Chain-Weighted Index (1)	In 1982 $ (2)	Difference (1) − (2)
1980	−4.51	−4.55	0.03
1981	1.63	1.61	0.02
1982	−6.15	−6.14	−0.01
1983	6.45	6.45	−0.00
1984	11.78	12.20	−0.42
1985	3.17	3.81	−0.64
1986	1.70	2.26	−0.56
1987	3.82	4.34	0.51
Annual average	2.24	2.50	−0.26
Total period growth	18.04	20.43	−2.38

Table 10.5 **GNP/Manufacturing Ratios**

	Chain-Weighted Technique			National Income Accounts Basis (1982 $)			
Year	GNP (1)	Manufacturing (2)	Ratio A (2)/(1)	GNP (3)	Manufacturing (4)	Ratio B (4)/(3)	Difference Ratio B − A
1979	1.000	1.000	1.000	1.000	1.000	1.000	0.000
1980	0.999	0.955	0.956	0.998	0.955	0.956	0.000
1981	1.020	0.970	0.951	1.018	0.970	0.953	0.002
1982	0.995	0.911	0.915	0.992	0.910	0.918	0.003
1983	1.029	0.969	0.942	1.027	0.969	0.943	0.001
1984	1.093	1.084	0.991	1.093	1.087	0.995	0.003
1985	1.126	1.118	0.993	1.134	1.129	0.996	0.003
1986	1.158	1.137	0.982	1.165	1.154	0.991	0.009
1987	1.197	1.180	0.988	1.207	1.204	0.988	0.011
Total period change			−0.014			−0.002	0.011

Note: Figures may not sum to zero due to rounding.

10.4 Other Measures

Mishel has examined alternative measure of manufacturing output to infer the accuracy of the manufacturing output measures. In fact, as reported in table 10.6, the most commonly used measures tell a consistent story. In particular, the Federal Reserve Board (FRB) Industrial Production Index for manufacturing, derived using different methods from the GNP output measure, provides a picture of manufacturing output which is remarkably similar to the GNP measure. Between 1979 and 1987 the FRB suggests output growth of 21 percent, an estimate virtually identical to the GNP measure. Similarly, those

Table 10.6 U.S. Manufacturing, 1979 to 1987

Year	Value-added Share in GDP[a]	Value Added	Industrial Production	Industrial Capacity	Gross Capital Stock	Net Capital Stock
1979	22.2	100	100	100	100	100
1980	21.2	95	97	104	104	104
1981	21.1	97	99	107	108	107
1982	20.4	91	92	110	111	109
1983	20.9	97	99	113	112	108
1984	21.9	109	110	116	115	109
1985	22.0	113	113	120	117	111
1986	21.8	115	116	123	119	112
1987	22.0	120	121	126	121	112

Sources: U.S. National Income Accounts; Federal Reserve Board; *Survey of Current Business.*
[a]Measured in 1982 dollars.

concerned about the manufacturing base can draw some comfort from the measures of the gross capital stock and industrial capacity, both of which have their own problems, but both of which indicate a rise in industrial capacity of over 20 percent. The net capital stock, which reflects the rapid depreciation of short-lived assets, is a less optimistic measure and the only indicator suggesting a sluggish expansion of the industrial base.

Finally, as reported in table 10.7, the national income accounts' measure of goods production, obtained from expenditure data, also shows a growth in the 1980s that has kept pace with GNP. This measure shows that goods value added accounted for 43.2 percent of GDP in 1979 and 44.3 percent in 1988.

10.4.1 Expenditure Measures

Measures of final demand expenditures have the virtue that they are not subject to sectoral allocation problems. When BEA estimates real consumption it measures purchases of products directly and can avoid the problems of allocating output by industry. In addition, the goods measure does not apply an inappropriate deflator to imported goods. The measure of goods in GNP is obtained by subtracting the deflated value of imported merchandise from real expenditures on consumption, investment, government spending, and exports. Accordingly, the goods measures offer a useful check on the consistency of the output data. Indeed, Edward Denison has argued that industry productivity measures should be supplemented by estimates that allocate inputs by sectors of final demand.

But the expenditure data do suffer from certain disadvantages if they are to be used to deduce U.S. manufacturing production. On the one hand, final expenditures on products classified as goods include not only value added in sectors such as agriculture, mining, and manufacturing, but also distribution margins and other service inputs embodied in goods. On the other hand, final expenditures on nongoods categories (e.g., construction and services) reflect

Table 10.7 **Goods Share in GDP**

Year	(1) GVA/GDP	(2) Margin	(3) Sales	(4) (2/3)
1960	43.9	13.6	48	28.4
1970	42.9	13.3	49.2	27.1
1979	43.2	14.4	52	27.7
1980	42.9	14.9	51	29.2
1981	43.3	15.1	51.4	29.3
1982	42.4	14.9	50.4	29.5
1983	42.3	15.2	51	29.8
1984	43.6	15.5	53.8	28.8
1985	43.4	15.2	53.6	28.3
1986	43.3	15.8	54.5	28.9
1987	43.5	16.1	55	29
1988	44.3			

Note: Sales = value added in goods plus merchandise imports in 1982 dollars; Margin = GVA minus value added in manufacturing, mining, and agriculture.

Table 10.8 **Sources of Goods Demand (derived from 1983 I-O table; in Billions of Dollars)**

	Goods-Producing Industries	Manufacturing
Value added	906.7	707.8
Due to nongoods end use	218	157.1
(2)/total nongoods end use	0.13	0.09
Due to goods end use	688.7	550.7
(4)/total goods final demand	0.54	0.43
Due to major nongoods end use	141.4	112.3
Share of major nongoods end use	0.65	0.71

Note: I-O sectors 11, 12, 65–68, 70–79 (i.e., construction and services besides trade). Major nongoods = construction (I-O 11 and 12), eating and drinking places (I-O 74) and health, educational, and social services and nonprofit organizations (I-O 77).

value added to services by the manufacturing and other goods-producing sectors. Final spending for construction, for example, reflects payments for building equipment and materials in addition to construction services. Similarly, final spending on health care reflects payments for the gold dentists use in fillings.

Nonetheless, the goods expenditure data corroborate the BEA value-added estimates, particularly for the 1981–86 period about which questions have been raised. As shown in table 10.8, goods output has matched GDP growth throughout the 1980s. Goods were actually a higher share of real GDP in 1982 dollars in 1988 (44.3 percent) than they were in 1980 (42.9 percent), 1979

(43.2 percent), or 1970 (42.9); the 1987 share was only slightly lower than the share in 1969 (43.9 percent).

In the light of the large trade deficit which emerged in this period, the rapid growth in goods output is a surprise. But it reflects the strength of the growth in final sales of goods. As reported in table 10.8, real goods sales, defined as goods value added plus merchandise imports, grew considerably more rapidly than real GDP. By 1987 the ratio of goods *sales* to GDP of .55 was almost 10 percent higher than in 1982. In 1987, real merchandise imports were equal to 11.5 percent of GDP in 1982 dollars, up from 7.4 percent in 1982.

Assume for the moment that none of the products of the goods-producing sectors (i.e., manufacturing, agriculture, and mining) are embodied in expenditures on services and construction. If value added in manufacturing production was overstated in the GNP accounts, but goods expenditures (and value added in mining and agriculture) were accurately measured, subtracting the GNP estimates of value added in the goods-producing sectors would yield too *low* a margin for distribution and other services embodied in final sales of goods. As reported in table 10.7, however, between 1982 and 1987 the margin computed in this fashion *increased* by 0.9 percent of GDP. One should of course expect some increase in the margin because it will include the distribution margins on imports. But even taking account of these goods by comparing the margin with sales rather than with output does not suggest that in 1987 the margin was suspiciously low. Thus the goods end-use data do not suggest a decline in the real share of manufacturing in value added over the 1980s.

But this analysis ignores the role of value added in the goods sector and embodied in final sales of nongoods (i.e., services and structures). If value added in the production of these goods grew at a different pace from value added in goods production elsewhere, this analysis could be seriously flawed.[7] To get a better handle on this issue I have used the 1983 input-output table to determine if this is in fact a problem. I-O table 5 for 1983 allows an estimate of goods production embodied in nongoods (i.e., services and construction) final domestic demand.

This computation requires taking account of imported inputs. I-O table 5 indicates the direct and indirect requirements by industry for each dollar of final demand. It does not, however, explicitly indicate the import content of these requirements. One plausible assumption is that purchases of imports of a product by an industry are proportional to the overall share of imports in total shipments of that product.

Using this assumption to adjust overall inputs for domestic inputs, I estimate that in 1983 the value of goods embodied in the final demand for services and construction was $218 billion (see table 10.8). This represented 12.6 percent of the overall value of nongoods final demand and 24 percent of the over-

7. I am indebted to Lawrence Mishel for pointing this out to me.

all value added in goods-producing industries. Subtracting $218 billion from total value added in goods-producing industries ($906.7 billion) implies that $688.7 billion, or 76 percent of the value added in goods-producing sectors, is embodied in the final demand for goods. In 1983, this represented 54 percent of final goods demand. A similar analysis indicates 22.2 percent of *manufacturing* value added is embodied in nongoods final demand and that *manufactured* goods account for just 43 percent of the value of final goods sales.

To use goods-output final sales data to infer performance in goods-producing sectors, it is necessary to assume that the relative influence of the services and construction sectors remained constant (the demand for goods due to nongoods final demand grew at a rate similar to the demand for goods due to goods final demand). This appears to have been the case. According to the input-output table, in 1983 three sectors (construction, food and drinking establishments, and health, education and nonprofits) accounted for about 65 percent of the overall demand for goods due to nongoods final demand (and 71 percent of the manufactured goods embodied in nongoods final demand). Between 1982 and 1986, real demand for construction, purchased meals and beverages, and health, education, and nonprofit services increased in all 5 percent *faster* than real GDP. It seems reasonable to assume, therefore, that the demand for *goods* embodied in sales by these sectors increased proportionately. Taking account of the role of goods embodied in services, therefore, *strengthens* the inference that goods production value added grew at least as rapidly as real GNP over this period.

For a precise estimate of the role of goods-value added in components of final demand, it is necessary to have I-O data that are up to date. Nonetheless, these back-of-the-envelope calculations using the 1983 I-O matrix and a few major final demand components suggest that BEA estimates of growth in real manufacturing value added are roughly consistent with the story provided by the expenditure data. And the story told by these data is that the ability of the United States to produce goods has grown as rapidly as its ability to produce services.

The data for final goods sales do not distinguish between value added to goods in manufacturing and value added in nongoods sectors. Thus the expenditure data are consistent with a shift of production activities from the manufacturing sector to the services sector.

10.5 Disaggregation

A related issue concerns the degree to which the data can be taken as representative of manufacturing performance in general. Most international comparisons are done for manufacturing sectors as a whole. These variables are often used to explain export and import prices and to predict trade and investment flows for manufacturing as a whole.

But if U.S. output growth has been confined, for example, to just one sector

Table 10.9 Manufacturing Output Growth By Industry, 1979–86

Industry	IP (1)	GNP Value Added (2)	IP−GNP (1)−(2)	Of which 1983/1979	1988/1983
Food and kindred	26.1	12.2	13.9	−0.12	14.02
Tobacco	−7.2	−30.3	23.1	6.9	16.2
Textile mills	4.6	8.8	−4.2	−6.48	2.28
Apparel	4.9	0.8	4.1	−4.07	8.17
Lumber	21.8	2.4	19.4	12.11	7.29
Furniture	28.9	10.2	18.7	10	8.7
Paper	23.2	15.8	7.4	2.23	5.17
Printing	42.8	12.5	30.3	8.91	21.39
Chemicals	18.5	15.8	2.7	−5.3	8
Petroleum and coal	−8.9	−8.6	−0.3	−0.58	0.28
Rubber and plastics	31.8	34.2	−2.4	−0.24	−2.16
Leather	−35.4	−29.4	−6	−2.13	−3.87
Stone, clay and glass	6.5	−5.1	11.6	4.57	7.03
Primary metals	−30.8	−31.2	0.4	7.28	−6.88
Fabricated metals	−1.2	3.3	−4.5	−7.57	3.07
Machinery, except electric	18.4	75.5	57.1	−7.2	−49.9
Electric and electronic equipment	31.8	33.3	−1.5	4.35	−5.85
Transportation equipment	17.9	8.4	9.5	1.36	8.14
Instruments	17.8	12	5.8	0.86	5.14
Miscellaneous	−0.9	13	−13.9	−8.62	−5.28

Sources: Data Resources Index, Bureau of Labor Statistics; Department of Commerce.
Note: IP = industrial production index.

of manufacturing (e.g., computers), does it make sense to use data on relative unit labor costs to draw conclusions for trade flows in general? Indeed, taking the U.S. GNP data at face value suggests that besides the nonelectrical-machinery sector (the sector that includes computers), U.S. manufacturing performance has been weak (see table 10.9, col. 2). Similarly, the dispersion in Japanese performance may be even higher than in the United States (see table 10.10). In particular, the electronics sector has dominated Japanese performance. Does it make sense then to draw inferences for Japanese trade flows and other aspects of manufacturing performance when the data actually reflect behavior in just a few sectors?

The comfort taken from the apparent consistency of the aggregate data quickly disappears when the components are examined in greater detail. Take, for example, the U.S. data on output growth by 2-digit SIC codes, as measured by the GNP accounts and by the industrial production index reported in table 10.9. While both measures suggest that manufacturing growth has been around 20 percent between 1979 and 1986, they locate this growth in very different sectors. These divergences have existed for a long time (Popkin

Table 10.10 Japanese Manufacturing Output, 1986 (1980 = 100)

Industry	Manufacturing Value Added	IP	Difference
Manufacturing Total	143.4	121.6	21.8
GNP Measure Greater:			
Chemicals	198.6	122	76.6
Machinery	226	154.2	71.8
Electric and electronic	299.3	227.9	71.4
Fabricated metals	150.6	97.7	52.9
Machinery, except electric	151.3	112.6	38.7
Transportation	130.7	104.8	25.9
Stone, clay and glass	113.9	92.1	21.8
Miscellaneous manufacturing	125	107.8	17.2
Paper	129.9	116.1	13.8
Textile mills	105.3	94.3	11
Primary metals	102.7	95.6	7.1
Instruments	155		
IP Measure Greater:			
Petroleum and coal	28.4	81.1	52.7
Food and kindred	87.5	103	15.5

Sources: National Income Accounts; Japan Statistical Yearbook 1987.
Note: IP = industrial production index.

1979, Gottsegen and Ziemer 1968). The GNP view suggests that the manufacturing performance is essentially a computer story; it reports nonelectric machinery growth at 75.5 percent over this six-year period.[8]

This suggests one should be very cautious in forecasting *aggregate* manufacturing trade and investment flows on the basis of these numbers. At a minimum these data should be adjusted to reflect their importance in trade flows rather than domestic production.

But the industrial-production (IP) data suggests manufacturing growth has been relatively diffused. Nonelectrical machinery IP grew by 18.4 percent, not much faster than the manufacturing aggregate. With the major exception of nonelectrical machinery, IP growth was considerably faster than GNP growth in most sectors. Remarkable differences for growth in the 1980s include the estimates for printing and publishing, with IP up 42.8 percent and GNP up just 12.5 percent, and those for tobacco and lumber.

10.5.1 The Role of Outsourcing

Is there a relationship between sectors which have high or increasing amounts of outsourcing and sectoral differences in growth as estimated by these different measures? If both measures are accurate, we might not be sur-

8. In the GNP data, manufacturing minus nonelectrical machinery grew by just 10.8 percent between 1980 and 1986. Nonelectrical machinery accounted for almost half of all manufacturing growth.

prised if, particularly in the short run, IP shows more rapid growth than GNP in sectors where the industry *increases* its degree of outsourcing. IP which measures physical output units will fail to take account of the lower value-added ratios. On the other hand, if the sector has a high *level* of outsourcing, IP will grow more slowly than GNP, if relative import price declines in inputs are ignored.

My proxy for levels of import dependence was derived using the 1983 input-output table, together with shipments and import data for 1986. As discussed above, purchases of imported inputs used by each 2-digit industry were estimated by assuming that the share of imported inputs of each commodity by each industry equals the share of imports in total output of each commodity. The variable LEV is equal to the ratio of estimated manufactured imported inputs to 1983 value added.

My measure of changes in sourcing is the growth in imports used by each industry if 1983 output had been produced using the share of imports in output of each commodity in 1986. The variable CHANGE is the ratio of the growth in estimated imported inputs to 1983 value added.

Table 10.11 reports the correlation between LEV and CHANGE, and the differences between growth in industrial production and in GNP by 2-digit industry over the years 1979–1986 and two subperiods (DIFF). If outsourcing is important, DIFF should be positively correlated with CHANGE. If deflation is important, DIFF should be negatively correlated with LEV and CHANGE.

The correlations are negative, but none are significant. Neither levels nor changes in the degree of outsourcing appear to provide an explanation for the differences between IP and GNP measures of growth. When these variables are regressed against DIFF neither is significant (*t*-ratios are around 0.2) and the R^2 is extremely low.

In sum it is not possible to find a simple explanation for the differences between the GNP and IP measures on the basis of the effects of levels or changes in foreign outsourcing. This result resembles that of Griliches and

Table 10.11 Relationship of Differences in Growth of Industrial Production and Manufacturing GNP to Measures of Outsourcing

	1983/1979	1986/1983	1986/1979	LEV	CHANGE
1983/1979	1				
1986/1983	0.275	1			
1986/1979	0.679	0.892	1		
LEV	−0.221	−0.342	−0.385	1	
CHANGE	−0.283	−0.309	−0.369	0.953	1

Sources: Data Resources Index; Department of Commerce.
Note: Values of *R* greater than .45 are significant at the 95% level. LEV = ratio of estimated use of manufacturing inputs to value added; CHANGE = ratio of estimated change in use of import manufacturing inputs to value added. Estimates of inputs derived using 1983 I-O table.

Siegel (1989). They concluded at a more disaggregated level that an industry's propensity to outsource was not related to its acceleration in productivity.

10.5.2 Comparison with Japan

Increasingly, industries in the United States are comparing their performance to that of Japanese industries (Gordon and Baily 1989). It is of interest therefore to consider if Japanese data present a more consistent picture of performance disaggregated by industry than the U.S. data do. Table 10.10 reports growth by 2-digit sector in Japan as reported in the GNP accounts and the Japanese industrial production data. The differences are striking. For the United States, at least for the aggregate the manufacturing GNP and IP indexes agree; in the Japanese data the growth story is orders of magnitude different. The overall rise in the GNP of 43.4 percent between 1980 and 1986 was over twice the 21.8 percent rise recorded in the industrial production index.

The similarity between the Japanese and United States data is in the degree to which growth has been concentrated in just a few sectors. Just as changes in U.S. manufacturing output growth have been influenced heavily by changes in the nonelectrical machinery sector, so changes in Japanese growth have been dominated by changes in electrical machinery. This suggests that the use of this aggregate data, weighted with domestic weights, may not be particularly useful when drawing implications about trade performance or international investment flows. Thus, for example, measures of manufacturing unit labor costs provide a very poor explanation for Japanese export prices. However, measures reweighting industry unit labor costs by export shares do much better (Lawrence 1979, pp. 101–212).

Those using the aggregate manufacturing to draw implications about trade, do so at their peril.

10.6 Conclusion

This analysis provides some comfort for those who use the aggregate data on manufacturing output. I have come to several conclusions. (1) The census and recent input-output data do not suggest that major systematic misclassifications led to an upward bias in the GPO output measures. (2) The inappropriate use of domestic deflators for imported inputs imparted an upward bias to growth of between 2 and 3 percent between 1982 and 1985, but by 1987 the bias had been almost completely reversed. (3) The goods output data, together with the expansion in expenditures by major goods-using sectors, suggest the GPO estimates for goods production are consistent with the more accurate expenditure data. (4) Some of the puzzling rise in value-added intensity in the early 1980s is due to the use of inappropriate deflators, but much of it could be a reflection of reality. On a priori grounds increased outsourcing could raise or lower the ratio of value added to shipments. (5) Finally, the

GNP, gross capital stock, and industrial production measures all tell the same story.

On the other hand, not all of the objections to the data can be laid to rest. In particular, the issues relating to the weighting of computer prices remain troublesome. Indeed there are reasons to believe that post-1982 growth *has* been overstated as a result of the weights used for computer prices (Young 1989a, 1989b). These weights bias upwards the post-1982 growth in both goods expenditure and manufacturing output. Using chain-weighted indexes suggests that between 1979 and 1987 the annual growth rates in manufacturing output should be lower by 0.26 percent.

The dramatic differences in the 2-digit industry output growth between the industrial production and NIPA measures do not inspire much confidence. I was unable here to find a simple explanation for the differences between these series on the basis of levels and changes in foreign outsourcing, so these troublesome differences remain. Such differences appear even larger in the data for Japan.

Edward Denison (1989) has questioned the validity of productivity analysis by industry. He argues that the allocation of output by industry is so difficult and unstable that industry productivity measures are unreliable. He advocates estimating productivity growth by allocating inputs to sectors of final demand. Nonetheless, policymakers are inevitably led to rely on these measures in making judgments about economic performance. The analysis here certainly lends support to Denison's view that disaggregated measures, particularly those below the one-digit SIC level, need to be taken with a large grain of salt.

The sectoral dispersion of growth appears relatively high. Those using these data to explain international flows should give serious thought to the degree to which the aggregate manufacturing data represent developments that are highly concentrated in a few sectors.

10.6.1 Mishel

While he raises numerous questions about the manufacturing data, Mishel (1989) concentrates on four effects which he quantifies to support his case that real manufacturing output growth has been severely overstated. What remains of these effects in the light of the analysis above?

1. The overstatement in growth due to the neglect of import prices is important in the early 1980s but, according to BEA, leaves growth between 1972 and 1985 unaffected. Since the dollar depreciated in 1971, growth between 1970 and 1985 is likely to be understated rather than overstated.

2. The fudge-factor adjustments are difficult to appraise. It does appear, however, that the BEA data conform with the industrial production and goods expenditure data. It should also be noted that these adjustments became necessary when the data were rebased to 1982. Measured in 1972 dollars, manufacturing growth in the 1970s was as rapid as GNP growth.

3. Mishel points out that the services purchased by the manufacturing sec-

tor have been overdeflated. He uses what he terms a "relatively arbitrary" estimate that this effect was one percent per year. Indeed, his estimate is totally arbitrary. In any case, this problem leads to an overstatement of growth in manufacturing but an understatement of the growth of services embodied in manufactured goods. It would have no impact on conclusions about what has happened to the ability of the United States to produce goods.

4. There remains the impact due to the weighting of computers. As demonstrated above, this effect is significant after 1984, but the argument remains valid that over the long run and over the 1980s, manufacturing has not declined as a share of GNP.

10.6.2 Data

There are two critical data problems faced by those trying to study these issues. The first is one of a lack of timeliness. The input-output tables present a unique set of matched nominal data for inputs, outputs, and trade, but there is an extremely long delay before these data are made available. This is a major hindrance, not only for analysts but also for those government agencies that estimate other data. In estimating purchased inputs to determine value added, for example, BEA assumes, in the absence of current dollar detail, that manufacturers continue to purchase inputs—both materials and services—in the same proportions as they did in the most recent comprehensive input-output table. This study utilized the most recent comprehensive input-output table available, based on the quinquennial census conducted in 1977. This table was published in 1984. The next benchmark table, based on the 1982 census, became available only in late 1989. The pattern of past delays suggests that this 1982 table will be used as a benchmark through 1994.

When the most recently available data for the United States were from 1977, some input-output data for Japan for 1987 were already readily available, and complete I-O tables for Japan were available for 1985. Indeed, the lag in producing the U.S. I-O table has become an obstacle to Japan's statistical work. The Japanese government is trying to construct an I-O table for a major portion of the world economy. It has been forced to purchase the (nonbenchmark) estimate of the I-O table for the United States for 1985 compiled by the University of Maryland, instead of waiting for the release of the official U.S. table for that year.

A second major problem is the absence of price series available at a level compatible with the I-O data. In the case of imports, this problem has been partially remedied recently with the new BLS price series. It would be useful if price aggregates were available that are more appropriate indicators of foreign sourcing than the end-use categories.

Finally, as international factors become increasingly important in the U.S. economy it is important that the data reflecting this activity be improved and that domestic measures take better account of international developments. Accordingly, even though over the period 1982 through 1987 as a whole, real manufacturing value-added growth measures have not been heavily affected by the inadequate input price measures currently used, the inadequacies in the data have led to serious distortions in other subperiods. BEA should deflate inputs by price series which include imported input prices.

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Comment Lawrence Mishel

I will limit my comments to the evaluation of the U.S. manufacturing output data, BEA's Gross Product Originating (GPO) Series. Of course, these data are essential to international competitiveness issues since they are used to measure: trends in U.S. manufacturing productivity and unit labor costs relative to our competitors; recent trends in U.S. manufacturing productivity relative to past performance; and the share of manufacturing in total U.S. output, an indicator of the shrinkage of our "industrial base."

My first comment is that Lawrence neglects to inform the reader that BEA has suspended publication of the GPO series pending a thorough revision. In July 1988 BEA responded to criticism of the GPO series, acknowledging that "the criticisms warrant careful attention," and providing their own estimates of the magnitudes of various measurement errors in the GPO series.[1] In June 1989 BEA suspended the series until it could be thoroughly revised (eventually back to 1972). As of December 1990, no new data have been released. Spokespersons for the Bureau of Labor Statistics, which uses the GPO series in its productivity series, have also indicated agreement with the criticisms.[2]

This history suggests two points. First, Lawrence may feel that GPO series reflects economic reality, but the two statistical agencies involved are quite skeptical of their own data. Second, given BEA's acknowledgement of measurement errors, the issue is not whether the GPO series is wrong; instead, the issues are the size of the measurement errors and whether a properly corrected GPO series will yield significantly different trends in manufacturing output and productivity growth. Lawrence, in a confusing logic, examines some measurement errors to see whether they explain the "value-added intensity puzzle" in one subperiod (1982–85), finds that they do not, and then concludes that the GPO series does not overstate the growth of manufacturing output enough to suggest that sector has declined as a share of GNP.[3]

Lawrence's analysis does not provide an evaluation of the GPO series. It is only a partial analysis covering selected time periods and measurement errors. Because Lawrence does not assess the cumulative effect of the measurement

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1. Bureau of Economic Analysis, "Gross Product by Industry: Comments on Recent Criticism," *Survey of Current Business* 68 (1988):132–33. Criticism came from: Lawrence Mishel, *Manufacturing Numbers: How Inaccurate Statistics Conceal U.S. Industrial Decline* (Washington, D.C.: Economic Policy Institute, 1988); Edward F. Denison, *Estimates of Productivity Change by Industry: An Evaluation and an Alternative* (Washington, D.C.: The Brookings Institution, 1989); and U.S. Congress, Office of Technology Assessment, *Technology and the American Economic Transition: Choices for the Future* (Washington, D.C.: Government Printing Office, 1988).

2. See Bureau of Labor Statistics, Council on Competitiveness, "Manufacturing 'Comeback' Disputed," *Challenges* (March 1989).

3. For lack of space, I do not deal with Lawrence's doubts as to whether there is the "value-added intensity puzzle" I raised in Mishel (1988). It should be noted, however, that *all* measurement errors which lead to an overstatement of constant dollar value-added growth will contribute to an explanation of the puzzle.

errors his analysis is not disciplined so as to distinguish between "large" and "small" problems with the GPO series. My assessment of Lawrence's analysis will show that the measurement errors in the GPO series are so large that a properly corrected series will yield significantly different trends.

Table 10C.1 and the following analysis, drawn from my earlier assessment of the GPO series[4] provide a useful reference point.

How does Lawrence's analysis compare to mine? Let's start with the "import price bias," the problem arising when domestic price trends are used to track imported input prices. (When import prices rise more slowly than domestic prices, then inputs are understated and value added overstated.) Lawrence says a 10 percent import price bias results in a 1.5 percent overstatement of output and, consequently, that the 19 percent relative price increase between 1982 and 1985 overstated 1985 output by 2.9 percent. Data in Lawrence's table 10.2 allow us to extend this analysis to the 1980 to 1985 period, where a 32.6 percent import price bias implies a 4.9 percent output overstatement in 1985. My analysis (based on the BEA analysis) points to an 0.5 percent annual error, or a roughly 3 percent output overstatement over the 1979 and 1985 period. Lawrence's estimate for the 1982–85 period is thus equal to my estimate for the entire 1979–85 period. Extending his analysis to 1980–85 shows an estimated measurement error—the 4.9 percent overstatement—which is *larger* than my estimate (assuming no bias in 1979–80 based on the similar value of the dollar) and which is equivalent to saying that 4.9 percentage points, or more than a third, of the 13.4 percent manufacturing output growth in the GPO series between 1979 and 1985 is fictional.[5]

Now turn to computers. Lawrence calculates that one needs to reduce manufacturing output growth by 0.26 percent annually to correct for the misleading weighting scheme in the 1979–87 period. My correction was for an 0.3 percent per year error; there is not much difference on this point.

Lawrence in passing seems to accept the presence of a measurement error due to the overstatement of service input prices (see Denison 1989, BEA 1988, and Mishel 1989), which BEA suggests overstates manufacturing output growth by 0.3 percent annually.[6]

My evaluation of Lawrence's analysis is that he assesses the specific GPO measurement errors in the 1979–87 period to be as large or larger than I do. I

4. Lawrence Mishel, "The Late Great Debate on Deindustrialization," *Challenge* (January-February 1989): 35–43.

5. One reason it is larger may be that Lawrence, quite appropriately, accounts for both the rise in imports and the price bias, while BEA only examined the latter. Lawrence points out that BEA estimated the effect of the import bias over the 1972–85 period as inconsequential. Nevertheless, the measurement error clearly affects the timing of growth, improving trends in the 1970s relative to the 1980s.

6. Lawrence properly notes my "arbitrary" assignment of a one-percent overstatement of service input prices. My analysis simply repeats that of BEA. It can easily be argued that productivity growth in financial services and in other sectors selling to manufacturing has been understated by at least one percent.

Table 10C.1 **Revisions to Output and Productivity Growth Rates (annual growth rates, %)**

	1973–79	1979–85	1985–87
Published Data			
Value added (1982 $)	1.94	2.04	3.29
Hours	0.50	−1.30	−0.52
Labor productivity	1.43	3.38	3.84
Corrections			
Import prices	0.44	−0.50	0.35
Computer weighting	0.00	−0.30	−0.40
Service prices	−0.30	−0.30	−0.30
Adjustments	−0.70	−0.10	0.00
Corrected Estimates[a]			
Value added (1982 $)	1.42	0.91	3.14
Labor productivity	0.92	2.23	3.68

[a]Corrected estimates are not simply the difference between the published estimates and the individual corrections, because of the cumulative effect of corrections.

would therefore disagree with Lawrence's conclusion that his analysis "provides some comfort to those who use aggregate data on manufacturing output," especially for the years since 1979.

Any appraisal of the GPO data for the 1970s must center on the propriety of the fudge-factor adjustments made to the 1972 and 1973 data. These adjustments shifted output equal to 2 percent of GDP out of manufacturing and into other sectors, thereby raising output growth rates from that base period. The size of these adjustments is surprising, given that they were made for a benchmark year (1972) in the best-measured sector. I would only point out that BEA is reexamining the appropriateness of these adjustments.

Both of our analyses may overstate manufacturing output growth by not considering the possible upward bias in the measurement of nominal value-added growth (which leads to an understatement of nominal input growth and an overstatement of constant-dollar value-added growth). Lawrence dismisses this problem, saying Census and BEA nominal value added have had "similar" growth rates over the long period (1977–86). However, since Census value added includes purchased services, one would expect the Census measure to grow more rapidly, as it did in the 1972–79 period (according to table 10.1, 11.3 percent versus 91.8 percent). It is curious that when the GPO series increases at the same rate as the Census measure, as from 1977 to 1986, or much faster, as from 1979 to 1986 (45.9 percent versus 38.4 percent). Lawrence finds a "similar" growth rate by combining a period when the Census measure appropriately rises faster than the BEA measure and a period when the BEA measure inexplicably grows faster than the Census measure. It must be noted that a seemingly small difference in growth rates of nominal value added implies a significant difference in constant-dollar value-added growth.

The deviation between the Census and GPO nominal trends from 1979 to 1986 implies an annual difference of 0.45 percent in constant-dollar growth, an amount equal to one-fourth the reported growth.

Table 10.6 provides little comfort that the GPO series is correct. Lawrence's own analysis shows the vast disparity between the FRB industrial production (IP) indexes and BEA measures at a 2-digit level, so the fact that the aggregates move together is only serendipitous.[7] The FRB industrial capacity index adds no further independent information, since it is derived from the IP index and capacity utilization data. This leaves us with the gross and net growth of capital stock. I would argue that the net measure of capital is the better measure of the growth of our industrial base, and it grew only 60 percent as quickly as the GPO series. Lawrence should also consider the growth of gross output in this table; it is a measure of output that grew far less than the GPO measure.

What does all of this tell us about the critical international competitiveness indicators based on the GPO series? My "corrected" estimates of the GPO series and, I submit, Robert Lawrence's own analysis, suggest several conclusions. (1) Manufacturing productivity was better in the 1980s than in the 1970s, but significantly less so than previously believed. (2) U.S. manufacturing productivity growth was below average relative to other advanced countries during the 1980s. (3) Manufacturing's share of output declined by from 3 to 4 percentage points since 1973 (but mostly since 1979), indicating a shrinkage of our industrial base (called deindustrialization); more than half of the shrinkage of manufacturing employment is due to this deindustrialization (which has cost 3 to 4 million jobs), and not to relatively faster productivity growth.

Comment Barry Eichengreen

The reader of Robert Lawrence's interesting paper and Lawrence Mishel's equally interesting response has the sense of observing a curiously choreographed boxing match. The two pugilists know one another well from prior encounters, it would appear. They circle one another warily. Many of the punches they throw fail to connect. To the crowd it is unclear whether their aim is off or whether they are really trying to set one another up for the ultimate sucker punch.

In this comment I put on my referee's striped shirt and step into the ring. I

7. It is worth noting that the annual growth rate of the IP series exceeded that of the GPO series by about 0.7 percent throughout the postwar period to 1973, and by 1 percent in the 1973–79 period.

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hope that proximity will enable me to ferret out the protagonists' true intentions. Hopefully there will be no stray punches to KO the referee.

Robert Lawrence has argued in a series of influential publications that the manufacturing sector of the U.S. economy is holding up relatively well. The share of manufacturing output in U.S. GDP has remained virtually unchanged over the past fifteen years. In contrast, Lawrence Mishel has argued in various publications on the subject that American manufacturing is in deep water. The standard statistics used to assess its competitive position, Mishel asserts, are seriously flawed. Appropriately corrected, they reveal an alarming downward trend in the share of manufacturing in national output.

According to the Commerce Department measure of value added upon which Lawrence relies, the manufacturing share of GDP has declined at most from 23 percent in 1973 to 22 percent in 1987. According to Mishel, these aggregates disguise the alarming fact that the share of noncomputer manufacturing in GDP has fallen from 20.4 percent to 18.0 percent over the period. Leaving aside computer production, Mishel warns, American manufacturing is shrinking before our eyes.

Should we be disturbed by this decline in the noncomputer manufacturing share of GDP? If we are shareholders or employees of other manufacturing industries, the answer is probably yes. If we are concerned, however, with the international competitiveness of U.S. manufacturing as a whole, the answer is probably no. Manufacturing competitiveness is renewed and maintained through structural shifts from sunset to sunrise industries. One can imagine similar calculations for the early twentieth century showing that the buoyancy of the manufacturing share of GDP was due largely to automobiles; we might have worried then about the competitiveness of other manufacturing, perhaps citing the declining wagon and buggy-whip trades as illustrations of the fate of American industry.

It is reassuring to learn from the paper that similar trends are evident also in some other countries whose manufacturing industries are rarely criticized for inadequate competitiveness. Lawrence shows that in Japan the contribution of electronics has been even more important than in the United States. Japanese textiles, primary metals, and food production are in decline. The broad similarities across countries in these patterns suggest that what we are observing is mainly the Schumpeterian process of creative destruction.

The more fundamental challenge to Lawrence's optimism is Mishel's next argument: that even including computer production, the share of manufacturing in U.S. GDP is in rapid decline, and that the phenomenon is disguised from the naive observer by flaws in the statistics. Value-added measures suggest more rapid growth of U.S. manufacturing output than do gross output measures. Such rapid growth of manufacturing is implausible, Mishel suggests, since there has been rapid growth of outsourcing in the 1980s. If all that Honda plants in the U.S. have been doing is assembling imported kits, then value added should be growing more slowly than gross output, not faster, as the official statistics show. Lawrence points out that gross output figures not only count foreign-sourced inputs but also double count shipments between U.S. plants. Outsourcing, while it creates one bias, eliminates another. Though this is a valid point in theory, we need more information about how much difference it makes in practice.

Another statistical problem concerns import prices. Since value added is constructed by subtracting inputs from gross output, accurate input price deflators are critical. The BEA input price series is derived from shipments by domestic facilities. When import prices are falling relative to domestic prices, as in the first half of the 1980s, the price of inputs will be overstated and their quantity understated. Estimates of output and productivity growth will overstate actual performance. The implication is that output and productivity grew more slowly than suggested by the official statistics before 1985, faster thereafter. Mishel eliminates a quarter of the growth of value added between 1979 and 1989 on these grounds and increases the growth rate by about 10 percent between 1985 and 1987.

Lawrence suggests that Mishel's adjustments are arbitrary. He shows that between 1982 and 1985 (the period during which value added grew more rapidly than gross output) the prices of imported industrial supplies fell by 18 percent when compared to the prices of manufacturing materials and components, but by only 8 percent when compared to the prices of domestic crude materials. The question is which comparison is appropriate. Compromising and assuming that domestic prices understate the fall in import prices by 10 percent and recognizing that imported inputs account for less than 10 percent of total inputs suggests that this bias can account for only a small share of the divergence between the value-added and gross-output measures of growth. Lawrence's own guess is that this bias accounts for 30 percent of the total divergence during the period.

Lawrence's data (table 10.3) suggest that the decline in the relative prices of industrial supplies was more than reversed after 1985. Mishel's data suggest that it was not. The dispute remains unresolved.

The Commerce Department itself adjusts its value-added data to make the components for manufacturing, services, and other sectors sum to aggregate output, which is derived separately and more reliably from expenditure data. These adjustments revise downward 1972–73 manufacturing output very dramatically, producing a much more rapid growth rate of output thereafter. Mishel argues that it is not valid to apportion any significant share of the discrepancy to manufacturing, since estimates for that sector are much more reliable than those for the rest of the economy. Input-output data, as he analyzes them, are more consistent with the preadjustment data. Mishel reverses half of the Commerce Department's adjustment and shows that this eliminates more than a third of the growth of U.S. manufacturing in the 1970s. For the 1980s, in contrast, the effect is minimal.

Lawrence also analyzes input-output data, demonstrating that it converges with other sources by the 1980s. He thus supports Mishel's conclusion that the Commerce Department adjustment has little impact on the estimated growth of U.S. manufacturing in the 1980s. This debate matters for how we view U.S. manufacturing's competitive performance in the 1970s, but not in the 1980s.

In the end, one comes away from this debate with the image of the protagonists as blowing soap bubbles at one another. The available statistics are simply too fragile to firmly support either view, or to do irreparable damage to either. If ever there was a debate that supported the case for further investment in statistical refinement, this is it.