

Are We Engineering Ourselves out of Manufacturing Jobs?

by Mark Schweitzer and Saeed Zaman

The manufacturing sector has seen sharp declines in employment of late. These declines follow a decade in which the sector saw only a modest employment drop, even as the service sector experienced double-digit increases in employment. What accounts for these dramatically different outcomes? Many observers point to productivity differences as the explanation.

A 2003 *Washington Post* article told the story of how General Motors needed nearly half a million workers about a quarter-century ago to turn out five million automobiles a year. Today, the company needs only about a quarter of that employment level to produce the same number of cars. In fact, during the 20-year period from 1980 to 2000, U.S. manufacturing output nearly doubled, whereas manufacturing employment remained flat.

Anecdotes like this one are common, and they lend credence to the notion that differences in the productivity of the manufacturing and service sectors are at the center of the differing employment experiences. However, a closer look at more detailed industry data reveals why this conclusion may be misguided, and why an apparently straightforward relationship between changes in productivity and employment may be more complicated than it appears. In this *Economic Commentary*, we focus on the extent to which strong productivity growth in detailed manufacturing industries is associated with weak employment growth, and thus with generally weaker employment growth compared to the service sector.

■ The Productivity Boom of the 1990s

During the 1990s, the United States experienced a substantial boom in productivity growth, particularly in the latter half of the decade. During the 1970s and 1980s, productivity growth in the overall economy rose an average of 1.7 percent a year, but this rate had nearly doubled by the end of the 1990s.

Manufacturing productivity growth rose even more dramatically during the 1990s. Figure 1 plots the annual growth rate of productivity in the manufacturing sector (red bars) and in the overall economy (blue bars). (The nonfarm business sector represents the overall economy and the manufacturing sector is a subset of it. Most nonmanufacturing businesses in the nonfarm business sector are service-sector firms.) From 1990 to 1995, manufacturing productivity averaged 1.7 percentage points higher than the economywide average. Despite a strong increase in overall productivity growth during the second half of the 1990s, productivity in the manufacturing sector continued to trend 1.6 percentage points above the economywide figure.

The implication is that productivity growth in the larger service sector must be lower than in the manufacturing sector. The Bureau of Labor Statistics does not actually make this calculation, partly because the nonmanufacturing remainder of nonfarm businesses includes some complicated categories such as nonfinancial, noncorporate businesses where productivity is difficult to measure reliably. Still, this has not prevented many analysts from concluding that service-sector industries have had decidedly lower productivity growth, if any.

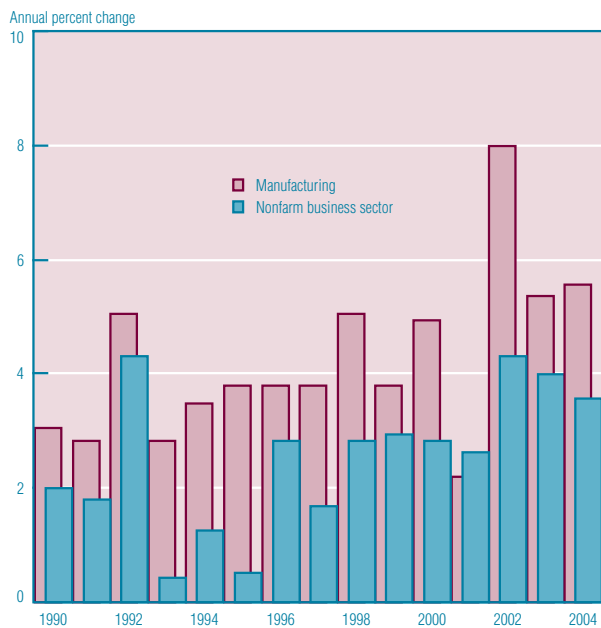
Since the 1970s, productivity growth in the manufacturing sector has outpaced the overall economy, yet the sector's share of the workforce has declined dramatically. This leads us to ask if we are in fact engineering ourselves out of jobs. This *Economic Commentary* explores the relationship between productivity and employment and points out why this apparently straightforward relationship may be more complicated than it appears.

Over the 1990s, service-sector firms increased employment 25 percent, whereas manufacturers lost about 2.4 percent of their collective employment. Clearly, this aggregate result is consistent with the story that greater manufacturing productivity gains lowered employment from what it would have been otherwise. Indeed, if the desired amount of output from a sector is fixed, then productivity growth can only come from employment declines. But before we jump to this conclusion, it is helpful to look at data at the industry level. This will help to refine our understanding of the 1990s productivity boom, as well as to better assess the impact of this boom on sectoral employment changes.

■ Productivity Growth in Detailed Industries

We use the full detail provided by the Bureau of Labor Statistics' Industry Productivity and Costs program—that is, the 3-, 4-, 5-, and 6-digit codes of the North American Industrial Classification System (NAICS). These data provide

FIGURE 1 MANUFACTURING PRODUCTIVITY



SOURCES: U.S. Department of Labor, Bureau of Labor Statistics, Division of Industry Productivity Studies; and Federal Reserve Bank of Cleveland calculations.

complete coverage of manufacturing industries and about half the service-sector industries (coverage of the service sector is limited because of measurement difficulties). In the service sector, the data include all of the wholesale and retail trade industries and some measure of transportation, information, finance, real estate, professional services, and administrative services. Service industries such as education and most of the health services are excluded, but a reasonable guess would put their productivity growth rates near those of related service industries.

Figure 2 depicts the range of productivity growth rates for detailed manufacturing industries during the 1990s. The figure charts the share of the manufacturing workforce working in industries with a given level of productivity growth. For example, 12.5 percent of the manufacturing workforce worked in industries that achieved only 0.5 percent (± 0.25 percent) productivity growth per annum. Interestingly, a careful look at the chart reveals that most manufacturing industries (weighted by employment) did not see the same sharp increase in productivity during the 1990s that was average for the sector, 4.0 percent.

In fact, only about 20 percent of the industries in the manufacturing sector

saw productivity gains at or above 4.0 percent during the decade. Two industries in particular saw astounding growth rates: computer and peripheral equipment, and semiconductors and electronic components. In these cases, advances in chip technology are widely acknowledged as having driven the dramatic productivity gains in the semiconductor sector and, in turn, the computer equipment sector. (These gains illustrate Moore's law: the ability of the semiconductor industry to double the processing speed of computer chips every 18 months.) Figure 2 shows us that these two industries were instrumental in pushing up the average level of productivity growth in the manufacturing sector.

A more typical gain can be seen in cutlery and hand tools manufacturing, which had an annual productivity increase during the 1990s that was roughly at the median among manufacturers, about 2.3 percent. Though this is an impressive rate, it is still well below the 4.0 percent average reported for manufacturing during this period.

Figure 3 shows the distribution of productivity growth rates across service-sector industries from 1990 to 2000, again weighted by share of employment. These figures range from -2.6 percent to 17.6 percent. On the low side, we see

industries such as drinking places (-1.8 percent) and specialty food stores (-1.5 percent). These industries illustrate the standard reasoning for the service sector's lack of productivity growth: The level of service that customers expect in these industries requires a fairly fixed amount of labor.

On the high end, commercial equipment wholesalers (17.6 percent) and electronics and appliance stores (14.1 percent) led the way. Consolidation into physically larger stores is one obvious explanation for these exceptional productivity growth rates, but it turns out that employment levels did not decline in these industries. During the same period, employment actually increased in the software publishing and wireless telecommunications sectors by 10 percent and 18 percent, respectively, with attendant productivity increases of 15.3 percent and 7.6 percent, respectively.

Most interestingly, the median increase in productivity among service-sector industries during the 1990s was essentially the same as the median rate recorded by manufacturers. Although the average was, in fact, lower for service-sector industries than for manufacturers during the 1990s, this difference was almost entirely the result of the remarkable performance of the computer and semiconductor industries. Significantly, the high levels of productivity growth within these two industries should not have directly altered employment in other manufacturing industries. Productivity growth in most manufacturing industries was remarkably similar to that of the service sector, at least within its easily measured portion. Employment growth, however, was considerably weaker within the manufacturing sector.

■ Industry Output and Employment Growth

The foregoing analysis seems to weaken the conventional case that strong productivity growth dampened increases in employment in the manufacturing sector during the 1990s. So just what can we say about the relationship between productivity growth and employment change? Productivity is defined simply as the amount of output for a given quantity of labor. Accordingly, in a simple sense, increases in productivity must reflect either an increase in output for a fixed amount of employment or a decrease in the amount of labor required to produce a fixed amount of output. (Of course, both the amount of labor and output could change at once.)

FIGURE 2 MANUFACTURING PRODUCTIVITY GROWTH, 1990–2000

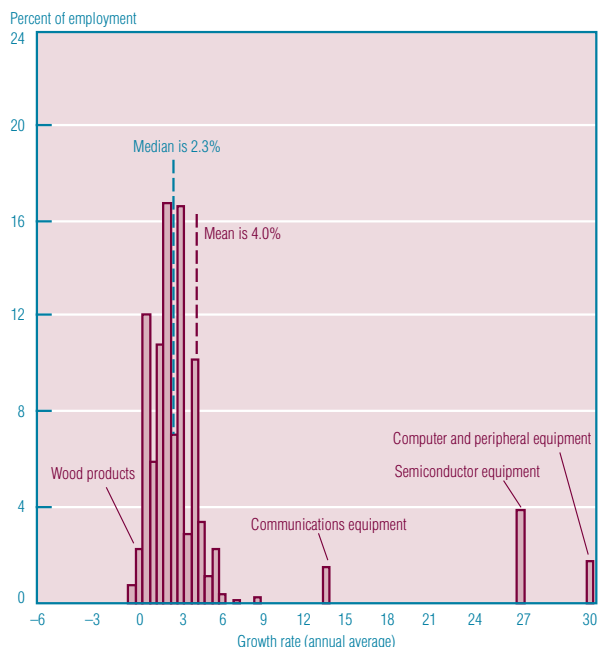
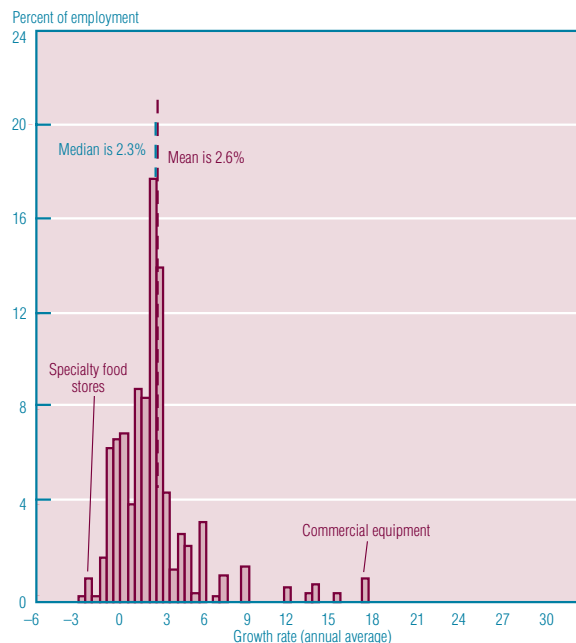


FIGURE 3 SERVICES PRODUCTIVITY GROWTH, 1990–2000



SOURCES: U.S. Department of Labor, Bureau of Labor Statistics, Division of Industry Productivity Studies; and Federal Reserve Bank of Cleveland calculations.

TABLE 1 CROSS-SECTIONAL CORRELATION WITH PRODUCTIVITY CHANGE

	Output Growth		Employment Growth	
	Manufacturing	Services	Manufacturing	Services
1990–2000	0.90	0.84	−0.08	0.24
1990–1995	0.86	0.77	−0.16	0.07
1996–2000	0.86	0.86	−0.05	0.30
2000–2003	0.66	0.76	0.07	−0.05
1990–2000 ^a	0.57	0.84	−0.21	0.24

a. Excludes semiconductors and computer and peripheral equipment.

SOURCES: U.S. Department of Labor, Bureau of Labor Statistics, Division of Industry Productivity Studies; and Federal Reserve Bank of Cleveland calculations.

Using a simple correlation analysis, we can determine, industry by industry, whether increases in productivity resulted more from increases in output or decreases in employment. If productivity growth was perfectly associated with employment reductions, then the correlation between employment growth and productivity growth would be -1 . If productivity growth is always associated with increasing output and a fixed level of labor, then the correlation between output growth and productivity growth would be 1 .

Table 1 shows the results of this correlation analysis for several time periods. We find that productivity growth in both services and manufacturing is associated far more with output growth than it is with

employment reductions. From 1990 to 2000, the correlation between output growth and productivity growth was 0.90 for manufacturing and 0.84 for services. Over the same period, the correlation between employment growth and productivity growth was -0.08 for manufacturing and 0.24 for services. An employment correlation near zero indicates that a firm was nearly as likely to have increased employment as it was to have reduced it over this period regardless of how its productivity changed. Again, this is true in both services and manufacturing, even though manufacturing gained few workers during the 1990s, whereas service-sector employment expanded 25 percent.

There are examples of industries that increased their efficiency primarily through labor reduction. Electronic instrument manufacturing is one: Over the 1990s, employment in this industry fell 2.6 percent while output rose just 1.3 percent per year. However, the other extreme exists as well, even among old-line manufacturers. In motor vehicle bodies and trailers, for instance, productivity rose 2.9 percent while employment increased nearly 3.6 percent.

Overall, these data suggest that productive industries tended to have more output growth than employment reductions. This result is remarkably robust and holds true regardless of whether we include the unusually high productivity growth rates seen in computers and semiconductors in the analysis. Furthermore, this conclusion is true for both the early 1990s and the late 1990s and even for the period from 2000 to 2003, which includes the most recent recession.

Conclusion

By definition, the recent high rates of output growth with little increase in labor imply strong productivity growth. But can strong productivity growth directly explain the long-run weakness of manufacturing employment? Not in

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any important sense. Changes in production technologies do alter both measured productivity growth and firms' desired employment levels, and ultimately they allow the economy to grow faster than its labor resources. However, the amount of labor required in an industry also depends on how consumers respond to prices: If consumers sufficiently expand their consumption of a product as the quality-adjusted price falls, then the new technology can increase employment levels. This is difficult to predict a priori, but the data over the last decade show this scenario is relevant and occurs often enough. It turns out to be largely a coin toss whether high-productivity-growth manufacturers added or lost employment in the 1990s; the same holds true for low-productivity-growth manufacturers.

From this perspective, the long-run decline of U.S. manufacturing employment is just as much the result of declining consumption of manufactured goods produced in the United States as a share of total income. As recently as 1990, roughly 30 percent of U.S. gross purchases were domestically produced goods, whereas 52 percent of purchases were domestic services. Now, only

25 percent of U.S. purchases are domestically produced goods. About half of this decline is attributable to the rise of imported goods, but the rest is simply the result of greater consumption of services, which likely reflects a change in consumption preferences.

This *Commentary* is in no way a full accounting of the factors that determine employment levels. Other factors, such as our export volumes and lower interest rates as a result of associated capital flows, are also important. However, it suggests that factors other than productivity changes can and do have important implications for employment growth.

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