# Productivity in the fabricated plate work industry: 1982–94

*Increased use of computer technology in the industry's design and production operations has been an important factor in the advance in productivity*

James D. York

Over the period from 1982 to 1994, labor productivity in the fabricated plate work industry—which manufactures boilers, tanks, and similar products—increased at an average annual rate of 1.8 percent.[1] Although output actually declined by 0.1 percent per year over the period, employee hours declined more rapidly, at a rate of 1.8 percent per year. The more rapid decline in hours than in output was largely due to technological improvements in the industry.

## Productivity and output

Because this industry produces a wide variety of products—including fabricated steel plate, heat exchangers and steam condensers, boilers, gas cylinders, and metal tanks—there are many different types of customers for its products. Metal storage tanks, for example, are used in such diverse industries as chemical processing, water and sewage treatment, and petroleum processing and storage, and for transporting products such as chemicals. Boilers have both residential and commercial applications, providing heat and hot water for homes, businesses, and other establishments; they also provide steam for various industrial processes, including cooking, cleaning, and heating.

With such an assorted mix of customers, output in the fabricated plate work industry does not necessarily follow the business cycle. The needs for boilers, for example, may deviate from trends in the overall national economy. Similarly, the demand for storage tanks among commercial customers—for such uses as chemical processing—may increase *after* a busy period, rather than during one. And this is reflected in industry output trends. For example, although the 1982–86 period was one of robust economic expansion, industry output actually declined over the period by 7.5 percent per year. Then, in 1987, industry output increased substantially, rising by 13.1 percent in a single year.

As shown in table 1, productivity growth in this industry was erratic from 1982 to 1989, rising at a rate of just 0.4 percent per year. During this period, there were 5 years of productivity decline and only 2 years of growth. A large increase of 15.7 percent in 1987 kept the overall rate positive. From 1989 to 1994, however, productivity showed strong and consistent growth, increasing at a rate of 3.7 percent per year, with no years in which productivity declined. Also over the 1989–94 period, output increased by 2.0 percent per year, and hours declined by 1.6 percent annually. Contributing to this period of rapid productivity growth was the increasing use in the industry of information processing technology.

## Labor

Total employment in the fabricated plate work industry decreased by 24 percent between 1982 and 1994. On an average annual basis, the rate of decline was 2.3 percent. In 1982, employment was at its highest point of the period, at 129,300; the following year, it declined by 19.5 percent—the steepest single-year decrease of the period.

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Employment continued to decline in all but one year, until 1987, when it reached its low point of the period, at 90,200. It recovered strongly the subsequent year, and then fluctuated over the next few years. By the end of 1994, employment stood at 98,300. Clearly, most of the decline took place in the first part of the period, during 1982–87, when employment decreased at an average annual rate of 6.9 percent. During the latter portion of the period, 1987–94, employment increased by 1.2 percent per year.

Also during the period, nonproduction workers (managers, professionals, office personnel) as a percent of total employment declined. These workers represented 41.1 percent of total employment in 1982, but by 1994, the comparable figure had dropped to 30.2 percent.

From 1982 to 1994, average hourly earnings for production workers increased 29 percent, from $9.60 to $12.40. This rise did not keep pace with earnings growth in other industries, however. Average hourly earnings in the manufacturing sector as a whole, for example, rose 42 percent during this same period, from $8.49 to $12.06. After adjustment for inflation (using the CPI–U), earnings in the fabricated plate work industry fell by 16 percent over the 12-year period. By comparison, inflation-adjusted wages for all manufacturing workers fell by almost 8 percent over the period.

## Comparisons with other industries

The Bureau of Labor Statistics publishes labor productivity measures for two other industries that are in the same larger group (SIC 344) as fabricated plate work: fabricated structural metal (SIC 3441) and metal doors, sash, and trim (SIC 3442). This section presents comparisons with these two related industries, as well as with total manufacturing.

**Table 1. Productivity and related indexes for the fabricated plate work industry (SIC 3443), 1982–94**

[1987=100]

| Year | Output per employee hour | Output | Employee hours | Employees |
|---|---|---|---|---|
| 1982 | 87.7 | 120.8 | 137.7 | 143.3 |
| 1983 | 91.5 | 102.6 | 112.2 | 115.4 |
| 1984 | 88.3 | 97.5 | 110.5 | 111.5 |
| 1985 | 87.5 | 97.6 | 111.5 | 112.5 |
| 1986 | 86.4 | 88.4 | 102.4 | 103.9 |
| 1987 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1988 | 96.2 | 110.4 | 114.7 | 113.7 |
| 1989 | 90.3 | 108.3 | 119.9 | 118.8 |
| 1990 | 94.1 | 112.0 | 119.1 | 118.4 |
| 1991 | 94.3 | 110.7 | 117.4 | 116.7 |
| 1992 | 98.3 | 109.2 | 111.1 | 110.3 |
| 1993 | 98.3 | 107.7 | 109.6 | 108.9 |
| 1994 | 108.4 | 119.7 | 110.4 | 108.6 |
| | Average annual rates of change (in percent) | | | |
| 1982–94 | 1.8 | –0.1 | –1.8 | –2.3 |

Over the 1982–94 period, productivity in the fabricated structural metal industry—which manufactures iron and steel products used in the construction of bridges, buildings, and ships—outpaced that of the fabricated plate work industry (2.2 versus 1.8 percent, annually). Output declined in both industries during the period—by 0.1 percent per year in fabricated plate work, and by 0.6 percent per year in fabricated structural metals. But the more rapid drop in employee hours in the latter industry (2.7 versus 1.8 percent per year) enabled its productivity growth to exceed that of the fabricated plate work industry.

The comparison was somewhat different for metal doors, sash, and trim, an industry in which productivity increased by 0.7 percent per year during the 1982–94 period. In contrast to the other two industries in this comparison, output in this industry increased over the period, rising at a rate of 1.5 percent per year. Because hours also posted an overall increase, however—rising at a rate of 0.9 percent per year—productivity growth in this industry was slower than in both fabricated plate work and fabricated structural metals, even though it was the only one that experienced an overall gain in output.

Finally, productivity growth in all three of these industries lagged that of total manufacturing. Productivity in manufacturing rose at an average annual rate of 2.9 percent over the 1982–94 period, reflecting an increase in output of 3.4 percent per year, combined with an annual increase in hours of 0.5 percent.

## Sources of productivity growth

A major factor in the growth of industry productivity has been the utilization of computer technology in the production process. Computers have been used in a wide variety of ways to benefit production and related operations.[2] They also have been making an important contribution in the initial design process. Computer-aided design (CAD) and computer-aided manufacturing (CAM) together form a system that uses computer-controlled methods to integrate several manufacturing technologies. The use of CAD and CAM has led to greater efficiency as well as improved product quality.

With CAD, computers are used to draw, design, analyze, and test simulations of parts and products, contributing to increased productivity in a number of ways. For example, CAD eliminates many of the errors that occur with manual drafting. It also reduces the number of drafting personnel required and makes engineers more productive. CAD permits improved designs and better product quality. Enhanced product quality has meant less time spent in rework.

With CAM, computer programs now direct the operation of one or more numerically controlled machine tools. The substitution of computer-driven tools for numerically controlled

**Table 2. Annual percent change in productivity, output, hours, and employment in the fabricated plate work industry (SIC 3443), 1982–94**

| Year | Output per employee hour | Output | Employee hours | Employees |
|---|---|---|---|---|
| 1983 | 4.3 | −15.1 | −18.5 | −19.5 |
| 1984 | −3.5 | −5.0 | −1.5 | −3.4 |
| 1985 | −.9 | .1 | .9 | .9 |
| 1986 | −1.3 | −9.4 | −8.2 | −7.6 |
| 1987 | 15.7 | 13.1 | −2.3 | −3.8 |
| 1988 | −3.8 | 10.4 | 14.7 | 13.7 |
| 1989 | −6.1 | −1.9 | 4.5 | 4.5 |
| 1990 | 4.2 | 3.4 | −.7 | −.3 |
| 1991 | .2 | −1.2 | −1.4 | −1.4 |
| 1992 | 4.2 | −1.4 | −5.4 | −5.5 |
| 1993 | .0 | −1.4 | −1.4 | −1.3 |
| 1994 | 10.3 | 11.1 | .7 | −.3 |
| | Average annual rates of change (in percent) | | | |
| 1982–94 | 1.8 | −0.1 | −1.8 | −2.3 |

machine tools driven by punched tape has benefited productivity. Either type has advantages over manual machine tools, but computer technology has boosted the reliability and the scope of automatic operations of the simpler numerically controlled tools. The latter are controlled by numerical commands punched into paper tape. Each time a program is changed, a new paper tape has to be prepared—a time-consuming process. With computer numerical control, however, computer software makes it possible to convey numerical data directly to a machine control unit. The programmed operations can simply be called up and depended upon for perfect repetition of a machining function, resulting in a consistently high level of product quality. Once a skilled worker devises a correct program for a part, for example, workers of lesser skill can repeat the process indefinitely, because the necessary knowledge is incorporated into the program.

Another technological improvement that has enhanced productivity in the fabricated plate work industry is the introduction of microprocessor controls for many types of production and related equipment. Automated welding, for example, is run by computer control, increasing productivity and reducing product defects. Fewer defects mean less rework. Improvements in welding procedures and tools have improved the quality of products in various ways. For example, a procedure that removes some of the heat from the metal during welding permits better fusion of metal at lower temperatures. This is particularly important in the manufacture of steel tanks for chemical transport, because welding at lower temperatures makes the metal less susceptible to chemical attacks.

LABOR PRODUCTIVITY GREW by 1.8 percent per year in the fabricated plate work industry between 1982 and 1994, even though output dropped during the period. Because hours of labor fell more rapidly than output, output per hour rose. Also, the increased use of computer technology in the industry's design and production operations was an important factor underlying the advance in productivity. □

## Footnotes

[1]The fabricated plate work industry (SIC 3443) includes establishments primarily involved in the production of power and marine boilers, pressure and nonpressure tanks, processing and storage vessels, heat exchangers, weldments, and similar products through the process of cutting, forming, and joining metal plates, shapes, bars, sheet, and other metal inputs to custom or standard design, for factory or field assembly. Labor productivity is measured by output per hour. All average annual rates of change are based on the compound growth method of computation. For more technical information on BLS productivity measures, see *BLS Handbook of Methods*, Bulletin 2490 (Bureau of Labor Statistics, 1997), ch. 11, "Industry Productivity Measures," pp.103–9.

[2]The section on sources of productivity growth is based in part on discussions with industry sources.