

# Productivity in the metal doors, sash, and trim industry

*The overall rate of output per hour increased slowly from 1967 to 1983, reflecting low output growth and an increase in employee hours; moderate advancement is expected to continue*

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From 1967 to 1983, output per hour in the metal doors, sash, and trim industry<sup>1</sup> increased at an average annual rate of 0.9 percent. In comparison, the rate of productivity growth for all manufacturing industries during this period was 2.4 percent. The slow productivity rise reflected a relatively low output growth of 1.5 percent per year and an increase in employee hours of 0.6 percent per year. (See table 1.) The industry's demand is dependent upon residential and nonresidential building construction, where wide seasonal and cyclical fluctuations have been common. The productivity growth experienced in this industry has been aided by gradual improvements in equipment design and the increased application of easier-to-use aluminum materials.

Year-to-year changes in industry output and productivity have generally shown similar movements. Large increases in output have been associated with above average gains in productivity. For example, in 1971, output increased 11.3 percent and productivity jumped 11.3 percent. Similarly, output advanced 11.4 and 24.7 percent in 1976 and 1977, while productivity gained 4.0 and 7.6 percent. In 4 of the 6 years that output declined, productivity also fell. Despite declines in output during 1975 and 1982, productivity advanced as manufacturers were able to adjust their work force hours to meet demand changes.

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## Subperiod productivity trends

In the metal doors, sash, and trim industry, productivity growth can be divided into two distinct periods: 1967–72 and 1972–83. From 1967 to 1972, productivity grew at a rate of 2.4 percent per year based on a gain in output at a 3.8-percent rate and an increase in hours at a 1.4-percent rate. This growth, however, reflected a slight decrease during 1967–70, with a substantial growth in 1970–72 of 6.5 percent per year. Following the economic recession of 1970, industry output grew strongly in 1971 and 1972.

Between 1972 and 1983, productivity increased at the low rate of 0.5 percent per year, reflecting an annual output growth of 1.2 percent and an increase in hours of 0.7 percent per year. This slow growth resulted from a balancing off of diverse movements. From 1972 to 1974, productivity fell at an average annual rate of 3.2 percent, but from 1975 to 1977 it rose to a rate of 5.8 percent as a result of an average increase in output of almost 18 percent per year. From 1977 to 1981, productivity again declined at a rate of 2.4 percent per year, largely as a result of the economic recession in 1980. But it rebounded in 1982 and 1983, increasing at an annual rate of 4.6 percent.

## Output

Establishments in this industry manufacture metal and metal covered doors and sash, window and door frames, screens, molding, and trim. In 1983, more than two-fifths of the industry's output consisted of doors, including garage

doors, and around one-third of window units and related items. The industry's output depends closely on building construction markets. More than four-fifths of the output was used in building construction.<sup>2</sup> Approximately two-fifths of output was used in new residential housing, including additions and alterations. One-sixth was used in new nonresidential buildings, which include educational and commercial buildings. Additionally, almost one-quarter of output was used in maintenance and repair construction on existing buildings.

In spite of several economic downturns, overall output of the metal doors, sash, and trim industry increased an average of 1.5 percent per year between 1967 and 1983. In comparison, over the same period, all manufacturing output increased an average of 2.3 percent per year.

The industry's output generally paralleled the trend for new building construction.<sup>3</sup> Between 1967 and 1972, for example, the industry's output grew at an average annual rate of 3.8 percent. In comparison, the deflated value of new building construction put in place increased 3.6 percent annually over this period. From 1972 to 1975, the industry's output fell 10.6 percent per year as the market for new buildings experienced an 11.0-percent annual decline.

Since the mid-1970's, this pattern has changed somewhat. To offset market fluctuations in new building construction, manufacturers have produced more of their output for the replacement market. In 1973, new construction accounted for about 52 percent of the value of total industry revenues.<sup>4</sup> By 1983, this market had fallen to about 40 percent of revenues. The replacement market comprised about 59 percent of revenues in 1983, rising from 46 percent in 1973. This trend is expected to continue.

**Metal doors.** One factor affecting the demand for industry output has been the wider use of metal doors. In single family housing construction, homebuilders are installing more metal than wooden doors in projects costing less than \$100,000.<sup>5</sup> According to the Architectural Aluminum Manufacturers Association (AAMA), aluminum doors accounted for more than three-fourths of all residential patio doors used in 1982. The introduction of more energy efficient metal door units along with increased consumer demand for security and fire safety, also has contributed to a shift in the type of entry door in new construction from wood to metal.

Demand for garage doors, particularly by the metal buildings industry, has grown substantially in the past 20 years. Before 1966, only 5 percent of all overhead garage doors were manufactured out of metal.<sup>6</sup> Technological advances such as the development of prepainted doors, which have eliminated the need for on-site painting, and new insulating core materials, along with improved economies of scale, which have lowered average unit costs, have led to increased demand for metal doors. By 1980, about 90 percent of the doors installed on steel buildings were made of galvanized steel.

**Aluminum windows.** Another factor contributing to the growth of industry output has been the increasing penetration of the new housing market by manufacturers of aluminum windows. In 1967, aluminum and, to a small extent, steel windows accounted for about 55 percent of all new residential window installations, with wood making up the other 45 percent.<sup>7</sup> Except for 2 years in the mid-1970's when aluminum window prices rose relative to wooden ones, the industry's share of the window market has grown steadily to approximately 70 percent of the total in 1980.

Demand for metal windows varies from region to region and by type of building. Aluminum windows are more popular in the South and parts of the West, while wood windows are more popular in the Northeast and North Central parts of the United States. Among residential units, the use of aluminum windows is more prevalent in attached single family houses and apartments than in detached single family homes. Between 1977 and 1983, about 71 percent of new private housing starts occurred in the South and West regions. During this period, townhouses and apartments also increased their share of the new housing market. As a result, manufacturers of aluminum windows increased their share of new residential construction.

**Storm windows and doors.** The vast majority of storm windows and doors are made of aluminum. According to AAMA statistics, aluminum units comprised almost 95 percent of all storm windows and doors shipped from 1970 to 1983. Beginning in the mid-1970's, shipments increased substantially because of rising heating and cooling costs and energy tax credit incentives. Several years of high installation rates reduced the number of homes containing only single glazed windows that were available for storm window

**Table 1. Productivity and related indexes for metal doors, sash, and trim, 1967-83**

Year	Output per employee-hour	Output	All employee hours	Employees
1967 .....	81.7	81.0	99.1	97.1
1968 .....	85.6	81.7	95.4	94.8
1969 .....	83.7	81.9	97.9	96.4
1970 .....	82.1	79.5	96.8	94.7
1971 .....	91.4	88.5	96.8	95.7
1972 .....	93.1	100.9	108.4	107.4
1973 .....	92.0	98.2	106.7	105.8
1974 .....	87.2	88.6	101.6	101.2
1975 .....	89.3	72.0	80.6	81.6
1976 .....	92.9	80.2	86.3	85.7
1977 .....	100.0	100.0	100.0	100.0
1978 .....	94.8	102.9	108.6	108.5
1979 .....	92.8	103.4	111.4	111.4
1980 .....	90.6	96.3	106.3	107.0
1981 .....	90.4	100.1	110.7	109.1
1982 .....	96.0	96.6	100.6	100.8
1983 .....	98.9	104.1	105.3	107.1
<b>Average annual rates of change (in percent)</b>				
1967-83 .....	0.9	1.5	0.6	0.7
1978-83 .....	0.9	-0.3	-1.2	-1.0

and door applications. This temporary market saturation along with a fall in new housing starts contributed to a total decline in product shipments of 53 percent from 1978 to 1982.

*Insulated doors and windows.* Since the mid-1970's, much progress has been made in the energy efficiency of door, window, and wall design. According to the Insulated Steel Door Institute, advancements in weatherstrip systems and improvements in insulating technologies for door sections has led to a reduction in heat loss of more than 40 percent. In glass areas of buildings, the best improvement has been achieved by using double glazed insulating glass. In many cases, heat loss through glass areas has been cut in half. The use of better seals and coated glass also has improved the energy efficiency of windows. These product improvements along with home energy conservation incentive programs contributed to an increase in the replacement and retrofitting of existing doors and windows with more energy efficient units. Replacement and remodeling activity has helped to sustain the industry's output by offsetting the impact of declining new building construction.

### **Employment**

Total employment in the metal doors, sash, and trim industry grew at a rate of 0.7 percent per year between 1967 and 1983. In comparison, all manufacturing industries showed no average annual change in employment over the same period. Employment growth for the industry was uneven, however, rising from 63,900 in 1967 to 70,700 in 1972, declining to 53,700 in 1975, again rising to a peak of 73,300 in 1979, and then declining again to 66,300 in 1982. The proportion of production workers fell from 75.0 percent in 1967 to 73.8 percent in 1983.

The majority of jobs in the metal doors, sash, and trim industry consisted of stamping, blanking, and forming of metals. Almost 50 percent of the production workers were engaged in these three operations.<sup>8</sup> Other main types of work in this industry consist of galvanizing iron and steel, painting, lacquering, or enameling. About 15 percent of the employees worked in these finishing occupations. About 11 percent worked in a tool and die shop. Eleven percent worked in plate or structural fabrication. About 9 percent worked in a machine shop. The remaining 8.5 percent of production workers were engaged in electroplating, heat treating, or worked in the pattern shop.

Female employees constitute an increasing proportion of the workers in the metal doors, sash, and trim industry, rising from an 18-percent share of the work force in 1967 to almost 27 percent of all industry employees in 1983.<sup>9</sup> During the period, average weekly hours of production workers declined 1 hour, from 40.6 hours in 1967 to 39.6 in 1983.

### **Capital expenditures**

Increases in capital expenditures are important and frequently contribute to advances in output per hour. During

the 1967–83 period, the annual rate of growth in new capital expenditures per employee averaged 9.2 percent in the metal doors, sash, and trim industry. In comparison, the average for all manufacturing establishments was 10.0 percent. Although the growth rate was close to the average, the level of capital expenditures per employee in this industry was less than half the level for all manufacturing industries. In 1983, the industry spent about \$1,350 per employee for new capital expenditures, compared with more than \$3,500 for all manufacturing. During 1983, the metal doors, sash, and trim industry allocated around 70 percent of capital expenditures to the purchase of new machinery and equipment. In comparison, the average for all manufacturing during 1981 (most recent year for which data is available) was more than 80 percent. The remainder was expended on new structures and plant additions.

### **Size of establishments**

In 1982, the Bureau of the Census reported a total of 1,738 establishments in the metal doors, sash, and trim industry. A small percentage of these accounted for the majority of industry shipments. Nearly 10 percent of the industry's establishments averaged more than 100 employees and generated approximately 57 percent of the industry's value of shipments. In contrast, more than one-quarter of the establishments reported four or fewer employees and accounted for only 1 percent of shipments.

The number of metal window manufacturers has increased substantially during the past 20 years. Currently, about 750 companies make prime metal windows, and 175 firms manufacture metal storm windows.<sup>10</sup> Although some large firms manufacture metal windows and doors in several establishments, most producers are small, one-plant companies that serve local or regional markets.

Metal windows usually are manufactured in a variety of custom-ordered sizes. To be responsive to special orders, manufacturers of windows generally are located near their market outlets. In 1977, the majority of metal window frames and sash produced was shipped less than 200 miles from the manufacturers' plants to their customers.

### **Technology**

Technological change in this industry during recent years has primarily consisted of modifications and improvements in existing methods and equipment.

The manufacture of aluminum framing members for window and curtain walls essentially consists of the remelting, extruding, anodizing, and fabricating of aluminum to specified dimensions. Aluminum scrap is remelted in an aluminum cast house to produce aluminum billets. To produce extruded shapes, a hydraulically operated ram forces a hot (but not molten) aluminum billet through openings in a precision-made die. The result is a fine grained extrusion conforming to the configurations and dimensions of the die. In this process, it is possible to form an infinite variety of uniform products.

Anodizing is a protective treatment used to improve the corrosive and abrasive resistance of aluminum. This treatment does not apply a coating but converts a thin layer of aluminum on the surface to an oxide that is extremely hard. In recent years, anodizing processes have been developed that result in anodic films in amber shades, ranging from light to dark. In many cases, amber colored finishes have been used in architectural work in place of clear anodizing. Anodic films developed with these processes are much harder, denser, and longer lasting than former clear anodizing finishes. Another recent modification at one plant replaced a one-step, 19 bath anodizing process with a two-step, 18–20 bath process. The two-step process which uses better controls has improved the quality of the aluminum oxide coating, and reduced energy and labor requirements for this operation.

The anodized aluminum extrusions are fitted and assembled in the factory to modular or custom sizes. The joints in aluminum windows and frames are either welded or fastened mechanically. Mortise and tenon joints, that is, joints between members at right angles to each other, are commonly used. The clip, epoxy, and stake (CES) method is often used when joints are fastened together mechanically. The clip, a type of corner fastener, is placed into the joint with epoxy. Then a machine mechanically drives the extruded sections together.

Although not widely diffused in the industry, the computer-aided design and computer-aided manufacture (CAD/CAM) system have been introduced into the operations of some plants. This technology uses computers to assist in developing designs for products to be manufactured. It is most feasible for large plants which have a sizable volume of fabricating work, generally destined for the commercial building sector. The CAD/CAM system has improved design

analysis and cut unit labor requirements for skilled drafters through its greater sophistication, accuracy, and operation speed.

A recent equipment improvement has been the introduction of programmable controllers into new machines that perform complex operations. These electrical testing devices that replace limit switches allow the source of electrical problems to be more easily located, thereby reducing machine downtime. Another equipment improvement has been the development of drilling machines that drill holes of different configurations. Compared with previously used equipment, these machines reduce set up time, and thus, lower unit labor requirements.

## Outlook

As indicated earlier, short-term changes in productivity generally reflect changes in output and output in this industry is directly related to trends in residential and nonresidential building construction. According to macroeconomic projections by the U.S. Department of Commerce, building construction should continue to grow during the next 5 years. Private nonresidential construction is expected to increase in quantity and value put in place. The number of residential units built is expected to level off. Because of increases in the average size per unit, however, the value of residential construction put in place is expected to grow slightly. Based on these projections, the demand for the metal doors, sash, and trim industry's products should also rise during the next 5 years. This projection, along with the experience over the 1967–83 period, suggests that productivity should continue to advance moderately. Wider adoption of recent innovations, particularly among large manufacturers, should also contribute to the growth of labor productivity. □

## —FOOTNOTES—

<sup>1</sup> The metal doors, sash, and trim industry is classified as SIC 3442 in the *Standard Industrial Classification Manual 1972* and its 1977 supplement, issued by the U.S. Office of Management and Budget. This industry includes establishments primarily engaged in manufacturing ferrous and nonferrous metal and metal covered doors and sash, window and door frames, and screens, molding, and trim.

<sup>2</sup> *The Detailed Input-Output Structure of the U.S. Economy 1977, Volume 1, The Use and Make of Commodities by Industries 1977* (U.S. Department of Commerce, 1984), pp. 17–35.

<sup>3</sup> This output measure includes the value of new private residential buildings, new private nonresidential buildings, and new public buildings put in place, in constant 1977 dollars. See *Construction Review*, International Trade Administration, July–August, 1983, pp. 9–15.

<sup>4</sup> "Prospects Good for Metal Doors, Windows, Study Says," *Metal Building News*, May 1984, p. 41.

<sup>5</sup> "Sales Power of Doors and Windows," *Professional Builder*, June 1980, p. 122.

<sup>6</sup> "Metal Builders and the Overhead Door Industry," *Metal Building Review*, October 1984, pp. 24, 64, and 65.

<sup>7</sup> See Architectural Aluminum Manufacturers Association, *Architectural Aluminum Industry Statistical Review 1980*, 1981, p. 20.

<sup>8</sup> Computed from survey material in the *1977 Census of Manufactures*, Vol. 1, Table 3, "Selected Metal Working Operations by Industry," pp. 10–27.

<sup>9</sup> See *Employment and Earnings, United States, 1909–79*, Bulletin 1312–11 (Bureau of Labor Statistics, July 1979); and *Supplement to Employment and Earnings, United States, 1909–78* (Bureau of Labor Statistics, July 1985).

<sup>10</sup> "Market Trends in the U.S. Window Industry," *Construction Review*, International Trade Administration, January–February 1984, p. 3.

## APPENDIX: Measurement techniques and limitations

The productivity indexes in this study measure the change over time in industry output per unit of labor input. They do not measure the specific contribution of labor, but reflect the influence of many factors such as technology, capital investment, and managerial skills, as well as the skill and effort of the work force.

The output index is based on value of shipments data adjusted for inventory change, published by the Bureau of the Census. Detailed data from the Census of Manufactures for 1967, 1972, 1977, and 1982 were used to derive benchmark indexes, to which the annual indexes for intervening years, based on the Annual Survey of Manufactures, were adjusted. The value of shipments of the various product classes were adjusted for price changes by appropriate Producer Price Indexes to derive a real output measure. These, in turn, were combined with employee hour weights to derive the overall output measure. Employment and employee hour indexes were derived from census data. Employees and employee hours are considered homogeneous and additive, and thus do not reflect changes in the qualitative aspects of labor, such as skill and experience of persons constituting the aggregate.

Data on the quantities of goods produced by the metal doors, sash, and trim industry are not complete. Real out-

put, therefore, was estimated on the basis of a deflated value technique. That is, changes in the price levels of the current dollar value of production were removed by means of appropriate price indexes. Because an adjustment for changing price levels usually lowers the dollar value, such a series is referred to as a deflated value measure. In an industry such as the metal doors, sash, and trim industry, where the raw material may differ from one product to the next, this technique may result in some bias in the measure. However, the bias is minimal.

To combine segments of the output measure, employee hour weights relating to the individual segments were used. This technique was used at various levels of subaggregation for the variety of products manufactured by this industry. These procedures result in a final output index that is conceptually close to the preferred output measure.

Indexes of output per employee-hour relate total output to one input of labor time. The indexes do not measure the specific contribution of labor, capital, and any other single factor. Rather, they reflect the joint effects of such factors as changes in technology, capital investment, capacity utilization, shop design and layout, skill and effort of the work force, managerial ability, and labor-management relations.

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### Verifying basic skills

Employers report in survey after survey that what they are seeking in young employees is, first, the basic skills needed to learn on the job, and, second, the dependability and world-of-work skills to show up on time and follow instructions. Vocational skills are less frequently required, although important for some jobs such as secretarial work. Employers do not usually give academic or other tests, and have little basis for judging the dependability of those with limited work experience, so they judge on the basis of academic credentials and other considerations such as vouching by acquaintances or relatives, best bets based on previous experiences with similar individuals, or prejudice. Employment and training programs recruit and serve those unable to secure jobs in the private sector. Unless these enrollees attain academic credentials recognized by employers, or are sorted so that those who prove to be dependable and trainable are identified, participants who are disadvantaged at entry will be equally disadvantaged at exit.

—NATIONAL COUNCIL ON EMPLOYMENT POLICY  
*Investing in America's Future: A Policy Statement*  
by the National Council on Employment Policy  
(Washington, National Council  
on Employment Policy, 1984), pp. 24–25.