Millwork industry shows slow growth in productivity

During 1958–80, output per hour advanced at half the rate of growth for all manufacturing industries, reflecting unstable demand and low capital investment

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Labor productivity in the millwork industry rose at an average annual rate of 1.4 percent from 1958 to 1980,[1] a modest advance when compared with total manufacturing. Over this period, output in millwork increased at a rate of 2.7 percent annually and employee hours at 1.3 percent. The productivity rise partly reflected low growth in capital investment, particularly over the past decade, and evidently slow diffusion of modernized production technologies. These factors, combined with instability in demand for the industry's products, retarded productivity. Industry demand depends mostly upon residential construction, where fluctuations have been frequent and substantial.

The overall rate of increase in the productivity of the millwork industry reflects basically two periods in each of which the productivity movements differed significantly. Between 1958 and 1972, productivity rose at an average annual rate of 2.6 percent, rising 42 percent by 1972, to a high for the period (107.2 on a 1977=100 basis). However, from 1972 to 1980, productivity declined at a rate of 1.4 percent a year, or by 13 percent. By contrast, productivity in the private nonfarm business economy continued to advance, although at a slower rate than earlier. The following tabulation shows the pertinent comparisons (average annual rates, in percent):

	1958–80	*1958–72*	*1972–80*
Millwork industry	1.4	2.6	-1.4
Private nonfarm business	1.8	2.1	0.9
Manufacturing	2.8	3.1	1.8

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Year-to-year changes in millwork productivity were quite volatile, ranging from a 12-percent rise (in 1967) to a 9-percent drop (in 1974). Productivity declined in 8 of the 22 years surveyed. In such years, output either fell more than employee hours or rose less. In 10 of the years of rising productivity, output gains exceeded employee hour increases. But in the other years of rising productivity, productivity improvements were associated with output declines being smaller than employee hour reductions.

Output and demand

The millwork industry manufactures wood window units, including sashes; window frames; doors and door frames; moldings; and stairs. In 1977, one-quarter of the industry's output consisted of window units and related items; and close to two-fifths of doors, including garage doors. Moldings represented another fifth of output. Approximately three-fourths of the industry's output was used in residential housing, including additions and alterations; small amounts of output were used in commercial and educational buildings, prefabricated wooden buildings, and in trailers and other transportation equipment. Millwork output is thus linked mainly to residential construction markets.

Output of millwork products rose at an average annual rate of 2.7 percent between 1958 and 1980, about in line with the trend in the deflated value of new residential housing units plus additions and alterations. Output movements during the period were characterized by differences in average annual rates of change between 1958–72 and 1972–80, which were similar to the variations in productivity movements noted above. During

1958–72, output rose 3.6 percent annually, in 1972–80 it declined 0.9 percent a year. Millwork output fluctuated generally less on a year-to-year basis than residential building activity. The lesser amplitude of millwork output fluctuations may partially relate to inventorying practices of jobbers through whom much of industry sales are conducted.

Millwork output was strengthened, particularly during the 1960's, by increases in the square foot area of single-unit housing—indicating more rooms as well as larger room size, hence more doors, windows, and moldings. During the study period, square foot area per housing unit rose more than 20 percent.[2] While the number of 1 to 3 room housing units being added to the housing stock declined between the 1960's and 1970's, additions to 4- and 6-room units grew strongly; the increment in 5-room units remained roughly the same. Units with 7 rooms or more recorded particularly strong increases during the 1970's. However, multi-unit dwellings gained in relative importance during the early and mid-1970's, when apartment construction rose to 37 percent of all private housing starts, up from 33 percent in the 1960's. Because only a relatively small proportion of millwork output is used in such construction, the sharp increase in multi-unit starts probably offset somewhat the demand from single-unit residential starts. (For example, more than 80 percent of window units installed in apartment buildings are of aluminum, as against 50 percent for 1- and 2-unit residences.)[3]

There were other factors pertaining to housing which sustained millwork output during most of the period studied. For example, the number of homes built with two stories or more, 17 percent of total starts in 1964, rose to 28 percent in 1978, indicating a greater demand for stairs, moldings, and other millwork items. The proportion of homes built with 1- and 2-car garages grew from 63 percent in 1963 to 74 percent in the late 1970's —spurring the demand for garage doors, an estimated 85 percent of which are made of wood.[4]

The demand for window units has of course fluctuated with housing starts. On balance, it rose substantially during the 1960's, and fell off somewhat in the 1970's. Demand in the 1970's was also crimped by a decline in the number of windows per dwelling unit, partially associated perhaps with builders' efforts to make homes more energy efficient; and by competition from aluminum and steel windows. Currently, the millwork industry accounts for one-third of all residential window installations, aluminum and, to a small extent, steel, making up the other two-thirds. 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 steadily declined from roughly one-half of the total in the late 1950's.[5]

Growth in the industry's output of doors has also been slowed by competitive materials. The industry

Table 1. Productivity and related indexes for millwork industry, 1958–80

[1977 = 100]

Year	Output per hour			Output	Employee hours		
	All employees	Production workers	Nonproduction workers		All employees	Production workers	Nonproduction workers
1958	75.6	77.0	70.7	58.5	77.4	76.0	82.8
1959	71.7	72.4	69.7	61.2	85.3	84.5	87.8
1960	73.2	74.8	67.7	55.7	76.1	74.5	82.3
1961	76.9	78.1	72.6	56.6	73.6	72.5	78.0
1962	78.1	78.8	76.3	59.7	76.4	75.8	78.2
1963	86.0	86.0	86.5	68.1	79.2	79.2	78.7
1964	86.0	85.9	87.2	69.2	80.5	80.6	79.4
1965	85.8	86.1	85.2	70.2	81.8	81.5	82.4
1966	82.7	84.0	78.4	66.6	80.5	79.3	84.9
1967	92.6	93.3	90.1	72.6	78.4	77.8	80.6
1968	93.9	93.7	96.0	78.7	83.8	84.0	82.0
1969	96.3	96.6	95.7	80.4	83.5	83.2	84.0
1970	95.9	97.6	89.7	77.1	80.4	79.0	86.0
1971	95.9	95.3	99.3	84.0	87.6	88.1	84.6
1972	107.2	104.5	121.6	103.6	96.6	99.1	85.2
1973	102.3	101.6	106.7	104.7	102.3	103.1	98.1
1974	92.7	94.4	85.5	84.6	91.3	89.6	99.0
1975	100.2	102.6	90.9	84.1	83.9	82.0	92.5
1976	99.1	99.6	97.3	92.5	93.3	92.9	95.1
1977	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1978	91.5	91.5	92.0	96.2	105.1	105.1	104.6
1979	93.9	95.2	88.2	96.2	102.5	101.1	109.2
1980	93.7	97.2	80.4	87.1	93.0	89.6	108.4
	Average annual rates of change (in percent)						
1958–80	1.4	1.4	1.3	2.7	1.3	1.3	1.4
1975–80	−1.7	−1.4	−2.8	0.7	2.4	2.2	3.6

accounted for close to three-fifths (by value) of all doors installed in new residential dwelling units in 1977, a slight decrease from earlier years.

Inroads into millwork's share of residential door installations have come chiefly from the wider use of steel for front and other exterior doors. In 1979, wood flush and panel doors accounted for 44 percent of all front door installations, compared with 68 percent in 1974 (the earliest year for which data are available). Displacement of wood by steel was similarly marked in the case of other exterior doors.[6] These tendencies have been somewhat offset by a slight but steady rise in recent years in the number of doors installed per dwelling.[7]

Whether industry output benefited from a continued shift from onsite carpentry of millwork items to factory production over the period cannot be readily determined. According to a BLS survey conducted in 1969, preassembled windows were installed in 78 percent of surveyed single-family houses built that year; and in 1968, prehung doors in 64 percent, and prefabricated staircase units in 25 percent.[8] No other such survey is available for the period examined here.

Window sashes and doors have been manufactured for more than a century, but most work was done onsite. Large-scale offsite production did not get underway until the 1930's and early 1940's, when a shift from onsite carpentry of millwork occurred.[9] Mass production of millwork was subsequently spurred by the large postwar demand for residential housing. Such product innovations as prehung doors (a door hinged on its frame, and delivered ready to be placed in the openings of the unit under construction) furthered the trend to factory production of items heretofore carpentered or finished at the site.[10] But no definitive data are available indicating the extent to which these developments raised the output of the millwork industry.

Employment increases moderately

Employment in the millwork industry, currently numbering 74,000 persons, rose at an average annual rate of 1.5 percent between 1958 and 1980. It peaked in 1978, when it stood 39 percent above the 1958 level. In general, it rose slightly during most of the 1960's, and more strongly in the early 1970's. Subsequent upswings and downswings were more marked than in earlier periods, reflecting similarly pronounced swings in the industry's output. Employee hours generally paralleled the trend in employment, rising at an average annual rate of 1.3 percent over the period. Average annual hours per employee in the millwork industry did not, on balance, change significantly between 1958 and 1972, and declined slightly between 1972 and 1980. Year-to-year changes were often larger for production worker employment than for production worker hours. The workweek per production worker averaged slightly less after 1972 (39.3 hours) than before (40.1 hours) indicating a drop in overtime. Generally, overtime averaged considerably less than for durables manufacturing as a whole.[11]

Differences in trend between production and nonproduction worker hours were not significant. But short-term fluctuations were much greater for production than for nonproduction worker employment and hours. The proportion of nonproduction workers, 18 percent in 1977, did not change materially over the study period, except for years of flagging industry output, when production worker employment weakened.

Industry employment evidences considerably higher turnover of production workers than durables manufacturing. In 1978, accessions (mostly new hires) in millwork, at 5.5 per 100 workers, were nearly two-fifths again as high as for all durables manufacturing; separations (mostly quits) were more than three-fifths again as high. High turnover rates mean a loss of trained and experienced workers[12] and more break-in periods required for newly hired workers, which may contribute to retarding productivity.

Technological developments

Millwork essentially consists of the sawing, shaping, planing, and sanding of wood to specified dimensions. The unfabricated lumber is delivered to the plant in the form of uniformly sized and quality-graded boards. Large-scale gluing operations are performed as part of the production process. Glazing is a normal part of the manufacture of windows and windowed doors.

Millwork is highly mechanized; virtually all work that transforms the lumber is done by machines. In some plants, feeding and tailing (the removal of the workpiece from the machine) are carried out manually, partly because of apprehension that a mechanized process would damage sensitive woods.

The basic technology used in millwork plants dates from the 1930's and 1940's when, as noted, large-scale production was first introduced in the industry. Factory production of millwork items antedates the 1930's, but large-scale operations were held back by the lack of waterproof, quick-curing adhesives. Moreover, millwork firms, at the time serving mostly local and regional markets, were slow in standardizing their product, hampering adoption by developers of housing projects. These obstacles began to be overcome with the innovation of synthetic resin adhesives, yielding waterproof bond.[13] Standardization progressed. Precision machinery became more widely available, probably accelerating the shift from onsite carpentry to the factory.[14] These developments also helped broaden the product lines of millwork firms. For example, complete double-hung windows mounted in prefabricated, weather-stripped frames, ready for installation at the construction site, were introduced in the 1940's and, subsequently, prehung doors.

Although the industry's basic machinery and equip-

ment reflect woodworking technologies that have existed for many decades, there are indications that much of this equipment is less than 20 years old, and that sizable proportions are 10 years old or less.[15] Thus, three-fifths of the finger jointing machinery and of automatic mortisers appear to be in the lower age group, and as much as three-quarters of many types of sawing machinery. Fifty percent of door sizers, and much of the glue room equipment—including clamps and clamping machines, glue guns and pumps, and spreaders and presses—are of comparatively recent date, as is finishing equipment (for example, hot air ovens). The same holds for such general plant equipment as air conditioners, dust collectors, and computers. However, it cannot be determined from the available data whether the more recently installed—therefore, more up-to-date—equipment is well diffused throughout the industry. It is believed that diffusion is slow, partly because of the fragmentation of the industry into many firms.

A trend toward automated systems in the industry seems to be underway.[16] This trend is furthered by the declining costs of numerical controls, which more and more entail one-station systems featuring microcomputers.[17] That trend also involves computer-controlled material handling systems, robotized transfer and palletizing, and carousels interfacing with conveyors, robots, and other material handling devices.[18] But some persons in the industry argue that automation is unlikely to make much headway in millwork because it compels a financial commitment to highly specialized equipment—a commitment which often cannot be justified because of the erratic demand for the industry's products.

Other, more narrowly focused technological advances have been made which have evidently been more readily adopted than automated equipment. For example, the versatility of machines fabricating moldings has been greatly extended so that a large variety of complex molding profiles can be cut and grooved at great speeds without loss of precision and insignificant loss in setup time.[19] Ripsaws have been introduced whose sawing patterns can be controlled by instructions relayed by manipulating the shadow of an overhead wire. Stock which is free from knots and other flaws can thus be mechanically selected, eliminating a number of strenuous manual operations and resetting of the sawing machine, and reducing waste.[20] Solid-state sensing devices have in recent years been attached to abrasive planers, ensuring uniform surfaces. Abrasive planers were developed in an era of low-cost energy, but have become more energy-efficient, as well as faster.[21] Hand-operated sanders have been disappearing as multifunctional sanding machines have evolved. Thus, automatic thickness settings permit ranges from bites of ¼ inch to the finest surface finish.[22] A gradual shift from electrically powered to air-powered hand tools has probably also contributed to improving productivity. Air-driven hand tools are believed to achieve job requirements more efficiently, and to be less fatiguing for the operator because of their light weight and a wider choice of such options as handles and styles.[23]

Significant advances have likewise been made in adhesive applications. High-speed production requires rapid curing, and the gluing process is therefore usually an integral part of the production process. Certain radio frequency gluing devices have reduced curing time from 20 to 2 minutes, and, for example, as many as 20 door stiles can be processed at the same time. The saving in labor requirements made possible by this process has been estimated at 35 percent.[24] Bonding strength, too, has been increased, permitting the elimination of clamping in some operations (clamping has usually been regarded as a bottleneck in high-speed millwork assembly where gluing is required).[25]

Capital expenditures

New plant and equipment spending by the millwork industry went up fairly rapidly between 1963 (when pertinent data first became available) and 1978. In terms of constant dollars, it rose at an average annual rate of 4.7 percent.[26] However, the annual increase between 1963 and 1972, 9.4 percent, by far exceeded that for 1972 to 1978—1.2 percent. Significantly, outlays for buildings and other structures rose at nearly the same rate as for equipment during the former period, but declined during the latter. Capital spending by the industry showed at times huge year-to-year swings, induced most likely by fluctuations in demand for the industry's product from residential construction. Comparisons with trends in the private economy's fixed investment outlays follow (average annual rates of change, in percent).[27]

	1963–78	*1963–72*	*1972–78*
Millwork:			
Total	4.7	9.4	1.2
Machinery and equipment	6.3	10.3	0.9
Structures	1.6	8.1	-3.9
Private fixed investment:			
Total	3.6	4.6	2.4
Producer durable equipment	5.2	5.7	4.3
Nonresidential structures	0.9	3.1	-1.3

The tabulation shows that the pattern of vigorous capital spending growth in the 1960's and early 1970's in the millwork industry closely resembled that of the private domestic economy, and likewise that of meager capital spending growth in the mid-to-late 1970's. But for millwork, the slowdown was far more pronounced and spelled virtual stagnation in investment in new machinery and equipment.

New capital expenditures per employee in millwork

represented only 42 percent of the comparable figure for manufacturing as a whole in 1978. That ratio does vary widely over time because of the large fluctuations of millwork firms' plant and equipment outlays (it was 61 percent in 1972). Yet, the comparative capital intensity of millwork is somewhat understated because its firms rent a larger proportion of plant structures and equipment than other manufacturers. In 1978, rents for structure represented the equivalent of 67 percent of millwork firms' purchases of structures, and rents for equipment, 22 percent. The corresponding figures for manufacturing were 34 percent and 9 percent. When rental payments are added to millwork's total capital outlays, the per-employee ratio to manufacturing mentioned above rises to 50 percent in 1978 (and 65 percent in 1972). That still spells relatively low capital intensity, a characteristic also manifest in the low value of the industry's fixed assets per employee—it represented between 42 and 44 percent of the manufacturing average in the 1970's. In 1976, each dollar of millwork shipments required 17 cents in fixed assets, compared with 34 cents for manufacturing in general.

Size of establishments

Millwork firms are preponderantly small—70 percent employed fewer than 20 workers in 1977, and another 23 percent employed from 20 to 99 workers. In this respect—that is, in terms of the size distribution of firms by employment—millwork closely resembles manufacturing. However, the smaller millwork establishments account for a much larger proportion of total employment in the industry than smaller manufacturing firms in general—50 versus 26 percent. The same pattern holds for the value of shipments, nearly one-half of which originated with the smaller millwork firms, compared with only about one-fifth for their counterparts in total manufacturing. Large millwork establishments—those employing 500 workers or more—recorded correspondingly smaller shares of total industry employment and shipments. The comparisons suggest that economies of scale are generally less of a factor of productivity improvement in millwork than in manufacturing.

LABOR PRODUCTIVITY IN MILLWORK should continue to advance moderately over the long term. The diffusion of automatic controls and the replacement of existing machinery with more up-to-date equipment will obviously be positive factors. But the predominance of smaller firms is likely to retard installation of automated transfer equipment, because, in their case, volume rarely justifies such equipment. Fluctuating residential building markets, and the trend toward apartment construction, will very likely continue to cause firms in the industry to be cautious in committing large funds to highly specialized automated machinery.

BLS employment projections have not been published for millwork alone, only for its industry group.[28] For it, a small, negative employment trend has been assumed during the 1980's. With demand from residential construction expected to expand, and industry employment to decline slightly, a moderate improvement in labor productivity is implied.[29] However, this progress is predicated upon the continued adoption of more advanced technologies by firms in the industry. □

FOOTNOTES

[1] The millwork industry has been designated as number 2431 in the 1972 Standard Industrial Classification Manual of the Office of Management and Budget. It consists of establishments which primarily manufacture such millwork products as moldings, wooden doors, windows, shutters, blinds, and awnings; and other architectural millwork items. All average annual rates of change are based on the linear least squares trend of the logarithms of the index numbers. The indexes for productivity and related variables will be updated annually and published in the annual BLS Bulletin, *Productivity Indexes for Selected Industries.*

[2] The data on average square foot are per single-unit dwelling, number of rooms and stories, and other examples mentioned in this and the following paragraph are from the following sources: *Characteristics of New One-Family Homes, 1968; Characteristics of New Family Housing: 1978*; both published by the Bureau of the Census, U.S. Department of Commerce, and U.S. Department of Housing and Urban Development, Washington, D.C.; James W. Myrtle, "Characteristics of New Housing," *Construction Review*, April 1979, pp. 4–9; Abraham Goldblatt, "Profile of New One-Family Homes," *Construction Review*, February 1973, pp. 4–8; and *Statistical Abstract of the United States, 1980* (Government Printing Office, 1980), p. 791.

[3] *Architectural Aluminum Industry Statistical Review* (Chicago, Architectural Aluminum Manufacturing Association, 1980), Table 14.

[4] Based on information from Housing Industry Dynamics, Crofton, Md.

[5] See footnote 3.

[6] Based on information from Housing Industry Dynamics.

[7] *Architectural Aluminum Industry Statistical Review, 1980.*

[8] Robert Ball, *Labor and Material Requirements for Construction of Private Single-Family Houses*, Bulletin 1755 (Bureau of Labor Statistics, 1972), p. 22.

[9] Information from William B. Lloyd, author of *Millwork: Principles and Practices* (Chicago, Cahners Publishing Company, 1966).

[10] *Millwork*, p. 208.

[11] The majority of millwork production workers hold jobs as machine and materials handling operators and assemblers. *Industry Wage Survey: Millwork, June 1979*, Bulletin 2083 (Bureau of Labor Statistics, 1980).

[12] Some effects of high turnover rates are discussed by Peter Henle, "Economic Effects: Reviewing the Evidence," in Jerome M. Rosow *The Worker and the Job* (Englewood Cliffs, N.J., Prentice-Hall, 1974), p. 125.

[13] *Millwork*, p. 8.

[14] *Millwork*, p. 8. Hours worked by carpenters in building a 1-family dwelling have undoubtedly declined, and the decline in part points to a shift of the work conventionally performed by the carpenter to manufacturing. Thus, according to the BLS publication cited in footnote 8, there were 29 onsite carpenter hours required per 100 square feet of a 1-family house in 1969. According to studies done by the BLS for 1-family frame houses built in 1946–47, onsite carpentry then required

about 70 hours per 100 square feet. The decline implied in the number of onsite carpenter hours may have partly occurred because of differences in survey methods, the type of houses selected, and other technical or statistical factors. Moreover, part of the decline may be attributable to productivity improvements in carpentry. Nevertheless, a significant portion of the decline is likely to have been linked to shifts to factory production of carpentering work, including here millwork items, as well as roof trusses, plywood subflooring, and so forth. See Edward M. Gordon, "House Construction: Man-Hours by Occupation, 1946–47," *Monthly Labor Review*, December 1948, pp. 611–14; and Adela L. Stuckey, "Labor Share in Construction Costs of New Houses," *Monthly Labor Review*, May 1949, pp. 517–20.

[15] *An Inventory of Machines and Equipment in the Woodworking and Furniture Market*, issued by *Woodworking and Furniture Digest*, Wheaton, Ill., 1979. *An Inventory* presents the number of woodworking machines, by type, for each woodworking industry (as classified by the Standard Industrial Classification Manual). In a separate presentation, *An Inventory* shows the age breakdown of each type of woodworking machinery, but the age breakdown is not grouped by industry. The discussion in the text assumes that the age breakdown applies to machinery in the millwork industry where this industry accounts for a relatively large proportion of a given type of woodworking machinery. The authors of *An Inventory* believe this assumption to be valid.

[16] *Woodworking and Furniture Digest*, February 1976, p. 65.

[17] *Woodworking and Furniture Digest*, August 1978, p. 83.

[18] *Woodworking and Furniture Digest*, July 1981, pp. 14–19.

[19] Industry source.

[20] Industry source.

[21] *Woodworking and Furniture Digest*, August 1978, p. 83; May 1981, p. 16.

[22] *Woodworking and Furniture Digest*, May 1981, p. 16.

[23] *Woodworking and Furniture Digest*, February 1981, pp. 10–19.

[24] Industry source.

[25] *Woodworking and Furniture Digest*, August 1978, p. 83 ff.; January 1981, pp. 10–19.

[26] Constant-dollar capital expenditures were derived by deflating the current-dollar census data on the millwork industry's new capital expenditures by the implicit price deflators for fixed investment, shown on p. 236 of *Economic Report of the President*, January 1981.

[27] The rates for private fixed investment (in 1972 dollars) are derived from Table B-2, *Economic Report of the President*, January 1981.

[28] The millwork industry is part of SIC 243, which includes veneer, plywood, and structural wood members. It accounts for about 35 percent of SIC 243 in terms of employment.

[29] See Data Resources, Inc., *U.S. Long-Term Review*, Spring 1982, p. 11.20; and Valerie Personick, "The outlook for industry output and employment through 1990," *Monthly Labor Review*, August 1981, especially p. 34.

APPENDIX: Measurement techniques and limitations

Indexes of output per employee hour measure changes in the relation between the output of an industry and employee hours expended on that output. An index of output per employee hour is derived by dividing an index of output by an index of industry employee hours.

The preferred output index for manufacturing industries would be obtained from data on quantities of the various goods produced by the industry, each weighted (multiplied) by the employee hours required to produce one unit of each good in a specified base period. Thus, those goods which require more labor time to produce are given more importance in the index.

In the absence of adequate physical quantity data, the output index for this industry was constructed by a deflated value technique. The value of shipments of the various product classes were adjusted for price changes by appropriate Producer Price Indexes to derive real output measures. These, in turn, were combined with employee hour weights to derive the overall output measure. The result is a final output index that is conceptually close to the preferred output measure.

Employment and employee hour indexes were derived from data published by the Bureau of the Census because BLS data were not available. Employees and employee hours are each considered homogeneous and additive, and thus do not reflect changes in the qualitative aspects of labor, such as skill and experience.

The indexes of output per employee hour do not measure any specific contributions, such as that of labor or capital. Rather, they reflect the joint effect of factors such as changes in technology, capital investment, capacity utilization, plant design and layout, skill and effort of the work force, managerial ability, and labor-management relations.