Productivity in wood containers

Rapid automation in the manufacture of pallets contributed to a productivity growth rate of 2.2 percent per year over the 1977-89 period in wood containers industries

James York

Virtually invisible to most consumers, products of the wood container industry are used to move products ranging from diapers to machine tools to groceries. Productivity gains spurred by widespread automation arrived to these suppliers of domestic industry as recently as the 1970's and 1980's. Productivity in the wood containers industry, as measured by output per employee hour, grew at an average annual rate of 2.2 percent during the 1977–89 period.[1] Wood container output increased at a rate of 2.8 percent. Employee hours, by comparison, increased at a rate of only 0.6 percent.

For the wood containers industry, productivity indexes represent the change in the ratio of the weighted output of specified products to the employee hours expended to produce that output. The output and employee hour series that underlie the industry productivity measure are based on data from the Bureau of the Census. The output index is deflated by matching producer price indexes from the Bureau of Labor Statistics. For a more complete description of the methodology, see the appendix at the end of this article.

Productivity and output

Industry productivity grew most rapidly—3.0 percent—during the 1977–84 subperiod (1984 was a turning point for long-term productivity gains in the wood container industry). Output increased at a rate of 2.8 percent, while hours declined at a rate of 0.3 percent. Productivity growth was not continuous during this subperiod, increasing in four years but decreasing in the other three. It surged in 1980 by 17.5 percent and in 1982 by 17.6 percent, posting by far the biggest increases of the subperiod. Output increased 4.7 percent in 1980 and 5.8 percent in 1982.

The largest output increase during the 1977 to 1984 subperiod was 10.8 percent in 1984, the year of greatest growth within the extended economic expansion of the 1980's. Employee hours also increased considerably, however, rising by 7.9 percent, holding productivity gains to 2.7 percent that year.

From 1984 to 1989, productivity growth slowed to a 0.9-percent annual rate. Output expanded at a rate of 2.9 percent, but hours rose at a rate of 1.9 percent. Productivity fell 3.2 percent in 1985 and 1.2 percent in 1986, but edged up 0.2 percent in 1987; it rose 3.6 percent in 1988 and peaked at 5.6 percent in 1989. Output rose 8.8 percent in 1988 and 8.0 percent in 1989, when the economic expansion was approaching its peak. Hours rose by 5.0 and 2.3 percent in those years.

Productivity growth in the overall wood containers industry has been heavily influenced by technological changes in the wood pallets and skids segment, its largest component. Mechanization of pallet manufacturing has been the driving factor in the growth of total industry productivity. In the 1970's, many producers began to believe economies of scale could improve efficiency in pallet manufacturing. Before then, a common belief held that transportation costs to more distant customers would offset any productivity gains to be made by automation or larger plants.[2]

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Nailed wood boxes and shook, and wood containers, not elsewhere classified, showed less dramatic technology improvements.[2]

The market

Pallets. Pallets are platforms which allow forklifts to move large crates and boxes either around warehouses or into trucks, ships, or railcars. Population growth (especially in suburban areas) and its accompanying growth of supermarkets and other retail outlets have helped to keep demand for pallets growing. The declining real cost of producing pallets has also helped to keep them popular and to stimulate sales.[3] Increases in the cost of labor for manually loading cargo—the primary alternative for pallet consumers—have made the use of pallets even more attractive. This competitive edge has become especially evident in the grocery industry.

Computerized systems have allowed buyers to make trade-offs between pallet cost and strength. Producers can now use thinner wood for such lowweight goods as toilet paper, which reduces raw material cost and results in more attractive pallet prices. Similarly, the systems can design pallets for buyers who want to reuse their pallets or who need extra strength, as in moving cans of motor oil.[4]

Recycling pallets has become an important business. Recyclers typically obtain used pallets at little or no cost and either repair them or dismantle them and use the components to make new pallets. Recycling can further expand the market by lowering prices because of reduced wood costs. Also, some municipalities have already banned the dumping of old pallets in local landfills.

Wooden boxes. The market for most wooden boxes, unlike pallets, has grown slowly when it has grown at all. Corrugated boxes and other products have proven stiff competitors. Also, because wooden boxes can come in a wide variety of sizes and designs, computerized methods are more difficult to apply.

Fruit and vegetable growers make up a big and growing market for wooden boxes. For wirebound boxes, agricultural markets represent about 60 percent of the total. Although the industrial market has experienced flat growth in real terms, it still represents about 35 percent of the wirebound box market. Government, including the military, is another important market.

Employment and plant size

Total employment in the wood containers industry increased 6.7 percent between 1977 and 1989, or 0.5 percent on an annual basis. After employment peaked in 1979 at 46,900 employees, it steadily declined to 37,600 in 1982. From 1977 to 1982, employment fell at an average annual rate of 2.2 percent.

During the economic expansion from 1982 through 1989, however, employment grew at a rate of 2.5 percent to 44,800 employees. Because pallets are used to move and store virtually all domestically made goods, the long period of expansion in the U.S. economy stimulated demand for wood container industry output and led to increases in employment.

Employment changes were not evenly distributed among the industry's work force, however. Over the entire 1977–89 period, the number of production workers increased at a rate of 0.2 percent, compared with an average annual rate of 2.9 percent for nonproduction workers. Rapid mechanization of pallet manufacture has lowered production worker requirements, but this trend was not consistent over the entire period.

In the 1977–82 subperiod (which ended with the cyclical trough in November 1982), the number of production workers declined at a rate of 3.2 percent while the number of nonproduction workers increased at a rate of 4.1 percent. But in the 1982–89 subperiod, the number of production workers increased at a 2.6-percent rate, faster than the 2.0-percent rate for nonproduction workers.

From 1977 to 1989, average earnings increased 72 percent, from $3.78 to $6.51 an hour. This rate did not keep pace with other industries; average hourly earnings in the manufacturing sector as a whole rose 85 percent over the period, from $5.68 to $10.48 an hour. After adjustment for inflation, earnings in the container industry fell 16 percent to $3.18 an hour, compared with a 10-percent decline to $5.12 an hour for all manufacturing workers.

Most wood container plants have fewer than 10 employees. In the nailed wood boxes and shook industry, 50 percent of the establishments had fewer than 10 employees in 1987 (the most recent data available), while 2 percent had 100 or more employees. Fifty-three percent of all wood pallet and skid establishments had fewer than 10 employees, and 1 percent had 100 or more employees. In the manufacture of miscellaneous wood containers, 61 percent of the establishments employed fewer than 10 workers. However, there were proportionately more large plants than in the other two industries: 9 percent of the establishments had 100 or more employees.

Technology

Pallets. Pallet production has benefited the most from automation. Gang resaws can process raw

Table 1. **Productivity and related indexes for the wood containers industry, 1977–89**

[1982=100]

Year	Output per employee hour	Output	Employee hours	Employee
1977	83.1	93.9	113.0	111.7
1978	83.2	98.9	118.9	118.1
1979	74.3	93.5	125.9	124.7
1980	87.3	97.9	112.1	113.0
1981	85.0	94.5	111.2	109.6
1982	100.0	100.0	100.0	100.0
1983	99.8	102.6	102.8	100.5
1984	102.5	113.7	110.9	109.0
1985	99.2	109.3	110.2	108.8
1986	98.0	108.0	110.2	108.5
1987	98.2	111.5	113.6	111.4
1988	101.7	121.3	119.3	116.5
1989	107.4	131.0	122.0	119.1
	Average annual rates of change			
1977–89	2.2	2.8	0.6	0.5
1984–89	.9	2.9	1.9	1.8

lumber by cutting a bunch of boards from each trimmed log in a single pass. More stationary gang resaws with less vibration allow producers to use thinner saw blades, which also improves the yield.[5] Automated feeding systems can increase or decrease feed rates as needed, and automated stacking equipment eliminates the need for a worker to stack the lumber before the assembly phase of the production process.

Workers used to have to nail pallets together by hand, but the introduction of hand-held nailing equipment helped speed up the assembly process. Today, two workers can produce 1,200 pallets per day on the most automated pallet assembly systems, compared with 200–300 pallets per day using hand nailers.

Even small producers are using highly automated systems, although big producers—with their bigger production runs—can best afford the most automated systems with the greatest production capacities. These systems position boards, nail them to the stringers (runners), flip over the partly assembled pallets, and nail boards to the other side. The machines can then automatically stack and transfer the finished pallets from the assembly equipment.

In recent years, these automated pallet assembly systems have become widespread for large production runs. As recently as 10–15 years ago, most producers still relied on semiautomated equipment and hand-held nailers. Producers still use hand nailing equipment for small runs or specialty orders where the volume does not justify use of the automated equipment.

Recyclers use unnailers to automatically disassemble the used pallets. Workers used to saw dismantled pallets to their proper lengths, but faster and more sophisticated sawing equipment is now available to speed up this part of the recycling operation.[6]

Wooden boxes. The production of wooden boxes (except wirebound) has not benefited as much from automation as has the production of pallets. The variety of boxes is so great that the long production runs needed to justify full automation are normally not available. But producers have improved productivity by using gang resaws. Boxes are often assembled on semiautomated equipment that has not changed much in recent years. Nail guns are often used as an alternative to semiautomated nailing equipment.

Over the past few years, producers who have access to large markets for specific types of boxes have used automated equipment for large production runs for those markets. Better conveyors and other improvements in materials handling equipment have also helped box producers increase efficiency.

Wirebound boxes. Parts for wirebound wood boxes are placed on moving conveyors and carried to a machine that stitches wire to the box with staples. The stapled parts are then moved to the rock fastener machine where the ends of the binding wires are formed into loops and clinched. A 25-percent increase in the speed of these machines in recent years has contributed to productivity improvements.

Wirebound box producers often process their own lumber or veneer. Productivity in these operations has benefited from new saws with more reliable microprocessor controls and scanners, which increase the yield per log. New strains of trees that grow straighter improve yields in the sawing operations. Better conveyors and other materials handling equipment have also helped productivity. Computers have improved efficiency in accounting, payroll, mailings, job costing, and inventory control.

The outlook

Continued improvements in pallet-making equipment and greater diffusion of the most automated systems will likely spur more productivity advances. While increased automation of pallet production—with its higher capital requirements— has made it more difficult for very small operators to enter the industry, the efficiency gains from this automation may continue to benefit productivity in the future. Although automation has not advanced as rapidly in box production, the productivity gains in pallet production should continue to affect the productivity of the overall wood containers industry favorably.

Computerized pallet design is a relatively new development and wider use of the technology should enable producers to design pallets to more closely meet the specific needs of individual customers. This should help to continue expanding the market for pallets. More improvements in production and materials handling equipment seem likely, although they may proceed at a more gradual pace than in the recent past.[7]

The growth of recycled pallets appears likely to continue. With landfill space becoming increasingly scarce, recycling should grow as disposing of old pallets becomes more difficult, more costly, and even illegal in some communities.[8]

As recycling grows, the efforts to improve productivity will have a more significant effect on overall industry productivity trends. Recyclers are much less automated than new pallet producers, but they seem to be moving toward increased automation and mechanization of their operations, which in turn should considerably increase their productivity. Growing competition in this segment of the market is also expected to improve efficiency.[9]

The wood containers industry has never faced any serious competition from foreign producers, and this does not appear likely to change in the near future. Increasing user demand should translate into continued growth in industry output. □

Footnotes

[1] The wood containers industry includes SIC 2441, nailed and lock corner wood boxes and shook for nailed and lock corner boxes; SIC 2448, wood or wood and metal combination pallets and skids; and SIC 2449, wood containers, not elsewhere classified, such as cooperage, wirebound boxes and crates, and other veneer and plywood containers. All average annual rates of change are based on the compound interest method of computation. Extension of the indexes will appear in the annual BLS bulletin, *Productivity Measures for Selected Industries*.

[2] David G. Martens, "Changing Characteristics of the Pallet Industry," *Pallet Enterprise*, November/December 1989, pp. 22–24.

[3] "Automation and Streamlined Operations Mean Expansion and Increased Productivity at Poag Lumber," *Pallet Digest*, January/February 1990, pp. 34–36; and "Changing Characteristics of the Pallet Industry."

[4] "Changing Characteristics of the Pallet Industry."

[5] "New Multi-Cut Band Saw Increases Lumber Production," *Pallet Digest*, March/April 1990, p. 37; "Viking Introduces Hew High Volume Multi-Cut Horizontal Band Resaw," *Pallet Enterprise*, May/June 1990, pp. 8–9; "Straight Line Ripping Means Thin Kerf Means Higher Yield," *Pallet Digest*, September/October 1989, pp. 38–39.

[6] "Power Pallet: Repair Automation by Pallet Unlimited," *Pallet Enterprise*, July/August 1989, pp. 26–30.

[7] "Changing Characteristics of the Pallet Industry."

[8] 1990 U.S. Industrial Outlook (U.S. Department of Commerce, 1990), pp. 6–8, 6–9.

[9] "Power Pallet: Repair Automation by Pallet Unlimited."

APPENDIX: Measurement techniques and limitations

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

The output index for manufacturing industries is computed from data on quantities of the goods produced in the industry, each weighted (multiplied) by the employee hours required to produce one unit of each good in a specified base period. Thus, goods requiring 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 using a deflated value technique. The values of shipments from the Census Bureau for a specified composite of products were adjusted for price changes by appropriate producer price indexes and industry sector price indexes to derive real output measures. These, in turn, were combined using fixed period employee hour weights and were adjusted for industry coverage and net changes in inventories for each of the three four-digit industries. The indexes for each four-digit industry are combined using employee hour weights to produce the final output index for the industry group, SIC 244, Wood Containers. Annual indexes are benchmarked to the more comprehensive data available every 5 years in the Census of Manufactures. These procedures result in a final output index that is conceptually close to an index developed using physical quantity data.

Employment and employee hour indexes were derived from BLS data. 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.