Nonwool yarn mills experience slow gains in productivity

During 1958–80, new equipment and techniques aided productivity growth; although the 2.3-percent rate of increase was less than for manufacturing as a whole, it accelerated during the last 8 years of the period

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As measured by output per employee hour, productivity in the nonwool yarn mill industry increased at an average of 2.3 percent during 1958–80, somewhat below the 2.8-percent rate for all manufacturing.[1] (See table 1.) Output increased at an average annual rate of 4.5 percent while employee hours advanced at a rate of 2.1 percent. For the most recent period, 1973–80, productivity has risen at a faster annual rate—averaging 3.0 percent. Improved preparatory and spinning equipment have contributed to these gains.

Growth varied over the period of study. From 1958 to 1965, productivity increased every year, rising at an average annual rate of 5.2 percent. The largest jump occurred in 1961 with a rise of 9.3 percent. The 5.2-percent average gain in productivity reflected an average annual growth of 6.7 percent in output and 1.5 percent in employee hours. Since 1965, productivity gains have slowed considerably. During 1965–73, output per employee hour grew at an average annual rate of only 1.2 percent. Output increased at a 4.6-percent rate—just slightly faster than that of 3.4 percent for employee hours. Productivity movements displayed much year-to-year fluctuation during this time. There were increases in only 5 of 9 years, with the largest—7.1 percent—occurring in 1971.

In contrast to productivity movements for most industries, the growth in this industry accelerated during 1973–80, rising at an average annual rate of 3.0 percent. Output grew at a rate of 2.6 percent, while employee hours declined at a rate of 0.4 percent. Recessionary conditions in the economy in 1974 and 1975 had a strong impact on the trends in output and employee hours. In 1974, the yarn industry began sharp reductions in employee hours, as output fell 3.5 percent. The more than proportional drop in employee hours of 7.9 percent led to a 4.8-percent rise in productivity. In 1975, output posted a further decline of 4.2 percent. In the face of this continuing deterioration in output, employee hours experienced their largest single-year decline in the entire 1958–80 period, 15.7 percent. The resulting productivity increase, 13.6 percent, was the largest of the two-decade period.

Employment and plant size

Total employment in the spun yarn industry increased by more than 28 percent between 1958 and 1980, rising at an average annual rate of 2.1 percent. There were 67,800 employees in 1958, but by 1980 the total had risen to 86,900. However, the increase in employment was not steady; cyclical patterns were evident throughout the period, which were related to trends in the overall economy.

The establishments which produce yarn vary in size but, generally, are rather large. According to the 1977 Census of Manufactures, nearly 40 percent of all establishments employ 100 to 249 employees and these account for more than 30 percent of industry value of

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Table 1. Productivity and related indexes for nonwool yarn mills, 1958–80

[1977=100]

Year	Output per employee hour	Output	Employee hours	Employees
1958	59.5	39.4	66.2	72.9
1959	62.3	44.8	71.9	72.9
1960	65.3	42.5	65.1	68.6
1961	71.4	45.1	63.2	65.6
1962	74.7	48.7	65.2	66.3
1963	76.3	50.3	65.9	66.3
1964	80.6	57.4	71.2	69.1
1965	84.6	66.5	78.6	73.8
1966	81.8	66.7	81.5	78.0
1967	77.5	61.7	79.6	80.1
1968	80.2	68.2	85.0	83.3
1969	84.5	74.4	88.0	89.3
1970	84.3	70.9	84.1	86.3
1971	90.3	82.0	90.8	89.2
1972	91.0	91.2	100.2	96.4
1973	85.0	88.9	104.6	102.7
1974	89.1	85.8	96.3	101.2
1975	101.2	82.2	81.2	87.7
1976	93.5	89.7	95.9	97.7
1977	100.0	100.0	100.0	100.0
1978	104.2	103.8	99.6	100.3
1979	103.9	99.0	95.3	95.8
1980	106.1	97.5	91.9	93.4
Average annual rates of change (in percent)				
1958–80	2.3	4.5	2.1	2.1
1975–80	1.7	3.4	1.7	0.7

shipments. Of the 456 establishments in the industry, almost 20 percent employ 250 to 499 employees and also account for more than 30 percent of total value of shipments. Only about 7 percent of all establishments employ 500 to 999 employees but these produce more than 20 percent of industry value of shipments.

Production workers have always represented a high proportion of total industry employment and that proportion has changed very little over time. In 1958, they accounted for slightly more than 94 percent of total employment and in 1980 their share was still about 92 percent. The proportion of female employees has increased in recent years, rising from approximately 44 percent of the work force in 1972 to 46 percent in 1980.

Average hourly earnings in the spun yarn industry have remained well below those of all manufacturing. In 1972, the first year for which such data are available, average hourly earnings were $2.53, significantly less than the $3.82 for all manufacturing. By 1980, average hourly earnings in the industry had risen about 89 percent to $4.78. However, this was still well below the average for all manufacturing, which was up to $7.27.

Diverse industry markets

Spun yarn is used for the manufacture of the great majority of textile products; household items which contain yarn include carpets and rugs, bedspreads, draperies, and towels. Its demand can be influenced by population changes, housing starts, changes in lifestyle or consumer tastes, and general economic conditions.

Nonwool yarn is purchased by many different manufacturers. Broad woven fabric mills are major users of spun yarn. These mills produce goods made from cotton, synthetic fibers, and silk, such as sheets, pillowcases, draperies, and towels. The firms which use synthetic fibers and silk are the largest purchasers of spun yarn. From 1963 to 1977, purchases by nonwool spinning mills increased nearly 90 percent, but those by broad woven cotton mills changed very little.[2]

Mills which produce knit fabric also account for a large proportion of total spun yarn purchases. These mills knit tubular or flat fabric and dye or finish knit fabric; their output increased rapidly from 1963 forward. This increase in output translated into rising yarn purchases by these mills. It is estimated that between 1963 and 1967, purchases of spun yarn by both circular and warp knit fabric mills increased by approximately 136 percent.

Other types of knitting mills also use spun yarn, including knit outerwear and underwear mills and hosiery mills. The first type manufactures products such as suits, slacks, shirts, neckties, and skirts. Although complete information is not available for all years, estimates indicate that purchases of spun yarn by knit outerwear mills decreased during the 1963–77 period.

Exports have historically accounted for a negligible portion of the total market. In 1979 and 1980, although exports increased rapidly, they only accounted for approximately 2 percent of yarn shipments. Imports have had little impact on the domestic market, making up less than 1 percent of apparent consumption in recent years.[3]

Advances in technology

The production of spun yarn involves a number of different operations. Improvements in technology have taken place at different stages of the production process and have contributed to the industry's overall growth. Much of the advance has resulted from gradual improvements in the equipment over time.

The raw material arrives at the mill as bales. The adoption of automatic bale opening and blending equipment, which eliminates the need for manual performance of this operation, has led to greater efficiency in this initial stage of the production process.

Likewise, improvements have occurred in the carding operation. In it, the fibers of the raw material are made parallel to each other and most of the foreign matter is removed. The fibers emerge in a form known as sliver. Formerly, the yarn entered a picker which formed it into a roll before being fed into the carding machine. However, the introduction of the automatic chute feed which permits the blended fibers to be fed directly into

the carding machine, has eliminated the need for a picker. The carding machinery itself has increased in speed, further contributing to productivity gains.

The drawing and roving operations follow the carding process. The drawing operation makes the slivers more uniform. In the roving process, a twist is imparted to the sliver by the roving frame. This results in greater strength. The product that emerges is known as roving and is wound onto bobbins which are taken up when full. The adoption of larger bobbins has reduced the amount of tending necessary because they do not have to be removed as often. Improved roving equipment has been introduced which is faster and eliminates the need to remove the flyers (which insert twist into the fibers) for doffing (removal of the bobbins).

After the roving operation, the roving bobbin proceeds to the spinning operation. The spinning drafts (draws out) the fibers to size the yarn and puts the desired twist into it, providing necessary strength. Yarn is spun onto bobbins; the use of larger ones on spinning machines has reduced the frequency with which bobbins have to be removed. The introduction of automatic doffing equipment—equipment which removes the full bobbins and replaces them with empty ones—has also improved productivity. Increased operating speed of the spinning equipment itself has also contributed to productivity gains.

After spinning, the yarn is taken to the winding department. Here, winding machines remove the yarn from the spinning bobbins and wind it onto cones for direct customer shipment or onto tubes for dyeing. Automation in winding equipment has taken place and has increased productivity growth immensely.[4]

A number of plants have introduced open-end spinning, which has also aided productivity. This combines into one process the three separate operations of roving, spinning, and winding, thus eliminating the need for a separate roving and winding operation. Open-end spinning can wind the yarn onto a package rather than a spinning bobbin; thus, a separate winding operation to transfer the yarn from the spinning bobbin to a cone is no longer needed.[5]

Capital spending

Rises in labor productivity are frequently linked to increases in capital formation. Data available through 1979 indicate that, over 1958–79 as a whole, current-dollar new capital expenditures rose at an average annual rate of 9.4 percent. However, the advances were not uniform throughout the period, and the most rapid ones took place in the earlier years. From 1958 to 1966, new capital expenditures increased at a 22.1-percent rate. This acceleration in capital spending coincided with rapid productivity growth. During 1958–66, the rate of increase in output per employee hour was 4.6 percent. Both productivity and capital expenditures posted increases in all but one year of the 1958–66 subperiod.

The tremendous growth in capital expenditures during this time caused the ratio of capital expenditures per employee to go up far more rapidly than for all manufacturing. In 1958, capital spending per employee was only $229 in the spun yarn industry, compared with $619 for all manufacturing. However, by 1966, capital spending per employee in the industry had risen to $1,368, compared with $1,112 for all manufacturing.

From 1966–79, the trends in both capital expenditures and productivity were quite different from the preceding years. The rate of increase in capital expenditures declined to 4.9 percent. There were even substantial decreases in a number of years. Productivity growth likewise experienced a slowdown, dropping to an average annual rate of increase of 2.2 percent. As in the case of capital expenditures, there were declines in some years. The decline in the growth rate of capital expenditures caused the rate of increase in the ratio of capital expenditures per employee to fall behind that of all manufacturing. From 1966–79, capital spending per employee in the spun yarn industry advanced at an average annual rate of only 3.0 percent, compared with a rate of 9.2 percent for all manufacturing. Consequently, capital spending per employee was only $1,607 in 1979, compared with $3,118 for all manufacturing.

PRODUCTIVITY SHOULD CONTINUE to increase as improvements in production equipment take place and as more manufacturers take advantage of these. Some of the newer equipment, which embodies more advanced technologies than past models, is capable of producing better quality yarn with fewer imperfections and weak spots. This top quality is increasingly demanded by customers as they adopt higher speed weaving and knitting machinery.[6] This is accelerating the adoption of more modern production equipment by nonwool yarn mills.

Some industry officials expect labor market conditions to provide added stimulus for use of improved production equipment.[7] Relocation of the manufacturing operations of many industries into major textile producing areas exerts additional pressure on existing labor and wages. This, in turn, is impelling more yarn manufacturers to utilize the equipment and techniques which provide the greatest levels of output per employee hour.

Open-end spinning will continue to contribute to productivity gains as it becomes more widely adopted. This form of spinning has a particularly favorable effect on production efficiency because, as noted earlier, it combines the separate operations of roving, spinning, and winding into a single process. □

FOOTNOTES

[1] The nonwool yarn mill industry consists of establishments primarily engaged in spinning yarn wholly or chiefly by weight of cotton, synthetic fibers, or silk. It is designated as industry 2281 in the 1972 Standard Industrial Classification (SIC) Manual. All average annual rates of change are based on the linear least squares trend of the logarithms of the index numbers. Extension of the indexes will appear in the annual BLS Bulletin, *Productivity Measures for Selected Industries.*

[2] The discussion of yarn purchases from nonwool yarn mills by the consuming industries is based on constant-dollar estimates.

[3] *U.S. Industrial Outlook* (U.S. Department of Commerce, 1981), p. 402.

[4] See McAllister Isaacs III, "Winding a 138 Percent Boost in Operator Pounds," *Textile World,* February 1980, pp. 79–82.

[5] See Brenda V. Lloyd, "Meeting the Challenges of Modernization," *Textile Industries,* September 1979, pp. 114–17. Also, see McAllister Isaacs III, "Avondale Open-End Cuts Labor, Ups Output," *Textile World,* May 1980, pp. 63–66.

[6] W. Bud Newcomb, "U.S. Sales-Yarn Firms Are Poised For Future Growth," *Textile World,* September 1980, p. 203.

[7] See Douglas A. Bowen, "Linn-Corriher: Yarn Making Pioneer," *Textile Industries,* March 1980, p. 50. Also, see Joseph L. Lanier Jr., "Plants and Equipment," *America's Textiles,* June 1976, p. 21.

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 some 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.