Productivity trends in the ball and roller bearing industry

During 1958–79, annual productivity increased an average of 2.7 percent, slightly above manufacturing as a whole; increase was linked to the adoption of improved production equipment

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As measured by output per employee-hour, productivity in the ball and roller bearing industry grew at an average annual rate of 2.7 percent during 1958–79, slightly more than the 2.6 percent rate for all manufacturing.[1] This rise was associated with average annual increases of 3.5 percent in output and 0.8 percent in employee-hours. (See table 1.) The adoption of electronic control equipment to run production machinery, coupled with continuing improvements in this machinery, has also been an important factor in the productivity gains in this industry.

The period of 1958–79 was characterized by rapid productivity growth in the early years, followed by slower growth in later years, and most recently, a drop in 1979. From 1958–66, output per employee-hour increased at an average annual rate of 6.2 percent. Output increased at a rate of 10.6 percent, greatly outpacing that of employee-hours, 4.2 percent. During this period, output growth benefitted from a rapid increase in industrial production. Because a wide variety of industrial products utilize bearings, the growth in manufacturing output meant a rising demand for them.

From 1966 to 1979 productivity growth proceeded more slowly than in earlier years, growing at a rate of 1.6 percent annually. During this period, productivity changes experienced several cyclical swings. Productivity declined from 1966 to 1970 at an average annual rate of 0.9 percent, while output decreased at a rate of 3.4 percent, and employee-hours, 2.5 percent. The decline in output reflected the downturn in the economy during 1970, but as the economy recovered, the demand for ball and roller bearings increased rapidly. Productivity advanced continuously from 1970 to 1974, rising at a high average annual rate of 5.8 percent. Output rose at a rate of 8.6 percent, greatly outpacing that of employee-hours, 2.6 percent.

In 1975, however, industry output declined sharply as a downturn in the economy resulted in decreased consumption of bearings. During 1974–75, output dropped by more than 17 percent, which greatly exceeded the decline in employee-hours, and resulted in a 6.4-percent productivity drop.

Productivity growth was resumed gradually after 1975, increasing by only 1.7 percent in 1976 and 1.3 in 1977. However, in 1978, productivity rose by 4.9 percent, but in 1979, it declined 1.6 percent as output growth (4.0 percent) was exceeded by that of employee-hours (5.7 percent).

Numerous industry markets

Bearings are used to reduce the friction between moving parts of machines or various types of equipment. Because so many different products have moving parts, the overall market for bearings is very diverse. Although no individual segment has been predominant in determining output trends, certain types of machinery and equipment have accounted for major shares of the market.

The most significant market for bearings is the motor vehicle and equipment industry. Nearly two-thirds of the domestic consumption of tapered roller bearings, for example, is accounted for by the automotive and related industries.[2] From 1958 to 1978, the output of motor ve-

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Table 1. Productivity and related indexes for the ball and roller bearings industry, 1958–79

[1967=100]

Year	Output per employee-hour			Output	Employee-hours		
	All employees	Production workers	Nonproduction workers		All employees	Production workers	Nonproduction workers
1958	60.8	61.7	57.3	39.8	65.5	64.5	69.4
1959	76.2	73.8	87.0	62.4	81.9	84.5	71.7
1960	74.7	74.3	76.4	57.2	76.6	77.0	74.9
1961	76.8	77.2	75.3	55.4	72.1	71.8	73.6
1962	83.5	82.8	86.7	66.4	79.5	80.2	76.6
1963	84.9	86.1	80.1	68.4	80.6	79.4	85.4
1964	91.4	91.4	91.3	78.0	85.3	85.3	85.4
1965	103.8	102.7	108.4	95.0	91.5	92.5	87.6
1966	104.0	102.6	109.8	106.6	102.5	103.9	97.1
1967	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1968	103.6	106.1	94.6	99.1	95.7	93.4	104.8
1969	101.3	102.9	95.3	101.8	100.5	98.9	106.8
1970	98.6	102.7	85.1	88.7	90.0	86.4	104.2
1971	102.1	107.7	85.0	80.8	79.1	75.0	95.1
1972	113.7	115.8	106.3	96.0	84.4	82.9	90.3
1973	119.4	119.9	117.0	111.5	93.4	93.0	95.3
1974	121.1	122.0	117.8	113.8	94.0	93.3	96.6
1975	113.4	117.5	99.8	94.2	83.1	80.2	94.4
1976	115.3	118.8	103.7	95.5	82.8	80.4	92.1
1977	116.8	120.7	104.1	101.3	86.7	83.9	97.3
1978	122.6	125.9	111.2	107.4	87.6	85.3	96.6
1979	120.6	121.9	115.6	111.7	92.6	91.6	96.6
	Average annual rates of change (in percent)						
1958–79	2.7	2.9	2.0	3.5	0.8	0.6	1.5
1974–79	0.7	0.6	0.7	1.0	0.4	0.4	0.4

hicles and equipment increased at an average annual rate of 5.6 percent and this provided an important source of demand for the output of the bearings industry.

Motor vehicles is not the only transportation related industry which has provided an important end use for bearings. The manufacturers of aircraft, and aircraft engines and equipment consume large quantities of bearings, as does the railroad equipment industry. The current dollar value of bearings purchased in 1977 (the latest year for which data are available) for the production of railroad equipment was nearly nine times the amount purchased in 1958.

The use of bearings in construction machinery has also provided a strong source of demand. Between 1958 and 1977, the value of bearings consumed in the production of construction machinery increased almost seven-fold, reaching nearly $120 million. Other important markets for bearings include farm machinery and equipment and industrial machinery, such as machine tools.

Rising imports have meant heightened competition for domestic markets. The benefits of large production volume possessed by the largest domestic manufacturers are also enjoyed by some foreign producers. For example, SKF of Sweden, produces approximately 20 percent of the world's bearings (including domestic U.S. operations).[3] At least two Japanese companies, Nippon Seiko and NTN Toyo Bearing Company, also have production capacities which rival those of the largest U.S. producers. The market for commodity type bearings (those used in commercial products such as household appliances) has already been deeply penetrated by foreign producers.[4] Imports have captured a rising proportion of the domestic bearings market—about 13 percent in 1978.[5] As imports have increased, some evidence suggests that they are acting as another incentive for domestic producers to continue improving the efficiency of their production facilities.[6]

Employment patterns change

The role of large establishments has diminished from 1958 to 1979, affecting their employment patterns. In 1958, there were 13 establishments with 1,000 employees or more, accounting for 60 percent of the industry's value added. In 1977, the number of this type of establishment dropped to 11, but their share of industry value added had fallen to about 48 percent.

For the period as a whole, employment in the ball and roller bearings industry increased slightly, on an average annual basis, at a rate of 0.6 percent. Employment in 1979 was nearly 59,000 compared with about 44,000 in 1958, with the most rapid growth in the early part of the period. From 1958–66, the average annual rate of increase was 3.3 percent. Employment increased in every year except 1960 and 1961. A large increase, 10.2 percent, took place in 1966, the year which marked the end of the growth trend in industry employment.

During 1966–69, employment remained fairly stable, followed by a decline in subsequent years. Employment decreased at an average annual rate of 0.5 percent from 1969 to 1979. Decreases were recorded in 4 years of this subperiod with the largest decline, 13.4 percent, in 1971.

Nonproduction workers have gradually increased their proportion of total industry employment. During 1958–79, nonproduction workers increased at an average annual rate of 1.4 percent, while production workers increased at a rate of only 0.4. The adoption of improved production equipment has enabled producers to increase output without proportionately increasing production worker employment. However, nonproduction workers have not been as strongly affected by technological advances.

Technology improves

Continual improvements in production equipment have contributed greatly to the industry's productivity gains. Bearings consist of several components—the balls or rollers, the separator which keeps them in place, and an inner and outer ring. The balls (or rollers) are enclosed between the two rings and move within a groove, or raceway, cut into each of the rings. There may also be a seal for the bearing lubricant and some form of handle, or housing, to serve as an attachment.

The balls are given their initial shape in a heading operation where raw material is forced into header dies. The speed of the ball header equipment has been increasing over the years, aiding productivity. The development and adoption of better die materials has extended the life of the dies used in this operation, helping to reduce downtime.

The excess metal remaining on the balls after the heading operation must be removed by soft grinding. The adoption of meehanite plates has increased grinding speed in this operation, and has also eliminated the need for any secondary grinding.

The production of other components, such as the inner and outer rings, has benefitted from changes in the automatic screw machine, which turns out the basic blanks. Mechanical improvements have been incorporated into this machine; the use of increasingly better materials in the cutting tools has led to greater cutting speeds. Improvements in the cutting oils have also increased cutting speeds and have reduced downtime. Many producers have adopted electronic equipment to control the operation of the automatic screw machine. Without such controls, the operator must periodically test blanks for precise size and then stop the machine to make any necessary adjustments, resulting in lost production. Where electronic equipment is used to control the machine, the necessary adjustments are made in a continuous fashion, thus avoiding periodic shutdowns. The electronic controls themselves have been improved over time, reflected in additional productivity gains.

The cutting performed on the blanks by the automatic screw machine may need to be supplemented by a secondary cutting operation, in which screw holes may be drilled or burrs removed from faulty blanks. Better cutting tools and adoption of electronic controls have aided productivity. More sophisticated machines permit additional cutting operations to be carried on simultaneously.

The various bearing components must be subjected to a heat treatment process to develop the necessary hardness. Great improvements in furnaces have increased efficiency in the heat treating operation. Changes in gas burners and electric elements have permitted temperatures to be raised much faster. Improvements in timing and heat controls have also increased the speed with which blanks can be heat-treated. The use of atmosphere-controlled, continuous rotary retort furnaces has enabled producers to harden balls on a continuous flow basis, a step up from earlier batch methods.

After heat treatment, the bearing blanks are tempered to remove the stresses and strains from the steel. Tempering furnaces have been improved in many of the same ways as the heat treatment type, further contributing to productivity gains.

The various bearing components must be ground to extremely precise tolerances. The balls, after being soft ground, must undergo a hard grinding operation, which follows heat treatment. Other components such as the inner and outer rings, must also be precision ground. Advancements in ball handling equipment and in much of the grinding equipment have contributed to productivity gains. Qualitative changes in the grinding equipment itself include improved bearings, gearing, and cutting tools.

Improvements in materials handling equipment such as cranes, forklifts, and conveyors have developed over the years. In addition, the adoption of automatic equipment has helped to increase efficiency in the packaging of the bearings for shipment.

Continued productivity gains likely

Increasing competition from foreign producers is likely to spur domestic manufacturers to strive for further production efficiencies.

More widespread adoption of electronic control equipment should be accompanied by continued mechanical improvements in production machinery. Experimentation by several firms with a new ring-roll forming process may lead to a reduction in machine downtime.[7] This system uses coldforming rather than cutting to make bearing rings.

The current sales boom enjoyed by the industry should mean continued growth in output and possible increases in defense spending could lead to additional output demand. Faced with the prospect of strong markets, some producers have already announced plans for new production facilities. The opening of more modern plants should have a favorable effect on industry productivity. □

——— *FOOTNOTES* ———

[1] The ball and roller bearing industry is composed of establishments primarily engaged in manufacturing ball and roller bearings (including ball or roller bearing pillow blocks, flange, take-up cartridge, and hanger units) and parts. The industry is designated as SIC 3562 in the *Standard Industrial Classification Manual, 1972.* 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 Indexes for Selected Industries.*

[2] "Tapered Roller Bearings and Certain Components Thereof From Japan," (U. S. International Trade Commission, January 1975), p. 6.

[3] "A Low-Profit Boom for Makers of Bearings," *Business Week,* October 1979, p. 160.

[4] "A Low-Profit Boom," p. 160.

[5] *U.S. Industrial Outlook* (U.S. Department of Commerce, 1980), p. 239.

[6] *U.S.,* p. 166.

[7] *U.S. Industrial Outlook* (U.S. Department of Commerce, 1979), p. 251.

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. These procedures result in a final output index that is conceptually close to the preferred output measure.

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, for example, changes in technology, capital investment, capacity utilization, plant design and layout, skill and effort of the work force, managerial ability, and labor-management relations.