

# Productivity gains lukewarm for makers of nonelectric heating equipment

*Increase in output per hour, aided by new technology in metalworking but moderated by stagnant demand, averaged only 1.6 percent a year over the 1972-85 period*

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Productivity, or output per employee hour, in the nonelectric heating equipment industry rose at an average annual rate of 1.6 percent from 1972 to 1985.<sup>1</sup> For all manufacturing, the rate of increase was 2.2 percent. The growth in productivity reflected a negligible decline in output of 0.1 percent per year and a decline in employee hours of 1.7 percent. (See table 1.) Contributing to the rise in productivity for the industry were advances in metalworking, improved plant layout, and increases in capital expenditures per employee.

The productivity trend for the 13-year period examined here was marked by much volatility, rising in 7 years and falling in 6. In general, productivity movements have been influenced by changes in output. For the 1972-76 period, productivity declined at a rate of 0.8 percent, as output dropped 7.2 percent annually. During the 1976-80 period, productivity increased dramatically, rising 2.9 percent a year, as output rebounded to a 10.8-percent annual rate of growth. Since 1980, productivity has varied with underlying movements in output while registering a slight increase of 0.1 percent per year. The following tabulation shows average annual rates, in percent, for periods between 1972 and 1985.

	<i>Output per employee hour</i>	<i>Output</i>
1972-85 .....	1.6	-0.1
1972-76 .....	- .8	-7.2
1976-80 .....	2.9	10.8
1980-85 .....	.1	-4.3

## Industry description

The nonelectric heating equipment industry comprises establishments primarily engaged in the manufacture of heating equipment, including gas, oil, and stoker coal-fired equipment for the automatic use of gaseous, liquid, and solid fuels. Included in the products of this industry are domestic heating stoves, boilers, floor and wall furnaces, solar energy collectors, and oil burners. Production is capital intensive and basically involves the cutting and forming of metal, as well as the welding, brazing, and soldering of components.

The nonelectric heating equipment industry is made up of more than 900 establishments generally characterized as small to medium in size. In recent years, the small to medium establishments have grown in number and relative importance.

In 1982, companies with fewer than 50 employees accounted for 86 percent of all establishments, 29 percent of employment, and 25 percent of sales. In 1972, by compari-

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son, these small companies had accounted for only 70 percent of establishments, 11 percent of employment, and 12 percent of shipments.

For establishments with more than 249 employees, declines were dramatic. From 1972 to 1982, the share of these large establishments dropped from 7 percent to 2 percent of all establishments, while employment fell from 51 to 23 percent and sales declined 49 to 30 percent. Although nonelectric heating establishments could be found in every region of the United States, the leading States in employment were Pennsylvania, California, New York, and Illinois. These States accounted for approximately 35 percent of the industry's employment.

### Output and demand

The growth in output over the entire 1972-85 period has been negligible in the nonelectric heating equipment industry, although output movements have varied significantly from time to time. Industry production has been primarily influenced by residential construction.<sup>2</sup>

From 1972 to 1976, output of the nonelectric heating equipment industry declined at an average annual rate of 7.2 percent. The decrease in demand in this industry was largely a result of a slump in the homebuilding industry as a downturn in housing starts led to a subsequent reduction in the demand for new heating units. Housing starts fell from 2.4 million units in 1972 to 1.5 million units in 1976. The deepest slump occurred in the multifamily homebuilding industry. Rising costs of land, labor, materials, and money, together with high equity requirements and the prospects of low returns in rents discouraged builders from adequately attempting to meet the demand for rental housing.<sup>3</sup>

The late 1970's were years of expansion for the nonelectric heating equipment industry. From 1976 to 1980, output grew 10.8 percent annually as the industry responded to the heating needs of newly built homes. Although failing to reach the peak level of 1972, housing starts increased in the late 1970's and leveled off at 2.0 million units.

Since 1980, production in the nonelectric heating equipment industry has fluctuated with decreases in output in 1981, 1983, and 1985, and increases in output in 1982 and 1984. The underlying causes of the volatility in demand for heating units has been the slowdown in the homebuilding industry in the 1978-82 period, the heating needs created by a 12-percent rise in the value of new construction of nonresidential buildings in 1979 (in constant dollars), and a sharp 60-percent advance in housing starts in 1983. However, with more than three-fourths of the recent addition to the Nation's housing stock occurring in the warm climates of the South and West, the demand for heating equipment has been weak.<sup>4</sup>

### Product mix and relative fuel prices

In addition to residential construction, changes in relative fuel costs and replacement demand have also influenced the

demand for heating equipment.<sup>5</sup> Although demand varied widely for the products of the nonelectric heating equipment industry during the 13 years covered by this study, the middle 1970's were years of growth for the industry. Rising sales of gas-fired products, the introduction of new products, and increased spending on new plant and equipment occurred at the same time that productivity was improving.

The Arab oil embargo led to a sharp rise in the price of oil in the early 1970's. Manufacturers of floor and wall furnaces felt the change in the relative prices of oil and gas when the number of gas-fired floor and wall furnaces shipped in 1976 rose 21.8 percent over 1975, while shipments of oil-fired floor and wall furnaces dropped 22 percent. Although there were some conversions from oil to other fuels, it was not until 1978 and the wide availability of natural gas after a decade of curtailment that the mass conversions began.<sup>6</sup> The market for domestic heating stoves boomed in 1979 with the shipments of gas stoves, 55.4 percent higher than the number of units delivered a year earlier. From 1977 to 1982, gas-fired cast iron boiler shipments grew by 73.8 percent, while boilers fired by other fuels fell 30.3 percent. Depressed by high oil prices and few housing starts in the Northeast, shipments of residential oil burners tumbled 39.7 percent between 1978 and 1982.

By the late 1970's and early 1980's, inflationary activity in oil prices was joined by rapidly rising gas and electric prices, causing consumers to look at alternative fuels such as wood, kerosene, and solar power, as ways to conserve energy. In 1972, 1.3 million domestic heating stoves (representing 8 percent of industry receipts) were shipped, of which 68 percent burned gas. By comparison, in 1985, manufacturers shipped 1 million stoves (representing 15

**Table 1. Productivity and related indexes for the nonelectric heating equipment industry, 1972-85**  
[1977=100]

Year	Output per employee-hour				Employee-hours		
	All employees	Production workers	Nonproduction workers	Output	All employees	Production workers	Nonproduction workers
1972	85.5	86.3	83.7	103.5	121.0	120.0	123.7
1973	85.0	85.0	85.1	109.1	128.3	128.3	128.2
1974	78.9	81.2	73.3	94.5	119.8	116.4	129.0
1975	80.4	85.4	69.2	86.6	107.7	101.4	125.2
1976	84.5	88.3	75.4	80.0	94.7	90.6	106.1
1977	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1978	101.6	101.6	101.5	113.2	111.4	111.4	111.5
1979	95.8	96.8	93.2	115.9	121.0	119.7	124.4
1980	99.7	102.6	92.4	124.2	124.6	121.1	134.4
1981	94.6	103.7	76.2	96.5	102.0	93.1	126.7
1982	102.3	114.0	79.9	100.7	98.4	88.3	126.0
1983	93.2	100.6	77.4	93.4	100.2	92.8	120.6
1984	102.0	110.3	84.6	95.6	93.7	86.7	113.0
1985	97.7	102.9	85.7	92.9	95.1	90.3	108.4
	Average annual rates of change						
1972-85	1.6	2.2	.3	-.1	-1.7	-2.2	-.4
1972-76	-.8	.5	-4.1	-7.2	-6.4	-7.7	-3.3
1976-80	2.9	2.7	3.4	10.8	7.7	7.9	7.2
1980-85	.1	.2	-.3	-4.3	-4.4	-4.6	-4.1

percent of industry receipts), of which 62 percent burned wood, while only 17 percent used gas.

Although used in Florida as early as the 1920's, solar energy caught the interest of consumers in the middle 1970's. In 1974, the first year for which data are available, manufacturers shipped 1.3 million square feet of solar paneling. Increasing at an impressive average annual rate of 43.4 percent for 7 years, sales peaked at 20.1 million square feet of paneling in 1981. From 1981 to 1984, solar paneling shipments declined 6.9 percent per year.

Costly repairs of heating equipment and high utility bills opened up a whole new market for the nonelectric heating equipment industry in the early 1980's. Consumers developed a willingness to pay more for higher efficiency, beginning with heating units using less energy in new homes, and subsequently, using more efficient units to replace inefficient ones in good working order. In recent years, an estimated 80 percent of residential oil burners shipped have been retention head or other energy efficient units installed to replace burners using excessive amounts of energy. Much of the boiler market is also for replacement units.<sup>7</sup>

### Employment and hours

Employment in the nonelectric heating equipment industry numbered 24,000 in 1985, having fallen at a rate of 1.6 percent per year, from the 1972 level of 30,900. Employee hours declined at a slightly faster 1.7-percent average annual rate. The decrease in industry employment was larger for production workers than for nonproduction workers. Between 1972 and 1985, production worker jobs declined 25.9 percent, while nonproduction worker jobs fell 13.5 percent.

Over the period studied, trends in employee hours displayed patterns of expansion and contraction similar to those noted for output. From 1972 to 1976, employee hours fell at an average annual rate of 6.4 percent. They rose sharply from 1976 to 1980, but between 1980 and 1985, employee hours again declined at an annual rate of 4.4 percent.

Production workers accounted for 68 percent of the nonelectric heating equipment industry work force in 1985, compared with 71 percent in 1972. Although data on the employment of women, and the skill composition of the work force are not available for the industry, data are available for the plumbing and heating equipment industry to which the nonelectric heating equipment industry belongs. (The nonelectric heating equipment industry represents about one-half of the work force of the plumbing and heating equipment industry.)<sup>8</sup> In the plumbing and heating equipment industry, women composed 25 percent of the industry employment in 1985, compared with 18 percent of industry employment in 1972. The proportion of female employees found in the plumbing and heating equipment industry is similar to that in the total durable goods industry.

Skill composition of the work force of the plumbing and heating equipment industry differs from that for manufactur-

ing as a whole. In 1984, operatives and assemblers accounted for 42 percent of industry employment, compared with 35 percent for all manufacturing. Managerial, technical, and professional personnel composed 18 percent of the industry work force, versus 21 percent of all manufacturing employment. Craft and related workers made up 13 percent of industry employment, compared with 15 percent for all manufacturing. However, administrative, sales, and support staff accounted for 17 percent of both industry and all manufacturing employment.

Average hourly earnings in the nonelectric heating equipment industry rose from \$3.61 in 1972 to \$8.52 in 1985. Hourly wages were somewhat higher in durable goods manufacturing, registering \$4.07 in 1972 and \$10.10 in 1985.

### Investment in plant and equipment

Measured in constant dollars,<sup>9</sup> the nonelectric heating equipment industry's capital expenditures declined slightly at an average annual rate of 0.2 percent from 1972 to 1985. In contrast, real capital spending of all manufacturing industries rose 2.4 percent annually between 1972 and 1985.

The largest decline occurred from 1972 to 1976 when investments in plant and equipment by firms in this industry fell at an average annual rate of 17.9 percent. During the same years, all manufacturing industries increased their capital expenditures 4.8 percent per year. From 1976 to 1980, however, capital spending rebounded in the industry, growing 15.4 percent annually. After 1980, capital spending slowed throughout the manufacturing segment of the economy and fell 0.3 percent per year in the nonelectric heating equipment industry.

While real capital expenditures declined slightly in the nonelectric heating equipment industry, there was an increase in real capital spending per employee. Real capital expenditures per employee in the industry rose 1.4 percent per year from 1972 to 1985. For all manufacturing establishments, the comparable figure was 2.4 percent. From 1972 to 1976, capital spending per employee by the nonelectric heating equipment industry fell at an average annual rate of 12.5 percent. From 1976 to 1980, industry capital expenditures per employee grew at an average annual rate of 6.7 percent, faster than the 3.2-percent growth rate registered by all manufacturing industries. This was also the period of greatest productivity growth experienced by the industry. Capital spending per employee continued to rise in the 1980's.

### Technology

Productivity has been aided by improvements in metalworking equipment which have taken place in the sheet metal operations of the nonelectric heating equipment industry.<sup>10</sup> The broadest improvement has occurred in metal fabrication. The straightening, cutting, and bending of rolled steel previously performed by manual labor is increasingly being done by machinery. The basic metalworking equip-

ment is the production press which makes use of power-operated clamps to close one or more dies at a proper speed and pressure. The dies with which a press is equipped shear or bend the sheet metal forming the desired shape. The metal is generally worked cold. The die may be single purpose, as when a workpiece is simply cut or shaped, or it may be progressive. Progressive dies, consisting of multiple work stations, subject the workpiece to several sequential strokes or punches. In such operations, the steel is usually fed automatically from coils through the multiple work stations as a continuous ribbon of material up to the last station of the die, where the part is sheared off. The installation of labor-saving progressive dies is just beginning to take place in the more advanced and larger shops in the industry. Manual feeding of steel remains prevalent in the smaller shops.<sup>11</sup>

However, the nonelectric heating equipment industry is characterized by a large number of small establishments, utilizing a sizable inventory of older dies.<sup>12</sup> These older dies must be bolted into the press and transported by crane or forklift. While the small shops in the industry may not have had the resources to install progressive dies in the production process, they have been able to raise labor productivity by taking advantage of more modest improvements in metalworking.

Some shops have raised productivity by improving the punching of sheet metal. Previously, templates were conventionally affixed to the punch press. Presently, computer taped instructions are fed to the press, speeding production and ensuring greater quality control in the finished shape. Another improvement has been the adoption of a multiple spindle drill by some shops. This high capacity drill is able to bore multiple holes through several planes of sheet metal in one operation. Productivity in many shops has been increased by replacing stick welding with automatic wire-feed welding. In addition to improvements in metalworking technology, reorganization of floor space has boosted productivity in some of the establishments of the nonelectric heating equipment industry.

### Age of equipment

Despite the technological advances described here, the nonelectric heating equipment industry retains a large investment in older machinery that has been rebuilt many times! According to the most recent *American Machinist* inventory of metalworking equipment, taken in 1983, 28 percent of the metalcutting and 16 percent of the metalforming tools used in the plumbing and heating equipment industry were less than 10 years old.<sup>13</sup> In 1973, the proportion of tools under 10 years of age was 24 percent for metalcutting tools and 23 percent for metalforming tools.<sup>14</sup> The industry has reduced the age of its metalworking equipment, increasing the proportion of newer metalcutting tools between 1973 and 1983. Although the proportion of newer metalforming equipment has declined, two observations should be noted.

First of all, industry metalcutting tools outnumbered metalforming tools by more than 2 to 1 in 1973, and continued to do so in 1983. Secondly, metalforming tools tend to have a longer life than metalcutting tools. Thus, they need to be replaced less often.

Included in the metalworking equipment under 10 years of age are increased numbers of numerically controlled machine tools. The efficiency of the plumbing and heating equipment industry's metalworking equipment has been augmented by the rise in the number of numerically controlled machine tools. In 1983, numerically controlled machine tools accounted for 7 percent of the metalcutting tools and 9 percent of the metalforming tools that were under 10 years old. In 1973, the corresponding figures were 2 percent and 2.5 percent. The percentage increase in numerically controlled tools understates the increase in the output capabilities of these machine tools. The *American Machinist* cites the "vastly increased productivity of NC [numerically controlled] machines as compared with their manually controlled equivalents."<sup>15</sup>

The higher end of the age distribution of metalworking equipment shows almost no change in the proportion of older metalworking equipment in the industry. The share of metalcutting machine tools 20 years or older rose from 41 percent in 1973 to 42 percent in 1983. The proportion of metalforming equipment 20 years or older remained unchanged at 43 percent between 1973 and 1983. Furthermore, the older tools cannot be readily judged inefficient, because the *American Machinist* inventory does not take into account the retrofitting of older machines with up-to-date components and control devices.<sup>16</sup>

The number of machine tools in all metalworking industries declined from more than 15 per 1,000 persons in the U.S. population in 1973 to less than 10 per 1,000 persons in 1983. The *American Machinist* states that "this represents in part the greater productivity of machine tools, in part the simplification of design of many products, so that less machining is required."<sup>17</sup> This statement also applies to the industry studied here. Between 1973 and 1983, the number of machine tools in the industry fell by more than a third, and capacity utilization rates in the nonelectric heating equipment industry declined. During this same period, the output of the nonelectric heating equipment industry remained virtually unchanged, indicating a substantial rise in the output capability of its metalworking equipment.

### Outlook

*Equipment.* Moderate improvement in productivity is indicated for the nonelectric heating equipment industry.<sup>18</sup> Diffusion of the more efficient metalworking machinery and metal fabrication techniques throughout the industry is far from complete. Furthermore, competition with foreign manufacturers may force domestic producers of heating equipment to look for ways to improve productivity. In 1972, less than 1 percent of the new supply (domestic production plus

imports) of nonelectric heating equipment in the United States was imported. By 1981, the latest year for which data are available, imports had risen to more than 7 percent of the new supply of nonelectric heating equipment. During the same years, the percent of domestic production exported changed little, hovering around 6 percent.<sup>19</sup>

Numerically controlled machine tools are expected to become more widely used in the nonelectric heating equipment industry, either as replacements of obsolete equipment or through retrofitting of older equipment. Numerical control enhances managerial control by predetermining and coding every stage of machining onto a control tape. Managers can plan more accurately such operations as machine loading and shop scheduling. Numerically controlled tools can produce parts with greater precision and uniformity, saving machine time and minimizing scrap losses.

Further into the future of the industry may be the installation of computer numerical control machine tools. Software advances make it possible for a computer to convey numerical data directly to a machine control unit, eliminating the problem of constant redoing of the control tape of numerically controlled tools.

Going beyond computer numerical control tools are computer-aided design and computer-aided manufacture systems. These systems use computer-controlled methods to unite several technologies. Computers are used in developing designs of products, guiding workpieces among machines on computer controlled material handling systems, and directing numerically controlled machine tools.<sup>20</sup>

The major reason for the lack of diffusion of the newer technologies throughout the nonelectric heating equipment industry is expected to be the low level of demand for many of the industry's products. The overall weakness and volatility of demand for the industry's products may make the risk of investment too great, particularly for the many small shops.

*Employment.* The skill composition of the work force of the plumbing and heating equipment industry is not expected to change much over the next decade. Based on Bureau of Labor Statistics projections, the proportion of craft and related workers and the proportion of operatives and assemblers are expected to remain unchanged. Managerial, technical, and professional personnel are projected to grow from 18 percent of industry employment in 1984 to 19 percent of industry employment in 1995. The proportion of the industry work force employed as administrative, sales, and support staff is expected to fall from 17 percent in 1984 to 16 percent in 1995.

Average labor costs in the industry have fallen from 33 to 27 percent of total costs during the period of this study, and this trend is expected to continue. Projections indicate that the plumbing and heating equipment industry will have an increased reliance on managers and engineers in designing and monitoring more efficient production processes.<sup>21</sup> One industry source predicts that the machine operator of today will become a manager of several machines in the future. □

— FOOTNOTES —

<sup>1</sup> The nonelectric heating equipment industry is designated by the Office of Management and Budget as sic 3433 in the *Standard Industrial Classification Manual, 1972*. This industry comprises establishments primarily engaged in the manufacturing of heating equipment including gas, oil, and stoker coal fired equipment for the automatic utilization of gaseous, liquid, and solid fuels. Products include cast iron heating boilers, cast iron radiators, cast iron convectors, domestic heating stoves, steel heating boilers, floor furnaces, wall furnaces, and solar energy collectors. Also found among the primary products of the industry are duct furnaces, unit heaters, infrared heaters, mechanical stokers, oil burners, gas burners, heat transfer coils, range boilers, expansion tanks, hot water storage tanks supplied by separate heaters, unit ventilators, and nonelectric prefabricated metal fireplaces. Excluded from this industry are establishments primarily engaged in the manufacturing of electric heating equipment, warm air furnaces, cooking stoves, industrial process furnaces, industrial process ovens, industrial, power and marine boilers.

Average annual rates shown in the text and tables are based on the linear least squares trend of the logarithms of the index numbers. The indexes for productivity and related variables are updated annually, and published in *Productivity Measures for Selected Industries and Government Services*, Bulletin 2296 (Bureau of Labor Statistics, November 1987).

<sup>2</sup> "Statistical Panorama," published each April by the *The Air Conditioning, Heating, and Refrigeration News*.

<sup>3</sup> "The Homebuilders Clutch at Hope," *Business Week*, February 2, 1976, pp. 14-15.

<sup>4</sup> U.S. Department of Commerce, Bureau of the Census, Construction Reports, Series C20 and C30.

<sup>5</sup> "Statistical Panorama".

<sup>6</sup> *Ibid.*, and industry sources.

<sup>7</sup> *Ibid.*, and industry sources.

<sup>8</sup> Figures cited in this section are based on data developed by the Bureau of Labor Statistics.

<sup>9</sup> Capital expenditures were deflated by the implicit price deflator for producers' durable equipment, as published in *The Economic Report to the President*, transmitted to the Congress, January 1987, p. 248, table B3.

<sup>10</sup> Industry sources. See also Horst Brand and Clyde Huffstutler, "Productivity in making air conditioners, refrigeration equipment, and furnaces," *Monthly Labor Review*, December 1984, pp. 11-17.

<sup>11</sup> Industry sources. See also Horst Brand and Clyde Huffstutler, "Trends in labor productivity in metal stamping industries," *Monthly Labor Review*, May 1986, pp. 13-20.

<sup>12</sup> Industry sources.

<sup>13</sup> "The 13th American Machinist Inventory of Metalworking Equipment 1983," *American Machinist*, November 1983, pp. 113-144.

<sup>14</sup> "The 11th American Machinist Inventory of Metalworking Equipment 1973," *American Machinist*, October 29, 1973, pp. 143-166 and "Corrections to the 11th Inventory Summary," *American Machinist*, November 26, 1973, p. 58.

<sup>15</sup> "The 11th . . . Inventory of Metalworking Equipment," p. 162.

<sup>16</sup> Brand and Huffstutler, "Productivity in making air conditioners, refrigeration equipment, and furnaces," p. 14.

<sup>17</sup> "The 13th . . . Inventory of Metalworking Equipment," p. 123.

<sup>18</sup> The Office of Economic Growth and Employment Projections of the Bureau of Labor Statistics has projected a 2.6 percent annual growth rate for productivity in the plumbing and heating equipment industry for 1985-2000.

<sup>19</sup> Figures cited in this section are based on data developed by the Bureau of Labor Statistics.

<sup>20</sup> Industry sources. See also A. Harvey Belitsky, "Technology and Labor in Metalworking Machinery," *Technology and Labor in Four Industries*, BLS Bulletin 2104 (Bureau of Labor Statistics, 1982) and "Adopting Factory Automation," *American Machinist*, December 1985, pp. 88-90.

<sup>21</sup> Figures cited in this section are based on data developed by the Bureau of Labor Statistics.

## 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. 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 for production are given more importance in the index. Often, however, as an alternative, unit value weights are used when unit labor requirement weights are not available.

Because neither unit labor nor unit value weights are available for all of the industry's products, an alternative technique was used to derive the output index for this industry. Therefore, real output for the industry was estimated by a "deflated" value technique. Changes in price levels were removed from current-dollar values of production by means of appropriate price indexes at various levels of subaggregation for a variety of products in the group. To combine segments of the output index into a total output measure, employee hour weights relating to the individual segments

were used, resulting in an output index that is conceptually close to the preferred output measure.

The annual output index series derived from the earlier discussed deflated value technique was then adjusted (by linear interpolation) to the index levels of the "benchmark" output series. This benchmark series (also utilizing the deflated value technique) incorporates more comprehensive but less frequently collected economic census data.

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

The average annual rates of change presented in the text are based on the linear least squares trend of the logarithms of the index numbers. Extensions of the indexes will appear annually in the BLS bulletin, *Productivity Measures for Selected Industries and Government Services*. A technical note describing the methods used to develop the indexes is available from the Office of Productivity and Technology, Division of Industry Productivity and Technology Studies.