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FEDERAL RESERVE BANK OF CLEVELAND

MANUFACTURING ACTIVITY IN METROPOLITAN AREAS

(Fourth District)

A recent article in the *Review* discussed the use of electric power as an indicator of manufacturing activity in the Fourth District.¹ Two significant characteristics of the District's manufacturing activity were identified in that article: (1) short-run fluctuations in manufacturing activity are more pronounced in the District than in the nation because of the preponderance of durable goods industries in the District; and (2) since the 1957-59 period, activity of the manufacturing sector has grown less in the District than in the

nation, although the gap apparently has narrowed somewhat since early 1963.

In this article, electric power data are used to develop patterns of manufacturing activity in seven metropolitan areas of the Fourth District. In conjunction with other economic times series, such as bank debits, employment, payrolls, retail sales, and construction activity, the weighted electric power indexes are useful in taking the pulse of local business conditions.²

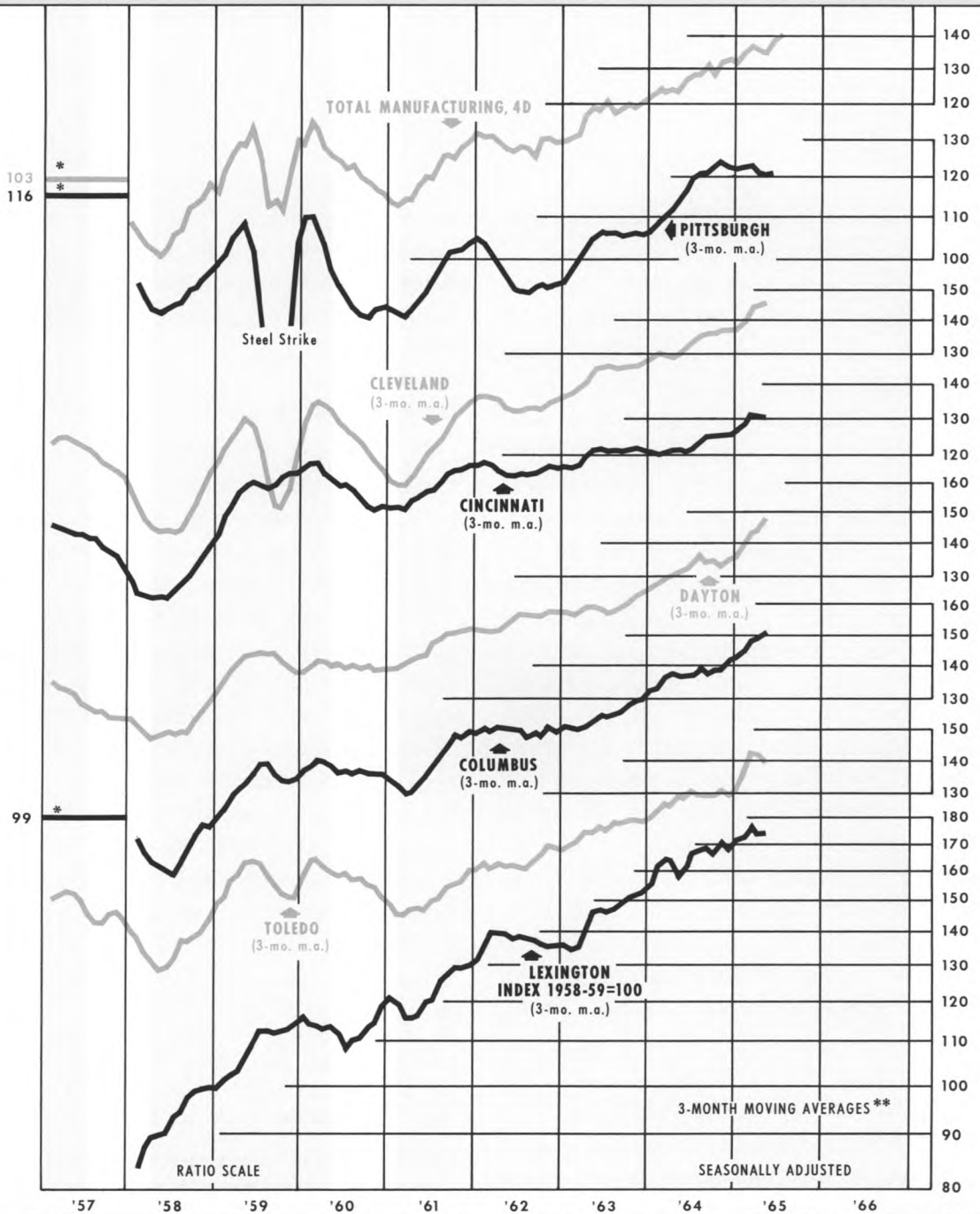
²To correct for differences between an industry's electric power consumption and its contribution to final output, the electric power indexes have been weighted by a measure of value added per kilowatt hour of electricity used in each major industry.

¹ See "Electric Power — An Indicator of Manufacturing Activity," *Economic Review*, Federal Reserve Bank of Cleveland, August 1965.

MANUFACTURING ACTIVITY in SELECTED METROPOLITAN AREAS

FOURTH DISTRICT

INDEX 1957-59=100



* Horizontal line represents annual average
Source of data: see appendix

** Except Total Manufacturing, 4D plotted monthly

For the most part, cyclical fluctuations in local manufacturing activity can be explained by the composition of an area's industrial activity, that is, by the distribution of durable and nondurable manufactures and by the relative roles and performance of individual industries. As a general matter, areas with large shares of durable goods production undergo wider fluctuations in manufacturing activity than areas with large shares of nondurable goods production.

On the other hand, growth rates of manufacturing output in the metropolitan areas, as implied by the electric power indexes, are more difficult to explain. If the use of electric power per unit of output within each industry has remained unchanged since the base period, the electric power indexes would measure an area's growth rate. Growth of the manufacturing sector then could be explained by market demands for the area's products. But constant ratios of electric power consumption to output for individual industries cannot be assumed. Consequently, the accuracy of the electric power indexes in measuring growth rates of metropolitan areas cannot be established, at least at this point. Nevertheless, employment trends in the metropolitan areas discussed in this article suggest that the electric power indexes do provide a rough guide in assessing rela-

tive growth patterns. It should be remembered, however, that the major job of the indexes is to indicate direction and magnitude of short-run changes in manufacturing activity.³

OVERALL PERSPECTIVE

As illustrated in Chart 1, the Fourth District index of manufacturing activity provides a frame of reference for examining differences in cyclical patterns and in growth trends among the seven metropolitan areas.⁴ It is obvious that the individual areas experience changes in manufacturing activity of unequal magnitude and duration. Differences in levels of manufacturing activity, both among the metropolitan areas and with respect to the entire Fourth District, also indicate dissimilar growth rates. Pittsburgh, Cleveland, and Toledo are areas that have been most vulnerable to business recessions and to slowdowns in general economic activity. The Lexington, Columbus, and Dayton areas have expanded at a pace above the average for the Fourth District.

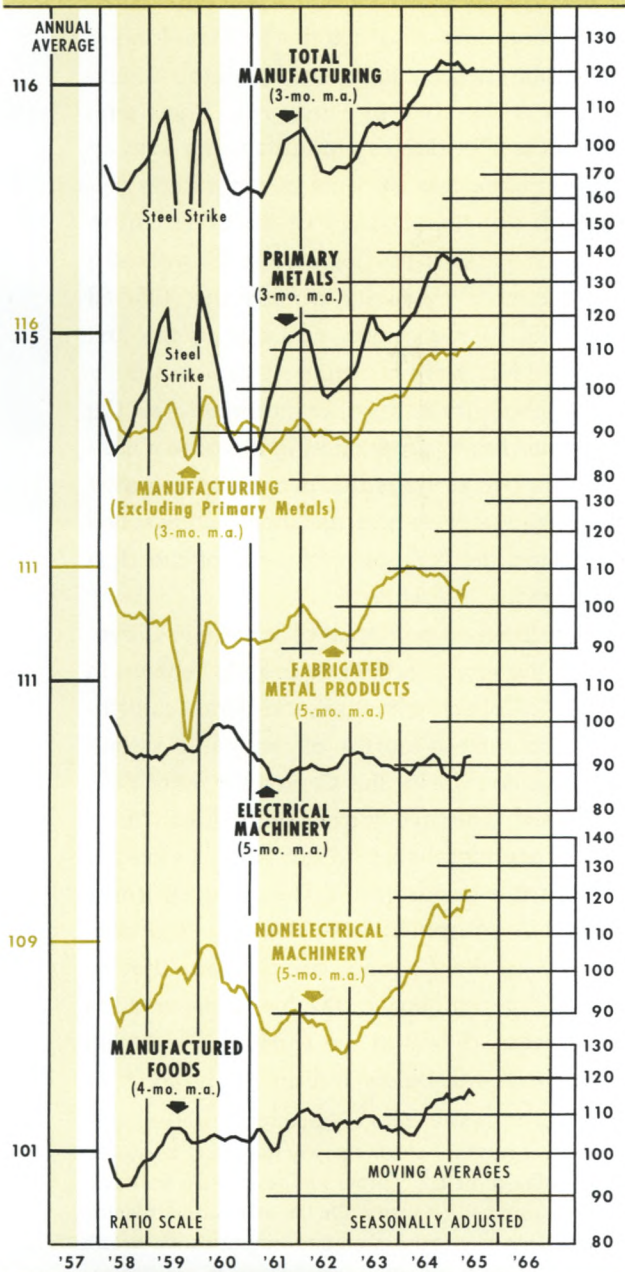
³ All subsequent references to cyclical fluctuations and growth trends are in terms of the *changes associated with the use of electric power*.

⁴ Because a ratio scale is used for the chart, equal vertical distances measure equal percentage changes.

2.

MANUFACTURING ACTIVITY in PITTSBURGH
By Industrial Groupings and Major Industries

INDEX 1957-59=100



Source of data: see appendix

PITTSBURGH

Among the District's metropolitan areas, Pittsburgh has the highest concentration of total manufacturing employment in durable goods industries (84 percent in 1964). Pittsburgh has also experienced the widest fluctuations in manufacturing activity. The volatile primary metals industry, which accounts for approximately 45 percent of Pittsburgh's manufacturing employment, is largely responsible for the magnitude of the swings in the area's manufacturing output (see Chart 2).⁵

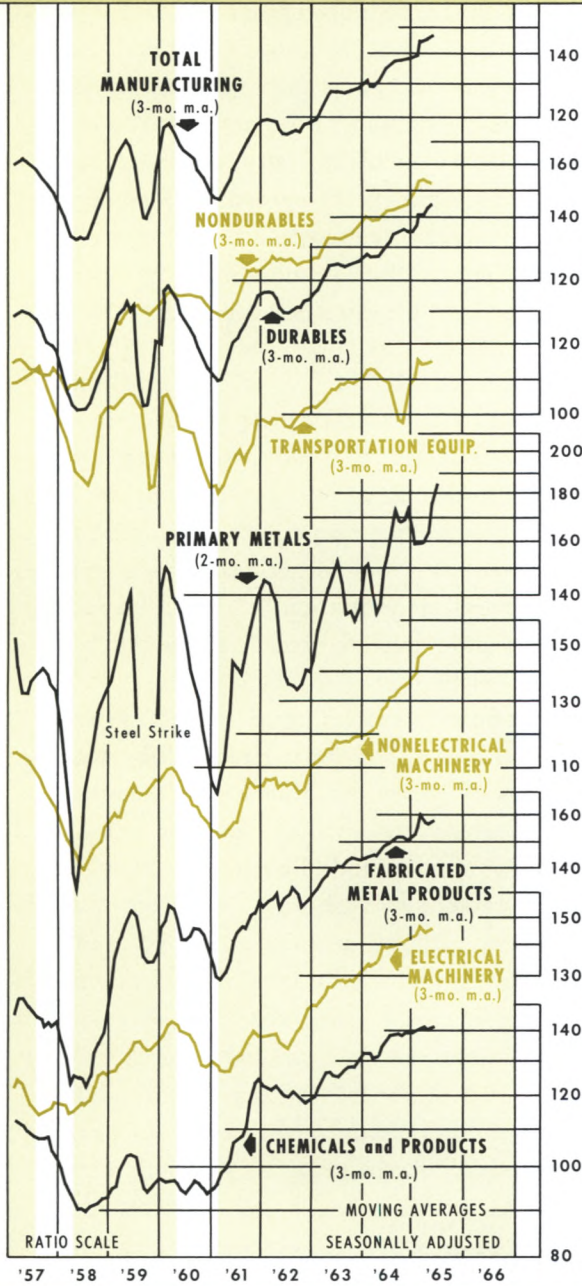
The relatively slow growth of Pittsburgh, while attributable in part to the primary metals industry, can be ascribed mainly to "all other" manufacturing industries. Although manufacturing activity excluding primary metals has undergone considerable improvement since the end of 1962, the index shows little overall growth since the base period of 1957-59.

Pittsburgh's second, third, and fourth largest durable goods industries — fabricated metals, electrical machinery, and nonelectrical machinery — account for one-fourth of the area's value added by manufacture. The improvement in Pittsburgh's index for manufacturing activity excluding primary metals during the past two-and one-half years stems largely from the dramatic gains registered by the nonelectrical machinery industry. The other two major industries have not shown comparable records, as indicated in Chart 2. Pittsburgh's major nondurable goods industry, manufactured foods, has contributed little to the growth of the area's manufacturing sector.

⁵ See appendix for a chart on ingot production and electric power consumption of the steel industry in Pittsburgh.

3.

MANUFACTURING ACTIVITY in CLEVELAND
By Industrial Groupings and Major Industries
INDEX 1957-59=100



Source of data: see appendix

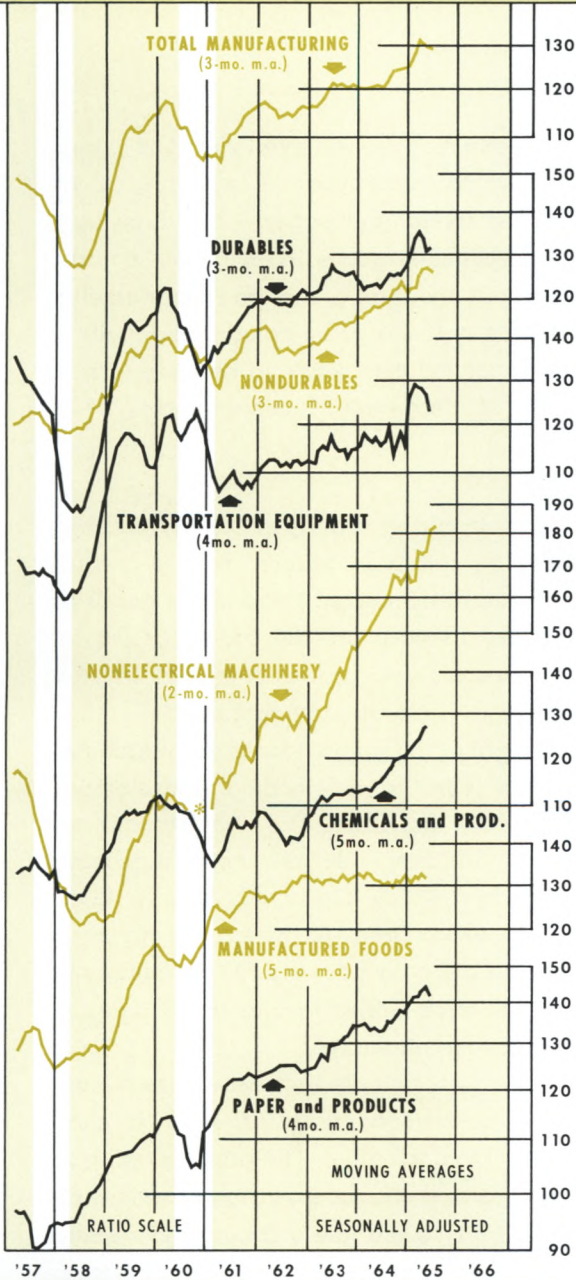
CLEVELAND

Cleveland also has a large concentration of manufacturing employment in durable goods production (about 75 percent). However, manufacturing activity in Cleveland is not dominated by the primary metals industry, as is the case in Pittsburgh. Short-term swings in Cleveland's manufacturing activity are therefore less extreme in magnitude (although not necessarily in duration) than those in Pittsburgh. Declines in Cleveland's manufacturing activity during the 1957-58 and 1960-61 recessions, and during the first half of 1962, were attributable almost totally to the behavior of durable manufactures. On the other hand, production in the area's non-durable goods industries is more stable over the business cycle and, as Chart 3 shows, has exceeded the long-term growth of the durable goods industries.

The direction and pace of activity in Cleveland's six major industries are also shown in Chart 3. Collectively, these industries contribute about three-fourths of the value added by manufacture in the Cleveland metropolitan area. The five largest industries, all of which are metalworking activities, belong to the durable goods group. The index for transportation equipment has close *cyclical* conformity to the national counterpart, that is, the FRB production index for transportation equipment, although the *trend* in Cleveland activity is well below that in the nation.⁶ As

⁶ Bureau of Census data on production worker man-hours suggest that electric power data may be understating the growth of output in Cleveland's transportation equipment industry. On the other hand, electric power data may be overstating output in the area's primary metals industry — partly due to greater reliance on electric furnaces for steel processes. In both cases, further analysis is obviously necessary.

4. **MANUFACTURING ACTIVITY in CINCINNATI**
 By Industrial Groupings and Major Industries
 INDEX 1957-59=100



*Data not available
 Source of data: see appendix

shown in Chart 3, the primary metals industry has displayed wide and erratic swings in activity rates.⁷ Activity in Cleveland's metal fabricating and machinery industries has moved steadily upward since the latter part of 1962, when the climate for capital spending generally turned more favorable.

Chemicals and allied products, Cleveland's major nondurable goods industry, accounts for roughly one-fourth of nondurable manufactures. Most of the short-term changes in the area's nondurables sector are attributable to fluctuations in the chemicals industry.

CINCINNATI

In the Cincinnati area the durable-nondurable shares of manufacturing are more evenly distributed than either in Pittsburgh or in Cleveland (58 percent of Cincinnati's manufacturing employment in 1964 was in durable manufactures). The greater stability of manufacturing activity in Cincinnati thus reflects the behavior of the more stable nondurable goods industries in the area.

The two major durable goods industries, transportation equipment and nonelectrical machinery, account for 17 percent and 8 percent, respectively, of the area's value added by manufacture. The transportation equipment industry, almost half of which consists of firms producing aircraft and aircraft components, has contributed little to the growth of manufacturing activity in Cincinnati. By contrast, the area's nonelectrical machinery industry, much of which is machine

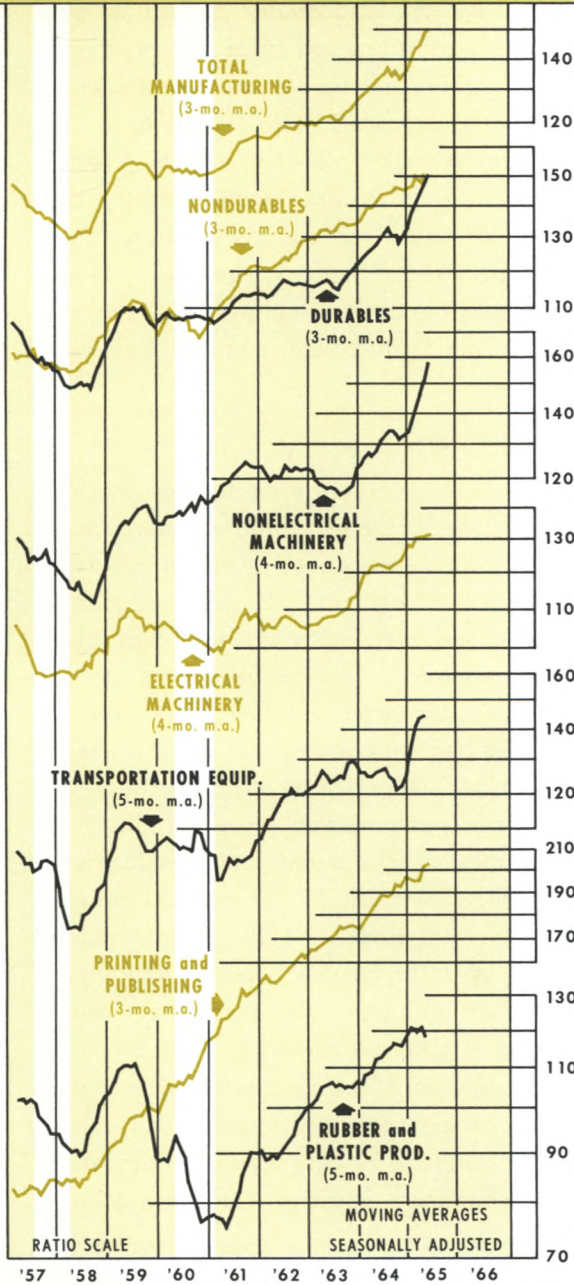
⁷ See appendix for a note on seasonal patterns in the primary metals industry.

5.

MANUFACTURING ACTIVITY in DAYTON

By Industrial Groupings and Major Industries

INDEX 1957-59=100



Source of data: see appendix

tool production, has enjoyed vigorous expansion during recent years. Chemicals, manufactured foods, and paper — the three largest nondurable goods industries — contribute about one-third of the area's manufacturing output. It should be noted that activity in the paper industry tends to precede turning points of the general business cycle.

DAYTON

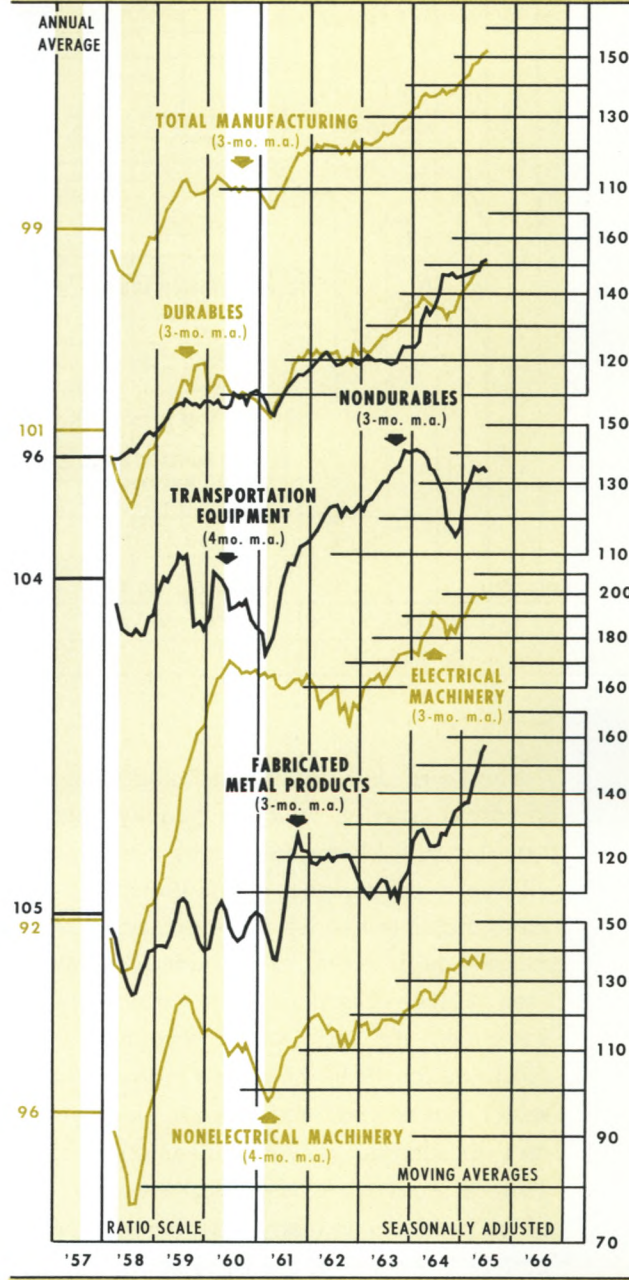
Manufacturing activity in Dayton has tended to be relatively stable, despite a fairly large share (68 percent) of durable goods industries. In addition, the index for Dayton indicates a faster growth rate than those of the three areas already discussed.

Roughly half of Dayton's manufacturing activity is in the nonelectrical and electrical machinery industries. The nonelectrical machinery industry — largely office machinery production — has displayed a more favorable growth trend. At times, the divergent patterns of behavior in the two machinery industries have helped to smooth the index for durable manufactures.

Patterns of activity in the area's two major nondurable goods industries stand in sharp contrast to each other. The printing and publishing group has shown virtually continuous expansion, while the rubber and plastics group has experienced cyclical fluctuations of considerable magnitude.

6.

MANUFACTURING ACTIVITY in COLUMBUS
 By Industrial Groupings and Major Industries
 INDEX 1957-59=100

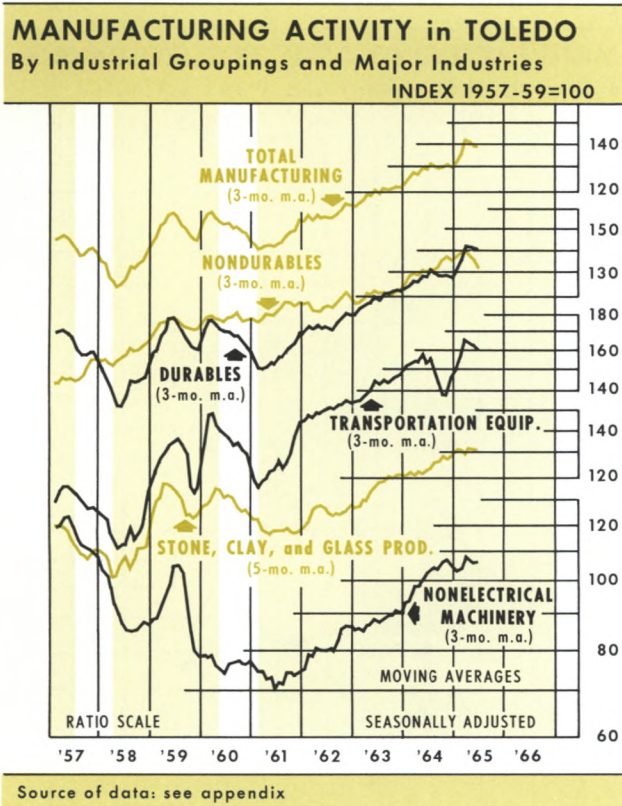


Source of data: see appendix

COLUMBUS

Both the cyclical swings and rate of growth of manufacturing activity in Columbus closely resemble patterns for Dayton. The durable goods share of total manufacturing employment in Columbus (71 percent in 1964) is also similar to the proportion for Dayton. In Columbus much of the short-term variation in durable goods manufacturing activity is attributable to the area's major industry, transportation equipment. The favorable growth of manufacturing activity in Columbus stems largely from the area's second major industry, electrical machinery, where both employment and electric power consumption have more than doubled since 1958. Also included in Chart 6 are indexes for the other important durable goods industries in Columbus, fabricated metal products and non-electrical machinery.

7.



TOLEDO

Short-term fluctuations in Toledo's manufacturing activity, which is heavily concentrated in durable manufactures, are virtually all due to the durable goods industries. The three major industries in Toledo account for roughly half of the value added by manufacture (see Chart 7). The transportation equipment industry, which accounts for almost one-fourth of the area's manufacturing sector, has scored large gains in employment and in electric power consumption since 1957-59. Activity in Toledo's stone, clay, and glass products industry has been approximately in step with the pace set by the national counterpart. Activity in Toledo's non-electrical machinery industry, which sus-

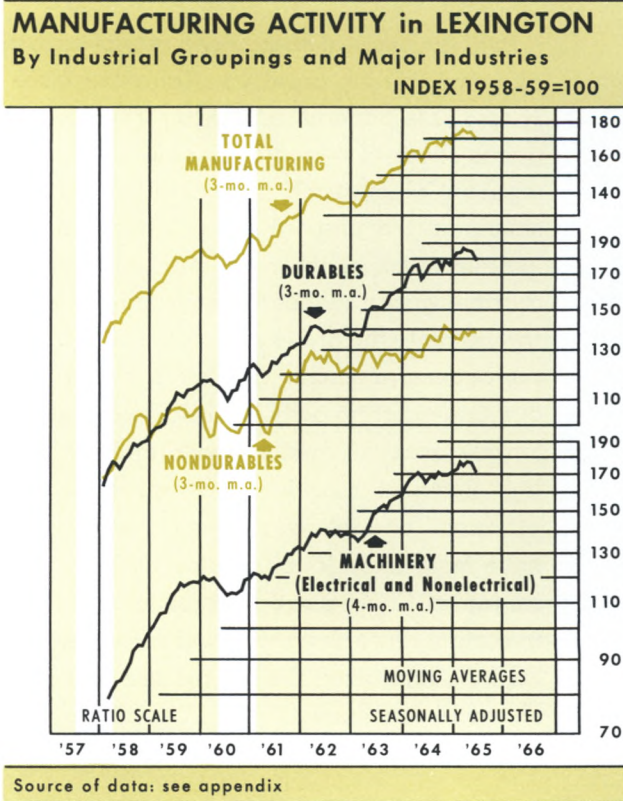
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tained heavy losses in late 1959 and during the early 1960's, has recovered considerable ground during recent years.

LEXINGTON

The growth of manufacturing activity in Lexington stands in sharp contrast to all other Fourth District metropolitan areas (see Chart 8). Roughly half of manufacturing employment in Lexington is in the two machinery industries, nonelectrical and electrical. It is clearly the activity of those industries that is largely responsible for the area's rapid growth. Production in the nonelectrical machinery industry, which is the larger of the two, consists mainly of office machinery and equipment. Most of Lexington's nondurable manufactures is in the tobacco processing, apparel, and manufactured foods industries.

8.



APPENDIX

The geographical areas of the Fourth District centers discussed in this article are not coterminous with the definitions established by the U.S. Bureau of the Census for standard metropolitan statistical areas. The accompanying map shows the geographical coverage of each metropolitan area's index.

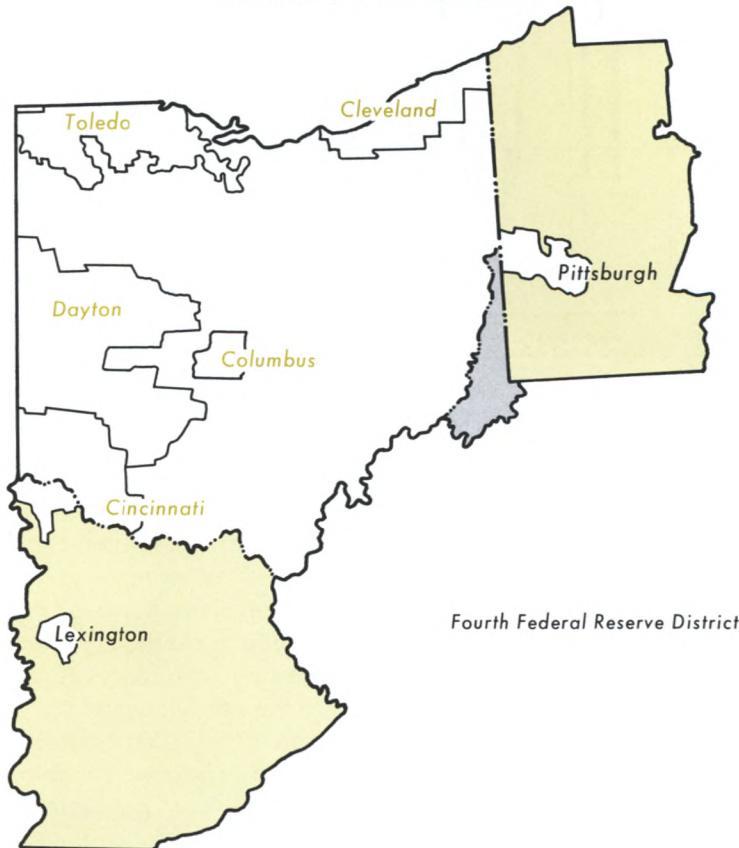
The electric power data used to construct the indexes are supplied to the Federal Reserve Bank of Cleveland by the investor-owned utilities serving each area and by manufacturing establishments that generate electric power for their own use.

It should be noted that there are special problems in determining appropriate sea-

sonal adjustments for electric power consumption (or production) in the primary metals industry. Wide fluctuations of activity in the steel industry, which in large part reflect periods of steel inventory accumulation and liquidation associated with the uncertainties of labor negotiations, tend to distort the "true" seasonal pattern. Therefore, the seasonally adjusted indexes for the primary metals industry, particularly in Pittsburgh but also in Cleveland, should be interpreted with discretion.

Fortunately, the steel industry is one of the few major industries for which output data, in physical units, are available. For that rea-

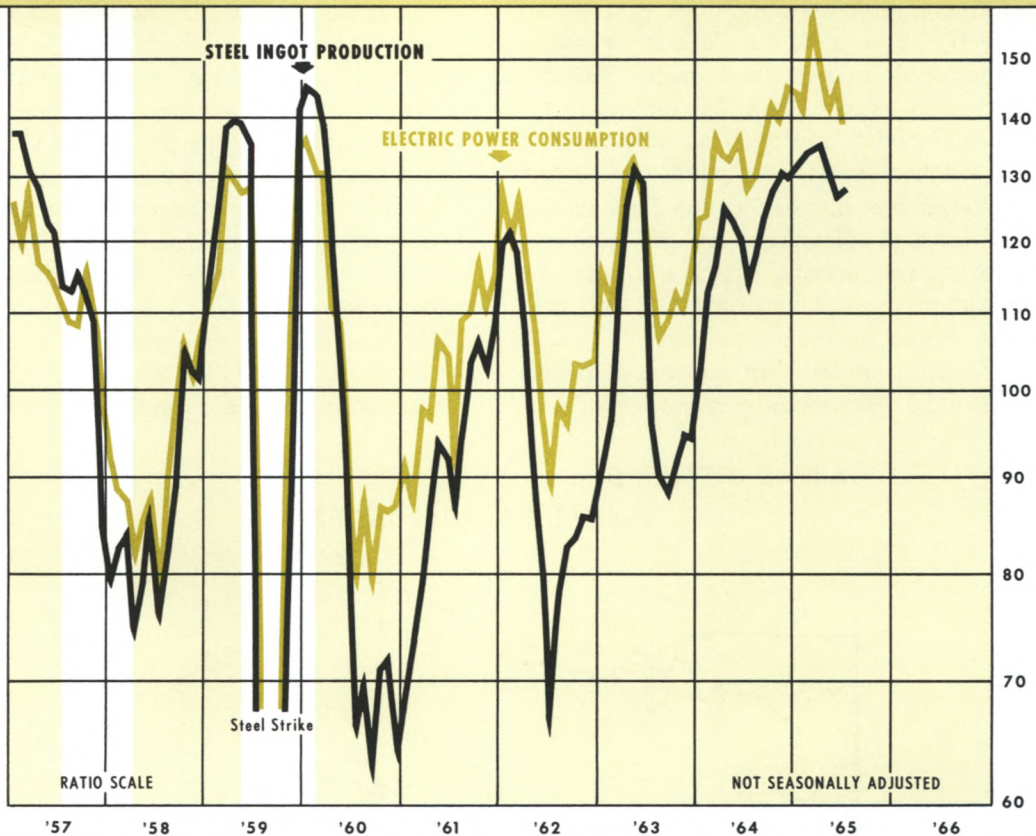
AREAS INCLUDED in
ELECTRIC POWER INDEXES



**INGOT PRODUCTION and ELECTRIC POWER CONSUMPTION
by the STEEL INDUSTRY**

PITTSBURGH

INDEX 1957-59=100



Sources of data: American Iron and Steel Institute and Federal Reserve Bank of Cleveland

son and because steel is so important to Pittsburgh's economy, a special chart is shown for steel ingot production and electric power consumption in Pittsburgh's steel industry, that is, SIC 331, blast furnaces and steel mills. The monthly production indexes are computed from the American Iron and Steel Institute's weekly indexes for the Pittsburgh district; the electric power data correspond essentially to that area (somewhat broader than the Pittsburgh area shown on the accompanying map).

The month-to-month movements in electric power consumption generally conform to

changes in steel ingot production; some discrepancies occur because the electric power data are not adjusted for differences in monthly working days and because the weekly production indexes often are allocated arbitrarily between two months. It should be noted, however, that electric power consumption does not rise or fall in equal proportion to steel ingot production. That is due to certain overhead components associated with the use of electric power. Since the base period of 1957-59, electric power consumption has increased roughly 10 percent more than steel ingot production in the Pittsburgh district.

CONSUMPTION OF COAL IN OHIO

Consumption of bituminous coal in the United States, on balance, has barely held its own during the past 25 years. A sharp rise in coal consumption during World War II was offset by a gradual decline in the next ten years which then tapered off into a period of relative stability at a level around that of 1940 (see Chart 1). Recent stability of coal consumption has occurred even though coal deposits in the nation are relatively accessible, advantageously located, and more abundant than any other mineral fuel, being in fact sufficient to last an estimated 1,500 years at present rates of consumption.

In contrast to the lack of growth in the amount of annual coal consumption, the economy as a whole has expanded considerably since 1940. At the same time, and more germane to the subject of this article, total consumption of all mineral fuels doubled during the 1940-63 period. As a result, coal accounted for only one-fifth of mineral fuel consumption in 1963 as compared with al-

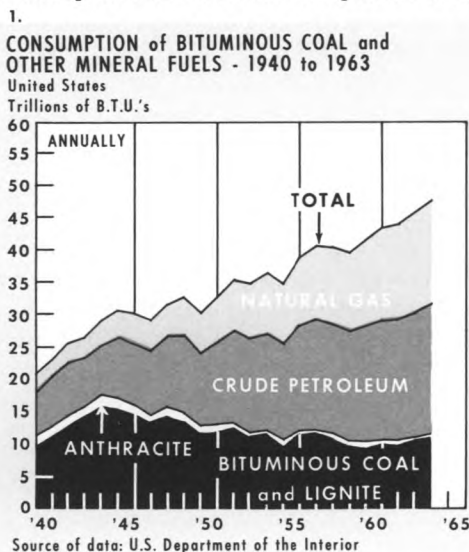
most one-half in 1940. During the same period, use of natural gas as a proportion of total mineral fuel consumption nearly tripled while crude petroleum, the largest source of energy, registered a modest relative increase.

Two major developments appear largely responsible for the downtrend in coal consumption following World War II. For one thing, railroads converted from steam to diesel locomotives, thereby virtually eliminating a market for coal which, at its peak in 1944, accounted for more than one-fifth of total coal consumption. In addition, introduction of the welded pipeline and subsequent installation of transcontinental oil and gas pipelines resulted in a decline in the volume of coal consumed in homes and industries.

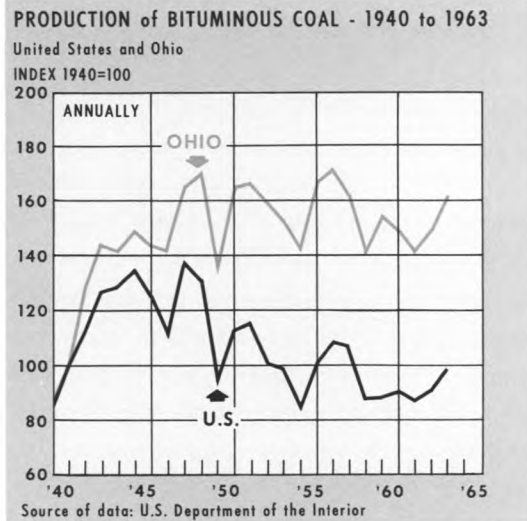
The downward trend of the U. S. coal industry since World War II has been interrupted repeatedly by cyclical fluctuations, as suggested by Chart 2. The cyclical sensitivity of coal can be traced in large part to its role in coke manufacturing, which in turn closely reflects the fortunes of the iron and steel industry, itself an industry characterized by wide swings. The amount of coal consumed by other industrial users also fluctuates in accordance with general economic conditions, but to a lesser degree.

AN IMPORTANT COAL STATE

The coal industry in Ohio is an important part of the U. S. coal industry. As a coal producer, Ohio ranks fifth following West Virginia, Kentucky, Pennsylvania, and Illinois in descending order. On the consumption side, Ohio was the leading coal-using state in the nation from 1959 to 1962 and since that



2.



time has ranked slightly behind Pennsylvania; from 1959 through 1963, more than 10 percent of U. S. coal consumption was accounted for by Ohio.

Coal production in Ohio has closely resembled production in the U. S. in both frequency and amplitude of cyclical fluctuations during the postwar period, as Chart 2 indicates. However, the Ohio industry has differed considerably from that of the U. S. inasmuch as a general decline in production did not occur. This appears to be due mainly to the greater relative importance of the electric utility coal market in Ohio than in the U. S., to the extent that increased coal consumption by the utilities has cushioned the loss of the railroad and other coal markets. Another aspect in which the coal industry in Ohio differs from the national pattern is the greater relative importance of coal as a source of energy. In 1963, coal accounted for 60 percent of the mineral fuel energy consumed in Ohio, as compared with 20 percent in the nation; these relationships have changed little in recent years.

The present article is concerned with coal consumption in Ohio between 1958 and 1963.

The time period is chosen because of availability and comparability of data on coal consumption by state. The discussion is directed to four major coal markets or groups of consumers—electric utilities, coke producers, other industrial users, and retail consumers. A future article will discuss coal production in Ohio and the movement of coal between Ohio and surrounding states.

A LEADING INDUSTRIAL STATE

Prominence as a coal consumer stems from Ohio's importance as an industrial state. Using value added by manufacture as a measure of industrial activity, Ohio is third largest in the U. S., exceeded only by New York and California. Moreover, the industrial structure of Ohio shows a heavier concentration of industries using large amounts of fuel and electric energy than other states. In Ohio, 74 percent of value added by manufacture is accounted for by the ten largest fuel and electric energy-using industries, compared with 70 percent in Pennsylvania (the next largest), 67 percent in Illinois, and 68 percent in the U. S. as a whole.¹

Total coal consumption in Ohio amounted to 49.2 million tons in 1963, or 11 percent more than in 1958.² Over the 1958-63 period,

¹ The ten largest fuel and electric power-consuming industries are, in order of importance: primary metals; chemicals and allied products; petroleum and coal products; stone, clay, and glass products; paper and allied products; food and kindred products; transportation equipment; textile mill products; nonelectrical machinery; and fabricated metal products.

² The 1958 to 1963 period under discussion has the disadvantage of beginning with a year that includes a cyclical trough and ending with an expansion year. Part of the increase in coal consumption thus merely reflects recovery to prerecession levels, which should be borne in mind throughout the following discussion.

increased sales to the large electric utility market and to industrial consumers combined to more than offset a sharp decline in retail coal sales; coke manufacturers consumed about the same volume of coal in both 1958 and 1963, although there were marked fluctuations during the interim.

ELECTRIC UTILITIES

LARGEST COAL CONSUMER

Electric utilities represent the largest coal market in Ohio, accounting for nearly one-half of all coal currently consumed in the state. Practically all electric power produced in Ohio is generated by coal and since the state is the nation's largest producer of fuel-electric power, the electric utilities in Ohio consume more coal than those in any other state.³ Almost exclusive use of coal by Ohio electric utilities is dictated by the low cost of coal in Ohio compared with other fuels. Since nearly one-half of production expenses of an electric utility are accounted for by fuel cost, use of the lowest cost fuel is more important for electric utilities than for most other industries. In 1963, the cost of coal for all Ohio electric utilities averaged 22.0 cents per million British thermal units (Btu's) compared with 26.3 cents per million Btu's for gas and 69.4 cents for oil.

Electric utilities in Ohio, like those in the nation, substantially increased the volume of coal consumed from 1958 to 1963. By 1963, the 26 electric power companies in Ohio, which operate 44 generating plants, were consuming 23.0 million tons of coal annually, or 22 percent more than in 1958. Gains in coal consumption by electric utilities, however,

³ California is a larger producer of electric power than Ohio, but a large amount of that state's production is generated by waterpower rather than fuel.

were less than growth of electric power production as the amount of coal required per kilowatt hour of electricity generated in Ohio declined somewhat.

The decline in per-unit coal requirements reflected an increase in the average size of Ohio generating plants between 1958 and 1963, which in turn resulted in increased operating efficiencies and economies of scale. It further reflected the more efficient use of coal due to improved methods of burning coal in the process of generating electric power.

The electric utility market is crucial for the Ohio coal industry, not only because it is expanding but because it is relatively stable in periods of recession, thereby helping to mitigate sharp declines in more volatile coal markets, especially coke production. For example, while coal consumption by Ohio electric utilities did decline from 1957 to 1958 and from 1960 to 1961, these changes were more moderate than those in other coal markets (see Table I).

COKE A LARGE BUT VOLATILE MARKET

The second largest single market for coal in Ohio is coke manufacturing, accounting for about one-fifth of the state's total coal consumption. (In coke manufacturing, coal is carbonized mainly for use in combination with limestone and iron ore for pig iron production.) The magnitude of the coke market reflects Ohio's position as the second largest pig iron producer in the nation, following Pennsylvania. The volume of coal consumed by coke manufacturers in Ohio totaled 9.1 million tons in 1963, or slightly less than in 1958.

TABLE I

Annual Coal Consumption in Ohio, by Major Markets, 1958-63
Tonnage (thous. tons) and Percent Change from Preceding Year

	Total All Markets		Electric Utilities		Coke Plants		Other Industrial Users		Retail Sales	
	Volume	Change	Volume	Change	Volume	Change	Volume	Change	Volume	Change
1958	44,390	- 20%	18,776	- 7%	9,119	- 42%	12,100	- 18%	4,395	- 13%
1959	50,071	+ 13	20,450	+ 9	12,570	+ 38	13,043	+ 8	4,008	- 9
1960	49,624	- 1	21,375	+ 5	11,880	- 6	12,898	- 1	3,471	- 13
1961	44,998	- 9	20,243	- 5	9,129	- 23	12,713	- 1	2,913	- 16
1962	48,324	+ 7	21,918	+ 8	9,482	+ 4	13,822	+ 9	3,102	+ 7
1963	49,157	+ 2	22,991	+ 5	9,061	- 4	14,482	+ 5	2,623	- 16

Source: U.S. Department of the Interior

The coke rate (the amount of coke consumed per ton of pig iron produced) declined from 1958 to 1963, as evidenced by a 34-percent increase in pig iron production accompanied by a gain of only 8 percent in coke consumption.⁴ The major reason for the lower coke rate was more widespread use of agglomerates in pig iron production by a method utilizing fine ores and low iron content ores in blast furnaces while requiring a smaller volume of coke per unit of pig iron produced.

In contrast to the relative stability of the electric utility coal market, the coke market is highly volatile, reflecting the fact that demand for coke is derived largely from pig iron (and steel) production. The latter, of course, tends to fluctuate widely over the path of business activity.

GAINS IN OTHER INDUSTRIES

Industries other than electric utilities and coke plants directly account for nearly one-third of coal consumption in Ohio and, indirectly, further contribute to total coal consumption as an important user of electricity, which is generated entirely by coal in Ohio.

⁴The seeming inconsistency of the decline in coke production and the gain in coke consumption is due to the fact that some coke is produced in other states before shipment to Ohio. This will be discussed in a forthcoming article.

By 1963, "other" industrial consumers had increased their coal consumption to 14.5 million tons, or 20 percent more than in 1958. The ten largest coal-using industries in Ohio, listed in Table II, account for approximately two-thirds of the coal consumed by industries other than electric utilities and coke manufacturers.

Changes in coal consumption of the ten individual industries between 1958 and 1962⁵ ranged from an increase of 164 percent for the nonelectrical machinery industry to a decline of 28 percent for food and kindred products. Of the eight industries registering gains, the stone, clay, and glass products, and chemicals and allied products groups had the largest increases in absolute volume (see Table II).

A REAL GAIN?

It is almost impossible to separate the "real" gain in coal consumption by industries other than electric utilities and coke plants between 1958 and 1962 from increases that represented recovery from recession losses. (A recession trough occurred in April 1958.) At the least, a portion of the 20-percent gain in coal consumption by "other" industries can be assumed to represent a real in-

⁵Due to the limited availability of data on coal consumption by industry, discussion is confined to changes between 1958 and 1962.

TABLE II

**Coal Consumption and Value Added by Manufacturing
Ten Largest Coal-Using Industries in Ohio ^a**

	1962 (thous. tons)	Coal Consumed Change from 1958 to 1962		Value Added Change from 1958 to 1962
		Actual (thous. tons)	Percent	Percent
Chemicals and Allied Products . . .	2,442	+597	+ 32%	+29%
Stone, Clay, and Glass Products . . .	1,674	+613	+ 58	+ 9
Paper and Allied Products	1,507	+154	+ 11	+25
Rubber and Plastics	1,289	- 97	- 7	+25
Transportation Equipment	677	+ 67	+ 11	+43
Food and Kindred Products	595	-228	- 28	+21
Machinery, except Electrical	343	+213	+164	+37
Electrical Machinery	320	+115	+ 56	+29
Fabricated Metal Products	262	+ 5	+ 2	+22
Petroleum and Coal Products	73	+ 21	+ 40	+14

^a Other than electric utilities and coke plants.

Source: U.S. Department of Commerce

crease, reflecting a number of factors operating to expand coal consumption.

On *a priori* grounds, industrial growth probably helped to increase coal consumption by these industries. Increases in the output of the ten largest coal-using industries in Ohio between 1958 and 1962, measured in terms of value added, are shown in Table II. As the volume of production increased, it would be expected (other things being equal) that inputs, including fuel, would also have increased, although perhaps at a slower rate.

Prices or other considerations causing some industries to shift to coal may have contributed to the gain in coal consumption. While perhaps not as important as for electric utilities, coal prices are important to industrial consumers; they cannot be ruled out as a possible stimulant to larger use of coal from 1958 to 1962, despite the lack of definitive data. Changes in coal prices paid by the ten largest coal-using industries in Ohio between 1958 and 1962 were inverse and disproportional to consumption changes, as shown in Table III. The average coal price paid by the

chemicals and allied products industry, for example, declined 16 percent from 1958 to 1962 while consumption increased 32 percent. Two industries — rubber and plastics, and food and kindred products — showed higher prices paid for coal but declines in volume consumed.⁶

A shift in the type of fuel used by an industry may result from special considerations that influence some industries more than they do electric utilities and coke producers, who

⁶ Differences in coal prices among industries, which can be seen in Table III, reflect in part variations in the quality of coal required by individual industries. High quality coal, which commands a higher price, is necessary for some heating processes in the stone, clay, and glass industry. Prices of coal are also increased by washing and sorting, in relation to the degree of these services required or desired by a specific industry. In addition, prices vary because of differences in the bargaining power of individual consumers, which in turn may reflect volume of purchases. An industry such as chemicals and allied products, composed of relatively few large firms each using a large volume of coal, would generally be expected to have a stronger bargaining position than an industry with many small establishments such as the food and kindred products industry, all other things being equal.

TABLE III

**Price Changes and Consumption Changes in Coal
Ten Largest Coal-Using Industries in Ohio ^a
1958 to 1962**

	Price ^b		Consumption
	Per Ton 1962	% Change from 1958	% Change from 1958
Chemicals and Allied Products	\$5.45	-16%	+ 32%
Stone, Clay, and Glass Products	6.87	-55	+ 58
Paper and Allied Products	6.66	- 9	+ 11
Rubber and Plastics	5.62	+ 5	- 7
Transportation Equipment	6.73	-13	+ 11
Food and Kindred Products	7.55	+13	- 28
Machinery, except electrical	7.01	-14	+164
Electrical Machinery	7.15	- 6	+ 56
Fabricated Metal Products	6.08	-15	+ 2
Petroleum and Coal Products	6.48	-15	+ 40

^a Other than electric utilities and coke plants.

^b The price of coal by industry used for calculating the price change was determined by dividing the total cost of coal to an industry by the total amount of coal consumed by that industry. The price is thus the average cost per ton of coal to an industry.

Source: U.S. Department of Commerce

are tied to coal by price and nature of product, respectively. For example, the type of heating process used influences the fuel choice of some industries. An industry that has a continuous heat treating process might burn coal, but gas would be preferred if the process were intermittent, due to the relative ease with which a gas fire can be turned off. Factors that must be considered by industrial consumers in selecting a fuel are available storage facilities and location of the plant. Some coals may deteriorate when exposed to inclement weather. On the other hand, industrial consumers might shift away from coal for convenience or ease of handling. An industrial consumer, for example, may prefer gas, despite its higher cost, because gas is cleaner. Gas also releases energy more easily and may be a lower cost fuel in certain industrial applications.

New technology and burning techniques could also have played a significant role in the rise in coal consumption by individual

industries. One type of innovation which may have led to gains is that permitting a wider quality range of coals to be utilized and fuel costs to be reduced by burning lower quality coal.

An indirect gain in coal consumption, which ultimately was reflected in coal sales to electric utilities, has resulted from rapid expansion in industrial use of electricity. Although a portion of this gain represents a shift from self-generated to purchased electricity—or from the industrial to the electric utilities market for coal—substantial net gains have been recorded. Of the ten largest coal-using industries in Ohio, only the chemicals and allied products group consumed less electric power in 1962 than in 1958, as shown in Table IV.

ABATEMENT OF RETAIL SALES

The retail coal market, which accounts for only 5 percent of total coal consumption in Ohio, amounted to 2.6 million tons in 1963, or 40 percent less than in 1958. In large part,

the decline reflected preference changes by homeowners, the major consumers in this category. Homeowners tend to prefer a cleaner, less bulky fuel than coal, regardless of price. As incomes have increased, many homeowners have converted home heating units to oil, gas, and, to a lesser extent, electricity. A gain in electric heating, it should be noted, is an indirect gain to the coal industry since all electricity in Ohio is generated by burning coal.

SOME CONCLUDING COMMENTS

Barring technological changes that would replace coal as an energy fuel, coal consumption in Ohio can be expected to increase in total although not in each of the individual markets.

The electric utility market in Ohio appears likely to record substantial gains in coal consumption at least in the near future. Nuclear fuel, a long-run competitor of coal, is expected to account for about one-fifth of electric power generation in the U. S. by 1980.

Areas where nuclear power will be economically feasible will be those now generating electric power by higher cost mineral fuels such as oil and gas. The electric utilities in Ohio, like those in other coal-producing states, will probably be among the last to convert to nuclear power due to the availability of low-cost coal.

The coke market is expected to require a declining share of total coal consumption in Ohio. Technological advance may further reduce the amount of coke required per unit of pig iron produced. The outlook for coal consumption by industries in Ohio other than electric utilities and coke plants poses a question. Changing technology could open new industrial markets for coal if methods currently under study for handling, burning, or using coal are developed to the point of economic feasibility. A continued decline in the retail market for coal can be expected, although growth in electric heating would indirectly help offset the decline.

TABLE IV

Electric Power Consumption Ten Largest Coal-Using Industries in Ohio ^a Percent Change, 1958 to 1962

	Quantity Purchased	Self- Generated	Total Consumption
Chemicals and Allied Products	- 5%	- 48%	- 8%
Stone, Clay, and Glass Products	+17	- 26	+ 7
Paper and Allied Products	+63	+2546	+196
Rubber and Plastics	+35	n.a.	+ 35 ^b
Transportation Equipment	+26	n.a.	+ 26 ^b
Food and Kindred Products	+14	- 50	+ 11
Machinery, except electrical	+33	+ 1	+ 31
Electrical Machinery	+26	n.a.	+ 26 ^b
Fabricated Metal Products	+12	n.a.	+ 12 ^b
Petroleum and Coal Products	+19	n.a.	+ 19 ^b

n.a. — Not available

^a Other than electric utilities and coke plants.

^b Percentage gain in purchased electric energy only.

Source: U.S. Department of Commerce

