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A New Regional Economic Indicator: The Mid-Atlantic Manufacturing Index

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Despite the omnipresence of McDonald's and Burger King, the U.S. economy is not homogeneous. Economic performance varies from region to region for many reasons--including differences in the mix of industries, in investment patterns, in population growth, and in climate. The first five years of the current economic expansion provide ample evidence of these regional variations. From December 1982 to December 1987, employment surged 21.7 percent in California and 31.9 percent in Florida, while in Louisiana and Oklahoma, two "oil patch" states, it fell 5.4 percent and 7.0 percent, respectively.

In the face of such wide divergences, information about the nation alone is not sufficient for business and government planners. Bankers, retailers, real estate agents, construction contractors, and many others in the private

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sector need information about the regional and local markets they serve. In the public sector, budget analysts who project tax revenues, welfare administrators who estimate needs, and economic development officials who seek to attract firms need local data for responding to changing regional conditions. Moreover, these planners need current information. Yet much of the regional and local economic data is published with a lag of more than a year.

In 1988 the Federal Reserve Bank of Philadelphia developed a monthly index of manufacturing production for the Mid-Atlantic region. With the publication of this index, the Philadelphia Fed joins company with the Federal Reserve Banks of Cleveland, Chicago, Dallas, and Richmond, which have recently begun to publish comparable manufacturing production indexes. (See *Manufacturing Production Indexes in the Federal Reserve System.*) These new indexes promise to be valuable tools for evaluating regional economic activity in a timely manner.

WHY FOCUS ON MANUFACTURING PRODUCTION?

With the much publicized decline in manufacturing employment over the past decade, it would be tempting to conclude that manufacturing activity is no longer a very important barometer of the economy. But a look at other measures of manufacturing activity shows that such a conclusion is not warranted. The U.S. Department of Commerce calculates that the constant-dollar value of manufactured goods hovered around 22 percent of gross national product from 1950 to 1985.[1] In other words, the output from U.S. factories continues to represent a sizable proportion of national economic activity. Moreover, the relative constancy of the manufacturing share indicates that the U.S. economy still possesses a strong industrial base.

For some regions and states, the manufacturing sector is significantly more important than it is for the nation. In 1986, it accounted for about one-third of the real gross state product (GSP) in five states: Michigan (34.7 percent), Indiana (33.1 percent), Ohio (32.9 percent), New Hampshire (32.8 percent), and North Carolina (32.8 percent).[2] These percentages point to the importance of having comparable regional manufacturing production indexes for assessing how well a region's manufacturing sector is performing and the extent to which regional performances differ. The indexes can be helpful also in investigations of deindustrialization in some of the heaviest manufacturing states.[3] The Midwest Manufacturing Index has already been used for this purpose by the Federal Reserve Bank of Chicago.[4]

Besides the fact that manufacturing constitutes a sizable proportion of U.S. output, the fact that it fluctuates with the business cycle to a greater degree than the service sector makes it an important sector to monitor both nationally and regionally. Business firms are vitally interested in knowing the onset of recession and recovery. Although turning points in manufacturing are not expected to precede turning

[1] U.S. Congress and U.S. Office of Technology Assessment, *Technology and American Economic Transition: Choices for the Future*, Summary (May 1988) p. 25. There is some reason to believe, however, that this estimated proportion may be too high. See the above and Lawrence Mishel, *Manufacturing Numbers: How Inaccurate Statistics Conceal U.S. Industrial Decline* (Washington, D.C.: Economic Policy Institute, 1988). For a reply, see U.S. Department of Commerce, Bureau of Economic Analysis, "Gross Product by Industry: Comments on Recent Criticisms," *Survey of Current Business* (July 1988) pp. 132-33.

[2] U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, *Gross State Product by Industry*, 1963-1986 (price-adjusted values: 1982=100) (May 1988).

[3] See the companion article by Gerald A. Carlino in this *Business Review*.

[4] Robert H. Schnorbus and Alenka S. Giese, "Is the Seventh District's Economy Deindustrializing?" Federal Reserve Bank of Chicago *Economic Perspectives* (November/December 1987) pp. 3-9.

Manufacturing Production Indexes in the Federal Reserve System

The Federal Reserve System has maintained a longstanding interest in manufacturing production indexes. At the national level, the Federal Reserve Board publishes a monthly index of industrial production and separate indexes for manufacturing, mining, and utilities. Various Federal Reserve Banks also share a long tradition of interest in regional manufacturing indexes. In October 1963, the Federal Reserve Bank of Boston adopted a methodology that used the national industrial production index and enabled the timely publication of a manufacturing index for the six states in its district. The New England index was discontinued in June 1985. In the early 1970s the Federal Reserve Bank of San Francisco generated indexes for several industries using the Cobb-Douglas production function and employing three inputs instead of the usual two. The estimation of the production function was costly, however, and publication of the indexes has not continued in recent years.

The Federal Reserve Bank of Atlanta began publishing a manufacturing production index in June 1970 using an improved methodology very similar to that described in the Appendix. This method, which is more cost effective than that employed by the San Francisco Fed, has been adopted by several Federal Reserve Banks. Unfortunately, the Atlanta Fed's publication of the regional index and a separate index for Georgia has been discontinued.

In 1983, the Federal Reserve Bank of Dallas adopted the Atlanta Fed's methodology to produce the Texas Industrial Production Index. Although this index includes mining and utilities, a separate index for manufacturing is also calculated. The latest revision is benchmarked to gross state product data instead of the state value-added data used for the other indexes.

Since early 1987, the Federal Reserve Bank of Cleveland has published the Ohio Manufacturing Index. Like the one for Texas, this index is for a single state and follows the Atlanta Fed's methodology. More recently, a Midwest Manufacturing Index for the states of Illinois, Indiana, Iowa, Michigan, and Wisconsin was developed by the Chicago Fed using the same technique. And most recently, the Fed of Richmond began publication of a newly developed monthly index of manufacturing production for its district, as well as separate indexes for its five states--Maryland, North Carolina, South Carolina, Virginia, and West Virginia--and three major industries. Except for some modification for the individual state indexes, the same methodology is employed. This methodology is now used in the Mid-Atlantic Manufacturing Index, the fifth such index to be published regularly. The rapid increase in the number of indexes indicates the new importance attached to understanding regional changes in economic activity. The Research Department of the Federal Reserve Bank of Philadelphia will publish monthly updates of the index that will be available on request.

points in the general economy, timely data on manufacturing activity can be useful in providing early evidence that a downturn or recovery is under way. The use of manufacturing data makes business cycle turning points more perceptible, since the downturns and upturns are steeper in manufacturing than in the economy in general. A timely regional index of manufacturing production activity is useful also in assessing the severity of a recession and the robustness and completeness of a recovery.

GETTING A HANDLE ON MANUFACTURING PRODUCTION

Since it is published monthly with little delay, employment in manufacturing establishments has been the commonly used measure of regional manufacturing activity. However,

manufacturing employment alone is a deficient measure of production. Although the number of employees is often cited as an indicator of output levels, the number of labor hours is a better measure, since the length of the workweek can vary. More important, labor is only one factor in the production process. The other major factor is capital, or what is often referred to as plant and equipment. The use of more machinery with more sophisticated technology increases the productivity of labor. If labor productivity is rising, employment gains understate the increase in manufacturing production. If labor productivity rises sufficiently, the level of employment or number of hours worked in manufacturing could even decline while production levels are rising.

The truest measure of industrial output is the actual count of what is produced--for example, the number of cars from an automobile plant or loaves of bread from a bakery. Some individual industries publish these kinds of statistics, and some of them are used in the Federal Reserve Board's industrial production index for the U.S. economy. However, these data are seldom available on a state or regional basis. Also, it is impossible simply to add together such diverse units to measure the total output of our factories. Economists therefore express aggregate production in terms of value added.

The U.S. Department of Commerce reports data on the value added by various manufacturing industries for each state in its publication, the *Annual Survey of Manufactures*. These value-added data form the basis for most of the regional manufacturing production indexes. In principle, the value added by any manufacturing plant equals the value of its output less the cost of products purchased from other firms. For example, the value added by a book printing facility would equal the value of the books produced less the cost of paper, ink, and glue. Since the value-added data are published in current dollars, however, any increase in value added from a plant can be the result either of increased production or increased prices. To eliminate the effect of changing prices on changes in the value added, analysts use the industry price index to deflate the number reported by the Department of Commerce. The result is the final, useful measure of output--which is real value added, or value added in constant dollars.

If the value-added data were published monthly on a timely basis, they would provide a direct measure of changes in manufacturing output for each state. Unfortunately, the value-added data are published only annually and with a considerable time delay. For this reason, regional production indexes are based on estimates of the changes in value added that are calculated from monthly measures of the amounts of labor and capital employed in the production process, which are reported in a more timely manner. For labor, the number of hours worked provides a measure of the physical input of labor. Measurements of the physical capital are more difficult to obtain, but a commonly used proxy or indicator of the capital input is the amount of kilowatt hours of electricity used by manufacturing firms. The labor data and kilowatt hour data are available monthly and with little delay. Using these monthly data, a regional index can be generated within 60 days after the month to which it refers.[5] Such an indicator can provide valuable early information on the regional economy.

THE MID-ATLANTIC INDEX--HOW IS IT GENERATED AND WHAT CAN IT TELL US?

The new Mid-Atlantic index covers the four states of Delaware, New Jersey, New York, and Pennsylvania.[6] These adjacent states are

[5] The Federal Reserve Board is able to release its monthly national industrial production index 15 days after the month to which it refers. Revised estimates are published 30, 60, and 90 days thereafter. Annual and occasional major revisions of the index are also published.

linked by a transportation system that supports well-integrated markets for a wide variety of goods and services. The large numbers of workers commuting across state lines in the Philadelphia, Trenton, New York City, and Wilmington metropolitan areas attest to the economic integration among these states. Also, three of the four states--New Jersey, New York, and Pennsylvania--constitute the Middle Atlantic Census Division.

How the Index Is Generated. The new Mid-Atlantic Manufacturing Index is a composite of monthly indexes for 19 separate industries, which are based on the sum of calculated real value added contributed by labor and capital, seasonally adjusted.[7] (See the *Appendix* for details.) The value added for each industry is calculated in 1982 dollars so that changes in the index will reflect only changes in real output and not changes in prices. For each industry the calculated real value added is indexed so that the average monthly value for 1982 equals 100. The composite index is the weighted average of these 19 industry indexes with the weights determined by each industry's contribution to real value added in the base year, 1982.

What the Index Can Tell Us. The Mid-Atlantic Manufacturing Index provides us with a new and more comprehensive measure with which to analyze manufacturing activity in the region over time and compare it with the nation and other regions. Take, for example, a regional analyst seeking to assess the health of regional manufacturing in the latter part of 1981. As Figure 1 (p. 8) indicates, the Mid-Atlantic Index, had it been in existence then, would have declined sharply, indicating that a contraction was under way locally. (The vertical bars in Figure 1 depict recessions.) Continued monitoring of the index would have shown that the bottom occurred in the last several months of 1982. The index would have signaled a robust recovery throughout 1983, and in 1984 and 1985 the regional analyst would have detected a slowdown or pause as the index flattened out. Continued tracking of the index in 1986, 1987, and 1988 would have shown the analyst a resumption of the upward trend but with a more erratic pattern.

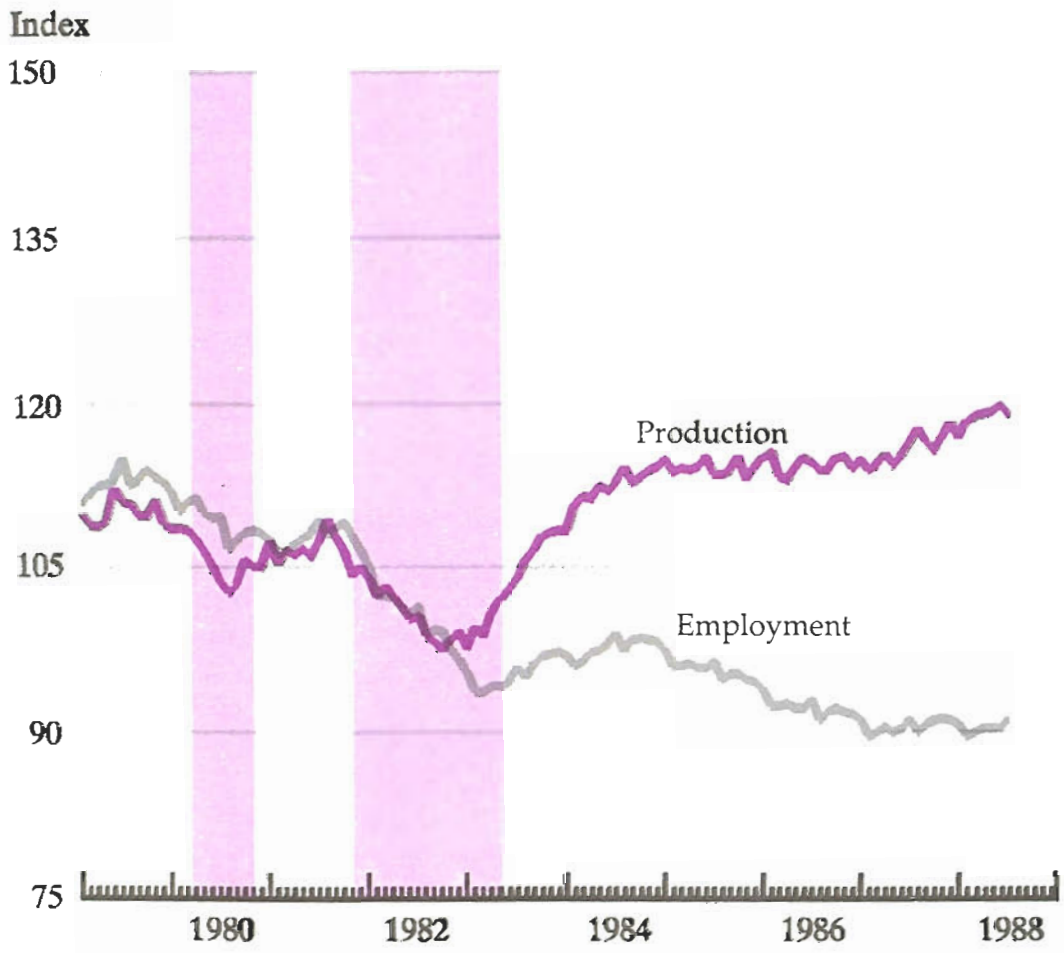
For the most part, analysts have been confined to using employment as an indicator of manufacturing production. Figure 1 shows how misleading this can be. An employment index of the 19 industries covered by the Mid-Atlantic index shows a decline of 5.5 percent from November 1982 to June 1988. During this same period of expansion, the manufacturing index, which takes into account the use of capital, shows an increase of 20.1 percent. This difference between employment and production is accounted for by increases in labor pro-

[6] It has proven impossible to construct an index for only the Third Federal Reserve District, which includes the eastern two-thirds of Pennsylvania, the southern part of New Jersey, and the entire state of Delaware. First, data for manufacturing value added, employment, and average weekly hours are available only for entire states. Second, the kilowatt hour data are collected by the Federal Reserve Banks within the boundaries of their districts. Thus, the kilowatt hour data for the Philadelphia District do not include western Pennsylvania and northern New Jersey. The historical kilowatt hour data for western Pennsylvania were provided by the Federal Reserve Bank of Cleveland. Because historical electricity data cannot be obtained for northern New Jersey separately, Districts Two and Three have been combined. By this combination, electricity, value-added, and employment data are available for the entire four states; however, the electricity data also include Fairfield County in Connecticut, part of the New York Fed's district.

[7] The 19 industries are the so-called two-digit SIC manufacturing industries: food and kindred products; textile mill products; apparel and other textile products; lumber and wood products; furniture and fixtures; paper and allied products; printing and publishing; chemicals and allied products; petroleum and coal products; rubber and miscellaneous plastics products; leather and leather products; stone, clay, and glass products; primary metal industries; fabricated metal products; machinery, except electrical; electric and electronic equipment; transportation equipment; instruments and related products; and miscellaneous manufacturing industries. The tobacco products industry was omitted, owing to lack of data.

FIGURE 1

The Mid-Atlantic Region's Manufacturing Output Has Grown While Employment Has Fallen



ductivity over this period. We do not have an official regional data series on productivity, but at the national level the annual average growth in the productivity of manufacturing workers is estimated to have been 1.5 percent for the period 1979-82 and 4.5 percent for the period 1982-87.[8] In this latter period of rapid productivity growth, the manufacturing production index for the Mid-Atlantic region diverged sharply from the employment index (Figure 1).

Within the Third District, the gap between output and employment growth has been apparent for some time in the Philadelphia Fed's *Business Outlook Survey*. From 1984 through 1986, respondents were generally reporting increases in output but declines in employment, a clear case of productivity growth. In the past, we have been able to check the survey responses only with actual employment growth

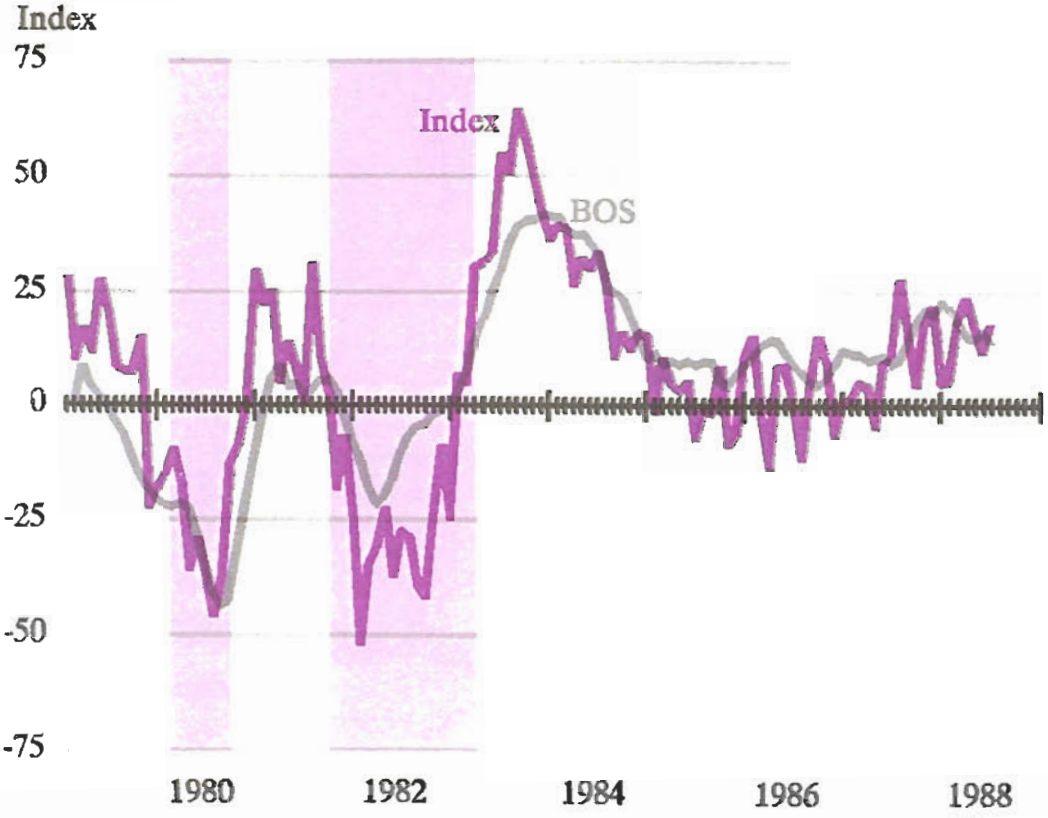
[8] These calculations are based on the Bureau of Labor Statistics' indexes of productivity, hourly compensation, and unit costs (quarterly, seasonally adjusted).

rates, but the new manufacturing index allows us to make some comparisons between survey responses and actual output.[9] Changes in the manufacturing index and the survey responses are quite consistent. (See *Manufacturing Index Supports the Business Outlook Survey Results.*)

Relative to the Nation... When we compare manufacturing activity in the Mid-Atlantic region to activity in the nation, we see both similarities and differences. Even though the Mid-Atlantic index and the manufacturing portion of the Federal Reserve Board's indus-

[9] See John Bell and Theodore Crone, "Charting the Course of the Economy: What Can Local Manufacturers Tell Us?" this *Business Review* (July-August 1986) pp. 3-16.

The Mid-Atlantic Index Supports the *Business Outlook Survey* Results



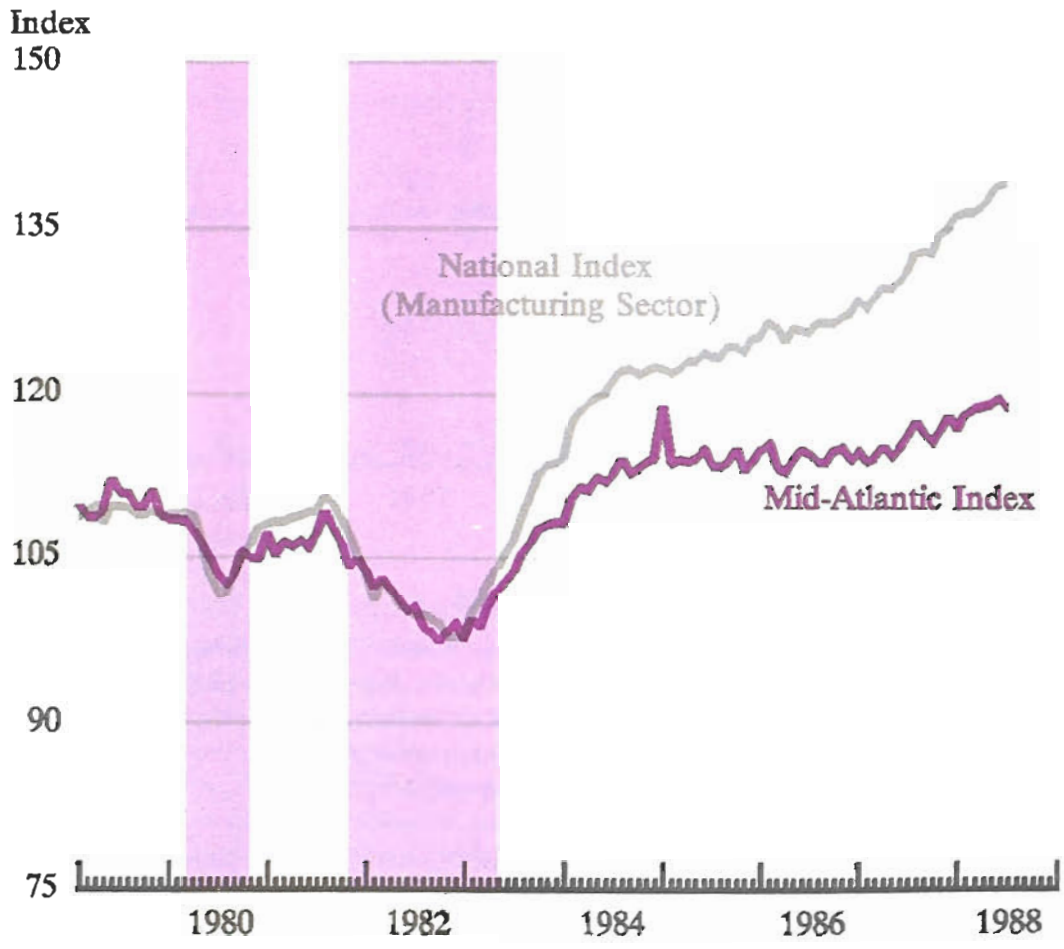
The Federal Reserve Bank of Philadelphia provides another indicator of regional manufacturing activity with its monthly *Business Outlook Survey* (BOS). Respondents to this survey indicate whether their activity was up or down from the previous month. A diffusion index is calculated by subtracting the percentage of respondents reporting a decrease from the percentage reporting an increase. Although the BOS covers only the larger manufacturing employers within the Third Federal Reserve District, the historical patterns of the two indicators are similar. Since the diffusion index from the BOS is based on the percentage of respondents who report increases or decreases in activity, the proper comparison is between the diffusion index from the BOS and percentage changes in the manufacturing index. The graph compares the six-month moving average of the diffusion index with the six-month moving average of monthly percentage changes in the Mid-Atlantic Manufacturing Index.

trial production index are calculated differently, they show the same basic pattern of decline and expansion over the past 10 years (Figure 2). From the late 1970s through the 1981-82 recession, the pattern was almost identical. In the current period of expansion, both indexes showed the robust growth typical of the manufacturing sector in the early recovery phase of the business cycle. The tapering off of growth beginning about mid-1984 is also typical, but the slowdown was more severe in the Mid-Atlantic region than in the nation as a whole. More recently, growth has revived in the region, although at a slower pace than in the nation. Thus, the recovery in manufacturing has been less robust and complete in this region than in the nation.

...And Relative to Other Regions. Four

FIGURE 2

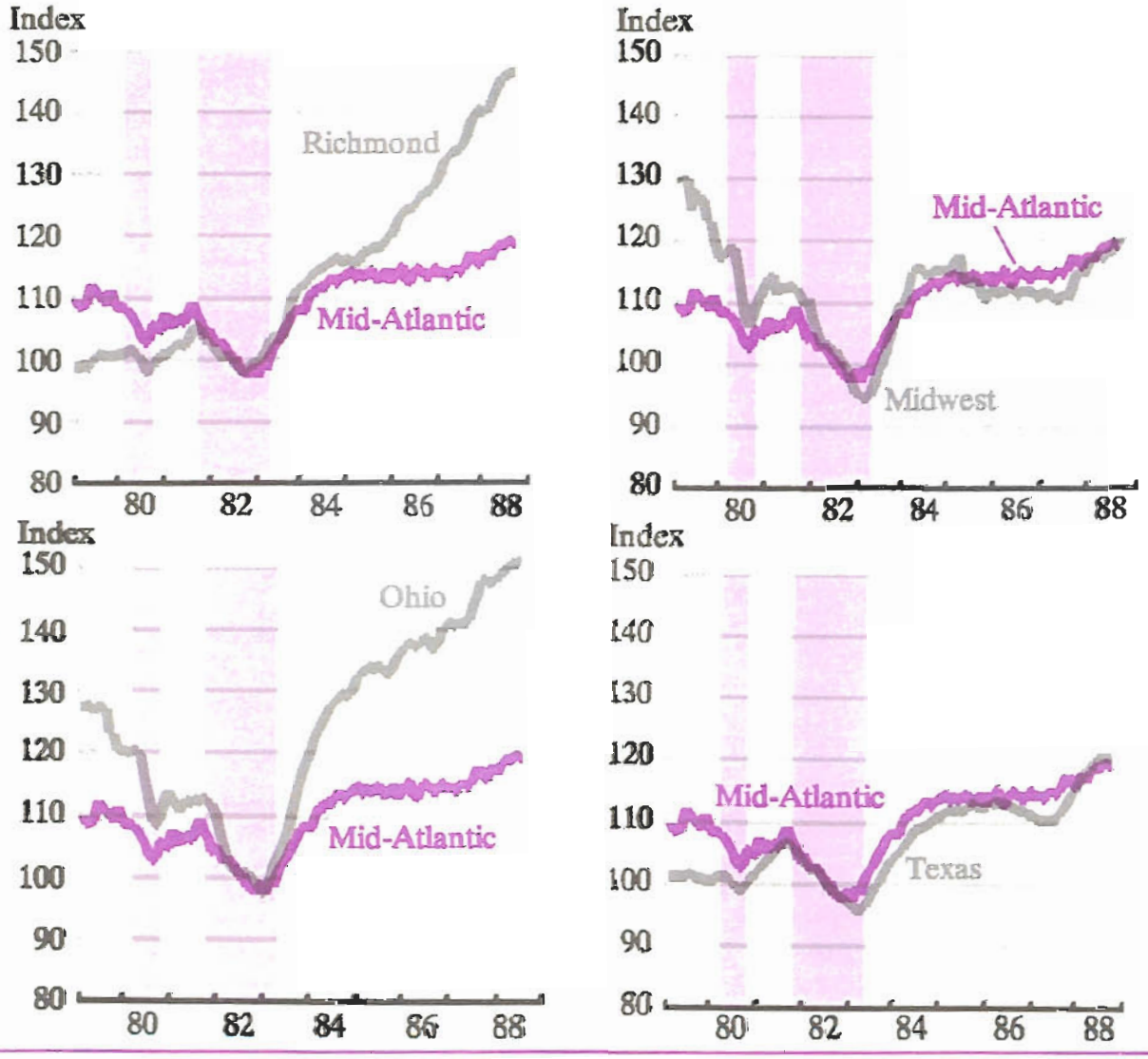
Manufacturing's Recovery: Less Robust for the Region Than for the Nation



other indexes currently calculated by Federal Reserve Banks using the same basic methodology as the Mid-Atlantic index allow us to compare the recent patterns of manufacturing activity. The Cleveland Fed's Ohio Manufacturing Index, displayed in Figure 3, indicates more pronounced fluctuations in recent years. From January 1979 to November 1982, the trough of the most recent national recession, the Ohio index dropped almost 24 percent while the Mid-Atlantic index declined somewhat more than 9 percent. The recovery was also more dramatic, with the Ohio index rising 55 percent by June 1988 while the Mid-Atlantic index climbed only 20 percent. Both indexes are currently above the high points reached in 1979. Thus, the manufacturing sector in Ohio was much more volatile than that in the Mid-

FIGURE 3

The Mid-Atlantic Index Compared With Other FRB Indexes



Atlantic region.

Chicago's Midwest Manufacturing Index also paints a picture of precipitous decline during the last two recessions, with a drop of 26 percent from January 1979 to November 1982 (Figure 3). However, the Midwest recovery has been slightly stronger than the Mid-Atlantic recovery: the Midwest index rose 26 percent between November 1982 and June 1988. In contrast to the Ohio and Mid-Atlantic indexes, the Midwest index has not returned to levels reached at the end of the 1970s.

Richmond's index for Fifth District manufacturing indicates a regional economy with a strong growth trend that was less affected by the recent recession than other regions (Figure 3). From its peak in August 1981 to its trough in November 1982, the index declined only 6 percent. As in the other regions, a strong recovery was followed by a slowdown in 1984 and 1985. However, the growth beginning in 1986 has been stronger than it was in the Midwest and Mid-Atlantic regions. By mid-1988, the index had risen 47 percent above its November 1982 level.

The manufacturing component of the Dallas Fed's Texas Industrial Production Index exhibits a more distinctive pattern in the recovery period (Figure 3).[10] Like Richmond's, the Texas index peaked in the summer of 1981 and recorded a moderate decline, of 9 percent, through November 1982. Like the other indexes, Dallas's showed the regional recovery tapering off in 1984; however, beginning in early 1986, this pause turned into a decline, as a plunge in world oil prices hurt the Texas economy. Not until April 1987 did Texas manufacturing resume its expansion. Indexes for other regions would undoubtedly reveal other patterns. The ability to identify these differing patterns is a primary advantage of regional indexes.

SUMMARY

Where has the level of manufacturing activity been in the Mid-Atlantic region and where is it now? The new Mid-Atlantic Manufacturing Index provides some answers. Although measures of manufacturing employment have always been available, this new index is constructed in a way that combines a measure of industry's use of capital with a measure of employment. Updated on a monthly basis, this new indicator complements a variety of other economic data available on states and regions. It gives us another tool for comparing the Mid-Atlantic economy with that of the nation and other regions.

[10] The Texas Manufacturing Index shown in Figure 3 is the revised version benchmarked to gross state product data.

APPENDIX
Calculation Methodology and Equations

The methodology employed in the Mid-Atlantic Manufacturing Index follows the pioneering work of the Federal Reserve Bank of Atlanta. This technique is currently employed by the Federal Reserve Banks of Chicago, Cleveland, Dallas, and Richmond. First, a separate index is constructed for each industry. As a basis for the calculations, it is assumed that manufacturing firms maximize profits in competitive markets, use only labor and capital in producing their products, and experience constant returns to scale. It can be shown that:

(1) $VA = P_l L + P_k K$

where
VA is value added
P_l is the unit price of labor
L is units of labor
P_k is the unit price of capital, and
K is units of capital.

Thus, each industry index is based upon the simple identity that the output, or real value added, equals the sum of the contributions attributable to labor and capital.

Since collecting data for the unit prices of labor and capital would be a costly undertaking, transformations are made to reduce the amount of data that must be collected:

$(L/VA)(VA/L) = 1$ and
$(K/VA)(VA/K) = 1$, so
$VA = (L/VA)(VA/L)(P_l L) + (K/VA)(VA/K)(P_k K)$, and then
$VA = (P_l L/VA)(VA/L)L + (P_k K/VA)(VA/K)K$

where
$P_l L/VA$ is the share of value added attributable to labor, called S_l
VA/L is the productivity of labor, called Q_l
$P_k K/VA$ is the share of value added attributable to capital, called S_k
and VA/K is the productivity of capital, called Q_k

The usable equation is then:
(2) $VA = (S_l)(Q_l)L + (S_k)(Q_k)K$

For each of 19 two-digit SIC manufacturing industries, monthly data for the labor input (employment times average weekly hours) are first summed for the four states covered by the Mid-Atlantic Index and then summed to provide an annual number for labor (L). Electric kilowatt hour usage is employed as a proxy for capital (K) in equation (2). These monthly kilowatt hour data are collected by the Federal Reserve Banks. From publications of the U.S. Bureau of the Census, the *Annual Survey of Manufactures*, and the *1982 Census of Manufactures*, annual data are obtained for calculating the relative contributions of labor and capital to value added and productivity. The annual payroll divided by the value added for each industry provides the share of value added attributed to labor (S_l). By assumption, the share attributed to capital (S_k) is one minus labor's share.

The value-added numbers are divided by the implicit price deflators for each industry, which have a base year of 1982. The price-adjusted value added divided by the labor hours and the price-adjusted value added divided by the kilowatt hour usage equal the productivities for labor (Q_l) and capital (Q_k).

From the annual numbers, monthly values for shares and productivity are interpolated for the intervening months and extrapolated for the months after the last annual published observations. The annual values are assumed to be for July of each year. Monthly interpolations are made with increments that equal one-twelfth of the change from July to July for both shares and productivity. The monthly extrapolations for both shares and productivity are made with increments equal to the average monthly increment from the year of the first annual observation, 1979, to the most recent annual observation.

The derived monthly values for shares and productivity are combined with the seasonally adjusted monthly values for labor hours and kilowatt hours in equation (2) to calculate the price-adjusted value added for each of the 19 manufacturing industries. The value added is then divided by the average monthly value for 1982 to derive an index. The final composite index is the weighted average of the 19 indexes based on 1982 weights for value added by each industry.

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