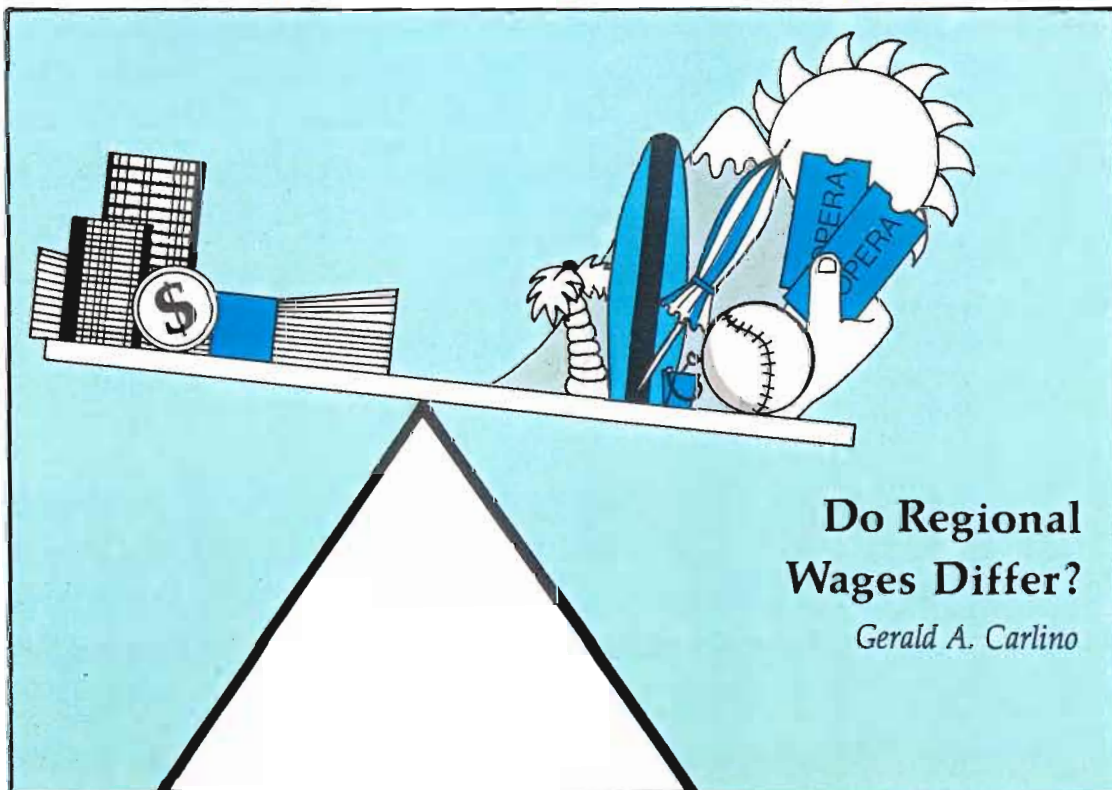
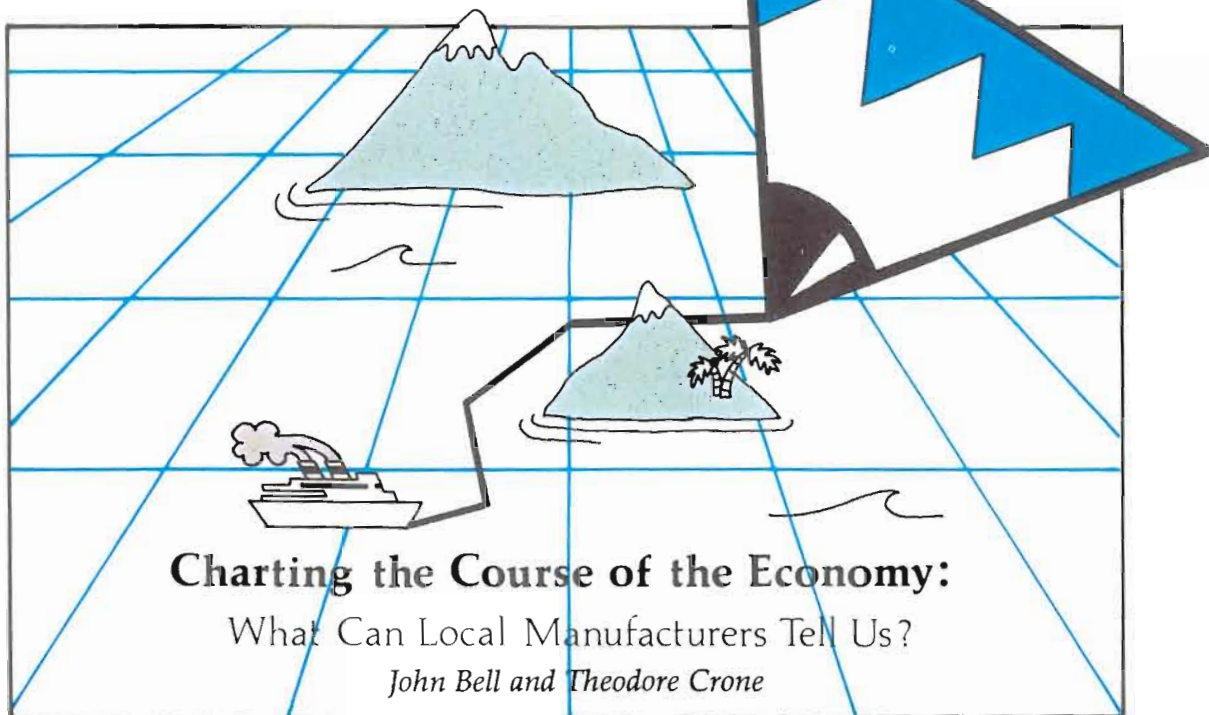


# BUSINESS REVIEW

ISSN 0007-7011

Federal Reserve Bank of Philadelphia

JULY•AUGUST 1986



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Federal Reserve Bank of Philadelphia  
Ten Independence Mall  
Philadelphia, Pennsylvania 19106

JULY/AUGUST 1986

## CHARTING THE COURSE OF THE ECONOMY:

### What Can Local Manufacturers Tell Us? ..... 3

*John Bell and Theodore Crone*

Planners of all kinds need to get readings on what the status of the economy is and where it is headed—and the sooner, the better. A relatively quick and cost-efficient tool planners can use is a business survey. For almost 20 years, the Philadelphia Fed has conducted such a survey, asking selected local manufacturers about both their current conditions and their expectations for the future. But just how accurate is the survey information compared to the numbers released by the official statistical collection agencies? This analysis finds that the survey gives early and accurate information on most (but not all) of the indicators of economic conditions and trends at both the local and national levels.

### DO REGIONAL WAGES DIFFER? ..... 17

*Gerald A. Carlino*

If you compared the classified ads from papers all over the country, you'd notice a lot of variety in the wages being offered. But does that necessarily mean you should pack your bags and move to the area where wages on the average appear higher? According to recent studies of regional wage differences, that might be a mistake. These studies find that numerous factors affect a region's wages, including what it costs to live there and what types of jobs are available. Moreover, they find that, to a large extent, a region's amenities, or lack of them, also play a significant role. So, when wages are adjusted for these factors, they don't really differ much from region to region at all.

The BUSINESS REVIEW is published by the Department of Research every other month. It is edited by Judith Farnbach. Artwork is directed by Ronald B. Williams, with the assistance of Dianne Hallowell. The views expressed herein are not necessarily those of this Bank or of the Federal Reserve System. The Review is available without charge.

Please send subscription orders and changes of address to the Department of Research at the above address or telephone (215) 574-6428. Editorial communications also should be sent to the Department of Research or telephone (215) 574-3805. Requests for additional copies should be sent to the Department of Public Services.

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# Charting the Course of the Economy: What Can Local Manufacturers Tell Us?

*John Bell and Theodore Crone\**

*If we could first know where we are and whither we are tending,  
we could better judge what to do and how to do it.  
— Abraham Lincoln, 1858*

In this quote, Lincoln was referring to the pre-Civil War campaign against slavery, but he could just as well have been referring to the normal conduct of business or government. Businesses must constantly assess the general state of the

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\*Both authors are members of the Research Department of the Federal Reserve Bank of Philadelphia. John Bell is Director of Research Support, and Theodore Crone is a Research Officer and Economist.

economy and make projections, well informed or not, which are used to determine the appropriate level of inventories, to decide on capital expenditures, and to anticipate future labor needs. Government decisions also are affected by the expected pace of economic activity. In order to pursue an effective countercyclical policy, the federal government needs accurate information on current economic activity as well as some assessment of what lies ahead. As a



result, U.S. businesses and governments spend millions of dollars each year trying to measure the level of economic activity and predict its course, and since the end of World War II, a small industry has developed in this country to provide economic information and forecasts.

One of the least costly methods of gathering economic information in terms of time and professional expertise is to survey businesses about recent activity. Most surveys can be answered quickly and the results summarized in a simple tabulation of responses, since respondents are only asked whether certain measures of activity at their firm have increased or decreased, but not by how much. There is a trade-off, however. The information provided by the respondents is qualitative rather than quantitative and less precise than information from other sources. The accuracy of this type of information can be measured only by comparing it to more precise data from other sources.

Since May 1968, the Federal Reserve Bank of Philadelphia has been conducting its own monthly survey of manufacturers. This survey, known simply as the *Business Outlook Survey* (BOS), has been helpful in indicating "where we are and whither we are tending" in both the region and the nation.

### THE THIRD DISTRICT BUSINESS OUTLOOK SURVEY

The *Business Outlook Survey* gathers information on a specific sector of the economy—the manufacturing industry in the Third Federal Reserve District.<sup>1</sup> There are three reasons for wanting to monitor this particular sector. First, although there has been a general shift in the economic base of the region in recent years—away from manufacturing and toward service industries—manufacturing remains an important component of the area's economy. Second, the pulse of business is more easily taken in

manufacturing than in service-oriented industries, because the output manufacturers produce is tangible and easily measurable. Third, manufacturing generally tends to be more sensitive than do service industries to business cycles, and the pinch of an economic downturn can often be felt in manufacturing before other sectors of the economy begin to react.

Because there are a great many manufacturing establishments located in the Third Federal Reserve District, participation in the BOS is limited to large organizations—those manufacturing firms with plants in the area that employ 350 or more workers. The survey covers makers of both durable and nondurable goods, and includes firms in most of the metropolitan areas of the District as well as some plants that lie in rural counties. Currently, there are about 550 establishments eligible to participate in the BOS, and about 100 have agreed to do so. Each month, the managers of these plants are mailed the survey questionnaire; in 1985, an average of 54 responded each month. Periodically, the sample is revised to add new firms that meet the participation criteria and to remove those establishments that no longer do.

The survey questionnaire asks participants two sets of questions on ten measures of business activity: employment, working hours, general activity, new orders, order backlogs, shipments, inventories, delivery times, prices paid and prices received. The first set of questions pertains to the current pace of business at the participant's plant. The participant is asked to indicate whether each measure has increased, decreased, or remained the same as it was the month before. The second set of questions addresses expectations of future business. Participants are asked whether they expect each measure of business activity to be higher, lower, or about the same in six months. In addition to the ten items included under the current activity section, the expectations section also includes a question about capital spending plans.

**Interpreting Survey Responses.** In order to put the individual survey responses into a form

<sup>1</sup>The Third Federal Reserve District includes the eastern two-thirds of Pennsylvania, southern New Jersey, and all of Delaware.



useful for tracking business conditions, we construct a diffusion index for each question in the survey. A diffusion index is a statistical tool used to measure the diversity of the components of some aggregate indicator. In the case of the BOS, we measure the diversity of the responses to each question by subtracting the percentage of respondents reporting a decrease (or, in the case of the future activity questions, *expecting* a decrease) from the percentage of respondents reporting (expecting) an increase. Each index has a maximum value of +100, when all respondents report an increase in an indicator, and a minimum value of -100, when all respondents report a drop in the indicator. Respondents are rarely unanimous, so the diffusion index usually takes on a value somewhere between -100 and +100. The closer the index is to either of these two extremes, the more in agreement, or the less diverse, are the responses to the question. In other words, the diffusion indexes measure the *scope* of an expansion or contraction in an indicator—the degree to which manufacturing firms and industries in the survey are participating in the pickup or slowdown.

Measuring the diversity or scope of survey responses is useful because of the way ups and downs in the economy generally develop. The effect of an economic expansion is usually felt by just a few industries at first. When firms in those industries observe a pickup in business, they step up production to meet the stronger demand. They buy more raw materials and machinery, hire more labor, and so forth. This process repeats itself at the firms that supply materials to the first few firms, and the higher employment leads to higher household income, which gives a boost to industries that produce consumer goods. As this process continues, we observe the effects of the expansion spreading from industry to industry, being *diffused* throughout the economy.

Given this kind of process, the diffusion indexes calculated from the BOS results should exhibit certain kinds of behavior at different points in the typical business cycle. Specifically,

as the economy pulls out of a recession and starts to pick up steam, more and more businesses will start to share in the expansion, and the diffusion indexes will increase. Then, as the expansion matures and its pace slows, fewer firms will be able to post additional gains, and the diffusion indexes will begin to drop back. When the expansion stops and the economy actually begins to contract, the number of firms reporting decreases in various indicators will start to outweigh the number reporting increases, and the diffusion indexes will fall below zero.

Consider, for example, the behavior of new orders. In the early stages of an economic expansion, just a small fraction, say 15 percent, of the firms responding to the survey may report increases in new orders, while 75 percent report no change and 10 percent report a decrease. Thus, the diffusion index for new orders would be +5, fairly close to 0. As the pickup spreads to other firms and industries, however, a larger percentage of respondents, say 75 percent, may report gains in new orders, while just 15 percent say there has been no change and 10 percent indicate declines. The diffusion index would then be +65. Thus, as more and more firms participate in the expansion, the diffusion index has moved closer to its maximum value of +100. Then, as firms find it more difficult to post additional gains, the index will start to drop; at this point, perhaps just 35 percent of the respondents will report further increases in new orders, while the remaining 65 percent say new orders are unchanged from the previous month. The diffusion index would therefore drop to +35. When the expansion has run its course, the number of firms reporting increases and decreases in new orders will roughly offset each other, and the diffusion index will again be close to 0. This is a sign that the level of new orders is at a turning point, in this case a peak, and is about to turn down. Finally, when a recession is well under way, 70 percent of the survey respondents may say new orders are falling, while 30 percent say they are increasing. In this case the diffusion index would be a -40.

## WHAT KIND OF INFORMATION DO WE GET FROM THE BOS?

The data collected in the *BOS* provide several types of information. In many cases, the *BOS* fills a void by providing the only information available on some indicators of local business conditions. In other cases, where official statistics on regional indicators are collected, the *BOS* precedes and supplements these data. In addition, the *BOS* reflects national industrial conditions. The Third District accounts for a significant portion (about 7 percent) of national manufacturing employment; and, to the extent that the industrial profile of the region matches that of the nation as a whole, local business conditions will parallel national conditions. Finally, because the *BOS* asks not only about current conditions, but also about future expectations, it can suggest the course of future regional and national economic developments.

Since the *BOS* is based on qualitative responses, it is natural to ask how well it performs compared to more precise quantitative measures of regional and national activity collected and reported in official statistics. Two issues must be addressed, however, before we can make these comparisons. The first involves the timing of the *BOS*, and the second involves the relationship between official statistics and the kind of data collected in the *BOS*.

The period for collecting responses for the *BOS* does not coincide with the data collection periods for most official statistics. As *THE TIMING OF SURVEYS* shows, the collection periods for most official statistics cluster in the middle of each month. The *BOS* survey, on the other hand, takes place between official collection periods, specifically, from about the 20th of one month through the 5th of the next month. Therefore, the *BOS* data reflect conditions that would be recorded in the official statistics for both months. For example, the April *BOS* employment data, collected from March 20 through April 5, can be compared to the Department of Labor data for April, which is collected in mid-April. But it can also be compared to the Labor Department's

employment data collected in mid-March. In short, the *BOS* for any month must be compared not only to the official statistics for that month, the *reference month*, but also to the official statistics for the previous month.

In addition to accounting for the timing difference between the *BOS* and the official statistics, it is also necessary to ensure that we look at the appropriate form of official statistics in order to compare them to the diffusion indexes calculated from the *BOS*. Because the *BOS* questions and diffusion indexes basically represent a *change* in business indicators from one month to the next, the *BOS* results are comparable to the rates of change of business indicators calculated from official statistics, rather than to the absolute levels of those indicators. Although the relationship is not exact, the pattern of the diffusion index for a particular indicator is related to the pattern of that indicator's rate of change. (See *ABOUT DIFFUSION INDEXES AND GROWTH RATES*, p. 8.)

## ASSESSING THE BOS AS A TOOL FOR TRACKING CURRENT BUSINESS CONDITIONS. . .

One of the chief advantages of the *BOS* is the early availability of its results. In many situations, an early reading of the state of the economy can be especially valuable to private and public decisionmakers. For example, a sudden drop in employment may call for a reduction in retailers' inventories. In the public sector, monetary and fiscal policymakers want to know as soon as possible whether a given change in policy has had the desired effects.

The *BOS* provides an up-to-date reading of the state of the economy because the data collected in the survey, although qualitative, are collected and processed quickly. For regional conditions, the *BOS* results are available before any official statistics (including preliminary numbers) for the reference month and even for the previous month. So, relatively speaking, the *BOS* gives a fairly early indication of local business activity. For the national economy, however, official sta-



THE TIMING OF SURVEYS

COMPARING SURVEY DATA COLLECTION AND PUBLICATION TIMING

The shaded portion shows the survey period for the April 1986 BOS. The results of this survey were published on April 15, 1986. The graph also depicts the survey periods and publication dates of the official statistics for both March and April, 1986. These statistics are collected and published by the following agencies:

- U.S. Department of Labor  
Bureau of Labor Statistics (BLS)
- Manufacturing Employment
  - Average Workweek
  - Producer Prices

- Board of Governors,  
Federal Reserve System
- Industrial Production

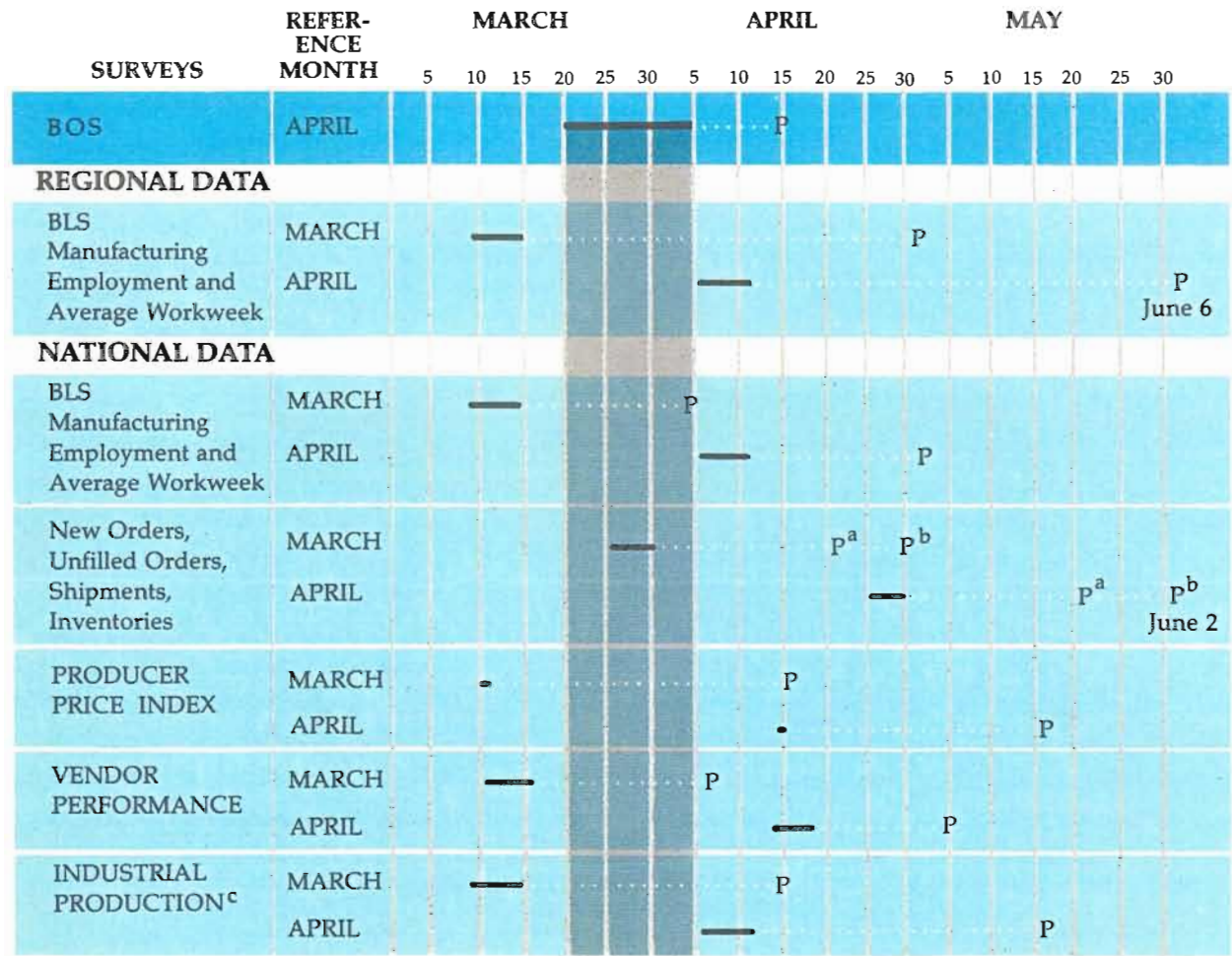
- U.S. Department of Commerce  
Bureau of the Census
- New Orders
  - Shipments
  - Unfilled Orders
  - Inventories

- Purchasing Management Association
- Vendor Performance

—

Data Collection Days

P Publication Date



<sup>a</sup>Advanced. Does not apply to Inventories.

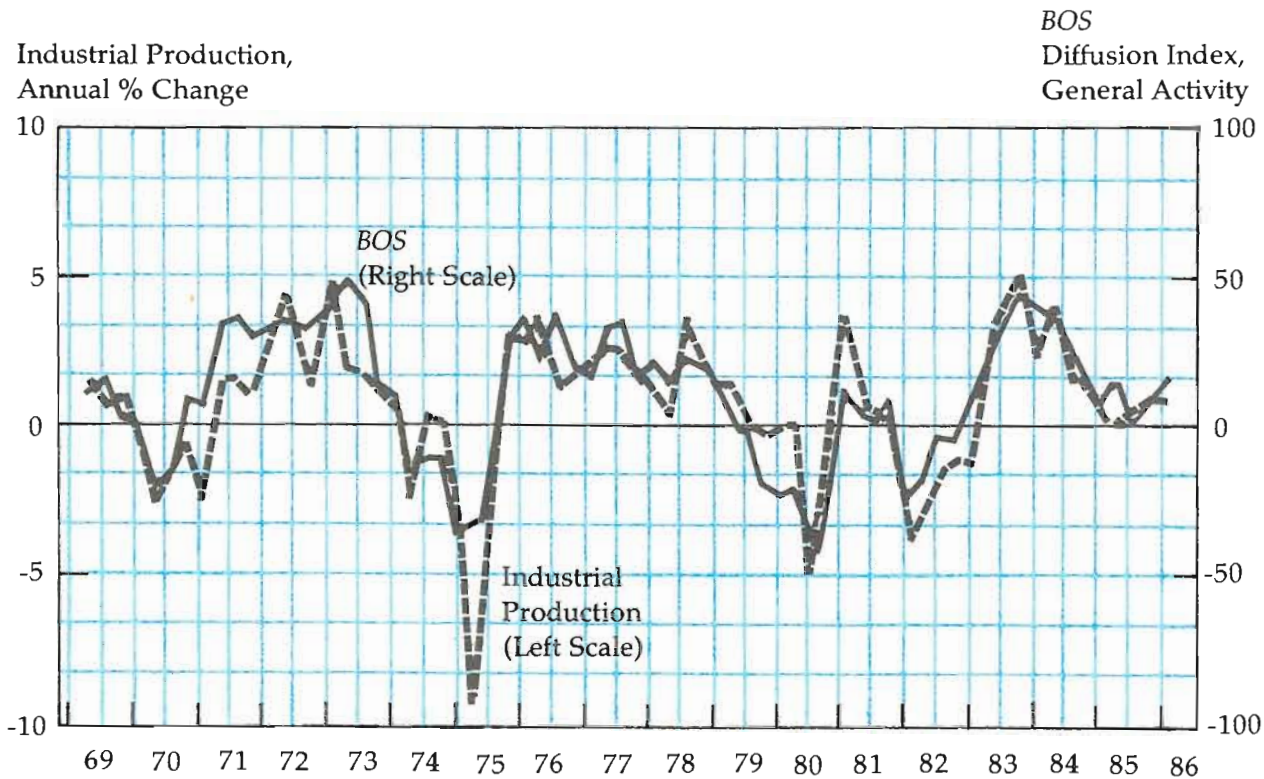
<sup>b</sup>Preliminary.

<sup>c</sup>This series is based partly on the BLS survey; it also contains data on (1) electric power usage over various billing periods in the month, and (2) trade association information available at various times during the month.

ABOUT DIFFUSION INDEXES AND GROWTH RATES

Strictly speaking, a diffusion index measures only the scope of an expansion or contraction, and not the strength or speed with which an indicator is growing or declining. Most policymakers and business owners, however, would not feel comfortable making decisions based on the scope of an expansion alone; they would also want information on the rate of growth of economic indicators. Diffusion indexes may provide some information here as well. Although the relationship is not exact, the scope of an expansion or contraction in an economic indicator is roughly related to the growth rate of that indicator. The figure shows this relationship. Generally, when the annualized growth rate in manufacturing output (industrial production) is high, the BOS diffusion index for general business activity is also high, and when the annualized growth rate of industrial output is negative, the diffusion index is also negative.

The relationship between diffusion indexes and growth rates is not exact, however, for two reasons. First, the survey responses used to construct the diffusion index contain no information on magnitude. They tell us whether a company's business is up or down, but not by how much. It may sometimes be the case that many firms report a pickup in business, but that each is only seeing a small improvement. In this case, the diffusion index would be very high, but the actual magnitude of the increase would be small. Second, the responses to the BOS are not weighted by the size of the respondent relative to the industry. If one industrial giant reports a drop in shipments and many small firms report an increase, the diffusion index will be very high. But if that one large firm accounts for a significant portion of total shipments in the industry, the actual growth rate of total shipments may be very low or even negative.





tistics are more plentiful and are available earlier than their regional counterparts. Nevertheless, the BOS still provides some early information for the reference month, with results available two to five weeks before the official statistics. Given that we can get some early information from the BOS, two other questions become relevant. First, is the information accurate? Second, is the information new?

**Measuring Accuracy.** To answer the first question, the various diffusion indexes calculated from BOS results can be correlated with the growth rates of the corresponding official data series. Correlation coefficients show how well the BOS data have tracked changes in the official series. Since diffusion indexes and growth rates are not the same thing, a perfect or near-perfect correlation between the BOS and more precise official data is not to be expected. On the other hand, the relative accuracy of the various indexes from the survey will be reflected in the size of the correlations, and significance tests can tell us whether they are statistically different from zero.

At the regional level there are only two official series available to compare to the BOS indexes—manufacturing employment and average workweek.<sup>2</sup> As Table 1 shows, the BOS responses

<sup>2</sup>The official data from the Department of Labor’s Bureau of Labor Statistics are collected for metropolitan statistical areas; therefore, to compare these data with BOS results for the entire Third District, some adjustments were required. For manufacturing employment, we combined the published

TABLE 1  
THE BOS TRACKS CURRENT  
BUSINESS CONDITIONS

	Previous Month	Reference Month
REGIONAL		
Manufacturing Employment	.58*	.54*
Average Workweek	.04	.01
NATIONAL		
Manufacturing Employment		.62*
Average Workweek		.02
Industrial Production		.57*
New Orders		.17*
Unfilled Orders		.50*
Shipments		.21*
Inventories		.23*
Vendor Performance <sup>a</sup>		.66*
Producer Price Index (correlated with BOS “prices paid”)		.47*
Producer Price Index (correlated with BOS “prices received”)		.44*

\*Significantly different from zero at the .01 level.

<sup>a</sup>Since this is a diffusion index, the actual index was used for the correlations rather than the percentage change.

correlate well with official data on manufacturing employment for both the reference month and the previous month. This is encouraging, since those who monitor local economic activity often concentrate on the employment situation for

figures for the metropolitan areas within the District to obtain a regional total. For the average workweek, we calculated a weighted average across metropolitan areas to obtain an average for the District; the weight for each metropolitan area was equal to its share of the District’s manufacturing employment.

lack of a more comprehensive measure of the state of the economy, such as gross regional product. The BOS and the official series on the length of the average workweek, however, differ a great deal. This may be due to differences between the survey sample and the actual industrial profiles of the region and the nation. By design, the BOS sample is heavily weighted toward large firms; and, it happens that, the sample has a larger proportion of primary metals firms than do either the regional or national industrial sectors. Changes in the average workweek at larger plants or primary metals firms may follow a different pattern from changes in working hours at a broader range of companies.

At the national level, we measure the correlation between the BOS and official series for the reference month only, since the BOS does not provide early information on the national economy for the previous month. Each BOS index has a corresponding official series at the national level, and with the exception of the average workweek, correlations between the BOS series and growth rates calculated from the official series are all positive and significant (see Table 1). Moreover, the size of the correlation coefficients indicates that some of the most accurate information provided by the BOS is on the important economic measures of manufacturing employment and industrial production. These are the most comprehensive measures of manufacturing activity gathered at the national level. The BOS also provides reliable information on some national variables that are important indicators of where the economy is headed, such as new orders, changes in inventories, and vendor performance.

**Is the Information New?** Some have contended that business surveys don't add much, because we can (almost) as easily know "where we are and where we are tending" simply by looking at where we have been. The idea of pinpointing present and future economic conditions based on historical performance is formalized and quantified in a standard statistical tool called an autoregressive model. The autoregressive

model incorporates the past behavior of one data series, such as manufacturing employment, to estimate the current month's change in that series.<sup>3</sup> If the inclusion of the current diffusion index from the corresponding BOS series in the autoregressive model improves the estimation, the BOS is providing information over and above that contained in the past behavior of the series—new information.

For the region, this search for new information is applied only to manufacturing employment, since there is no positive relationship between the BOS and official series for the average workweek, the only other indicator available at the regional level. Testing the BOS in an autoregressive model for local manufacturing employment reveals that the BOS does not contain additional information about changes in employment for the previous month. For the reference month, however, it does improve on the estimate made by the autoregressive model and therefore does add to the information obtained from an autoregressive model.<sup>4</sup>

The BOS can also provide additional information about the current state of the national economy before the official statistics come out. An autoregressive model of official data corresponding to the BOS data was estimated for all series except the average workweek and new orders. As with the regional data, there is no correlation between the BOS and official national data for the average workweek, and in the case of new orders, future changes could not be explained with a simple autoregressive model

<sup>3</sup>See Richard W. Lang, "Using Econometric Models to Make Economic Policy: A Continuing Controversy," this *Business Review* (January/February 1983) pp. 3-13.

<sup>4</sup>The BOS does not provide additional information on local employment in the previous month mainly because national employment figures for that month are available by the time the BOS is published. Because national and regional employment statistics are so closely linked, the national figures can be used to make a reasonable approximation of local employment. The Technical Appendix explains how the national and local employment data are used in the autoregressive model.



(see TECHNICAL APPENDIX, p. 14). For the seven remaining national indicators—manufacturing employment, industrial production, unfilled orders, shipments, inventories, vendor performance, and producer prices—statistical tests indicate that the BOS does provide new information about the current month’s change.

... AND AS AN INDICATOR OF THINGS TO COME

Corresponding to each of the questions about current economic activity on the BOS is a question about the respondent’s expectation of changes over the following six months. Do these expectations provide any information about changes in regional or national economic indicators over that period? And do they add new information that could not be derived from an autoregressive model?

Are Expectations Met? When matched against the performance of the regional economy, the expectations of the BOS respondents about employment growth over the next six months have generally been realized (see Table 2). In contrast, their expectations about the average workweek have not corresponded well with the changes that actually took place. On the national level, the six-month-ahead changes in manufacturing employment, average workweek, industrial production, and producer prices generally have corresponded to the expectations of the BOS respondents. The story is different for three other national indicators. The respondents’ expectations with respect to

unfilled orders, inventories, and vendor performance have been systematically wrong when compared to the actual changes in these variables. Only a detailed examination of the survey responses since 1968 could uncover the cause of this discrepancy. But there may be a simple explanation. When answering these three survey questions, some respondents may record what they would like to see happen or what they plan with respect to the backlog of unfilled orders, inventories, and vendor performance. However, the pace of the economy may not allow their firms to make the desired adjustments.

TABLE 2  
THE BOS AS AN INDICATOR OF FUTURE ACTIVITY

CORRELATION OF BOS WITH PERCENT CHANGE OVER SIX MONTHS IN OFFICIAL DATA SERIES  
REGIONAL

Manufacturing Employment	.31*
Average Workweek	.11

NATIONAL

Manufacturing Employment	.38*
Average Workweek	.37*
Industrial Production	.46*
New Orders	.11
Unfilled Orders	-.24*
Shipments	-.02
Inventories	-.27*
Vendor Performance <sup>a</sup>	-.53*
(six month average of index)	
Producer Price Index	.35*
(correlated with BOS “prices paid”)	
Producer Price Index	.40*
(correlated with BOS “prices received”)	

\*Significantly different from zero at the .01 level.

<sup>a</sup>Since this is a diffusion index, the six month average of the index was used for the correlations rather than the percent change in the index.

**Can the BOS Help Us Predict?** The question of whether the BOS can help us predict the future course of the regional or national economy can be answered by comparing the diffusion index from the survey with the error from a six-month-ahead forecast from an autoregressive model. If the error in the forecast for any economic indicator is correlated with the BOS future diffusion index for that indicator, then the respondents' expectations contain information about the future not contained in the history of the indicator itself. For regional manufacturing employment, statistical analysis uncovered no evidence of a systematic relationship between errors in the six-month forecast and the diffusion index on future employment from the BOS. In terms of the national economy, the expectations of the survey respondents with respect to the average workweek and industrial production do provide additional information about the future. This is especially important for the expectations on general activity or industrial production. The index based upon these expectations has generally been used as the major leading indicator from the BOS. For manufacturing employment at the national level and producer prices, however, forecast errors from an autoregressive model are *not* systematically related to the expectations index from the BOS.

#### DOES THE BOS SIGNAL DOWNTURNS IN THE BUSINESS CYCLE?

When business and government look to the future, the ability to anticipate turning points in the business cycle is especially valuable. A diffusion index can be helpful in this regard. If expansions typically become more and more diffuse and then slow down before the peak in production, turning points in the diffusion index will precede turning points in the business cycle itself. And, indeed, the current and future general activity indexes from the Third District Business Survey turned down before the onset of three of the four national recessions since 1968 (see THE BOS GENERAL ACTIVITY INDEX SIGNALS RECESSIONS).

Although it is relatively easy to identify recession signals from a chart of BOS indexes *after* recessions have been dated, what really matters is whether the survey provides clear recession signals that are neither too early nor too late. A lead time of one to twelve months is generally considered an acceptable range.<sup>5</sup> More importantly, a leading indicator should miss few, if any, downturns and should send very few false signals. In order to meet these criteria, forecasters have applied simple rules of thumb to the national index of leading indicators to predict downturns in a business cycle.<sup>6</sup> One of the most frequently used rules is that three consecutive declines in that index signal an imminent recession. Under this rule, the index of leading indicators has signaled all four recessions since 1968 with lead times of three to five months and no false alarms.

For the diffusion index from the BOS, the analogue to the rule of three consecutive declines would be three consecutive negative values. We applied this rule of thumb to the diffusion index calculated from responses about future general activity. Under this rule, the index signaled three of the four recessions since 1968 with leads of one to thirteen months. It failed to signal one recession (1981-82) and gave no false signals. Its record is respectable, but less impressive than the recent performance of the national index of leading indicators.<sup>7</sup>

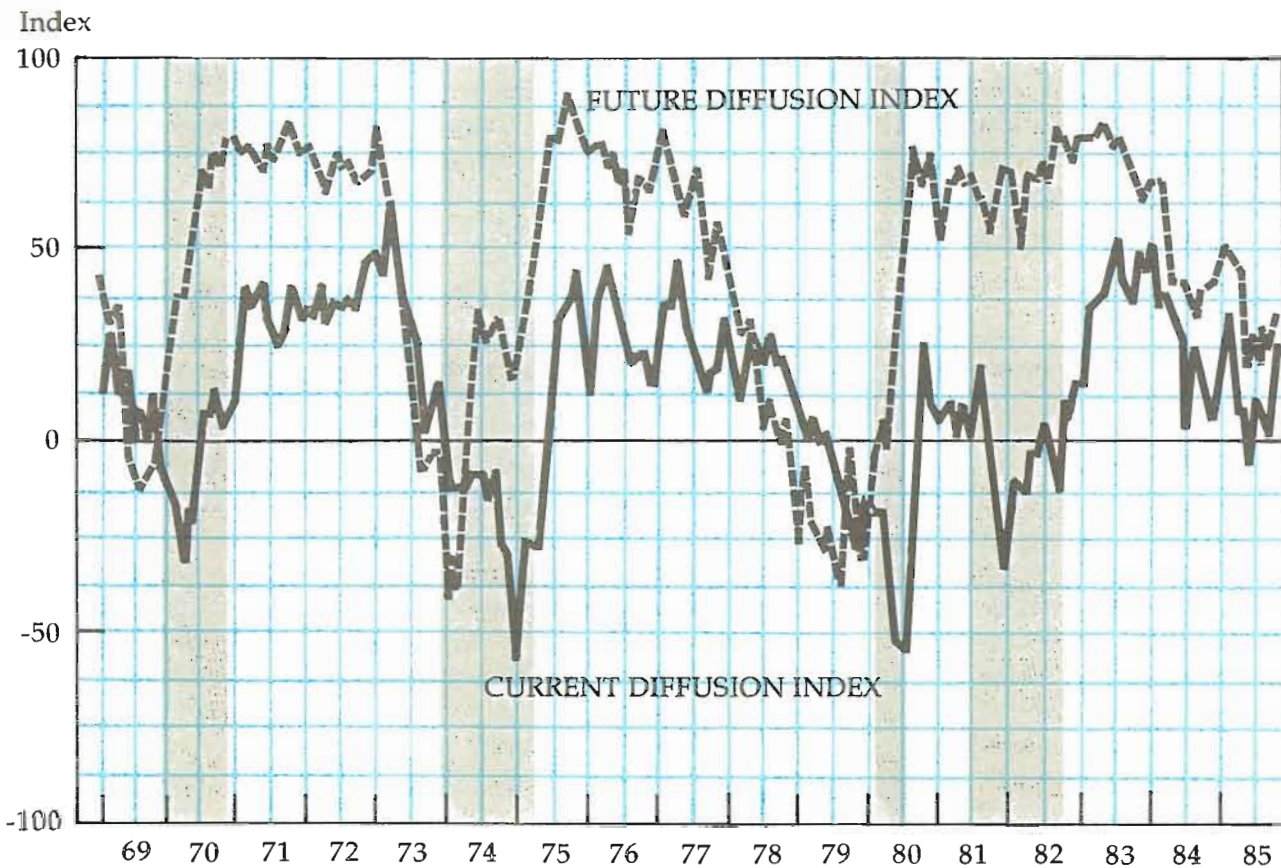
<sup>5</sup>See Carl J. Palash and Lawrence J. Radecki, "Using Monetary and Financial Variables to Predict Cyclical Downturns," Federal Reserve Bank of New York *Quarterly Review* (Summer 1985) pp. 36-45.

<sup>6</sup>See Gary Gorton, "Forecasting with the Index of Leading Indicators," this *Business Review* (November/December 1982) pp.15-27.

<sup>7</sup>Recently, more sophisticated techniques have been developed to refine the use of leading indicators in predicting downturns. See Salih N. Neftci, "Optimal Prediction of Cyclical Downturns," *Journal of Economic Dynamics and Control* 4(1982) pp. 225-241. Neftci's method takes into consideration the history of a leading indicator from the beginning of the expansion prior to each downturn. Since the BOS only dates from 1968, the method can be used with the indexes



FIGURE 1  
THE BOS GENERAL ACTIVITY INDEX SIGNALS RECESSIONS



NOTE: Index represents the percentage of respondents indicating an increase minus percentage indicating a decrease. The shaded portions represent periods of national recession.

### SCORECARD FOR THE BOS

Business surveys in general are valuable as quick and cost-efficient means of obtaining up-to-date information on the economy. At the regional level they may also provide the only data available about certain economic indicators, and

from the survey for only three recessions. When applied to the future diffusion index, the method would have signaled two recessions with a 90 percent probability and missed one. However, one of the two recessions was signaled with an unacceptable lead time of twenty-four months. When applied to the national index of leading indicators, Neftci's method signaled two of the last three recessions with acceptable lead times and gave no false signals.

this is the case for most of the questions on the BOS.

The ultimate value of such surveys, however, depends upon how accurately they reflect the state of the economy. The information from the BOS about current conditions corresponds well with changes in several important regional and national indicators such as manufacturing employment, industrial production, and producer prices. Furthermore, the responses to the survey contain information on the current state of the regional and national economy that could not be derived from the recent history of the official data series. They provide information that will be reflected in official statistics only two to six

weeks after the *BOS* is published.

Aside from their importance in gathering current information, business surveys are a favorite vehicle for obtaining information on expectations. Statistical tests show that the value of the expectations of the respondents to the *BOS* varies greatly depending upon what question is asked. For some major economic indicators, like manufacturing employment, average workweek, industrial production, and producer prices, the

respondents' expectations have generally been fulfilled. For other indicators like unfilled orders, inventories, and vendor performance, their expectations have been misleading. These discrepancies between expectations and the actual performance of the economy illustrate the need to test business surveys, as we have done with the *BOS*, to determine their strengths and weaknesses.

### TECHNICAL APPENDIX ADDITIONAL INFORMATION FROM THE *BOS*

In those cases where simple correlations indicated that the *BOS* provides information on the change in a regional or national variable, we attempted to determine whether the survey results add information to what is already available in the history of the series itself, that is, whether it could improve the forecast derived from an autoregressive model.

Because official statistics for the average workweek in the region did not correlate well with the diffusion index from the *BOS*, regression analysis of regional variables was confined to manufacturing employment. When the *BOS* is published, the latest available regional employment data is for two months previous. National employment statistics for the preceding month are available, however, and they include data from the region. Therefore, past changes in national manufacturing employment were included in the regression equation which took the following form:<sup>a</sup>

$$\dot{R}_t = \alpha + \sum_{j=2}^{13} \beta_j \dot{R}_{t-j} + \sum_{k=1}^{13} \gamma_k \dot{N}_{t-k} + \delta D_t$$

where

$\dot{R}_{t-j}$  = the percentage change in regional manufacturing employment for time  $t-j$

$\dot{N}_{t-k}$  = the percentage change in national manufacturing employment for time  $t-k$

$D_t$  = the diffusion index based on the *BOS* for period  $t$ .

A positive estimate for  $\delta$  which is significantly different from zero in a statistical sense would indicate that the diffusion index on employment provides new information on regional employment in the reference month that is not contained in the history of the regional or national employment series. Our estimates produced a positive estimate for  $\delta$  ( $=0.025$ ) that is significantly different from zero in a statistical sense ( $t=5.22$ ).<sup>b</sup> To determine whether the diffusion index contains new information for the previous month, we replaced  $R_t$  on the left hand side of the equation above with  $R_{t-1}$  and reestimated the parameters. In this case, the estimate of  $\delta$  was positive ( $=0.003$ ) but not significantly different from zero ( $t=0.87$ ).

<sup>a</sup>Data from May, 1968 through December, 1984 were used for all the regressions reported in this appendix.

<sup>b</sup>Similar equations with 6- and 18-month lags were also estimated with no qualitative difference in the results, that is, with a positive and significant estimate of  $\delta$ .



We also tested to see if the BOS provides independent information on changes in national variables by estimating the parameters of the following equation,

$$\dot{V}_t = \alpha + \sum_{j=1}^{12} \beta_j \dot{V}_{t-j} + \delta D_t$$

where

$\dot{V}_{t-j}$  = the percentage change in the national variable for time  $t-j$ ,<sup>c</sup>

$D_t$  = the relevant diffusion index based on the BOS for period  $t$ .

We did not estimate this regression for the average workweek because the correlation with the diffusion index was very low. Furthermore, preliminary estimates failed to reveal any kind of simple autoregressive process for changes in new orders. Low F-statistics would not allow us to reject the hypothesis that all of the coefficients were zero in autoregressive models with six, twelve, and eighteen lags for this variable. In the cases of the remaining seven national variables (industrial production, unfilled orders, shipments, inventories, vendor performance, producer prices, and manufacturing employment), the estimate of  $\delta$  was positive and significant, indicating that the diffusion index does provide additional information (see Table A1).<sup>d</sup>

TABLE A1

National Variable	Estimate of $\delta$	t-Statistic
Manufacturing Employment <sup>a</sup>	.032	6.56
Industrial Production <sup>a</sup>	.035	5.97
Unfilled Orders	.015	3.79
Shipments	.053	4.83
Inventories	.007	1.78
Vendor Performance	.156	3.03
Producer Prices (BOS index for "prices paid")	.017	4.08
Producer Prices (BOS index for "prices received")	.019	4.00

<sup>a</sup>Because of low Durbin-Watson statistics for the equations with twelve lags, the estimated  $\delta$  and t-statistics for these variables are from equations with eighteen lags.

<sup>c</sup>In the case of vendor performance, the actual index was used in this regression instead of the percentage change since vendor performance is itself a diffusion index.

<sup>d</sup>The criterion we used was a significance level of .05 for the estimate of  $\delta$  based upon a one-tailed test.

To determine whether the responses to the BOS on future economic activity add any new information to what is contained in the history of the series themselves, we calculated six-month-ahead forecasts from a simple autoregressive model for all the regional and national variables that have a positive and significant correlation with the future diffusion index from the BOS (regional manufacturing employment, national manufacturing employment, industrial production, producer prices, and average workweek).<sup>e</sup> We then regressed the six-month forecast error on the relevant diffusion index using the following equation:

$$E_t = \alpha + \beta(FD)_t + e_t$$

where

$E_t$  = the cumulative six-month-ahead forecast error from the autoregressive model

$(FD)_t$  = the diffusion index calculated from the relevant question on the survey about activity six months in the future.

The estimates of  $\beta$  were not significantly different from zero for manufacturing employment at the regional or national level or for producer prices. The index contained no information that could have improved the six-month-ahead forecast from the autoregressive model for these variables. However, positive and significant  $\beta$ 's indicated that the respondents' expectations with respect to industrial production and the average workweek could improve the six-month-ahead forecasts for these national variables (see Table A2).

TABLE A2

Regional Variable	Estimate of $\beta$	t-Statistic
Manufacturing Employment	.015	1.59
National Variable		
Manufacturing Employment	.013	1.08
Average Workweek	.022*	2.35
Industrial Production	.033*	2.11
Producer Prices (BOS index for "prices paid")	-.001	0.04
Producer Prices (BOS index for "prices received")	.022	0.19

\*Statistically different from zero at the .05 level.

<sup>e</sup>The forecasts were based on an autoregressive model with twelve lags, except for national industrial production and manufacturing employment which were based on a model with eighteen lags. Since the entire sample was used to estimate the coefficients in the autoregressive equation, these are six-month-ahead, in-sample forecasts. It was not possible simply to include the diffusion index in an autoregressive model estimating six-month-ahead changes rather than one-month-ahead changes because of serial correlation problems.