Using Manufacturing Surveys to Assess Economic Conditions

Matthew Harris, Raymond E. Owens, and Pierre-Daniel G. Sarte

Starting in the 1980s, the Richmond Fed began surveying District manufacturers as input into the Bank's Beige Book reports. The effort, which mimics the Institute of Supply Management's (ISM) national survey, was undertaken because little timely information on regional manufacturing activity was available. Surveys such as the ISM's are generally used because they are thought to provide a good balance between collection effort and the information obtained. While the earliest Richmond Fed Surveys appeared to be useful gauges of activity, they had an important shortcoming. They were conducted approximately every six to seven weeks—prior to the Fed's Beige Book reports, so that the results did not coincide with the regular monthly or quarterly findings from other surveys or economic reports. This irregular timing meant that Richmond Survey results could not be easily verified against other "benchmark" data, leaving unanswered the appropriate weight to assign the information. To overcome this shortcoming, the Richmond Survey was redesigned and conducted on a monthly basis starting in November 1993.

To address this question, we examine why surveys are conducted, and what information is collected. We also examine how the Richmond Fed Survey specifically compares to other benchmarks, including the ISM and the Philadelphia Fed Business Conditions Survey, how well it gauges regional economic activity, and what improvements may be made to the Survey going forward to increase its value.

We find that the ISM is a very good gauge of national economic activity as measured by GDP. Its accuracy is highly valued by analysts because it is

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available up to three months before final GDP data. We also find that the Richmond Manufacturing Survey—alone and when used in conjunction with the Philadelphia Fed Survey of Business Conditions—is highly correlated with the ISM. In addition, we find the Richmond Survey to be a good predictor of several important measures of Fifth District Federal Reserve regional economic activity. It follows, therefore, that the value of the Richmond Survey would increase if it were released sooner and contained an overall measure of economic activity.

1. WHY SURVEY?

Prior to the Richmond Survey, information on Fifth District manufacturing activity was available primarily from the annual Gross State Product (GSP) reports of District states as well as manufacturing employment. But the GSP data are typically released one to two years after the period covered by the report. Other information, such as manufacturing employment, is received in a more timely manner, though still with a one- to two-month lag. Since manufacturing activity has historically shown cyclical behavior, the long lag in the GSP data is problematic. With lags, the cyclical nature of manufacturing activity raises the likelihood that current conditions in manufacturing activity differ from those described in the GSP report, rendering the data useful as a historical benchmark, but sharply reducing their value in assessing current conditions.

A second alternative was the monthly survey of manufacturing conditions provided by the National Association of Purchasing Management (NAPM), now called the ISM. Although timely, the ISM Survey gauges manufacturing activity at the national level rather than at the regional level. This broad geographic coverage raises questions about the NAPM's ability to represent accurately Fifth District manufacturing activity. The Richmond Fed's Survey was undertaken to fill this gap. The information gathered is timely, but has it been accurate? To address this question, an examination of the Richmond Survey and its results follows.

2. THE RICHMOND SURVEY

The Richmond Survey is distributed to approximately 200 manufacturers in the Fifth Federal Reserve District during the second week of each month, with approximately 40 of those manufacturers also receiving the Survey by e-mail. Responses are delivered to us by mail, fax, or via the Internet where respondents can directly input their data by the deadline. Responses must be received by the cutoff date—usually the first day of the following month—and typically number about 90 to 100. After compiling the results, the Richmond

Fed places them on the bank's Web site at 10:00 a.m. on the second Tuesday of the month following the survey month.

The survey sample is designed to approximate the distribution of manufacturing output by state, industry type, and firm size. Firms possessing the desired characteristics are typically identified through industry listings or other means. Once chosen, each manufacturer is invited by mail, e-mail, or by telephone to participate. Periodically, new names are added to the sample to improve the distribution's characteristics, to replace or to enlarge the sample, or to take advantage of a particular manufacturer's offer to participate.

The first portion of the Survey asks about business activity. Each survey includes questions on shipments, new orders, backlogs, finished goods inventories, employment, average workweek, vendor lead time, capacity utilization, and capital expenditures. Manufacturers are asked whether their firms experienced an increase, decrease, or no change in a variety of activity measures in each variable over the preceding month. They are also asked whether they expect an increase, decrease, or no change in the next six months. Raw data are combined to create diffusion indexes equal to the percentage of respondents reporting increases minus the percentage reporting decreases. Diffusion indexes are a standard survey tool and are used by many agencies, including the Philadelphia and Kansas City Feds.[1]

The diffusion index used for the Richmond Survey is centered on 0, meaning that 0 infers that the level of activity is unchanged from the prior month's level. A positive reading indicates a higher level, and a negative reading infers a lower level. Greater or lesser readings compared to the prior month are interpreted as faster or slower rates of change in activity, respectively. The diffusion index is computed according to the standard form,

$$\text{Index Value} = 100(I - D)/(I + N + D), \tag{1}$$

where I is the number of respondents reporting increases, N is the number of respondents reporting no change, and D is the number of respondents reporting decreases.

Once the raw diffusion indexes are derived, seasonal adjustment factors are applied. The factors are determined from the last five years of data using the Census X-12 program.[2]

The second portion of the Survey focuses on inventory levels. Manufacturers are asked how their current inventory levels compare to their desired

[1] For a recent detailed description of the Kansas City Fed Survey, see Keeton and Verba (2004).

[2] The Richmond Survey's results are bounded between -100 and 100 by construction. It has been suggested that the results could be transformed into an unbounded series using a logit transformation procedure before being seasonally adjusted. However, a comparison of this method with the simple add-on method reveals no substantial difference in the results.

levels. They may respond too low, too high, or correct. The manufacturers are also asked a similar question about their customers' inventories.

The third portion of the Survey covers price trends. We ask manufacturers to estimate recent annualized changes in raw materials and finished goods prices and price changes expected in the next six months. We report the simple means of their responses; no seasonal adjustment factors are applied.

The most recent survey form and the most recent press release are shown in Appendixes A and B. Unlike the ISM and the Federal Reserve Bank of Philadelphia, Richmond does not publish an overall or composite business index.[3] The construction is straightforward, however, and to allow for comparability, we construct a regional business index similar to that of the ISM. Our index differs from the ISM's in two respects. First the Richmond Survey asks only three questions similar to the five asked by the ISM. Given this, our weights on the questions differ from those of the ISM. The composite index, defined by the following components and weights, is used in the next section: shipments (0.33), new orders (0.40), and employment (0.27).

Before analyzing the usefulness of the Richmond Survey specifically, we first address the design and ability of the overall ISM to capture changes in economic activity at the national level.

3. THE ISM

The ISM Survey's indexes are highly regarded by business analysts because they have proven to be a reliable gauge of economic activity over a long period. The ISM's extensive history is a result of purchasing managers' long-standing desire to obtain industry-level information. The earliest purchasing manager survey was the local New York City's association poll of its members regarding the availability of specific commodities. The survey began in the 1920s and, by the 1930s, was broadened to capture a wider range of business activity measures. Following World War II, the report assumed a format similar to the current survey instrument, asking about production, new orders, inventories, employment, and commodity prices. Beginning in the 1970s, other series were added, including supplier deliveries and new export orders, and, in the 1980s, the Purchasing Manager's Index (PMI) was developed. The PMI is a weighted average of several of the seasonally adjusted series in the ISM survey and will be referred to as the ISM index in this article. The components and their weights are production (0.25), new orders (0.30), employment (0.20), supplier deliveries (0.15), and inventories (0.10).

At present, the Survey is sent to approximately 400 purchasing managers at industrial companies across the country each month. The sample is stratified

[3] The Federal Reserve Bank of Philadelphia does not construct an index from a weighted average of several questions. Rather, the survey directly asks about business conditions.

Figure 1 GDP Growth Rate

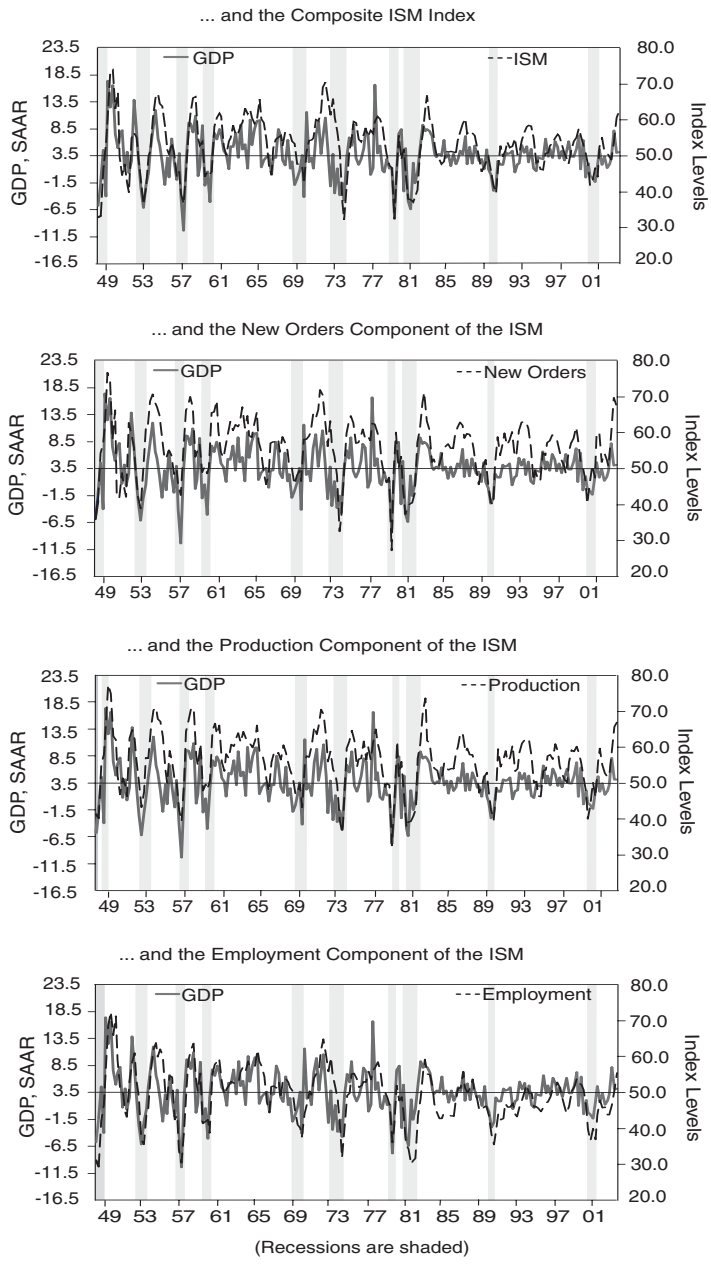
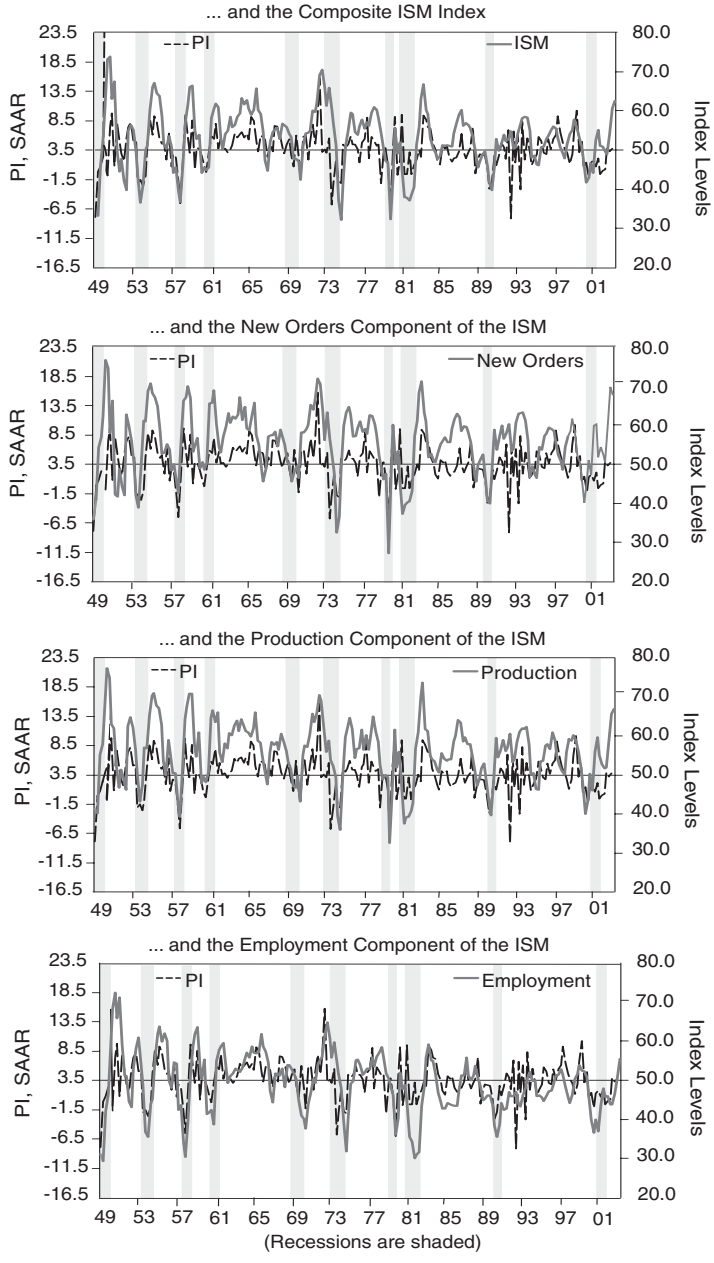


Figure 2 U.S. Personal Income Growth



to represent proportionally the 20 two-digit SIC manufacturing categories by their relative contribution to GDP. In addition, the Survey is structured to include a broad geographic distribution of companies (Kauffman 1999).

The ISM survey questions are not released by the organization, so we do not know precisely what questions respondents answer or whether the questions changed over time. In addition, the number of respondents is not revealed by the organization, making variations in response rates impossible to determine.

Despite a lack of detailed information on the survey instrument and response size, the purchasing manager's report has an enviable track record as an indicator of both national manufacturing and general economic conditions. A review of the ISM as an indicator of broader economic conditions follows.

4. THE ISM AND THE BUSINESS CYCLE

Figures 1 and 2 illustrate how various components of the ISM have moved with GDP and personal income, respectively, over the post-war period. The ISM appears to track movements in GDP closely. Note also that both the volatility of GDP growth and that of the ISM seem to have fallen together beginning in the early 1980s. Over the period from 1949 to 1984, the standard deviation of GDP growth was 5.0 percent, as compared to just 2.2 percent from 1984 to the present. This represents a decline of more than 50 percent between the two sample periods. Similarly, the standard deviation of the ISM fell from 8.8 percent over the 1949–1984 period to 4.6 percent since 1984. McConnell and Quiros (2000) argue that much of the reduction in output fluctuations over the last two decades can be attributed to a discrete fall in the volatility of durables output around 1984. Khan et al. (1999) then make the case that the fall in durables volatility itself reflects technological innovations in inventory management. To the degree that this explanation is an important factor driving the fall in output volatility starting in the early 1980s, one would expect the ISM to show precisely the kind of corresponding decrease in standard deviation it has experienced over the same period. In fact, all components of the ISM display a significant decrease in volatility after 1984.

Figures 3 and 4 show the cross-correlations between primary components of the ISM and GDP as well as personal income. Leads and lags in Figures 3 and 4 are measured in quarters. In both cases, the ISM correlates quite well with those measures, although the cross-correlations with personal income are generally smaller. Observe also that the cross-correlations are highest contemporaneously (i.e., $k = 0$) across components of the ISM, seemingly suggesting that the ISM offers no advance information on the state of the business cycle. However, the cross-correlations depicted in Figures 3 and 4 relate to revised GDP releases. Since GDP numbers for a given quarter are

released in preliminary form with a one-month lag, and in revised form with up to a four-month lag, the ISM appears to provide surprisingly accurate real-time information on the business cycle, essentially one quarter or more ahead of the release of the final GDP report.

Interestingly, the cross-correlations with both GDP and personal income are highest not for the overall ISM but for its production component (as much as 70 percent contemporaneously in the case of GDP), which is not surprising. The production component of manufacturing most directly represents the sector's contribution to the value of real GDP in a contemporaneous setting. In contrast, new orders represent demand for some future period, and though they can offer insight about future production, they can also be canceled or altered.

The notion that the individual components of the ISM are not equally useful in terms of assessing current economic conditions is best reflected in its employment component. In the case of personal income, for instance, Figure 4 shows that the correlogram peaks at $k = 1$, indicating a one-quarter lag with respect to the business cycle. This lag is consistent with the idea that, once layoffs have taken place in a downturn and the economy subsequently begins to pick up, manufacturing firms at first are reluctant to hire new workers and would rather induce their current labor force to work longer hours. In other words, firms may adjust first along the intensive, rather than the extensive, margin.

While Figures 3 and 4 show that the ISM is highly correlated with GDP, the following rolling regressions show that it also generally improves the forecast performance of both GDP and personal income, as measured by the mean-squared forecast error. The regressions are run against two lags of the dependent variable and each of the ISM components, in turn, over the period 1949:Q1 to 1994:Q1, using a ten-year rolling window.

In Table 1, $\text{MSE}^{y,x}$ and MSE^{y} denote the mean-squared error of the y forecast with and without the ISM, or one of its components, respectively. Here, y refers to the cyclical component of GDP obtained from a Hodrick-Prescott (HP) filter decomposition.[4] Observe that the ratio of the MSEs is significantly less than one. This value demonstrates that including lags, either of the ISM or one of its components, always improves upon the current-quarter forecast of either GDP or personal income, relative to using their own lags alone.[5] Moreover, the ISM series performs better a quarter ahead for both GDP and personal income. The production series most improves the forecastibility

[4] GDP growth can be used in place of cyclical movements without substantial changes in the findings.

[5] Forecasting current-quarter GDP is a useful exercise because advance, preliminary, and final GDP data are released approximately one, two, and three months, respectively, after the quarter ends. In contrast, the ISM data are available one business day after the quarter ends.

Figure 3

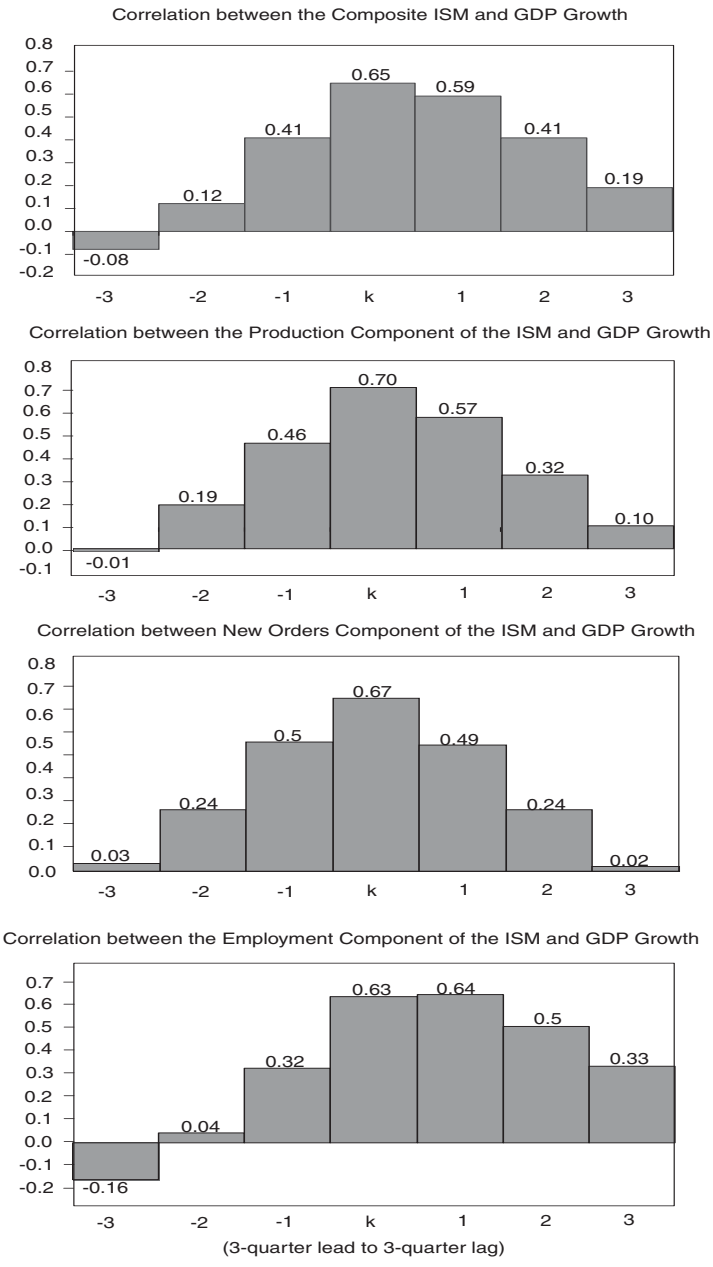

Correlation between the Composite ISM and GDP Growth
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.08
0.12
0.41
0.65
0.59
0.41
0.19
-3
-2
-1
k
1
2
3
Correlation between the Production Component of the ISM and GDP Growth
-0.01
0.19
0.46
0.70
0.57
0.32
0.10
Correlation between New Orders Component of the ISM and GDP Growth
0.03
0.24
0.5
0.67
0.49
0.24
0.02
Correlation between the Employment Component of the ISM and GDP Growth
-0.16
0.04
0.32
0.63
0.64
0.5
0.33
(3-quarter lead to 3-quarter lag)

Figure 4

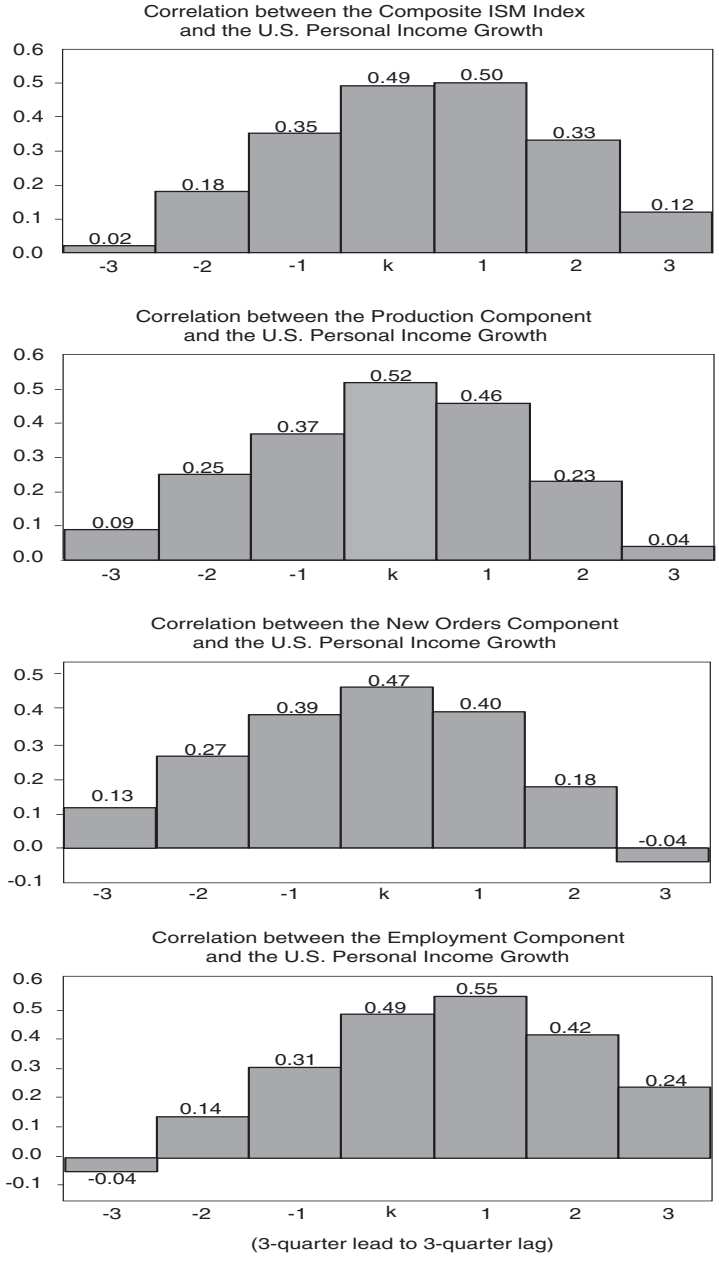

Correlation between the Composite ISM Index and the U.S. Personal Income Growth
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.02
0.18
0.35
0.49
0.50
0.33
0.12
-3
-2
-1
k
1
2
3
Correlation between the Production Component and the U.S. Personal Income Growth
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.09
0.25
0.37
0.52
0.46
0.23
0.04
-3
-2
-1
k
1
2
3
Correlation between the New Orders Component and the U.S. Personal Income Growth
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
0.13
0.27
0.39
0.47
0.40
0.18
-0.04
-3
-2
-1
k
1
2
3
Correlation between the Employment Component and the U.S. Personal Income Growth
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.04
0.14
0.31
0.49
0.55
0.42
0.24
-3
-2
-1
k
1
2
3
(3-quarter lead to 3-quarter lag)

Table 1 Results from Rolling Regressions

$$y_t = \sum_{j=1}^{2} \alpha_j y_{t-j} + \sum_{j=0}^{1} \beta_j x_{t-j}$$

A: *y denotes detrended GDP*		
Predictor, *x*:	Current Quarter $MSE^{y,x}/MSE^{y}$	1 Quarter Ahead $MSE^{y,x}/MSE^{y}$
ISM	0.78	0.69
ISM - Production	0.74	0.64
ISM - New Orders	0.78	0.71
ISM - Employment	0.75	0.64
B: *y denotes Personal Income*		
Predictor, *x*:	Current Quarter $MSE^{y,x}/MSE^{y}$	1 Quarter Ahead $MSE^{y,x}/MSE^{y}$
ISM	0.86	0.84
ISM - Production	0.86	0.83
ISM - New Orders	0.87	0.85
ISM - Employment	0.87	0.85

of both GDP and personal income in the current quarter and one quarter ahead. This result is not surprising, as production most closely matches GDP conceptually and would be expected to perform well compared to personal income. In addition, the new orders component of the ISM generally improves both the current and one-quarter-ahead forecasts of GDP, although to a slightly lesser degree than the other components of the ISM one quarter ahead. This underscores the notion that new orders may not translate into shipments at a later date.

Although the ISM and its components improve the ability to forecast personal income in both the current quarter and one quarter ahead, Table 2 indicates that this improvement is somewhat reduced relative to GDP in Table 1. While personal income tends to track GDP over the long run, there are often substantial deviations between the two in the short run because of measurement error in personal income as well as differences in its definition. For example, personal income includes income from interest and rental sources which do not closely track movements in GDP.

While we have shown that the survey of purchasing managers is effective in tracking movements in GDP in real time (i.e., considerably ahead of the GDP release for the corresponding time period) and forecasting real growth, a more central question concerns its ability to alert us of impending recessions. Figure 1 shows that the ISM and its individual series tend to fall prior to recessions. As in Dotsey (1998), we can establish whether this behavior contains any predictive power most simply by assessing the signal value of

Table 2 Signal Value of the ISM and its Components One Quarter Ahead

Predictor, x:	$x < \mu - \frac{\sigma}{2}$	$x < \mu - \sigma$	$x < \mu - \frac{3\sigma}{2}$
ISM			
Total Signals	42	21	11
Frequency of True Signals (%)	61.90	71.43	90.91
Production			
Total Signals	29	14	5
Frequency of True Signals (%)	68.97	78.57	80.00
New Orders			
Total Signals	21	12	3
Frequency of True Signals (%)	66.67	83.33	66.67
Employment			
Total Signals	78	31	18
Frequency of True Signals (%)	38.46	67.74	72.22

the ISM series at different thresholds. Accordingly, let us define a signal as true if the ISM or one of its components falls below its mean (μ) by at least ϕ standard deviations (σ), where ϕ is alternatively $1/2$, 1, and $3/2$, and a recession occurs in the following quarter. We define a signal as false if no recession takes place in the quarter following one of the above signals. We can also carry out this exercise with respect to two-quarter-ahead predictions. In general, examining the relative frequency of true signals gives us a sense of how reliably the purchasing managers' survey anticipates recessions. Note, however, that this procedure says nothing about potential Type 2 errors—that is, situations in which a recession takes place without a signal occurring. As in Dotsey (1998), "this exercise lets us determine if" the ISM series "are like the boy who cried wolf or, in other words, if they correctly predict a weakening economy." The results from this non-parametric exercise are shown in Tables 2 and 3.

The results from Table 2 confirm the graphical intuition obtained from Figure 1 in that the ISM and its individual components generally represent a reliable, albeit imperfect, signal of future recessions. These results explain why both market participants and policymakers place so much emphasis on the monthly ISM release. For comparison, the unconditional likelihood of a recession over the period 1948:Q1 to 2004:Q1, as defined by the relative frequency of recession quarters, is just 20 percent. In contrast, conditioning on the ISM being one standard deviation below its mean, Table 1 indicates that the likelihood of being in a recession next quarter jumps to 71 percent. As expected, the weakest signal of an impending recession associated with the survey of purchasing managers stems from the employment series. For that series, the majority of false signals distinctly occurs towards the end of

Table 3 Signal Value of the ISM and its Components Two Quarters Ahead

Predictor, x:	$x < \mu - \frac{\sigma}{2}$	$x < \mu - \sigma$	$x < \mu - \frac{3\sigma}{2}$
ISM			
Total Signals	42	21	11
Frequency of True Signals (%)	42.86	42.86	54.55
Production			
Total Signals	29	14	5
Frequency of True Signals (%)	51.72	50.00	40.00
New Orders			
Total Signals	21	12	3
Frequency of True Signals (%)	42.87	50.00	33.33
Employment			
Total Signals	78	31	18
Frequency of True Signals (%)	26.94	38.72	44.44

recessions where the employment index remains low despite the end of the recession. As discussed earlier, this feature reflects firms' reluctance to hire new workers until they are convinced that the recession has come to an end. Table 3 indicates that the signal value of the ISM and its components in terms of foretelling recessions falls significantly two quarters ahead, although the frequency of true signals still hovers around 40 to 50 percent for most series. Again, the one exception is the employment series of which the signal value becomes barely more than the unconditional likelihood of a recession.

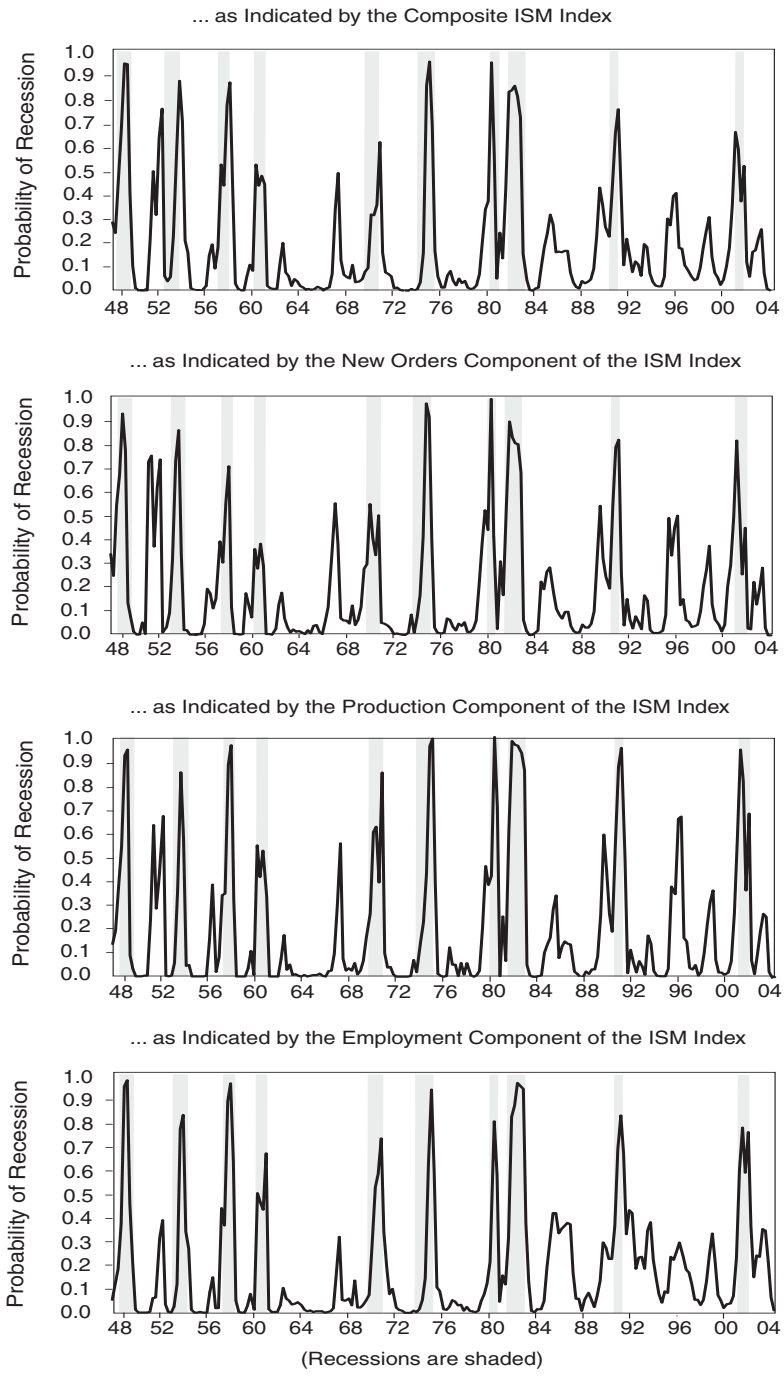
The above analysis can be refined by adding more structure to the way the likelihood of a recession is modeled conditional on observing the ISM or one of its components. In particular, one approach would be to model the probability of a recession as depending continuously on both the observed predictor, x (i.e., the ISM or one of its series), and some parameter, β, that translates the effect of the predictor on the likelihood of a recession. The probit model, for instance, expresses the likelihood of a recession as

$$\begin{aligned} \Pr(\text{recession}) &= \int_{-\infty}^{\beta x} \phi(\omega) d\omega \\ &= \Phi(\beta x), \end{aligned} \tag{2}$$

where $\phi(\omega)$ is the normal density function that corresponds to the cumulative distribution, $0 \leq \Phi(\omega) \leq 1$. It follows that the likelihood of not being in a recession at a given date is simply $1 - \Phi(\beta x)$. Moreover, from (2), we can immediately see that the probability of a recession now increases continuously with the predictor, x.

Figure 5 shows the results from having estimated equation (2) using the ISM or one of its individual series as the conditioning variable. Observe that

Figure 5 Probability of Recession



actual recessions, shaded in gray, are generally associated with spikes in the estimated probability of a recession at those dates. This is especially true for the production series where many of the spikes are very near 1. Furthermore, consistent with the signal value analysis exercise carried out above, Figure 5 generally shows few cases of spikes taking place without a recession. In that sense, the ISM is typically not "a boy who cries wolf." Recall that our signal analysis had nothing to say about potential Type 2 errors—that is, situations where a recession took place without a signal from the survey of purchasing managers. In fact, Figure 5 suggests that these situations are seldom the case. One obvious exception concerns the 1960–1961 period where, despite a recession having taken place, the ISM, as well as all of its components, nevertheless implied a relatively low recession probability. This implication suggests that factors outside of manufacturing may have played an unusually large role in generating that specific downturn.

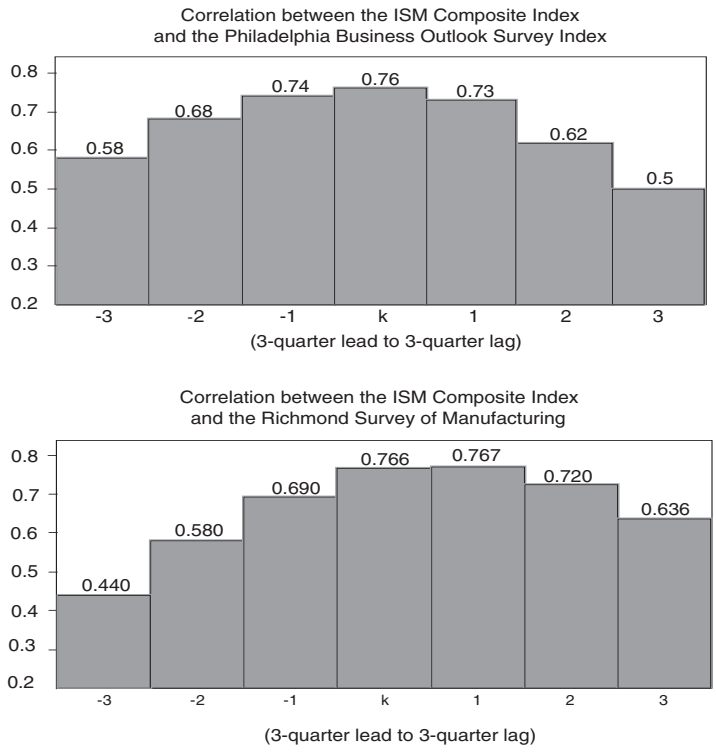
5. DO THE PHILADELPHIA AND RICHMOND SURVEYS HELP FORECAST THE ISM?

Among the regional Fed Surveys, Philadelphia has the longest running effort—stretching back to May 1968—and Richmond has the second oldest with monthly data beginning in November 1993. More recent surveys are those by Kansas City (quarterly, dating to late 1994) and New York (monthly, first released in 2002). In addition, Dallas is currently developing a manufacturing survey.

While the Philadelphia and Richmond Surveys are designed to gauge manufacturing conditions in their Districts, their results—seasonally adjusted and released monthly—also generally track the national ISM. It is noteworthy, however, that the regional Fed Banks collect and analyze their survey results prior to the release of the ISM data. The Philadelphia Survey, for example, is released on the third Thursday of the survey month compared to the first business day of the following month for the national ISM release. Similarly, while Richmond currently releases its index results to the public after the purchasing managers' index is made public, the Bank has preliminary results available internally well before the public release date. In any case, in the remainder of this analysis, the Richmond Survey information will be treated as if it is available to the public prior to the release of the ISM results.

A second issue related to the gathering of regional information has to do with the limits of the ISM. Ultimately, as with the Beige Book, dispersion matters. Although the current state of manufacturing nationally can be assessed with the ISM, information may also be gained by gauging manufacturing activity in regions. To see why, imagine a manufacturing sector composed of two industries, one stable and one volatile. If overall activity declines, but the source cannot be identified, the question of whether or not the decline is

Figure 6



a likely trend decline (if the stable industry declines) or a more temporary change (if the volatile sector declines) remains unanswered. But if the source of the decline can be identified, the question may be partially addressed. To the extent that more detailed information can be gathered by surveying regions with different manufacturing structures, insights may be gained by comparing their relative performances.

Figure 6 shows the cross-correlations of the ISM with the regional indexes constructed by the Federal Reserve Banks of Philadelphia and Richmond. Because these two Banks' Surveys are monthly and have long histories—like the ISM—they can be easily compared. From the figure, it is apparent that both regional indexes correlate very well with the ISM, over the period analyzed, although the Richmond index seems to lag the ISM slightly, relative to the Philadelphia regional index. Both Surveys display virtually identical contemporaneous correlations at 0.76. However, while these contemporaneous correlations with the ISM are very similar, they nevertheless stem from different regional information sets. Put another way, while the Philadelphia and

Richmond indexes correlate with the national survey to the same degree, we now show that they capture slightly different aspects of the ISM behavior.

In the following discussion, let P, R, and N denote, respectively, the survey indexes computed by Philadelphia, Richmond, and the national survey of purchasing managers. We assume that P, R, and N are random variables such that

$$E(N|P) = \alpha + \beta p \tag{3}$$

for all values p taken on by P. In other words, the expectation of the ISM number conditional on having observed the Philadelphia Survey index number is simply a linear function of that regional number. Under this assumption, one can show that

$$\alpha = \mu_N - \mu_P \frac{\varrho(N, P)\sigma_N}{\sigma_P}, \text{ and } \beta = \frac{\varrho(N, P)\sigma_N}{\sigma_p}, \tag{4}$$

where μ and σ denote means and standard deviations, respectively, while $\varrho(.)$ represents the correlation between two variables. In addition, we can interpret assumption (3) as deriving from the following equation,

$$N = \alpha + \beta P + \varepsilon, \; E(\varepsilon|P) = 0, \tag{5}$$

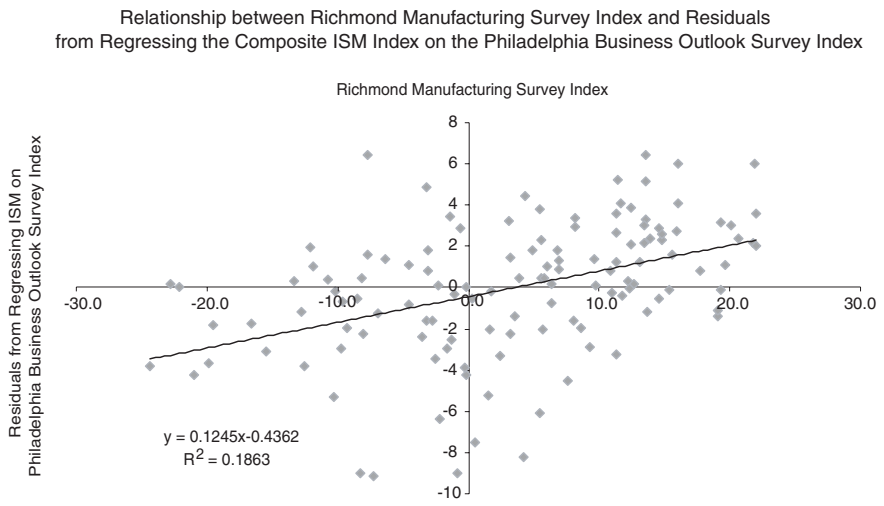
where ε denotes movements in the ISM that are not related to regional information captured by the Philadelphia Survey. Using equations (4) and (5), it is straightforward to show that

$$\varrho(N, R) = \varrho(N, P)\varrho(P, R) + \frac{\varrho(\varepsilon, R)\sigma_\varepsilon}{\sigma_N}. \tag{6}$$

Put simply, the degree to which regional information gathered in the Richmond Survey correlates with the ISM, $\varrho(N, R)$, can be split into two parts. The first term on the right-hand side of equation (6) tells us that the degree to which the Richmond Survey co-moves with the ISM is driven in part by the Richmond and Philadelphia Surveys sharing a common component, $\varrho(P, R)$, and the fact that the Philadelphia Survey itself moves with the ISM, $\varrho(N, P)$. Put another way, the correlation between the Richmond Survey and the ISM is explained by regional information common to both Philadelphia and Richmond. In contrast, the second term on the right-hand side of (6) depicts the co-movement between the Richmond Survey Index and variations in the ISM that are not captured by the Philadelphia Survey.

We know from Figure 6 that both $\varrho(N, R)$ and $\varrho(N, P)$ are around 0.77. Additional calculations yield that $\varrho(P, R) = 0.64$, so that approximately 64 percent of the correlation between the Richmond regional index and the ISM is accounted for by regional information common to Richmond and Philadelphia. This means that roughly 36 percent of the co-movement between the Richmond and purchasing managers indexes derives from the component of ISM movements, ε, orthogonal to the Philadelphia Survey index. The fact that the Richmond index is correlated with ε appears clearly in Figure 7.

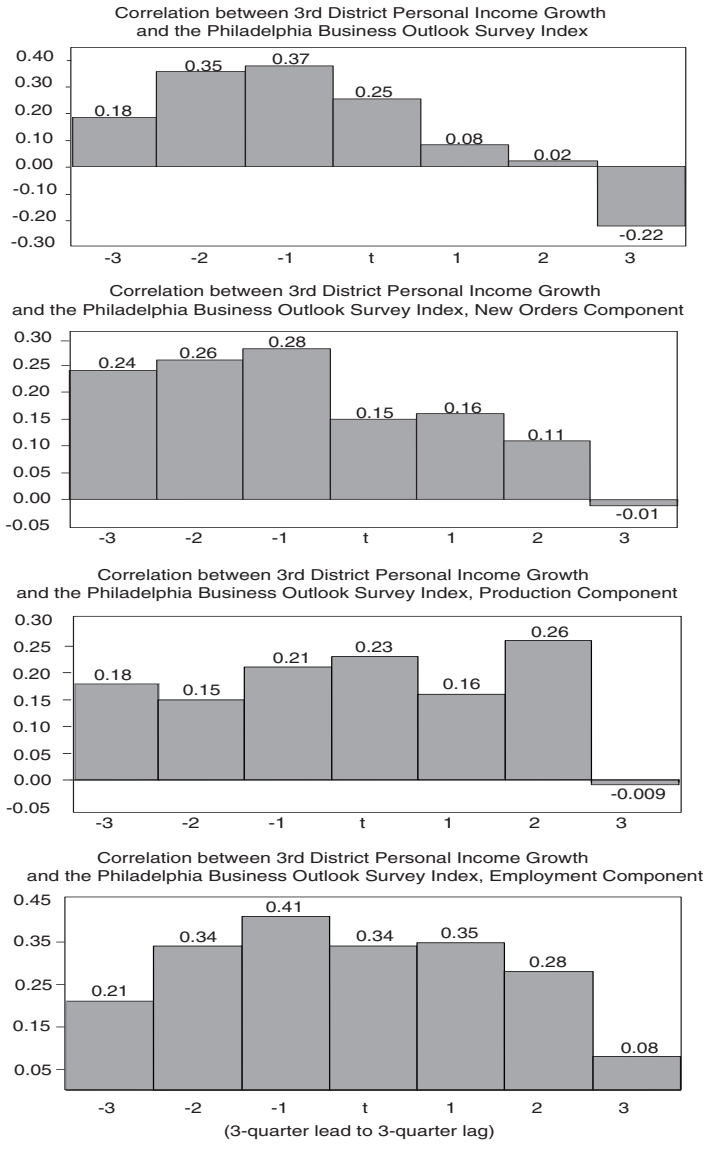
Figure 7



As mentioned earlier, the Philadelphia business outlook survey is typically released approximately ten or more days prior to the ISM. Therefore, given the ISM's ability to convey changes in business conditions outlined in the previous section, the exercise we have just carried out suggests that Philadelphia's regional index constitutes one of the earliest available gauges of the business cycle. Moreover, because the Richmond Manufacturing Survey captures variations in the ISM that are unexplained by Philadelphia's business outlook, we expect a simultaneous release of the two Surveys to convey most of the ISM's information in real time. Put another way, once regional information is gathered across the Third and Fifth Federal Reserve Districts, we already have a relatively accurate reading of what the national survey might indicate. But this reading cannot be fully exploited at present because the Richmond Survey results are released after the ISM results. As was mentioned earlier, though, we treat the Richmond results as if they were available in advance of the ISM. Tables 4 and 5 illustrate this point.

Analogous to the previous section, the first column of Table 4 tells us that when the Philadelphia business outlook index falls more than 0.5 standard deviations below its mean, the ISM behaves likewise almost 81 percent of the time within the same month. This number increases to 84 percent in the second column when both the Philadelphia and Richmond indexes fall below their respective means by at least 0.5 standard deviations. On the up side, the last column of Table 4 indicates that the ISM is above its mean by more than 0.5 standard deviations 88 percent of the time when both the Philadelphia and

Figure 8



Richmond Surveys behave likewise within the same month. Note that this finding represents an increase from 68 percent in the third column when the Philadelphia Regional Survey alone is considered.

Having established that the Richmond Survey—along with the Philadelphia Survey—is a good indicator of the ISM, the question of whether it also is

Table 4 Signal Value of the Philadelphia and Richmond Regional Surveys

ISM, z:	$z < \mu_z - \frac{\sigma_x}{2}$		$z > \mu_x + \frac{\sigma_x}{2}$	
Philadelphia, x:	$x < \mu_x - \frac{\sigma_x}{2}$	$x < \mu_x - \frac{\sigma_x}{2}$ and	$x > \mu_x + \frac{\sigma_x}{2}$	$x > \mu_x + \frac{\sigma_x}{2}$ and
Richmond, y:		$y < \mu_y - \frac{\sigma y}{2}$		$y > \mu_y + \frac{\sigma_y}{2}$
Total Signals	31	25	44	25
Freq. of True Signals	80.65%	84.00%	68.18%	88.00%

a good indicator of Fifth District economic conditions remains. We now turn our attention to that question.

6. THE RICHMOND SURVEY AND FIFTH DISTRICT ECONOMIC ACTIVITY

The Richmond Survey is useful in assessing some—though not all—aspects of regional economic activity. It is not, for example, a good gauge of gross state product (GSP) data. GSP data are only released on an annual basis, which, in terms of the Richmond Manufacturing Survey and the Fifth Federal Reserve District, represent only 13 data points. In contrast, personal income at the state level is available quarterly, and Figure 9 depicts the cross-correlations of the Richmond business surveys with Fifth District personal income. These cross-correlations are computed over the sample period for which the Richmond Manufacturing Survey numbers are available, 1994–2004.

Although the Richmond manufacturing index shows a generally high correlation with Fifth District personal income, it lags personal income by approximately one quarter. However, because state-level personal income data are released with a one-quarter lag, the Richmond results provide a more timely gauge of movements in Fifth District personal income.

More encouraging, as shown in Figure 11, the Richmond employment index distinctly leads changes in manufacturing employment by one quarter. This is noteworthy because changes in manufacturing employment are among the most timely and closely watched regional economic data.

7. CONCLUDING REMARKS

Given the strong interest in timely information on both national and regional economic conditions, the Richmond Survey of Manufacturing performs a useful role. In a national economic setting, the Survey appears capable of adding

Figure 9

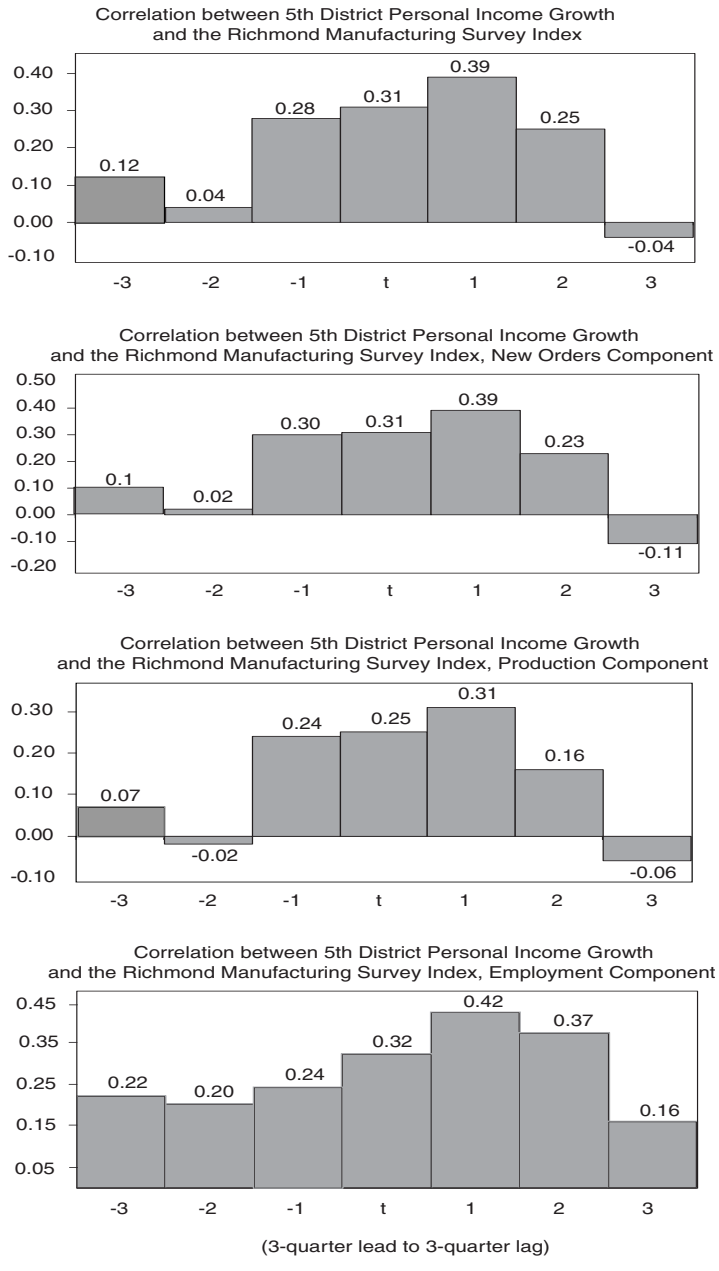

Correlation between 5th District Personal Income Growth
and the Richmond Manufacturing Survey Index
0.40
0.30
0.20
0.10
0.00
-0.10
0.12
0.04
0.28
0.31
0.39
0.25
-0.04
-3
-2
-1
t
1
2
3
Correlation between 5th District Personal Income Growth
and the Richmond Manufacturing Survey Index, New Orders Component
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
0.1
0.02
0.30
0.31
0.39
0.23
-0.11
-3
-2
-1
t
1
2
3
Correlation between 5th District Personal Income Growth
and the Richmond Manufacturing Survey Index, Production Component
0.30
0.20
0.10
0.00
-0.10
0.07
-0.02
0.24
0.25
0.31
0.16
-0.06
-3
-2
-1
t
1
2
3
Correlation between 5th District Personal Income Growth
and the Richmond Manufacturing Survey Index, Employment Component
0.45
0.35
0.25
0.15
0.05
0.22
0.20
0.24
0.32
0.42
0.37
0.16
-3
-2
-1
t
1
2
3
(3-quarter lead to 3-quarter lag)

Figure 10

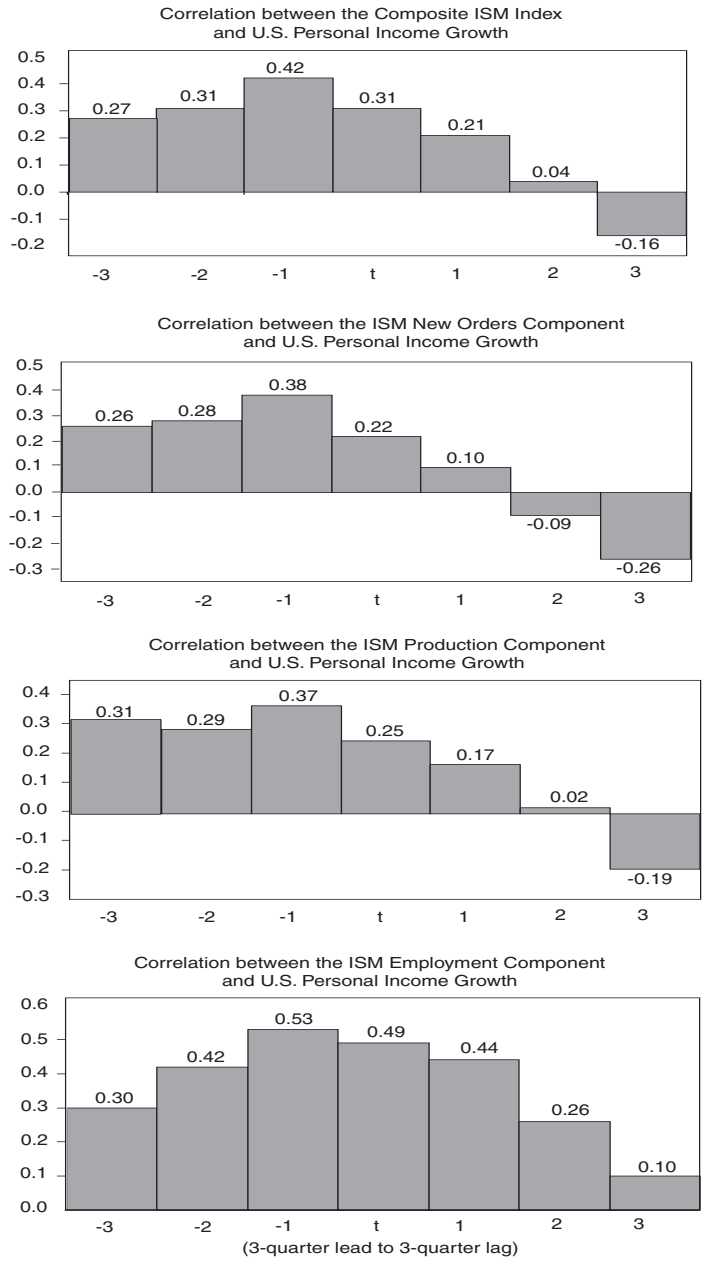

Correlation between the Composite ISM Index
and U.S. Personal Income Growth
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
0.27
0.31
0.42
0.31
0.21
0.04
-0.16
-3
-2
-1
t
1
2
3
Correlation between the ISM New Orders Component
and U.S. Personal Income Growth
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
0.26
0.28
0.38
0.22
0.10
-0.09
-0.26
-3
-2
-1
t
1
2
3
Correlation between the ISM Production Component
and U.S. Personal Income Growth
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
0.31
0.29
0.37
0.25
0.17
0.02
-0.19
-3
-2
-1
t
1
2
3
Correlation between the ISM Employment Component
and U.S. Personal Income Growth
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.30
0.42
0.53
0.49
0.44
0.26
0.10
-3
-2
-1
t
1
2
3
(3-quarter lead to 3-quarter lag)

Table 5 Signal Value of the Philadelphia and Richmond Regional Surveys

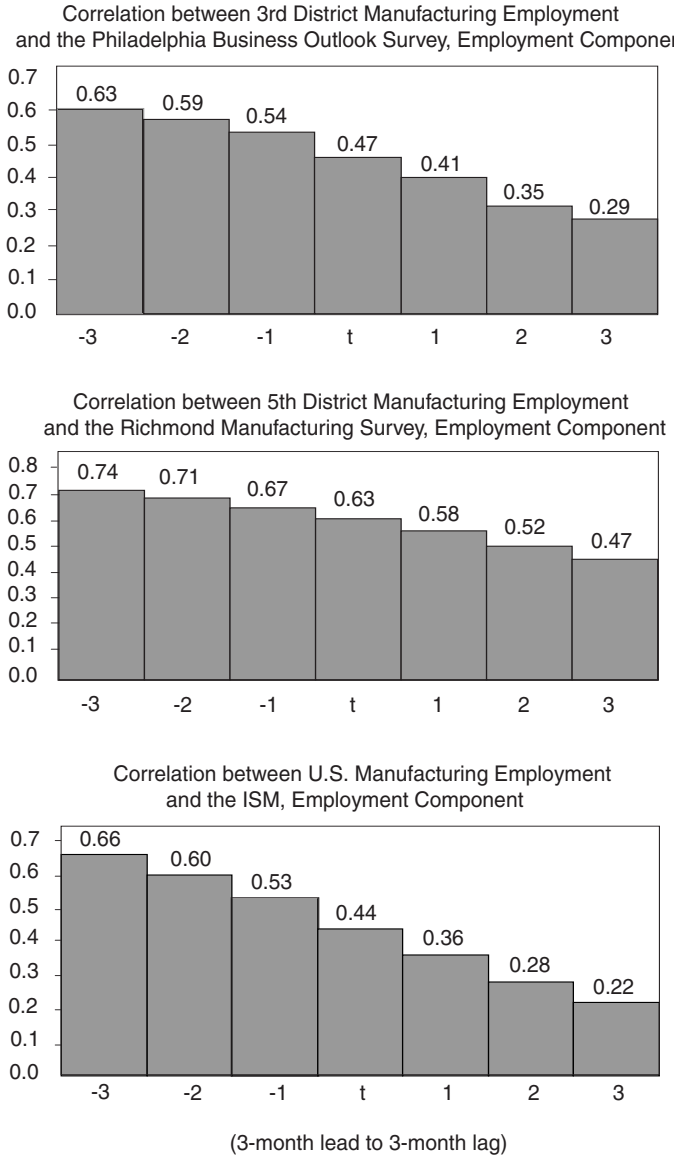
ISM, z :	$z < \mu_z - \sigma_z$		$z > \mu_z + \sigma_z$	
Philadelphia, x:	$x < \mu_x - \sigma_x$	$x < \mu_x - \sigma_x$ and	$x > \mu_x + \sigma_x$	$x > \mu_x + \sigma_x$ and
Richmond, y:		$y < \mu_y - \sigma_y$		$y > \mu_y + \sigma_y$
Total Signals	22	15	16	6
Freq. of True Signals	68.18%	86.67%	62.50%	66.67%

to the ability to forecast the PMI component of the ISM index, especially when combined with the results of the Philadelphia Fed's Survey results. This is important because the ISM has been a very good gauge historically. The ISM is released well ahead of GDP data, and it provides relatively accurate signals of both substantial changes in the growth rate of GDP and turning points in the economy.

Both the Philadelphia and Richmond Federal Reserve Banks produce monthly indexes that are highly correlated with the ISM. The Philadelphia Index is currently released well in advance of the ISM and serves as a valuable predictor of the ISM.

The Richmond Survey results are less useful at present. The results are reported as components only rather than in the format of an ISM-style weighted index. Moreover, the Richmond results are released after the ISM. But this memo suggests that some modification of the Richmond Manufacturing Survey could add substantial value to forecasters. First, as was done in this analysis, existing questions in the Survey could be combined and weighted in a manner similar to the construction of the ISM. One such construction, considered in the memo, is shown to correlate very well with the ISM. A second change would be to advance the release date of the Richmond Survey results. Because the information is currently available internally to the Richmond Fed well before it is released to the public, moving up the release date would provide the same advantage to the public. A second important finding is that the Richmond Survey is a good indicator of economic activity in the Fifth District. It provides a timely view of economic activity in the Fifth Federal Reserve District. While the Richmond Survey tends to lag its Federal Reserve District's personal income measure by around a quarter, the Survey's information is made available well in advance of the District personal income data and so effectively provides an advance look at Fifth District personal income. In addition, the Richmond Survey Index distinctly leads changes in Fifth District

Figure 11



employment, giving an advance indication of changes in the region's labor market.

APPENDIX A: SURVEY OF FIFTH DISTRICT MANUFACTURING ACTIVITY

Business Activity Indexes

Compared to the previous month	September	August	July	3-month avg.
Shipments	22	18	6	5
Volume of new orders	8	13	13	11
Backlog of orders	-6	1	-3	-3
Capacity utilization	13	9	5	9
Vendor lead time	14	21	15	16
Number of employees	5	-2	6	3
Average workweek	1	-1	6	2
Wages	10	10	12	11
Six months from now				
Shipments	23	28	33	28
Volume of new orders	24	24	31	26
Backlog of orders	5	11	14	10
Capacity utilization	10	16	17	15
Vendor lead time	11	6	4	7
Number of employees	3	7	9	6
Average workweek	7	-4	0	1
Wages	34	42	46	41
Capital expenditures	9	19	17	15
Inventory levels				
Finished good inventories	16	16	19	17
Raw materials inventories	11	7	7	8

Price trends

(percent change, annualized)	September	August	July
Current trends			
Prices paid	1.71	2.28	2.33
Prices received	1.25	2.17	3.20
Expected trends during next 6 months			
Prices paid	1.25	2.17	3.20
Prices received	0.08	1.37	2.59

Notes: Each index equals the percentage of responding firms reporting increase minus the percentage reporting decrease. Data are seasonally adjusted. Results are based on responses from 94 of 201 firms surveyed

All firms surveyed are located in the Fifth Federal Reserve District, which includes the District of Columbia, Maryland, North Carolina, South Carolina, Virginia, and most of West Virginia.

APPENDIX B: FIFTH DISTRICT MANUFACTURING ACTIVITY PRESS RELEASE

Manufacturing Output Strengthens in September; Employment Improves; Average Workweek Flat

On balance, manufacturing activity continued to generally strengthen in September, according to the latest survey by the Richmond Fed.[6] Factory shipments advanced at a quicker pace although the growth of new orders edged lower. Backlogs retreated into negative territory while capacity utilization inched slightly higher. Vendor lead-time grew more slowly than last month while raw materials inventories grew at a slightly faster rate. On the job front, manufacturers reported that worker numbers were higher at District plants; the average workweek was flat and wage growth stayed on pace of recent months.

Looking ahead, respondents' expectations were generally less optimistic than those of a month ago—producers looked for shipments and capital expenditures to grow at a somewhat slower pace during the next six months.

Price increases at District manufacturing firms continued to increase at a modest pace in September. Raw materials prices grew at a marginally slower rate, while finished goods prices grew at a slightly quicker rate. For the coming six months, respondents expected raw materials goods prices to increase only modestly and finished goods prices to be nearly flat.

Current Activity

In September, the seasonally adjusted shipments index inched up four points to 22, and the new orders index inched down five points to 8. In addition, the order backlogs index moved into negative territory, losing seven points to end at -6. The capacity utilization index advanced four points to 13 while the vendor lead-time index shed seven points to 14. The level of finished goods inventories was unchanged in September when compared to August, while the level of raw materials inventories increased. The finished goods inventory index held steady at 16, while the raw materials inventory index added four points to finish at 11.

Employment

Employment at District plants showed signs of improvement in September. The employment index posted a seven-point gain to 5 from -2; the average

[6] Released 12 October 2004.

workweek index picked up two points to 1 from -1. Wage growth remained modest, matching August's reading of 10.

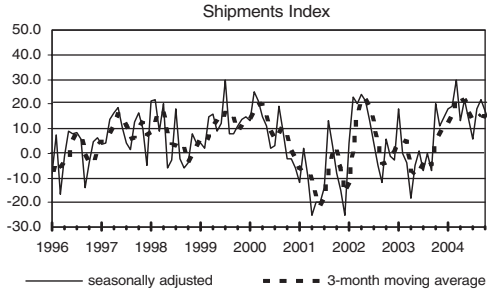
Expectations

In September, contacts were slightly less optimistic about demand for their products during the next six months. The index of expected shipments moved down five points to 23, while the expected orders index stayed at 24. The expected orders backlogs index dropped six points to end at 5 and the expected capacity utilization index shed six points to 10. The index for future vendor lead-time inched up five points to 11. In contrast, planned capital expenditures registered a ten-point loss to 9.

Manufacturers' plans to add labor in coming months were mixed. The index for expected manufacturing employment inched down four points to 3, while the expected average workweek index advanced eleven points to 7. The expected wage index posted a ten-point loss to 9.

Prices

Price changes remained modest in September. Manufacturers reported that the prices they paid increased at an average annual rate of 1.71 percent compared to August's reading of 2.28 percent. Finished goods prices rose at an average annual rate of 1.25 percent in September compared to 0.79 percent reported last month. Looking ahead to the next six months, respondents expected supplier prices to increase at a 1.25 percent annual rate compared to the previous month's 2.17 percent pace. In addition, they looked for finished goods prices to nearly match the pace of last month's expected 1.37 percent rate.



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