

Gauging Manufacturing Activity: The Federal Reserve Bank of Richmond's Survey of Manufacturers

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Midmorning on the second Tuesday of each month, the Federal Reserve Bank of Richmond posts the results of its latest survey of Fifth District manufacturers. The survey provides a comprehensive set of indicators of business conditions within the region's manufacturing sector. Survey participants share first-hand knowledge of recent changes in manufacturing activity at their companies and offer insights into expected developments six months ahead. Their compiled responses provide unique information on a broad range of manufacturing activities, including shipments, new orders, employment, and capacity utilization.

The survey of manufacturers is a valuable tool for Federal Reserve research staff responsible for monitoring the Fifth District economy.¹ It is also a source of information for analysts outside the Federal Reserve System seeking measures of the strength of manufacturing in the area. Interest in such regional economic data has grown rapidly in recent years, particularly among analysts searching regional data for clues to the future direction of the national economy. Financial press coverage of regional manufacturing and business condition polls has expanded as well. From time to time, the media cites the Federal Reserve

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¹ The Fifth Federal Reserve District consists of the District of Columbia, Maryland, North Carolina, South Carolina, Virginia, and most of West Virginia.

Bank of Richmond's (Richmond Fed) survey in reports on economic activity or business developments.²

This article explains the techniques employed in gathering data and compiling results for the Richmond Fed's manufacturing survey. It also evaluates the survey's usefulness as a tool for economic analysis and compares survey indexes to aggregate manufacturing data and to indexes from similar surveys conducted by the Federal Reserve Bank of Philadelphia (Philadelphia Fed), the Federal Reserve Bank of Atlanta (Atlanta Fed), and the National Association of Purchasing Management (NAPM). The analysis indicates that the Richmond survey not only contributes to a better understanding of the District's manufacturing sector but may also provide timely indicators of changes in several closely watched national manufacturing data series.

1. PURPOSE AND HISTORY OF THE SURVEY

The Richmond Fed's survey of manufacturers was developed to gather timely and consistent data on manufacturing activity in the Fifth District. It is one of several research tools employed by the Bank's research staff to evaluate business conditions in the District and to collect the regional economic information needed by the Federal Reserve System to carry out effective monetary policy. Regional economic activity is tracked by each of the 12 regional Reserve Banks in the System, and their reports of changes in economic conditions around the country often receive considerable attention in monetary policy deliberations.³

The survey is the source of much of the manufacturing information presented by the Richmond Fed in its periodic reports on District economic conditions. These reports are prepared several weeks in advance of meetings of the Federal Open Market Committee (FOMC), which normally convenes eight times a year.⁴ Each regional Reserve Bank produces such a report; these reports are compiled into a document informally referred to as the "beige book." The manufacturing survey is also a source of timely information for the development of policy recommendations made by the president of the Richmond Fed at FOMC meetings.

² The results of the Richmond Fed's manufacturing survey are reported every month by a number of prominent business news services specializing in providing economic and financial market information to their clients.

³ References to regional economic information appear in the minutes of most Federal Open Market Committee (FOMC) meetings. The minutes from the November 17, 1998, meeting, for example, refer to anecdotal reports that "pointed to solid growth in most though not all regions of the country. . ." Minutes of FOMC meetings are published in the *Federal Reserve Bulletin* and in annual reports of the Board of Governors of the Federal Reserve System.

⁴ The voting members of the FOMC consist of the Federal Reserve's Board of Governors and five of the Reserve Bank presidents, one of whom is always the president of the Federal Reserve Bank of New York.

The survey of Fifth District manufacturers was initiated in June 1986. From 1986 to 1993, it was conducted every six or seven weeks, in a cycle directly linked to the preparation of the Federal Reserve's beige book.⁵ Quantitative data from the survey enhanced the information contained in the District's beige book reports by supplementing anecdotal information acquired from manufacturing contacts through telephone conversations. Survey data also offered a timelier alternative to "official" manufacturing data released by government agencies or trade organizations. Most of these data series are available only after a lag of several months or more, thus limiting their usefulness in evaluating current economic conditions.

The survey of manufacturers took its present form in November 1993. It was converted to a monthly survey at that time and the results were made available to the general public. Its purpose, however, has remained the same over the years: to provide timely information on recent changes in manufacturing activity and changes in manufacturers' expectations about their business prospects six months ahead.

Manufacturing's share of total employment in the Fifth District, as in the nation, has declined in the 1990s as the service sector has expanded.⁶ An understanding of the manufacturing sector, however, remains instrumental to grasping the dynamics of the overall economy. The sector is one of the more cyclical components of the economy, and movements in measures such as new orders and workweek are closely observed as leading indicators of economic performance. In addition, output in the manufacturing sector is easier to quantify than output in most services sectors, and changes in industry data are more readily interpreted. And, despite the steady advances of service industries in recent years, the manufacturing sector remains a sizeable component of the District economy.⁷ About 1.9 million people are currently employed in manufacturing jobs in Fifth District states. These workers represent 15 percent of nonfarm employment in the region.⁸

⁵ Chmura (1987/88) describes the origins of the manufacturing survey and provides charts of indexes of employment, capital expenditures, shipments, new orders, order backlogs, and inventories from 1986 to 1987.

⁶ The Richmond Fed also produces a services-sector survey each month that gathers information on wholesale and retail trade, transportation, public utilities, finance, real estate, and business and health services, among other industries. The services-sector survey is similar to the manufacturing survey in size and methodology.

⁷ These or similar arguments for surveying manufacturers appear in Bell and Crone's (1986) article on the Philadelphia Fed's manufacturing survey and in Rogers's (1992) article on the Atlanta Fed's survey. See Trebing (1998) for a more recent description and analysis of the Philadelphia Fed's survey.

⁸ An overview of the Fifth District's manufacturing sector is provided in the Appendix.

2. MANUFACTURERS SURVEYED

Each participant in the Richmond Fed's survey is classified as a manufacturer under the Office of Management and Budget's 1987 Standard Industrial Classification (SIC) system and has production facilities located in the Fifth District. The District's manufacturing base is quite diverse and a wide variety of manufacturing firms respond to the survey. Of the 20 major manufacturing groups identified by the SIC manual, only petroleum refining and leather production are not currently represented in the survey.

The survey sample reflects both the geographic distribution of Fifth District manufacturers as well as their distribution across various types of manufacturing industries. The number of District employees in each of the 20 major manufacturing groups defined by the SIC system is a major factor in determining the mix of companies by industry included in the survey sample. Value added in manufacturing is a second consideration in the choice of industry mix. Fifth District employment and value added by industry are itemized in Table 1.⁹

As the data in Table 1 demonstrate, the two measures can yield very different results. The chemical industry (SIC 28), for example, represents only 7.8 percent of manufacturing employment in Fifth District states but contributes 19.3 percent to value added in manufacturing. Textiles, on the other hand, has an opposite distribution. The textile mill products industry (SIC 22) represents 16.6 percent of manufacturing employment in the District but only 8.3 percent of value added in manufacturing.

Table 1 also provides a distribution of survey responses by two-digit SIC code. Response percentages represent averages for the period January through April 1998; since survey participation is voluntary, percentages may vary considerably from month to month. The distribution of survey responses is within 2 percentage points of the distribution of employment for most industries. By the employment measure, primary metals manufacturers are currently the most overrepresented, since they account for 7.8 percent of survey responses but only 3.2 percent of Fifth District manufacturing employment. By the same measure, textiles and apparel manufacturers are the most underrepresented. Three industries (tobacco, textiles, and chemicals) show large differences in distributions depending on whether measured by employment or value added. In each of these cases, the survey distribution falls between the industry distribution as measured by employment and the industry distribution as measured by value added.

The survey sample also reflects the relative contribution of each state to the District's manufacturing sector. Table 2 provides a breakdown of survey

⁹ The data in Table 1 reflect manufacturing employment for the entire state of West Virginia. Six counties in the northern panhandle region of the state, however, are not part of the Fifth District. Manufacturing employment in these counties represents approximately 20 percent of total West Virginia manufacturing employment.

Table 1 Distribution of Survey Responses, Employment, and Value Added by Industry

Manufacturing Industry	SIC Code	Survey Response Distribution (%)	Fifth District Employment Distribution (%)	Fifth District Value Added Distribution (%)	U.S. Employment Distribution (%)
Food & kindred products	20	5.7	8.0	8.7	9.1
Tobacco products	21	3.4	1.4	6.3	0.2
Textile mill products	22	12.8	16.6	8.3	3.3
Apparel/other fabric products	23	1.7	5.6	3.1	4.4
Lumber & wood products	24	4.1	5.6	2.9	4.3
Furniture & fixtures	25	4.1	5.8	2.8	2.7
Paper & allied products	26	6.4	4.0	4.7	3.7
Printing & publishing	27	5.7	6.7	5.0	8.3
Chemicals	28	8.4	7.8	19.3	5.5
Petroleum refining	29	0.0	N/A	0.1	0.8
Rubber & plastics	30	3.4	5.5	5.4	5.3
Leather	31	0.0	N/A	0.1	0.5
Stone, clay, & glass products	32	3.7	3.3	3.1	3.0
Primary metal industries	33	7.8	3.2	3.3	3.8
Fabricated metal products	34	5.4	5.1	4.1	7.9
Industrial machinery	35	9.8	6.7	6.6	11.6
Electronic equipment	36	10.5	7.6	7.7	9.0
Transportation equipment	37	4.7	4.8	5.2	9.9
Instruments	38	1.0	1.8	3.0	4.6
Miscellaneous manufacturing	39	1.4	0.6	0.5	2.1
TOTAL		100.0	100.0	100.0	100.0

N/A: Not available. District employment in each of these industries (SIC Codes 29 and 31) is generally less than 1 percent of manufacturing employment.

Notes: District employment and value added in manufacturing are calculated by summing state data. Two-digit SIC data are not reported by state for all manufacturing industries. Approximately 95 percent of total manufacturing employment and value added in Fifth District states are represented in the percentages shown in Table 1.

Sources: Federal Reserve Bank of Richmond, "Survey of Fifth District Manufacturing Activity," January–April 1998. Department of Labor, Bureau of Labor Statistics [1999]. Department of Commerce, "1996 Annual Survey of Manufactures," April 1998.

responses (January through April 1998) by state.¹⁰ North Carolina, Virginia, and South Carolina account for about 85 percent of manufacturing employment

¹⁰ Manufacturers in the District of Columbia are not surveyed. Manufacturing employment in Washington, D.C., represents less than 1 percent of total manufacturing employment in the Fifth District.

Table 2 Distribution of Survey Responses, Employment, and Value Added by State

	Survey Response Distribution (%)	Manufacturing Employment Distribution (%)	Manufacturing Value Added Distribution (%)
Maryland	13.5	9.5	9.9
Virginia	22.3	21.7	24.1
West Virginia	13.9	4.4	5.1
North Carolina	34.1	44.9	43.4
South Carolina	16.2	19.5	17.5
TOTAL	100.0	100.0	100.0

Sources: Federal Reserve Bank of Richmond, "Survey of Fifth District Manufacturing Activity," January–April 1998. Department of Labor, Bureau of Labor Statistics [1999]. Department of Commerce, "1996 Annual Survey of Manufactures," April 1998.

and value added in the Fifth District. The distributions in Table 2 suggest that North Carolina has been substantially underrepresented in survey responses while West Virginia has been overrepresented. Efforts have been undertaken recently to increase participation by North Carolina manufacturers.¹¹

3. THE QUESTIONNAIRE AND DATA COLLECTED

Survey participants are asked to provide an assessment of changes in business conditions at their companies by answering two series of questions. The first series asks about changes in various measures of manufacturing activity compared to the previous month; the second series asks for changes between current activity and expected activity six months in the future. In each case, the respondent indicates only a direction of change: whether a particular activity has increased, decreased, or remained unchanged. This request for "categorical" rather than quantitative responses makes it easier to complete the questionnaire and helps keep survey response rates high.

Manufacturers are questioned about new orders, order backlogs, shipments, capacity utilization, vendor lead time, number of employees, average workweek, and wages. Responses to these questions yield insight into product demand, product flows in the manufacturing process, and use of resources. In addition, employment, workweek, and wage data contribute to a better understanding of current and future labor market conditions.

¹¹ Survey participation tends to decline over time and thus new participants must be recruited periodically in order to maintain an adequate sample size and mix of manufacturers. The latest recruitment of companies took place in February 1999.

The questionnaire also inquires about inventory levels and price changes. Respondents provide information regarding inventories of both raw materials and finished goods. They are asked whether inventory levels, when compared to a desired inventory level, are too high, too low, or correct. In the prices section, the questionnaire asks for an estimate of the percent change (on an annualized basis) of prices paid for raw materials and prices received for finished goods.

Survey questionnaires are mailed around the twelfth of each month and are typically addressed to plant managers or controllers—individuals with detailed knowledge of business activity at each facility. Because most of the completed questionnaires are returned within a week of receipt, their data reflect business conditions as of the middle of the month. Responses are accepted, however, up until the week before final survey results are released on the second Tuesday of the subsequent month. Typically, 60 to 75 of the approximately 175 firms that received a questionnaire each month in 1998 provided responses.

4. SURVEY RESULTS

The results of the manufacturing survey are generally expressed as diffusion indexes.¹² A separate diffusion index is determined for each question asked and is calculated as

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

where

I = number of respondents reporting increases,

N = number of respondents reporting no change, and

D = number of respondents reporting decreases.

Each diffusion index can range in value from minus 100, if all respondents reported decreased activity, to 100, if all respondents reported increased activity. While diffusion indexes can be scaled in other ways, this particular methodology has the appeal of assigning positive values when more respondents are reporting increased activity than decreased activity.¹³

A diffusion index is a measure of the scope of change in an activity across the firms participating in the survey.¹⁴ A large diffusion index for employment,

¹² Changes in prices are reported as annualized percent changes rather than as diffusion indexes.

¹³ In addition to the equation above, a diffusion index can be calculated as $\text{Index} = 100(I+0.5N)/(I+N+D)$ where I = the number of respondents reporting increases, N = the number of respondents reporting no change, and D = the number of respondents reporting decreases. This approach results in an index range of 0 to 100 and a value of 50 if the number of respondents reporting increases equals the number reporting decreases.

¹⁴ Although diffusion indexes are often associated today with the analysis of survey data, they have broader applicability. The concept of measuring the "diffusion" of economic change originated as a tool for forecasting national economic trends. Researchers at the National Bureau

for example, means that higher employment is much more widely reported than lower employment. The index does not directly measure the magnitude of changes in the levels of manufacturing activity. Survey participants report only that a particular activity has increased, decreased, or remained unchanged; they do not report the magnitude of any changes.¹⁵

After initial diffusion indexes are calculated from survey responses, seasonal adjustments are made. Seasonal patterns appear in responses to most of the questions. Such patterns are not unusual in manufacturing data since many goods producers have traditional periods of lower production or shutdown of operations as they retool or make other major adjustments to their production processes.

Seasonal adjustments are made using the Department of Commerce's X-11 methodology.¹⁶ The X-11 methodology breaks time-series data into trend-cycle, seasonal, and irregular components. These components are extracted by means of a series of moving-average filters. Seasonally unadjusted diffusion indexes are reported only when historic data series are not long enough to allow adequate seasonal adjustment. At present, unadjusted series include current wages and capacity utilization as well as many of the indexes of manufacturing activity six months ahead. Most of these series begin in 1996 or 1997 and will not be seasonally adjusted until four years of historic data are available.

Final survey results are released to the public at 10:00 a.m. on the second Tuesday of each month. A summary of recent trends is provided along with three months of index data and a three-month moving average of index data. Table 3 provides the manufacturing indexes and price trends reported in a recent release of survey results.

5. INTERPRETATION OF SURVEY RESULTS

Manufacturing survey indexes represent a compilation of the perceptions of a representative sample of District manufacturers regarding current and future business activity. They are unique data that reveal a great deal about manufacturing activities at firms participating in the survey. The indexes can also provide insight into the strength of the overall manufacturing sector in the

of Economic Research calculated diffusion indexes as early as 1950 to measure the extent of change in component series of leading and coincident U.S. economic indicators.

¹⁵ In addition, the diffusion index is a summary statistic; information about the number of increases, decreases, and unchanged responses is not conveyed. There may be times when it would be useful to know, for example, whether a diffusion index of zero meant that all respondents reported "no change"; that a large number of respondents reporting "increase" had been offset by an equally large number of respondents reporting "decrease"; or, perhaps most likely, that most respondents reported no change while a fairly small number of reported increases were offset by an equal number of reported decreases.

¹⁶ See Shiskin, Young, and Musgrave (1967) for a detailed description of the X-11 technique.

Table 3 Survey of Fifth District Manufacturing Activity
(Information Reported January 12, 1999)

	December 1998	November 1998	October 1998	3-Month Average
Business Activity Indexes				
Compared to Previous Month				
Shipments	4	8	-4	3
New orders	-7	0	4	-1
Backlog of orders	-9	-6	-5	-7
Capacity utilization*	-16	-7	6	-6
Vendor lead time*	3	5	0	3
Number of employees	5	-14	5	-1
Average workweek	-2	1	-7	-3
Wages*	3	9	11	8
Six Months from Now				
Shipments	27	31	18	25
New orders*	33	19	13	22
Backlog of orders*	16	18	-3	10
Capacity utilization*	31	15	9	18
Vendor lead time*	7	2	-6	1
Number of employees	12	-7	-2	1
Average workweek	6	5	-4	2
Wages*	42	40	42	41
Capital expenditures*	13	18	22	18
Inventory Levels				
Finished goods inventories*	25	31	36	31
Raw materials inventories*	19	18	29	22
Prices (Percent Change, Annualized)				
Current				
Prices paid	0.76	0.49	0.60	
Prices received	0.03	-0.04	-0.74	
Expected (Next Six Months)				
Prices paid	0.84	0.74	0.78	
Prices received	0.27	0.45	0.07	

*Indicators not seasonally adjusted due to insufficient historical data.

region. However, care must be taken in interpreting the survey and extending survey results to the District or nation as a whole.

The first and perhaps most obvious caution is that survey indexes can be volatile from month to month, making them difficult to interpret. Some of this volatility is undoubtedly due to the survey's relatively small size; a larger number of responses would likely decrease monthly fluctuations. Furthermore, since the survey is voluntary, the group of respondents changes somewhat

from month to month, which may also contribute to volatility. The three-month moving average of data reported with survey results smooths the series and allows longer-term trends to be more readily identified.

A second caveat relates more broadly to survey sampling. While the companies participating in the survey are selected to be representative of Fifth District manufacturers, they are not selected based on statistical criteria for sampling. Therefore, one cannot conclude with any specific level of confidence that a change in an index number necessarily implies a change in the corresponding activity for the manufacturing sector in Fifth District states.

Statistical analysis indicates, however, that trends in key survey indexes are generally consistent with trends in manufacturing data series available from other sources. In particular, key indexes from the Richmond Fed's survey are positively correlated with comparable indexes from the manufacturing surveys of the Philadelphia Fed, the Atlanta Fed, and NAPM. Furthermore, a number of indexes from the Richmond Fed survey are positively correlated with changes in comparable official data series, suggesting that the Richmond Fed survey may be of value as a timely indicator of changes in the Fifth District and national economies.

6. COMPARISON TO OTHER MANUFACTURING SURVEYS

Figures 1–3 show selected Richmond Fed survey diffusion indexes plotted with comparable diffusion indexes from NAPM's "Report on Business" survey. The NAPM survey is widely regarded as one of the most reliable indicators of manufacturing activity in the country.¹⁷ With the exception of a four-year break during World War II, the "Report on Business" has been published every month since 1931. NAPM's survey covers the entire country and receives considerable attention from the financial press when it is released on the first business day of each month.

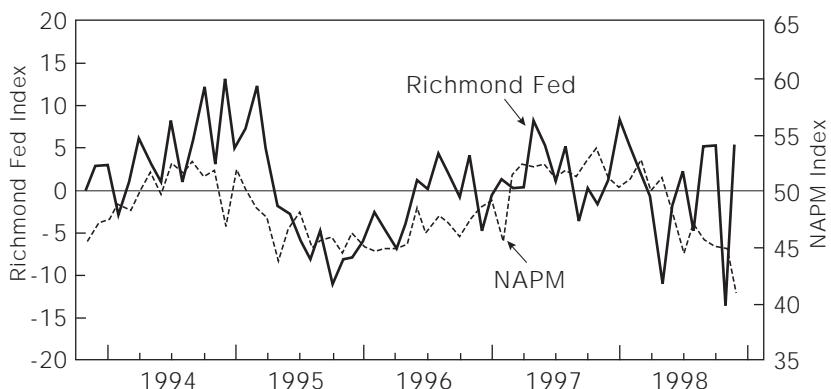
Diffusion indexes in the NAPM survey are calculated by adding the percent of respondents reporting an increase to half the percent of respondents reporting no change. An index reading above 50 indicates an activity is expanding. An index of 50 on NAPM's scale, therefore, is comparable to an index of zero on the Richmond Fed's scale. Employment, new orders, and shipments/production indexes from both surveys for the period November 1993 to December 1998 are graphed.¹⁸

Richmond Fed survey indexes can also be compared to the manufacturing surveys conducted by two other Federal Reserve banks. The Philadelphia and

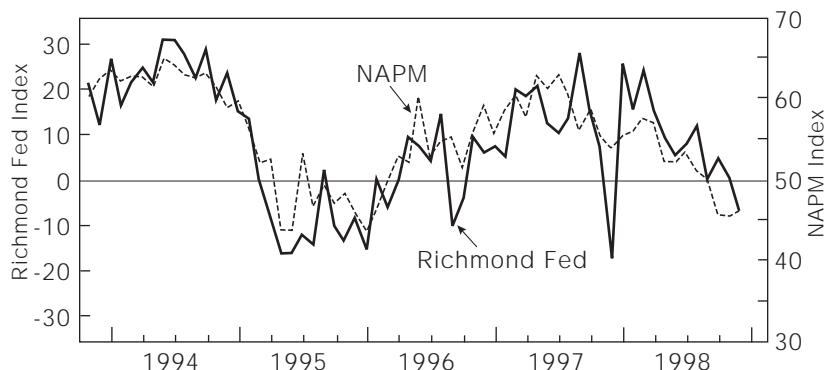
¹⁷ See, for example, Klein and Moore (1988).

¹⁸ The NAPM production index is used as a proxy for shipments in Figure 3.

**Figure 1 Manufacturing Employment
Richmond Fed and NAPM**



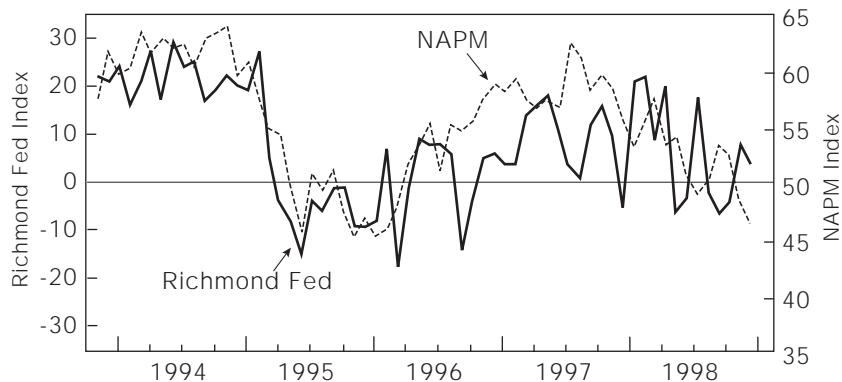
**Figure 2 New Orders
Richmond Fed and NAPM**



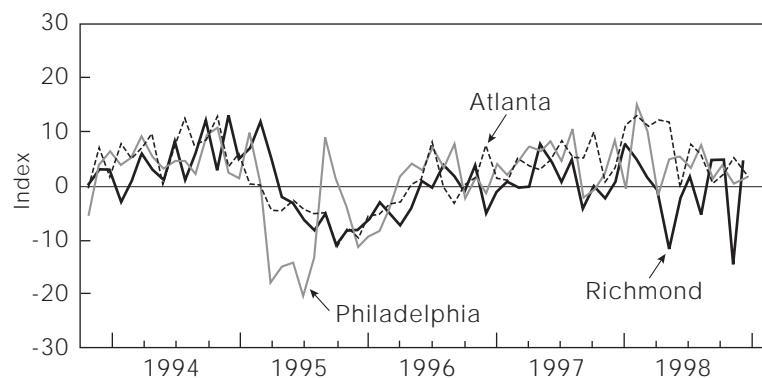
Atlanta Feds produce their surveys of District manufacturers on a monthly basis and calculate their diffusion indexes the same way that Richmond does.¹⁹ The Philadelphia survey has been conducted since 1968, while the Atlanta survey

¹⁹ The Federal Reserve Bank of Kansas City also conducts a manufacturing survey, but it is administered on a quarterly rather than monthly basis.

**Figure 3 Shipments/Production
Richmond Fed and NAPM**



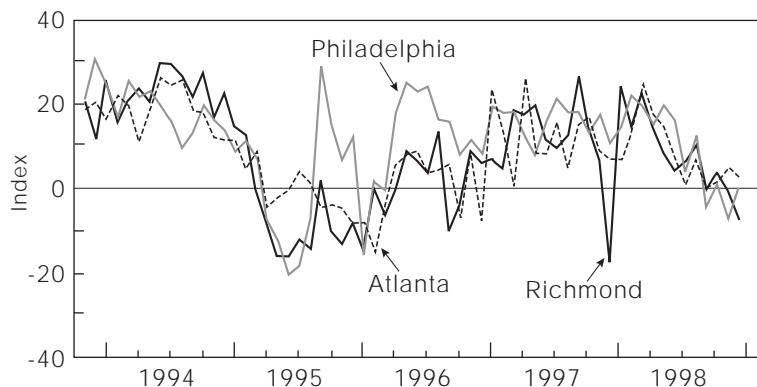
**Figure 4 Manufacturing Employment
Federal Reserve Surveys**



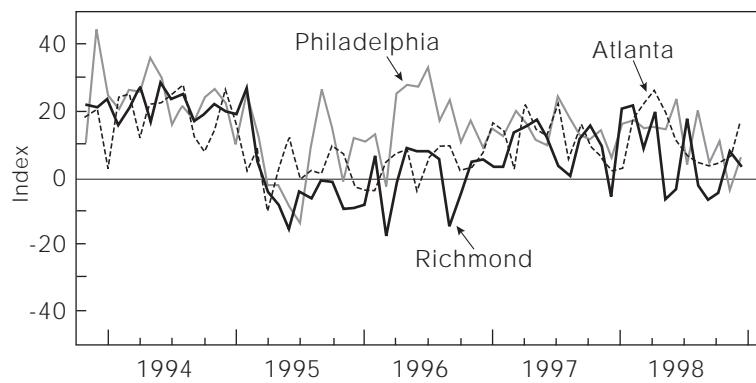
was initiated in 1991. Philadelphia releases its results on the third Thursday of the month, Atlanta on the second business day after the tenth of the month. Graphs of selected diffusion indexes from the Richmond, Philadelphia, and Atlanta manufacturing surveys are provided in Figures 4–6. Indexes for employment, new orders, and shipments are plotted.

Table 4 provides correlation statistics from a comparison of Richmond

**Figure 5 New Orders
Federal Reserve Surveys**



**Figure 6 Shipments
Federal Reserve Surveys**



survey indexes to selected indexes from NAPM and the Philadelphia and Atlanta Feds based on the study period of November 1993 to December 1998. The data in Figures 1–6 and Table 4 indicate that the Richmond Fed's survey indexes for these three major measures of manufacturing activity tend to track the indexes of the NAPM survey and those of other Federal Reserve surveys during most of the study period.

Table 4 Correlations between Richmond Fed Survey and Other Manufacturing Surveys (Major Indexes)

	Employment Index	New Orders Index	Shipments/ Production Index
Richmond Fed survey			
Compared to			
NAPM survey	0.358	0.812	0.674
Philadelphia Fed survey	0.369	0.628	0.507
Atlanta Fed survey	0.376	0.727	0.513

Notes: Numbers represent Pearson correlation coefficients. All correlations are significant at a 95 percent confidence level. NAPM's production index is used as a proxy for shipments. Indexes are seasonally adjusted.

7. DISTRICT AND NATIONAL ECONOMIC MEASURES

While a comparison of Richmond Fed survey indexes to comparable indexes from other manufacturing surveys provides useful information, a more direct test of the survey as a tool for gauging manufacturing activity is to compare survey indexes to "official" manufacturing statistics from government agencies or industry sources.²⁰ Directly comparable data in the form of diffusion indexes are not available, but month-to-month changes in some aggregate data series can be used as a proxy for the purpose of comparison to survey indexes. Since survey questions ask about changes in business activity, survey indexes are more directly related to changes in official data series than absolute levels of such data.

Efforts to "benchmark" Richmond manufacturing survey indexes against changes in official monthly statistics at a District level are limited by the paucity of regional manufacturing data. Manufacturing employment and workweek data, however, are available by state from the Labor Department's Bureau of Labor Statistics (BLS) and were aggregated to develop Fifth District totals. Month-to-month percent changes in these District totals were then compared to diffusion indexes from the manufacturing survey. Correlation coefficients based on a three-month moving average of data for the period November 1993 through December 1998 are included in Table 5. Employment data are compared on a seasonally adjusted and nonadjusted basis. While correlation coefficients are positive for both employment and workweek, they are significant only for the employment measures.

²⁰ The approach taken in comparing survey indexes to official statistics follows, in general, that taken by Bell and Crone (1986).

**Table 5 Richmond Fed Manufacturing Survey
Correlations of Survey Indexes with
Changes in District Aggregate Data**

Employment Index (SA)	0.639*
Employment Index (NSA)	0.613*
Workweek (NSA)	0.131

*Variables significant at a 95 percent confidence level.

SA: Seasonally adjusted.

NSA: Not seasonally adjusted.

Notes: Numbers represent Pearson correlation coefficients. Comparisons are based on a three-month moving average of variables.

Source: Department of Labor, Bureau of Labor Statistics: employment in manufacturing, average workweek.

Further analysis of survey data suggests that several of the indexes may also provide a timely indication of changes in national manufacturing activity. While the survey is designed to collect information solely from Fifth District manufacturers, District manufacturing activity often tracks national activity, since the economic and business conditions that prevail in the region often prevail throughout the country. Moreover, Fifth District states account for a considerable portion, about 10 percent, of total national manufacturing employment. As shown in Table 1, the distribution of manufacturing employment across industries in the Fifth District, with the exception of textiles, is similar to the distribution of manufacturing employment in the United States.

Relationships between survey index data and national manufacturing statistics were explored by comparing survey indexes for employment, shipments, new orders, workweek, and prices paid to changes in comparable aggregate measures of national manufacturing activity from the Labor Department and Department of Commerce. Correlation coefficients based on a three-month moving average of seasonally adjusted data are included in Table 6. NAPM survey indexes for employment, production, and new orders are also compared to changes in aggregate measures of national manufacturing activity. Since the NAPM surveys companies nationwide, its indexes are more directly comparable to national economic measures. Correlation coefficients from a comparison of NAPM indexes to changes in aggregate measures of manufacturing activity provide a rough benchmark of the degree of correlation that might reasonably be expected in the Richmond survey.

The employment indexes in both surveys are highly correlated with official employment data. The Richmond Fed's survey indexes for shipments, new orders, and prices paid are also correlated with comparable national

Table 6 Correlations of Survey Indexes with Changes in National Aggregate Data

Index	Richmond Fed Survey	NAPM Survey
Employment	0.552*	0.623*
Shipments	0.432*	0.486*
New orders	0.338*	0.403*
Prices paid	0.851*	—
Workweek	0.062	—

*Variables significant at a 95 percent confidence level.

Notes: Numbers represent Pearson correlation coefficients. Comparisons are based on a three-month moving average of variables. NAPM's production index is used as a proxy for shipments.

Sources: Department of Labor, Bureau of Labor Statistics: employment in manufacturing, average workweek; PPI for commodities, materials and components for manufacturing; Department of Commerce: manufacturers' shipments and orders.

manufacturing statistics.²¹ As was the case in the comparison to District data, the workweek index correlation statistic is not significant.

Do the survey's "expectation" indexes reliably foretell changes in District or national manufacturing activity? The results to date are mixed. Table 7 contains correlation statistics from comparisons of various expectation indexes to corresponding changes in actual manufacturing data six months later.²² The workweek and prices-paid variables show significant positive correlations with "official" data, while the employment and shipments indexes do not. The relatively high correlation of the prices-paid index is consistent with the strong correlation shown for prices paid in Table 6. Prices are reported on an annualized percentage-change basis; the index is an average of the percent changes reported and thus not a diffusion index. The fact that more information is captured in the prices-paid index may explain part of the high correlations for this index. The high correlations for expected workweek are in contrast to the low correlation statistics for workweek reported in Tables 5 and 6.

²¹ Balke and Petersen (1998) explore a broader but related issue. They examine how well beige book descriptions of economic activity by Federal Reserve Banks match national economic activity as measured by real GDP growth. The authors find that their quantified measures of beige book descriptions track current GDP growth "quite well." The Richmond Fed was one of several Federal Reserve Banks whose regional description, when quantified, was statistically significant in predicting current-quarter real GDP growth.

²² Questions regarding employment, shipments, workweek, and prices paid have appeared in the survey since November 1993. Most of the other "six-month-ahead" variables were not added until May 1997. Thus, sufficient data do not exist to evaluate these more recent indexes.

**Table 7 Richmond Fed Manufacturing Survey
Correlations of Expectation Indexes with
Changes in Regional and National Data**

Index	District Comparison	National Comparison
Employment	−0.041	−0.210
Shipments	—	−0.033
Workweek	0.546*	0.386*
Prices paid	—	0.557*

*Variables significant at a 95 percent confidence level.

Notes: Numbers represent Pearson correlation coefficients. Comparisons are based on a three-month moving average of data. All results based on seasonally adjusted data, except for workweek comparison at the District level.

8. CONCLUSIONS

The Federal Reserve Bank of Richmond's manufacturing survey provides a practical set of indexes for tracking changes in production activities within a representative group of Fifth District manufacturers. These indexes are timely and comprehensive, covering all major facets of operations, from new orders received to the volume and prices of products shipped. Collectively, they paint a composite picture of manufacturing activity in the region. Because the survey has enabled the systematic compilation of such data as a complement to anecdotal manufacturing information gathered from other sources, it has proven to be a valuable tool for regional economic analysis.

While periodic surveys of Fifth District manufacturers have been conducted since the mid-1980s, the monthly manufacturing survey in its current form dates back only to November 1993. It is thus just beginning to develop a track record long enough to allow statistical testing and comparison to other manufacturing data series. The analysis conducted to date indicates that several major indexes, including employment, shipments, and new orders, are consistent with similar indexes from other surveys and with manufacturing data available from government or industry sources. A longer study period, however, is needed before one can draw firm conclusions regarding how well the Richmond survey tracks other data series.²³ Survey performance over periods of both economic expansion and contraction, in particular, needs to be evaluated. The U.S. economy

²³ A longer study period would allow for improved statistical analysis of the survey indexes included in Tables 4–7. The survey indexes that have thus far not been subject to any statistical analysis because of limited historic data could also begin to be evaluated. These indexes include wages, vendor lead time, and capacity utilization as well as many of the expectation indexes.

overall has not contracted during any quarter since the initiation of the monthly manufacturing survey in late 1993.

The passage of time will allow the collection of additional data and further statistical analysis. The results of such analysis will provide additional information regarding how well survey indexes track other measures of manufacturing activity and, perhaps, how much confidence can be placed in survey results. But, to a large extent, the manufacturing survey indexes stand on their own. They are unique diffusion indexes of Fifth District manufacturing activity; no directly comparable data exist.

APPENDIX : MANUFACTURING IN FIFTH DISTRICT STATES

The lion's share of manufacturing output in the Fifth District—about 85 percent—comes from facilities located in North Carolina, South Carolina, and Virginia. This area has a long, rich manufacturing history dating back to the earliest years of English settlement in North America. Two industries, cotton textiles and tobacco, have anchored the manufacturing base in the region for over a hundred years; while they no longer dominate the region's manufacturing sector, they remain vital industries. Today the manufacturing sector in the Carolinas and Virginia is a diverse mix of many types of firms, large and small, traditional and cutting edge.

North Carolina is the largest manufacturing state in the Fifth District and the eighth largest industrial state in the country. Over 800,000 people are employed in the manufacturing sector in North Carolina; twice as many as any other state in the District. Its preeminence as the leading industrialized state in the South was established early in the century as its textiles, tobacco, and furniture industries flourished.

More than one-quarter of manufacturing workers in North Carolina are employed in the textile and apparel industries. Output from these industries represents approximately 16 percent of the state's manufacturing product. North Carolina has been a leading textile-producing state in the country since the 1920s, when the center of the cotton textile industry in the nation began shifting from New England to the South. The textile industry remains by far the largest manufacturing employer in the state.

Tobacco has roots that extend even deeper into North Carolina's past. By the 1880s, rapidly expanding production of a new strain of milder, "bright leaf" tobacco in North Carolina boosted the state's tobacco fortunes and allowed North Carolina to begin to rival Virginia in tobacco production. Approximately

40 percent of value added in manufacturing U.S. tobacco products today comes from North Carolina manufacturers. The tobacco industry represents 13 percent of the state's manufacturing output.

Furniture making is the second-largest manufacturing industry in terms of employment in North Carolina. The state has been a leading producer of wood household furniture since the 1930s. The success of the furniture industry has also stimulated related industries, including logging and lumber operations. Employment in the lumber and furniture-making industries makes up about 14 percent of manufacturing employment and 8 percent of manufacturing output in North Carolina.

Textiles and apparel manufacturing, tobacco production, and furniture making collectively represent one-third of North Carolina's manufacturing output. Other large sectors include chemicals, electronic equipment manufacturing, and industrial machinery. The state's textiles and apparel manufacturers, as well as its tobacco producers, have seen their shares of state manufacturing output decline in the 1990s, while the chemical industry has grown.

South Carolina's manufacturing sector is less than half as large as North Carolina's. Over one-quarter of manufacturing employment (17 percent of output) is in the textile and apparel industries. Chemical industries contribute the largest share of manufacturing output, about 21 percent, and 10 percent of the sector's employment. Paper production and industrial machinery manufacturing are also primary industries. Manufacturing output has grown faster in South Carolina than in any other state in the District since 1990, in part because of expanding automobile manufacturing.

Virginia is the second-largest industrial state in the District with a little over 400,000 manufacturing employees. Manufacturing in Virginia has traditionally been more diverse than in North and South Carolina; it has not been as heavily concentrated in textile manufacturing as states further south. The tobacco industry remains Virginia's largest manufacturing industry as measured by value of product: 15 percent of gross state product in manufacturing comes from tobacco. The textiles and apparel industries are also major industries in the state, employing approximately 47,000 people. The chemical industry produces 12 percent of manufacturing output, while 10 percent of employment and output is in food production. Automobile manufacturing and shipbuilding facilities in the state give it a larger presence in transportation industries than any other Fifth District state.

West Virginia and Maryland contribute about 15 percent to the District's manufacturing output. Chemical and primary metals firms dominate West Virginia's manufacturing sector. These two industries account for one-third of manufacturing employment and over 60 percent of manufacturing output. Substantial lumber operations also exist in the state. Maryland's manufacturing sector is larger than West Virginia's and much more diverse. Food

production is another major industry; large poultry operations thrive on Maryland's Eastern Shore. The state also has substantial printing and publishing, industrial machinery, instrument, and chemical industries.

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