

# House Prices and the Quality Of Public Schools: What Are We Buying?

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**W**hen a family with school-age children looks for a house to buy, the quality of the local public schools is often a major consideration. Real estate agents respond to this concern by identifying the school district and sometimes the local elementary school in the information sheet they provide on houses for sale. They also report the property taxes on the house, most of which are used to finance local public schools. The press responds to the interest in the quality of local schools by periodically publishing

available information on per pupil expenditures, teacher-student ratios, average class sizes, and test scores by school district and often by individual school. For example, in September 1997, the *Philadelphia Inquirer* published a special section of the Sunday paper containing this information for schools in the Philadelphia metropolitan area.

Does the availability of such information and home-buyers' concerns for high quality schools result in higher house prices in neighborhoods with better schools? And to what extent are the policies of the local school districts responsible for differences in school quality and, therefore, for any school premium in house prices? A large

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number of statistical studies support the common assumption that differences in the quality of local schools are reflected in house prices. There is less agreement, however, on the extent to which school district policies determine school quality as measured by student performance.

### MEASURING THE SCHOOL PREMIUM IN HOUSE PRICES

In most areas, certain schools or school districts have reputations for being better than others. Presumably, home buyers are willing to pay a premium for public schools that are considered better than average, just as supermarket shoppers are willing to pay more for name brands than for generics. There is a major difference, however, in the way we purchase ordinary goods and local public services like education. We buy soup, soda, and spices directly, but we purchase public education only indirectly by buying or renting a house in a specific neighborhood. So, to identify any school premium in house prices, we have to separate it from the effects of other neighborhood characteristics and the basic quality of the house.

**What's a Good School Worth?** Only a few studies have used direct measures of the community's evaluation of the local school to determine how it affects house prices. In a 1973 study, A. Thomas King used the responses to a survey of home buyers about their neighborhoods in the New Haven, Connecticut, area. The survey included questions on the quality of the local elementary and high schools, and King even defined neighborhoods by the boundaries of the elementary schools. But in his measure of neighborhood quality, King combined the ratings of school quality with ratings on other neighborhood characteristics, such as the danger of crime and quality of garbage collection.<sup>1</sup>

The overall measure of neighborhood quality was highly significant in explaining the variation across school boundaries in the prices

of houses with similar characteristics, such as the size and age of the house, the lot size, and distance from New Haven. King's sample included houses sold between 1967 and 1969. The difference in price between similar houses in the least desirable and the most desirable neighborhoods was more than \$5000.<sup>2</sup> While King could not attribute all this difference to the reputation of the local schools, the ratings on the local elementary and high schools were the most important factors in his overall measure of neighborhood quality.

Ronald Ridker and John Henning also used data from the 1960s to estimate the effect of neighborhood characteristics on house prices. Their main focus was the effect of air pollution on house prices, but they also developed a direct measure of the reputation of the local school. They interviewed educators and real estate agents to classify school districts in the St. Louis area as above average, average, or below average. The authors took into account some housing and neighborhood characteristics like the median number of rooms per house and accessibility to shopping. Surprisingly, in most cases they found no association between the school's reputation and the median house price by census tract, and in some cases, they found that schools with better reputations were associated with lower house prices. The authors themselves suggest that a failure to fully account for other neighborhood characteristics may have led to this result. Ridker and Henning also did not use any direct measure of school district taxes to determine how they may have affected house prices.

A 1997 study by William Bogart and Brian

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<sup>1</sup>King combined the different dimensions of neighborhood quality by using a statistical technique called principal components analysis.

<sup>2</sup>The mean value of the houses in King's sample by census tract ranged from \$10,000 to \$41,000.

Cromwell provides more recent evidence that house values are higher in school districts with better reputations. They examined house prices in three neighborhoods in the Cleveland metropolitan area, where children in each neighborhood attended public schools in two different districts. In each neighborhood, all the houses were in the same municipality, and home owners were assumed to enjoy the same level of public services provided by the municipality. But each neighborhood was partly in one school district and partly in another, so that educational services and school taxes differed among home owners in the same neighborhood. Bogart and Cromwell did not have a direct measure of school quality, but in each neighborhood, one school district clearly had a better reputation than the other. After accounting for differences in the size and quality of the houses, the authors estimated the remaining difference in the value of houses in what was considered the better school district in each neighborhood. The estimated differences were \$5600 in the first neighborhood, \$10,900 in the second, and \$12,000 in the third.<sup>3</sup> Since Bogart and Cromwell do not control for differences in school district taxes, these differences in house values represent the *combined effect* of differences in school quality and taxes. Even though Bogart and Cromwell do not have a direct measure of school quality, the difference in house prices between school districts implies that a better reputation for local schools translates into

a measurable difference in house prices.

A school's reputation is not easy to measure. It has many dimensions, including physical appearance, library facilities, quality of teachers, students' academic performance, and the range of extracurricular activities. People have different opinions about school quality, and the differences between local schools or school districts may be slight. Moreover, surveys on school quality, such as the ones used by King or Ridker and Henning, are seldom available, so researchers have looked to more objective measures, such as school resources or student performance, to estimate the school premium in house prices. They assume that reputation ultimately depends on these objective measures.

**School Resources.** Expenditures per pupil are the standard measure of school resources, and since the late 1960s, a series of articles on what determines house prices have used per pupil expenditures as a proxy for the quality of the local school.<sup>4</sup> Most of these studies have found that after accounting for other neighborhood characteristics, the prices of *similar* houses are higher in school districts with higher expenditures per pupil.<sup>5</sup> Other studies have found no positive relationship between school expenditures and house prices, but the weight of the evidence is that home owners do value school districts that spend more per pupil.<sup>6</sup>

Higher school expenditures, however, may

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<sup>3</sup>These differences are in 1987 dollars. The total difference in the average value of houses in different school districts was \$9600 in the first neighborhood, \$33,100 in the second, and \$17,600 in the third. But some of the total difference was due to factors other than the schools, such as the size and quality of the house, lot size, and street traffic. The results on the difference in the value of schools are from regression equations that use a dummy variable for the school district and control for differences in the houses. The estimates of the differences in house prices between school districts are all statistically significant.

<sup>4</sup>A. Thomas King (1973) also used student-teacher ratios as a measure of school resources, but he found no statistically significant relationship between student-teacher ratios and house prices.

<sup>5</sup>See the articles by Wallace Oates, 1969 and 1973; Henry Pollakowski; Richard Gustely; A. Thomas King, 1977; Timothy Gronberg; and Raymond Reinhard.

<sup>6</sup>See the articles by Matthew Edel and Elliot Sclar; Richard Dusansky, Melvin Ingber, and Nicholas Karatjas; and Kathy Hayes and Lori Taylor.

necessitate higher taxes, and higher taxes depress house prices, making it difficult to assess the *net* effect of school taxes and expenditures on house prices.<sup>7</sup> A few studies have suggested that raising property taxes and applying the revenues to local schools would increase the average value of the houses in their samples.<sup>8</sup> But Jan Brueckner argues the opposite. For the communities in his sample, he concluded that a reduction in both property taxes and school expenditures would increase house values. Home owners certainly prefer more school resources to less if their tax bills remain unchanged. But we cannot conclude that home owners would be willing to pay for increased school funding in the form of higher taxes or cuts in other services. And once we take into consideration the tax effect, higher school expenditures may not increase house values.

A more serious concern about using expenditures as a measure of quality is that expenditures are an input into the education process, not a measure of the output. Expenditures represent the financial resources available to the school. They can be used to reduce class size, purchase equipment, or fund a broader range of courses. But even smaller class sizes, state-of-the-art facilities, and a broad curriculum are not direct measures of how well a school is fulfilling its mission. Home buyers are more likely to view student achievement as the primary indicator of the quality of public schools. But how do we measure student achievement?

**Performance Measures.** Some recent studies imply that future earnings are the ultimate measure of student achievement and school quality. But future earnings are not a very prac-

tical measure of school quality for prospective home buyers. Home buyers would normally find it impossible to get information on the earnings of former students in order to evaluate the quality of local public schools, and they would have to assume that the quality had not changed since those students attended the schools.<sup>9</sup>

A school's performance is typically measured by how well it fulfills the immediate goals of primary and secondary education. These goals can include furthering artistic and vocational skills, fostering good work habits and civic awareness, and imparting academic knowledge.<sup>10</sup> Performance in some of these areas is difficult to measure, so traditionally school quality has been judged by academic achievement. And this is the principal gauge of quality for many prospective home buyers.

Comparing academic performance across schools or school districts requires a common measure of achievement, such as scores from standardized tests. These scores are often available upon request and are sometimes even reported in the local press. Several studies have used a standard measure of academic achievement, such as test scores, to estimate the effect of school quality on house prices.<sup>11</sup> These stud-

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<sup>9</sup>No study has tried to directly link house prices to the earnings of former students at the local school. But studies have attempted to identify the characteristics of local schools that are associated with higher lifetime earnings. The jury is still out on the question of whether any of the typical primary and secondary school characteristics such as student-teacher ratios or the length of the school term directly affect lifetime earnings. See the articles by Julian Betts, 1995 and 1996; David Card and Alan Krueger; and James Heckman, Anne Layne-Farrar, and Petra Todd.

<sup>10</sup>See the study by Elchanan Cohn and Stephen Millman and the one by Robert Leekley.

<sup>11</sup>See A. Thomas King, 1973; Gerald McDougall; Harvey Rosen and David Fullerton; Donald Jud and James Watts; Raymond Reinhard; and Sandra Black. In the study by

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<sup>7</sup>Most studies that estimate the effect of per pupil expenditures on house values attempt to estimate that effect while holding taxes or tax rates constant.

<sup>8</sup>See the articles by Wallace Oates (1969) and Richard Gustely.

ies have consistently found that higher achievement is associated with higher house prices. Most studies have used the average score for a given grade on some standard reading, math, or general academic test as the measure of achievement, and higher average scores are associated with higher house values in the neighborhood. Raymond Reinhard sought to get a more accurate measure of what the school contributes to academic achievement by looking at the *improvement* in the average reading level between first and third grade. He found that the greater the improvement in average reading levels, the higher were neighborhood house prices.<sup>12</sup>

Although empirical studies consistently find a positive link between school test scores and house prices, do test scores necessarily represent what the school has contributed to the student's academic development? For example, children with higher innate abilities will have higher test scores on average, but why should house prices reflect the higher abilities that children bring to the local school? The school premium in house prices should reflect what the school contributes to the student's achievement, and there is considerable debate about how much difference a school makes.

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Mingche M. Li and H. James Brown test scores were positively associated with house prices in three different estimations, but only one of the estimations was statistically significant.

<sup>12</sup>Two studies that use some measure of academic achievement for school quality also include other measures of quality. King (1973) found that higher test scores and his measure of the residents' estimation of quality have separate effects on house prices. This suggests that a school's reputation is based on more than the academic assessment and home buyers use objective as well as subjective criteria in assessing the value of the local school. And Reinhard found that greater improvement in reading and higher expenditures per pupil have independent positive effects on house prices, suggesting that both resources and student performance are used to evaluate a school's quality.

## TO WHAT EXTENT DO SCHOOLS MAKE A DIFFERENCE?

Clearly, there are significant differences in academic achievement across school districts and among schools in the same district. Standardized test scores from schools in the Philadelphia suburbs illustrate the extent of the differences. Each year fifth, eighth, and 11th grade students in Pennsylvania are given a set of tests called the Pennsylvania System of School Assessment tests. In the 1996-97 school year, the percentage of fifth grade students who scored in the top quartile of all Pennsylvania students taking those tests varied widely among the suburban Philadelphia school districts.<sup>13</sup> For the reading test, the percentage of students in the top quartile ranged from 4 percent in the lowest ranked school district to 51 percent in the highest ranked district. For math, the range was from 2 percent to 57 percent. If we consider the test results for individual schools rather than school districts, the percentage of students in the top quartile ranges from 1 to 69 percent across the schools for reading and from 0 to 75 percent for math.<sup>14</sup> But districts with high av-

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<sup>13</sup>For these comparisons we did not include data from schools in the City of Philadelphia because the size of the district and the extremely wide variation among schools distinguish the Philadelphia district from the suburban districts. These data refer only to the Philadelphia suburbs in Pennsylvania, not in New Jersey, because the test is taken only in Pennsylvania.

<sup>14</sup>A standard analysis of variance shows that 38 percent of the variation in top reading scores was due to differences *within* districts and 62 percent was due to differences *between* districts. For the top math scores, 33 percent was due to differences *within* districts and 67 percent was due to differences *between* districts. We assume that the differences within districts are not due to any significant differences in school resources. We have no comprehensive information about the distribution of resources *within* school districts in Pennsylvania, but Linda Hertert found that the distribution of spending for elementary schools in California was fairly equal within districts.

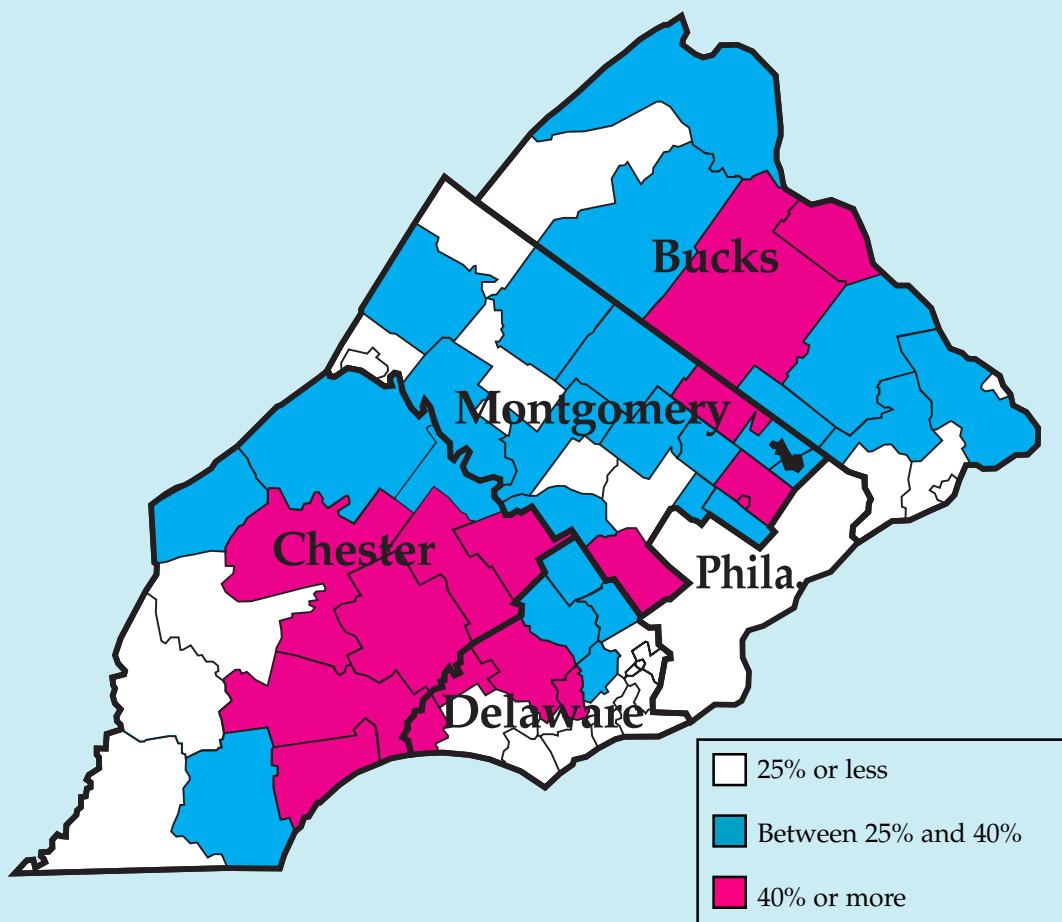
erage achievement are clustered together geographically, so is it school district resources and policies or the characteristics of the population in those areas that determine students' achievement levels? (See *Percentage of Students in Top Quartile for Reading and Math Scores*.)

In a 1966 report from the U.S. Office of Education entitled *Equality of Educational Opportunity*, James Coleman and his colleagues sug-

gested that "differences between schools account for only a small fraction of differences in pupil achievement."<sup>15</sup> This suggestion initiated a long-running debate about the extent to which local schools and the resources available to them matter for academic achievement. The Coleman

<sup>15</sup>James S. Coleman et al., p. 21.

### Percentage of Students in Top Quartile for Reading Scores Pennsylvania System Assessment Tests 1996-97

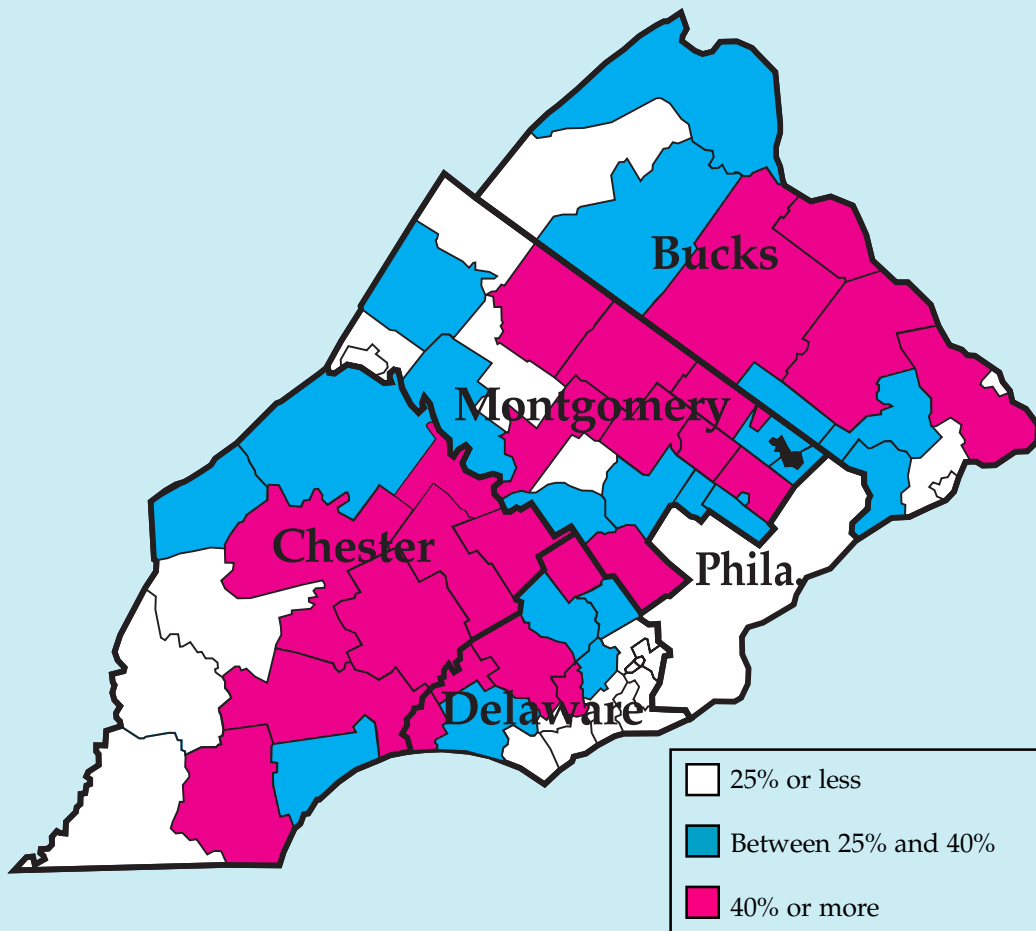


report also found that family background and the achievement level of the other students in class were important for an individual student's performance. Somehow the prospective home buyer has to weigh all these factors in assessing how much the local school or school district adds to the value of a house.

**School Resources.** Few researchers would argue that school resources never affect stu-

dent's academic achievement, but the empirical estimates of the effects of school resources on student performance present a mixed picture. Eric Hanushek (1996a) catalogued estimates from 90 published studies on the effect of various measures of school resources on student performance. He looked at expenditures per pupil and more specific measures like student-teacher ratios; the education, experience,

### Percentage of Students in Top Quartile for Math Scores Pennsylvania System Assessment Tests 1996-97



Black area is Bryn Athyn. Public school students there attend schools in other districts.



and salaries of teachers; and the condition of the school's physical facilities. In most cases, the estimated effects of these resources on student performance were not statistically significant. Among those estimates that were significant, most were positive but some were negative. Thus, Hanushek concluded that "there is no consistent relationship between the key resources to schools and student performance."

Richard Laine, Rob Greenwald, and Larry Hedges examined some of the same studies as Hanushek and came to a somewhat different conclusion. They considered the statistical significance of the estimates in each of the studies and concluded that the studies do provide some evidence that certain measures of school resources, such as per pupil expenditures, student-teacher ratios, and teachers' experience and salaries, have a positive effect on student achievement.<sup>16</sup> Even Hanushek agrees with the limited conclusion that in some situations school resources can make a difference in academic achievement, but he still maintains "that there is no strong or systematic relationship between school expenditures and student performance."<sup>17</sup>

**Family Characteristics.** Those studies that find little or no relationship between traditional school resources and student achievement often find that neighborhood or family characteristics are related to achievement.<sup>18</sup> For ex-

ample, a higher education level of the parents and other adults in the neighborhood is associated with higher test scores. To the extent that we can get data on the use of libraries by the family and the number of books or magazines in the home, these indicators are associated with higher academic achievement by the children in the family. The presence of both parents in the home also has a positive effect. The larger the family, however, the lower the average academic achievement of the children. Family income, which is highly correlated with many of these other family characteristics, is also positively related to achievement.<sup>19</sup> Some studies combine several family characteristics, such as income, family size, and parents' education and occupation, into an index of socioeconomic status. The studies consistently find that these indexes predict higher academic achievement by the children.<sup>20</sup> If family characteristics were the sole explanation for higher student achievement, paying a premium for a house in a school district with high test scores would make no sense. Moving into the district will not change the family background of the student.

**Peer Group Effect.** A final factor may go a long way to explain why families are willing to pay a premium for houses near schools with high test scores. Researchers call it the peer group effect: the effect that a student's classmates or schoolmates have on his or her academic achievement. According to the Coleman report, "It appears that a pupil's achievement is strongly related to the educational backgrounds and aspirations of the other students in the school."<sup>21</sup>

<sup>16</sup>Laine, Greenwald, and Hedges applied stricter criteria than Hanushek to the studies they chose, and their analysis is based on 60 studies of school resources and student performance. The authors used a method of combined significance tests to estimate the joint significance of the results from different studies. For an explanation, see the 1994 article by Hedges, Laine, and Greenwald.

<sup>17</sup>See Hanushek, 1994, 1996a, and 1996b.

<sup>18</sup>For evidence on specific family characteristics, see Anthony Boardman, Otto Davis, and Peggy Sandy; Donald Baum; Mark Dynarski, Robert Schwab, and Ernest Zampelli; Eric Hanushek, 1992; and Susanna Loeb and John Bound.

<sup>19</sup>See the articles by Wallace Oates, 1977; Mark Dynarski et al.; and Eric Hanushek, 1992.

<sup>20</sup>See the articles by Byron Brown and Daniel Saks; Anthony Boardman et al.; and Herbert Walberg and William Fowler.

<sup>21</sup>James S. Coleman et al., p. 22.



A true test of the peer group effect requires data not only on the academic progress of individual students but also some measure of the intellectual abilities or academic performance of their classmates. Two studies from the 1970s had such data on individual students, and both found a significant peer group effect.

In 1977, Anita Summers and Barbara Wolfe examined school, family, and peer group factors that influenced the change in test scores between third and sixth grade for 627 students in the Philadelphia school system. After taking into account family characteristics such as income and characteristics of the school such as the teachers' education and experience, Summers and Wolfe found that higher academic performance by classmates helped lower achievers improve their test scores. They found no significant peer group effect for high achievers, however.

In the second study of the peer group effect, Vernon Henderson, Peter Mieszkowski, and Yvon Sauvageau identified the factors that improved language and math scores for 7000 French-speaking students in Montreal. They found that the higher the average IQ of the other students in the class, the greater the improvement in test scores for all students, no matter what their own level of achievement. Thus, both high achievers and low achievers benefited from the peer group effect.<sup>22</sup>

The existence of a peer group effect allows children to benefit from the innate abilities and the family characteristics of the other students

in their school. Hence, the makeup of the student body is a factor in the educational process at the primary and secondary levels.

### **SO WHAT ARE WE BUYING WITH THE SCHOOL PREMIUM?**

This survey of housing prices and school quality has identified at least two possible sources for the school premium: the resources available to the school and the composition of the student body. Even though the overall relationship between school resources and student achievement is a matter of controversy, most researchers agree that when extra resources are used wisely, they can enhance the quality of education and thereby contribute to higher house prices. These extra resources might be used to improve academic achievement, but they might also be used to improve other dimensions of school quality, such as the physical attractiveness of the school or the range of extracurricular activities.

The empirical evidence also shows that academic achievement can be improved by the peer group effect. This effect represents a classic spillover, whereby students reap benefits from the personal and family characteristics of their classmates. Therefore, prospective home buyers are applying an appropriate yardstick when they focus on average test scores to help decide what the school premium should be. The peer group effect justifies higher house prices in areas where schools have higher test scores. It is not easy to disentangle the school premium from the value of many other neighborhood characteristics. But the premium clearly exists, and it is an important factor in the difference in house prices across neighborhoods.

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<sup>22</sup>Henderson et al. did find that lower achievers benefited more from the peer group effect.

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# What's Happening in Manufacturing: "Survey Says..."

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**F**inancial journalists and market participants have focused a great deal of attention in recent years on the *Business Outlook Survey* (BOS) conducted by the Philadelphia Fed. The survey results are reported by the major financial wire services immediately after their release. This monthly survey seeks information from manufacturers in the Third Federal Reserve District about current conditions at their plants and their expectations for the future. The survey has been conducted monthly since 1968 and offers a valuable source of information in tracking developments in the District's manufacturing sector.

How useful is the survey in providing new information on the broader economy? Clearly, market participants see value in the survey results. Statistical analysis offers evidence that the survey provides information on short-term changes in the regional and national manufacturing sectors.

## **A SURVEY ABOUT THE DIRECTION OF BUSINESS ACTIVITY**

The *Business Outlook Survey* asks participants to indicate the direction of change in overall business activity and in various measures of activity at their plants: employment, working hours, new and unfilled orders, shipments, inventories, delivery times, prices paid, and prices received. They are asked to indicate whether each measure has increased, decreased, or re-

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mained the same since the previous month and whether they expect the measure to increase, decrease, or remain unchanged during the coming six months.<sup>1</sup> The section about expectations also includes a question about capital spending plans (see *Description of the Business Outlook Survey*). Surveys about the direction of change like the BOS have distinct advantages over traditional ways of measuring economic activity.

**Advantages.** One advantage of qualitative surveys is the nonintrusive nature of the questions. Since the survey asks only for information about the direction of change and not for specific numbers, firms may be more willing to participate. Firms do not have to reveal confidential information regarding sales. Moreover, results are

<sup>1</sup>Such qualitative surveys are common in Europe, where they are generally referred to as “tendency surveys.” The Centre for International Research on Economic Tendency Surveys (CIRET) in Munich, Germany, has cataloged more than 100 institutions in 43 countries that conduct such business-cycle surveys.

## Description of the Business Outlook Survey

The Philadelphia Fed’s *Business Outlook Survey* was started in 1968 and has remained essentially unchanged since that time. The survey questionnaire is a “box check” variety (see the *Business Outlook Survey Questionnaire* to the right). Respondents indicate whether the value of each economic indicator (except capital expenditures) has increased, decreased, or stayed the same over the past month. They are also asked about their expectations for each indicator over the next six months. No quantitative information (dollar amounts or volume) is requested for any of the variables, although participants can voluntarily submit comments about economic conditions or special factors relevant to their business. All the questions refer specifically to a firm’s own activity except the first one on general business activity. The response to the first question is not necessarily based solely on information from the firm, but the high correlation of aggregate responses to this question with the responses to the question on shipments indicates that a firm’s answer to the first question is primarily based on its own activity.<sup>a</sup>

Each month, about 250 large manufacturing firms located in the Third Federal Reserve District receive the survey.<sup>b</sup> Only those that have 100 or more employees are asked to participate in the survey, and participation is voluntary. The survey is sent to the same individual each month, typically the chief executive or a designated officer. The voluntary reporting panel has changed over time, and the group of participating firms is periodically replenished as firms drop out or a need arises to make the panel more representative of the industrial mix of the region.

Surveys are mailed to the participating firms near the end of each month, and the Fed asks that responses be returned by the end of the first full week of the following month. The period for collecting responses, therefore, does not coincide with the data collection period for most official statistics. In fact, the *Business Outlook Survey*’s collection period spans two calendar months. For example, the survey for July 1997 was mailed in late June with a return deadline of July 5, although survey forms are normally accepted after the return date. Therefore, most responses were based on activity through the first week of July. In recent years, between 100 and 125 firms have responded each month. For example, in July 1997, 114 respondents returned questionnaires. As shown in Table 1, data for the *Business Outlook Survey* are published ahead of comparable official data on the manufacturing sector.

Results of the survey are always published at 10:00 a.m. E.T. on the third Thursday of the month. Results are available immediately to market participants via the major national and international news wire services. The monthly release along with aggregate historical data series is also available on the Bank’s Internet site at ‘<http://www.phil.frb.org>’.

<sup>a</sup>The correlation coefficient between the diffusion indexes for current activity and shipments is 0.85.

<sup>b</sup>The Third Federal Reserve District comprises the state of Delaware, the southern half of New Jersey, and the eastern two-thirds of Pennsylvania.

# BUSINESS

## OUTLOOK

Federal Reserve Bank  
of Philadelphia

## Survey

July 1997

**CONFIDENTIAL: Individual replies will not be published or quoted.**

Name of Firm	Respondent
Title	Date

We would like your opinion of business conditions. Please complete this questionnaire by checking the appropriate box and return it by the 5th of the month. If it is more convenient to fax the survey, send it to (215) 574-4364.

Indicator	July vs. June			Six Months from Now vs. July		
	Decrease	No Change	Increase	Decrease	No Change	Increase
<b>General Business Conditions</b> What is your evaluation of the level of general business activity?						
<b>Company Business Indicators</b> New Orders						
Shipments						
Unfilled Orders						
Delivery Time						
Inventories						
Prices Paid						
Prices Received						
Number of Employees						
Average Employee Workweek						
Capital Expenditures						

Please comment on any special factors that may be affecting your business. Use reverse side if necessary.





# BUSINESS

## OUTLOOK

Federal Reserve Bank  
of Philadelphia

## Survey

July 1998

Regional manufacturing activity is reportedly expanding at a slower pace this month. Most of the survey's current indicators of economic performance declined from their relatively high readings of the previous month. Upward price pressures are notably absent this month. The manufacturers' responses indicate that overall weaker performance is expected over the rest of the year.

### Indicators Fall to Their Lowest Readings This Year

The current general activity index declined from 28.2 in June to 11.6 this month, the lowest level since December (see Chart). Nearly 29 percent of the manufacturers report increases in activity this month, compared with nearly 40 percent the previous month. Slowing is also evident in firms' responses regarding shipments and new orders this month. Although the percentage of firms reporting increases in shipments and new orders is greater than the percentage reporting decreases, the diffusion indexes for both dropped to their lowest readings this year. The current shipments index declined from 27.4 to 7.2. The current new orders index fell from 22.6 to 7.5.

The percentage of firms reporting increases in employment (18 percent) edged out the percentage reporting declines (14 percent). The current employment index fell from 7.9 to 4.5. The average workweek index, however, declined markedly from 11.8 to -2.1.

Despite regional manufacturing's slower rate of growth, responses

regarding unfilled orders and delivery times changed little. The percentage of firms reporting increases in unfilled orders (26 percent) is greater than the percentage reporting decreases (19 percent). The current unfilled orders index increased from 6.8 to 7.5. More firms reported longer delivery times (19 percent) than reported shorter ones (10 percent). The delivery time index, which remained positive for the third consecutive month, increased from 2.3 in June to 8.2.

### Price Indexes Fall to Relative Lows

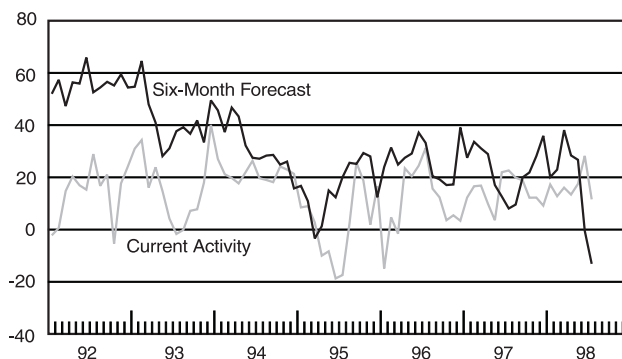
Pressures on input prices moderated notably this month, according to the region's manufacturers. For the first time since February 1996, the percentage of firms indicating declining input prices (12 percent)

was larger than the percentage indicating increases (9 percent). The current prices paid index fell from 6.1 to -2.1.

Prices of final manufactured goods are reported steady by 69 percent of firms. For the first time since March, the percentage of firms reporting declining prices for goods (18 percent) is greater than the percentage reporting rising prices (12 percent). The current prices received index fell from 1.1 in June to -5.8.

**Current and Future Manufacturing Activity**  
(January 1992 to July 1998)

Diffusion Index\*



\*Percentage of respondents indicating an increase minus percentage indicating a decrease.

To subscribe to this publication call (215) 574-6428. This publication can be found on the Internet using the World Wide Web at '<http://www.phil.frb.org>'.

## Forecasts Fall Precipitously in Past Few Months

A notable decline in expectations was in evidence in the previous survey and again this month. The future activity diffusion index fell from -0.5 in June to -13.1, its lowest reading since 1990 and the fourth consecutive month of decline (see Chart). Although 44 percent of respondents expect no change in activity from current levels, the percentage expecting declines (32 percent) is greater than the percentage expecting increases (19 percent). A similar pattern is in evidence regarding firms' expectations about future new orders and shipments. Firms anticipate that declines in orders

will be accompanied by declines in unfilled orders and shorter delivery times. On balance, inventories are expected to decline from current levels.

For the second consecutive month, the percentage of firms expecting declines in employment (26 percent) is greater than the percentage expecting increases (19 percent). The future employment index also fell from -2.9 to -7.4, its lowest reading since January 1996. Declines in average work hours are also consistent with declines in other broad forecast indicators. The future index for average employee workweek declined from -10.5 to -23.5.

## Summary

Although last month's survey reported robust growth in regional manufacturing, *Business Outlook Survey* indicators this month suggest only slight improvements in overall business. Slowing of growth is evident in responses regarding new orders, shipments, and average work hours. More firms reported declines in input and output prices this month than reported increases. Sharp declines in the six-month forecast indicators over the past few months suggest weaker conditions are expected through the end of the year.

## BUSINESS OUTLOOK SURVEY

### Summary of Returns

July 1998	July vs. June				Six Months from Now vs. July			
	Decrease	No Change	Increase	Diffusion Index	Decrease	No Change	Increase	Diffusion Index
What is your evaluation of the level of general business activity?	17.0	54.5	28.6	11.6	32.0	44.3	18.9	-13.1
Company Business Indicators								
New Orders	24.8	42.9	32.3	7.5	35.9	34.0	28.8	-7.1
Shipments	18.0	56.9	25.2	7.2	35.6	38.1	22.4	-13.2
Unfilled Orders	18.8	54.9	26.3	7.5	41.0	45.4	9.7	-31.3
Delivery Time	10.3	70.0	18.6	8.2	30.4	59.1	6.7	-23.8
Inventories	26.9	57.3	15.7	-11.2	35.3	43.1	20.8	-14.6
Prices Paid	11.5	79.1	9.4	-2.1	5.4	59.8	33.4	28.1
Prices Received	17.7	69.3	11.9	-5.8	18.9	55.2	25.5	6.5
Number of Employees	13.9	67.7	18.4	4.5	26.1	55.3	18.6	-7.4
Average Employee Workweek	22.0	58.1	19.9	-2.1	35.7	50.5	12.2	-23.5
Capital Expenditures	—	—	—	—	14.1	43.1	22.6	8.5

Notes: (1) Items may not add up to 100 percent because of omission by respondents.

(2) All data seasonally adjusted.

(3) Diffusion indexes represent the percentage of respondents indicating an increase minus the percentage indicating a decrease.

**TABLE 1**  
**The Timing of Surveys and Publication Dates**

The table below depicts the publication dates for the July 1997 reference month and the corresponding publication date for selected U.S. and regional manufacturing data. The collection period for the *Business Outlook Survey* spans two months. For example, the July 1997 report reflected only one week in the month of July, but it was available in advance of the comparable official statistics for the manufacturing sector for that month.

	Reference Month	Publication Date
<b><i>Business Outlook Survey</i></b>	July	July 17
<b>Regional Data</b>		
U.S. Department of Labor Bureau of Labor Statistics		
Manufacturing Employment	July	August 26
Average Workweek in Manufacturing	July	August 26
<b>National Data</b>		
U.S. Department of Labor Bureau of Labor Statistics		
Manufacturing Employment	July	August 1
Average Workweek in Manufacturing	July	August 1
Producer Prices	July	August 13
U.S. Department of Commerce Bureau of the Census		
New Orders, Shipments, and Unfilled Orders	July	September 4
Board of Governors, Federal Reserve System		
Industrial Production	July	August 14
National Association of Purchasing Managers		
Backlog of Orders and Supplier Deliveries	July	August 1

published only in the aggregate, so information about individual companies is not disclosed.

Qualitative surveys also take less time to fill out than quantitative surveys because there is no need to collect exact numbers. Busy executives are more likely to respond to a survey whose time requirements are minimal. Moreover, because qualitative surveys can be filled

out more quickly, they are returned more quickly, so the data can be processed in a more timely fashion.

Qualitative surveys also enjoy a cost advantage over quantitative surveys. A major cost in processing any survey involves entering data into computer systems, editing the data for validity and quality, and obtaining missing re-

ports. Qualitative surveys require fewer costly processing steps, and data are simpler to enter and edit.

**Interpreting Qualitative Surveys.** By their nature, qualitative surveys provide less precise information than quantitative ones. A response that new orders rose 2.1 percent this month is much more informative than one that merely states that orders rose. The less precise nature of a qualitative survey is manifested in the large percentage of BOS respondents each month who indicate "no change" for many of the variables. It is unlikely that all these respondents have experienced absolutely no change. For some, a change may be so small that it is insignificant for their operation. Others may not know the direction of change in each variable, and a "no change" response may reflect a reasonable state of uncertainty.

Even though the information is less precise, is there any evidence that responses to qualitative surveys are systematically biased? In the case of the *Business Outlook Survey*, a large percentage of responses come from chief executives, financial officers, or other individuals in a position to know.<sup>2</sup> Occasionally, the accuracy of individual responses has been verified through telephone conversations with respondents. Many firms decide not to participate in the BOS, and sometimes a firm may decide not to respond to a particular question. When participants do answer the questions, however, there is little reason to suspect that they systematically bias their confidential responses.<sup>3</sup>

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<sup>2</sup>This constitutes an important difference between the BOS and other frequently cited national surveys, which focus on specific professional groups, for example, the National Association of Purchasing Management, which distributes surveys to purchasing management professionals; or the APICS survey, which polls manufacturing production and inventory control professionals.

<sup>3</sup>In his 1991 study, John Carlson of the Cleveland Fed also argues that there is "no reason to dismiss evidence from surveys on the assumption that people are systematic li-

## COMPARING THE SURVEY'S RESULTS WITH OTHER REGIONAL AND NATIONAL DATA

The main goal of the BOS is to obtain meaningful information about the pace of growth in the District's manufacturing sector. To put the individual survey responses into a form useful for tracking business conditions, the Philadelphia Fed constructs a diffusion index to summarize each indicator. The diffusion index is calculated for each indicator in the *Business Outlook Survey* by subtracting the percentage of respondents indicating a decrease from the percentage indicating an increase. Each index has a maximum value of 100 and a minimum value of -100. For example, if 100 percent of the respondents indicate increases in new orders compared with the previous month, the diffusion index for current new orders would be 100. Similarly, if 100 percent reported declines in new orders this month, the index would have a value of -100. None of the indexes is likely to take on such extreme values. In practice, a large percentage of firms will report no change for many variables, and the diffusion index is determined by those reporting increases and decreases. If 60 percent of firms report "no change," 30 percent report "increase," and 10 percent report "decrease," the diffusion index would equal 20 (30 - 10).

To derive meaningful information about activity in the manufacturing sector from the BOS diffusion index, we need to account for unintentional seasonal bias in responses. For example, a manufacturer of chocolate candy would naturally have higher shipments during certain months because of holiday consumption. But it may not be clear to the manufacturer how to report this seasonal change. Prior

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ars." He advocates more frequent use of surveys by economists but cautions: "Designers of surveys and users of the results should think carefully about whether the respondents might have any systematic tendencies to give false or misleading answers."

to 1985, respondents to the BOS were asked not to report changes that were only seasonal. Despite this request, the aggregate data displayed significant seasonal patterns, most noticeably a consistent pattern of a business slowdown during the summer months and at year-end.<sup>4</sup> More recently, individual respondents have not been asked to adjust for any seasonal pattern, and the Philadelphia Fed seasonally adjusts the percentages for increase, decrease, and no change for each BOS index.<sup>5</sup>

Like a statistical average, the diffusion index is an incomplete summary measure. For example, consider two situations that result in identical diffusion indexes but portray two very different distributions of responses. If 50 percent of respondents indicate increases in new orders this month and 50 percent report declines, the overall diffusion index is zero. The index would also be zero when only 5 percent of firms report increases, 5 percent report declines, and 90 percent report no change. In these two situations, the zero diffusion index characterizes quite different distributions of responses.<sup>6</sup> Consequently, the publication of re-

sults includes the distribution of responses as well as the diffusion index (see Summary of Returns on July 1998 BOS).

Although the diffusion index does not completely describe the distribution of responses, it has always dropped below zero during recessions, then moved above zero during the recovery phase of a business cycle (Figure). Through recessions and expansions, the index has been highly correlated with rates of change in corresponding quantitative measures.

One major benefit of the *Business Outlook Survey* is that it is available before comparable quantitative measures. One criterion for evaluating the importance of the survey's information to market participants and policymakers is its ability to predict the quantitative measures. In other words, the ultimate test of the BOS diffusion indexes as measures of manufacturing activity is how well the indexes correspond to changes in the manufacturing statistics from quantitative surveys. At the regional level, only two government statistics are comparable to indexes from the BOS: manufacturing employment and average work hours.<sup>7</sup> The correlation between the BOS diffusion index on the number of employees and the monthly changes in employment is reasonably high. But the BOS diffusion index on the average workweek is not significantly correlated with changes in the average workweek in the region.<sup>8</sup>

Even though the BOS is a regional survey, the indexes also reflect conditions in the national manufacturing sector. The BOS diffusion

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<sup>4</sup>The historical data suggest seasonal components have diminished over time but are nonetheless very important. The traditional reasons for such seasonal slowdowns may have become less important. For example, summer closings for capital equipment maintenance, summer vacations, and inventory valuation are less prevalent.

<sup>5</sup>We use an additive seasonal adjustment procedure in which separate seasonal factors are calculated for the aggregate increase, decrease, and no change proportions. The additive procedure accommodates zero percentages (for example, no respondents indicating price reductions in a given month). Minor adjustments are made to the seasonal calculations to prevent the situation where the seasonally adjusted individual percentages might take on negative values.

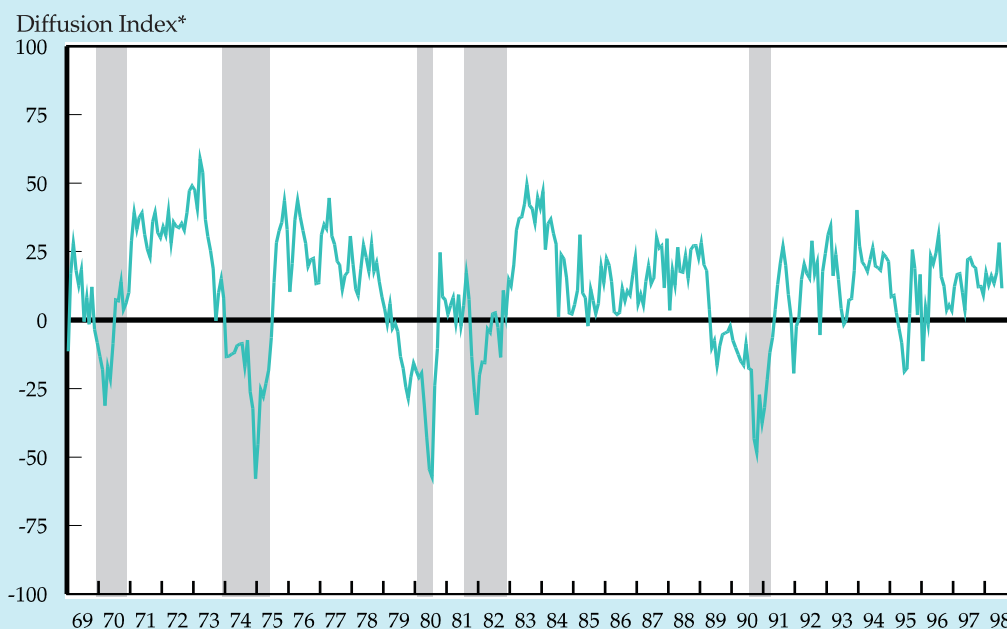
<sup>6</sup>This is similar to using the statistical mean or average to describe data. Although the mean is a good summary measure of the central tendency of a distribution, the standard deviation is the statistic that helps to describe the degree of dispersion of the data.

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<sup>7</sup>The Bureau of the Census also computes annual estimates of value-added for each industry at the state level based on the *Census of Manufactures* and the *Annual Survey of Manufactures*. But these data are available only on an annual basis and are published with a considerable lag.

<sup>8</sup>The correlation coefficient between the BOS's current average workweek index and changes in regional employment, however, is 0.48 and is significant at the 1 percent level.

**FIGURE**  
**Business Outlook Survey**  
**Current Activity (January 1969 - July 1998)**



\*Index represents percentage of respondents indicating an increase minus percentage indicating a decrease.

Note: Shaded areas denote official recessions as defined by the National Bureau of Economic Research.

indexes are positively and (with one exception) significantly correlated with changes in the corresponding national series.<sup>9</sup>

Several factors may explain the positive cor-

<sup>9</sup>Correlation coefficients between BOS diffusion indexes and monthly changes in comparable U.S. manufacturing indicators range from a high of 0.58 for the monthly change in U.S. manufacturing employment to a low of 0.04 for the monthly change in the U.S. manufacturing workweek. All of the correlation coefficients are statistically significant at the 1 percent level with the exception of the one for average workweek. Table 2 provides more details from the perspective of regression analysis.

relations with national data. First, the manufacturers who respond each month represent relatively large establishments (most have more than 250 employees), and their markets are national. Second, many of the manufacturers have plants operating in other parts of the country, and growth in the Third District reflects growth for the national organization. Moreover, goods produced by some of the firms in the survey represent inputs for other firms that operate in national markets.

To determine how well a BOS diffusion index can predict changes in the corresponding national or regional data, we used the common

statistical technique of regression analysis. We show the results of 12 simple models in which the current month's diffusion index alone is used to predict the change in the corresponding regional or national data (Table 2). The BOS indexes are most successful at forecasting industrial production, regional and national manufacturing employment, and producer prices.<sup>10</sup> The indexes are less successful at predicting changes in more volatile monthly series, such as new orders and inventories, but the BOS indexes still have significant relationships with these series. Only in the case of the average workweek does the BOS index not have a statistically significant relationship to the change in the corresponding official data.

For example, consider the results in regard to the relationship between the current general activity index and the monthly change in the U.S. manufacturing component of the industrial production index (second row of Table 2). According to the regression results, each one-point increase in the BOS is consistent with a 0.02 percentage point rise in the monthly change of the U.S. manufacturing index. For example, a BOS reading of 10 suggests a monthly percent increase in manufacturing production of 0.2 percent ( $10 \times 0.02$ , the estimated coefficient from the regression shown in the second row). A diffusion index of zero, in this case, also corresponds to essentially no change in the manufacturing index as suggested by the theory underlying the index's construction (see Appendix).

The regression results in Table 2 also allow us to calculate a break-even point, a value for the diffusion index that is consistent with no change in the official statistic. These break-even points range from -36.3 for inventories to 14.8 for producer prices. The break-even points for industrial production and employment,

however, are close to zero, as would be suggested by the analytic model described in the Appendix. For all the BOS indexes, only values above the break-even point suggest an increase in the corresponding official series for the current month, and only values below the break-even point suggest a decline in the official series.

### **BUT DOES THE SURVEY CONTAIN ANY NEW INFORMATION?**

The correlations and regression results suggest that most of the BOS indexes track corresponding official statistics reasonably well and exhibit distinct cyclical behavior. This information is potentially valuable because the BOS collection periods overlap the collection periods of the official series and the BOS is published prior to the official series.<sup>11</sup> But do the indexes actually give us any useful information ahead of other measurements of the manufacturing sector?

We can assess the value of the information in the BOS in at least three different ways. First, does the diffusion index alone help predict the change in the official series? The simple regression results indicate this is true for all but one of the BOS indexes (Table 2). Second, we can apply a more stringent criterion. Does the addition of the index from the BOS help us predict this month's change in the official series better than we could with just the past changes in the official series? And, finally, if we also use other relevant information available when the BOS is published, will we improve our predictions further still by incorporating the BOS in-

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<sup>10</sup>The results presented here are generally consistent with those found in Bell and Crone (1986).

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<sup>11</sup>For example, preliminary estimates of U.S. industrial production for a given month are available in the second or third week of the following month. Because the BOS collection period cuts across two months, the current month's BOS (which is always released on the third Thursday of the month) contains some information that would correspond to the yet-to-be-published industrial production statistics.



**TABLE 2**  
**Simple Regression Results Using U.S. and Regional Economic Measures Against Their Counterpart BOS Diffusion Indexes**  
**(1969:01 to 1997:06)**

Dependent Variable: (percent change in measure)	Corresponding Explanatory Variable (BOS diffusion index)	Constant	Diffusion Index Coefficients (t statistics)	R <sup>2</sup>	Break- even Point*
<b>National Data</b>					
U.S. Industrial Production Index	current activity	0.0011 (0.026)	0.0203 (11.33)	.27	-0.05
U.S. Industrial Production Index: Manufacturing Component	current activity	.0008 (.018)	0.0235 (11.82)	.29	-0.03
Manufacturing Shipments	current shipments	0.174 (1.48)	0.0233 (4.09)	.05	-7.5
Manufacturing New Orders	current new orders	0.353 (2.73)	0.017 (2.69)	.02	-20.7
Manufacturing Employment	current employment	0.003 (0.14)	0.023 (13.11)	.34	-0.1
Manufacturing Workweek	current workweek	0.038 (0.42)	0.0096 (1.14)	.004	-4.0
Unfilled Orders	current unfilled orders	0.621 (0.054)	0.026 (7.47)	.14	-23.9
Inventories	current inventories	0.581 (10.0)	0.016 (4.09)	.05	-36.3
Producer Prices (Finished Goods)	current prices received	0.145 (4.37)	0.0176 (10.59)	.25	-8.2
Producer Prices (Intermediate Goods)	current prices paid	-0.311 (-6.18)	0.021 (16.52)	.45	14.8
<b>Regional Data</b>					
District Manufacturing Employment	current employment	-0.14 (-0.59)	0.01 (6.33)	.26	14.0
Average manufacturing workweek in the District	current workweek	0.03 (0.42)	0.01 (1.14)	.01	-3.0

\*The break-even point is defined as the level of the diffusion index consistent with no change in the underlying official statistic according to the regression model. It is equivalent to the negative of the ratio of the estimated intercept and slope coefficient.

dex? Using all three methods, we tested the value of the general activity index in predicting changes in the U.S. manufacturing index for the years 1969 to 1997.

First, we ran a simple regression. This regression used the BOS activity index to forecast monthly changes in the U.S. manufacturing index (see the first row of numbers in Table 3). The BOS index explains about 29 percent of the variation in the monthly change in the U.S. index.<sup>12</sup>

A second, more demanding test for the value of the diffusion index is whether it adds any information not in the history of the manufacturing production index itself. This question can be addressed by including in the equation past monthly changes in the manufacturing production index to explain the current change. The past values of the manufacturing index explain less of the variation in the manufacturing index than the current diffusion index from the BOS (compare the first and second rows of Table 3).<sup>13</sup> Moreover, if we add the BOS diffusion index to past values of the manufacturing index (row 3 of Table 3), we can account for 14 percentage points more of the monthly variation

in the manufacturing index than if we depend only on past values of the manufacturing index.<sup>14</sup>

Mark Rogers of the Atlanta Fed has sug-

**TABLE 3**  
**Testing for New Information in the**  
***Business Outlook Survey***  
**Dependent Variable: Monthly Change in U.S.**  
**Manufacturing Production Index**  
**(1969:01 to 1997:06)**

Explanatory Variables:	Coefficient on Diffusion Index ( t-statistic)*	R <sup>2</sup>
current BOS activity index	.0235 (11.82)	.29
12 lagged values of change in manufacturing index	—	.17
12 lagged values of change in manufacturing index plus BOS diffusion index	.0235 (8.13)	.31
12 lagged values of change in manufacturing index and lagged values of change in total manufacturing hours worked	—	.20
12 lagged values of change in manufacturing index, current and lagged values of change in total manufacturing hours worked, plus BOS diffusion index	.024 (7.43)	.32

<sup>12</sup>The R<sup>2</sup> statistic (0.29) reported in the second column of numbers in Table 3 can be interpreted as the proportion of the total variation in the dependent variable (monthly changes in the official statistic in this case) explained by the regression model. This is the same model reported in row two of Table 2.

<sup>13</sup>The difference between the R<sup>2</sup> for in-sample forecasts in the first row and the second row is 0.12. Also, the coefficient in the BOS diffusion index remains significant even after past values of monthly changes in industrial production are added (row 3).

\*The t-statistic tests the hypothesis that the coefficient is significantly different from zero. In all the reported regressions, the diffusion index is significant at less than the 0.01 level, meaning there is less than a 1 percent probability that the diffusion index coefficient is equal to zero.

gested an even more rigorous test of the value of the information in the BOS diffusion index. Rogers showed that a relatively successful forecast of monthly changes in the manufacturing production index is possible using available employment and average workweek statistics along with past changes in industrial production. These employment and workweek data can contain additional important information on short-run changes in production. Our final test is based on a model that estimates changes in manufacturing production from past changes in manufacturing work hours (employment times average hours worked) and past changes in the manufacturing index itself. Adding the BOS index to this expanded model explains 12 percentage points more of the variation in

changes in the manufacturing production index (see the fourth and fifth rows of Table 3).<sup>15</sup> Thus, the BOS diffusion index adds information to what is known from several variables at the time the index becomes available.

## SUMMARY

The *Business Outlook Survey* has gained a reputation as a key cyclical indicator for both the regional and national manufacturing sectors. We applied rigorous methods to test the ability of the information in the BOS to forecast changes in national manufacturing output. The evidence suggests that the survey's indexes provide statistically significant information to market participants in forecasting movements in the manufacturing sector.

Although the analysis has focused on the use of the survey's indexes in forecasting national economic statistics, the results for the limited data that are readily available on manufacturing at the regional level bolster the use of the survey as a regional indicator. Finally, the relatively low cost and timely availability of the survey results suggest that this kind of approach to obtaining economic information has been underused.

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<sup>14</sup>A question arises regarding whether the BOS diffusion index is valuable because of the overlap in collection periods (the survey responses reflect the result of a period spanning the current and previous months) or the early publication of the survey results. That is, does the BOS diffusion index contain information that is forward-looking and backward-looking? Some information can be gleaned by including the lagged value of the change in manufacturing production as the dependent variable along with the current BOS diffusion index as the explanatory variable. The current diffusion index remains significant in this equation and the explanatory power of the model remains similarly high. Therefore, the BOS diffusion index appears to contain information about both the past and future, as one might expect from the collection period.

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<sup>15</sup>Experimentation with different periods of sample estimation and an evaluation of out-of-sample forecast performance did not appreciably change these conclusions.

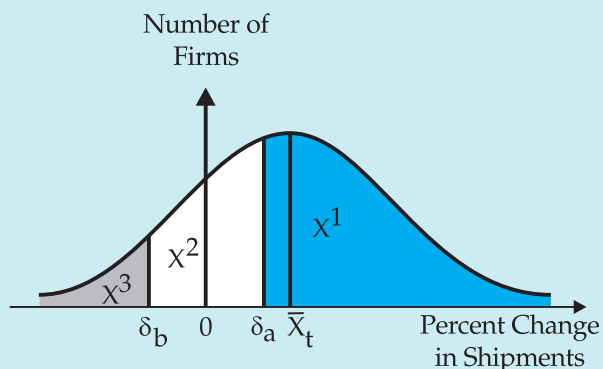
## APPENDIX

### DIFFUSION INDEXES AND GROWTH RATES

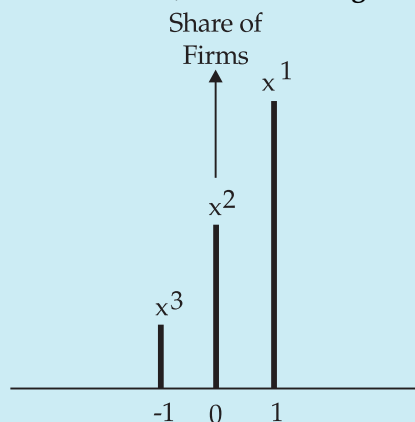
Diffusion indexes can be useful indicators of the rate of change in economic variables.\* To illustrate, suppose that at any given time, some firms in the manufacturing sector are experiencing growth in shipments, while others are experiencing declines. Also assume that firms are of equal size. If the distribution of firms experiencing growth and decline is the same as that shown in Figure A (a normal distribution), the average growth rate ( $\bar{X}_t$ ) is greater than zero.

Now consider a random sample of firms from this distribution and their responses to a qualitative survey question about the direction of change in shipments from the previous month. For example, assume Figure A represents the true distribution of growth in shipments for all firms in a given reporting period. Few, if any, firms would have exactly no change in production. Assume, however, that for some "small" change the respondent would report no change. We refer to this small change as the "indifference interval." The upper and lower bounds of the indifference interval ( $\delta_a$  and  $\delta_b$  in Figure A) are referred to as "reporting thresholds" or "just noticeable difference

**FIGURE A**  
Distribution of Firms Experiencing Increases and Decreases in Shipments



**FIGURE B**  
Proportion of Firms Reporting Increases (+1), Decreases (-1), and No Change (0)



\*M.H. Pesaran provides a comprehensive study of the problem of converting survey data into aggregate summary measures.

## APPENDIX (continued)

parameters." While the reason for this "no change" or indifference interval may not be clearly understood, some possible explanations are that the respondents are not sure or changes in production are so small that levels are not much different from the previous month's numbers. The area to the right of  $\delta_a$  would be associated with firms reporting an increase, and the area to the left of  $\delta_b$  would be associated with those reporting decreases.

If individual responses for increase, no change, and decrease are coded as 1, 0, and -1, respectively, the distribution of the monthly reported change in shipments can be represented as a discrete distribution (Figure B). The height of the line segments ( $x_t^1$ ,  $x_t^2$ , and  $x_t^3$ ) corresponds to the proportion of firms in each category (increase, no change, and decrease), and the total length of the three segments must sum to one. A little arithmetic reveals that the mean of this distribution is  $x_t^1 - x_t^3$ , and if multiplied by 100, it is commonly referred to as the net change, balance, or diffusion index. This diffusion index will be positively correlated with the average change ( $\bar{X}_t$ ) in shipments among manufacturing firms.

Now let's consider how one can relate the responses summarized in Figure B with the true distribution of change in Figure A. The percentage of firms reporting increase, no change, or decrease is represented by the three areas under the curve in Figure A corresponding to  $X^1$ ,  $X^2$ , and  $X^3$ , respectively. So long as the shape of the true distribution and the indifference interval do not change markedly from month to month, changes in the diffusion index will correlate with shifts in the corresponding distribution of individual firms. In other words, the value of the diffusion index would be positively correlated with the average change in shipments among manufacturing firms.

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