

# THE INDEX OF LEADING ECONOMIC INDICATORS AS A SOURCE OF EXPECTATIONAL SHOCKS

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## INTRODUCTION

A recurrent theme in the literature on business cycle fluctuations is the importance of expectational shocks that change the beliefs of agents concerning the future level of aggregate activity, but that do not reflect real movements in the fundamentals. For example, shocks to “animal spirits” or “swings in optimism and pessimism” figured prominently in the writings of macroeconomists of an earlier era, such as Keynes [1936] and Pigou [1929; 1949]. More recently, the literature on sunspot equilibria, such as Azariadis [1981], Cass and Shell [1983], and Woodford [1987], and macroeconomic models characterized by strategic complementarity, such as Diamond [1982], Bryant [1983], and Cooper and John [1988], both suggest that aggregate activity can be significantly affected by movements in expectations that do not reflect real movements in the fundamentals.<sup>1</sup> This paper identifies a source of the type of shock suggested to be of significance by the above literatures. In particular, we employ the American Statistical Association-National Bureau of Economic Research (ASA-NBER) Survey of Forecasts by Economic Statisticians to measure expectations concerning future growth in the economy, and demonstrate that errors in the initial announcements of the index of leading economic indicators are an important source of this type of expectational shock.

In the literatures mentioned above, the expectations of agents concerning “other” agents’ production plans are a determinant of future aggregate activity. That is, if all agents suddenly revised upwards their beliefs concerning the production plans of other agents—even if there were no change in any real variable—the result would be a type of self-fulfilling increase in the future level of production. The intuition behind this result is easiest to see in the literature concerning strategic complementarity. A macroeconomic model that exhibits strategic complementarity is simply one in which the higher is aggregate production, the larger is the incentive for any individual agent to produce. Suppose that in such a world all agents were to become more optimistic

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concerning the production plans of other agents. Even if this did not reflect a change in the fundamentals of the economy, the result would be an increase in actual planned production levels and a subsequent increase in future aggregate activity.

The obvious place to look for shocks that affect expectations concerning future aggregate activity is at those pieces of information agents employ in trying to predict future activity. In the U.S. economy there are many sources for such information. For example, Data Resources Incorporated (DRI) and Wharton Econometric Forecasting Associates (WEFA) are commercial firms that specialize in predicting future aggregate activity. Also, the widely publicized index of leading economic indicators is an index of economic variables purposefully constructed to signal changes in the direction of future aggregate activity. In this paper we focus on the initial announcements of the index of leading indicators and, in particular, on the errors in those initial announcements. The reason we focus on the errors in the initial announcements rather than on the initial announcements themselves is that, although the initial announcements are likely to be correlated with movements in the real fundamentals of the economy, the errors in the initial announcements are unlikely to be correlated with those movements.

One can get a measure of the error component of an initial announcement concerning the leading indicator index because of the revision process associated with the index. The way the index works is that for each monthly number there is an initial announcement and then a series of revisions. By looking at the difference between the initial announcement and the final announcement one can get a measure of the error associated with the initial announcement. For example, if the initial announcement concerning this month's number is 150 and the final announcement is 151, then we have an estimate of the error associated with the initial announcement equal to  $-1$ .

To investigate the importance of these errors on movements in expectations concerning future aggregate activity, we employ the ASA-NBER Survey of Forecasts by Economic Statisticians. This is a quarterly survey of forecasters' predictions concerning the U.S. economy. The advantage of using this survey to measure expectations, rather than, say, a survey of consumer or business confidence, is that our goal is to identify shocks that change the beliefs of agents concerning future aggregate activity and this survey specifically focuses on beliefs concerning the future. Our empirical analysis looks at the period 1968-1990 and asks whether the errors in the initial announcements of the leading indicator index were a source of expectational shocks during this period and, in particular, whether they were a more important source of expectational shocks after 1976.

As explained in more detail later, the main reason for investigating whether there was a change after 1976 is that the method of construction of the index changed after 1976 in a way that should have made the initial announcements of the index better predictors of future activity. That is, since agents should have relied more heavily on the initial announcements after 1976 to the extent they were better predictors of future activity after this date, we have the prediction that the errors in the initial announcements of the index should be a more important source of expectational shocks after 1976. Our first finding is that prior to 1976 the errors in the initial announcements of the leading indicator index are either not a source of expectational shocks or a relatively unimportant source. Our second finding, however, is that after 1976 these

errors have both an economically significant as well as a statistically significant effect on movements in expectations concerning future aggregate activity. In other words, we find that after 1976 these errors are an important source of the type of shock central to the analyses of Keynes, Pigou, and a number of more recent authors.

This paper is related to Oh and Waldman [1990]. In that paper, we explored the relationship between revisions of the leading indicator index and movements in future production and found evidence of both a statistically significant and economically significant negative relationship. Our interpretation was that the errors in the initial announcements of the leading indicator index are a source of expectational shocks. Here, we directly test whether these errors are a source of expectational shocks by investigating the relationship between these revisions and movements in expectations concerning future aggregate activity as measured by the ASA-NBER Survey of Forecasts by Economic Statisticians, and find evidence consistent with our earlier interpretation.

Similarly to the above discussion, Matsusaka and Sbordone [1995] argue that if an economy is characterized by strategic complementarity, then movements in expectations that are independent of real movements in the fundamentals should be a determinant of aggregate output. They test this hypothesis by running Granger causality tests on vector autoregressions of GNP, consumer sentiment, and other series that are good predictors of GNP. Their results support the idea that such movements in expectations are an important determinant of aggregate activity.

In interpreting their results, Matsusaka and Sbordone [1995] do not make any suggestions concerning potential sources for the type of expectational shock they focus on. The main point of this paper is that after 1976 errors in the initial announcements of the index of leading economic indicators are an important source of this type of expectational shock. That is, errors in the initial announcements of the leading indicator index are likely to be uncorrelated with real movements in the fundamentals, yet after 1976 they are important determinants of expectations concerning future output.

As a final introductory point, in thinking about our findings in this paper one might be tempted to say “of course” and “so what.” The “of course” refers to the idea that forecasters should consider all relevant information in forming forecasts, so it is not surprising that the initial announcements of the leading indicator index matter and, in turn, that the errors in those initial announcements also matter. The “so what” refers to the idea that, given that it is not surprising that the initial announcements and the errors in those initial announcements matter, why are the results in this paper of interest?

We agree with “of course” but disagree with “so what.” That is, we feel it is quite intuitive and therefore not surprising that initial announcements and errors in the initial announcements matter. Rather than thinking this makes the paper uninteresting, however, we believe it makes it more interesting. To the extent that the finding is intuitive, it is natural to put more weight on its validity. Further, if, as we argue here, forecasters do indeed consider initial announcements in making forecasts and are thus affected by the errors in those announcements, then it would also not be surprising for those errors to be an important source of business cycle fluctuations as

we argued in our earlier paper. In turn, it should be obvious that this second conclusion is indeed an important one.

The outline for the paper is as follows. The second section discusses the available evidence concerning the predictive power of the initial announcements of the leading indicator index. The third section describes our data and empirical methodology. The fourth section presents an empirical analysis of the relationship between errors in the initial announcements of the leading indicator index and movements in expectations concerning future aggregate activity. In the fifth section we discuss the various theoretical mechanisms that could explain our findings. The last section presents concluding remarks.

### **THE PREDICTIVE POWER OF THE INITIAL ANNOUNCEMENTS OF THE LEADING INDICATOR INDEX**

The idea of an index of leading economic indicators for use in business cycle forecasting was originally developed by Mitchell and Burns [1938] at the National Bureau of Economic Research. Despite the fact that since its inception the approach has faced frequent criticism for the lack of a theoretical underpinning such as found in Koopmans [1947], it has continually grown in importance. Responsibility for the index was moved from the NBER to the U.S. Department of Commerce in 1968, and in recent years the initial announcement of a monthly value of the index has been widely reported in both the popular and financial presses.<sup>2</sup>

An important issue from our perspective is the predictive power of the initial announcements of the index. Saying that the errors in the initial announcements of the leading indicator index constitute an important source of expectational shocks implies that individuals rely on the initial announcements as a useful tool for predicting future activity. This is more likely to the extent that the initial announcements have strong predictive power concerning future activity. Most studies of the predictive power of the leading indicator index look at final announcements rather than initial announcements. In terms of final announcements, the consensus is that the index provides a significant incremental contribution in standard forecasting approaches, such as linear prediction of industrial production based on lagged values of production, and commonly estimated vector autoregressions.

As suggested, however, from our perspective, studies of the predictive power of the final announcements of the leading indicator index are of limited interest. Employing final announcements is looking at information not available to individuals trying to forecast future activity on the basis of initial announcements, so these studies likely overstate the usefulness of initial announcements for forecasting purposes. A study that is more relevant given our interests is that of Diebold and Rudebusch [1991]. Rather than employing final announcements, they use the leading indicator numbers that were available at the dates of the forecasts. This weakens the predictive power of the index and, more importantly, for predicting future levels of industrial production they find that including the index in forecasting specifications no longer improves forecasting performance.

One factor that Diebold and Rudebusch [1991] do not incorporate into their analysis is that over the years the U.S. Department of Commerce periodically changed the method, that is, the identity of the individual components and the weights, with which it constructed the index. One possibility is that these changes improved the predictive power of the initial announcements in later years. Of particular interest is a series of changes instituted in 1975 and 1976. A comparison of the discussion in Moore and Shiskin [1967, Ch. 2] with that in Zarnowitz and Boschan [1975] indicates that, relative to the criteria employed in choosing components for the index prior to these changes, the post-1976 criteria placed more weight on choosing components for which the initial announcements would be good predictors.

To be more precise, Moore and Shiskin [1967] describe the criteria employed prior to the changes in 1975 and 1976. They state that the magnitude of revisions is one of a number of criteria used in judging the statistical adequacy of a potential component indicator, where statistical adequacy is itself one of six general criteria used in "scoring" potential components. In contrast, Zarnowitz and Boschan [1975] describe the criteria employed beginning with these changes. They state "...because business forecasters must use preliminary estimates in lieu of the as yet unknown final values, series that are subject to large revisions which frequently involve directional changes are particularly troublesome. For this reason such series, regardless of their statistical adequacy score, are not included in the composite index of leading indicators" [Zarnowitz and Boschan, 1975, vii]. Clearly, a change in criteria for choosing components of the type described could have had a significant impact on the predictive power of the initial announcements.

In Oh and Waldman [1990], we investigated whether this change in the criteria for choosing components had an effect on the predictive power of the initial announcements. Our finding was that the predictive power of the initial announcements improved substantially after 1976. In particular, prior to 1976 the initial announcements of the leading indicator index only had significant ability for predicting growth rates for the first quarter following the announcement dates, while after 1976 the initial announcements had significant ability for predicting growth rates for the first three quarters following the announcement dates.<sup>3</sup>

Overall, the evidence concerning the predictive power of the initial announcements of the leading indicator index is mixed. Diebold and Rudebusch [1991] find that starting from predictions based on lagged values of production, the leading indicator numbers available at the dates of the forecasts had no incremental value for forecasting future levels of production. Our own earlier analysis suggests that, to the extent the initial announcements had positive value, the value was higher after 1976. Hence, judged from the standpoint of the evidence concerning the predictive power of the initial announcements of the leading indicator index, one does not have a strong prior concerning whether the errors in these initial announcements are likely to be a source of movements in expectations concerning future aggregate activity. What we show in the following sections, however, is that, despite the mixed evidence concerning predictive power, more direct evidence indicates that after 1976 the errors in the initial announcements of the leading indicator index are in fact an important source of such expectational shocks.

## DATA AND METHODOLOGY

This section begins by describing the data we employ in our empirical analysis. We then discuss our empirical methodology. The following sections present the analysis and a discussion of possible interpretations of our results.

### *Data*

In describing our data the first step is to describe the revision process for the index of leading economic indicators.<sup>4</sup> During the time period we study (see Note 2), at the end of each month the Bureau of Economic Analysis at the U.S. Department of Commerce (BEA) made an initial announcement for the previous month's value of the index, and announced revised values of the index for each of the preceding eleven months. In addition, on an occasional basis the whole series was revised back to 1948. The revisions fall into three categories. The first category consists of revisions due to changes in the unadjusted values of one or more of the component series. We will refer to this category as data revisions. Such revisions occur for a number of reasons. First, as time passed the BEA received better information due to larger and/or more representative samples. Second, for some of the component series there was no information available at the time of the initial announcement.<sup>5</sup> Third, methods of seasonal adjustment also lead to data revisions.

A second category of revisions consists of revisions due to changes in statistical factors. In computing the index of leading economic indicators the BEA made a number of statistical adjustments. For example, to prevent more volatile component series from dominating the index, values of each component series were adjusted so that the average percentage change did not vary across component series. There was also a standardization procedure that equalized the long-run average of the leading indicator index with the long-run average of the coincident indicator index, and a trend adjustment procedure that equalized the trends of the two indexes. Over time the BEA updated these statistical factors, and new revisions were then calculated using the updated values.

The third category of revisions consists of what we will refer to as definitional revisions. Over time the BEA made changes to the definition of the leading indicator index. Such changes include changes in the identity of the component series, changes in the weights assigned to the various components, and changes in the definitions of specific component series. There have been a number of definitional changes over the years, with major definitional changes occurring on average approximately once every two years. As with changes in statistical factors discussed above, when there was a definitional change new revisions were calculated using the updated definition.

For our purposes, it is only the data revisions that are of interest. The reason is that it is only the data revisions that are a measure of the errors associated with the initial announcements. In constructing our revision variable, we thus adjusted the data to eliminate the effects of both definitional revisions and revisions due to changes in statistical factors. The specific procedure we employed to adjust the revision data is as follows. We first identified every quarter for which, between the initial announcement of that quarter's value and the final announcement, there was a significant



change in the method of construction of the index due either to a change in the definition of the index or a change in statistical factors. For each such quarter, we then took the first announcement of that quarter's number made after the change in the method of construction of the index and divided that number by the last announcement made prior to the change. The resulting ratio measures the proportional change in that quarter's value of the leading indicator index due to the change in the method of construction of the index. We then multiplied the initial announcement of that quarter's value of the leading indicator index by this ratio, and used the resulting number in constructing the revision variable. Adjusting an initial announcement in this way yields a value for the revision that is an unbiased estimate of that part of the total revision due to data revisions.

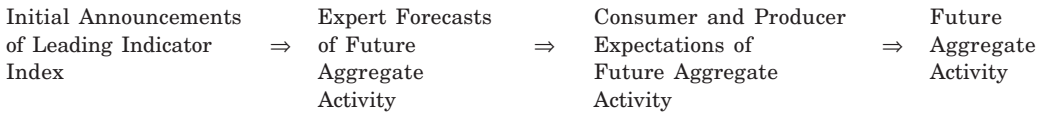
In our empirical analysis we employ two variables constructed from the leading indicator series. As will be discussed in more detail shortly, we look at quarterly series even though announcements are monthly because our data on expectations is quarterly in nature. Let  $A_t^F$  be the true or final announcement of the index in quarter  $t$ , and let  $A_t^I$  be the initial announcement of the index in quarter  $t$  (given the adjustment process described above). The first variable we employ is  $I_t^F$ , which is the true or final announcement of the quarterly growth rate of the leading indicator index in quarter  $t$ . This is given by  $I_t^F = (A_t^F - A_{t-1}^F) / A_{t-1}^F$ . The other variable we employ is  $R_t$ , which is the revision of the leading indicator index in quarter  $t$ . This is given by  $R_t = (A_t^F - A_t^I) / A_t^F$ .

Our data on expectations is from the ASA-NBER Survey of Forecasts by Economic Statisticians. This is a quarterly survey of professional forecasters' predictions concerning future aggregate activity. The survey asks for predictions concerning a variety of economic variables including industrial production for each of several quarters following the forecast date. We employ the mean forecasts to construct measures of expected growth in industrial production for each of several quarters beyond the forecast date.<sup>6</sup> Our focus will be on the mean value in quarter  $t$  of the forecasted growth rate in industrial production for quarter  $t + j$ , which we denote as  $E_t(IP_{t+j})$ .<sup>7</sup> Our analysis covers the fourth quarter of 1968 to the first quarter of 1990.<sup>8</sup>

### **Methodology**

Our goal is to capture the effect that initial announcements of the leading indicator index and, in particular, the errors in those initial announcements have on expectations of future aggregate activity. To better understand our focus consider Figure 1. This figure captures how, if expectational shocks are important, the initial announcements of the leading indicator index would affect future aggregate activity. That is, suppose that there was an increase in an initial announcement of the leading indicator index but no change in any real variable. We would expect this to cause experts to increase their forecasts of future aggregate activity which, in turn, would cause consumers and producers to become more optimistic concerning future aggregate activity. The subsequent final result is then an increase in future aggregate activity itself.

FIGURE 1



One might at first think that the way to test for this effect is to consider the correlation between the initial announcements of the leading indicator index and expert forecasts concerning future aggregate activity, between the initial announcements and consumer and producer expectations concerning future aggregate activity, and between initial announcements and future aggregate activity itself. But there is a problem with this approach. The initial announcements of the leading indicator index are positively correlated with the true or final announced values of the index and these final announced values are purposefully constructed to be correlated with movements in future aggregate activity. Hence, it is quite possible that, even if the announcement effect described above did not exist, there would still be a positive correlation between initial announcements of the leading indicator index and future aggregate activity. Further, since expert forecasts and consumer and producer expectations are likely to be correlated with future aggregate activity, even without an announcement effect there could also be a positive correlation between initial announcements and both expert forecasts and consumer and producer expectations.

The alternative approach that we took in Oh and Waldman [1990] and will also take here is to decompose the initial announcements of the leading indicator index into its components—the final announced values for the index and the revisions. In a multiple regression analysis with both of these components as independent variables, a negative correlation between the revisions and expert forecasts, between the revisions and consumer and producer expectations concerning future aggregate activity, and between the revisions and future aggregate activity itself would be evidence of the announcement effect described above. The reason is that a higher value for the revision holding the final announced value constant translates into a lower value for the initial announcement with no change in the final announced value. In Oh and Waldman [1990] we considered the correlation between the revisions and future aggregate activity and found that after 1976 there was a statistically and economically significant negative correlation. Here we consider whether there is also a statistically and economically significant negative correlation between the revisions and expert forecasts of future aggregate activity.

With the above in mind we begin our empirical analysis with a regression specification of the following form:

$$(1) \quad E_t(IP_{t+j}) = b_1 + b_2 E_{t-1}(IP_{t+j-1}) + b_3 I_t^F + b_4 R_t + e_t,$$

where  $e_t$  is an error term. The dependent variable  $E_t(IP_{t+j})$  is the forecast from the survey taken after but closest in time to the release of the initial announcement of the leading indicator index in quarter  $t$ . The timing is best understood through an example. Let quarter  $t$  be the October-December quarter. The leading indicator variables we use are the ones corresponding to the initial announcement of the December number,



which is in fact announced at the end of January.  $E_t(IP_{t+j})$  is the mean expectation from a survey sent out in the middle of February, for which the respondents return their forecasts over the next three weeks. The earliest forecasted growth rate we consider is the one corresponding to the April-June quarter. By focusing on the initial announcement that occurs prior to but closest in time to the date of the survey, we are attempting to avoid any indirect effect that the initial announcement might have on the forecast. For example, if there was a longer time period between the announcement and the forecast, then the forecast could potentially reflect forecasters' observations of how producers are responding to the announcement. Our specification is intended to minimize this effect and only capture the direct effect of the announcement on the forecast.<sup>9</sup>

In considering Equation (1) the reader might initially be concerned that the final announcement of the leading indicator index,  $A_t^F$ , which is used to construct both  $I_t^F$  and  $R_t$ , is not known at the time that forecasts are being made. Hence, the equation seems to be testing for the effect that variables unknown at the time of the forecasts have on the forecasts. But this is in fact not the case. The initial announcement is known at the time of the forecasts and the components of the initial announcement are the true value of the index and the error in the initial announcement. What we are doing, therefore, is including what is observed but breaking it up into its components: i) the true value, which is measured by  $I_t^F$ ; and ii) the error in the initial announcement, which is measured by  $-R_t$ . As described in detail below, by doing this we get a better understanding of the extent to which forecasters rely on these initial announcements and the extent to which errors in these initial announcements matter.

In interpreting our results there are three main alternative hypotheses. The first hypothesis is that respondents do not consider the initial announcements in forming their expectations, and the information that the respondents do consider is uncorrelated with both  $I_t^F$  and  $R_t$ . This hypothesis predicts  $b_3 = 0$  and  $b_4 = 0$ . The second hypothesis is that respondents do not consider the initial announcements, but the information that the respondents do consider is positively correlated with  $I_t^F$  but there is no correlation with  $R_t$ . This hypothesis predicts  $b_3 > 0$  and  $b_4 = 0$ . Finally, the third hypothesis is that respondents consider the initial announcements, in which case the prediction is  $b_3 > 0$  and  $b_4 < 0$ . The logic for this prediction is described informally above and more formally as follows.

Given  $I_t^F = (A_t^F - A_{t-1}^F)/A_{t-1}^F$ ,  $R_t = (A_t^F - A_t^I)/A_t^F$ , and holding  $A_{t-1}^F$  fixed, an increase in  $I_t^F$  given no change in  $R_t$  translates into an increase in both  $A_t^F$  and  $A_t^I$ , while an increase in  $R_t$  given no change in  $I_t^F$  translates into no change in  $A_t^F$  and a decrease in  $A_t^I$ . In other words, from a multiple regression standpoint the coefficient on  $I_t^F$  captures how forecasts change when the initial announcement is higher due to a higher true value, while the coefficient on  $R_t$  captures how forecasts change when the initial announcement is lower due to a lower value for the error in the initial announcement. Hence, if the respondents consider  $A_t^I$  in forming their expectations, we have

that  $I_t^F$  should be positively correlated with expectations while  $R_t$  should have a negative correlation.

There is, of course, a fourth alternative hypothesis, which is that respondents do not consider the initial announcements, but the information they do consider is positively correlated with  $I_t^F$  and negatively with  $R_t$ . As with the third hypothesis above, this hypothesis predicts  $b_3 > 0$  and  $b_4 < 0$ . Although this hypothesis is a theoretical possibility, given the nature of the errors that cause the revisions, we feel that this hypothesis is unlikely to be correct.<sup>10</sup> The errors we are focusing on are due mostly to the fact that initial announcements are based on the incomplete sampling of the BEA, and we feel it is unlikely that the respondents would acquire information from other sources that is correlated with the errors caused by this incomplete sampling.

We end this section with two additional points concerning our methodology. First, our methodology relies on initial announcements of the leading indicator index being rational forecasts of the true values of the index. That is, to the extent that initial announcements are not rational forecasts, then initial announcements can be improved upon and the revision may be a biased measure of the error transmitted through an initial announcement. We can get information concerning this issue by looking at the mean and standard deviation of the revision and the correlation coefficients between  $I_t^I$  and  $R_t$ , where  $I_t^I = (A_t^I - A_{t-1}^F) / A_{t-1}^F$ . The mean and standard deviation for the revision are  $-0.005$  and  $0.023$  for the full sample,  $-0.012$  and  $0.035$  for the pre-1976 subsample, and  $-0.001$  and  $0.009$  for the post-1976 subsample, while the correlation coefficients between  $I_t^I$  and  $R_t$  are  $0.096$  for the full sample,  $0.095$  for the pre-1976 subsample, and  $0.097$  for the post-1976 subsample (we consider these three samples because later tests focus on these three). This evidence indicates that the initial announcements are either rational forecasts of the true values or at least very close to rational forecasts. Note that Diebold and Rudebusch [1988] also considered this issue and found that, similar to our conclusion, there is a bias in the revision but that in practice this bias is small.

Second, one drawback of this methodology is that it does not distinguish between "real" and "sunspot" reasons for why forecasters might consider the initial announcements of the leading indicator index in forming their expectations. To see what we mean here, suppose we were to find  $b_3 > 0$  and  $b_4 < 0$  and the correct interpretation was the third hypothesis above, that is, respondents consider the initial announcements of the index in forming their expectations. There are still two possibilities for what is happening. The first is that an initial announcement contains real information about fundamentals and thus agents pay attention to initial announcements in order to find out what that information is. The second is that initial announcements serve as a pure sunspot. That is, an initial announcement contains no information about fundamentals but agents pay attention to the initial announcements anyway because each agent (correctly) believes that other agents pay attention. We come back to this issue later when we discuss how one should interpret our findings.

## TESTS

This section presents the results of a series of tests based on the empirical methodology presented in the previous section. Table 1 reports results of a regression analysis of Equation (1) for  $j = 2, \dots, 5$ . The regressions reported in Table 1 provide evidence that there is indeed a negative correlation between revisions of the leading indicator index and contemporaneous movements in expectations concerning future growth rates. The coefficient on the revision variable has the predicted sign in all four regressions. Further, looking at the coefficients individually, we see that the coefficient for  $j = 2$  is statistically significant at approximately the 90 percent level, while for  $j = 3$  and 4 the coefficient is significant at the 95 percent level.

In contrast, the results concerning  $I_t^F$  are weaker. For this variable the coefficient has the predicted sign in only two of the four regressions, and in only one of these is it significant at standard levels. The weak results concerning  $I_t^F$  are possibly due to a multicollinearity problem between  $I_t^F$  and the lagged value for expectations. Another possibility discussed in detail in the following section is that agents “overreact” to surprises, where this could lead to the results found in Table 1 if there is a high correlation between the revisions of the leading indicator index and the surprises associated with the initial announcements. Given the weak results concerning  $I_t^F$ , in the tests that follow we focus on the coefficients on the revision variable.

**TABLE 1**  
**The Impact on Professional Forecaster Expectations**  
**of the Revision of the Leading Indicator Index<sup>a</sup>**

	$j = 2$	3	4	5
Intercept	0.002 (1.97) <sup>b</sup>	0.002 (1.97)	0.002 (1.98)	0.002 (2.31)
$E_{t-1}(IP_{t+j-1})$	0.605 (6.74)	0.759 (8.91)	0.843 (11.73)	0.810 (10.08)
$I_t^F$	0.112 (2.85)	0.024 (0.78)	-0.018 (0.94)	-0.023 (1.11)
$R_t$	-0.069 (1.66)	-0.063 (2.00)	-0.048 (2.17)	-0.021 (0.78)
Adj. R <sup>2</sup>	0.56	0.61	0.70	0.63

a.  $E_t(IP_{t+j}) = b_1 + b_2 E_{t-1}(IP_{t+j-1}) + b_3 I_t^F + b_4 R_t + e_t$ .  $E_t(IP_{t+j})$  denotes the mean value from the ASA-NBER Survey of Forecasts by Economic Statisticians of the forecasted growth rate in industrial production for quarter  $t + j$ , where the forecast is from the survey taken after but closest in time to the release of the initial announcement of the value of the leading indicator index for quarter  $t$ .  $I_t^F$  denotes the true growth rate of the leading indicator index in quarter  $t$  and  $R_t$  denotes the revision of the leading indicator index in quarter  $t$ .

b. t-statistics are reported inside the parentheses.

In Table 1 we focused on how announcements affect forecasts of quarterly growth rates. Another way to analyze the data is to consider forecasts over longer time periods. That is, do our results get weaker or stronger when we focus on predictions of growth over a number of quarters rather than a single quarter? We consider this issue in Table 2. In particular, the dependent variable is now the forecasted cumulative growth in industrial production from quarter  $t + 2$  through quarter  $t + j$ , while our independent variables are still the lagged value for expectations, the final announced value of the leading indicator index, and the revision. The table indicates that when we aggregate the forecasted growth rates across quarters we find stronger evidence of a negative correlation between revisions of the leading indicator index and contemporaneous movements in expectations. Specifically, when we aggregate across each of two and three quarters the coefficient on the revision variable is negative and statistically significant at the 95 percent level, while when we aggregate across four quarters the coefficient is negative and significant at the 99 percent level.

**TABLE 2**  
**The Impact on Professional Forecaster Expectations**  
**of the Revision of the Leading Indicator Index<sup>a</sup>**  
**(the dependent variable aggregated over quarters)**

	$j = 3$	4	5
Intercept	0.004 (1.92) <sup>b</sup>	0.004 (1.64)	0.004 (1.34)
$E_{t-1}(\Delta IP_{t+j-1})$	0.716 (8.43)	0.815 (10.55)	0.890 (12.53)
$I_t^F$	0.121 (1.89)	0.067 (0.89)	-0.025 (0.30)
$R_t$	-0.134 (2.04)	-0.178 (2.34)	-0.289 (3.35)
Adj. $R^2$	0.62	0.70	0.77

a.  $E_t(\Delta IP_{t+j}) = b_1 + b_2 E_{t-1}(\Delta IP_{t+j-1}) + b_3 I_t^F + b_4 R_t + e_t$ .  $E_t(\Delta IP_{t+j})$  denotes the mean value from the ASA-NBER Survey of Forecasts by Economic Statisticians of the forecasted cumulative growth in industrial production from quarter  $t + 2$  through quarter  $t + j$ , where the forecast is from the survey taken after but closest in time to the release of the initial announcement of the value for the leading indicator index for quarter  $t$ .  $I_t^F$  denotes the true growth rate of the leading indicator index in quarter  $t$  and  $R_t$  denotes the revision of the leading indicator index in quarter  $t$ .

b. t-statistics are reported inside the parentheses.

Another interesting set of tests concerns breaking up the sample into subperiods. As discussed earlier, relative to the criteria employed in choosing components for the leading indicator index prior to 1976, in the post-1976 time period the U.S. Department of Commerce placed more weight on choosing components for which the initial

announcements would be good predictors. Further, there is some evidence that indicates that in the later time period the initial announcements of the index were indeed better predictors. This suggests an additional test to perform. To the extent that the initial announcements of the index were better predictors after 1976, we would expect that in making forecasts of future activity individuals would have placed more weight on these initial announcements in the later time period. In turn, if this is the case, then the negative correlation between revisions of the leading indicator index and contemporaneous movements in expectations should be stronger in the later time period.

Before proceeding, it is worth pointing out that there is a second reason for conducting the following set of tests. As discussed briefly in the Introduction and in the second section, in Oh and Waldman [1990] we investigated the relationship between the revisions of the leading indicator index and future movements in aggregate activity. We found both a statistically significant and economically significant negative relationship between these two variables, with this negative relationship being much stronger after 1976. Our interpretation was that errors in the initial announcements of the leading indicator index serve as a source of expectational shocks, and these shocks in turn cause subsequent movements in aggregate activity. Further, we hypothesized that the reason the negative relationship was stronger after 1976 is that agents paid more attention to the initial announcements of the index after 1976, and thus a given error in an initial announcement translated into a larger movement in expectations in the post-1976 time period. Below we explore whether this interpretation of our earlier results is correct by directly testing how errors in the initial announcements of the leading indicator index affect expectations in the pre-1976 and post-1976 time periods.

In Table 1, we considered the correlation that holds for the full sample between revisions of the leading indicator index and contemporaneous movements in expectations of future quarterly growth rates, and found evidence of a statistically significant negative correlation. In Table 3 we run the same test broken down by time period. The table indicates that for each of  $j = 2, 3,$  and  $4$  the coefficient on the revision variable is larger in absolute value and has a higher degree of statistical significance in the later time period than either in the earlier period or in the full sample. Further, it is worth noting that for each of  $j = 2$  and  $3$  the coefficient on the revision variable in the later time period is statistically significant at the 99 percent level.

In Table 2, we ran a test similar to that in Table 1 with the major change being that the dependent variable was an aggregate of growth rates across quarters. We found that when we aggregate the growth rates across quarters the coefficient on the revision variable is consistently negative and statistically significant. Table 4 runs the same test broken down by time period. Consistent with the findings of Table 3, the coefficients on the revision variable are larger in absolute value and have a higher degree of statistical significance in the later time period. Overall, our empirical analysis indicates that, consistent with the findings in Oh and Waldman [1990], the errors in the initial announcements of the leading indicator index were a more important source of expectational shocks in the post-1976 time period.<sup>11</sup>

**TABLE 3**  
**The Impact on Professional Forecaster Expectations of the**  
**Revision of the Leading Indicator Index<sup>a</sup>**  
**Broken Down by Time Period**

	Pre-1976 Subsample				Post-1976 Subsample			
	<i>j</i> = 2	3	4	5	<i>j</i> = 2	3	4	5
Intercept	0.004 (1.45) <sup>b</sup>	0.003 (1.44)	0.002 (1.36)	0.002 (1.16)	0.001 (0.97)	0.001 (1.13)	0.002 (2.03)	0.003 (2.22)
$E_{t-1}(IP_{t+j-1})$	0.533 (3.22)	0.616 (3.76)	0.806 (6.05)	0.837 (7.24)	0.730 (7.17)	0.861 (9.87)	0.791 (8.93)	0.733 (6.45)
$I_t^F$	0.103 (1.32)	0.076 (1.28)	0.001 (0.02)	0.003 (0.11)	0.093 (2.17)	-0.017 (0.55)	-0.027 (1.14)	-0.042 (1.46)
$R_t$	-0.020 (0.27)	-0.069 (1.29)	-0.049 (1.45)	-0.032 (1.21)	-0.355 (3.78)	-0.252 (3.77)	-0.155 (2.64)	-0.061 (0.77)
Adj. R <sup>2</sup>	0.47	0.46	0.65	0.73	0.67	0.74	0.71	0.55

a.  $E_t(IP_{t+j}) = b_1 + b_2 E_{t-1}(IP_{t+j-1}) + b_3 I_t^F + b_4 R_t + e_t$ .  $E_t(IP_{t+j})$  denotes the mean value from the ASA-NBER Survey of Forecasts by Economic Statisticians of the forecasted growth rate in industrial production for quarter  $t + j$ , where the forecast is from the survey taken after but closest in time to the release of the initial announcement of the value for the leading indicator index for quarter  $t$ .  $I_t^F$  denotes the true growth rate of the leading indicator index in quarter  $t$  and  $R_t$  denotes the revision of the leading indicator index in quarter  $t$ .

b. t-statistics are reported inside the parentheses.

**TABLE 4**  
**The Impact on Professional Forecaster Expectations**  
**of the Revision of the Leading Indicator Index<sup>a</sup>**  
**(the dependent variable aggregated over quarters)**  
**Broken Down by Time Period**

	Pre-1976 Subsample			Post-1976 Subsample		
	<i>j</i> = 3	4	5	<i>j</i> = 3	4	5
Intercept	0.006 (1.36) <sup>b</sup>	0.006 (1.14)	0.010 (1.11)	0.002 (0.97)	0.003 (1.17)	0.004 (1.31)
$E_{t-1}(\Delta IP_{t+j-1})$	0.640 (4.06)	0.778 (5.43)	0.848 (5.74)	0.822 (9.09)	0.849 (10.56)	0.865 (11.24)
$I_t^F$	0.156 (1.26)	0.113 (0.79)	-0.011 (0.06)	0.064 (0.95)	0.020 (0.27)	-0.043 (0.50)
$R_t$	-0.088 (0.78)	-0.134 (1.06)	-0.208 (1.39)	-0.630 (4.43)	-0.785 (4.83)	-0.813 (4.40)
Adj. R <sup>2</sup>	0.53	0.63	0.63	0.74	0.79	0.80

a.  $E_t(\Delta IP_{t+j}) = b_1 + b_2 E_{t-1}(\Delta IP_{t+j-1}) + b_3 I_t^F + b_4 R_t + e_t$ .  $E_t(\Delta IP_{t+j})$  denotes the mean value from the ASA-NBER Survey of Forecasts by Economic Statisticians of the forecasted cumulative growth in industrial production from quarter  $t + 2$  through quarter  $t + j$ , where the forecast is from the survey taken after but closest in time to the release of the initial announcement of the value for the leading indicator index for quarter  $t$ .  $I_t^F$  denotes the true growth rate of the leading indicator index in quarter  $t$  and  $R_t$  denotes the revision of the leading indicator index in quarter  $t$ .

b. t-statistics are reported inside the parentheses.



Tables 1 through 4 establish that the errors in the initial announcements of the index of leading economic indicators have a statistically significant impact on contemporaneous movements in expectations. In Table 5 we consider whether the impact of these errors is also economically significant by looking at the proportion of the variability in expectations that can be explained by the revision variable. As in Tables 2 and 4, the dependent variable we employ is the forecast for the growth in industrial production aggregated across quarters. The table reports results for the full sample, the pre-1976 subsample, and the post-1976 subsample.

Before describing our approach, let us briefly discuss why we do not employ a variance decomposition approach. The reason is that a variance decomposition would likely capture an indirect effect that errors in the initial announcements of the leading indicator index have on the forecasts. As described below, the only revision included in our analysis is the revision that corresponds to the initial announcement of the leading indicator index that immediately precedes the forecast. Thus, our approach should only capture the direct effect that the errors in the initial announcements of the leading indicator index have on the forecasts. In contrast, in a variance decomposition, in addition to the revision variable included in our approach, the analysis would include revisions that correspond to the initial announcements of the leading indicator index that occurred significantly before the forecast. Thus, rather than only capturing the direct effect that the errors in the initial announcements of the leading indicator index have on the forecasts, a variance decomposition would also capture forecasters' observations of how producers respond to errors in the initial announcements of the leading indicator index.

Consider the variability in expectations not explained by a one-period lag in expectations—we will refer to this as the residual variability. One can think of the residual variability as a rough estimate of the variability in expectations not explained by the information held by agents one quarter earlier. In Table 5 we calculate the incremental contribution of the revision variable through a comparison of  $R^2$  values as described in Theil [1971], and then use this number to calculate the proportion of the residual variability that is explained by the revision variable.<sup>12</sup> There are two points worth noting. First, the table indicates that, in general, the more quarters we aggregate across, the larger is the proportion of the residual variability that is explained by the revision variable. Second, consistent with the findings reported in Tables 3 and 4, the revision variable explains a larger proportion of the residual variability in the later time period. For example, when we aggregate the growth rates across four quarters, the revision variable explains 12.9 percent of the residual variability in the full sample, while it explains 8.1 percent in the pre-1976 subsample and 27.9 percent in the post-1976 subsample. Overall, our analysis indicates that the errors in the initial announcements of the index of leading economic indicators have both an economically significant as well as a statistically significant effect on contemporaneous movements in expectations.

As a final point, it should be noted that there is an alternative explanation for our findings. In the above discussion, we interpret our results as indicating that in making their forecasts economic forecasters place significant weight on the initial announcements of the leading indicator index. Another possibility is that the forecasters do not

place significant weight on the initial announcements of the index, but rather place weight on the initial announcements of one or more of the component series used to construct the index. Although it is an alternative explanation for our findings, in terms of the underlying argument there is really no important difference. Even if the correct explanation is that the forecasters place significant weight on the initial announcements of one or more of the component series used to construct the index rather than the index itself, our findings still indicate that errors in initial announcements concerning economic statistics are a source of the type of shock central to the analyses of Keynes, Pigou, and more recent authors such as Diamond and Woodford. Or, to put this another way, whichever explanation is correct, our results suggest that expectational shocks due to errors in initial announcements concerning economic statistics are an important factor in understanding how expectations concerning future growth evolve over time.

**TABLE 5**  
**The Explanatory Power for Contemporaneous Movements in Expectations of the Revision of the Leading Indicator Index<sup>a</sup>**

<i>k</i>	Full Sample				Pre-1976 Subsample				Post-1976 Subsample			
	<i>j</i> = 2	3	4	5	<i>j</i> = 2	3	4	5	<i>j</i> = 2	3	4	5
1	0.533	0.615	0.686	0.720	0.470	0.552	0.652	0.607	0.575	0.647	0.689	0.717
2	0.563	0.619	0.688	0.740	0.519	0.569	0.652	0.646	0.593	0.647	0.695	0.737
3	0.579	0.639	0.709	0.776	0.520	0.579	0.666	0.678	0.691	0.754	0.799	0.816
4	3.4%	5.2%	6.7%	12.9%	0.2%	2.2%	4.0%	8.1%	23.1%	30.3%	33.4%	27.9%

a. The numbers for  $k = 1$  are the values for  $R^2$  from the estimation of  $E_t(\Delta IP_{t+j}) = b_1 + b_2 E_{t-1}(\Delta IP_{t+j-1}) + e_t$ . The numbers for  $k = 2$  are the values for  $R^2$  from the estimation of  $E_t(\Delta IP_{t+j}) = b_1 + b_2 E_{t-1}(\Delta IP_{t+j-1}) + b_3 I_t^F + e_t$ . The numbers for  $k = 3$  are the values for  $R^2$  from the estimation of  $E_t(\Delta IP_{t+j}) = b_1 + b_2 E_{t-1}(\Delta IP_{t+j-1}) + b_3 I_t^F + b_4 R_t + e_t$ . The numbers for  $k = 4$  are the values for  $[(\text{row } 3 - \text{row } 2) / (1 - \text{row } 1)] \cdot 100$ .  $E_t(\Delta IP_{t+j})$  denotes the mean value from the ASA-NBER Survey of Forecasts by Economic Statisticians of the forecasted cumulative growth in industrial production from quarter  $t + 2$  through quarter  $t + j$ , where the forecast is from the survey taken after but closest in time to the release of the initial announcement of the value for the leading indicator index for quarter  $t$ .  $I_t^F$  denotes the true growth rate of the leading indicator index in quarter  $t$  and  $R_t$  denotes the revision of the leading indicator index in quarter  $t$ .

**INTERPRETATIONS**

The above analysis shows that the errors in the initial announcements of the index of leading economic indicators serve as a type of expectational shock, while our previous analysis shows that these shocks are an important source of business cycle fluctuations. But there is still the important question, what is the underlying theoretical mechanism that translates the errors in the initial announcements of the leading indicator index into subsequent movements in aggregate activity? As suggested in the Introduction and in Section II of Oh and Waldman [1990], our preferred explanation is that the economy is characterized by strategic complementarity, where strategic complementarity means that each agent has a higher incentive to produce when he or

she believes that future aggregate activity will be high. The logic here is that a positive error, for example, causes each agent to raise his or her expectations concerning the production plans of other agents, and, due to strategic complementarity, this in turn causes each agent to in fact produce more.

But the presence of strategic complementarity is not the only possibility for how errors in the initial announcements of the leading indicator index could get translated into subsequent movements in aggregate activity. For example, these errors might be important not because there is strategic complementarity, but because the economy is characterized by aggregate cost shocks and each agent wants to produce more when his or her costs are low. In this explanation, information about the current aggregate cost shock is dispersed among various producers in the economy. In turn, agents pay attention to the initial announcements of the leading indicator index and thus the errors matter because the index aggregates this dispersed information in a way that allows each producer to better predict his or her own costs.<sup>13</sup>

As discussed in the third section, a related issue is that even if strategic complementarity is important there are still two possibilities. On the one hand, agents may look at the initial announcements of the leading indicator index because these announcements contain information about the real fundamentals of the economy. In this case the errors in the initial announcements are important because errors matter in almost any learning context in which important information is announced but measured with error. On the other hand, the initial announcements of the leading indicator index may serve as a pure sunspot, that is, each agent considers the initial announcements not because they capture any information about real fundamentals but because other agents are looking at the announcements. In this case the errors are important because together the agents' behavior creates a self-fulfilling prophecy, that is, because each agent acts as if the initial announcements are important, the announcements and the errors in those announcements become important.

In considering the above possibilities we believe there are strong reasons to favor the idea that the economy is characterized by strategic complementarity. For example, as discussed by Cooper and Haltiwanger [1996], the predictions of models characterized by strategic complementarity match a number of real-world business-cycle properties, such as co-movement of activity across sectors and positive serial correlation of various aggregate time series. Further, there are a number of historical episodes, such as the response of the economy to the 1933 National Industrial Recovery Act, that suggest an important role for strategic complementarity. Finally, we do not believe there is much evidence at this point that would allow one to distinguish between the idea that the initial announcements of the leading indicator index contain information about the real fundamentals of the economy and the idea that they serve as pure sunspots. As discussed briefly in the Conclusion, we believe that trying to resolve this issue is an important avenue for future research.

We will end this discussion by mentioning one final possibility. All the theoretical mechanisms discussed above assume that agents form their expectations in a fashion consistent with Bayesian learning or rational-expectations-type learning. Another possibility is that the economy is characterized by strategic complementarity but forecasters "overreact" to surprises, as suggested by research in experimental psychology,

such as Kahneman and Tversky [1982], and in behavioral economics, such as De Bondt and Thaler [1985]. The reason we suggest this as a possibility is that overreaction potentially explains a puzzling aspect of our empirical findings. As discussed briefly at the beginning of the empirical analysis, a puzzling aspect of our findings is that the coefficient on the revision variable is consistently negative and statistically significant but we do not find evidence for the corresponding prediction that the coefficient on the true or final announced value of the leading indicator index should be positive. One possibility is that this is due to a multicollinearity problem. As discussed below, another possibility is that forecasters overreact to surprises.

Suppose that, as must be the case, prior to an initial announcement concerning the leading indicator index forecasters have expectations concerning what that initial announcement will be. Further, let overreaction mean that each forecaster does not pay attention to the initial announcement itself in putting together his or her forecast but rather is only concerned with the difference between the actual initial announcement and his or her prior expectation concerning that announcement, that is, each forecaster only considers the surprise contained in the initial announcement. This would explain the puzzling aspect of our findings if the correlation between the errors in the initial announcements and the surprises in the initial announcements is higher than the correlation between the true values for the leading indicator index and the surprises.<sup>14</sup> Further, we would expect the former correlation to be higher than the latter since forecasters' expectations concerning initial announcements of the index should be positively correlated with the true values for the index but, given the source of the errors, uncorrelated with the errors.

## CONCLUSION

In Oh and Waldman [1990] we found both a statistically significant and economically significant negative relationship between revisions of the index of leading economic indicators and movements in future production. The interpretation we posited is that errors in the initial announcements of the leading indicator index are a source of expectational shocks. In this paper, we employed the ASA-NBER Survey of Forecasts by Economic Statisticians to measure expectations, and directly investigated whether these errors are a source of expectational shocks. Our findings indicate that after 1976 the errors in the initial announcements of the index of leading economic indicators are indeed both an economically significant as well as a statistically significant source of expectational shocks.

As discussed, for example, in Basu and Taylor [1999], much of the current empirical work on business cycle fluctuations focuses on the importance of monetary shocks and technology shocks as causes of these fluctuations, and ignores the possibility of expectational shocks, which is central to the theoretical literatures concerning sunspots and strategic complementarities. Between this paper and our earlier 1990 analysis, we have identified a source of expectational shocks and shown that these shocks serve as an important source of business cycle fluctuations. Further, given that there are likely other similar sources of expectational shocks (such as the errors in the initial announcements of other government statistics), our work suggests that the

empirical literature on the sources of business cycle fluctuations needs to pay more attention to the possible role of expectational shocks.

One might be tempted to conclude from our findings that publication of the leading indicator index is socially counterproductive. We feel, however, that our results do not in fact justify this conclusion. We say this for two reasons. First, publication of the index potentially results in benefits due to agents in the economy being better informed, and it is possible that these informational benefits outweigh any costs associated with the expectational shocks identified here. Second, if the index was not published then agents would look elsewhere for information concerning future aggregate activity and, depending on the reliability of these alternative sources of information, this could in fact lead to larger expectational shocks than the ones we have identified.

Finally, there are many directions in which the analysis in this paper could be extended. One interesting issue that we discussed earlier is whether we have found a pure sunspot type of expectational shock or whether information about real fundamentals plays an important role. We have found a pure sunspot type of shock if the initial announcements of the leading indicator index contain no information about the real fundamentals of the economy. In this case, agents pay attention to the initial announcements of the index because each agent believes that *other* agents will look at the initial announcements in forming their beliefs. Alternatively, agents could look at the initial announcements of the index because those announcements contain information about movements in the real fundamentals of the economy. In future work we plan to investigate which of these two mechanisms is at work.

## NOTES

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1. Other papers on these topics include Woodford [1986; 1990], Bryant [1987], Haltiwanger and Waldman [1989], Cooper and Haltiwanger [1990; 1996], Oh and Waldman [1994], Sethi and Franke [1995], and Bomfim and Diebold [1997].
2. Starting in December 1995, responsibility for the index was moved from the U.S. Department of Commerce to the Conference Board. Since our study covers the period 1968-1990, the U.S. Department of Commerce was responsible for the index during the whole period of our study.
3. To be precise, after 1976 the initial announcements were significant at the 99 percent level in the regressions concerning growth rates one and two quarters following the announcement dates, while the initial announcements were significant at the 90 percent level in the regression concerning growth rates three quarters following the announcement dates.
4. For a more detailed description of the revision process see U.S. Department of Commerce [1984].
5. After the major definitional change of the leading indicator index that took place in January 1989, there were no longer components for which no information was available at the time of the initial announcement.
6. We have also run our tests using the median forecasts, and there was no change in the qualitative nature of the results.
7. The index of leading economic indicators is constructed to signal changes in the direction of aggregate economic activity, where a variety of statistical series are used to measure economic activity. These series include both industrial production and GNP. See Zarnowitz and Boschan [1975] for a discussion. Note that most previous studies of the predictive power of the index have focused on the ability of the index to predict either industrial production or GNP.

8. Our analysis does not cover more recent quarters because the ASA-NBER survey was discontinued in 1990.
9. Note that we have also run our tests including  $E_{t-1}(IP_{t+j})$  as an explanatory variable rather than  $E_{t-1}(IP_{t+j-1})$ . This did not change the qualitative nature of the results, but with this alternative specification there was significant serial correlation among the residuals.
10. See the end of this section for a discussion of one scenario in which the other information considered by respondents is correlated with both  $I_t^F$  and  $R_t$ .
11. One question that could be asked is whether the coefficients on  $R_t$  could be affected by a multicollinearity problem between  $I_t^F$  and  $R_t$ . The correlation coefficients between these two variables are 0.518 for the full sample, 0.750 for the pre-1976 subsample, and 0.280 for the post-1976 subsample. Hence, to the extent that multicollinearity between these two variables is affecting our results, the effect should be weakest in the later time period where we find the strongest evidence for a negative relationship between expectations and revisions of the index.
12. In calculating the proportion of the residual variability that is explained by the revision variable, we have also let  $E_{t-1}(\Delta IP_{t+j})$  be the one-period lag in expectations rather than  $E_{t-1}(\Delta IP_{t+j-1})$ . This did not change the qualitative nature of the results, but with this alternative specification there was significant serial correlation among the residuals. Finally, analysis indicates there is little or no correlation between the revision variable and the other explanatory variables. Hence, our incremental contribution approach by comparison of  $R^2$  values should provide an unbiased estimate of that part of the residual variability that is explained by the revision variable.
13. We would like to thank Russell Cooper for suggesting this explanation to us.
14. This is easy to see in the following case. Suppose that there is a positive correlation between the errors in the initial announcements and the surprises in the initial announcements, while there is no correlation between the true values and the surprises. Further, assume that each forecaster only considers his or her previous forecast and the current surprise in making this period's forecast. In this case we would expect the coefficient on the revision variable in our tests to be negative since a more positive revision means a more negative error, which translates on average into a more negative surprise. On the other hand, given no correlation between the true values for the index and the surprises, we would expect the coefficient on the final announced values of the index to be close to zero, since a higher true value would have no effect on the expected value of the surprise.

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