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How Do Forecasts Respond to Changes in Monetary Policy?

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BY LAURENCE BALL AND DEAN CROUSHORE

Just as changes in atmospheric conditions affect weather forecasts, changes in monetary policy affect economic forecasts. When monetary policy shifts, forecasters change their predictions about growth and inflation. But does the economy change to the same extent that forecasts do? In this article, Laurence Ball and Dean Croushore examine forecasts from the *Survey of Professional Forecasters* to determine if forecasts and the economy respond in tandem or if there are significant differences.

Forecasts are important because they affect what people do. If the weather forecast calls for rain, people carry umbrellas and cancel outdoor activities. If the economic forecast calls for a rise in the unemployment rate, people will reduce their spending on consumer goods.

And just as atmospheric conditions affect weather forecasts, changes in monetary policy affect economic forecasts. If the Federal Reserve tightens monetary policy, forecasters predict slower economic growth and lower inflation; if the Fed eases monetary policy, forecasters predict faster growth and higher inflation. But does the economy change to the same extent the forecasts do?

To answer this question, we'll look at forecasts from a survey of professional economic forecasters. We'll see how the economy responds to a change in monetary policy compared with how forecasts respond, to determine if the responses are identical or if there are significant differences.[1]

Why should we care about whether the economy changes to the same extent the forecasts do? If forecasts systematically respond differently than the economy does to a shift in monetary policy (that is, to a greater or lesser degree or with different timing), we might reach two conclusions: forecasters are irrational (since a good forecast should change in the same way the economy does) and forecasts aren't accurate guides to what happens in the economy when monetary policy changes.

Such conclusions can have repercussions. First, if forecasters are irrational, people will be less likely to believe their prognostications. Second, inaccurate forecasts may influence economic activity indirectly by setting up false expectations about how monetary policy will affect the economy. Acting on those expectations, people will behave in a certain way. But since people are misinformed about what effects monetary policy will have, they'll behave in a manner different from how they'd act if they had better information. Thus, monetary policy might affect real output in the economy partly because people were misinformed about its effects.

On the other hand, if forecasts align well with how the economy changes when monetary policy shifts, that's a sign that economic forecasters are rational. This alignment also eliminates the possibility that monetary policy affects the economy because people misinterpret its effects.

FORECAST DATA

To investigate forecasts, we'll use the *Survey of Professional Forecasters*

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[1] This paper reports the results of the authors' joint research. For additional details of their research, see their working paper, cited in the References.

(SPF).[2] The survey, which began in 1968, reports the forecasts of economists throughout the business world, on Wall Street, and at consulting firms. The survey asks participants to provide their quarterly forecasts for 18 major macroeconomic variables, including real GDP and all of its components. The survey form typically runs four to six pages; sometimes the survey includes special questions, which vary depending on current economic conditions. Because of the amount of detail the survey asks for, economists who participate in the survey are those for whom forecasting represents a major part of their job responsibilities. The survey, which is run by the Federal Reserve Bank of Philadelphia, is the leading quarterly survey of U.S. economists' forecasts.[3]

How good are the forecasts overall? If we examine just the average across the forecasters in the survey, we'd like to know if that average forecast is reasonable. If you wanted a good forecast for future output growth or inflation, would these surveys be useful to you? The answer is yes. These surveys almost always pass analysts' statistical tests for accuracy. For example, Dean Croushore recently studied the inflation forecasts from the *Survey of Professional Forecasters* and several other surveys and found that the SPF forecasts were quite good, though there were periods in which SPF respondents made severe forecast errors. Those periods were most often associated with oil-price shocks, mostly in the 1970s and early 1980s, when the economy performed poorly and inflation was rising dramatically.[4]

Figure 1 gives an overview of how accurate survey forecasts are. It shows the one-year-ahead forecasts for output growth made each quarter, from the fourth quarter of 1968 to the fourth quarter of 1999, compared with the data that show what actually happened. (For example, the forecast made in the fourth quarter of 1968 predicts output growth from the fourth quarter of 1968 to the fourth quarter of 1969. We compare the forecast with the actual data over the same period.) Figure 2 does the same for inflation forecasts. All the forecasts are looking one year ahead, and the date the forecast was made is shown on the horizontal axis.

Figure 1 demonstrates that, for the most part, output forecasts are good, in the sense that, on average, the difference between the forecast and what actually happened was near zero.[5] Consequently, one-year-ahead output forecasts match up with the data fairly well. The forecasts aren't quite as volatile as the actual data, which is a characteristic of all good forecasts. But the general pattern of movement over time is the same for the two series. There have been no long periods in which forecasts were consistently too high or too low except, perhaps, in the late 1990s.

In Figure 2, you can see that inflation forecasts over the past 15 years were pretty good, but they were much

[2] We've carried on similar research with the *Livingston Survey* of economists and the Michigan survey of consumers. In all cases, the results were nearly the same as those reported here for the *Survey of Professional Forecasters*.

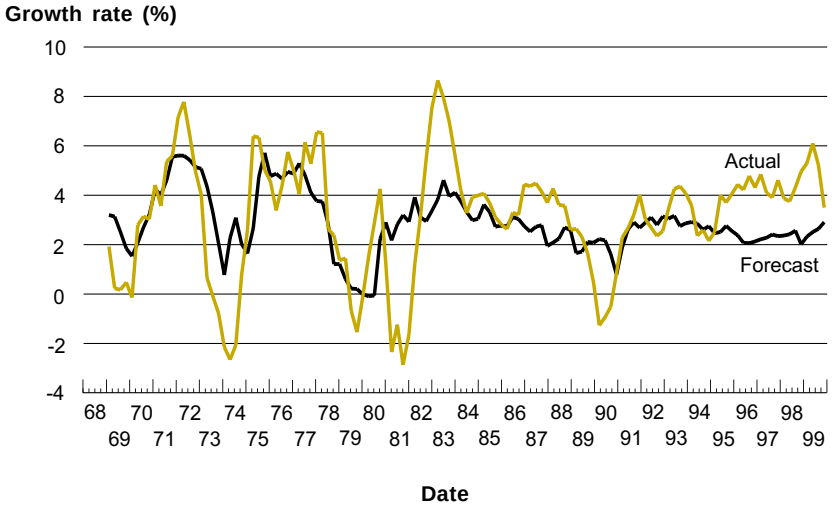
[3] For more details on the survey, see Dean Croushore's 1993 article in the *Business Review*. All of the survey's results are available on the Internet at http://www.phil.frb.org/econ/spf/index.html.

[4] For more details on these results, see Croushore's 1998 working paper and his 1996 *Business Review* article.

[5] For details, see the authors' 2001 working paper.

FIGURE 1

Mean Output Growth: Forecast and Actual



Note: Dates shown are dates when one-year-ahead forecasts were made; actual is for one year ahead from date of forecast. For example, in 1968Q4, forecasters on average predicted that output growth would be 3.2% between 1968Q4 and 1969Q4; output growth turned out to be 1.9%.
Source: *Survey of Professional Forecasters* and authors' calculations.

worse in earlier years. In the late 1960s and throughout the 1970s, forecasts for inflation were too low, with errors averaging 1.6 percent; in the early 1980s, inflation forecasts were too high, with errors averaging 1.7 percent; and through much of the 1990s, inflation forecasts were again too high, but the errors were smaller, averaging 0.8 percent. Nonetheless, standard statistical tests suggest that, overall, the forecasts are not biased, that is, they weren't consistently wrong in one direction or another. Thus, they pass a simple test for accuracy.[6]

Measuring Monetary Policy. Given that the forecasts look fairly good overall, the question arises: how do the forecasts respond to changes in monetary policy? To answer that question, we need a quantitative measure of monetary policy. Economists often use a real interest rate, that is, the interest rate adjusted for expected inflation, as a variable for determining how monetary policy is changing. Since the Federal Reserve generally operates by targeting the federal funds rate, which is the interest rate on short-term loans between banks, our measure of monetary policy is the *real* federal funds rate.[7]

COMPARING FORECASTS WITH REALITY

To see how well the forecasts compare with what actually happens in the economy, we'll break them into several parts. First, we'll look at a benchmark forecast formed using only past values of output or inflation, to get a rough idea of how output or inflation might change if there were no changes in monetary policy. Then, we'll compare each survey forecast with this benchmark forecast. Finally, we'll compare the survey forecast to what actually happened in the economy.

A Benchmark for Comparison. We're going to begin our analysis by using a simple model as a benchmark for comparison. A simple forecast of output growth is one based only on past data for real output growth.[8] Similarly, our benchmark model for inflation attempts to provide a useful forecast of inflation based solely on past inflation rates.

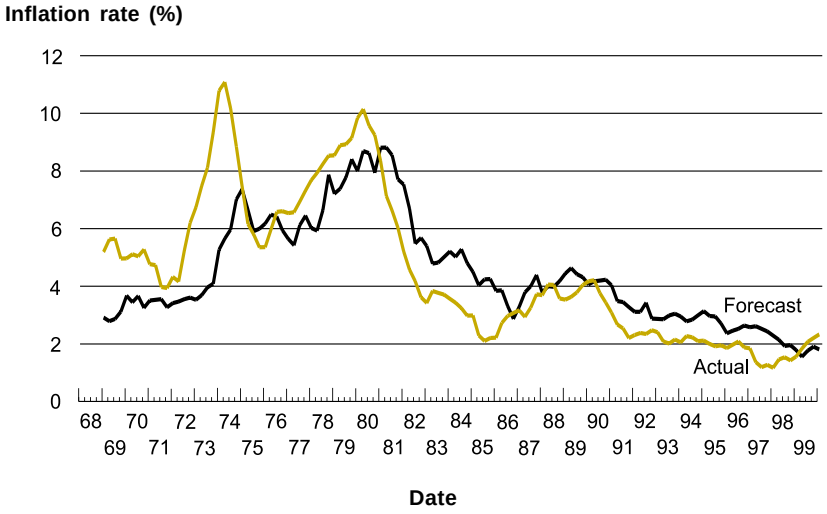
We chose this simple model as a benchmark because it ignores any past changes in monetary policy that are likely to affect output growth or inflation in the future. Then, by comparing the forecasts from this benchmark model with the forecasts made in our surveys, we can observe, in principle, how the survey forecasts respond to changes in monetary policy. Of course, if monetary policy doesn't change, the benchmark model's forecasts should be similar to the survey forecasts.

You might think that these types of models wouldn't be very good at forecasting; however, our tests suggest that they do very well. When we ran the forecasts through a battery of tests (see our working paper for details), they passed every one.

Measuring the Effects of Monetary Policy. To see how monetary policy affects output growth, we'll look

FIGURE 2

Mean Inflation: Forecast and Actual



Note: Dates shown are dates when one-year-ahead forecasts were made; actual is for one year ahead from date of forecast. For example, in 1968Q4, forecasters on average predicted that inflation would be 2.9% between 1968Q4 and 1969Q4; inflation turned out to be 5.2%.
Source: *Survey of Professional Forecasters* and authors' calculations.

[6] The inflation forecasts sometimes missed the mark, especially when there were big oil-price shocks, but they were not consistently wrong. For more on testing for bias in forecasts, see Croushore's 1996 article and his 1998 working paper.

[7] The real federal funds rate is defined as the nominal federal funds rate minus the expected inflation rate. Even if the survey's expected inflation rate turned out to be biased, the real federal funds rate defined this way would still be the correct measure of the stance of monetary policy because it's a key variable that people use in making economic decisions.

[8] In technical terms, this is called a univariate time-series model.

at the difference between actual output growth over the course of the year and our benchmark model's forecast for output growth over the same period. This difference is called the benchmark error. If monetary policy's effects on the economy are not fully reflected in the benchmark forecasts, we would expect to find that changes in monetary policy are associated with benchmark errors. In particular, we would think it likely that tighter monetary policy today (a higher real federal funds rate) would reduce future output growth but that our simple model wouldn't pick up this effect because the model doesn't incorporate information about monetary policy. So tighter monetary policy should be correlated with a negative value of the benchmark error. Similarly, easier monetary policy should be correlated with a positive benchmark error, since such policy would increase actual output growth but would not affect the benchmark forecast.

The simplest way to demonstrate this is a scatterplot showing the benchmark error, that is, the difference between actual output growth and the benchmark model's forecast on the vertical axis and the measure of monetary policy — in this case, the change in the real federal funds rate over the preceding year — on the horizontal axis (Figure 3a).[9] The plot shows a clear negative relationship.[10] Tighter monetary policy, which is a positive change in the real federal funds rate, is associated with negative values of the benchmark error. A more formal statistical test confirms that the relationship is statistically significant.[11]

We also can examine differences between actual inflation and our benchmark forecast for inflation. In this case, tighter monetary policy is expected to lead to lower inflation than the univariate time-series model suggests. So increases in the real federal funds rate would be correlated with negative values of the benchmark error. Similarly, declines in the real federal funds rate would be correlated with positive values.

When we look at the data on inflation and changes in monetary policy, we don't see a clear relationship, in part because monetary policy takes longer to act on inflation than on output. This suggests that we need to look at changes in monetary policy from longer ago. Indeed, if we look at the change in the real federal funds rate from two years to one year prior to the forecast, we see a negative impact, as expected, though the relationship is a bit weaker than in the case of output (Figure 3b). Again, statistical tests confirm this negative relationship.

Overall, tighter monetary policy reduces both future output and future inflation in a way that our benchmark forecasts do not pick up.

How Survey Forecasts Reflect Information About Monetary Policy. Next, let's examine how the survey forecasts reflect the fact that the economists surveyed make their forecasts using information about monetary policy. If they didn't use such

[9] To be consistent with the timing of the survey forecasts, and to ensure that the forecasters knew the value of the measure of monetary policy at the time their forecasts were made, we follow this timing convention: For a forecast made in a particular quarter (for example, the fourth quarter of 1968), we look at the change in the real federal funds rate over the year that ends in the previous quarter (for example, from the third quarter of 1967 to the third quarter of 1968). That's because the survey forecasts are made in the middle of the quarter, so the survey respondents don't yet know the value of the real federal funds rate for the quarter in which they make their forecasts (in this example, the fourth quarter of 1968).

[10] We've highlighted this relationship by drawing a regression line, which represents a linear relationship between the variables on the horizontal and vertical axes.

[11] Technically, we ran a regression of the forecast error on the one-year change in the real federal funds rate, then tested the significance of the regressor with an exclusion test. The test is slightly complicated by the fact that the observations are quarterly and the forecast horizon is one year ahead, so we must use a Newey-West procedure to adjust the covariance matrix. See our working paper for test details. We perform all tests at a 5 percent significance level.

information, we'd expect the survey forecast for output growth to be similar to that of our simple benchmark model. But if survey participants use information about monetary policy in setting their forecasts, the difference between the *survey forecast* and our *simple benchmark forecast* would vary depending on whether monetary policy was tight or easy. In particular, tighter

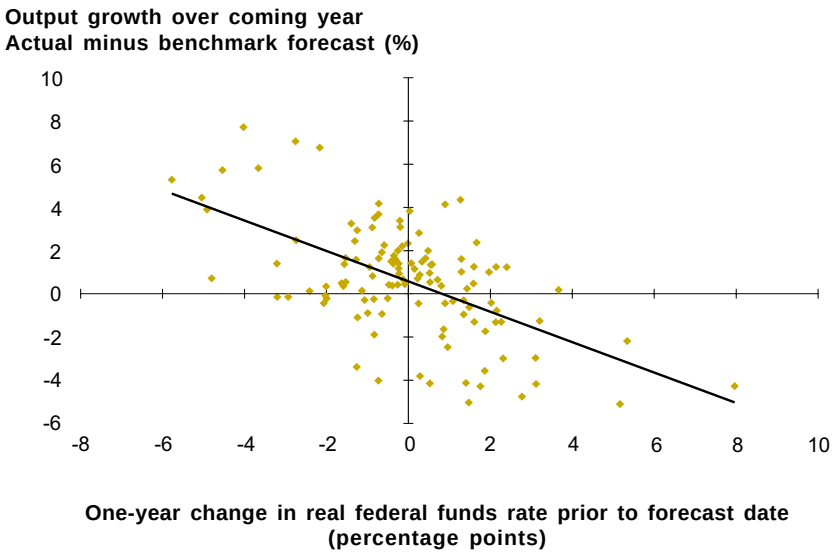
> Survey forecasts of output don't fall enough when monetary policy tightens, but survey forecasts of inflation decline by the right amount.

monetary policy (an increase in the real federal funds rate) would lead survey forecasts for output growth to be lower than our benchmark forecasts. That is, we'd expect the difference between these forecasts to be negative. Similarly, forecasters anticipating easier monetary policy (a decrease in the real federal funds rate) would expect growth to increase. Thus, survey forecasts would tend to be higher than the simple benchmark forecasts, so we'd expect the forecast difference to be positive. Again, the same type of analysis can be done for inflation as for output growth.

Let's repeat the analysis shown in Figure 3a, but this time we'll look at the difference between forecasts for output growth from the *Survey of Professional Forecasters* (SPF) and the benchmark forecasts. The same type of scatterplot shows a negative relationship (Figure 4a), which is what we expect. Tighter monetary policy (a positive value of the change in the real federal funds rate shown on the horizontal axis in the figure) is associated with a negative forecast difference. This

FIGURE 3a

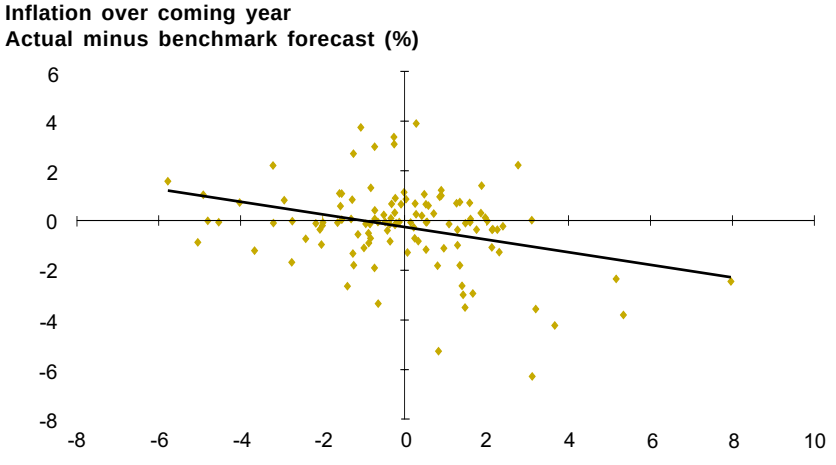
The Effect of Monetary Policy on Output



Example: The difference between actual output growth and the benchmark forecast between 1981Q4 and 1982Q4 was -4.3 percentage points and the change in the real federal funds rate between 1980Q3 and 1981Q3 was 8.0 percentage points. This is the point farthest to the right in the figure. Note: A linear regression line is plotted.
Source: *Survey of Professional Forecasters* and authors' calculations.

FIGURE 3b

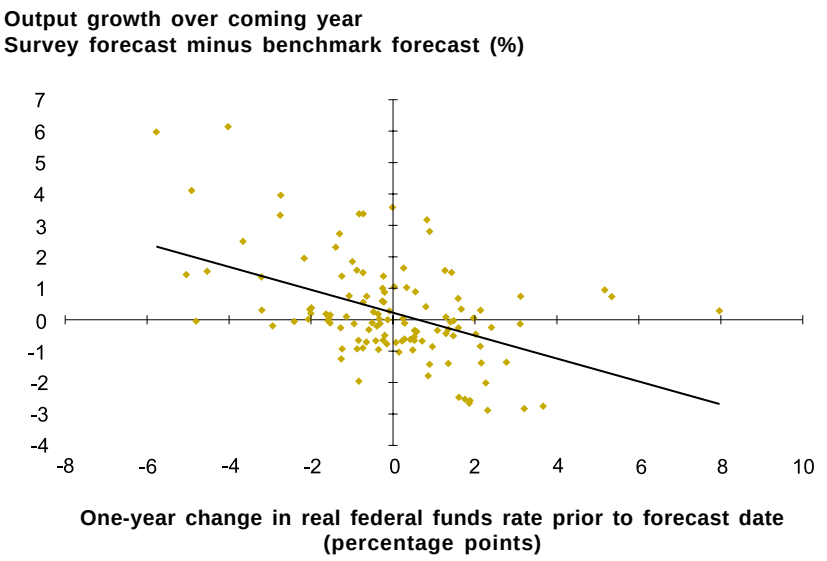
The Effect of Monetary Policy on Inflation



Example: The difference between actual inflation and the benchmark forecast between 1982Q4 and 1983Q4 was -2.4 percentage points and the change in the real federal funds rate between 1980Q3 and 1981Q3 was 8.0 percentage points. This is the point farthest to the right in the figure. Note: A linear regression line is plotted.
Source: *Survey of Professional Forecasters* and authors' calculations.

FIGURE 4a

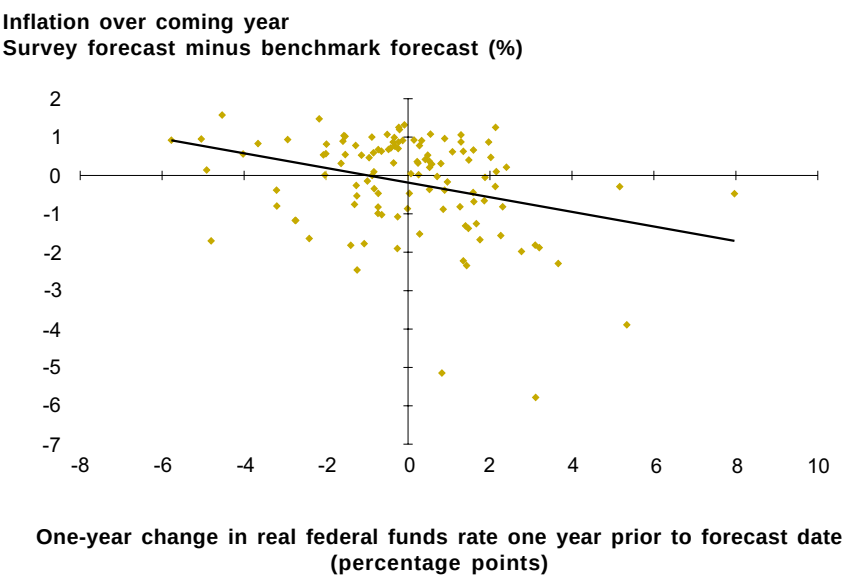
The Effect of Monetary Policy on Survey Forecasts of Output



Note: A linear regression line is plotted.
Source: *Survey of Professional Forecasters* and authors' calculations.

FIGURE 4b

The Effect of Monetary Policy on Survey Forecasts of Inflation



Note: A linear regression line is plotted.
Source: *Survey of Professional Forecasters* and authors' calculations.

suggests that economists may incorporate changes in monetary policy into their forecasts while the simple benchmark forecasts can't do so. The same is true of inflation forecasts. But, again, we need to look at changes in monetary policy from a year earlier to see an effect, and again the relationship isn't as clear as it was for output (Figure 4b). This time, however, formal statistical tests show that the negative relationship isn't strong enough to be statistically significant. Thus, monetary policy doesn't significantly affect survey inflation forecasts relative to our benchmark forecasts.

Overall, tighter monetary policy may lead survey forecasts of output growth to be lower than benchmark forecasts, but it doesn't have a statistically significant effect on survey forecasts of inflation relative to benchmark forecasts.

Are the Survey Forecasts Rational? We can also compare the survey forecasts with actual output growth and inflation. This comparison indicates whether the survey forecasts are rational. If they are rational, the survey forecasts should change in response to shifts in monetary policy in the same way that actual output growth or inflation changes. Otherwise, the survey forecasts are irrational — that is, survey respondents could make better forecasts using the information available about monetary policy.

To investigate the rationality of the forecasts, once again we'll look at the forecast errors — the difference between actual output growth or inflation and the survey forecast for those variables. If monetary policy gets tighter (an increase in the real federal funds rate), both actual output growth and the survey forecast for it should decline by the same amount; therefore, the forecast error shouldn't be correlated with monetary policy. The same should be true of easier monetary policy: there should be no relationship between a

measure of monetary policy and the forecast error for output growth. Similar results should hold for inflation.

For output growth, we will look at the forecast error to see if it's correlated with our measure of monetary policy. A scatterplot shows a negative relationship between the forecast error and the measure of monetary policy (Figure 5a), which is statistically significant. The relationship isn't as strong or as large in magnitude as the relationship shown in Figure 3a, which suggests that the survey forecasts do respond to changes in monetary policy, but not enough. In other words, when monetary policy tightens, survey forecasters reduce their forecasts of output growth, but not by enough to match what actually happens. Similarly, easier monetary policy leads forecasters to raise their forecasts of output growth, but not by enough to match reality.

What about inflation forecasts? When we plot the inflation forecast error against past changes in the real federal funds rate, there's a slightly negative relationship (Figure 5b), but it isn't statistically significant. So it appears that forecasters are able to change their forecasts of inflation in response to changes in monetary policy in a rational way.

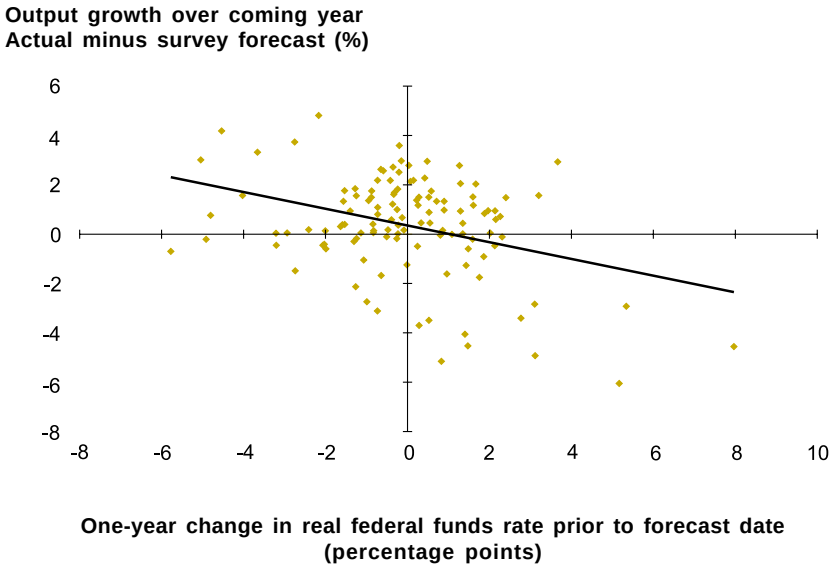
In summary, survey forecasts of output don't fall enough when monetary policy tightens, but survey forecasts of inflation decline by the right amount. Thus, forecasters are inefficient in forecasting output when monetary policy changes.

CONCLUSIONS

What implications do the results discussed in this article have for how we think about forecasts and monetary policy? If the survey forecasts fail to capture the impact of monetary policy on output growth, then monetary policy could have an additional, indirect effect on the economy; our working paper presents a formal model in which

FIGURE 5a

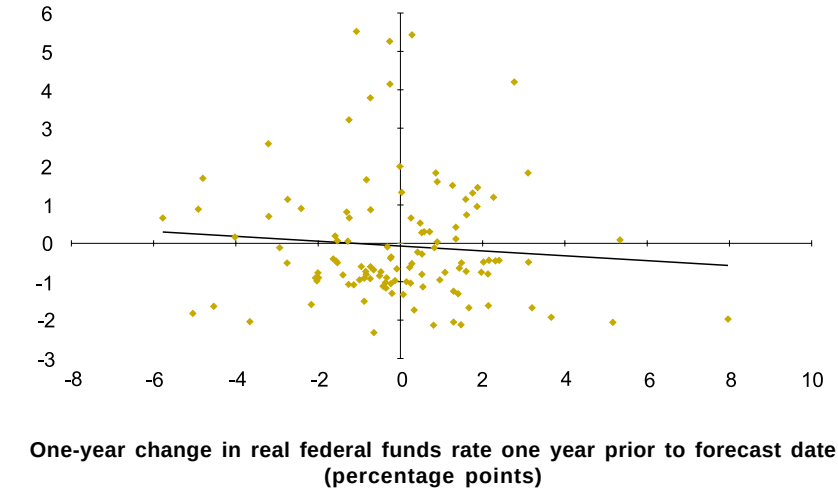
Are Survey Forecasts of Output Rational?



Note: A linear regression line is plotted.
Source: *Survey of Professional Forecasters* and authors' calculations.

FIGURE 5b

Are Survey Forecasts of Inflation Rational?



Note: A linear regression line is plotted.
Source: *Survey of Professional Forecasters* and authors' calculations.

this occurs. In particular, some models of the economy assume that a change in monetary policy affects the economy only if the change is a surprise. But even if a change in monetary policy isn't a surprise, its effects may be. Indeed, our evidence suggests that this is so. Even though monetary policy, as measured by a change in the real federal funds rate, is readily observable, forecasts of output don't fully react to it. And this under-reaction provides one possible channel through which monetary policy may affect the economy.

When we examine simple benchmark forecasts, survey forecasts, and actual movements of output growth and inflation, we find three key results. First, the survey forecasts and actual movements of output growth and inflation change when monetary policy changes. Both output growth and survey forecasts of output growth decline when monetary policy tightens and increase when monetary policy eases. Second, there's evidence that forecasts of inflation from the *Survey of Professional Forecasters* are rational; that is, they change as much as they should when monetary policy changes. Third, we've found some evidence that forecasts of output growth from the *Survey of Professional Forecasters* aren't rational, since they don't change as much as they should when monetary policy changes.

This last result is a bit surprising. After all, survey participants provide the best forecasts publicly available for the U.S. economy. Perhaps there have been significant changes in the relationship between output growth and monetary policy, and forecasters will eventually modify their forecasts to reflect that change. But for now, it remains a mystery as to why we find that forecasts aren't fully rational.

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