

Inflation Forecasts: How Good Are They?

*Dean Croushore**

Forecasts of inflation are important because they affect many economic decisions. Investors need good inflation forecasts, since the returns to stocks and bonds depend on what happens to inflation. Businesses need inflation forecasts to price their goods and plan production. Homeowners' decisions about refinancing mortgage loans also depend on what they think will happen to inflation.

*Dean Croushore is an assistant vice president in charge of the Macroeconomics Section in the Philadelphia Fed's Research Department.

In the early 1980s, economists tested the inflation forecasts in surveys taken over the previous 20 years and found that the forecasts systematically underpredicted inflation. But economic theory suggests that this shouldn't happen. To some extent, forecasters' livelihoods depend on how well they forecast, so they have a strong incentive to avoid such systematic mistakes. Faced with evidence that forecasters make systematic errors, economists suggested that either those who surveyed the forecasters weren't collecting the proper data or forecasters were irrational in their beliefs about infla-

tion. As a result, many economists stopped paying attention to the forecast surveys.

If we look at the data on actual inflation and the forecasts of inflation, the problem with the forecasts is clear. In the mid-1970s, and again in the late 1970s, inflation increased dramatically, rising to much higher levels than were forecast. But that doesn't mean that the forecasters weren't doing the best they could using the available information. Major increases in oil prices because of political events in the Middle East made the job of accurately forecasting inflation impossible. When oil prices rose, inflation rose sharply as well. Given that no one anticipated these huge increases in oil prices, it isn't surprising that the inflation forecasts underpredicted inflation. Another problem for forecasters was that, before 1973-74, they had never faced such a large increase in oil prices, so they didn't know how inflation would respond.

So economists may have been too rash in abandoning the surveys of forecasters. The key question is this: does adding data from the 1980s and early 1990s suggest that the forecasts are better than when we just looked at data from the 1970s and before? The answer is yes: the forecasts are much better when you look at the entire period through 1994. One interpretation is simply that the sharp rise in oil prices caused a period of inflation underprediction; inflation forecasts are generally good otherwise. And it's understandable that forecasters facing such a huge economic shock weren't sure what would happen.

But the forecasts aren't perfect. Forecasters don't seem to account properly for changes in monetary policy. When inflation is increasing and the Federal Reserve raises short-term interest rates, the forecasts suggest that inflation will stop rising much more quickly than it actually does. Systematic errors such as these suggest that while inflation forecasts are correct on average, forecasters are inefficient in their use of information about monetary policy. These er-

rors could arise because forecasters don't do their jobs well, because the economy is too complicated and changes too frequently, because it takes time to learn about changes in the economy, or because monetary policy isn't fully credible.

FORECASTS SHOULD BE UNBIASED

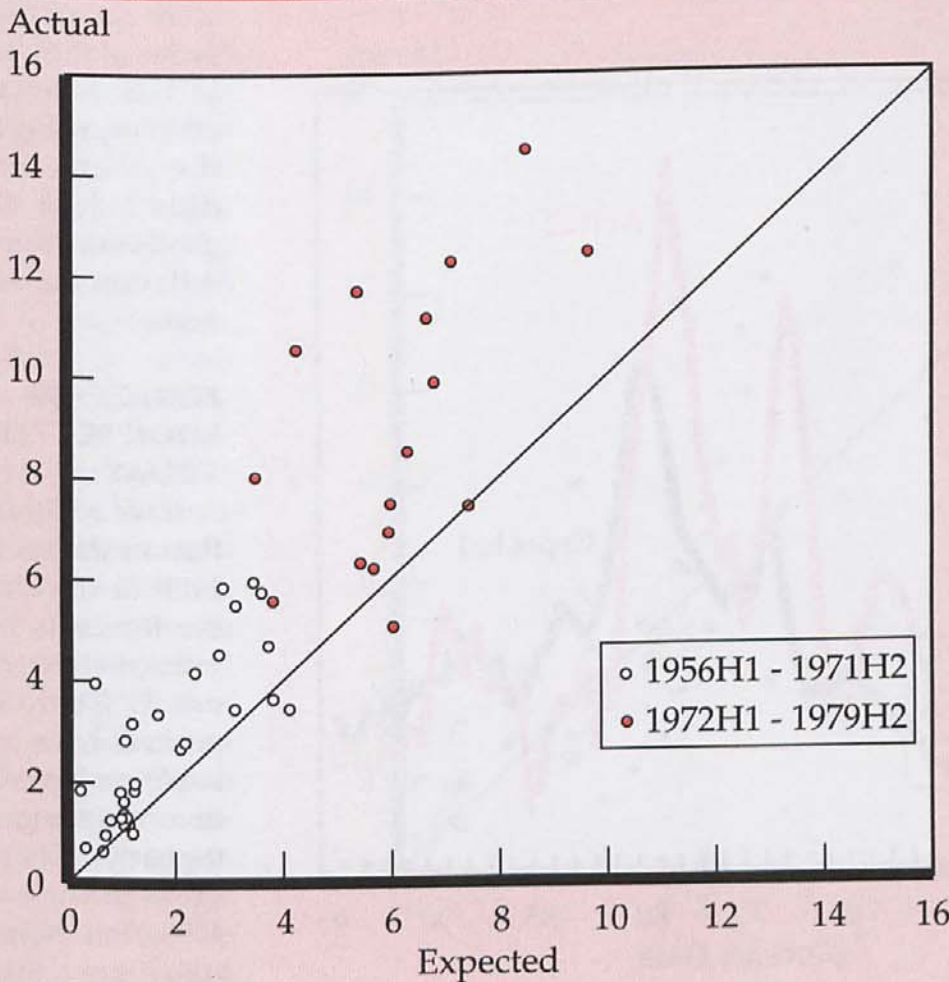
The economic theory of *rational expectations* implies that forecasts for inflation should meet two criteria: (1) they must be *unbiased*, that is, forecast errors (actual inflation minus the forecast) must average out to zero over time; and (2) they must be *efficient*, that is, forecasters must use all the relevant information at their disposal in forming forecasts.

Forecasts are unbiased if, when you look at the data on inflation and on inflation forecasts over a long period, positive and negative errors cancel each other out. But a look at actual inflation compared with expected inflation (as estimated from the Livingston Survey of economists from 1956 through 1979) shows a problem (Figure 1).¹ If the inflation forecasts are correct on average, they should be located symmetrically around the 45-degree line drawn in the figure. As you can see, the points tend to be above that line—actual inflation has usually been higher than expected inflation. These forecasts are biased because they show a systematic underprediction of inflation.

Many formal statistical studies of the data available in the early 1980s also suggested that forecasts were biased.² This discovery, with statistical support behind it, persuaded economists

¹The Livingston Survey, which collects economists' forecasts of inflation and other economic variables twice a year, has been in existence since 1946. For more information on the Livingston Survey, which is conducted by the Federal Reserve Bank of Philadelphia, see the article by Herb Taylor. John Carlson discusses some statistical problems in using the survey. The figure shows the mean forecasts of CPI inflation over the 14 months following each survey, compared with actual inflation over those 14 months.

FIGURE 1
Actual and Expected Inflation
 Livingston Survey 1956H1 to 1979H2



supply their forecasts, and they made their forecasts anonymously. An alternative view was that the people being surveyed weren't very good at forecasting inflation because they had no reason to be good at doing so; their livelihoods didn't depend on their inflation forecasts. As one participant suggested, the benefits of working on a joke for the speech he was about to give were greater than the benefits from a slight refinement in his inflation forecast.

INFLATION AND THE OIL SHOCK

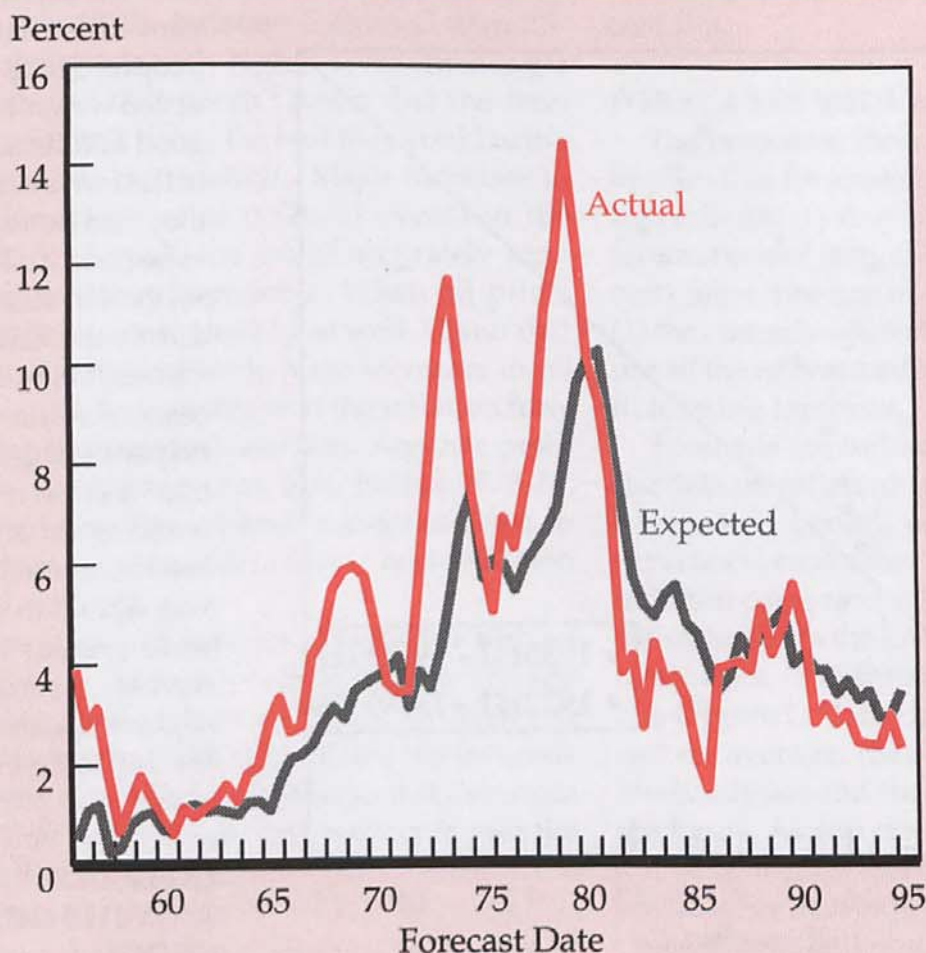
that there must be something wrong with surveys of inflation expectations. Some economists believed that people didn't have a strong enough incentive to respond accurately to the surveys, because they weren't being paid to

Economists had become interested in testing people's expectations about inflation at the worst possible time. In 1973 and 1974, the price of oil rose dramatically on world markets in response to a sharp reduction in supply from the Arabian peninsula, catching everyone by surprise. As a result, inflation in the United States and many other countries rose sharply, and the forecasts of inflation looked very bad (Figure 2).³ The oil-price

²These studies include those by Stephen Figlewski and Paul Wachtel; Edward Gramlich; Eugene Fama and Michael Gibbons; and Michael Bryan and William Gavin. For a review of the issues and the statistical results, see the article by G.S. Maddala. Technically, a biased forecast isn't necessarily worse than an unbiased forecast, if the bias is small and if the biased forecast has smaller errors, on average. But the bias found in these studies was quite large.

³As before, the data in this figure are the mean responses from the Livingston Survey for the 14-month-ahead forecast of CPI inflation.

FIGURE 2
Actual and Expected Inflation
Livingston Survey



Note: "Expected" is the inflation forecast for the year following the forecast date; "Actual" is the actual inflation rate over that period.

shock of 1973-74 was followed by another one in 1978-79, which is also apparent in the figure.

The two oil-price shocks were unexpected. But compounding the problem was the fact that people didn't know how the economy would respond. Would the oil price increases cause a recession in the United States? Would inflation rise permanently or temporarily and by how much? How would monetary policy respond? We know now that the sharp increases in oil prices led directly to a large increase in infla-

tion, but at the time, no one knew what would happen.⁴ Since these were the first episodes of their kind in U.S. history, it isn't surprising that the forecasters didn't do a very good job in forming inflation expectations.

FORECASTS LOOK BETTER TODAY

If we add the inflation data since 1980 to the chart, the forecasts look much better (Figure 3). There appears to have been some overprediction of inflation in the early 1980s and again in the early 1990s, but these errors are much smaller than the errors in the 1970s.⁵

Formal statistical tests on the

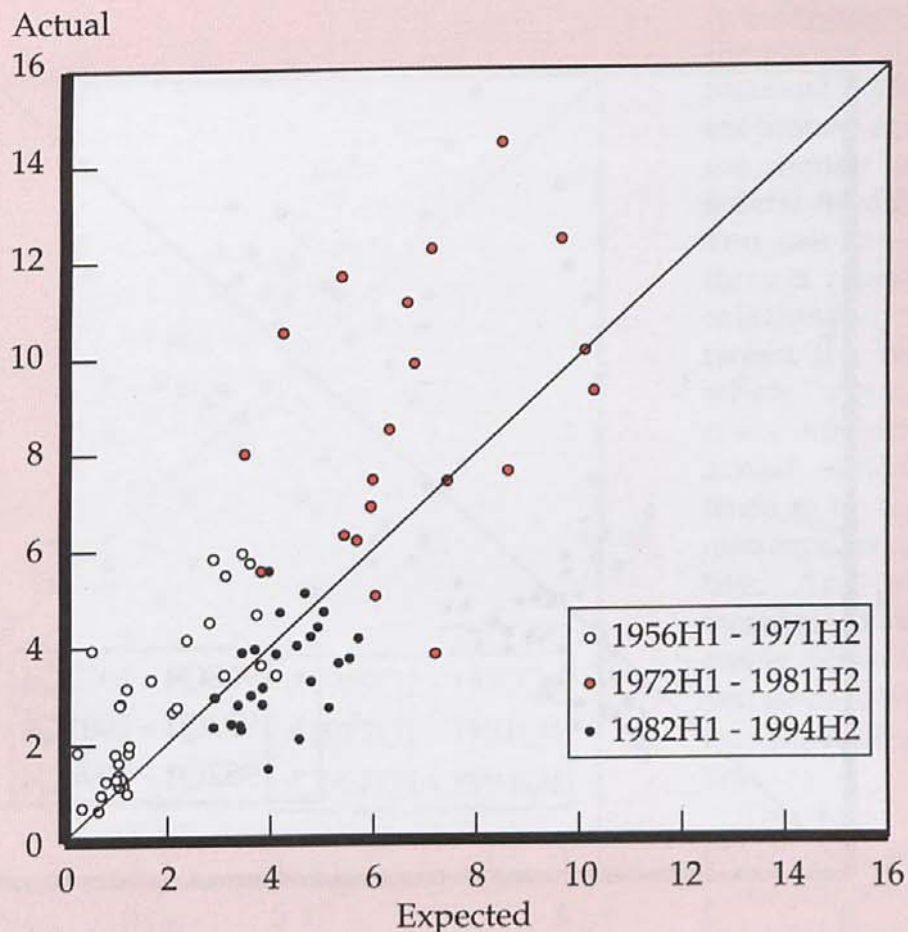
⁴CPI inflation rose from just over 3 percent in 1972 to almost 9 percent in 1973 and over 12 percent in 1974. In the second oil shock, inflation rose from just under 7 percent in 1977 to 9 percent in 1978, then to about 13 percent in 1979 and 1980.

⁵The error in a forecast is defined as the actual inflation rate over the period minus the forecast of the inflation rate over the period. If forecasts are good, forecast errors should be fairly small, and the plotted points should be close to the 45-degree line in the figure.

data, which are identical to the ones economists performed in the early 1980s, show much-improved performance.⁶ The forecasts no longer show any bias. In the figure, the points are fairly symmetric around the 45-degree line.

What's more, this result holds up when we look at data from other surveys of forecasts or data other than the CPI inflation rate. We've done the same statistical tests using the Survey of Professional Forecasters (Figure 4) and the University of Michigan Survey of Consumers (Figure 5).⁷ The expected inflation variable in the fig-

FIGURE 3
Actual and Expected Inflation
Livingston Survey 1956H1 to 1994H2

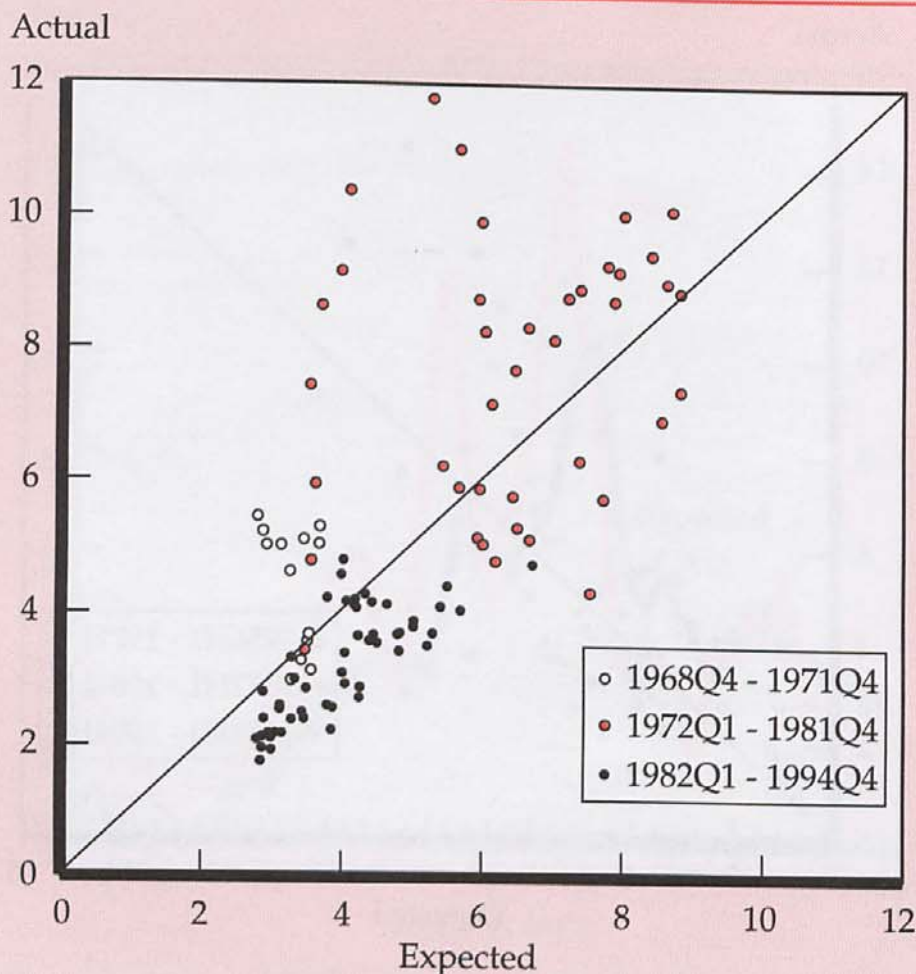


ure for the Survey of Professional Forecasters is the mean of the survey participants' forecasts of the GNP implicit price deflator (GDP deflator after 1991) over the next year, which is compared to actual inflation over the next year; for the Michigan survey it is the mean of the survey participants' forecasts of the CPI inflation rate over the next year, which is compared to actual inflation over the next year. Though these surveys differ in the types of people responding to the survey and the type of inflation variable being forecast, there is no apparent bias in the figures, a finding supported by formal statistical tests.

⁶In this analysis, we add data from the 1980s and 1990s to the original data from the 1950s through the 1970s. A similar figure for just the 1980s and 1990s shows a very impressive forecast pattern, with very small differences between actual and expected inflation. The formal results, which are based on regression analysis, are available from the author upon request.

⁷See my 1993 article for a detailed description of the Survey of Professional Forecasters, which began in 1968. See the article by Nicholas Noble and Windsor Fields for more details on the University of Michigan Survey of Consumers, which, in 1969, began to collect inflation forecasts once a quarter.

FIGURE 4
Actual and Expected Inflation
 Survey of Professional Forecasters 1968Q4 to 1994Q4



So it appears that the bias found in earlier studies of the surveys of inflation forecasts was largely due to the oil-price shocks in the 1970s. Those shocks made all forecasts of inflation look bad. Still, these forecasts may have been the best possible forecasts of inflation at the time; people should realize that unpredictable shocks sometimes occur.

BUT FORECASTS MAY STILL BE INEFFICIENT

Even though the forecasts appear to be un-

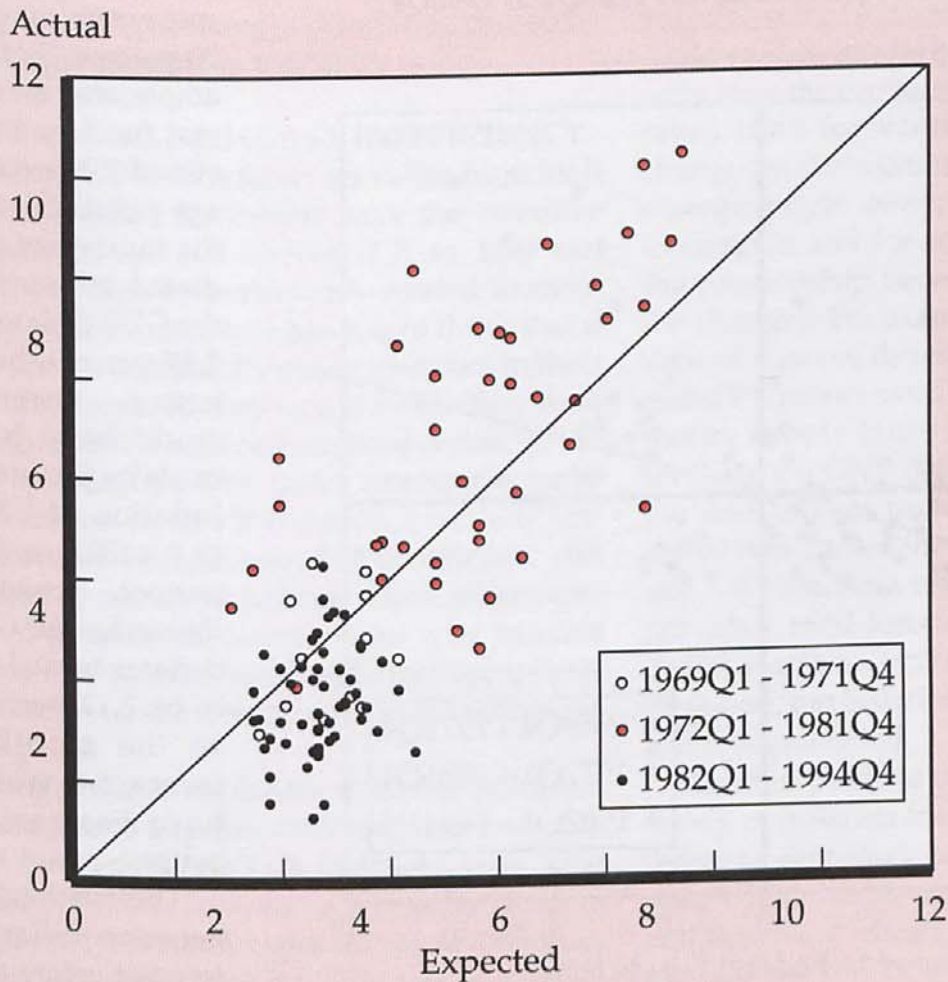
biased, there is some evidence that they are *inefficient*. The term inefficient applies to forecasts that could be improved by using additional information. That is, forecasters could have done a better job at forecasting if they had used all the data available to them in the right way. My research with Larry Ball of Johns Hopkins University has found that forecasters do not use information about monetary policy in the best way possible.⁸ Our research suggests that when inflation is rising, leading the Federal Reserve to tighten monetary policy, forecasters underestimate the degree to which inflation

continues to rise even after the Fed has taken action. Forecasters thus seem to assume that tight monetary policy will have a more immediate impact on inflation than is actually the case.

In our research, we examine the correlation between the inflation forecast error (that is, the

⁸Detailed results can be found in our 1995 working paper. Frederick Joutz, as well as John Schroeter and Scott Smith, also found that forecasters don't use information about monetary policy efficiently.

FIGURE 5
Actual and Expected Inflation
 Michigan Survey 1969Q1 to 1994Q4



relationship, which can be seen in a plot of the data (Figure 6). In this figure, we've shown the inflation forecast error from the Survey of Professional Forecasters plotted against the change in the federal funds rate. You can see that there is a positive relationship between the two—when monetary policy is tightening, actual inflation tends to be higher than expected inflation. And when monetary policy is easing, actual inflation tends to be less than expected inflation.

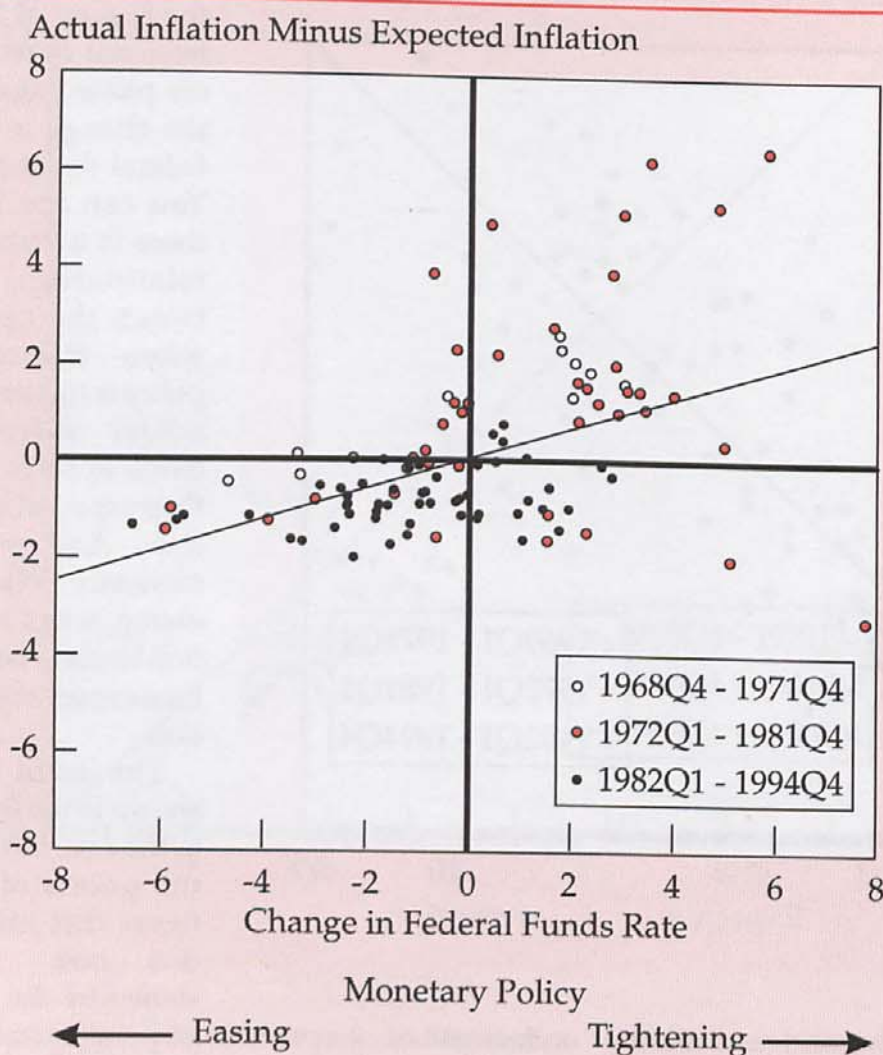
The solid line shown in the figure is the line through the points of the figure that fits the data best. As shown by the line,

actual inflation rate over the next year minus the expected inflation rate) and the change in the federal funds rate (our measure of monetary policy) over the past year. If the forecasters are efficient in using information about monetary policy, there should be no relationship between the forecast error and the annual change in the federal funds rate; otherwise the forecasters should have used the relationship between the forecast error and the change in the federal funds rate to produce an improved forecast. But our formal statistical tests show a positive rela-

an increase of one percentage point in the federal funds rate over the past year is associated with an increase in the forecast error of 0.32 percentage point, on average.

Further investigation of this result shows that the forecasters' errors lie in the timing of the response of inflation to monetary policy, not in the magnitude. That is, the forecasters are right about the size of the effect that tighter monetary policy has in reducing inflation, but their forecasts suggest that inflation will respond to monetary policy quickly. In fact, it

FIGURE 6
**Inflation Forecast Errors and
 Monetary Policy**
 Survey of Professional Forecasters 1968Q4 to 1994Q4



ing this procedure over the last six years of the period we study would have lowered forecast errors roughly 20 percent.⁹ For example, after the federal funds rate declined 2.4 percentage points in 1992, the forecasters predicted inflation in the GDP deflator of 2.87 percent, but a better forecast could have been made by predicting inflation of $2.87 - (2.4 \times .32)$, or 2.10 percent. Actual inflation for the GDP deflator turned out to be 2.13 percent, so the modified forecast would have been much better.

This relationship between inflation forecast errors and past changes in monetary policy also appears when we use the Livingston Survey or

takes longer for monetary policy to work than the forecasters think.

An improved inflation forecast can be devised by using the information from Figure 6. To get a new inflation forecast, take the average survey forecast for inflation (in the GDP deflator) over the coming year and add to it an amount equal to 0.32 times the change in the federal funds rate over the past year. Follow-

the University of Michigan Survey of Consum-

⁹Technically, the root mean squared forecast error is 17 percent lower, while the mean absolute error is 24 percent lower. The root mean squared forecast error is found by taking the square of the forecast error at each date, calculating the average of these squared values, and taking the square root. The mean absolute error is found by taking the average of the absolute values of the forecast errors.

ers as the basis for expected inflation. This suggests that forecasters could use information about monetary policy to make better forecasts. In particular, forecasters would need to make sure that their inflation forecasts reflected the proper timing of changes in inflation caused by recent movements in monetary policy.

EXPLAINING FORECAST INEFFICIENCY

Why do inflation forecasts suffer from inefficiency? Don't forecasters have the incentive to provide optimal forecasts? If so, how can forecast errors be persistently related to monetary policy measures? You might think that if forecasters continually made mistakes in their inflation forecasts, they would realize they were doing so and would correct those errors. So the real question is: why don't forecasters make adjustments so that they produce not only better forecasts but also ones that are efficient with respect to monetary policy? There are a number of possible explanations for why forecast errors may persist, but no convincing explanations for why the forecasts are inefficient in the first place.

One possible explanation for the failure of forecasters to improve their forecasts is simply that forecasters don't do their jobs well. That is, they must not have enough incentive to form completely rational expectations of inflation, perhaps because their inflation forecasts aren't that important to them. It's possible that, except for the few forecasters whose forecasts of inflation are used by traders to buy and sell bonds and thus have a lot of money riding on them, the forecasters in the survey may not care about inflation very much. If their forecasts are wrong, it doesn't hurt them.

Another possible explanation for why forecast errors may persist is that the macroeconomy is very complicated, and no one has a complete understanding of how it works. The Phillips curve (which relates inflation to the unemployment rate) was thought to be a great model of inflation until the 1970s, when it failed

miserably. Nobody knew ahead of time that the oil-price shocks in the 1970s would raise inflation so much. And the most popular theoretical models of the economy today seem far too abstract to use in forecasting. As a result, it isn't surprising that forecasting inflation is difficult.

Related to our lack of understanding of exactly how the economy works is the fact that it takes time for economists to learn about changes in the economy. They don't see trends emerging right away; it takes time for the data to come in and for economists to realize that the relationship between economic variables has changed. For example, in the late 1980s, the Federal Reserve developed a model of inflation called P^* (pronounced P-star), which related the money supply (measured by M2) to the price level for the GNP deflator. But the changes in the demand for money that occurred in the early 1990s altered the relationship between M2 and inflation. As a result, the model no longer provided good forecasts. For example, it predicted a large reduction in inflation in the 1993-95 period, but inflation didn't decline nearly as much as predicted.

Another possible explanation for the inefficiency of inflation forecasts concerns the credibility of monetary policy. In the early 1980s, people had doubts about how serious the Federal Reserve was about fighting inflation. They thought the Fed might allow inflation to drift upward, rather than keeping inflation at 4 percent or less. That may be why forecasters persistently overpredicted inflation in the mid-1980s. So, clearly some degree of inefficiency in forecasting inflation may be due to uncertainties about monetary policy.

Credibility may also have played a role in the early 1990s. Again, forecasters kept predicting a rise in CPI inflation from about 3 percent to about 3.5 percent. The overprediction was small, but it persisted for several years. This persistence may have resulted from a combination of doubts about the Fed's commitment to low inflation and the lack of a good macro-

economic model of inflation, since monetary aggregates (M1, M2, M3) seemed to have lost their predictive power.

While these explanations may help us understand why forecasters have difficulty in forecasting inflation and perhaps also why they don't adjust their forecasts to better use the information about monetary policy, they don't tell us why the forecast errors are systematically related to monetary policy in the first place.

CONCLUSION

Surveys of inflation forecasts have had a bad reputation. Based on statistical tests in the early 1980s, economists had doubts about how accurate the forecasts were. But that was largely the effect of the oil-price shocks in the 1970s. If we look at the data today, the forecasts look much better. Nonetheless, there appears to be some inefficiency in the forecasts with respect to their relationship to monetary policy.

REFERENCES

- Ball, Laurence, and Dean Croushore. "Expectations and the Effects of Monetary Policy," Federal Reserve Bank of Philadelphia Working Paper No. 95-22, October 1995.
- Bryan, Michael F., and William T. Gavin. "Models of Inflation Expectations Formation: A Comparison of Household and Economist Forecasts," *Journal of Money, Credit, and Banking* 18 (November 1986), pp. 539-43.
- Carlson, John A. "A Study of Price Forecasts," *Annals of Economic and Social Measurement* 6 (Winter 1977), pp. 27-56.
- Croushore, Dean. "Introducing: The Survey of Professional Forecasters," Federal Reserve Bank of Philadelphia *Business Review* (November/December 1993), pp. 3-15.
- Fama, Eugene F., and Michael R. Gibbons. "A Comparison of Inflation Forecasts," *Journal of Monetary Economics* 13 (May 1984), pp. 327-48.
- Figlewski, Stephen, and Paul Wachtel. "The Formation of Inflationary Expectations," *Review of Economics and Statistics* 63 (February 1981), pp. 1-10.
- Gramlich, Edward M. "Models of Inflation Expectations Formation," *Journal of Money, Credit, and Banking* 15 (May 1983), pp. 155-73.
- Joutz, Frederick L. "Informational Efficiency Tests of Quarterly Macroeconometric GNP Forecasts from 1976 to 1985," *Managerial and Decision Economics* 9 (1988), pp. 311-30.
- Maddala, G.S. "Survey Data on Expectations: What Have We Learnt?" in Marc Nerlove, ed., *Issues in Contemporary Economics*, vol. II. Aspects of Macroeconomics and Econometrics. New York: New York University Press, 1991.
- Noble, Nicholas R., and T. Windsor Fields. "Testing the Rationality of Inflation Expectations Derived from Survey Data: A Structure-Based Approach," *Southern Economic Journal* 49 (October 1982), pp. 361-73.
- Schroeter, John R., and Scott L. Smith. "A Reexamination of the Rationality of the Livingston Price Expectations," *Journal of Money, Credit and Banking* 18 (May 1986), pp. 239-46.
- Taylor, Herb. "The Livingston Surveys: A History of Hopes and Fears," Federal Reserve Bank of Philadelphia *Business Review* (January/February 1992), pp. 15-27.