How Monetary Policy in 1985 Affects the Outlook

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The U.S. economy should grow strongly in 1986, but slower growth and higher inflation will occur in 1987, according to an econometric forecasting model developed at the Federal Reserve Bank of Minneapolis.[1] The model projects that economic growth, the inflation-adjusted gross national product (real GNP), will accelerate in the next couple of quarters. In 1987, however, real GNP growth is projected to decline to near its historical average of 3.5 percent. Over the 1986–87 forecast period, the model predicts inflation to rise gradually but steadily from its current level of around 3 percent to nearly 6 percent in 1987.

This current forecast differs from the model's above-average growth, low inflation forecast published in last fall's *Quarterly Review* (see Litterman 1984a). In this paper we explore some of the reasons behind these differences and find that they can be attributed to two sources: (1) revisions to the historical data used to generate the forecasts and (2) new economic information in 1985, particularly changes in financial variables (interest rates, the money supply, the value of the dollar, and stock prices). We then focus on the new information in 1985 and attempt to use it to gauge the impact of recent monetary policy actions on future real growth and inflation. Our results support the view that an unexpectedly expansionary monetary policy in 1985 may have raised both the short-term prospects for real growth and the long-term prospects for inflation.

The Current Forecast for 1986–87

The model's current forecast for 1986–87 was generated using data available on December 13, 1985. The forecasts for three economic indicators of primary interest—real GNP growth, the unemployment rate, and inflation—are presented in Charts 1–3. Each chart shows a mean forecast surrounded by a range of uncertainty within which the actual outcome can be expected to fall 70 percent of the time. We emphasize this range (depicted by the shaded *confidence bands*) because it illustrates the large degree of uncertainty inherent in economic forecasting. Since any economic forecasting model will regularly be off the mark, it is important to be able to quantify how wide of the mark, on average, a forecast is likely to be. The point forecasts and levels for the three indicators, along with their postwar average values, are reported in Table 1. (To compare the model's forecast with those of other economists, see the box.)

Strong Real Growth

The current forecast includes very strong real growth in early 1986 followed by slower growth in 1987. A closer look at the components of real GNP, also shown in Table 1, indicates where the growth is projected to occur. We can see that growth in 1986 is expected to be broadly

[1]The forecast presented in this article is generated by a Bayesian vector autoregression (BVAR) model developed by research economists at the Minneapolis Fed. This statistical model projects a group of economic variables on the basis of their past behavior. Since 1982, the model has been used within the Bank for forecasting and policy analysis. A description of the model and a summary of the economic outlook as of November 1984 were published in the fall 1984 *Federal Reserve Bank of Minneapolis Quarterly Review* (see Litterman 1984a). For a general introduction to the methodology used to create this type of model, see Todd 1984.

Charts 1–3

The Model's Forecast for U.S. Growth, Unemployment, and Inflation

1984–3rd Quarter 1985, Actual; 4th Quarter 1985–1987, Forecast With 70 Percent Confidence Bands*

Chart 1 Growth (Real GNP)
(Quarterly Percentage Change at Annual Rate)

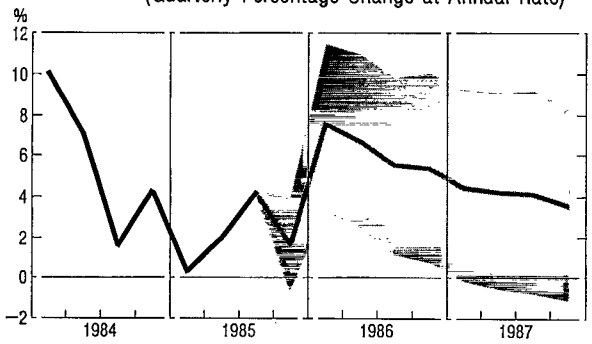


Chart 2 Unemployment Rate
(As Percentage of Civilian Labor Force)

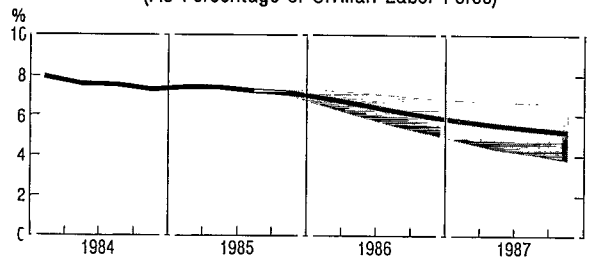
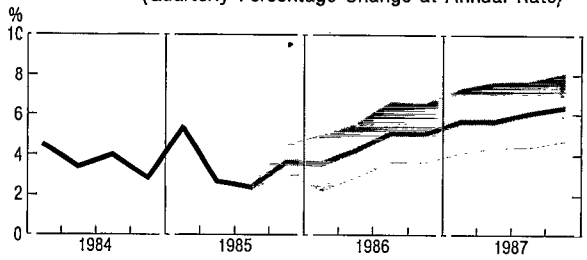


Chart 3 Inflation (GNP Deflator)
(Quarterly Percentage Change at Annual Rate)



*Most likely forecast surrounded by a range within which the variable is likely to fall 70 percent of the time, based on 1,000 simulations.

Sources of basic data: U.S. Departments of Commerce and Labor

based, with especially strong growth in consumer spending for durable goods, business fixed investment, and residential investment; about-average growth in consumer spending for nondurable goods and services; and below-average growth in government purchases. Inventory investment (the change in business inventories) is expected to contribute a small amount to growth over 1986, while net exports are basically expected to remain flat.

This component analysis of projected growth suggests one area where the model's forecast may be too strong. Table 1 clearly shows that the biggest boost to real growth is projected to occur in the business fixed investment component; however, this projection is much stronger than recent surveys of investment plans. (See, for example, McGraw-Hill Economics 1985 and BNA 1985.) Although such surveys are biased downward, on average, and are often far from accurate, they do contain information which the model does not factor into its forecast. A projection of forecast errors on such survey data suggests that if the survey results were added to the model, they would reduce the growth forecast for investment by a few points. This adjustment would reduce real GNP growth by perhaps 1 percentage point to roughly 4.6 percent in 1986.

The component analysis of real GNP for 1987 reveals that real growth is projected to slow due to weak consumer spending and investment. Residential investment, in particular, is projected to fall significantly. Overall, real growth would be even worse in 1987 except that a lessening trade deficit is projected to contribute to growth.

The forecast for 1987 also includes the possibility of recession (defined here as two consecutive quarters of negative real GNP growth). Simulations run on the model indicate that the probability of a recession is only 3 percent in 1986, but the probability jumps to 18 percent in 1987. And while the odds are about 1-in-2 of observing just one quarter of negative GNP growth in 1986, the odds jump to 3-in-4 that there will be at least one negative quarter in 1987.

Consistent with the forecast of strong real growth in 1986, the model projects the unemployment rate to decline rapidly, reaching 6 percent by the end of 1986. Unemployment is then expected to decline slowly in 1987, reaching 5.5 percent by the end of the year.

Rising Inflation

Perhaps the most disturbing aspect of the model's forecast is its projection of a steady increase in inflation throughout the 1986–87 forecast period. Inflation, measured by growth in the GNP price deflator, is expected to be 4.3

Table 1

The Model's Point Forecasts for 1986–87 With U.S. Postwar Averages

Indicator	Growth Rates (% Change 4th Qtr. Over 4th Qtr.) 1986	1987	U.S. Average Since WWII	4th Quarter Levels (Billions of 1972 $) 1986	1987
Real Gross National Product (GNP)	5.6%	3.6%	3.5%	$1,792.6	$1,857.6
Consumer Spending	4.5	2.4	3.5	1,163.8	1,192.3
Durable Goods	9.7	0.8	6.4	205.4	207.1
Nondurable Goods & Services	3.5	2.8	3.3	958.3	985.2
Investment	13.0	5.1	8.5	321.6	337.9
Business Fixed	10.1	7.6	4.7	240.4	258.5
Residential	8.2	−4.9	5.2	69.5	66.1
Change in Business Inventories	—	—		11.8	13.2
Net Exports	—	—		−28.7	−17.3
Government Purchases	1.9	2.6	4.3	335.9	344.7
Civilian Unemployment Rate	—	—	5.6*	6.0**	5.5**
Inflation (GNP Deflator)	4.3	5.7	4.1	243.8 †	257.7 †

*The postwar average for the civilian unemployment rate is a level.
**The civilian unemployment rate is a percentage of the labor force.
† Inflation is an index (1972=100).
Sources of basic data: U.S. Departments of Commerce and Labor

percent in 1986 and 5.7 percent in 1987.

Along with the deflator, all price variables in the model are expected to start rising more rapidly, especially in 1987. For example, the prices of raw industrial commodities, which fell by 16.8 percent from June 1984 to October 1985, are projected to rise by 23 percent in 1986. Energy prices, which have remained essentially flat for over four years, are projected to grow by 4.2 percent in 1986.[2] The model projects the consumer price index to rise from its current rate of about 4 percent to 6 percent by the end of 1987, whereas it has the producer price index rising only 2 percent in 1986 and 3.8 percent in 1987. In addition, all three measures of wages used in the model—the average hourly earnings in manufacturing, the employment cost index, and the compensation of employees per unit of output—are projected to grow at rates about 1 percent higher than those projected for the deflator.

Comparing the Current Forecast With Last Year's

In analyzing the current forecast, we start by comparing the current outlook for 1986–87 with last year's outlook for these years (see Table 2, columns 1, 2, and 4).[3] The current forecast for 1986 includes stronger real growth as well as higher inflation than was forecasted a year ago. In addition, the unemployment rate is projected to be much lower than was anticipated last year. The current real

[2]The model's current energy price projection for 1986 does not yet take into account OPEC's recent decision to allow oil prices to be set by market conditions. Experts expect this decision to result in lower oil prices. Information about this decision will eventually enter the model through the index of spot market prices for raw industrial materials, lower energy prices, and perhaps through movements in interest rates and other financial variables.

[3]Last year's forecast for 1986 and 1987 is taken from the model forecast generated on November 21, 1984, which formed the basis of the national outlook article in the fall 1984 *Quarterly Review* (see Litterman 1984a). The model's forecast for 1987, included here, was not actually published in that article.

How the Model's Forecast Compares With Others

It may be of some interest to compare the model's current forecast for 1986–87 with forecasts other economists have made for these years. To find out what other economists have predicted, we consulted *Blue Chip Economic Indicators* (Blue Chip 1985a, 1985b), a monthly newsletter that publishes a consensus forecast averaging the forecasts of approximately 50 business economists. To compare the two forecasts, our model's forecast was converted from fourth-quarter-over-fourth-quarter rates to year-over-year rates. The year-over-year rates for both forecasts are shown in the accompanying table.

As the table indicates, our model's current forecast for 1986 calls for much stronger growth than does the Blue Chip consensus, which expects below-average growth in 1986. In fact, if the model's forecast had been included on the Blue Chip list, it would have ranked as the fourth most optimistic growth forecast for 1986. Our model's unemployment forecast for 1986 is much lower than the consensus rate. However, the model basically agrees with the consensus forecast for inflation in 1986.

For 1987, our model agrees with the consensus projection that real growth will slow slightly. But the model continues to be more optimistic about unemployment in 1987, projecting a slow decline over the year to 5.7 percent; in contrast, the consensus shows no change from its unemployment prediction for 1986. The model's inflation forecast for 1987 is higher than what the consensus predicts.

Comparing Our Model's Forecast
With the Blue Chip Consensus Forecast

	Growth Rates* (% Change Year-Over-Year)	
Indicator	Our Model	Consensus
1986		
Growth (Real GNP)	4.7%	3.1%
Civilian Unemployment Rate	6.4 †	7.1 †
Inflation (GNP Deflator)	3.6	3.6
1987		
Growth (Real GNP)	4.3%	2.7%
Civilian Unemployment Rate	5.7 †	7.1 †
Inflation (GNP Deflator)	5.3	4.6

* For purposes of comparison, our model's forecasts have been converted from 4th quarter-over-4th-quarter to year-over-year percentage changes.

† The civilian unemployment rate is a percentage of the labor force and an annual average.

Sources: BVAR model forecast of December 13, 1985; Blue Chip 1985b (for 1986 forecast) and 1985a (for 1987 forecast)

growth forecast for 1987 is now lower than anticipated last year, while the inflation forecast is now much higher. The unemployment rate in 1987 is again much lower than projected last year.[4]

What factors are responsible for the differences between the two forecasts—for the strength of the model's current forecast for 1986 and for its projection of slower growth and higher inflation for 1987? We answer this question by treating last year's forecast as a starting point and then attributing the differences between it and the current forecast to two main sources: (1) revisions made to the historical data and (2) new economic information in 1985. Once we have separated out these two sources of differences between the forecasts, we focus on the second source and ask whether or not monetary policy actions have led to significant changes in the outlook for 1986–87.

Revisions to Historical Data

When last year's forecast was generated on November 21, 1984, the model used a set of historical data (dated from January 1948 to October 1984) which has since been revised.[5] Because these revisions were incorporated into the historical data set used to generate the current forecast, we need to determine how much they account for differences between last year's forecast and the current one. To do this we generate last year's forecast using the revised historical data and then compare that

[4]The fact that last year's forecast differs from the current one does not necessarily imply that last year's forecast was bad. In fact, last year's forecast performance proved quite accurate in some respects. See the Appendix for a closer evaluation of the model's performance in 1985.

[5]The revised historical data are those available as of December 13, 1985. They do not include the major revisions to the national income and product accounts released by the Commerce Department on December 20, 1985.

forecast with last year's original forecast (see Table 2, columns 2, 3, and 5). Column 5 shows that changes in the forecast due to revisions in the historical data, although noticeable, are not large relative to the total changes shown in column 4.

New Information in 1985

Having accounted for the first source of differences between the two forecasts, we can now focus on the second—the effects of new information in 1985 on last year's forecast. These effects are shown in Table 2, where we compare the current forecast (column 1) with the 1984 forecast that uses the revised historical data (column 3). The differences between these two forecasts (column 6) indicate the part of the change in the outlook that can be attributed to new information in 1985. We see that this new information has actually had a significant impact on real GNP growth and inflation, and that the impact on inflation has been larger than was apparent from the original forecast differences shown in column 4.

Causes for Differences: The Role of Monetary Policy

Having found that new information in 1985 contributed significantly to the change in the 1986–87 outlook since last year's forecast, we can now focus on this new information and attempt to pinpoint what caused the differences between the two forecasts. To find the source of these differences, we must first look for areas where the model was surprised by the new information in 1985—that is, areas where last year's forecast for 1985 was in error. This approach to analyzing the differences between the forecasts in terms of recent surprises in the data is based on the following intuition: If every economic variable had behaved in 1985 in the way it was projected to behave in last year's forecast, then today we would have no new reason to revise the current outlook; that is, the current forecast should basically coincide with last year's. Thus, the difference between the current forecast and last year's forecast for 1986–87 can be attributed to the surprises observed in the new data during 1985.

The model can identify surprises in the data that we observed in 1985 and can project what the implications of these surprises are for the future of the economy. The model can tell us, for example, that the stock market increased more than was expected in 1985 and that as a result, real growth is likely to be higher in the near future than it would have been otherwise.

The model alone, however, cannot interpret these surprises in terms of economically meaningful events. It cannot tell us, for example, what new information caused

Table 2

Accounting for Differences Between the Current Forecast and Last Year's Forecast for 1986–87*

	Forecasts			Differences		
	(1)	(2)	(3)	(4)	(5)	(6)
Indicator	Current (Dec. 13, 1985)	Last Year's (Nov. 21, 1984)	Last Year's With Revised Historical Data**	Between Current and Last Year's (1)−(2)	Due to Revised Historical Data** (3)−(2)	Due to New Information in 1985 (1)−(3)
1986						
Growth (Real GNP)	5.6%	3.9%	4.1%	1.7%	0.2%	1.5%
Civilian Unemployment Rate	6.0	7.2	6.9	−1.2	−0.3	−0.9
Inflation (GNP Deflator)	4.3	3.2	2.7	1.1	−0.5	1.6
1987						
Growth (Real GNP)	3.6%	3.8%	3.9%	−0.2%	0.1%	−0.3%
Civilian Unemployment Rate	5.5	7.1	6.8	−1.6	−0.3	−1.3
Inflation (GNP Deflator)	5.7	3.3	2.9	2.4	−0.4	2.8

*Growth rates are measured 4th quarter over 4th quarter; the unemployment rate is the 4th quarter level.

**Minor revisions made to the historical data set (January 1948–October 1984) by the U.S. Department of Commerce as of December 13, 1985.

the stock market to increase. To interpret the new information in 1985 in terms of cause and effect, we have to make some assumptions about the structure of the economy beyond the purely statistical correlations captured in the model.

We now attempt to make such an interpretation. In particular, we attempt to answer the question: What role did unexpected changes in monetary policy play in changing the outlook for 1986 and 1987?[6] To answer this question, we separate the surprises in the 1985 data into two sources: monetary policy surprises and other economic surprises (or *shocks*). This separation allows us to measure the extent to which monetary policy surprises are responsible for the changes in the outlook for real growth and inflation since last year's forecast.

Defining Monetary Policy for the Model

If we could observe monetary policy actions directly, we could simply add them to the model to measure their effect on the economy. However, because we don't observe policy actions directly but do observe their effects, we must make some assumptions that define what we mean by *policy* in the context of the model's variables. In order to identify surprise policy actions, we specify a set of impacts that we expect to see when an unexpected monetary policy action occurs. To identify the impact of a monetary policy action, we ask, What happens when the Fed injects more reserves into the banking system than were expected? We predict that within the same month of the policy action, there would be a lowering of interest rates, an increase in the monetary aggregates, a fall in the value of the dollar, and a rise in stock prices. We call this set of impacts a *monetary policy vector,* denoted by *M,* and display our assumptions about the appropriate relative weights for each vector component in Table 3. (The relative weights are based on the type of analysis described in Litterman 1984b.)

Projecting the Economy's Response

Given this definition of policy as a set of impacts, the model projects how the economy will respond over time to such a policy action. According to the model, in response to a monetary policy action that immediately lowers the federal funds rate by 1 percentage point (or 100 basis points)—and that affects the remaining components as indicated in Table 3—both money growth and real growth are raised for the next two years, with the bigger impact in the first year following the action. (Money growth increases by 1.3 percentage points in the first year and 0.7 of a point in the second. Real growth increases by 0.7 of a percentage point in the first year and 0.5 of a point in the second.) Following the more accommodative monetary policy, inflation also increases and continues to increase over time. (In the first year, inflation is increased by only 0.1 of a percentage point, while in the second it is increased by 0.4 of a point.) Unemployment also responds more strongly in the second year (being lowered by 0.1 of a percentage point in the first year and 0.2 of a point in the second). The Treasury-bill rate stays lower after the first year but then rises slightly above its originally forecasted value in the second. (The T-bill rate remains 0.6 of a percentage point lower after one year but rises to 0.1 of a percentage point above its forecasted value in the second.)

Table 3
The Monetary Policy Vector*

Variable	Weight of Vector Component
Interest Rates	
Federal Funds Rate	−1.00%
T-Bill Rate	−0.90
Bond Yields	−0.50
Monetary Aggregates	
Monetary Base	0.05
M1	0.10
M2	0.05
Value of the Dollar	−3.00
Stock Prices (S&P 500)	2.50
Other Variables	0.00

*Percentage change in the components of monetary policy vector *M* during the month in which an unexpected monetary policy action occurs.

Assumptions Identifying Monetary Policy in 1985

In each monthly time period t, we assume the economy is subject to a vector of economic shocks E_t and an unexpected monetary policy action. The scalar m_t gives the magnitude and sign (positive or negative) of the policy action at time t. The impacts on the economy in time t are

[6] *Unexpected* changes in policy are emphasized because the component of policy actions that is expected does not change the outlook from last year's.

Table 4

Projecting Monetary Policy Actions and Innovations in 1985
(Standard Errors)

		Interest Rates			Monetary Aggregates				
Date	Unexpected Policy Action m_t	Federal Funds Rate	T-Bill Rate	Bond Yields	Monetary Base	M1	M2	Value $	Stock Prices (S&P 500)
Nov. 84	0.7	−0.4	−0.2	−0.5	0.3	2.2	2.0	0.8	−0.2
Dec. 84	−0.3	−1.9	−1.0	−1.0	−1.1	0.1	−0.3	2.7	−0.3
Jan. 85	−0.7	0.7	−0.4	−0.3	−1.2	0.3	0.7	0.9	1.2
Feb. 85	−1.3	−0.1	1.0	1.0	−1.2	0.7	−1.1	2.1	1.1
Mar. 85	−0.4	−0.4	0.1	1.2	0.6	−0.5	−2.2	−0.8	−0.6
Apr. 85	2.8	−0.8	−1.1	−2.2	0.0	−0.0	−2.8	−3.7	0.2
May 85	0.9	−0.4	−0.7	−1.3	0.2	0.9	1.5	1.1	0.5
June 85	3.3	−0.7	−0.9	−1.8	2.5	2.2	1.4	−1.4	0.3
July 85	−0.7	1.1	0.3	1.7	−1.8	−0.7	−1.7	−2.9	0.3
Aug. 85	1.0	−0.3	−0.1	−0.2	−0.1	1.6	0.4	−0.9	−0.8
Sept. 85	−1.3	−0.3	−0.3	0.5	−1.1	−0.2	−1.2	1.0	−0.5
Oct. 85	2.7	−0.2	−0.2	−0.9	−1.8	−2.4	−1.9	−4.5	0.4

given by $m_t M$. The unexpected movements (or *innovations*) observed in the data U_t are the sum of these components; that is,

$$E_t + m_t M = U_t = Y_t - {}_{t-1}\hat{Y}_t$$

where ${}_{t-1}\hat{Y}_t$ is the forecast made in the previous month, time $t-1$, of the vector of economic variables Y_t.

Because we do not separately observe E_t and m_t, we use observations on U_t, along with our assumptions about the impacts of monetary policy embedded in M, to estimate m_t. In order to generate these estimates, however, we also have to make two more assumptions. The first concerns whether or not the policy actions are correlated with the economic shocks. The second concerns how much of the variation in the data, on average, is due to unexpected policy actions.

The first assumption is that monetary policy actions are uncorrelated with economic shocks. The lack of an immediate correlation between surprise policy actions and most economic shocks can be justified in monthly data by the lags associated with measuring economic variables. For example, an economic shock in December would not appear in the data until January, and a policy action reacting to the shock would probably not occur until January or later.

The second assumption, which concerns the average size of the policy actions, has an upper limit placed on it by the covariance matrix of the surprise observations in the data. For example, we cannot assume that unexpected policy actions contribute more variance to interest rates than is actually observed in the data.[7] This limitation leads to a choice of 0.07 for the variance of m. This value implies that policy actions cause unexpected movements in the federal funds rate of about 26 basis

[7]More generally, given the assumption that there is no correlation between E_t and m_t, the variance of m, denoted σ_m^2, must be such that

$$\Sigma_E = \Sigma_U - \sigma_m^2 MM'$$

(where Σ_E is the variance of E_t and Σ_U is the variance of U_t) is nonnegative definite. We have chosen to assume that the variance of m is close to but below the level where this condition becomes binding.

Table 5

Effects of Unexpected Monetary Policy Actions in 1985 on the Outlook for 1986–87*

Indicator	New Information in 1985 (U_t)	=	Other Economic Shocks in 1985 (E_t)	+	Unexpected Monetary Policy Actions in 1985 ($m_t M$)
	Differences Between Current and Last Year's Forecasts Due To				
1986					
Growth (Real GNP)	1.5%		0.3%		1.2%
Civilian Unemployment Rate	−0.9		−0.2		−0.7
Inflation (GNP Deflator)	1.6		0.8		0.8
1987					
Growth (Real GNP)	−0.3%		−1.0%		0.7%
Civilian Unemployment Rate	−1.3		−0.5		−0.8
Inflation (GNP Deflator)	2.8		1.6		1.2

points per month, on average, which composes about one-fourth of the total variation of interest rates. Policy-induced variation is less in the other variables (monetary aggregates, value of the dollar, stock prices).

Given these two assumptions, we can easily form the linear-least-squares projection of m_t on the observed innovations U_t. This projection gives us the most likely value for the policy action, based on our observation of the new data. We do this for each month, from November 1984 through October 1985.[8] In Table 4 we display our projections of monetary policy actions together with the components of U_t for some of the important policy indicators. We see that the monetary policy actions closely follow the unexpected movements in interest rates (that is, when m_t is positive, interest rates are negative—and vice versa). We see, for instance, that in each of the six months where the policy action m_t exceeded 1 standard error, the innovation in bond yields moved in the opposite direction, as expected. The possible exception is December 1984. (In that month, interest rates declined sharply, but the other indicators—the monetary aggregates, the value of the dollar, and stock prices—all moved in the opposite direction than what we associate with monetary ease. So our estimate of the policy action is essentially zero for that month.) For the most part, though, the model estimates that monetary policy in 1985 was more accommodative than expected. The mean of the total policy actions was a positive 0.56 standard error; this means that, on average, monetary policy actions lowered the federal funds rate by 15 basis points each month. Especially in April, June, and October 1985, monetary policy was surprisingly stimulative. The June policy action alone is estimated to have lowered the fed funds rate by 86 basis points.

[8]One unfortunate complication is that when we generated the forecast of November 21, 1984, we had more up-to-date information about some variables than others. In order to maintain that forecast as a baseline, we define the innovations for November 1984 to be the surprises relative to information we had available at the time of the forecast. Defined this way, the interest rate surprise, for example, is much smaller than it would have been if defined in the standard way relative to information available as of October 1984. Thus, even though unexpected monetary policy actions had already lowered interest rates as of November 21, 1984, we do not include those actions as surprises in 1985.

Measuring the Effect on the Outlook

We now return to our original question: How much of an effect did these unexpected monetary policy actions have in changing the 1986–87 outlook since last year? We generate an answer by running simulations on the model while applying the estimated monetary policy actions in 1985. In measuring the effect of these policy actions, we take into account both their direct impact as additive disturbances and their impact on the estimated coefficients of the model. We start by forecasting values for November 1984, just as we did to make last year's forecast. Then we add the impact of the monetary policy action estimated for November 1984 to our forecasted values. Next we treat these new values as if they were actual data, update the model's coefficient estimates, and generate a forecast for December 1984. We then add the impact of our estimated monetary policy action in December 1984 to the forecast and proceed as before. We continue this process through the final policy action in October 1985. After that, we extend the forecast unconditionally through 1986 and 1987.

The Results

Before presenting the results of the simulations, we must emphasize the need for caution in interpreting the results of this exercise. Any econometric forecast is subject to large uncertainty due to the estimation of coefficients, possible changes in the structure of the economy, and other considerations. When we go beyond a forecasting exercise and try to make statements about the effects of policy, we have to make further assumptions, such as those about the form of M and the size of the variance of m. These assumptions only increase the uncertainty of the results.

With this cautionary note, we now present the results of the exercise (see Table 5). We find that the unexpectedly stimulative monetary policy in 1985 raises the outlook for real growth by 1.2 percentage points in 1986 and by 0.7 of a point in 1987. At the same time, the stimulative monetary policy is projected to have increased the inflation outlook for both years—most dramatically in 1987. The inflation forecast for 1986 is up by 1.6 percentage points from a year ago, and half of that increase can be attributed to the stimulative monetary policy. For 1987 about 40 percent of the 2.8 percentage point increase in the inflation forecast (from last year's forecast of 2.9 percent to the current one of 5.7 percent) can be attributed to monetary policy actions in 1985. Thus, we can conclude that the stimulative monetary policy actions had a significant impact on the change in the 1986–87 outlook since last year's forecast.

Summary

The model projects a year of strong real growth in 1986 and a slight slowing in 1987. At the same time, inflation is projected to start rising steadily over 1986–87. We have used the model, together with assumptions about the effect of monetary policy actions, to estimate the impact that unexpected monetary policy actions in 1985 have had on the outlook. The results support the view that much of the stronger growth projected for 1986 and higher inflation projected for 1987 is due to stimulative monetary policy actions taken in 1985.

Appendix
Was Our Model On Target in 1985?

Last fall's issue of the *Quarterly Review* published a forecast based on our model in an article titled "Above-Average National Growth in 1985 and 1986" (Litterman 1984a). Now, with the year almost over, it appears rather unlikely that above-average growth will occur in 1985. Where did the model go wrong? How did it perform compared with other forecasts made at the time? And how far off target was it?

Upon closer analysis, it turns out that the model's forecast in last year's *Quarterly Review* was actually more accurate than the article's title. The forecasted level for real GNP in the third quarter of 1985 (1985:3), when compared with the most recent actual observation, was just about right. The problem with the forecast of above-average growth mentioned in the article's title was that it was based on a measure of growth from the fourth quarter of one year to the fourth quarter of the next. Since the actual level in 1984:4 turned out to be much higher than was expected in 1984:3, the actual year-over-year measure of growth was much lower than projected, even though the end result was about the same.

Two Performance Measures

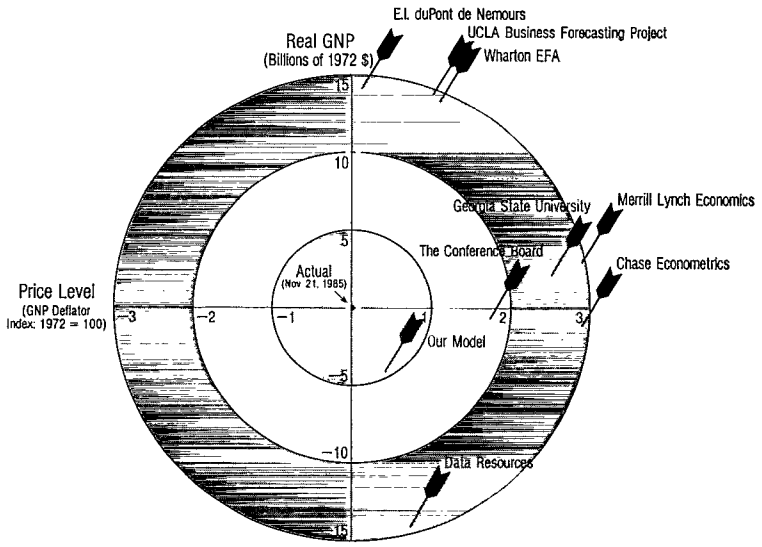
In evaluating the model's overall performance, we examine the size of its error in forecasting one year ahead because data on quarterly growth rates are very unreliable. On this basis, the model performed quite well in 1985—first, when compared with other forecasts and, second, when related to its own internal probability structure.

When compared with other forecasts made at the same time, our model performed quite respectably. The accompanying chart compares the model's November 1984 forecast of real GNP and the price level (measured by the GNP deflator) for 1985:3 with November 1984 forecasts made by other major forecasters. Although other forecasts came closer to predicting one of the two indicators, our model's came closest to predicting both.

When related to its internal probability structure, the model also did well. This relationship can be measured by counting the number of times actual values fell within the 70 percent confidence bands generated by the model. For the November

November 1984 Forecasts for Real GNP and the Price Level in the Third Quarter of 1985

(Difference Between Forecasted and Actual Levels)



Sources of basic data: BVAR model forecast of November 21, 1984; The Conference Board 1984; U.S. Department of Commerce

1984 forecast for 1985:3, the number was 30 out of 42 (or roughly 70 percent)—exactly the number that should have fallen within the bands.

The results of these two measures of forecast performance are commendable and suggest that the November 1984 forecast was successful in at least these respects. But these performance measures should not be taken too seriously. The model itself suggests that the accuracy of the forecasts of real GNP and the price level was largely due to luck. Both forecasts were much closer to the actual values than will be true on average. Moreover, the deviations of different components of GNP were actually relatively large and just happened to offset one another.

With respect to the 70 percent confidence bands, the nice result should also be recognized as only a modicum of evidence. It is, after all, only one possible test of the model, and it amounts to looking only at a few of the possible ways in which actual outcomes were consistent with the model's forecast.

More-Stringent Tests

If we were to apply a more stringent test of the model's performance by focussing on the interrelationships between the model's variables in the one-year-ahead forecast, rather than focussing on each variable separately, then we would soundly reject the model's probability structure. This more comprehensive approach uses more information and looks much more carefully at the outcome than do the 70 percent bands. It takes the assumptions about the model more seriously, looking, in effect, at all the different confidence bands for different probabilities and also checking the covariations of the different variables. This approach finds inconsistencies that the less rigorous test misses—for example, the fact that the monetary base fell below its 70 percent band while the money supply (M1) fell above its band. Since unexpected movements in these two series are highly correlated historically, this combination of events is seen as much more unlikely than each event taken independently.

Similarly, if we examine the monthly forecast errors rather than the one-year-ahead errors, we find further inconsistencies. For example, one error (for Commodity Credit Corporation payments in November 1984) is greater than 9 standard errors in size. Even though this is the exceptional error from a sample of over 500, if the normality assumption that we make were true, then we would virtually never see a 9 standard error innovation. Thus, it is clear that if we apply a stringent enough test, we can reject at least the normality assumption in the model's probability structure. This means that we must be very careful not to rely on results that depend on such an assumption, but it is not a critical assumption for this paper.

A Lucky Shot

So on the surface, at least, last year's forecast for 1985 was very nearly on target for the model's main variables— real GNP and the price level. Still, the model may have been nearly right but for the wrong reasons. An archer may hit a bullseye because of skillful training, arduous practice, a keen eye, and a steady hand. But then again, the shot may just be a lucky one. We may have to admit, although reluctantly, that when examined closely, the model's forecast accuracy in 1985 may largely have been due to luck.

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