ON RECOGNIZING INFLATION

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Introduction

Inflation is defined as a sustained increase in the general price level over time. It generally rises insidiously, building up momentum over a period of time. One economist has observed, "Inflation is like a slow curve ball; why is it so deceptive?" As this article will show, in the past even the best of forecasters were often unable to foresee an upswing in the inflation rate.

This article examines the quality of inflation forecasts in the 1972-82 period, which contained two episodes of especially virulent inflation. Special attention is given to the periodic forecasts of two prominent forecasting services, the consensus of quarterly forecasts published annually by this Bank[1] during the seventies, and the *Greenbook*[2] forecasts made by the staff of the Board of Governors of the Federal Reserve System. The *Greenbook* forecasts provide a particularly good vehicle for the study as they were: 1) as good or better than other forecasts, 2) consistent, 3) published regularly and often, and 4) generated primarily for policy briefings, which meant that one of their major interests was the outlook for inflation. The analysis will show that all of the forecasters had difficulty in predicting rising inflation.

An examination of the successes and failures of inflation forecasting in the seventies is especially relevant now, for there has been considerable concern recently that inflationary pressures are mounting again. Those who argue that inflation is heating up point to the more rapid increases in commodity prices and consumer prices as well as to the rising rates of utilization of capital and labor thus far in 1988.

Information of the kind presented here should be useful in reminding the reader of the serious inflation problem the nation faced on two occasions in the seventies. The annual rate of increase of the implicit deflator for GNP during 1972-74 rose from an average of 3.6 percent in the first half of 1972 to 14.3 percent in the third quarter of 1974, and the annual rate of increase of the deflator in the 1976-80 period rose from an average of 5.0 percent in the first half of 1976 to 12.1 percent in the fourth quarter of 1980. Yet, consistent with inflation's insidious nature, the severity of the underlying inflation risk was not fully recognized in the early stages of either of these episodes.

This article is not able to specify the exact sources of error in recognizing and forecasting the inflation of the seventies, but it does suggest some possibilities. These include: 1) the inability to foresee supply shocks (particularly oil shocks), 2) the difficulty of modeling the inflationary process, and 3) the tendency for actual money growth to exceed its target range in the seventies.

Theories of Inflation

As a preliminary, it may be useful to review briefly the theories of inflation prevalent during the period (1972-82) covered by this article. One of the most popular intermediate macroeconomic theory texts of the 1960s, Gardner Ackley's *Macroeconomic Theory*, defined inflation in approximately the way that it is defined now, namely, a ". . . persistent and appreciable rise in the general level or average of prices" [1, p. 421]. Ackley divided inflation into three basic types, demand inflation, cost inflation, and some combination of the two. Demand inflation denoted the classical type of inflationary process in which price increases came in response to excess aggregate demand.[3] Cost inflation came about as a result of the power of various groups, e.g., labor unions, large firms, trade associations, etc., to raise wages and prices even in the absence of excess demand for their goods or services.

* The author wishes to thank the members of the Research Staff of the Federal Reserve Bank of Richmond for their numerous helpful comments.

[1] The Federal Reserve Bank of Richmond published summaries of major economic forecasts at the beginning of each year over the 1953-86 time period. The Bank began to publish details of major quarter-by-quarter forecasts in the 1972 *Business Forecasts* booklet. The table showing the consensus (median) forecast was first published in the 1973 *Business Forecasts* booklet.

[2] The *Greenbooks* are briefing documents prepared by the staff of the Board of Governors of the Federal Reserve System prior to each meeting of the FOMC. They are distributed to the Presidents of the regional Banks as well as to the Governors and senior staff of the Board. The *Greenbooks* are highly confidential at the time of their release, and are available to the public (excepting some sensitive international material) after a five-year lag.

[3] Aggregate demand is composed of the demand for the economy's output of goods and services by consumers, investors, government, and foreigners.

During the seventies, cost inflation theories were folded into a more general supply shock theory of inflation. According to this theory, some event or another, such as a union-induced wage increase, a crop failure, a fuel shortage, etc., would restrict aggregate supply and, by causing a shortage, lead to an increase in prices.

Supply shock theories can explain a change in relative prices or a one-time rise in the price level, but they fall short as explanations of inflation (defined, remember, as a series of *continuing* rises in the general price level). There is an inherent inconsistency in a theory that explains a continuing rise in prices by a series of apparently unrelated random events, and this inconsistency has led to a decline in the use of supply shocks as explanations of inflation. The failure of anti-cost-push policies such as wage and price controls and wage/price guidelines to stop the inflation of the seventies also contributed to the decline in the usage of supply shock theories of inflation.

Supply shock explanations of inflation, however, were utilized heavily in the seventies and early eighties. The typical inflation forecast frequently enumerated a variety of supply factors[4] that would be likely to affect inflation in the near-term future. Such forecasts implied that inflation would subside naturally once the effects of the special factors had worked themselves out. If, however, the economy was actually plagued by a general inflation, each "special factor" would be succeeded by another, and the longer-term inflationary process would be seen as a succession of special situations.

Milton Friedman observed that "Inflation is, always and everywhere, a monetary phenomenon, produced in the first instance by an unduly rapid growth in the quantity of money" [4, p. 39]. His now-famous statement has been generally accepted by the economics profession. This conception of inflation implies that excess money growth is the source of excess aggregate demand, and it implicitly denies the relevance of supply shocks as sources of inflation (defined again as a *continuing* increase in the price level).

Inflation Forecasts

This section presents the forecasts for prices published in the *Greenbooks* prepared by the staff of the Board of Governors prior to each FOMC meeting over the 1972-82 time period. Over the 1972-82 time period, 118 separate forecasts for the price level and general business conditions were made, an average of almost 11 forecasts per year. The forecasts for the implicit deflator for GNP will be analyzed below. The analysis is primarily concerned with the accuracy with which the forecasts predicted the direction of inflation: that is, whether it would rise or fall. The reason for this primary concern relates to the nature of policymaking. Since policymakers are naturally sensitive to the potential short-run costs of efforts to restrain inflation, there is a risk that they may opt for too lenient (restrictive) policies if the inflation is incorrectly expected to subside (increase) on its own.

Each *Greenbook* forecast included estimates for the prior quarter, the current quarter, and projections for a varying number of quarters into the future. The lengths of the forecasts varied from zero (two forecasts, dropped from the analysis) to eight (one forecast) quarters into the future. Most of the forecasts had an horizon of four to six quarters. These forecasts are depicted in Charts 1 to 3.

Charts 1-3 For expositional clarity the plots of the forecasts are distributed among three charts. The charts are indexed along two dimensions. First, the charts are indexed by the month of the quarter in which the forecast was made. Chart 1, for example, shows forecasts made in the first month of the quarter, Chart 2 includes forecasts made in the second month of the quarter, and Chart 3 shows forecasts made in the third month of the quarter. Second, the charts are indexed by time period. Section (a) of the charts shows forecasts made during the period from the first quarter of 1972 (1972:1) to the first quarter of 1976 (1976:1), the (b) sections show forecasts made during 1976:1 to 1980:1, and the (c) sections show forecasts made in 1980:1-1982:4.

The white line on each chart shows the annualized quarterly rate of change of the implicit deflator for GNP as estimated two quarters after the date shown.[5] The thin black lines show the *Greenbook* forecasts. Every forecast began with an estimate of

[4] These factors included such items as employment costs, energy prices, food prices, price controls and decontrols, car prices, steel prices, strikes, industry desires to improve or protect profit margins and worker desires to restore real incomes, etc.

[5] For example, the rate shown for the first quarter of 1973 is the rate estimated for that quarter as of the third quarter of 1973. The data for the GNP and related accounts are revised several times, often substantially, after their original release. In order to provide a consistent series, and to be fair to the forecasters who were basing their forecasts on what they thought was historical data, the "actual" implicit deflator series used in this article ignores revisions made after two quarters. There are substantial differences, therefore, between the "actual" rates of increase in the implicit deflator in 1972-82 in the charts and the final official estimates.

Chart 1

IMPLICIT DEFLATOR FOR GNP:
Forecasts Made in 1st Month of Quarter

Annualized Percent Change

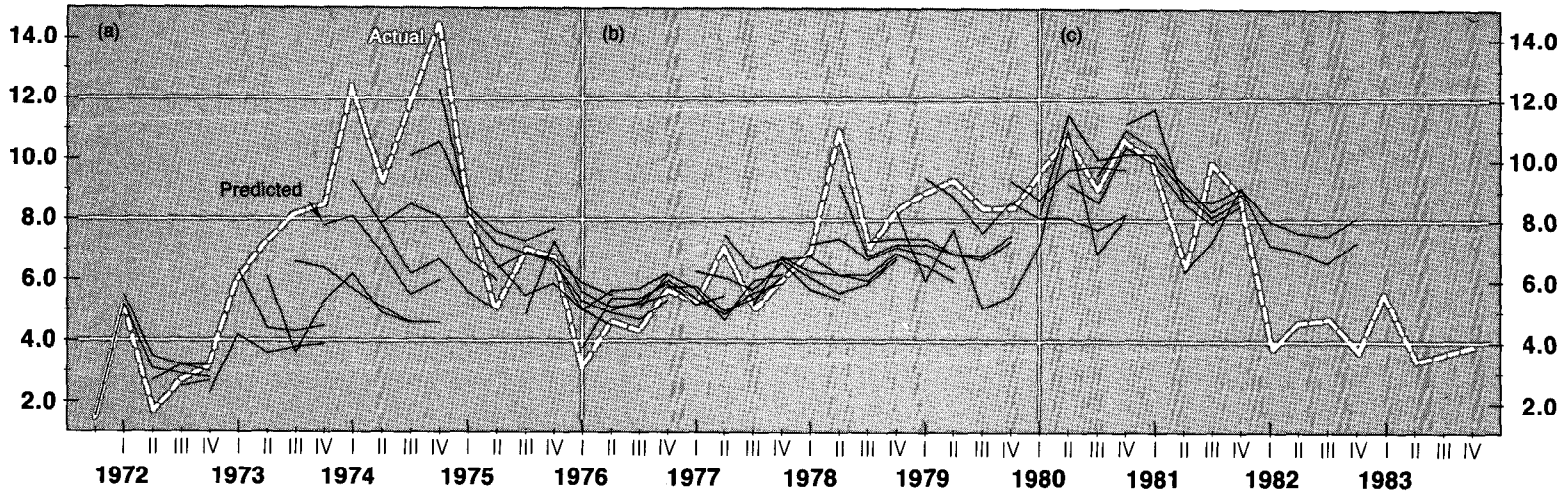


Chart 2

IMPLICIT DEFLATOR FOR GNP:
Forecasts Made in 2nd Month of Quarter

Annualized Percent Change

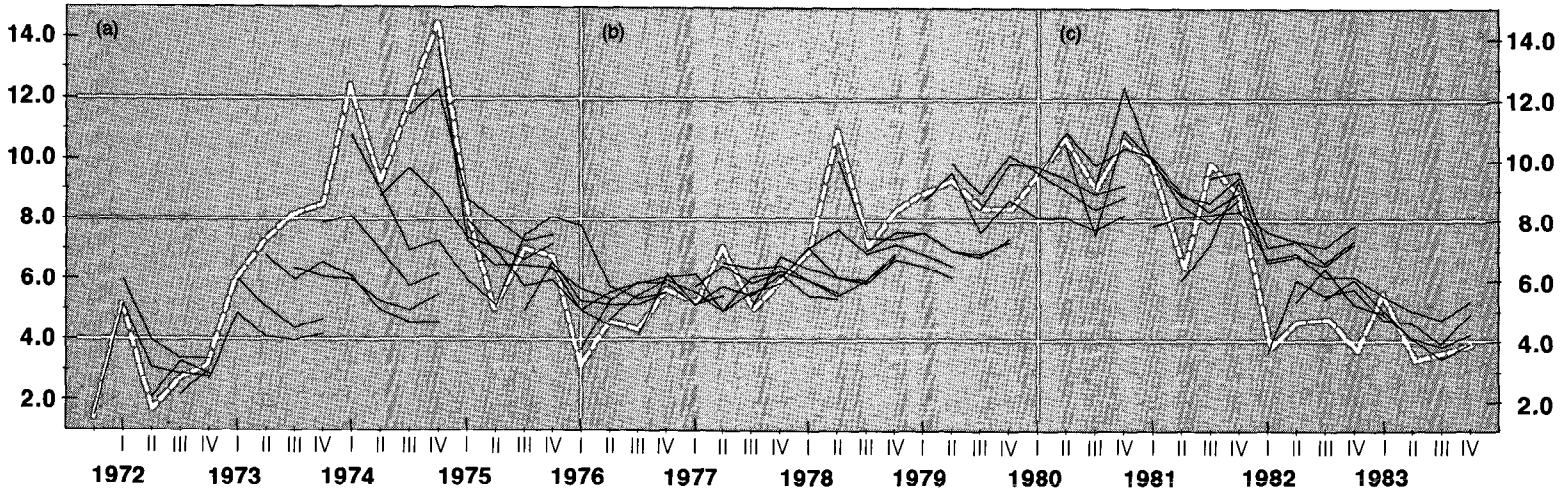
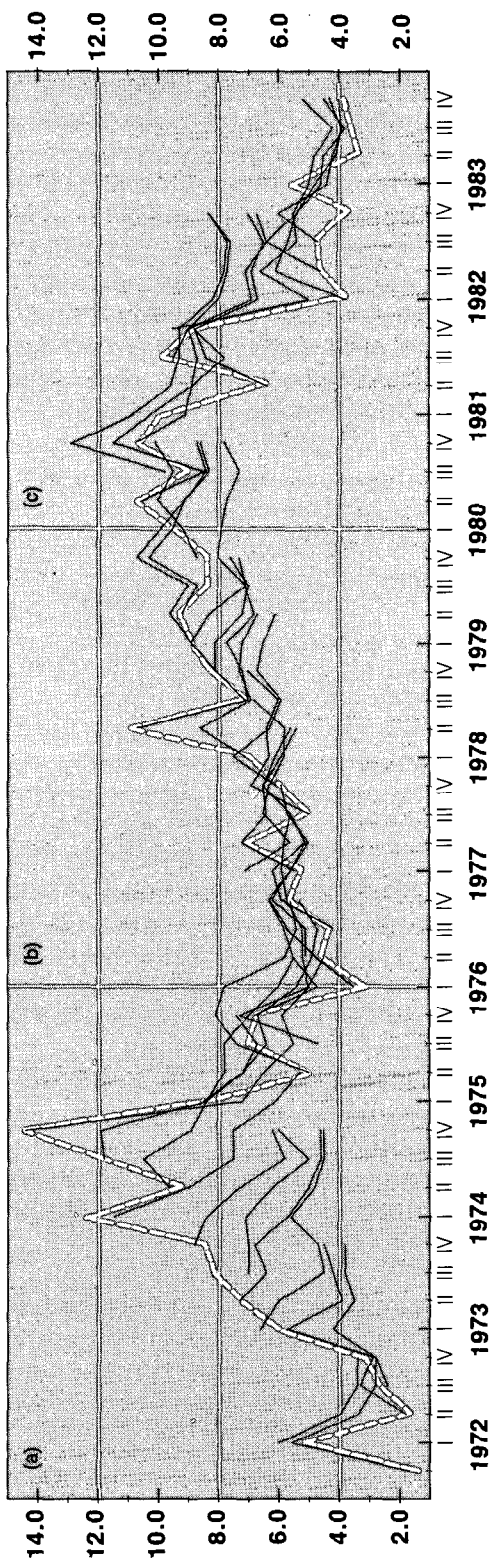


Chart 3
IMPLICIT DEFLATOR FOR GNP:
Forecasts Made in 3rd Month of Quarter
Annualized Percent Change



the increase in the deflator in the quarter prior to that in which the forecast was made, so the line depicting a forecast made in any one quarter always begins in the previous quarter.

The forecast made in January 1974, for example, contained the following projections for the annualized quarter-by-quarter rate of increase in the implicit deflator in the 1973:4 to 1974:4 time period: 7.8%, 8.1%, 6.9%, 5.5%, and 6.0%. The numbers representing this forecast are plotted as the thin black line, denoted by an arrow, in the middle of Chart 1.

The projections for the prior quarter tended, because of better availability of data, to be closer to the actual the later in the quarter they were made. Since the *Greenbooks* were usually prepared early in the month, the first-month-of-quarter forecasts were usually prepared before the U.S. Department of Commerce released the preliminary estimates for GNP and related accounts in the prior quarter.

The second-month-of-quarter *Greenbook* forecasts, however, could incorporate the Commerce Department's preliminary estimates for the prior quarter, and the third-month-of-quarter forecasts could utilize the first revision of the statistics.

As the charts clearly show, the forecasts generally tended to predict subsiding inflation, whether or not inflation actually subsided. The charts show that the tendency to underpredict rising inflation was especially apparent in the 1972:1 to 1975:1 period, and that the tendency continued, albeit to a more modest extent, in the 1976:1-1980:1 period. In contrast, the forecasts tended to overestimate the strength of inflation in 1980:2-1983:2.[6]

The charts also show clearly that the inflation forecasts in the 1976:1-1980:1 and 1980:2-1983:4 periods were considerably closer to the mark than the forecasts for inflation in the 1972:1-1974:3 period. The apparent improvement in forecasting ability after 1974:3 may indicate that the forecasters were able to model inflation better after having been able to evaluate the effects of oil and food shocks on the economy in 1972:1-1974:3. It may, however, merely indicate that economic conditions and inflation were particularly difficult to evaluate in the earlier period.

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[6] It should be noted that underpredicting inflation when its permanent component is rising, and overpredicting it when its permanent component is falling, need not reflect poor forecasting procedures. John Muth [7] showed that for a series generated by unobservable permanent and transitory components, the optimal forecasting technique would tend to systematically underpredict any rise or fall in the permanent component, approaching the correct forecast asymptotically.

Two summary statistics: F-slope and A-slope This article is not particularly concerned with examining how well the actual rate of inflation was predicted in any one quarter. Its concern, rather, is how well the forecasts capture the outlook for increasing (decreasing) inflation over the forecast horizon. In seeking to answer this question, the first step was to determine the slopes of the forecast lines using a regression technique. These estimated slopes are, essentially, the slope of whatever straight line would best represent each thin line depicted on the charts. For example, the forecast for January 1974 has a slope of −0.62, indicating that the annualized rate of rise in the deflator was expected to decline by 0.62 percentage points per quarter on average over the forecast horizon of 1973:4-1974:4.

The slope values for the forecasts, described above, will be termed "F-slope" values (where F denotes forecast) for future reference. Corresponding "A-slopes" were calculated for the actual changes in the deflator. For example, the A-slope value calculated from actual changes in the deflator over the 1973:4 to 1974:4 time period was 1.07, which indicates that the actual annualized rate of increase in the deflator was 1.07 percentage points per quarter, on average.

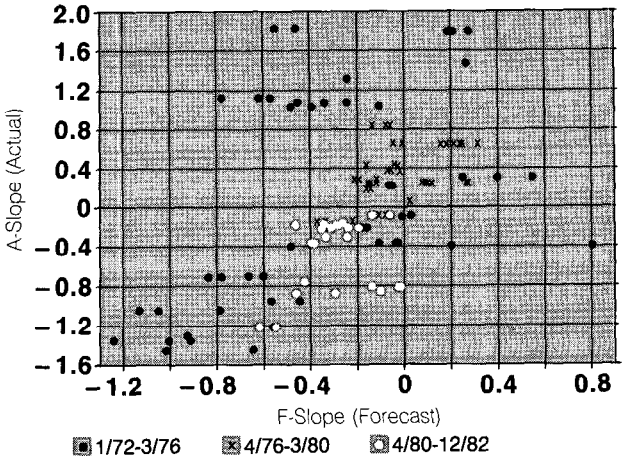
Over the 1972-82 period, the *Greenbook* predicted decreasing inflation (negative F-slope values) in 94 out of 118 forecasts. Inflation actually decreased in only 59 (exactly one-half) of the 118 forecast horizons. The forecasts correctly anticipated increasing inflation in 20 out of its 59 occurrences and incorrectly anticipated it (i.e., predicted rising inflation when inflation actually declined) four times. In contrast, the decreasing inflation was predicted correctly in 55 of 59 occurrences.

Chart 4 shows the scatter diagram of the 118 F-slopes and A-slopes. The F-slopes are plotted from the horizontal axis and the A-slopes are plotted from the vertical axis. Thus, if the sign of the A-slope was predicted correctly in a particular forecast, the point representing that forecast would be in the first (+, +) or third (−, −) quadrant of the graph. If the rising inflation were incorrectly expected to subside, the point would be plotted in the second (−, +) quadrant, while if subsiding inflation were incorrectly expected to rise, that point would be plotted in the fourth (+, −) quadrant. Different symbols are used in the scatter diagram to show whether a forecast was made in 1972-76, 1976-80, or 1980-82.

The scatter diagram clearly confirms the previous assertions about Charts 1-3, namely, that the inflation forecasts were least accurate in the 1972-76 period. The black dots, which are used to depict the earlier forecasts, are the outliers in the second and fourth quadrants of the diagram.

Chart 4

F-SLOPES VS. A-SLOPES
Jan.'72-Dec.'82



Forecast Errors

Table I presents a statistical analysis of the *Greenbook* forecasts and compares them to forecasts made by two major private econometric forecasting firms.[7] The table uses standard measures of forecast accuracy, root mean squared errors and mean absolute errors,[8] to evaluate the relative accuracy of the *Greenbook* F-slope values in periods of rising and subsiding inflation, respectively. It then compares the *Greenbook's* performance to the performance of the two private firms and the Richmond quarterly consensus to determine whether there was anything markedly unusual about the *Greenbook* performance in relation to other forecasters.

The first two rows of the table compare F-slope values to A-slope when the data were separated into periods of rising inflation (positive A-slopes) and periods of subsiding inflation (negative A-slopes). The root mean squared and mean absolute errors are shown to be roughly two and one-half times as large when inflation is actually rising as when it is subsiding. The last column of Table I shows the number of times that the sign of the A-slope was predicted

[7] Stephen McNees kindly provided the historical series on the forecasts made by the private forecasting firms.

[8] The root mean squared error is calculated by finding the difference between the F-slope and A-slope values for each forecast, squaring the differences, averaging the squared differences, and finding the square root of the average squared difference. The mean absolute error is calculated by giving each difference a positive sign and then averaging those differences. A set of perfect forecasts would have a root mean squared error and a mean absolute error of zero.

Table I

COMPARISON OF BOARD STAFF (GREENBOOK) FORECASTS OF THE OUTLOOK FOR INCREASING OR DECREASING INFLATION* TO THOSE OF TWO PRIVATE ECONOMETRIC FORECASTING FIRMS AND THE CONSENSUS FORECAST PUBLISHED IN THE BUSINESS FORECASTS BOOKLET

(Includes Forecasts Made Between January 1972 and December 1982)

Comparison	Root Mean Squared Error	Mean Absolute Error	Number of Observations	Number of Times Sign of A-Slope Was Predicted Correctly
Greenbook to Actual				
When inflation accelerates	0.93	0.71	59	20
When inflation decelerates	0.38	0.26	59	55
Greenbook to first econometric firm (EF1)				
When inflation accelerates				
Actual versus EF1	0.99	0.75	38	13
Actual versus GB match	0.95	0.71	38	13
When inflation decelerates				
Actual versus EF1	0.58	0.45	39	24
Actual versus GB match	0.41	0.29	39	35
Greenbook to second econometric firm (EF2)				
When inflation accelerates				
Actual versus EF2	0.99	0.75	39	13
Actual versus GB match	0.94	0.72	39	14
When inflation decelerates				
Actual versus EF2	0.55	0.42	37	20
Actual versus GB match	0.38	0.29	37	35
Greenbook to consensus				
Actual versus consensus	0.73	0.56	11	7
Actual versus GB match	0.64	0.48	11	8

* The price index forecasted is the Implicit Price Deflator for GNP. The forecasters estimated the annual percentage rate of increase in the deflator for the quarters in the forecast horizon. These forecasts were regressed on a quarterly time trend, and the statistical analyses shown above were applied to the slopes of the regression lines.

correctly. The sign was predicted correctly much more often when inflation was actually subsiding.

The information in the remaining rows of Table I provides a comparison of *Greenbook* forecasts to those made by two private forecasting services and to the consensus of quarter-by-quarter forecasts published annually in the Federal Reserve Bank of Richmond's *Business Forecasts* booklets during the 1972-82 time period. The private services did not forecast on a month-by-month basis, nor did the monthly publication dates of their forecasts correspond, so it was necessary to devise a *Greenbook* match for each service that would correspond to the forecasts made by the service. A different *Greenbook* match was also necessary for the consensus forecast, as it was published only once per year.

Table I shows that the *Greenbook* forecasts have lower root mean squared and mean absolute errors than the forecasts made by the services, regardless of whether inflation is rising or subsiding. The table also shows that while the *Greenbook* forecasts have only slightly lower error statistics than the services when inflation is rising, they have substantially lower error statistics when inflation is subsiding.

The table also shows that the Board staff forecasts had lower error statistics than the *Business Forecasts* consensus. Since there were only 11 of the consensus forecasts, they were not split into periods of increasing and decreasing inflation.

The analysis shown in Table I thus shows clearly that the *Greenbook* forecasts were no worse than those made by the forecasting services in predicting worsening inflation and clearly better than the services in predicting decreases in inflation. It also shows that all the forecasters studied were relatively less accurate in predicting rising inflation.[9]

As noted earlier, a visual comparison of the charts indicated that the *Greenbook* forecasts seemed to be further from the mark in the 1972-76 period than in the 1976-80 period. Table II shows the results of an analysis of the differences in the forecasts during the rising inflation portion of the two time periods. The table confirms the conclusion of the visual inspection. The root mean squared and mean absolute errors from July 1972 to March 1974 (the period of increasing inflation in 1972-76) are over three and a third times higher than they are in the February 1976 to November 1979 period. Table II also shows, however, that the *Greenbook* forecasts were modestly more accurate than the two competing forecasts in each time period.

The *Greenbook* forecasts actually predicted rising inflation accurately only slightly less frequently in the July 1972 to March 1974 period (7 of 21 episodes, 33 percent of the time), than in the February 1976 to November 1979 period (16 of 43 episodes, 37 percent of the time). The lower root mean squared errors for the later period, therefore, stem more from smaller misses in predicting the magnitude of the rise than from relatively fewer accurate predictions of the direction of inflation.

[9] The mean error statistics from this Bank's quarterly consensus series and from other analyses show that forecasters in general tended to underestimate inflation in the seventies (see reference to McNees [8] and Zarnowitz [11] in Karamouzis and Lombra's interesting study of Federal Reserve policymaking and forecasting [6, p. 12]. See also McNees [9, p. 18]).

Table II

EVALUATION OF BOARD STAFF (GREENBOOK) FORECASTS OF THE OUTLOOK FOR INFLATION* IN DIFFERENT TIME PERIODS AND A COMPARISON OF STAFF FORECASTS TO THOSE OF TWO PRIVATE ECONOMETRIC FORECASTING SERVICES

Comparison	Root Mean Squared Error	Mean Absolute Error	Number of Observations	Number of Times Sign of A-Slope Was Predicted Correctly
Greenbook to actual				
July 1972 to March 1974	1.47	1.33	21	7
February 1976 to November 1979	0.44	0.39	43	16
January 1980 to December 1982	0.38	0.26	26	26
Greenbook to first econometric firm (EF1)				
July 1972 to March 1974				
Actual versus EF1	1.55	1.39	14	5
Actual versus GB Match	1.48	1.32	14	4
February 1976 to November 1979				
Actual versus EF1	0.51	0.43	28	10
Actual versus GB Match	0.43	0.37	28	12
Greenbook to second econometric firm (EF2)				
July 1972 to March 1974				
Actual versus EF2	1.57	1.45	14	3
Actual versus GB Match	1.49	1.37	14	5
February 1976 to November 1979				
Actual versus EF2	0.45	0.38	28	12
Actual versus GB Match	0.43	0.37	28	11

* The price index forecasted is the Implicit Price Deflator for GNP. The forecasters estimated the annual percentage rate of increase in the deflator for the quarters in the forecast horizon. These forecasts were regressed on a quarterly time trend, and the statistical analyses shown above were applied to the slopes of the regression lines.

Possible Reasons for Mispredicting Rising Inflation

The discussion in this section attempts to evaluate three competing hypotheses that, taken individually or taken together, could explain the apparent difficulty that forecasters experienced in predicting rising inflation.

Proposed Hypotheses

1. Unpredictable supply shocks The inflation prediction errors resulted from unforeseen shocks to aggregate supply such as the OPEC oil embargo, crop failures, etc.

2. Tendency to underutilize the economic theory of the inflationary process The overall inflationary process was perceived as a series of supply shocks, so money growth was given insufficient attention.

3. Money growth in excess of that targeted The *Greenbook* and perhaps other forecasts assumed that the money supply would grow at the longer-run target rates previously set by the Federal Open Market Committee (FOMC), so the inaccuracy of the projections stemmed from actual money growth exceeding its target range over several sustained periods in the seventies.

Evaluation of the Proposed Hypotheses

1. Unpredictable supply shocks This hypothesis undoubtedly explains some of the forecasting errors. As noted in footnote six, John Muth [7] showed that, as a statistical matter, if the movement in a series over time was composed of transitory and permanent components that were not separable *ex ante*, the optimal forecasting technique would underpredict the series when the permanent component was rising and overpredict it when the permanent component was falling. As the charts showed, that pattern of forecast error describes the staff forecasts during the 1972-82 period, as inflation was underpredicted in 1972-74 and 1976-80 and overpredicted in 1980-82.

A brief review of supply shocks and their effects on staff forecasts in the two periods of sharply rising inflation, 1972-74 and 1976-80, follows.

1972-74 The inflation of 1972-74 was well under way before the imposition of the OPEC oil embargo in October 1973. The Nixon administration had imposed a wage/price freeze in August 1971 followed by a more flexible wage and price control program lasting from November 1971 to January 1973, when it was replaced by an even more flexible program that ran through June 1973. This last program was particularly ineffective, as the wholesale price index increased at a 24 percent annual rate during the five months of the program, and by the end of the program (June), the Consumer Price Index was rising at about a 10 percent annual rate.

The rate of money growth, however, had slowed in the first half of 1973 from the extraordinarily rapid rates of growth registered in 1972 (the slowing in money growth rates continued through the first quarter of 1975). There was thus a general belief during the second and third quarters of 1973 that the economy was cooling and inflation was beginning to subside. Thus, it was understandable, for example, when in April 1973 the *Greenbook* began to predict decreasing inflation on the grounds that price pressures would subside once the changes in the price control program had worked through the economy.

In theory, the imposition of the oil embargo in October 1973 and the consequent oil shortage should

have produced merely a one-time increase in prices combined with a reduction in output. Such probably would have been the case had the economy not previously been in a period of general inflation. Because it *was* in such a situation, however, inflationary expectations rose, and even though the rate of money growth was slowing, it was apparently sufficient to fuel continued increases in inflation until the third quarter of 1974.

1976-80 The inflation of 1976-80 was less influenced by unforeseen oil shocks, although undoubtedly the January 1979 Iranian revolution (and probably the shortages resulting from the Department of Energy's fuel allocation program) affected the price level in the first half of 1979. In any event, it is difficult to determine whether the major impetus for the rising inflation in 1979 stemmed from the oil shortages or from prior excess money growth and already rising inflationary expectations.[10]

Evaluation As was shown in Table II, the inflation forecasts for the 1976-80 period were closer to the mark than the forecasts made in 1972-74. Thus, although it is difficult to confirm, the oil shocks probably did affect the accuracy of the forecasts to a large extent in the 1972-74 period. This does not mean, however, that the unforeseen oil shock wholly explains the tendency to mispredict rising inflation, for that tendency was apparent both before and after the announcement of the 1973 oil embargo, and it was apparent in the 1976-80 period both before and after the Iranian revolution oil shock.

2. Underutilizing the economic theory of inflation as a monetary phenomenon Nearly all forecasters in the seventies routinely cited nonmonetary factors (supply shocks, etc.) in rationalizing their respective inflation forecasts. For example, the *Greenbook* cited such developments as expected changes in the minimum wage, unusual weather, and various fuel price increases[11] in explaining its forecasts. Among other forecasters, Walter Heller and George Perry referred to a ". . . chronic cost-push rate of about 6 percent per year" [5, p.1], and Albert Sommers stated as the consensus of the Conference Board's 1978 Economic Forum, "We are experiencing structural inflation, not cyclical inflation" [10, p. 7].

The emphasis given to these nonmonetary explanations of inflation may have diverted attention away from the effects of past growth in the money supply on observed inflation rates in both the 1972-74 and 1976-80 periods, and hence may have contributed to the forecast errors in the two periods. The relevant issue here is whether the permanent component of inflation in the seventies was predictable *ex ante* (see the discussion of Muth [7] above). From the viewpoint of the theory that inflation is a monetary phenomenon, the permanent component of the rate of growth of the price level should be explained by past rates of growth of money. Excessive reliance on nonmonetary factors to explain inflation thus may have contributed to the errors in inflation predictions by diverting attention from prior movements in money growth.

3. Money growth in excess of that targeted A third hypothesis is that the forecast errors resulted, at least in part, from actual money growth exceeding the Federal Reserve's monetary targets during periods of mounting inflationary pressure (especially in the late seventies). As Stephen Axilrod, former Staff Director for Monetary and Financial Policy at the Federal Reserve, observed:

> In 1977 and 1978, M1 had accelerated to a pace of slightly more than 8 percent per year, after growing by an average of 5½ percent per year over the previous two years. Not only did this acceleration itself appear to signal that policy was becoming more expansionary, but also the credibility of policy was being eroded by the consistency with which actual M1 growth came in above adopted target ranges in a strong economy. This psychological effect was made even worse in the circumstances of the time by the fact that new one-year target ranges were adopted quarterly, with the most recent quarter serving as a base . . . and with no apparent effort to make up for the preceding over shoots. This became known as "base drift." The erosion of credibility because the targets were missed and because the process of target setting also led to a perception that the targets were perhaps not serious constraints fueled inflationary expectations [2, p. 15].

The 1977-80 time period coincides with the second period of rising inflation depicted in section (b) of Charts 1 to 3. During that period the average year-by-year money growth was 7.2 percent, while the average announced target range was 4.25 percent to 6.75 percent (derived from Broaddus and Goodfriend [3, p.7]). Monetarists would argue that

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[10] Stephen Axilrod observed that "Growth of M1 failed to slow over the first three quarters of 1979. At the same time, prices were placed under additional upward pressure by the second oil shock in the early part of the year. Overall price increases moved into the double digit area. That had also occurred in 1974, but in the earlier period there had been less of a buildup in inflationary expectations and less of an erosion in the credibility of the Federal Reserve's will and capacity to control the situation" [2, p. 16].

[11] A complete list of relevant staff commentary on inflation from *Greenbooks* published between April 1972 and December 1982 and the numerical staff forecasts for the rate of increase in the implicit deflator for GNP made between January 1972 and December 1982 are available from the author upon request. The commentary demonstrates that nonmonetary factors were frequently used to explain the inflation forecasts.

the coincidence of this episode of above-target money growth and the period of inflationary buildup was not due to chance, since excess money growth fuels inflation.

As the *Greenbook* forecasts routinely assumed future money growth at the midpoint of the System's stated target range, it can be argued that the monetary overshoots were partially responsible for the *Greenbook* forecast errors. Still, the *Greenbook* forecasts were no worse than the private forecasts, which were not constrained to accept announced monetary targets. Of course, the extent to which the private forecasts were influenced by the Federal Reserve's announced monetary targets is not known, but it seems likely that the targets had some influence. Thus, although the missed money growth target hypothesis cannot be confirmed as a source of forecast error, neither can it be dismissed.

Conclusions

This study demonstrated that rising inflation was difficult to forecast in the seventies. The analysis indicated that both the forecasts contained in the Federal Reserve's *Greenbook* and those prepared by other prominent forecasters tended to mispredict rising inflation during the two episodes of sharply rising inflation in the decade, although the forecasting performances did improve somewhat in the second episode, between 1976 and 1980. The article also noted that forecasters tended to overpredict inflation somewhat in the early eighties when it began to diminish.

The article discussed three possible explanations for the forecast errors: 1) unpredictable supply shocks, 2) excessive attention to nonmonetary developments affecting the price level and insufficient attention to past money growth, and 3) actual money growth coming in above target in the seventies. The discussion concluded that none of the explanations could be ruled out.

The lesson to be drawn from the inflation forecasting experience of the seventies is that rising inflation is insidious and difficult to recognize. The past, however, is not necessarily prologue to the future. Forecasters, like everyone else, learn from their experiences. Virtually all forecasters—those at the Federal Reserve and elsewhere—are making strong efforts to improve on the inflation forecasting performance of the seventies and early eighties. It is hoped that this paper, by reviewing the earlier experience in some detail, will contribute to this effort.

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