Monetary Policy: Some Theory and Evidence

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Few topics have a larger or more rapidly growing literature than monetary policy. The literature has wide diversity, ranging from highly abstract analyses of optimal money growth to the commentary ground out daily or weekly by central bank watchers in many countries. In between are such issues as the choice of rules over discretion, the strategies and tactics of monetary action, the advantages of activism and, recently, the positive analysis of policymakers' decisions.

It is a daunting task to attempt a full summary and assessment of even the most actively researched topics of the recent past. The assessment is made more difficult by the many conflicts found in this literature and by the absence of empirical work that resolves the conflicts. This absence reflects several problems of which the most important is the sensitivity of empirical results to the choice of sample period or specification.

From the menu of choices, I have selected two topics. The sponsors of the conference are concerned with growth, so I discuss, first, what has been learned about the relation of money to economic growth. Then I consider and attempt to evaluate the costs or benefits of relying on forecasts when choosing monetary (or other) aggregate policy actions.

Money and Economic Growth

From the earliest systematic writings on monetary theory, writers have observed a relation between money and the price level. Two features of this early literature are (1) the relation was observed and noted independently in many different places and times, and (2) a common observation was of an inverse relation between the stock

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I mention the latter because their commentary reveals the current state of average informed opinion which, to some unknown degree, may affect asset managers' decisions about portfolio allocation.
called money and the value of a unit of that stock. Often, these or later observers asserted the relation that later was known as neutrality: an increase in money has no effect on the real value of the stock of money or other real values.

Neutrality remains a central proposition for all monetary theory. Differences remain about the importance of departures from neutrality and the speed of return, but departures from neutrality are attributed to misperception, costs of acquiring information, costs of changing prices or responding to such changes, and other impediments to immediate response. The neutrality of money is accepted as an implication of rational behavior.

When one turns from the static theory of money and output to the steady state relation between inflation and production or output, issues about temporary non-neutrality drop away. At issue is whether a fully anticipated rate of inflation can affect real economic activity. If individuals choose to hold money to satisfy desires for liquidity or safety, their higher demand for money raises the real rate of interest. To the individual, the higher interest rate is the return he forgoes to get more safety or liquidity. But society can provide the additional liquidity at zero (low) cost by producing money at a rate that satiates the demand for money. This rate of money growth is optimal for society.

In principle, government can increase economic welfare by providing the optimal rate of monetary expansion and inflation. My 1969 survey of the literature establishing this proposition showed that the size and even direction of the effect of inflation on economic activity was not robust to the assumptions made. Meltzer (1969). Of particular importance to the conclusion is the nature of the production function, the type of services provided by money, the extent to which the services of money substitute for other forms of consumption (and therefore alter the saving rate) or, if money is treated as a productive asset, the relative size of the effect of money growth on the ratio of money to capital and of capital to labor.

Recent surveys by McCallum (1990), Orphanides and Solow (1990), and

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2Hegeland (1951) provides an excellent summary that traces these observations to Confucius, Xenophon, and Copernicus among others.
Woodford (1990) discuss different parts of this literature. A common conclusion is that the direction of any effect of inflation or money growth on output is ambiguous. McCallum (1990, p. 973) suggests that any effect may be quantitatively unimportant, but Orphanides and Solow (1990) argue that it is difficult to move directly from this literature to actual economies until there is better understanding of the reasons people hold and use money.

If the services of money include saving of transaction and information costs, "money" serves as a substitute for time used to gather information and transact. The "money" that provides these services is not just the pieces of colored paper or claims at financial institutions. The meaning of "money" here should include the set of institutions that permit the public to develop optimal payment schedules -- schedules that minimize the costs of carrying out current and intertemporal transactions. The choice of a wealth maximizing rate of inflation requires analysis of how this institutional structure evolves under different known and fully anticipated rates of inflation.

Missing also from the literature is the distinction between a world economy with one source of paper money and a number of independent countries with independent monetary authorities in several countries. If the optimal rate of inflation is positive, as might occur with distortionary taxation, individuals can avoid the tax on cash balances by using less inflationary foreign money.³

In principle empirical work relating inflation to growth could capture relevant features missing from the models of optimal inflation. Unfortunately, there has been little effort to resolve the ambiguity about sign and magnitude of the optimal rate of inflation and money growth. Friedman (1969) assumes values for the relevant parameters and conjectures that the rate may be between -5% and -17% per annum. But he does not use his estimates when he makes his policy recommendation for money growth.

In Meltzer (1991), I estimated the relation between average growth rates and average inflation rates for the years 1965-1988. The sample consists of data for 100

³Woodford (1990) gives a detailed discussion of the optimal tax rate.
countries from the World Bank Development Report and for three subsets of countries at different levels of income. These are shown in Table 1.

Table 1
Dependent Variable: Per Capita Real GDP Growth*
1965-88

<table>
<thead>
<tr>
<th></th>
<th>Constant</th>
<th>Average Rate of Inflation</th>
<th>Adjusted R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 countries</td>
<td>2.00</td>
<td>-0.02</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>(7.38)</td>
<td>(1.94)</td>
<td></td>
</tr>
<tr>
<td>30 low income</td>
<td>1.69</td>
<td>-0.08</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td>(2.84)</td>
<td>(2.32)</td>
<td></td>
</tr>
<tr>
<td>32 middle income</td>
<td>2.34</td>
<td>-0.02</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>(5.36)</td>
<td>(1.63)</td>
<td></td>
</tr>
<tr>
<td>38 upper middle</td>
<td>2.63</td>
<td>-0.02</td>
<td>0.004</td>
</tr>
<tr>
<td>and high income</td>
<td></td>
<td>(1.08)</td>
<td></td>
</tr>
</tbody>
</table>

*statistics in parentheses

For the group as a whole, and for each of the subsets, the simple relation between growth and inflation is negative. Inflation lowers growth, and deflation raises it as Friedman's (1969) analysis implies. The effect is not negligible; a 10% rate of deflation would raise the average growth rate by 0.2 percentage points or 10% of the mean growth rate shown if we interpret the intercept as showing the average growth of per capita income resulting from factors other than inflation.

These estimates have both strengths and weaknesses. Judged by goodness of fit, the inflation rate explains little. This is not surprising; differences in the quantity and quality of human and physical capital are far more important sources of differences in growth. Perhaps a more relevant problem is the treatment of the average rate as the relevant rate for inflation and growth. This ignores the variability of inflation rates. Variability may be related to the average rate, so the coefficient may be biased. An
advantage of rates of growth and inflation averaged over more than twenty years, however, is that one-time changes from oil shocks, controls and decontrol, changes in sales or value added taxes, etc. have less influence.

A disadvantage is that strictly speaking, the relation we want to observe is between the long-run level of output and the rate of inflation, since optimal monetary policy would lower the real rate of interest once-and-for all. For this interpretation, the growth rates of output in the regressions should be interpreted as the rates computed over an interval rather than as steady state rates that would be maintained forever. This does not tell us the optimal rate of inflation however. The reason is that the linear relations in Table 1 imply that there are large (possibly infinite) gains if only the deflation rate is sufficiently high. To correct for this problem I estimated the relation between average per capita economic growth, average inflation and the squared value of average inflation for the same sample of 100 countries and the three subgroups. In 3 of the 4 cases, including the full sample, the coefficient of the linear term is negative while the coefficient of the quadratic term is positive. This implies, as in the linear relation, that growth is maximized at an extreme point. Low rates of inflation minimize economic growth. This result is surely wrong.

Results from theory and data analyses about the optimal rate of inflation or rate of money growth are inconclusive. It is not clear whether there is a unique, optimal monetary policy in the sense used in this literature. Given the many strong assumptions used to develop the theory -- such as a representative consumer, a single world money (or common optimal inflation rate in all countries), a government that seeks to maximize individual welfare, a constant returns to scale production function with neutral technological change, to name only a few -- the choice of monetary policy must continue to rest on considerations other than those stressed in the literature on optimal policy.

**Rules or Discretion: Some Evidence from Forecasts**

In practice, countries neither seek nor choose an optimal or even constant rate of money growth. Brunner and Meltzer (1964), Lombra and Moran (1983) and Hetzel
(1986) describe central aspects of policymaking in the U.S. at different times. They report no evidence of a fixed set of objectives. Objectives shift about. Greatest weight may be given to disinflation at one time, unemployment at another, and financial markets or exchange rates at other times. Cukierman and Meltzer (1989) analyze the shifting weights on objectives as changing randomly in response to changing concerns about the business cycle and inflation. These random shifts represent the non-systematic (or discretionary) behavior of the authorities.

In practice, the Federal Reserve's decisions to shift the weights on different objectives are based on forecasts of future values of unemployment, inflation, and the pace of economic activity. Forecasts are made by different methods, including both judgment and more systematic procedures. A central tenet of those who favor reliance on discretion is that the use of current information and forecasts when making decisions to change interest rates and money growth improves welfare.

If policy actions affect the economy with a lag, as much evidence suggests, discretionary actions must be based on forecasts. The case for replacing discretionary action with feedback rules that do not depend on forecasts is based on evidence that forecasts are so inaccurate relative to the average rate of change that they provide a poor foundation for discretionary policy decisions and actions or for rules based on forecast values.4

The thesis I present is that forecasts of main economic aggregates are so inaccurate on average that discretionary policies based on forecasts are unlikely to minimize variability. The thesis does not depend on any particular method of forecasting. It applies to all methods of forecasting that have been studied, including some based on judgment and some that are entirely mechanical. Nor does it depend on the choice of a particular time period. It appears to be true of all the recent time periods for which forecasts have been compared. Nor is it intended as a criticism of economists, forecasts. Their forecasts, though wide of the target, may be the best

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4The rest of the section and most of the following section is taken, with minor changes, from Brunner and Meltzer (1992, Lecture 4) and, is based in part, on Meltzer (1987).
available.

The record of more than twenty years of economic forecasting in the United States is summarized by the finding that, on average, the most accurate forecasters cannot predict reliably at the beginning of the quarter whether the economy will be in a boom or a recession during that quarter. Although forecasting improves as the quarter passes and additional information becomes available, the statement remains true; after more than half of the current quarter has passed, forecasters cannot distinguish reliably between an above average expansion and a recession.

For several major countries, forecasts of annual values are available, in many cases for nearly twenty years. These data support a similar conclusion. A policymaker who adjusts policy based on the forecast for the following year has little reason to be confident that he has changed policy in the right direction. Forecast errors are so large relative to the mean rate of change that forecasts cannot distinguish slow growth or recession from a boom. Similar conclusions hold for forecasts of inflation; forecast errors are so large relative to changes in the rate of inflation that reliance on forecasts will often mislead policymakers about the rate of inflation.

The size of average forecast errors poses a major problem for those who base discretionary policy on forecasts or propose rules that rely on forecasts. A study of forecast errors using different, and possibly changing, techniques suggests that the problem is likely to remain. No single method or model seems to be superior to others. Indeed, we should not expect one method to completely dominate the others or for significant differences in forecast accuracy to persist. Economists would have difficulty explaining the survival of inferior models or methods in a competitive market for valuable information about the future.

One plausible explanation of the size of forecast errors is that, for the best forecasts, the average errors that remain mainly reflect unpredictable, random shocks that hit the economy. The shocks may result from real events—changes in productivity, weather, and the like—or they may result from unanticipated or misperceived policy

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5Artis (1987) has some evidence on forecasts by IMF staff for less developed countries. Generally, these forecasts are less accurate than the forecasts discussed.
actions. Each model or method may weight the responses to a particular surprise or change in a particular time period differently, but the resulting differences -- while important for explaining differences in forecasts for a particular quarter -- appear to have little effect on measures of forecast accuracy.

A main objective of economic stabilization policy should be to reduce the uncertainty faced by consumers and producers to the minimum inherent in nature and trading arrangements. As always, there are two types of errors. Policy can be so active that uncertainty is increased. This can occur if policy actions are so unpredictable that observation of past behavior misleads the public or provides them with little information to guide current decisions. As in Friedman (1951), activist policies can increase uncertainty and variability also, if policymakers act on misjudgments--for example, mistake transitory for permanent changes, misinterpret nominal shocks as real shocks or base decisions on unreliable forecasts. On the other hand, policymakers can be too passive, as they were in the U.S. monetary collapse of the 1930s or in Europe and Japan when they maintained the Bretton Woods arrangement long after it had become clear that fixed exchange rates transmitted U.S. inflation to the rest of the world.

A standard conclusion in the literature on decision making is that actions should be based on all available information. Applications of this proposition to economic policy use the argument to show that a policymaker who maximizes social welfare will follow a contingent rule. The rule replicates the actions that would be chosen by a policymaker with complete discretion who acts to maximize social welfare. Assume that the policymaker seeks to stabilize the economy and reduce uncertainty. To say that the policymaker should not neglect current information is not the same as saying that he should rely on predictions or forecasts. Inaccurate forecasts can cause well-intentioned policymakers to increase variability and uncertainty, to destabilize rather than stabilize.

United States

For the United States, there are a large number of public and private forecasts
of quarterly and annual data. I have chosen data mainly on forecasts of real GNP and inflation, since comparative data are available for many countries, and these measures are prominent among the measures of social welfare. Table 2 shows the size of quarterly forecast errors for various periods. Sources do not measure the error in the same way, so I have used root mean square error (RMSE) or mean absolute error (MAE) when RMSE is not available. RMSE magnifies the effect of large errors, such as those made in many countries at the time of the first oil shock. My impression is that the two measures rarely give conflicting interpretations, although numerical values differ.

To judge the forecast errors, it is useful to compare average growth rates for the period. The mean growth rate of real GNP is 2.7% for 1970-85 and 2.4% for 1980-85. The rate of inflation (deflator) is 6.7% for 1970-85 and 5.4% for 1980-85. Nominal GNP growth is 9.5% for 1967-82, 9.8% for 1973-82 and 9.9% for 1970-83.

Root mean square errors are a large fraction of the reported growth rates of nominal and real GNP. Using twice the median value of the RMSE, the range within which real growth can fall during the current quarter, covers the range from deep recession to a strong boom. For example, the median error for the four forecasters considered by Zarnowitz, 3%, exceeds the average growth rate of real GNP, 2.4%, for the period. On average, forecasters have not been able to distinguish between booms and recessions beginning in the same quarter. One standard error covers the range -0.6% to 5.4% and two standard errors cover the range of real growth rates -3.6% to 8.4%. For nominal GNP growth, errors reported by Zarnowitz are smaller relative to nominal GNP growth for the period (9.8%). Still, the errors are large relative to the information required for stabilizing policy; two times the standard deviation covers the range 2.2% to 17.4%.

These data give no support to the idea that discretionary policy based on forecasts is likely to increase stability. The data make clear that the same conclusion

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\footnote{Forecasts for other data that I have reviewed include interest rates, money growth, investment, trade balance and balance of payments. Forecast errors are usually larger for these variables relative to mean values.}
follows for all quarterly forecasts considered, even if the lowest available value of the RMSE is used in place of the median, and for each of the periods considered. Large errors associated with the oil shocks may have increased forecast errors at the time.

Table 2
Quarterly Root Mean Square Forecast Errors, United States
per cent per annum

<table>
<thead>
<tr>
<th>Variable</th>
<th>Time Period</th>
<th>Range</th>
<th>Median or Actual</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1985/1</td>
<td></td>
<td>2.1</td>
<td>Lombra and Moran (1983)</td>
</tr>
<tr>
<td></td>
<td>1970/4-</td>
<td>2.8-3.6</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1983/4</td>
<td></td>
<td></td>
<td>Webb (1985)</td>
</tr>
<tr>
<td></td>
<td>1984/4</td>
<td>4.4-5.4</td>
<td>4.7</td>
<td></td>
</tr>
<tr>
<td>inflation</td>
<td>1980/2-</td>
<td>1.4-2.2</td>
<td>1.6</td>
<td>McNees (1986)</td>
</tr>
<tr>
<td></td>
<td>1985/1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1970/4-</td>
<td>2.0-2.6</td>
<td>2.2</td>
<td>Zarnowitz (1986)</td>
</tr>
<tr>
<td></td>
<td>1983/4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1970/1-</td>
<td>1.8-2.1</td>
<td>1.9</td>
<td>Webb (1985)</td>
</tr>
<tr>
<td></td>
<td>1984/4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>nominal GNP</td>
<td>1967-82</td>
<td>5.5</td>
<td></td>
<td>Federal Reserve</td>
</tr>
<tr>
<td>growth</td>
<td>1973-82</td>
<td>6.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1970/4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1983/4</td>
<td>3.5-4/3</td>
<td>3.8</td>
<td>Zarnowitz (1986)</td>
</tr>
</tbody>
</table>

a12 forecasts early in the quarter. Median values for 3 late quarter forecasts: real GNP, 2.4, inflation, 1.4.
bFrom Federal Reserve "green" books, various issues.

but cannot explain the persistent pattern. A footnote to table 2 reports the RMSE for forecasts made late in the quarter--for the current quarter--after one or two official estimates of monthly data on prices, industrial production, money, sales, jobless claims, employment and other data have been released. Forecast accuracy improves, but it remains true that the RMSE is a large fraction of the average growth rate of the period.

The errors for quarterly forecasts come from different models and methods that cover the range of techniques in common use. McNees (1986) compares judgmental
forecasts compiled by the American Statistical Association and the National Bureau of Economic Research, large-scale econometric model forecasts sold commercially, forecasts issued by banks, the Federal government's Bureau of Economic Analysis, economic consulting firms, university research groups and the Bayesian vector autoregression model developed by Robert Litterman. Webb (1985) compares seven mechanical forecasting procedures that use the autoregressive properties of economic time series to forecast interest rates, real GNP growth and inflation.

At times, policymakers and their staffs have access to information that is not available to others. They have earlier access to some data of particular importance. For example, they know more about current policy than the public. Can they use this advantage to forecast more accurately than outsiders?

Lombra and Moran (1983) compared quarterly forecasts by the staff of the Board of Governors for 1970-73 to an earlier study of forecast accuracy by McNees covering six private forecasts. Lombra and Moran use mean absolute error of forecast for their comparisons. They find a small advantage in favor of the Board, 0.1% for real growth and 0.2% for inflation in quarterly forecasts for the current quarter. The advantage disappears for forecasts made four quarters ahead. Lombra and Moran also report root mean squared errors for the Federal Reserve staff forecasts for the same period. The RMSE is shown in Table 2. For real growth, the reported error is the lowest value in Table 2. However, superior performance is not repeated in the nominal GNP growth forecasts available for a longer period. These are shown in the lower part of Table 2 where Federal Reserve forecasts errors are substantially larger than errors by other forecasters for a comparable period.

The Federal Reserve staff forecasts of nominal GNP growth for 1973-82 appear to be biased. The mean absolute error for the current quarter is 5.4%, very similar to the mean error.7 A plausible reason is that the Federal Reserve staff consistently underestimated inflation during the 1970s. This systematic error may have been the

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7The mean absolute error four quarters ahead is 5.2% and is also very similar to the mean error. Lombra and Karamouzis (1989) have a more detailed discussion of Federal Reserve forecasts in the 1970s.
result of unwillingness to recognize internally the inflationary consequences of past policies, or the use of adaptive models that adjust slowly to the new information, or evidence of a Keynesian model structure that minimizes or denies the effect of money growth on inflation. Whatever the reason for the bias, the presence of persistent bias over a relatively long period combined with lower accuracy than private forecasters give little support to arguments for discretionary policy actions intended to stabilize growth of output and the price level.

Recently, several economists have proposed using targets for expected nominal GNP growth to guide monetary policy. See Gordon (1983) and Tobin (1983). The claimed benefit of a rule for expected nominal GNP growth is that policy offsets changes in velocity growth; money should grow faster in periods when expected velocity growth is low and conversely. In this way, monetary policy stabilizes the growth of aggregate demand.

The nominal GNP growth forecasts in Table 2 cast doubt on the stabilizing properties of expected nominal GNP growth targets if the targets are forecast values. The Federal Reserve’s forecast error for nominal GNP growth in the current quarter is as much as 60% of the average rate of change. The smallest RMSE for private forecasts is 3.5%, more than 1/3 of the average growth rate for 1970-1983. These data give little reason for confidence in the stabilizing properties of this type of rule.

Quarterly data may reflect seasonal changes or transitory variations that distort the accuracy of current forecasting techniques. Also, quarterly data are not readily available for many countries, but annual data are. Table 3 shows annual data for the U.S.

Several of the annual forecasts are from the same source as the quarterly forecasts, so we can observe whether the size of errors differs for quarterly and annual forecasts. No uniform pattern emerges from the comparisons available.

One notable feature of the inflation forecasts is the comparatively large errors made by the Federal Reserve for 1970-73 and by the OECD for 1973-85. I noted earlier that the Federal Reserve persistently underestimated inflation during the period of rising inflation. Artis (1987, p. 46) shows that the OECD forecasts also
underestimated inflation when inflation rose in the 1970s and overestimated inflation when the inflation rate fell in the 1980s.

Table 3

Annual\textsuperscript{a} Root Mean Square Forecast Errors, United States
per cent per annum

<table>
<thead>
<tr>
<th>Variable</th>
<th>Time Period</th>
<th>Range</th>
<th>Median or Actual</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>real GNP growth</td>
<td>1980-2-</td>
<td>2.2-3.4</td>
<td>2.7</td>
<td>McNees (1986)\textsuperscript{b}</td>
</tr>
<tr>
<td></td>
<td>1985-1</td>
<td></td>
<td>3.5</td>
<td>Lombra and Moran (1983)</td>
</tr>
<tr>
<td></td>
<td>1970-1-</td>
<td>2.0-3.2</td>
<td>3.0</td>
<td></td>
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<tr>
<td></td>
<td>1984-4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1980-2-</td>
<td>2.2-3.4</td>
<td>2.7</td>
<td>OECD, Artis (1987)</td>
</tr>
<tr>
<td></td>
<td>1985/1</td>
<td></td>
<td>1.7</td>
<td>McNees (1986)\textsuperscript{b}</td>
</tr>
<tr>
<td></td>
<td>1970-73</td>
<td></td>
<td>3.5</td>
<td>Lombra and Moran (1983)</td>
</tr>
<tr>
<td>inflation</td>
<td>1970-1-</td>
<td>1.9-3.1</td>
<td>1.9</td>
<td>Webb (1985)</td>
</tr>
<tr>
<td></td>
<td>1984-4</td>
<td></td>
<td></td>
<td>IMF, Artis (1987)</td>
</tr>
<tr>
<td></td>
<td>1973-85</td>
<td></td>
<td>1.7</td>
<td>OECD, Artis (1987)</td>
</tr>
<tr>
<td></td>
<td>1973-85</td>
<td></td>
<td>4.6</td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{a}Four quarter ahead forecasts are included with annual forecasts.
\textsuperscript{b}12 forecasts early in the quarter

The RMSE in both cases is a relatively large fraction of the average rate of inflation. For 1970-73, the deflator rose at a compound annual rate of 5.7%, so the Federal Reserve RMSE is more than 60% of the average. For 1973-85, the average rate of inflation is 7.0%, and the RMSE is 66% of average inflation. Using two standard deviations as a measure of accuracy, the data suggest that neither the Federal Reserve nor the OECD could distinguish accurately between stable prices.
Wolf (1987) compared the forecasting record of fifteen private and public forecasters of the U.S. economy for the years 1983-86. The average forecast error for real GNP growth for the fifteen forecasts in each of the four years has a mean of 28%. Mean errors range from 19% (1984) to 44% (1983). For inflation, as measured by the CPI, the overall mean is higher and the range is wider. The mean error for the four years is 44% of the rate of inflation, and the mean errors range from 13% (1985) to 99% (1986). The year 1986 includes a large one-time change in the price level that temporarily reduced the measured rate of change, so the 99% error may be extreme. One-time shocks occur frequently, however. Discretionary policy or rules that depend on forecasts are subject to errors of this kind. Moreover, Wolf's data, like Artis's, show large errors in predicting the rate of inflation when the rate changes. For 1983, Wolf reports an average error of 50%.

Wolf computed a measure of overall forecast accuracy for each forecaster in each year and ranked forecasters by the accuracy of their forecasts of four variables. His measure assumes that users (and society) weight errors in each variable equally, so his results may change if forecast accuracy for unemployment and real growth are given different weights than inflation or Treasury bill rates. Using his rankings, he cannot reject the hypothesis that the ranking for each forecaster in each year is independent.

The low correlation that Wolf finds between ranks suggest that differences in the quality of forecasts may arise by chance. This inference receives support from the data in Tables 2 and 3. These show that there is some suggestion of a lower bound, in the neighborhood of 1.5%, for the RMSEs shown for inflation and real growth in the

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8The errors reported in Artis (1987) are taken from the World Economic Outlook prepared by the IMF staff. Artis computes the errors for year ahead forecasts by comparing the forecast to the first reported results. The data for annual growth rates used in the comparisons are based on revised data published by the Federal Reserve Bank of St. Louis. The difference between the first report and the revised data affects the magnitudes but does not appear to affect the qualitative conclusions based on Tables 3 and 4. Note also that the year ahead forecasts for 1973-79 were usually made in December. For 1980-85, forecasts were made in August or September.
United States. Further, several different forecast methods produce similar results. Similarity would arise if forecasters remove most of the systematic information in past data.

Remaining errors may not be entirely random. The managers of the various models often adjust their forecasts to reflect available information or perceptions. These adjustments do not appear to have much value on average; they do not reduce measured mean squared errors for real GNP relative to the autoregressive models included in the data of Tables 2 and 3. Possibly the adjustments affect errors in particular periods without changing the root mean square error or other measures of forecast accuracy.

Evidence showing negative correlation between the forecast errors obtained using different procedures would suggest that forecast errors can be reduced either by combining procedures or forecasts. Evidence of positive correlation is consistent with the hypothesis that the errors remaining in the most accurate forecasts are mainly random deviations that are missed by different models. While I have not found a systematic study, some work suggests that forecast errors for IMF, OECD and private forecasters are positively correlated. For real GNP growth and inflation forecasts in six countries, Artis (1987, pp. 51-52) finds most correlations between errors above 0.8 and many above 0.9.

Litterman (1985) published an analysis of the source of his forecast error and some evidence on the relation of errors to policy actions. He computed the effect of unanticipated policy changes in 1985 on his forecast for 1986 by comparing the model forecasts for 1986 made late in 1984 to the forecasts made approximately one year later. Since Litterman's autoregressive forecasting model adjusts only to past errors, changes in forecast values occur only when there are unanticipated changes--changes that were unanticipated from the past history of the series and related series at the time of the previous forecast. If there were no unanticipated changes in 1985, the forecast for 1986 would remain the same.

After adjusting for the relatively small changes in forecast values arising from the major revision of published historical time series, Litterman (1985, Table 5) shows
that most of the new information in 1985 was information about unanticipated monetary policy actions. Specifically, he reports that 80% of the change in his forecast of real growth and 50% of the change in the forecast of inflation were the consequences of differences between expected and actual monetary actions in 1985. These estimates suggest that monetary policy actions account for a large part of the uncertainty and variability experienced during the sample period. Holding monetary policy constant, or otherwise making policy more predictable, would reduce this source of variability.  

**Europe and Japan**

Since differences in policy rules and in the extent of discretionary action can affect the size of forecast errors, I consider annual forecast errors for other developed countries. The results are broadly comparable to the findings for the United States, so I limit the comparison to forecasts of real output growth. Comparisons are facilitated by the availability of data on OECD and IMF forecasts for several countries and for the same time periods. These are shown in Table 4.

The IMF and OECD forecasts have very similar RMSEs for four of the six countries, and substantial differences between countries. Forecast errors by the IMF and OECD are lowest for France both absolutely and relative to the reported growth rate. Forecast errors are highest for Japan, but the growth rate is highest also, so the

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9Litterman’s quantitative estimates overstate the effect of unanticipated monetary policy action. The reason is that Litterman includes common stock prices, the value of the dollar and bond yields as well as monetary aggregates and short-term interest rates in his measure of monetary policy action. Several of these variables are affected by real shocks and by foreign nominal shocks.

10One difference that is neglected is the difference between OECD and IMF forecasts. OECD has lower errors for growth but larger errors for inflation.

11Artis (1987) measures errors from the absolute value of the first reported data. These differ from the actual growth rates reported in Table 4. The difference is shown by a comparison of absolute growth and mean absolute actual shown for each of the five countries.
relative forecast error for Japan is among the lowest.

The mean ratio of RMSE to actual growth is approximately 1.0 for the set of forecasts in Table 4. As in the United States, forecasts on average cannot distinguish booms from recessions, so they are not a useful guide for setting policies in advance of events to smooth growth. Reliance on these forecasts to direct policy would mislead policymakers at critical times. Forecast errors tend to be largest at turning points. Artis (1987) investigated the source of errors by studying the relation of forecast errors to policy changes and OPEC shocks. He found that the effects of the first OPEC shocks were largely unforeseen. This is not surprising. Like Litterman (1985), Artis also found that the effects of monetary restraint were often underestimated. Unanticipated fiscal policy changes proved relatively unimportant and often had the "wrong" sign (Artis 1987, pp. 74 and 78). Most of the errors appear to be random.

Table 4

Annual Forecast Errors, Europe and Japan

<table>
<thead>
<tr>
<th>Country</th>
<th>Time Period</th>
<th>Actual Growth</th>
<th>Mean Absolute Actual</th>
<th>RMSE</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>1969-86</td>
<td>2.4</td>
<td></td>
<td>1.9</td>
<td>Council of Econ. Experts</td>
</tr>
<tr>
<td></td>
<td>1978-86</td>
<td>1.8</td>
<td></td>
<td>0.7</td>
<td>same</td>
</tr>
<tr>
<td></td>
<td>1973-85</td>
<td>1.8</td>
<td>2.7</td>
<td>2.2</td>
<td>IMF, Artis (1987)</td>
</tr>
<tr>
<td></td>
<td>1973-85</td>
<td>1.8</td>
<td></td>
<td>1.1</td>
<td>OECD, Artis (1987)</td>
</tr>
<tr>
<td>Holland</td>
<td>1953-85</td>
<td>3.6</td>
<td></td>
<td>3.2</td>
<td>Central Econ. Plan same</td>
</tr>
<tr>
<td></td>
<td>1975-85</td>
<td>1.6</td>
<td></td>
<td>2.0</td>
<td>IMF, Artis (1987)</td>
</tr>
<tr>
<td>Japan</td>
<td>1973-85</td>
<td>4.3</td>
<td>4.7</td>
<td>3.2</td>
<td>OECD, Artis (1987)</td>
</tr>
<tr>
<td></td>
<td>1973-85</td>
<td>4.3</td>
<td></td>
<td>2.8</td>
<td>IMF</td>
</tr>
<tr>
<td>France</td>
<td>1973-85</td>
<td>2.1</td>
<td>2.5</td>
<td>1.1</td>
<td>OECD</td>
</tr>
<tr>
<td></td>
<td>1973-85</td>
<td>2.1</td>
<td></td>
<td>1.5</td>
<td>IMF</td>
</tr>
<tr>
<td></td>
<td>1973-85</td>
<td>2.0</td>
<td>3.0</td>
<td>2.5</td>
<td>OECD</td>
</tr>
<tr>
<td></td>
<td>1973-85</td>
<td>2.0</td>
<td></td>
<td>2.5</td>
<td>IMF</td>
</tr>
<tr>
<td></td>
<td>1973-85</td>
<td>1.3</td>
<td>2.4</td>
<td>1.8</td>
<td>IMF</td>
</tr>
<tr>
<td>U.K.</td>
<td>1973-85</td>
<td>1.3</td>
<td></td>
<td>1.6</td>
<td>OECD</td>
</tr>
</tbody>
</table>

Forecast errors may depend on the choice of monetary regime. Meltzer (1985) found that forecast errors for Japan declined following the shift to fluctuating exchange rates and pre-announced targets for monetary growth. The variability of annual forecast errors for Germany and Holland, based on forecasts of output by the Council of Experts and the Central Planning Bureau, also declined under the system of preannounced monetary growth, adjustable pegged rates within the EMS and fluctuating rates against other major currencies.\textsuperscript{12} For Germany, forecasts are relatively accurate. The root mean square error is less than one-half the average growth rate for the period 1978-86. It remains true, however, that policymakers who rely on forecasts to determine the time for discretionary changes would mistake booms and recessions.

Smyth (1983) studied the accuracy of OECD forecasts for seven countries -- the United States, Japan, Germany, France, the United Kingdom, Italy and Canada -- for the years 1968-79. He found no correlation between the errors and the year of the forecast, suggesting that forecast accuracy has not improved significantly but did not worsen after major currencies adopted the fluctuating rate system. Zarnowitz (1986) reports a similar result.

Smyth reports the results of several tests. He used Theil's decomposition to show that most of the errors for output growth and inflation are random. He also compared the accuracy of forecasts to a naive model, the latter a random walk using preliminary data for the preceding year to forecast real output. He found that the OECD forecast for each country is more accurate than the random walk but, as Smyth notes, all of the improvement is in 1974-76, following the first round of oil price increases. Information about the oil shock was available to private individuals as well as to public bodies, so the mechanical procedure probably overstates the error that people would have made. The results for other years suggests that any private information available to the OECD could not be translated into greater forecast accuracy.

Table 5 permits one additional set of comparisons. The table compares the

\begin{footnotesize}
\textsuperscript{12}Data for seven additional German forecasters are available, but I have not computed the root mean square errors for each forecaster.
\end{footnotesize}
mean absolute error for year ahead forecasts by government, private and international agency groups. Mean absolute errors give less weight to large errors than RMSEs, so the reported errors are lower than in previous tables. The errors by the IMF staff are

Table 5
Mean Absolute Errors, Year Ahead Forecasts
Real Output Growth, 1973-85
in percent

<table>
<thead>
<tr>
<th>Country</th>
<th>Officiala</th>
<th>Privatea</th>
<th>IMFB</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>1.4</td>
<td>1.0</td>
<td>1.4</td>
</tr>
<tr>
<td>Japan</td>
<td>1.2</td>
<td></td>
<td>1.8</td>
</tr>
<tr>
<td>France</td>
<td>1.2</td>
<td>1.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Germany</td>
<td>1.2</td>
<td>1.9</td>
<td>1.6</td>
</tr>
<tr>
<td>Italy</td>
<td></td>
<td>1.1</td>
<td>2.2</td>
</tr>
<tr>
<td>U.K.</td>
<td></td>
<td></td>
<td>1.4</td>
</tr>
</tbody>
</table>

aFor details, see source
bArtis (1987), World Economic Outlook

typically higher than domestic sources, with France an exception. None of the errors is less than 1.0; the best forecasters have been able to do on average is to make errors equal to 28% of the average rate of growth (Japan). For countries other than the U.S. and Japan, the mean absolute errors are 50% or more of the average rates of growth in Table 4 above.

Private forecasters do not make larger errors in general than official agencies. Any advantage of classified information as a guide to discretionary management either does not affect the forecast or is offset by other errors. Timing cannot fully explain these data, since similar results were found using the quarterly data in Table 2.

Table 5 also compares the U.S. to Japan and the European countries. The differences appear to be relatively small in most cases. The results for the U.S., and the implications for policy, apply as much to Europe and Japan as to the United States. Discretionary policies that rely on forecasts are likely to increase variability and uncertainty.

The comparisons are suggestive, not conclusive. We have no direct evidence
on the variability that would have resulted if a rule had been used instead of discretion
or, in the case of countries that followed a rule, the variability that would have resulted
under an alternative rule. Lucas’s (1976) critique warns us that it is difficult to compare
alternative policies. Further, forecast errors often reflect more than differences in
models, methods of forecasting and policies. Many forecasters use current information
or intuition to adjust their forecasts. These well-known problems probably do not alter
the main conclusions drawn from these comparisons.

Neither policymaking agencies nor private forecasters, using the techniques
currently available, has been able to forecast, on average, whether the economy will
be in a boom or recession one to four quarters ahead. Given that econometric
research has been relatively unsuccessful at determining whether the lag between
policy action and its effect is short or long, it is not clear whether more accurate
forecasts could be used to reduce variability and uncertainty even if economists were
capable of producing them. While one cannot dismiss the possibility that new
research may change forecast accuracy, reliance on forecasts to make discretionary
changes in policy action does not seem useful in the current state of knowledge. Even
well-intentioned efforts, based on forecasts, to dampen fluctuations can have the
opposite effect of increasing fluctuations and the uncertainty borne by consumers and
producers.

What Rule Should Be Followed?

As yet research has not provided a basis, formal or empirical, for an optimal
monetary policy. A choice of policy cannot be avoided. In the United States, for many
years, monetary policy has been discretionary; the objective given greatest weight
shifts about without a predictable pattern. This practice is common but not universal.
Some countries fix their exchange rates. A few have chosen rule-like behavior to
achieve domestic price stability or relatively low inflation.

Typically, the case for rules or rule-like policies is entirely analytic. Here, and
elsewhere, I have taken an empirical approach by presenting evidence that one of the
necessary conditions for discretionary policy changes is not satisfied. The evidence
shows that forecast accuracy is sufficiently imprecise that it cannot rule out the
possibility that destabilizing actions will be avoided. Brunner and Meltzer (1983) show
that in the 1970s, inappropriate policy actions increased variance relative to a rule.
McCallum (1987) compared variability under some alternative rules to actual
variability and showed that rule-like policies would reduce variability.

Since Keynes (1923), economists who favored the goal of internal price stability
have proposed rules for monetary policy under fluctuating (or adjustable) exchange
rates. Friedman (1959) argues that this goal is more readily achieved if the central
bank specifies the rule in terms of the money stock or its growth rate. I have long
argued that the path for monetary policy should be stated as a growth rate for the
monetary base. The base is available daily and is much less affected by institutional
changes than other measures of money.

A rule to achieve price stability must specify whether the policymaker
accommodates or reverses one-time changes in the price level resulting from
permanent changes in productivity or other one-time changes in output. A rule that
reverses permanent price changes requires the policymaker to identify all such
changes. A rule that does not reverse price level changes allows the price level to
adjust as part of the process by which the economy adjusts real values to
unanticipated supply shocks. Once adjustment is complete, real values are the same
under either rule. Differences arise during the adjustment, however. To reverse the
price level change, the policymaker must know the proper amount by which to change
money and other nominal values, so he must know structural parameters including the
size of the real wealth effect, the magnitude of the productivity shock, and the price
elasticity of aggregate supply. The public must have confidence that the policymaker
knows these magnitudes. Such confidence would be misplaced. We simply do not
know and, after several decades of empirical work in macroeconomics, we should not
expect to learn these values with enough precision to improve on market adjustment of
the price level to one-time shocks.

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13If there is an optimal rate of inflation and the optimal rate is non-zero, the rule
should be stated as an optimal rate of inflation.
Further, there is no reason why current owners of nominally denominated assets should not share in the gains and losses resulting from changes in productivity or supply shocks. One of the main benefits of price stability is that stability of anticipated prices reduces uncertainty faced by transactors, thereby lowering the risk of long-term investment. This is, of course, the argument stressed by proponents of the classical gold standard. Another main benefit is that individuals who save for retirement (or for the distant future) and those who borrow at long-term to finance housing and other durables have less reason for concern about the form in which assets are held and less reason to fear that the real value of accumulated saving will be altered by unanticipated price changes. Stability of the price level reduces these risks.

Accommodating unanticipated price level changes does not forsake these benefits. Although the price level changes, and the anticipated price level adjusts to the changes, the rational anticipation at any point is that prices remain at their current level. There is no risk of price level drift. Under the proposed rule, the oil shocks of the 1970s would have raised the price level. The negative oil shocks of the 1980s would have reversed the direction of change, without eliminating all of the prior increases, so the actual and anticipated price levels would have increased. Productivity shocks are mainly positive shocks to the level of output that lower the price level. A bunching of positive (or negative) productivity shocks to firms, if sufficiently strong, would change the measured rate of change of output and, under the proposed rule, induce a change in money. The increased money stock would reverse the effects of supply shocks to the price level. For these reasons, and others, the price level would fluctuate, but there is no reason why the rule would produce a trend of the price level in either direction.\footnote{George Von Furstenberg pointed out that the variance of the price level in period t+n would increase with n.}

The rule I have proposed in several places has two parts - one domestic, one international. To achieve domestic price stability, the rule requires that the monetary base grow at a rate equal to the difference between the moving average growth of output and the moving average rate of growth of velocity computed to the most recent
quarter for which data are available. This rule requires no assumption about trends in output or velocity. If velocity and output are approximately random walks with drift and subject to unforseen changes in the drift, this rule remains applicable. If velocity and output growth are constant, the rule converges to Friedman's rule for constant growth of money. If the drift is constant or if mean reversal is rapid, the Friedman rule yields a smaller variance of the price level. If mean reversal is relatively slow or does not occur, the adaptive rule is superior.

The international part of the rule reduces exchange rate variability. This benefit can be achieved if the major countries in international trade and finance -- the United States, Japan, Germany and perhaps the United Kingdom -- adopt compatible rules for stability of the anticipated domestic price level. The rate of growth of the monetary base would differ with the experience of each country and would change over time. Anticipated and actual exchange rates would be subject to change with changes in relative productivity growth, rates of growth of intermediation, differences in saving rates, in expected returns, in labor-leisure choice or other real changes. Prices would continue to fluctuate, but anticipated price levels would be constant in all countries that follow the rule, so the rule eliminates this source of short-term instability in real and nominal exchange rates. The remaining changes in real exchange rates would work to facilitate the efficient allocation of resources in response to changes in tastes and technology at home and abroad.

An international rule for compatible monetary policies creates a public good. Smaller countries could choose to import enhanced price and exchange rate stability by fixing their exchange rate to a basket of the currencies of major countries or to one of those currencies. There would be no international agreement and no reason to impose the costs of a coordinating organization. Each country would choose its own course. If all countries choose independent policies, or make frequent discretionary changes, uncertainty would not be at a minimum.

There are opportunities for cheating as with any agreement. A country may choose to expand money growth to gain some temporary increase in output and employment. Cheating cannot be wholly avoided. Monitoring is improved, however, by
choosing the monetary base as the policy variable and by providing prompt publication of data for the base. The base can be controlled with precision by any central bank that chooses to do so. Prompt publication of the base provides the public with information to protect their wealth against loss from inflation.

Protection of individual wealth does not avoid the social cost of variability. As discussion of the gold standard has long recognized, rules can be abandoned in periods of crisis. There are opportunities for cheating in many ways such as shaving gold coins in one case or raising the growth rate of the base in the other. A public choice perspective requires some concern for incentives which raise the cost of departing from the rule.

On several occasions I have proposed a system of incentives to enforce a monetary rule. My specific proposal treats the problems of responsibility and accountability. An independent central bank has responsibility for monetary policy and inflation but it is not accountable directly to the public. If monetary growth produces inflation, recessions and uncertainty, the public holds elected officials accountable, not central bank governors.

The solution is to make the monetary authority accountable for its actions without making the monetary authority subservient to elected officials. An independent central bank has some merit. Since it is not directly under the control of political authorities it can, but does not always, protect the public from inflation. The value of independence is increased if the central bank is accountable.

My proposal allows the central bank to choose the growth rate of money consistent with the announced monetary rule. If the central bank fails to keep the growth of the base at (or near) the announced rate, the governor (or governors) must resign. The president can accept responsibility for the deviation by reappointing the governor if he is satisfied that the deviation is appropriate.

Resignation was, at one time, a standard response for a minister of finance whose policies had led to devaluation of the currency. The proposal would produce a similar result. Excessive money growth would devalue the currency relative to other countries following compatible rules or pursuing less inflationary policy. Failure to
follow the rule would require resignation. The rule would be symmetric; too little money
growth would require resignation also. Recently, New Zealand adopted a process of
this kind; one can hope that their action will succeed and spread.
References


Revie w, Federal Reserve Bank of Minneapolis (Fall), 2-13.

