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Goals, Guidelines, and Constraints Facing Monetary Policymakers

Proceedings of a Conference
Held in June 1994

Jeffrey C. Fuhrer
Editor

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This conference addressed three broad questions about the conduct of monetary policy. First, how efficiently has U.S. policy balanced the goals of price stability and full employment? Second, have rapidly changing financial markets made the use of intermediate targets, such as monetary aggregates, obsolete? Third, what can domestic policymakers learn from the tactics and strategies employed by foreign central banks? A concluding panel suggested improvements to monetary policy, in light of the conclusions drawn in the previous sessions.

Goals, Guidelines, and Constraints Facing Monetary Policymakers: An Overview

*Jeffrey C. Fuhrer**

The rate of inflation in the consumer price index over the past three years has been low and stable, averaging 2.8 percent and never exceeding that average by more than one-half percentage point in any quarter. Attending this success on the inflation front has been a gradual decline in the unemployment rate to a level that most economists agree is consistent with full employment. In broad terms, the Fed appears to have achieved the low-inflation "soft landing" that it sought.

Attaining this desirable economic state was not an easy task. Along the way, the Federal Reserve had to balance the often competing short-run goals of price stability and full employment, relying on a broad set of indicators to guide monetary policy in a changing financial environment. Maintaining this desirable state presents significant challenges as well. As Donald Kohn suggests in his comments on a paper by William Poole, "a central bank believing that it had learned sufficiently from its history to guarantee that it would not repeat its mistakes would be suffering a serious attack of hubris."

Looking forward, central bankers in the United States and abroad must grapple with a broad array of questions about how best to conduct monetary policy. How much should the goal of price stability be emphasized relative to the goal of employment stability? Does central bank independence aid in achieving either or both of these goals? Does a stable, short-run trade-off between inflation and unemployment exist, and can it be exploited by the central bank? And whether such a short-run trade-off exists or not, is there a long-run trade-off in the variability of employment and inflation? What instrument should the

*Assistant Vice President and Economist, Federal Reserve Bank of Boston.

central bank manipulate in order to achieve its short-run and long-run goals? What indicators will prove most reliable in signalling the level and direction of change of the central bank's ultimate goals?

In June of 1994, the Federal Reserve Bank of Boston sponsored a conference to address these questions. The five papers presented at the conference fall into three broad areas. First, John Taylor and Jeffrey Fuhrer each discuss the efficiency of U.S. monetary policy, taking as given that policy has both inflation and (in the short run) output targets, and that monetary policy adjusts an interest rate instrument in response to deviations of inflation and output from their target values. William Poole's paper (which by itself constitutes the second group) suggests ways in which the monetary aggregates may still be useful for the conduct of monetary policy. The third group, which comprises papers by Charles Goodhart and José Viñals and by Guy Debelle and Stanley Fischer, examines international evidence in order to shed light on the questions of central bank independence and accountability. A concluding panel considered ways in which monetary policy could be improved, in light of the discussion in the preceding sessions.

As one might expect, it was impossible to reach a consensus on many of the issues. Opinion ranged widely about how much emphasis should be placed on stabilizing employment relative to prices. One view suggested that the Fed cannot reliably affect any real variables and thus should not try to control them; the other worried about the seemingly exclusive focus on price stability and suggested that monetary policy must be responsible for prompt and appropriate management of real variables. Laurence Ball and Jeffrey Fuhrer reached exactly opposite conclusions about whether gradual or "cold turkey" disinflations were less disruptive. Finally, the assembled group disagreed about the nature of the "monetary transmission mechanism"—how changes in monetary policy instruments, such as the federal funds rate, affect the ultimate goals of policy.

Still, several broad conclusions emerged from the proceedings. First, many conference participants agreed that U.S. monetary policy had been quite successful over the past 15 years. The use of an interest rate instrument to bring inflation under control while minimizing disruption to output and employment has been a winning strategy. Second, most agreed that the role of the monetary aggregates in the conduct of monetary policy should remain downgraded. Finally, most conference participants agreed with the broad conclusions of the Debelle and Fischer paper, namely that clear articulation of the central bank's goals is desirable, while constraints that dictate how the goals should be achieved are not desirable.

How Efficient Has Monetary Policy Been?

John Taylor's paper, "The Inflation/Output Variability Trade-off Revisited," considers the trade-offs between inflation and output that monetary policy faces in pursuing its ultimate goals. If no long-run trade-off exists between inflation and real output, as Milton Friedman and Edmund Phelps first suggested and most economists today accept, and if we acknowledge considerable uncertainty about the nature of the short-run inflation/output trade-off, then is there any such trade-off that may be reliably exploited by monetary policy? If not, then monetary policy should focus exclusively on inflation (or the price level) and ignore the consequences, if any, for the real economy.

The Inflation/Output Variability Trade-off

Taylor suggests that we consider the inflation/output *variability* trade-off. Its essence is straightforward: Keeping the inflation rate extremely stable about a target may entail accepting much greater fluctuations of GDP about potential (or unemployment about the natural rate), even in the long run. If so, monetary policy may wish to balance its effects on inflation and output variability.

The Taylor paper provides a simple motivation for the long-run trade-off. The motivation is based on a textbook macroeconomic model in which output depends on real interest rates, inflation responds to deviations of GDP from potential, and monetary policy sets the short-term nominal interest rate in response to deviations of inflation from target and deviations of output from potential. The combination of the aggregate demand equation and the policy response implies that the output gap is negatively related to deviations of inflation from its target: If inflation exceeds its target, monetary policy will raise interest rates and depress output.

This simple characterization of the macroeconomy makes it easy to see why a trade-off between inflation and output variability may exist. When the economy is subjected to a price shock that raises the inflation rate, for example, the amount of output disruption that will occur depends on the response of monetary policy to inflation and output deviations. The more vigorously the Fed moves the interest rate to offset deviations of output from potential, the smaller will be the variability of output and the larger will be the variability of inflation. The converse is also true. Thus this simple model, coupled with alternative monetary policy behaviors, suggests a trade-off between the variability of inflation and the variability of output that monetary policymakers may be able to exploit in the long run. Based on rough calibration of the model to recent history, Taylor suggests that an approximately balanced response to

inflation and output deviations would yield roughly equal variance of inflation and output.

Taylor also discusses other potential long-run trade-offs, especially the effect of inflation on potential GDP, which is ruled out in the simple model that he uses. Reviewing work by Fischer (1993) and Motley (1994), he suggests that the link between inflation and productivity growth merits additional study.

Finally, Taylor considers the possibility that output fluctuations affect long-run growth, an idea that dates back to Schumpeter (1939). The notion that recessions might provide opportunities for firms to make structural adjustments that enhance productivity—a "cleansing effect"—has recently been advanced by Davis and Haltiwanger (1990) and Caballero and Hammour (1991). Taylor finds this link from fluctuations to growth unpersuasive, since a good deal of restructuring (through "job destruction") occurs during years when output is at or above potential. In addition, he suggests that greater output variability would have no net effect on the amount of restructuring, as larger positive fluctuations would decrease job destruction, while larger negative fluctuations would increase job destruction. The net effect of increased variability on productivity-enhancing restructuring would be zero.

Discussant Laurence Ball agrees with Taylor that monetary policymakers ought to focus more on medium- to long-term strategy than on the short-run trade-offs involved in the Phillips curve. Thus, the attention to the variability of inflation and output is appropriate. He also applauds the simplicity of the model used to motivate the variability trade-off but cautions that, while the model may be quite useful for normative purposes, it may be less useful for positive purposes. The reason is that the model assumes that inflation always reverts to the monetary authority's fixed inflation target whereas, over the past several decades, the inflation target appears to have moved around with a good deal of persistence. Understanding monetary policy has largely been a matter of understanding why the inflation target has changed, Ball suggests. Thus, while the model may fit the behavior of the economy since the late 1980s quite well, it is unlikely to fare well in explaining the behavior of the economy from the 1970s, when the inflation target apparently drifted up, through the 1980s, when the target declined precipitously under the direction of Fed Chairman Paul Volcker.

Ball, however, expresses some doubt that policymakers face a "painful trade-off between more variable output and more variable inflation." He notes that if demand shocks—shocks to Taylor's I-S curve and policy rule—are the only important sources of fluctuations, then it is, in principle, possible for the Fed to eliminate all of the variability in both output and inflation. In Taylor's simple model, in the face of a

demand shock—an unexpected surge in defense expenditures, for example—the Fed can, by raising the interest rate tremendously, offset any effect of the shock on output *and* on inflation. Ball recognizes that Taylor's model abstracts from important features of the economy that make it very difficult in practice for policymakers to completely offset demand shocks.

In the face of significant supply shocks—unexpected increases in the inflation rate in Taylor's model—Ball professes agnosticism about the presence of a trade-off between inflation and output variability. He notes, however, that in Taylor's simple model, the sum of the deviations of output from potential after a supply shock is invariant to the particular policy response chosen. The *timing* of the deviations can be affected: A policy that puts greater weight on output will spread the output deviations over a longer, smoother path. This reduces the variance of output, but not the sum of the output losses. Simply put, Ball questions whether two years of 1 percent lower output are preferable to one year of 2 percent lower output. Measured by variability, the first outcome would be preferred.

Finally, Ball suggests that a policy that tried to minimize output variability might not actually produce less output loss, although Taylor's model implies that it would. The reason is related to Ball's finding (Ball 1994) that moving inflation back gradually to its target is more costly than a rapid decrease in inflation. If so, then a policy that tried to minimize output variability by gradually reducing inflation after a supply shock could actually *increase* the output loss.

Optimal Policy Responses to Inflation and Output Fluctuations

Jeffrey Fuhrer's paper on "Optimal Monetary Policy and the Sacrifice Ratio" focuses on an age-old question: Is it less costly to disinflate gradually, or rapidly? In the small macro model developed previously in Fuhrer and Moore (1994), he finds that gradual disinflation is less costly. The reason is that, in a world in which wages and prices are predetermined by contracts, previously negotiated contract wages and prices cannot adjust immediately to the announcement of a disinflation. The more quickly and vigorously the Fed disinflates, the more contracts it catches unexpired. When these contract wages and prices cannot adjust to a monetary contraction, quantities of labor hired and goods produced must adjust, and thus the disinflation causes more disruption to the real side of the economy.

According to estimates presented in the paper, the U.S. central bank (the Federal Reserve) has recently chosen monetary policies that emphasize inflation far more than they emphasize deviations of output from potential. The consequence has been that the "sacrifice ratio"—the

shortfall of output below potential, per percentage point decrease in the inflation rate—has been quite high during the disinflations of the past 12 years. The paper suggests that the sacrifice ratio could have been lowered substantially by increasing the emphasis on output fluctuations in the Fed's reaction function.

If the Fed were already responding optimally to inflation and output fluctuations, increasing emphasis on output fluctuations would of necessity yield improvements in the variability of output at the expense of increased variability of inflation about its target. But could the responses required to reduce the sacrifice ratio also yield decreases in the variability of both output and inflation about their targets? Fuhrer argues that they could. Because vigorous inflation responses of the Fed have been suboptimal—they did not result in the smallest inflation and output variability combination attainable—the Fed could alter its responses to inflation and output so as to lower the sacrifice ratio *and* decrease the variability of inflation about its target. Thus, the Fed could achieve improvement on all fronts by suitable reaction to its ultimate goals.

N. Gregory Mankiw finds three broad areas of disagreement with Fuhrer's paper. The first is motivation: Why should we care about the sacrifice ratio in the way Fuhrer has defined it? In the typical discussion of the sacrifice ratio, one wishes to minimize the output loss during a one-time reduction in the inflation rate. But this paper looks at the ongoing effect of a particular monetary policy rule on the sacrifice ratio. In this context, a larger sacrifice ratio means a larger output loss when the inflation target falls, but it also implies a larger output gain when the inflation target rises. A better measure for this type of ongoing concern for output volatility is the variance of inflation, also considered in the paper.

The second disagreement is with respect to methodology. Mankiw suggests that, because expectations enter the model only through the wage contracting mechanism and through the effect of long-term interest rates in the I-S curve, the model may still be subject to instability across policy regimes, that is, the Lucas critique. In addition, Mankiw finds some of the identifying restrictions imposed by the rational expectations assumption in this model to be akin to Sims's "incredible" identifying assumptions. Mankiw stresses that we do not know enough about the price-adjustment process to trust the policy conclusions that arise from a particular rendering of the sticky-price paradigm. He argues that we need to find rules that are robust across a wide variety of competing models.

Finally, Mankiw doubts the paper's main conclusion that gradualism is less costly than cold turkey. Citing cross-country comparisons by Ball (1994) that impose little structure on the data, he feels more comfortable with the empirical regularity found there, which indicates

that more rapid disinflations are less costly. In addition, Mankiw argues that credibility effects, ignored in the Fuhrer paper, may be extremely important in determining the cost of disinflations. He cites the disparity between the Council of Economic Advisers' forecasts of inflation for the five years beginning in 1981 and the actual outcomes for those years as evidence that the Volcker policy was "not credible even to the Administration that had appointed Volcker" and thus may have played a role in the recession that accompanied the disinflation.

Summary discussant Martin Eichenbaum points out the similarities between the frameworks used by the Fuhrer and Taylor papers. Both assume that monetary policy uses the short-term nominal rate as its instrument, that the inflation rate responds sluggishly to aggregate demand, that policy-induced rises in the short-term rates are mirrored in long-term real rates, that long-term real rates affect aggregate demand, and that monetary policy affects inflation through its effect on aggregate demand.

Eichenbaum points out that the common structure employed by Fuhrer and Taylor ignores many of the financial market imperfections—credit crunches, liquidity constraints, and the like—that academics and Fed Chairman Alan Greenspan have alluded to in recent policy discussions. He considers the lack of direct evidence in support of the assumed monetary transmission a weakness of both papers.

Second, Eichenbaum suggests that while the models used in both the Taylor and Fuhrer papers imply an inflation variability/output variability trade-off, both papers should have included some direct evidence of the trade-off.

Eichenbaum then explores a vector autoregression (VAR) analysis of the three variables considered in the Taylor and Fuhrer papers. He finds that, for a particular ordering of the variables in the VAR, a positive shock to the funds rate causes a *rise* in the inflation rate. He suggests that this puzzling correlation arises because commodity prices are excluded from the reaction function. The positive response of inflation to an increase in the funds rate in the three-variable model is really masking a positive response of the funds rate to a rise in commodity prices—which preceded rises in inflation in the 1970s—and a subsequent fall in inflation.[1] Thus, Eichenbaum concludes that any empirical rendering of a Fed reaction function should include a reaction to the forward-looking information in commodity prices.

[1] In contrast, the impulse responses for Fuhrer's model reported in Fuhrer and Moore (1994) show that inflation *falls* following a positive shock to the funds rate.

Comparing Direct and Intermediate Targeting

William Poole provides a monetarist perspective on the question of where monetary aggregates should fit into the current policy process. Focusing on the past dozen years, Poole acknowledges both the problems with the behavior of monetary aggregates and the success in using an interest rate instrument to conduct monetary policy. However, he counsels that recent experience does not preclude effective use of a monetary aggregate in the conduct of monetary policy. He suggests that "there is a strong case for paying much more attention to M1 than has been true in recent years."

Poole suggests two explanations for the breakdown between money growth and inflation in recent years. The first is that, in an environment of low inflation and low nominal interest rates, the penalty for holding non-interest-bearing money is small. As a result, fluctuations in the stock of money created by the central bank are largely absorbed by the public; they do not translate into higher inflation.[2] The second is that a consequence of a well-executed monetary policy is that the observed correlation between monetary policy instruments and policy goals will be zero. If the Fed has moved its policy instruments (monetary aggregates) so as to pin its ultimate goals at their targets, then one will not be able to observe any correlation between the instrument settings and the ultimate goal, since the goal has not moved from its target. A corollary to this proposition is that a search for the best monetary aggregate by comparing correlations of aggregates to policy goals will be unsuccessful if the Fed is doing a good job.

Poole points out that monetary policy when using an interest rate instrument is less predictable and more difficult to communicate to the public than monetary policy when using a monetary instrument. Generally, a 1 percentage point decrease in money growth yields a 1 percentage point decrease in inflation and nominal interest rates in the long run. The simplicity of the monetary prescription for lowering inflation is lost when using an interest rate instrument, however. In order to lower inflation, the Fed must first *raise* nominal interest rates, then lower them. And Poole argues that we cannot say with any confidence how much of an increase in rates is required to lower the inflation rate 1 percentage point.

Poole suggests that the difficulty of the Fed's job under an interest rate regime is compounded by the interaction of the Fed's expectation of

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[2] One standard description of the link from money creation to increased inflation is as follows. If the Fed wishes to increase the stock of money, it must induce the public to hold the money by reducing the cost of holding money—the interest rate on alternative means of storing value. A fall in the interest rate raises demand for interest-sensitive spending, which may increase aggregate demand sufficiently to put upward pressure on prices.

how its actions will affect the credit markets with the credit markets' expectations of how the Fed will act. He asserts that it may be impossible to build a model that incorporates this simultaneity of expectations and implies a reliable rule of thumb such as the 1 to 1 rule implied by a monetary aggregates approach.

A Proposed New Role for Money Growth Targets

In light of the preceding observations, Poole proposes a modification of current monetary policy that builds on the successful use of the interest rate instrument but allows a role for money growth targets. He suggests that the Fed should allow the federal funds rate to "vary within a considerably wider band, perhaps 100 basis points, between FOMC meetings," as the demand for bank reserves fluctuates, keeping the supply of bank reserves on a steady path. The advantages of this policy, according to Poole, would be twofold. First, the transition to higher or lower interest rates would be smoother than the discontinuous path followed by rates under the current regime. Second, movements of credit market rates could once again provide important information to the Fed, as rates would reflect the markets' assessments of the significance of incoming data, not only "market speculation on how the Fed will respond to the data."

Benjamin Friedman reads the history of using the monetary aggregates to guide monetary policy somewhat differently. In response to Poole's two-pronged defense of monetary aggregate targeting, Friedman voices several objections. First, he argues that the objection that "no baseline prediction exists . . . as to how much . . . inflation will rise if the central bank, say, lowers interest rates by 1 percentage point" is invalid; the two papers in the first session of this conference provide examples of models that do exactly that. Conversely, a stable money demand function, the cornerstone of the baseline money model, is nearly impossible to find in the U.S. data. Thus, the empirical support for the interest rate approach is arguably stronger than that for the monetary aggregates approach. In addition, Poole's objection to a policy that *permanently* fixes the nominal interest rate carries little force, because no one has ever suggested that the central bank pursue such a policy.

Second, Friedman dismisses Poole's explanation of the vanishing money–income correlation. Friedman points out that, even if the Fed had pursued an optimal monetary policy, the *partial* correlation between money and income—the correlation holding the effects of other variables on income constant—would not be driven to zero; in fact, it would increase. Thus, the estimates of the partial correlation between money and income are not consistent with Poole's optimal monetary policy story.

Donald Kohn focuses on Poole's proposal to fix the supply of reserves and allow the federal funds rate to fluctuate within a band in response to changes in the demand for reserves. Kohn argues that the unpredictability in the demand for reserves would yield a volatile funds rate that often hit the upper or lower end of its band, imposing significant uncertainty on financial markets. He also asserts that it would be neither more nor less difficult to obtain information from asset prices under the fluctuating funds rate regime; market prices would still be determined in part by expectations of short-rate movements, now with the added burden of anticipating reserves demand.

Policymakers have drawn two important lessons from the experience of the past 25 years, Kohn argues. First, no feasible alternative is available to the present practice of using a short-term interest rate as their policy instrument and looking at all kinds of information to gauge their progress. Second, given the lags in the monetary transmission mechanism, policymakers must be ready to move their instrument quickly in response to new information.

Lessons from International Experience

Charles Goodhart and José Viñals's paper "Strategy and Tactics of Monetary Policy: Examples from Europe and the Antipodes" provides a comprehensive taxonomy of the current and projected issues facing monetary policymakers in Europe, Canada, and Australia/New Zealand. They first document that in virtually every country, price stability has become the primary objective for the central bank. Interestingly, where legislation has accompanied the focus on price stability, it is rare to find a precise definition of price stability. Most, although not all, arrangements allow the central bank to respond to other economic conditions, often with the stipulation that the prime directive be accomplished first.

Price Stability: The Central Bank's Primary Goal

As Goodhart and Viñals note, much of the support for an independent central bank with a primary objective of price stability has come from the theoretical economics literature. The time inconsistency argument, for example, asserts that central banks under pressure from the electorate will consistently accept unexpected output gains at the cost of increased inflation, thus building in an inflationary bias. While this bias towards inflating is widely cited as an argument in favor of legislating price stability as the only goal of the central bank, relatively little empirical backing for the inflationary bias exists, and thus some have questioned the exclusive focus on price stability. As an alternative,

many economists have suggested a nominal GDP target, which gives equal weight to prices and to deviations of output from potential. Goodhart and Viñals point out that central banks nonetheless have overwhelmingly opted for the price stability goal, perhaps because potential GDP is hard to estimate; data on GDP are available only with a lag and are subject to revision; and a focus on price stability underscores that central banks cannot be responsible for real variables in the long run.

The paper goes on to review the more detailed issues pertaining to the achievement of price stability: Should the central bank target the price level or the rate of change of prices? Should central banks adopt target ranges for prices, rather than point targets? At what horizon should the central bank announce that it intends to attain its goal? Which index (producer prices versus consumer prices, for example) should be used as the measure of price performance? Should explicit contracts that reward central bankers for good performance be used to provide the incentive to achieve the goal?

Next, Goodhart and Viñals address the merits of direct versus intermediate targets in achieving price stability. Citing Persson and Tabellini, they argue that "An inflation contract . . . generally dominates contracts based on intermediate monetary targets." Nonetheless, relatively few direct inflation targets are observed among central banks clearly concerned with price stability. Apart from historical accident, one reason may be that the effect of monetary policy on prices occurs with considerably more delay than the effect on monetary aggregates or other financial variables. Thus, use of a financial aggregate as an intermediate target could provide an earlier signal that policy has deviated from the agreed-upon course. Most European countries have made the exchange rate their primary target, on the grounds that it responds instantaneously to interest rates and is widely understood by the public. The larger and less open countries, such as Germany, France, and the United Kingdom, have chosen monetary targets, primarily in their belief that monetary aggregates are reliably linked to nominal variables, can be controlled by the central bank, convey information to the public about the stance of monetary policy, and thus facilitate monitoring by the public of monetary policy.

Goodhart and Viñals point out the possibility of a *deflationary bias* among central banks committed to price stability.[3] Given uncertainty about both the structure of the economy and the shocks that might perturb the economy during the delay between policy action and its effect on prices, central banks may attempt to lower inflation to its target

[3] This hypothesis provides an interesting counterpoint to the *inflationary bias* of central banks suggested by Barro and Gordon (1983).

level quickly, so as not to suffer derailment at the hands of unpredictable events. In fact, the experience in both Canada and New Zealand is consistent with this hypothesis: Both central banks have reduced inflation to, or below, their target levels in advance of the agreed horizon.

Finally, Goodhart and Viñals discuss the impact of a monetary union on monetary strategy and tactics in Europe. Countries currently differ significantly with regard to implementation of monetary policy: Reserve requirements, the discount window, and open market operations are used to differing degrees across Europe. Considering the diversity of current practice, the need to unify both policy formulation and policy execution remains a daunting task for the European Monetary Institute.

Richard Cooper points out that the excellent price stability performances by the central banks in the United States and Japan—the first an independent bank with no explicit targets, the second a central bank with little independence—run counter to the generalizations drawn in the Goodhart and Viñals paper. He also criticizes the easy acceptance that Goodhart and Viñals grant to price stability as the central bank's primary objective. Cooper stresses the importance of the central bank's role in maintaining the smooth functioning of the financial system in the face of large real and financial shocks, and also the "lubrication" that inflation can provide in allowing real wage adjustments when nominal wages are difficult to reduce.

Cooper points out the importance of the distinction between the independence and the accountability of a central bank. The central banks of the United States and Germany, he claims, are reasonably independent of the political process, but they are still accountable to it. The design of the European System of Central Banks essentially makes the central bank completely independent of the political process. Cooper finds this institutional arrangement "highly undesirable" because it removes a degree of longer-term accountability to the political process from the central bank's actions. Finally, he dismisses other rationalizations of the focus on price stability—money only affects prices in the long run, inflation decreases real growth and productivity—as lacking in empirical support.

The Costs and Benefits of Central Bank Independence

Guy Debelle and Stanley Fischer's paper "How Independent Should a Central Bank Be?" answers the question with a blend of sensible interpretation of empirical regularities and compact theoretical analysis. The authors stress the multidimensional nature of central bank independence. In particular, they distinguish between *goal* independence and *instrument* independence. They argue that the optimal

outcome may be one in which a legislative body sets the central bank's *goals*, but the central bank sets its *instruments* however it believes it can best attain the prescribed goals.

Debelle and Fischer begin by reviewing the results that relate measures of central bank independence and macroeconomic outcomes for various countries. They find that independence is negatively correlated with the rate of inflation: Countries with more independent central banks generally experience lower inflation rates. In addition, countries with greater central bank independence appear to attain better economic performance, perhaps because they are generally better disciplined and thus suffer fewer and smaller self-inflicted shocks. Thus, independence appears to be a "free lunch": Increased central bank independence yields better inflation outcomes with no loss to output.

Having said this, Debelle and Fischer turn to a comparison of German and U.S. performance during recent disinflations. Many believe that when a more credible central bank announces a disinflation, expected inflation will fall, prices will adjust in line with the newly expected inflation rate, and output will not suffer. Thus disinflations should be noticeably less costly in countries with credible central banks. The Bundesbank—widely viewed as the most credible central bank in the world—should have earned a "credibility bonus" that would allow it to disinflate with less cost than a central bank without such credibility. Debelle and Fischer, drawing on work by Ball (1994), find that German disinflation has been purchased at a *higher* cost than U.S. disinflation, particularly in the case of the 1981–86 episode. In addition, they find that this relationship extends beyond the U.S.-German comparison. For the countries in their sample, the output loss associated with a disinflation is higher for countries with greater central bank independence. This finding suggests a cost to greater independence, and is consistent with their conclusion that independent central banks must be held accountable for their actions, so that they do not pursue price stability to the exclusion of aggregate demand management.

In discussing Debelle and Fischer's paper, Robert Hall points out an intriguing irony in the evolution of macroeconomic theory and monetary policy implementation. Soon after the academic community warned of the inherent inflationary bias of central banks—which arises "for the same reason that a judge will impose too lenient a sentence on a miscreant—the crime has already been committed and the sentence can't deter it"—central banks proceeded to relentlessly wring inflation from most of the developed countries in the world. Thus, the prediction made by believers in the inflationary bias not only was not borne out, it was sharply contradicted by central banks around the world.

Hall regards the conclusions drawn by the Debelle and Fischer paper as "schizophrenic" with regard to the relationship between central bank independence and output volatility. Early in the paper,

they suggest that the pursuit of hawkish policies has no cost in terms of real performance. On the other hand, their final figure shows that hawkish countries appear to have more severe recessions. Germany and the United States have low output *variances* but the largest output *sacrifice ratios* during disinflations. Thus, any conclusion about the costs of maintaining central bank independence depends critically on the measure of output loss used.

With regard to the theoretical section of the paper, Hall points out that the Debelle-Fischer model violates Friedman's natural rate law. Sustained and fully anticipated inflation stimulates output in their model and creates a bias towards inflationary monetary policies.

Finally, Hall emphasizes that he agrees with the basic conclusion of the paper. We should not appoint central bankers who reflect our own preferences, since they will tend to produce too much inflation. One approach is to appoint inflation hawks, as in Rogoff (1985); the problem with this approach is that hawks will consistently underrespond to recessions. The best solution is to appoint central bankers with our preferences and build in incentives that penalize chronic inflation.

Panel Discussion

The conference closed with a panel discussion among five eminent macroeconomists. The panel revisited and expanded upon many of the themes taken up in the preceding sessions.

Paul Samuelson warns against lashing ourselves to the mast of a fixed policy rule; having seen any number of proposed rules come and go, he is skeptical that any rule is likely to perform well in practice. A little good sense goes much further. He sees no necessity that the Fed pursue a single goal, arguing that "God gave us two eyes and we ought to use them both." Rather, he suggests that to run the Fed, you need to focus on both the price level and real output profiles. He argues against reading too much from movements in the bond markets; they are, after all, only a reflection of our own actions. To do so would be to behave like a monkey who discovers his reflection in the mirror and "thinks that by looking at the reactions of that monkey—including its surprises—he is getting new information." Finally, he counsels against trying to isolate the central bank too much from the democratic process. This strategy cannot work in the long run; if the people are sufficiently displeased with the actions of the central bank, any legislation that shields the Fed will be overturned.

James Tobin agrees with many other participants that monetary policy did "pretty well" in the Volcker era. However, he observes that the economy has spent considerably more years producing below its potential than above it. Part of the explanation for this phenomenon,

Tobin asserts, is that the public believes that a recovery is defined as a period of nonnegative growth in GDP, instead of growth at or above the rate of potential. Tobin suggests that the result of this misconception is that "pressure for expansionary policy vanishes once the quarterly real growth report is positive." Tobin advises further that, because the link between the federal funds rate and the real economy is somewhat tenuous, the Fed should consider conducting open market operations in longer maturities that are "closer to the points of meaningful contact between the financial and real economies."

Tobin expresses dismay at the widely supported proposition that central banks ought to ignore real growth and employment and focus exclusively on price stability. Monetary policy must worry about real outcomes, Tobin argues, because it is unlikely that fiscal policy will be flexible enough to effectively manage them. Finally, Tobin cautions against using zero inflation as the default target, citing several arguments—the downward rigidity of nominal wages, the policy constraint of the zero floor of nominal interest rates, and upward biases in standard measures of inflation—in favor of a *positive* target rate of inflation.

Robert Barro urged the central bank to focus exclusively on control of nominal variables such as the price level, monetary aggregates, and nominal GDP, rather than real variables such as employment and real GDP. Nominal variables are the proper domain of monetary policy, he asserts, because monetary policy has "uncertain, and usually short-lived and minor, influences over . . . real variables." But for a price stabilization program to be successful, it must be attended by a credible commitment to the goal. Otherwise, the temptation will always be to accept ex post the real-side advantages that attend unexpected and unfavorable price shocks, thus deviating from the path of price stability. A commitment will likely be viewed as more credible the more binding are its legislative underpinnings; therefore, Barro cites the growing support of legislated, independent central banks as a reasonable means of committing to a rule.

Lyle Gramley also emphasized the successes of monetary policy in the 1980s, suggesting that they were attributable to the sharper focus on price stability as the goal of monetary policy, and to more forward-looking monetary policy. In addition, Gramley strongly advocates the use of an interest rate instrument to conduct monetary policy. This would decrease the cost to businesses of highly variable interest rates and improve overall performance relative to a monetary aggregates strategy. Finally, he argues for legislated definition of the Fed's goals, as suggested by Debelle and Fischer.

Bennett McCallum suggests that the Fed use policy rules, not as external constraints imposed on policymakers' behavior, but as benchmarks for use in the decision-making process. McCallum favors a rule in

which the monetary base is adjusted so as to attain a nominal GDP target. He suggests a GDP target because keeping GDP growth close to target would ensure a low average rate of inflation; the same cannot be said of achieving a target growth rate for a monetary aggregate. Using the base as the policy instrument is desirable, McCallum argues, primarily because it requires a very simple policy rule: Increase base growth when nominal GDP is below target, and decrease it when nominal GDP is above target. By contrast, an interest rate instrument requires a more complex rule, in part because what constitutes a restrictive interest rate depends on the rate of inflation and the state of the rest of the economy. For example, McCallum cites the confusing rule he tells his students: "If the Fed wants interest rates to be lower [through lower inflation], then it must raise the interest rate." McCallum has found that, in model simulations, his monetary base rule performs quite well.

Conclusion

At the first Federal Reserve Bank of Boston conference in 1969, Paul Samuelson opened his comments with the declaration: "The central issue that is debated these days in connection with macro-economics is the doctrine of monetarism . . . the belief that the primary determinant of the state of macro-economic aggregate demand . . . is money." Twenty-five years later, the status of money in the thirty-eighth conference is far from central; indeed, William Poole's paper strives hard to find *any* role for the monetary aggregates in the conduct of monetary policy.

In his opening remarks for the 1978 Federal Reserve Bank Conference, Federal Reserve Bank of Boston President Frank Morris expressed dismay that "it will be a long time before we again have the complete confidence which we had in the early 1960s—that we knew exactly what we were doing." Judging by the comments of many of the 1994 conference's participants, we should have regained in the 1990s some of the confidence that we lost in the 1970s: "the Fed has performed well indeed in recent years" (William Poole); "the results of monetary policy in the 1980s were remarkably good" (Lyle Gramley). At the time of the conference, it appeared that inflation was under control, real growth was positive and sustainable, and the Fed had found a policy strategy that could keep it that way.

Nevertheless, participants expressed concern about whether the current success could be maintained in a dynamic, changing economy. As this conference pointed out, we are still quite ignorant about much of the way the economy works. Economists do not agree on the degree of emphasis monetary policy should place on prices versus output; they do

not agree on the size of the output loss associated with further decreases in the inflation rate, or how to minimize that loss; and they do not agree on the mechanism by which monetary policy affects output and inflation. If monetary policy had to respond to a sizable supply shock, for example, these areas of ignorance would become more obvious weaknesses.

As with the 1978 conference, we did not expect this conference to produce the new synthesis that would dispel our ignorance. But we hoped that it would, as Frank Morris hoped, "generate a building block or two upon which a new synthesis will be based." The building blocks that emerged from this conference include a beginning understanding of the inflation/output *variability* trade-off that monetary policymakers face, a better understanding of the consequences of using a short-term interest rate as the instrument of monetary policy, and preliminary international evidence on the costs and benefits of central bank independence.

References

Ball, Laurence. 1994. "What Determines the Sacrifice Ratio?" In N. Gregory Mankiw, ed., *Monetary Policy*. Chicago: University of Chicago Press, pp. 155–82.

Barro, Robert and David Gordon. 1983. "A Positive Theory of Monetary Policy in a Natural Rate Model." *Journal of Political Economy*, vol. 91, no. 4 (August), pp. 589–610.

Caballero, Ricardo, and Mohamad L. Hammour. 1991. "The Cleansing Effect of Recessions." National Bureau of Economic Research Working Paper No. 3922.

Davis, Steven and John Haltiwanger. 1990. "Gross Job Creation and Destruction: Microeconomic Evidence and Macroeconomic Implications." In Blanchard, Olivier and Stanley Fischer, ed., *NBER Macroeconomics Annual*, vol. 5, pp. 123–68.

Fischer, Stanley. 1993. "The Role of Macroeconomic Factors in Growth." *Journal of Monetary Economics*, vol. 32, pp. 485–512.

Fuhrer, Jeffrey C. and George R. Moore. 1994. "Monetary Policy Tradeoffs and the Nominal Interest Rate–Real Output Correlation." Forthcoming, *The American Economic Review*.

Motley, Brian. 1994. "Growth and Inflation: A Cross-Country Study." Prepared for the Center for Economic Policy Research–Federal Reserve Bank of San Francisco conference, March 1994.

Rogoff, Kenneth. 1985. "The Optimal Degree of Commitment to a Monetary Target." *Quarterly Journal of Economics*, vol. 100, pp. 1169–90.

Schumpeter, Joseph A. 1939. *Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process*. New York: McGraw-Hill.

How Efficient Has Monetary Policy Been?

Monetary policymakers are charged with balancing the often competing objectives of price stability and low unemployment. Has recent policy achieved an efficient trade-off between the variability of prices and of employment? What modifications of current policy would improve efficiency?

The Inflation/Output Variability Trade-off Revisited

*John B. Taylor**

Describing the nature of the trade-off between inflation and output or unemployment has long been difficult and controversial. The Friedman-Phelps hypothesis, that there is no long-run Phillips curve trade-off between inflation and unemployment, has clearly won over most macroeconomists, but the debate has continued over what, if any, trade-off remains. The subtle notion that an uncertain short-run trade-off, but no long-run trade-off, exists between inflation and output has proved more difficult to analyze and describe.

The debate over monetary policy tightening in the United States in 1994 illustrates some of these difficulties. The distinction between long-run and short-run trade-offs was again blurred as many commentators expressed concern that the Federal Reserve's goal of low inflation would reduce real GDP growth. Typical of much financial and political reporting was a *New York Times* article on the rise in interest rates in 1994, which concluded, "the balance between . . . more growth and less inflation, shifts again—toward a slower economy" (Uchitelle 1994). The article even quoted Paul Volcker for support: "If you have a weaker economy, you have lower [nominal interest] rates. That is not a great world but that is the way it is." But a long-term analysis of the output versus inflation or interest rate trade-off would be stated differently. A weaker economy does not imply a lower inflation rate or a lower interest rate: In 1978, the unemployment rate was 6 percent, while interest rates

*Professor of Economics, Stanford University. This research was supported by a grant from the National Science Foundation at the National Bureau of Economic Research. The author is grateful to Laurence Ball and other conference participants for helpful comments.

and inflation were in double digits. Today the unemployment rate is no higher and the economy is no weaker, but interest rates and inflation are well below double digits. Thus, there is no long-run trade-off between a strong economy and low inflation or low nominal interest rates.

Several years ago, in an effort to more clearly delineate the short-run versus the long-run trade-off, I estimated a different type of trade-off between inflation and output (Taylor 1979). Rather than a long-run trade-off between the *levels* of inflation and output, I defined and estimated a long-run trade-off between the *variability* of inflation and of output. Because of this trade-off, efforts to keep the inflation rate too stable would result in larger fluctuations in real GDP and unemployment. Conversely, efforts to smooth out the business cycle too much would result in a more volatile inflation rate.

Such a variability trade-off is consistent with rational expectations and sticky prices and implies no long-run trade-off between the levels of inflation and output. It can also be estimated with stochastic optimal control methods. In fact, recent estimates by Fuhrer and Moore (1993) using modern techniques have found the shape and positions of the trade-off curve to be very similar to the one I estimated earlier. However, although little technical criticism has been made of the idea of such a variability trade-off, it is safe to say that it has not become part of the popular debate on the subject. While technically useful, the trade-off has not helped to clarify the distinction between the short run and the long run in popular discussions. It certainly has not replaced the Phillips curve!

The idea of the trade-off between inflation and output has been made even more confusing to outside observers by more recent strands of research. One strand—Fischer (1993), Lucas (1994), and Motley (1994)—has found that inflation has a quantitatively significant long-run effect on real GDP, or real GDP growth. Another strand of research (see Caballero and Hammour 1991) has examined whether efforts to smooth out short-term business cycle fluctuations might reduce long-run economic growth.

The purpose of this paper is to revisit the trade-off between the variability of inflation and output in order to clarify in simple terms the nature of this trade-off, as implied by recent research and experience, and to compare it with other notions of a trade-off. Rather than estimate a new trade-off using stochastic optimal control techniques—a topic of much current research (see Bryant, Hooper, and Mann 1993; Taylor 1993b; and Fuhrer and Moore 1993)—this paper will take a different approach, developing a more intuitive analysis using a series of simple diagrams and graphs. Such an analysis complements the ongoing technical research and provides additional insights that can improve public discussion and perhaps even public policy.

A Stylized Macroeconomic Model

Consider the following simple three-equation summary of the relationships between real GDP, the nominal interest rate, and the inflation rate:

$$y_t = -\beta(i_t - \pi_t - r^*) + u_t \tag{1}$$

$$\pi_t = \pi_{t-1} + \alpha y_{t-1} + e_t \tag{2}$$

$$i_t = \pi_t + g y_t + h(\pi_t - \pi^*) + r^f + v_t \tag{3}$$

where y_t is real GDP measured as a percentage deviation from potential GDP; i_t is the short-term nominal interest rate measured in percentage points; π_t is the inflation rate measured in percentage points; and e_t, v_t, and u_t are shocks that equal zero on average. The parameters of the model are π^*, r^f, r^*, α, β, g, and h, and are all positive.

Equation (1) describes an inverse relationship between the real interest rate and the deviations of real GDP from potential GDP. The deviations of real GDP from potential GDP are assumed to be due to fluctuations in aggregate demand; each component of aggregate demand—consumption, investment, and net exports—is assumed to depend negatively on the real interest rate. (Net exports depend on the real interest rate through the positive relationship between the real exchange rate and the real interest rate.) Potential GDP is assumed to be described by a production function—not shown separately—in which increases in capital, labor, and total factor productivity cause potential GDP to grow. Potential GDP is thus the normal or natural level of real GDP, rather than an upper bound on real GDP. When real GDP equals potential GDP ($y = 0$), the ex post real interest rate equals r^*, which is, therefore, the equilibrium real interest rate in the economy. Greater accuracy might be achieved in equation (1) by using the ex ante expected real interest rate as well as the long-term interest rate—using rational expectations for the term structure. However, to keep the model simple, only the actual inflation rate is included in equation (1). The variable u_t in equation (1) could represent changes in government purchases or any other factor that shifts aggregate demand.

Equation (2) summarizes price adjustment in the economy. When real GDP rises above potential GDP, inflation increases, with a lag because of the stickiness of prices. When real GDP falls below potential GDP, inflation decreases, again with a lag. The random variable e_t represents price shocks. Staggered wage and price setting as well as limited information are possible rationales for the stickiness of prices.

Equation (3) summarizes monetary policy in terms of the interest rate reaction of the central bank to deviations of inflation from a target π^* and to the deviations of real GDP from potential GDP. When inflation

rises, the policy calls for the nominal interest rate to rise by more than the inflation rate; and when real GDP rises relative to potential GDP, the interest rate also rises. The intercept term r^f in this relationship is the implicit real interest rate in the central bank's reaction function. The central bank takes actions to affect the nominal interest rate by open market operations, and these have implications for the growth rate of the money supply. Although these open market operations and money supply growth are not stated explicitly in these equations, they play an important role in the setting of interest rates.[1]

Long-Run Averages

The long-run average values of real GDP, inflation, and the nominal interest rate implied by the model can be found by setting the change in the inflation rate and all the shocks to zero in equations (1) through (3). This gives:

$$y = 0 \tag{4}$$

$$i = r^* + \pi \tag{5}$$

$$\pi = \pi^* + (r^* - r^f)/h. \tag{6}$$

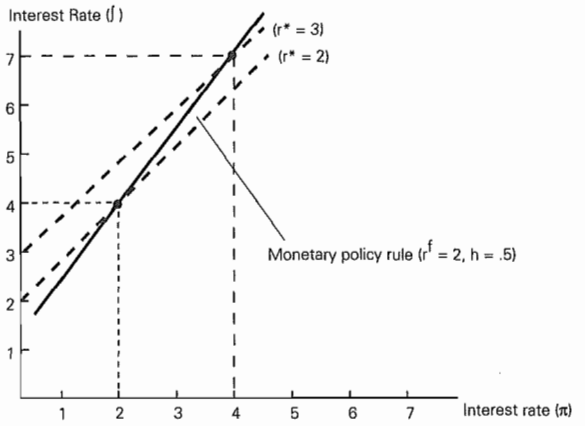
Equation (4) simply states that real GDP equals potential GDP in the long run; this equation follows immediately from the price adjustment equation (2). Equation (5) then follows from equation (1) with $y = 0$. Equation (6) follows from equation (3) with y and i given by equations (4) and (5). In addition, the growth rate of the money supply equals the growth rate of potential GDP plus the inflation rate π in equation (6) minus the growth rate of velocity.

It is obvious from equation (4) that no long-run trade-off exists between the inflation rate and the deviations of real GDP from potential GDP. With the deviations of unemployment from the natural rate proportional to the deviations of real GDP from potential (Okun's law), no long-run trade-off exists, therefore, between inflation and unemployment. Of course, the equations have been designed to capture these properties. It is certainly possible for either the natural rate of unem-

[1] Equation (3) could also be interpreted as the result of a monetary policy with a fixed growth rate of the money supply. The target inflation rate would then be the long-run average inflation rate implied by the quantity equation with the constant money growth rate. Then, when inflation rose above the target inflation rate, the demand for money would rise relative to the supply of money and interest rates would rise as shown in equation (3).

Figure 1

The Multiplier Effect of a Change in the Equilibrium Real Rate of Interest



ployment or potential GDP to be dependent on the inflation rate. However, strong evidence (summarized below) suggests no long-run trade-off.

Note that equation (6) implies that if the central bank chooses a monetary policy with an implicit real interest rate r^f, different from the equilibrium real interest rate in the economy r^*, then the steady state inflation rate π will not equal the target inflation rate π^*. If the equilibrium real interest rate r^* changes—perhaps because of a change in government spending policy—then the steady state inflation rate will change unless the central bank also adjusts its implicit real interest rate r^f. If the parameter h is less than 1, then equation (6) implies that the change in the equilibrium real interest rate has a multiplier effect on the inflation rate; that is, the inflation rate rises by more than the equilibrium real interest rate.

This multiplier effect is illustrated in Figure 1, which also shows how the long-run nominal interest rate and the long-run average inflation rate implied by the monetary policy rule combine with the given equilibrium real interest rate. The solid line showing the reaction function of the Federal Reserve is plotted in the case where $g = 0.5$, $h = 0.5$, $\pi^* = 2$ percent, and $r^f = 2$ percent. The dashed line shows the

relationship between inflation and the interest rate that must hold in the steady state if the equilibrium real interest rate is r^*. In the example in Figure 1, $r^* = 2$ percent, so that $r^* = r^f$ and the steady state inflation rate is 2 percent. However, if r^* rises from 2 percent to 3 percent, then the dashed line shifts up, the steady state nominal interest rate rises to 7 percent, and the steady state inflation rate rises from 2 percent to 4 percent, unless of course the central bank shifts up the policy rule so that r^f also equals 3 percent. Similarly, a decline in the equilibrium interest rate would lead to a decline in the steady state inflation rate unless the Fed adjusted its policy.

In reality, the central bank does not know the equilibrium real interest rate, so that we cannot expect it to accurately set r^f equal to r^*, and this is a disadvantage of a policy rule like equation (3) in contrast to money growth rules. If the central bank uses an incorrect estimate of the equilibrium real interest rate when using a monetary policy like equation (1), then an inflation rate higher or lower than targeted will result. However, such an error will not result in continuing increases or continuing decreases in inflation, as would a policy that tries to peg the real interest rate above or below the equilibrium real interest rate. Moreover, equation (6) shows that the impacts of the error on the long-run average inflation rate depend on the size of the response of monetary policy to the inflation rate. The larger the response parameter h, the smaller the impact of a change in the equilibrium real interest rate on the long-run average inflation rate. This is a reason not to choose a monetary policy with h too close to zero.

Because equation (3) may be less familiar than equations (1) and (2), Figure 2 is presented, showing how the equation describes actual Fed behavior in recent years. The actual federal funds rate and the federal funds rate implied by equation (2) are shown in Figure 2. After the Fed tightening moves early this year, the policy rule is back on track. (Figure 2 is an updated version of a similar plot from Taylor 1993a.)

Short-Run Fluctuations

Now, the fluctuations of real GDP and inflation will be considered. Substitute equation (3) into equation (1) to obtain:

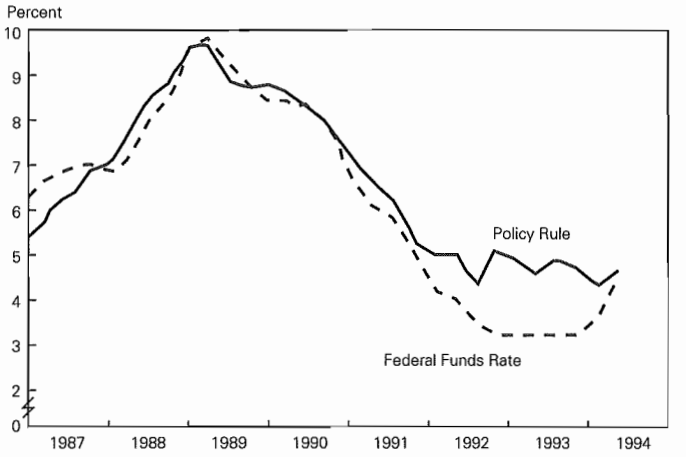
$$y_t = -c(\pi_t - \pi^*) - (c/h)(r^f - r^*) + (u_t - \beta v_t)/(1 + \beta g) \qquad (7)$$

where $c = \beta h/(1 + \beta g)$. If $r^f = r^*$, then the middle term on the right-hand side of the above expression drops out.

An easy way to derive the trade-off between the variability of inflation and the variability of the deviations of real GDP from potential is to substitute equation (7) into equation (2). This gives

Figure 2

Actual Federal Funds Rate and the Rate Implied by a Policy Rule (Equation 2)



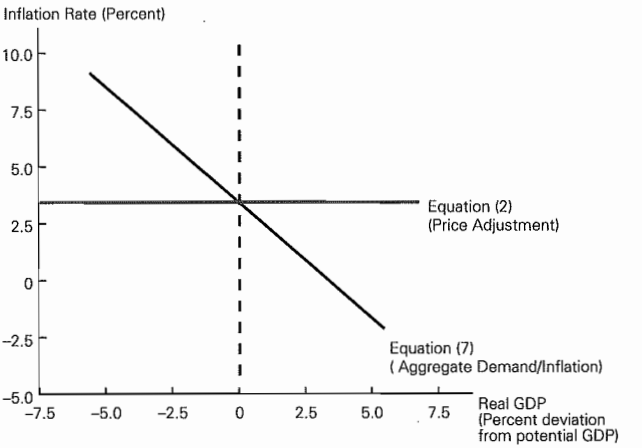
$$\pi_t - \pi^* = (1 - \alpha c)(\pi_{t-1} - \pi^*) - (\alpha c/h)(r^f - r^*) + \alpha(u_{t-1} - \beta v_{t-1})/(1 + \beta g) + e_t \quad (8)$$

which is simply a first order autoregression in $\pi_t - \pi^*$. The variance of $\pi_t - \pi^*$ can easily be obtained from equation (8), and from this the variance of y can be obtained using equation (7). For example, in the case with only price adjustment shocks (e_t), the standard deviation of $\pi - \pi^*$ is $\sigma/(1 - (1 - \alpha c)^2)^{1/2}$ and the standard deviation of y is $c\sigma/(1 - (1 - \alpha c)^2)^{1/2}$. In this case, a trade-off is traced out by varying c, which depends on the two policy parameters h and g.

However, the aim here is to provide an intuitive understanding of this trade-off. The two key relationships in the model describing inflation and the deviations of real GDP from potential are equations (2) and (7). Both describe a dynamic relationship between inflation and real GDP. These two relationships are graphed in Figure 3. The downward-sloping curve shows equation (7); it indicates how real GDP and inflation are negatively related. Recall that equation (7) combines the relationship between the interest rate and inflation with the central bank's policy rule. As inflation rises, the central bank raises the interest

Figure 3

Relationship between Inflation and Deviation of Real GNP from Potential, as Described in Equations (2) and (7)



rate and this lowers real GDP. The opposite occurs if inflation falls. The policy also calls for higher interest rates when real GDP rises above potential GDP, and that is also incorporated in equation (7) and the downward-sloping line in Figure 3. The downward-sloping line describes how aggregate demand depends on inflation, and therefore is called the aggregate demand/inflation (ADI) curve.

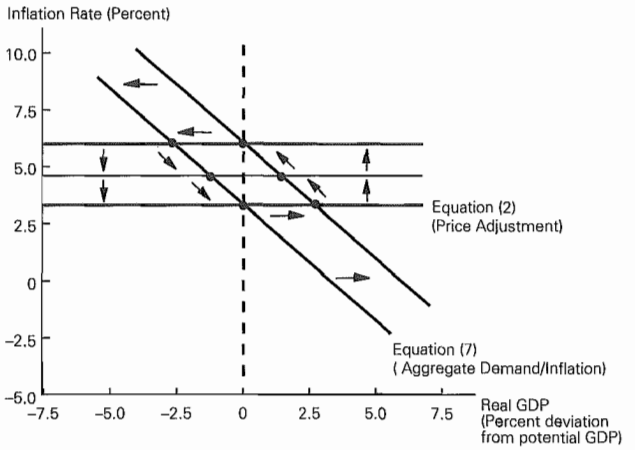
Equation (2) is shown as a flat line in Figure 3 because contemporaneous real GDP does not appear in the equation; only y_{t-1} appears. If real GDP rises above potential GDP, then inflation will start to rise and the flat line in Figure 3 will shift up over time. If real GDP falls below potential GDP, then the flat line will shift down. The intersection of the two lines determines real GDP at any particular time.

Now, fluctuations in real GDP and inflation occur if either of the two curves in Figure 3 shifts. The downward-sloping aggregate demand/inflation curve will shift to the right with a shift in monetary policy to a higher inflation target, a monetary policy mistake (v_t), or a shift (u_t) of equation (1). The price adjustment line will shift up if a price shock (e_t) to equation (2) occurs.

An example of how shifts in these two curves trace out fluctuations in inflation and output is shown in Figure 4. First, imagine that the Fed—either on purpose or by mistake—shifts monetary policy towards

Figure 4

Effects on Real GDP and Inflation of Shifts in the Price Adjustment or Aggregate Demand Equations



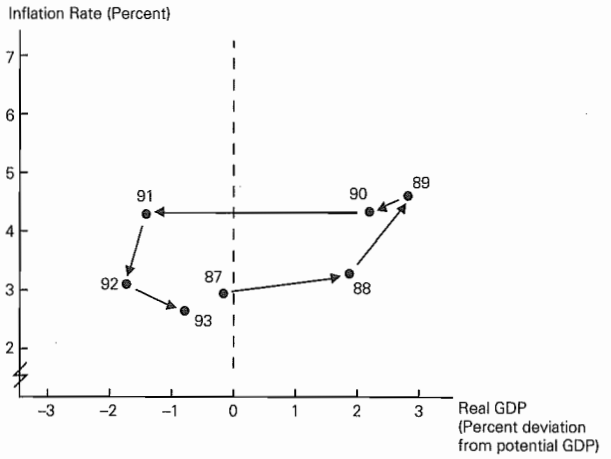
a higher inflation rate. Such a shift could be due to a shift to a higher rate of money growth, which would imply a higher inflation target. As seen in Figure 4, this causes an expansion of real GDP above potential GDP. In the short run, this has no effect on inflation, but over time inflation rises and real GDP moves back to potential GDP. If the Fed made no further changes in policy, then that would be the end of the story: higher inflation with real GDP back to potential GDP, consistent with the nonexistence of any long-run trade-off between inflation and real GDP.

On the other hand, the Fed could shift the policy back again—perhaps after learning that its policy mistake has increased inflation. Then the aggregate demand/inflation curve shifts back to where it was originally, causing a decline in real GDP below potential GDP, as shown in Figure 4. After a lag, inflation will start to decline; the price adjustment line shifts down gradually over time until real GDP returns to potential GDP.

The pattern of inflation and real GDP traced out in Figure 4 is a typical boom-bust cycle, with a boom and then rising inflation followed by a recession with subsequent falling inflation. Figure 5 shows that the actual pattern of real GDP and inflation in the past seven years looks similar to the points in Figure 4.

Figure 5

Relationship of the Deviation of Real GDP from Potential and the Inflation Rate, 1987 to 1993



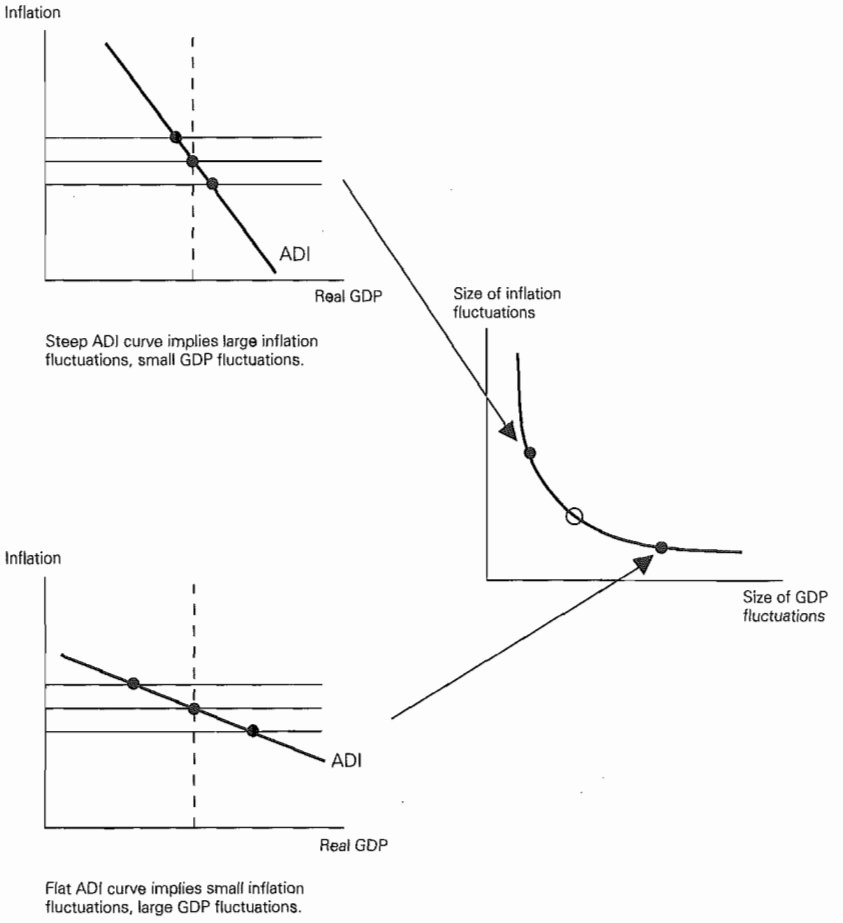
Now consider the trade-off between the fluctuations in inflation and real GDP. Monetary policy determines the slope of the aggregate demand curve, because the slope of the curve is given by $-(1 + \beta g)/\beta h$, and g and h are the parameters of the monetary policy rule. Thus, the curve is flatter either if h is higher—the central bank responds more aggressively to inflation—or if g is lower—the central bank responds less actively to deviations of real GDP from potential GDP. A lower h or a higher g makes the curve steeper.

The effects of the different policy parameters are shown in Figure 6. The hypothetical shifts in the price adjustment line in the two left-hand panels represent a given size of shifts to equation (3); that is, a given size for the price shocks. If the aggregate demand curve is flatter, then output declines by a large amount when a price shock occurs. If aggregate demand is steeper, then output declines by a small amount with a shock to inflation. Clearly the variance of real GDP is much smaller when the aggregate demand curve is steep—which is the case where h is small and the central bank does not respond very much when inflation rises.

It may appear from Figure 6 that the variance of inflation is not affected by the slope of the aggregate demand/inflation curve; however,

Figure 6

Effects of the Policy Parameters



the variance of inflation is lower in the case where the variance of real output is higher, because inflation returns to the target level more quickly after a shock. After a price shock, the sum of squared deviations of inflation from target inflation is smaller in the case where output falls

(or rises, in the case of negative price shocks) by a larger amount. In other words, if price shocks were the only shocks affecting the economy, then the vertical spread in a diagram like Figure 5 should not depend on the policy rule; only the speed at which real GDP returns to potential GDP would depend on the policy rule. By affecting the speed, the policy rule affects the variance of inflation as well as the variance of real GDP.

Finally, the right-hand panel of Figure 6 illustrates how the pairs of fluctuations in real GDP and inflation trace out the trade-off curve. The variance of inflation (π) is on the vertical axis, while the variance of real GDP (y) is on the horizontal axis. The parameters of the monetary policy rule change so that as interest rates respond more to inflation (higher h) and less to real GDP (lower g), the aggregate demand/inflation curve flattens and the variance of real GDP rises while the variance of inflation falls.

Observe that the objective of policy should be to keep the aggregate demand/inflation curve stable. However, if for some reason—a policy mistake or an unavoidable shock to consumption—the aggregate demand/inflation curve shifts, then inflation will move away from the target and the central bank is faced with the same trade-off as in the case of shock to the price adjustment line.

Note also that although only the slope of the aggregate demand/inflation line is important for the trade-off between inflation and real output fluctuations, the absolute sizes of the parameters g and h affect fluctuations in the interest rate. Choosing a g that is very high, for example, could result in large fluctuations in interest rates. Although fluctuations in interest rates are not directly a cause of concern in this model, in a more realistic model with lags and expectations such fluctuations would likely lead to instrument instability. Thus, raising g and h very high would probably not be a good policy in reality.

The estimated trade-off curve bends very sharply at a point such as that designated by the open circle in Figure 6. In other words, the opportunity costs of reducing inflation variability below the level at the open circle are very high, in terms of higher output variability. Similarly, the opportunity costs of reducing output variability below the open circle are also very high, in terms of higher inflation variability. This suggests that the optimal choice for policy is likely to be near the open circle. Even with large changes in preferences over time—say, because of a change in political sentiment—a country would therefore not be likely to move far from the sharp curvature point.

How does one go about choosing points on such a trade-off curve? Which utility function to use is not obvious. Perhaps the best way to make a choice is to examine different scenarios, such as the one depicted in Figure 5. In this 1987–93 scenario, the standard deviation of inflation is considerably less than the standard deviation of output. If the Fed had been successful in achieving a soft landing in 1990–91 rather than a

recession, then the standard deviation of real output would have been lower. The policy rule indicates that the actual pattern was achieved with $h = 0.5$ and $g = 0.5$. Hence, to lower the output fluctuation and thereby raise the inflation fluctuation, one would have to raise the coefficient on real GDP in the policy rule or lower the coefficient on inflation. For the reasons mentioned above, lowering the coefficient on inflation probably would be unwise because of uncertainty about the real interest rate. Hence, raising the coefficient on real GDP—perhaps to 0.7 rather than 0.5—might be considered.

Empirical Evidence

The trade-off between the variability of inflation and that of real GDP can be better understood by examining some data on real GDP, unemployment, and inflation in addition to the data presented in Figure 5.

Inflation and Unemployment

That no long-term trade-off exists between inflation and unemployment, or between inflation and the deviations of real GDP from potential GDP, has been well established. For completeness in this graphic analysis, Figure 7 provides a simple picture that summarizes the relevant evidence. It shows four years during which the economy was operating where real GDP was close to potential GDP, neither in recession nor in boom. Whether inflation was high, as in the late 1970s, or low, as in the early 1960s or the early 1990s, the unemployment rate was close to 6 percent. Clearly, no long-term trade-off exists between the levels of unemployment and inflation. The assumption in the above stylized model that the equilibrium value of y is zero is thus a good one.

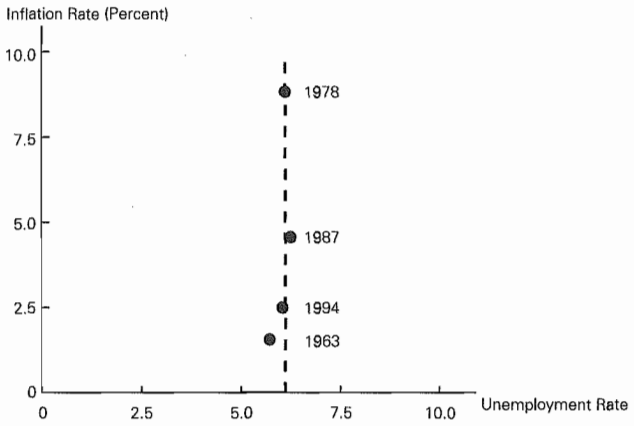
The Effects of Inflation on Long-Term Growth

Observations on economic growth in different countries indicate that inflation is negatively correlated with economic growth. In the stylized model this would mean that potential GDP depends on the inflation rate, but the assumption would still be maintained that the deviations of real GDP from potential GDP converge to zero in the long run.

How large are the long-run effects on potential GDP? Fischer (1993) and Motley (1994) provide a comprehensive set of estimates based on data in both developed and less developed countries. Motley finds that a reduction (increase) in the inflation rate of 1 percentage point would increase (reduce) the long-run productivity growth rate by 0.06 percentage points per year in the developed countries. For example, an increase

Figure 7

Rates of Unemployment and Inflation in Selected Years When Real GDP Close to Potential GDP



in the inflation rate from 2 percent—close to its level in the early 1960s—to 12 percent—close to where it was in the late 1970s—would lower productivity growth by 0.6 percentage points.

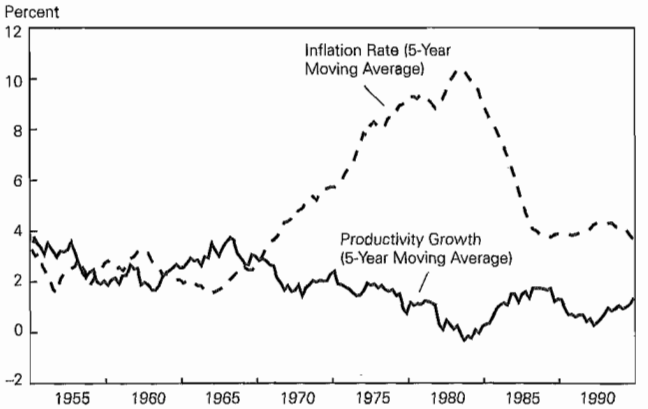
Figure 8a examines the pattern of inflation and labor productivity growth in the nonfarm business sector. (To abstract from the large cyclical productivity and inflation swings, Figure 8a reports five-year moving averages of both the inflation rate and the productivity growth rate.) Note that the start of the increase in inflation in the mid 1960s occurred at about the same time as the start of a slowdown in labor productivity growth. Moreover, the productivity growth slowdown ended at about the same time as the disinflation of the early 1980s, which ended the very high inflation period of the 1970s. Similar productivity growth slowdowns and inflation increases occurred in other countries.

Although the productivity growth slowdown has ended, the growth rate of productivity has not yet returned to the levels of the 1950s and 1960s. Figure 8b shows how much of a revival in productivity growth would be expected if the simple statistical relationship between productivity growth and inflation observed during those years persisted. According to Figure 8b, a rise in inflation of 1 percentage point

Figure 8

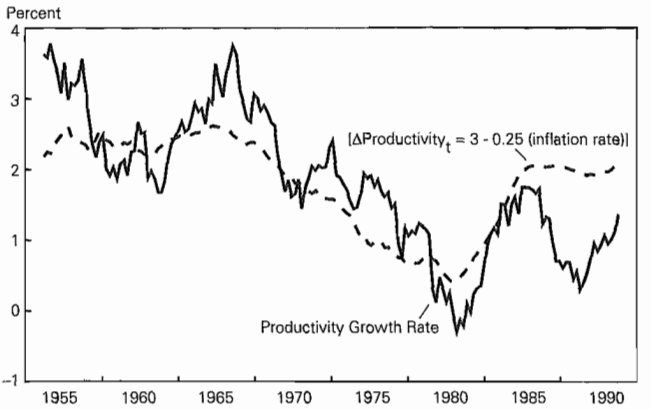
A

Inflation Rate and Rate of Growth in Labor Productivity, Nonfarm Business Sector



B

Predicted Increase in Productivity Growth



leads to a decline in productivity growth of 0.25 percent; this is a much larger effect of inflation on productivity growth than that reported in Motley (1994).

Figure 8b does not prove that inflation was the key factor in the great labor productivity growth slowdown. People have pointed to many other factors. Moreover, there is no reason to expect the 0.25 coefficient to be stable; most certainly it would not hold outside of the narrow range of observations in Figures 8a and 8b, but Figure 8b certainly suggests that inflation should be considered along with other reasons more commonly given for the productivity growth slowdown, such as lagging research and development, education, or public infrastructure investment.

Effects of Output Variability on Long-Term Growth

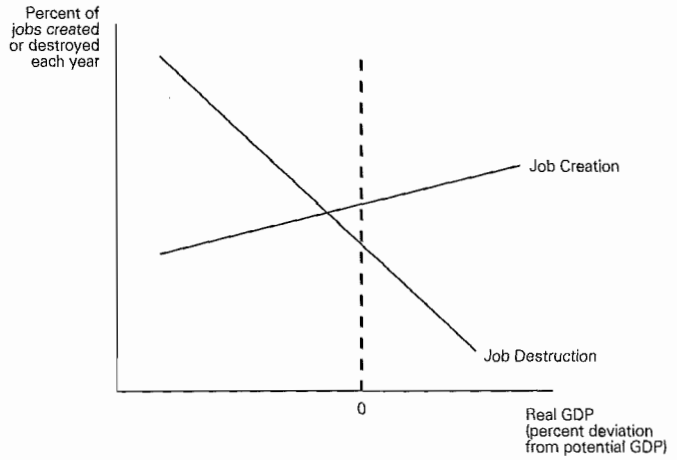
Schumpeter (1939) first pointed out the close link between economic growth and economic fluctuations. According to Schumpeter, booms are periods when inventions spread throughout the economy through innovation. Recessions are periods when the destruction of firms and jobs overtakes the creation of jobs. Schumpeter's analysis raised the possibility that recessions might enhance productivity growth, as firms take the opportunity of slack times to make structural adjustments.

Davis and Haltiwanger's (1990) recent studies of job creation and job destruction have been influential in assessing this "cleansing effect of recessions." Their finding that job creation is much less sensitive to the business cycle than job destruction has led Caballero and Hammour (1991) to argue that the cyclical fluctuations—in particular, recessions—are needed for the creative destruction described in Schumpeter's theory.

Figure 9 attempts to summarize the implications of Davis and Haltiwanger's research for the question about the effect of economic fluctuations on long-term growth. The figure presents a job creation curve and a job destruction curve, each showing the sensitivity to fluctuations in real GDP. As shown in Figure 9, when real GDP equals potential GDP ($y = 0$), job creation in the U.S. economy is greater than job destruction; thus, job creation is positive as the number of jobs in the economy grows. As real GDP falls below potential GDP, job destruction increases and job creation falls. Observe that the job destruction curve is steeper than the job creation curve, corresponding to Davis and Haltiwanger's findings. However, their finding that the slope of the job destruction curve is steeper than the slope of the job creation curve does not indicate that recessions are needed to increase productivity growth. Even with the steeper slope of the job destruction curve as shown in Figure 9, there appears to be little need for recessions to cleanse the economy. A considerable amount of job destruction occurs in normal years when real GDP equals potential GDP.

Figure 9

Response of Job Creation and Job Destruction to Deviations of Real GNP from Potential GDP



Moreover, as Figure 9 illustrates, the effect of output fluctuations on real GDP growth is related to the *size* of the fluctuations in real GDP—booms as well as recessions, because the level of unemployment cannot be affected by stabilization policy. Without non-linearities in the job creation and job destruction curves in Figure 9, larger fluctuations in real GDP around potential would not increase the amount of structural adjustment. More job destruction in recessions would cancel out with less job destruction in booms. The average would be the same, regardless of the size of the fluctuations. In any case, the evidence is mixed on the effects of recessions on long-term productivity growth.

Conclusion

This paper has explored the trade-off between the variability of inflation and that of output. The trade-off exists because of the slow adjustment of prices; monetary policy can determine where on the trade-off curve the economy lies. Although the trade-off is more abstract than the old Phillips curve trade-off, the simple graphs presented in the paper are meant to provide a better understanding of the trade-off and

why it exists. This approach is meant to complement ongoing econometric work on estimating such trade-offs.

The paper has also compared this variability trade-off with several other types of trade-offs relating to inflation and output. While no long-term relationship exists between inflation and the deviation of real GDP from potential GDP, inflation seems to have strong effects on productivity growth and therefore on the growth of potential GDP. Evidence was also presented that casts doubt on the idea that larger fluctuations in real GDP would increase the growth of potential GDP.

A useful extension of this paper would be to examine whether indirect evidence can be found for variability trade-offs; preliminary empirical work looking at different historical periods in the United States and other countries indicates that a negative trade-off may be difficult to find. Perhaps this is because, throughout history, countries have been far from the trade-off curve because of inefficient monetary policies.

References

Bryant, Ralph, Peter Hooper, and Catherine Mann. Eds. 1993. *Evaluating Policy Regimes: New Research in Empirical Macroeconomics*. Washington, D.C. The Brookings Institution.

Caballero, Ricardo and Mohamad L. Hammour. 1991. "The Cleansing Effect of Recessions." National Bureau of Economic Research Working Paper No. 3922.

Davis, Steven and John Haltiwanger. 1990. "Gross Job Creation and Destruction: Microeconomic Evidence and Macroeconomic Implications." *NBER Macroeconomic Annual*, Volume 5, pp. 123–68.

Fischer, Stanley. 1993. "The Role of Macroeconomic Factors in Growth." *Journal of Monetary Economics*, vol. 32 (December), pp. 485–512.

Fuhrer, Jeffrey and George Moore. 1993. "Monetary Policy and the Behavior of Long-Term Real Interest Rates." FEDS working paper, Board of Governors of the Federal Reserve System.

Lucas, Robert E., Jr. 1994. "On the Welfare Costs of Inflation." Paper presented at Center for Economic Policy Research–Federal Reserve Bank of San Francisco conference, March.

Motley, Brian. 1994. "Growth and Inflation: A Cross-Country Study." Paper presented at Center for Economic Policy Research–Federal Reserve Bank of San Francisco conference, March.

Schumpeter, Joseph A. 1939. *Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process*. New York: McGraw Hill.

Taylor, John B. 1979. "Estimation and Control of a Macroeconomic Model with Rational Expectations." *Econometrica*, vol. 47, no. 5 (September), pp. 1267–86.

———. 1993a. "Discretion versus Policy Rules in Practice." *Carnegie Rochester Conference Series on Public Policy* no. 39 (Autumn), pp. 195–214.

———. 1993b. *Macroeconomic Policy in the World Economy: From Econometric Design to Practical Operation*. New York: W.W. Norton.

Uchitelle, Louis. 1994. "Why America Won't Boom." *The New York Times*, June 12, Section 4.

Discussion

*Laurence M. Ball**

I have four sets of comments on John Taylor's paper.

First, the paper asks exactly the right question for policymakers: What are the trade-offs in choosing among policy rules? Policy discussions often focus on the short-run Phillips curve, which describes the trade-off facing policymakers at a given moment. When considering monetary strategy, however, we need to ask how different rules affect the stochastic behavior of the economy. And if we believe the natural rate hypothesis—so policy does not affect average output—then the variance of output and the variance of inflation are the right variables to focus on. We need to know how alternative policies affect these two variances.

Second, I very much like Taylor's methodology, his use of a simple, textbook-style model. The model consists of three linear equations that we can understand fully and use to build intuition. Current research tends to emphasize rigorous microeconomic foundations and quantitative accuracy, with the result that models are very messy. Often the models are too complicated to understand, and we lose track of the basic economic forces at work. Microfoundations and quantitative work are certainly desirable, but they should come *after* simple models, so we know what we are seeking foundations for or trying to quantify. We need more research in the style of Taylor's paper.

My third set of comments concerns the model itself. The first two equations of the model are conventional I-S and Phillips-curve equations. These equations are deservedly popular among applied researchers because they capture behavior that we see in actual economies. The third equation of the model is more novel. It is a description of monetary policy: The Fed varies the interest rate to offset deviations of output from

*Professor of Economics, The Johns Hopkins University.

its natural level and deviations of inflation from some target. Is this a good specification?

The answer to this question depends on whether we are considering normative or positive issues. Taylor's framework is nice for normative analysis: We can derive the optimal coefficients on output and inflation in the interest-rate rule. The model is less useful as a positive description of policy, because it assumes a constant inflation target π^*. This assumption implies that inflation reverts to a fixed mean, whereas actual inflation has had an important random walk component in recent decades. In the history of actual policymaking, much of the interesting action is changes in the Fed's inflation target. Paul Volcker, for example, reduced the target in the early 1980s, and Arthur Burns increased it by accommodating supply shocks in the 1970s. To explain monetary policy, we need to understand the reasons, both economic and political, for changes in inflation targets. Taylor's model does not address this issue.

Taylor shows that his interest-rate rule fits the data well for the period since 1987. However, this period happens to be one in which the Fed's inflation target was fairly stable. I doubt that Taylor's equation would fit over longer periods that include shifts in the target.

The Trade-off between the Variances of Inflation and Output

My fourth and longest set of comments concerns Taylor's central conclusion: Policymakers face a trade-off between the variance of inflation and the variance of output. In Taylor's model, a policymaker's job is to choose a point on this trade-off—to choose how much inflation variance to accept to reduce output variance. In contrast to Taylor, I doubt that this is the right way to think about policy. I am not sure that policymakers really face Taylor's trade-off.

To explain why, I must distinguish between different kinds of macroeconomic shocks. It appears that different trade-offs arise from demand shocks (shocks to the I-S equation or the policy rule) and supply shocks (shocks to the Phillips curve). I will consider these two cases in turn.

In the case of demand shocks, Taylor's model does not support his conclusion: There is no trade-off between the two variances. To see this point, consider the following versions of Taylor's equations (7) and (8). (For simplicity, I set the inflation target π^* to zero and assume that the Fed's target for the real interest rate, r^f, equals the equilibrium rate.)

$$y_t = -c\pi_t + 1/(1 + \beta g)[u_t - \beta v_t]. \tag{7}$$

$$\pi_t = (1 - \alpha c)\pi_{t-1} + \alpha/(1 + \beta g)[u_{t-1} + v_{t-1}] + e_t. \tag{8}$$

These equations imply that policymakers can completely eliminate the effects of demand shocks on *both* inflation and output. They do so by

choosing a very large value of the parameter g: With a large g, the coefficients on the demand shocks u and v approach zero in both (7) and (8). A very large g means that interest rates respond very strongly to output, that is, that policy is very countercyclical. Note that the choice of a very large g does not constrain the parameter c, which determines the effects of supply shocks: Policymakers can always adjust the parameter h to obtain their desired c. Taken literally, the model says that policymakers can costlessly eliminate all effects of demand shocks. Thus, demand shocks do not create any painful trade-off.

In the real world, of course, it is not trivial to eliminate the effects of demand shocks. Problems arise from time lags and uncertainty about the effects of policy, which lead to mistakes. One could add these problems to the model, for example by assuming that certain parameters are unknown. In this case, demand shocks would cause fluctuations in output and inflation. And a huge g would no longer be optimal, because extremely cyclical policy would magnify the effects of mistakes.

Nonetheless, I still doubt that the main problem facing policymakers is a trade-off between output variance and inflation variance. When shocks hit the I-S or interest-rate equations, the main job of policymakers is to minimize the resulting fluctuations in aggregate demand. This task requires that they choose the right degree of countercyclicality: Demand fluctuates excessively if policy is too passive, but also if it is too aggressive and creates large mistakes. A successful policy—one that reduces the variance of demand as much as possible—reduces the variances of *both* inflation and output. Thus, it is less important to weigh the relative costs of the two variances than to develop effective means for reducing both. As Michael Dukakis would put it, the key issue for policymakers is competence, not ideology.

Now consider policymakers' response to supply shocks, which Taylor emphasizes. In this case, the model does imply a policy trade-off: A lower choice of the parameter c reduces the variance of output but increases the variance of inflation. To interpret this result, consider the optimal policy for someone who cares more about output stability than about inflation stability. In Taylor's model, such a policymaker would set c low, accepting large inflation fluctuations to keep output stable. When an adverse supply shock occurs, a low c means that policy is very accommodative and inflation rises far above π^*. Inflation is eventually returned to π^* through tight policy, but this disinflation occurs slowly.

Are Taylor's theoretical results a good guide to practical policy? Can we really stabilize output when supply shocks occur by destabilizing inflation? Two issues make me doubtful. First, in Taylor's model the total output loss from an adverse supply shock is *not* reduced by accommodative policy. Equations (7) and (8) imply that the loss from a unit supply shock, summed over time, is $c\Sigma_{i=0}^{\infty}(1 - \alpha c)^i$. This expression reduces to $1/\alpha$, and thus is independent of the policy parameter c.

Intuitively, inflation must always return to π^* in the long run, and so the cost of a supply shock is eventually paid in lost output. Non-accommodative policy implies a large recession when a supply shock occurs. Accommodative policy reduces the initial recession, but output is lost when inflation is brought down after its initial rise.

How can we reconcile this result with the result that accommodation reduces the variance of output? The answer is that accommodative policy spreads the output losses from a supply shock over time, whereas non-accommodative policy concentrates the losses when the shock occurs. By spreading the output losses, accommodative policy reduces the sum of *squared* deviations of output even though the sum of absolute deviations is unchanged. Thus, Taylor's result depends on his quadratic loss function. It is crucial that we ascribe greater welfare costs to two points of lost output in one year than to one point in two years. It is not clear whether this assumption is reasonable, and so the benefits of accommodation are unclear.

My second worry about Taylor's result concerns the key parameter α—the slope of the short-run Phillips curve. Taylor's model assumes that α is invariant to policy, but this assumption may fail in important ways. Some empirical evidence suggests that the costs of reducing inflation are smaller if disinflation is quick (Ball 1994). If this is so, then accommodative policy creates large output losses during the long, slow process of bringing π back to π^*. At a deeper level, I think the inflation inertia captured by the Phillips curve arises from the adaptive nature of inflation expectations, which in turn arises because changes in inflation are usually quite persistent. If policy became very non-accommodative, then inflation would revert quickly to its mean after a shock. If people learned they were in this new regime, expectations would become less backward-looking, and this might reduce the costs of stabilizing inflation.

For these reasons, it is not clear to me that accommodative policy really helps to stabilize output. In contrast, the cost of accommodative policy—greater variability of inflation—is clear. So perhaps our presumption should favor non-accommodation. I do not have a firm conclusion, because the benefits of accommodation depend on unresolved issues, such as the shape of the social welfare function and the determinants of the Phillips-curve slope. We need more work on these issues. Again, Taylor's paper is a valuable first step because it asks the right question and presents a tractable model.

Reference

Ball, Laurence M. 1994. "What Determines the Sacrifice Ratio?" In N. Gregory Mankiw, ed., *Monetary Policy*. Chicago, IL: University of Chicago Press, pp. 155–82.

Optimal Monetary Policy and the Sacrifice Ratio

*Jeffrey C. Fuhrer**

The annual average rate of inflation in the GDP deflator for 1980 was 10.1 percent. By 1984, the same measure had dropped to 4.4 percent, and from 1990 through the end of 1993, the rate of inflation has averaged 3.2 percent, deviating only moderately from that average over the period. From 1981 to 1984, the civilian unemployment rate averaged 8.6 percent, peaking at 10.7 percent in the fourth quarter of 1982. A common interpretation of this episode is that intentionally contractionary monetary policy caused the rise in unemployment, and the fall in inflation was a consequence of the high unemployment rate. Under this interpretation, the period from 1982 to the present was a successful disinflation engineered by the Federal Reserve.

The disinflation was evidently successful insofar as it lowered the inflation rate. But was it in any sense an *optimal* disinflation? Was the *path* that the real economy took during the course of disinflation satisfactory? Did the Federal Reserve move its instrument so as to obtain the desired rate of inflation while minimizing the disruption to the real economy? If not, what course would have been better?

Fuhrer (1994) considers one way of assessing the performance of monetary policy. The measure is a steady-state, rather than a path-specific, notion of optimality. A policy is considered optimal if, given relative preferences (distastes may be a better word) over deviations of policy goals from their targets, the policy minimizes the weighted

*Assistant Vice President and Economist, Federal Reserve Bank of Boston. The opinions expressed here are those of the author and do not necessarily reflect official positions of the Federal Reserve Bank of Boston or the Federal Reserve System. The author thanks Alicia C. Sasser for excellent research assistance.

average of the unconditional variances implied by the policy for policy goals. Thus, an optimal monetary policy according to this metric will systematically set the policy instrument in response to deviations of policy goals—usually inflation and real output—from their targets so as to minimize this weighted average. The weights on inflation and real output reflect the monetary authority's relative distaste for inflation and real output deviations. An *optimal policy frontier* depicts the minimum attainable combination of variances for all possible preferences (weights on inflation and output variance), given the structure of the economy.

This paper explores the relationship between the optimal policy frontier and another, more commonly used measure of monetary policy performance, the *sacrifice ratio* entailed in altering the inflation rate. The sacrifice ratio is defined as the discounted percentage point shortfall of output below its potential, per point of inflation reduction. In many macroeconometric models, the size of the sacrifice ratio does not depend on the path that the economy follows during a disinflation; it is a fixed constant that translates points of inflation decrease into points of lost output and employment. In the contracting model considered here, the sacrifice ratio is *not* a constant; it depends on the rate at which the monetary authority disinflates. Because multi-period nominal contracts are outstanding at any particular time, a faster disinflation will cause greater output disruption (other things being equal), while a slower disinflation will yield less output disruption.

While the link from slower disinflation to less real disruption seems plausible, others have argued the reverse (see, for example, Ball 1994). If more rapid disinflations are also more credible disinflations, and if enhanced credibility decreases the stickiness of prices and inflation, then a more vigorous disinflation could lower the sacrifice ratio. However, the importance of credibility in the conduct of monetary policy must be viewed as marginal at best. It is hard to argue that the high cost of the disinflation in the 1980s arose because monetary policy did not act credibly. The Fed visibly and aggressively raised short-term rates in the early 1980s, pushing the short real rate over 10 percent in early 1981, with annual average real rates of 5 to 8 percent from 1981 to 1984. Still, because the link between monetary policy and the sacrifice ratio in this paper arises through the overlapping contract structure in the model, the conclusions reached here must be viewed as model-dependent.

Throughout the paper, monetary policy is characterized as a linear reaction function in which the short-term nominal interest rate is moved in response to deviations of policy goals from their desired values. The range of policies considered is thus limited to those that differ in the policy goals pursued and in the coefficients that determine the vigor with which the instrument responds to deviations of goals from targets. The reaction function approach appears to be a good approximation to

the actual conduct of monetary policy. Empirically, the reaction function captures most of the systematic variation of the short nominal rate.[1]

The next section briefly describes the data and the model used here to assess the performance of monetary policy. Next, the sacrifice ratios implied by the model are computed for a wide variety of policy responses, and the impact of backward- versus forward-looking policy responses on the sacrifice ratio is estimated. The optimal policy frontier for this model is then displayed, as derived in Fuhrer (1994). The sacrifice ratios along the optimal policy frontier are computed, and interactions between the two measures of monetary policy performance are considered.

The Data

A minimal characterization of monetary policy requires a description of the instrument of policy, here taken to be a short-term interest rate, as well as its targets, which include the rate of inflation, the growth rate of real output, and/or the real output gap. The transmission channel from policy instrument to ultimate goals also involves these variables. Thus, the data on which this study focuses are described in Table 1.

Table 1
Description of the Data
1966:I to 1993:I

Mnemonic	Definition
p_t	log of the implicit GDP deflator
π_t	inflation rate, $4\,\Delta p_t$
f_t	quarterly federal funds rate
y_t	log of per capita GDP ($1987)
$\tilde{y}_t$	deviation of y_t from trend, 1965:I to 1993:I
$m2_t$	log of *M2*

Table 2 presents the results of univariate augmented Dickey-Fuller tests for the data series of interest. The log of per capita output appears trend stationary. The inflation rate and the federal funds rate appear to be at best borderline stationary. Because monetary policy may have shifted the mean of the inflation process (and possibly its order of integration) over time, these longer sample tests for mean reversion may not be terribly informative. However, tests based on the last 12 years, reported in the last two rows of the table, include very few observations

[1] Fuhrer and Moore (1993b) and Fuhrer (1994) provide evidence of the reaction function's goodness-of-fit.

Table 2
Augmented Dickey-Fuller Test Results

Test regression: $\Delta x_t = \beta_0 x_{t-1} + \sum_{i=1}^{n} \beta_i \Delta x_{t-i} + \mu + \gamma t + \varepsilon_t$

Series	n	$Q(12)$	β_0	τ_μ	τ_τ
1966:I to 1993:I					
π_t	2	13.8	−.14	−2.03	
f_t	3	13.4	−.09	−2.34	
y_t	2	17.5	−.12		−3.23
$\tilde{y}_t$	2	15.1	−.08	−3.10	
1982:IV to 1993:I					
π_t	1	14.1	−.42	−2.70	
f_t	1	11.2	−.15	−2.86	

and thus are also suspect. In general, the magnitude of the coefficient β_0 for the subsample test regressions is larger, although the value of the ADF test statistic is not uniformly larger. For more discussion on the time-varying mean of inflation and the issue of the stationarity of the nominal variables in the model, see Fuhrer (1994). It is assumed for this paper, as in previous work, that inflation and interest rates are stationary and that real output is stationary about a deterministic trend.

The Model

This section will briefly describe the model. The price specification of the model has been shown to be stable across monetary policy regimes since 1966 (Fuhrer 1994); the aggregate demand specification shows some evidence of instability, so some of its parameters are estimated separately for the pre-1980 and the post-1979 periods; the reaction function is estimated only on the post-nonborrowed reserves operating procedure period, 1982:IV to the present. For more detail, see Fuhrer and Moore (1993b) and Fuhrer (1994).

The I–S Curve

The real economy is represented with a simple I–S curve that relates the output gap, y_t, to its own lagged values and one lag of the long-term real interest rate, ρ_{t-1}.

$$\tilde{y}_t = a_0 + a_1\tilde{y}_{t-1} + a_2\tilde{y}_{t-2} + a_\rho\rho_{t-1} + \varepsilon_{y,t}. \tag{1}$$

Monetary policy cannot affect potential output or the output gap in the long run; the output gap is 0 in equilibrium for all feasible monetary

policies.[2] The long-term real rate is the yield to maturity on a hypothetical long-term real bond. The realization of ρ_t is set equal to the weighted average of expected real returns on federal funds forecast by the restricted structural model.

The intertemporal arbitrage condition that equalizes the expected holding-period yields on federal funds and real long-term bonds is

$$\rho_t - D[E_t(\rho_{t+1}) - \rho_t] = f_t - E_t(\pi_{t+1}), \tag{2}$$

where D is a constant approximation to Macaulay's duration. Solving equation (2) for ρ_t in terms of ρ_{t+1} and $f_t - E_t(\pi_{t+1})$, then recursively substituting the result into itself, the long-term real rate is an exponentially weighted moving average of the forecast path of the real rate of return on federal funds.

$$\rho_t = \frac{1}{1+D} \sum_{i=0}^{\infty} \left(\frac{D}{1+D} \right)^i E_t(f_{t+i} - \pi_{t+i+1}). \tag{3}$$

The Reaction Function

The systematic behavior of monetary policy is summarized with a reaction function in which the monetary authority moves the federal funds rate in response to deviations of target variables from target. Limited information estimates of the reaction functions find no evidence of a response to M2 growth during the post-nonborrowed reserves operating procedure period. Thus the form of the reaction function is

$$f_t = \alpha_0 + \alpha_f f_{t-1} + \sum_{j=0}^{n} \alpha_{\pi,j} \pi_{t-j} + \sum_{k=0}^{p} \alpha_{y,k} \tilde{y}_{t-k} + \sum_{l=0}^{q} \alpha_{dy,l} \Delta y_{t-l} + \varepsilon_{f,t}. \tag{4}$$

The monetary policy reaction function relates the quarterly average of the federal funds rate to lags of the funds rate, contemporaneous and lagged levels of the inflation rate, contemporaneous and lagged levels of the output gap, and contemporaneous and lagged real output growth. In long-run equilibrium, the funds rate equals the equilibrium real rate of interest (determined by the I–S curve) plus the target rate of inflation (implicit in α_0).

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[2] See McCallum (1994) and the writer's comments in the same volume for further discussion of this point.

The Contracting Specification

The contracting specification is identical to that used in Fuhrer and Moore (1993a), and the reader is referred to that paper for greater detail. Agents negotiate nominal contracts that remain in effect for four quarters. The aggregate log price index in quarter t, p_t, is a weighted average of the log contract prices, x_{t-i}, that were negotiated in the current and the previous three quarters and are still in effect. The weights, ω_i, are the proportions of the outstanding contracts that were negotiated in quarters $t - i$,

$$p_t = \sum_{i=0}^{3} \omega_i x_{t-i} \tag{5}$$

where $\omega_i \geq 0$ and $\Sigma\omega_i = 1$. A downward-sloping linear function of contract length is used,

$$\omega_i = .25 + (1.5 - i)s, \quad 0 < s \leq 1/6, \quad i = 0, \ldots, 3. \tag{6}$$

Let v_t be the index of real contract prices that were negotiated on the contracts currently in effect,

$$v_t = \sum_{i=0}^{3} \omega_i (x_{t-i} - p_{t-i}). \tag{7}$$

Now suppose that agents set nominal contract prices so that the current real contract price equals the average real contract price index expected to prevail over the life of the contract, adjusted for excess demand conditions:

$$x_t - p_t = \sum_{i=0}^{3} \omega_i E_t(v_{t+i} + \gamma \tilde{y}_{t+i}) + \varepsilon_{p,t}. \tag{8}$$

Substituting equation (7) into equation (8) yields the real version of Taylor's (1980) contracting equation,

$$x_t - p_t = \sum_{i=1}^{3} \beta_i (x_{t-i} - p_{t-i}) + \sum_{i=1}^{3} \beta_i E_t(x_{t+i} - p_{t+i}) + \gamma^* \sum_{i=0}^{3} \omega_i E_t(\tilde{y}_{t+i}) + \varepsilon_t \tag{9}$$

where $\beta_i = \Sigma_j \omega_j \omega_{i+j}/(1 - \Sigma_j \omega_j^2)$, and $\gamma^* = \gamma/(1 - \Sigma_j \omega_j^2)$.

In their contract price decisions, agents compare the current real

contract price with an average of the real contract prices negotiated in the recent past and those expected to be negotiated in the near future; the weights in the average measure the extent to which the past and future contracts overlap the current one. When output is expected to be high, the current real contract price is high relative to the real contract prices on overlapping contracts.

Upon announcement of a disinflation, the rate of inflation begins to respond to lower current and expected excess demand conditions. Two aspects of the model moderate inflation's decline. First, nominal contracts negotiated prior to the disinflation and still in effect cannot (by assumption) adjust to the news. Thus, the rate of increase in these nominal contracts continues to feed into the rate of increase in the price level, albeit with diminishing weight as the disinflation proceeds (equation (5) implies that today's inflation rate is a weighted average of the rates of inflation in the current and last three quarters' nominal contract wages). Second, equation (9) implies that the current rate of change of contract wages depends on lagged and expected rates of change of inflation. In this way, the persistence in the inflation rate is extended through overlapping beyond the length of the longest contract.[3] A disinflationary policy that shrinks aggregate demand cannot alter this overhanging dependence on lagged inflation. Hence, a more rapid disinflation will cause greater output disruption than a gradual disinflation.

Parameter Estimates

Fuhrer (1994) provides details of subsample stability of the contracting and I–S parameters, including particulars of the method of estimation. The estimates presented here are taken from that paper. The final estimates for the reaction function estimated over the post-nonborrowed reserves operating procedure period (1982:IV to 1993:I) are summarized in Table 3. Interestingly, the parameters for the contracting specification appear stable across monetary policy regimes since 1966; the elasticity of the output gap with respect to the ex ante real rate is also stable across regimes, while the lags in the I–S curve show some sign of instability. Thus, the final specification uses contracting parameters and a real rate elasticity estimated since the mid-1960s, and I–S curve lagged output parameters that split at 1982:IV.

As shown in the table, the parameters of the I–S curve, the reaction function, and the contracting specification are of the expected sign and

[3] The Taylor specification exhibits the first, but not the second, kind of persistence. The equation in the Taylor specification that is analogous to equation (9) is $x_t = f(L^{-1})p_t + \gamma y_t$ (where $f(L^{-1})$ is a lead polynomial), so that the change in the contract wage depends on current and expected inflation, but not on lagged inflation.

Table 3
FIML Parameter Estimates: Final Specification

Equation	Parameter	Estimate	Standard Error	t-statistic
I-S Curve				
Full Sample	a_0	.012	.004	2.8
	a_p	−.350	.094	−3.7
1979:IV to 1993:I	a_1	1.527	.115	13.3
	a_2	−.551	.115	−4.8
Reaction Function				
1982:IV to 1993:I	α_0	−.003	.004	−.8
	α_{f1}	.838	.048	17.4
	$\alpha_{\pi 0}$	.271	.091	3.0
	$\alpha_{\pi 1}$	.142	.097	1.5
	α_y	.113	.035	3.3
	$\alpha_{\Delta y}$	.424	.117	3.6
Contracting Specification				
Full sample	s	.112	.010	11.1
	γ	.002	.001	1.6
Sample: 1982:IV to 1993:I				
Ljung-Box Q(12) Statistics:				
I-S curve	18.2			
Reaction function:	4.5			
Contracting equation:	21.8			
Dominant Roots Decay Rate (complex): 6.6% per quarter				

are estimated precisely. The slope of the contract distribution is a bit higher than that estimated in Fuhrer and Moore (1993a,b); the excess demand parameter is a bit smaller. The reaction function estimates indicate a significant response to inflation and to real output growth, as well as a strong tendency to smooth movements in the instrument ($\alpha_{f1} \simeq 0.8$).[4] The response of aggregate demand to the ex ante real interest rate is sizable and precisely estimated.[5] Aside from the reaction function parameters, which will be varied in the policy exercises that follow, the key parameters in the model are a_ρ, the real rate parameter in the I–S curve; s, the slope of the contract distribution; and γ, the

[4] Note that the reaction function indicates a response to contemporaneous output and inflation. Of course, policymakers have only partial information about the current quarter by the end of the quarter, so they cannot literally respond to current quarter variables. Thus, this estimate gives policymakers some information that they could not have had historically.

[5] See Fuhrer and Moore (1993b) for a discussion of the magnitude of the estimated real rate parameter in the I–S curve.

sensitivity of contract prices to excess demand. The sensitivity of the results to uncertainty surrounding these parameter estimates will be checked below.

Forward-Looking Monetary Policy

Previous work, and the estimated model presented above, have considered reaction functions that respond only to observable current and lagged information. This characterization appears to fit the data quite well. However, in the context of characterizing *optimal* monetary policy, the possibility that monetary policy is forward-looking must be considered, as in Hall and Mankiw (1993). Accordingly, all the parameters in the model are reestimated, allowing as many leads of policy targets to enter as there are lags in the estimated reaction function, restricting the coefficients on the lead variables to be proportional to the coefficients on the lagged variables. The estimated weight on lagged data is 0.97 with a standard error of 0.53, indicating little support in the data for a forward-looking reaction function.

A less restricted version of the forward-looking reaction function allows the funds rate to react to the four-quarter moving averages of the expected inflation rate, the expected growth rate of real output, and the expected output gap. The full information estimates of all of these effects are jointly and individually insignificantly different from zero.

How do we interpret the absence of forward-looking behavior in the estimated reaction function? After all, Federal Reserve System staff devote much of their time to preparing forecasts of policy goals. However, at least two explanations can be offered for the disparity between this observation and the empirical findings of this study. First, the forecasts in this specification are model-consistent expectations of future output and inflation; they may not closely resemble forecasts assembled by Fed staff. Staff forecasts may resemble fairly unrestricted projections of actuals on lagged values; the estimated reaction function already captures this. Second, voting members of the Federal Open Market Committee are not *required* to base their decisions on the staff forecasts. Thus, while the staff may have provided considerable forward-looking information, it may not have been reflected in movements of the policy instrument. For example, one would not necessarily characterize the disinflation of the early 1980s as the result of a forward-looking monetary policy. During this episode, the inflation rate rose above 10 percent while the unemployment rate stood below 6 percent; only a year later did short-term real rates rise above 1 percent.

Note that in addition to finding no support for forward-looking policy in the data, this study also finds that the optimal policy frontier

displayed below is approximately invariant to the inclusion of forward-looking monetary policy.[6]

The Effect of the Monetary Policy Rule on the Sacrifice Ratio

The contracting specification employed here implies different sacrifice ratios for different monetary policy responses. The more vigorous the policy response, the more outstanding contracts are caught unexpired during a disinflation, and thus the larger are the output costs. The converse is also true. To illustrate the magnitude of this effect, the sacrifice ratio implied by the model is computed for a grid of policy parameters that surround the estimated parameters from the last subsample and extend an order of magnitude in either direction.

To accomplish this, the simplified reaction function

$$f_t - f_{t-1} = \alpha_\pi(\pi_t - \pi^*) + \alpha_y \tilde{y}_t + .42\Delta y_t \tag{10}$$

is used, where a constant is suppressed, the estimated coefficient on the lagged funds rate of 0.8 is set to 1, and the baseline values for α_π and α_y are [0.5, 0.1], approximately equal to those estimated for the last subsample and displayed in Table 3. The coefficient on output growth is held fixed at its estimated value.[7] Because these parameters will be varied by an order of magnitude in either direction, exactly where the baseline is set is not crucial. The output sacrifice ratio is defined as the cumulative annual deviation of output from trend over the disinflation, discounted at 3 percent per year, for each percentage point reduction in inflation.[8]

Figure 1 displays the sacrifice ratio as a function of the policy parameters, varied over a logarithmic grid spanning two orders of magnitude around the baseline values. Table 4 displays the sacrifice ratios at selected policy parameter settings. The sacrifice ratio implied by the estimated reaction function is 4.0, almost exactly as estimated in Gordon (1985). Using the baseline parameters in the simplified reaction function (an approximation to the estimated reaction function) yields a sacrifice ratio of 3.7. The overall range of sacrifice ratios is impressive, from a low of 0.56 to a high of about 6.0. One striking feature of Figure

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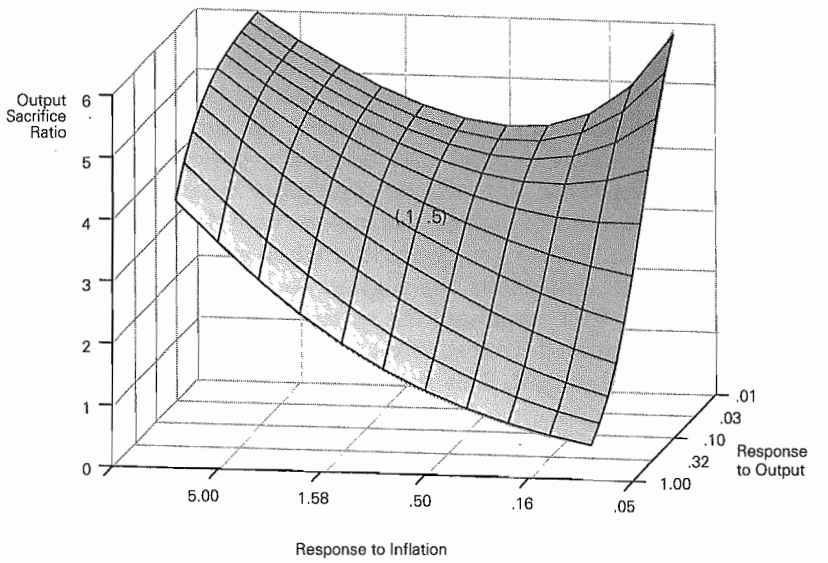
[6] Fuhrer (1994) provides evidence of this point.

[7] Changes in the response to real output growth produce relatively small changes in the grid of sacrifice ratios. For example, decreasing the response to real growth from 0.42 to 0 increases the sacrifice ratios by 0.05 to 0.4.

[8] The sacrifice ratio is computed analytically, rather than by simulation. See the Appendix for details of computation.

Figure 1

Sacrifice Ratio as a Function of Policy Parameters



1 is that the baseline policy's sacrifice ratio sits atop a large region of considerably lower sacrifice ratios.

For relatively balanced policies (α_π approximately equal to α_y), it is not possible to reduce the sacrifice ratio below 2.0. The sacrifice ratio is

Table 4
Sacrifice Ratios at Various Policy Settings

	Output Gap Response (α_y)						
Inflation Response (α_π)	.01	.03	.06	**.10**	.25	.63	1.00
.05	5.80	4.74	3.31	2.60	1.47	.78	.56
.32	4.24	4.06	3.68	3.38	2.59	1.73	1.36
.50	4.34	4.21	3.92	**3.68**	2.98	2.10	1.69
1.26	4.81	4.73	4.55	4.40	3.87	3.03	2.55
1.99	5.14	5.08	4.94	4.81	4.36	3.57	3.08
3.15	5.53	5.48	5.37	5.27	4.89	4.16	3.67
5.00	5.96	5.93	5.84	5.75	5.44	4.80	4.32

strictly decreasing in α_y and almost strictly increasing in α_π.[9] Significantly lower sacrifice ratios can be obtained for markedly unbalanced policies that respond strongly to output gap deviations and more weakly to inflation deviations. For inflation responses as low as 0.05, however, credibility becomes an issue. While the model contains no measure of credibility, it is likely that a 5-basis-point increase in the funds rate for every 1 percentage point that inflation exceeds its target (the top row of Table 4) would hardly be noticed by the markets and would not be viewed as a credible disinflationary policy. Policies that attack inflation even more vigorously than the estimates from the 1980s—increases in α_π holding α_y constant—can markedly increase the sacrifice ratio.

Thus, this model implies that monetary policy can significantly affect the sacrifice ratio. Note that in contrast to the evidence presented in Ball (1994), the costs of disinflation *increase* with the vigor and rapidity of the disinflation. Figure 1 suggests that while monetary policy has not pursued a course that yields the highest sacrifice ratio, neither has it pursued a course that minimizes the sacrifice ratio. It may be that doing so would have entailed undesirable trade-offs, perhaps in the variance of inflation or real output. This possibility is pursued below.

The Timing of Policy Responses and the Sacrifice Ratio

The simplified reaction function employed in the previous section assumed contemporaneous response of the funds rate to inflation and real output. The estimated model, however, shows a significant response to lagged inflation, as well as a tendency to keep the funds rate close to its most recent setting. The latter tendency will be denoted "interest rate smoothing." How do interest rate smoothing and lagged responses to policy outcomes affect the sacrifice ratio in this model?[10]

Table 5 displays the decrease (increase) in the sacrifice ratio relative to the baseline in Table 4, for various alterations in the timing of the funds rate response to policy targets. As shown in the first panel of the table, responding to lagged policy targets instead of the current period's expectation of the targets,

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[9] The sacrifice ratio *increases* as α_π and α_y both approach zero. With extremely low emphasis on both inflation and output, the model is stable, but behaves qualitatively differently. Under vigorous policy responses, policy moves nominal rates aggressively and controls short real rates (and thus long real rates). Under weak policy responses, inflation exhibits wide oscillations that dominate the movements in short real rates. Large real rate fluctuations cause large output fluctuations, and thus this policy implies a high sacrifice ratio. Ultimately, such policies are stable, but the dynamics of the economy are quite different from those under more standard policies.

[10] Roberts (1993) looks at the effects of information and response lags in a simplified annual version of Taylor's (1980) contracting specification.

Table 5
Change in Sacrifice Ratio Due to Change in Policy Response

	Output Gap Response (α_y)						
Inflation Response (α_π)	.01	.03	.06	**.10**	.25	.63	1.00
Lagged Response to π and y							
.05	.31	.25	.16	.12	.06	.02	.01
.32	.40	.38	.33	.30	.20	.11	.07
.50	.46	.44	.40	**.36**	.26	.15	.11
1.26	.61	.59	.56	.54	.44	.30	.23
1.99	.71	.70	.68	.65	.56	.42	.33
3.15	.84	.83	.81	.79	.71	.55	.45
5.00	1.00	.99	.97	.95	.88	.73	.62
Response to lagged 4-quarter moving averages of π and y							
.05	.72	.51	.29	.19	.08	.03	.02
.32	1.01	.91	.73	.60	.34	.15	.10
.50	1.15	1.06	.89	**.77**	.48	.23	.15
1.26	1.56	1.49	1.35	1.23	.89	.50	.35
1.99	1.84	1.78	1.65	1.54	1.18	.73	.52
3.15	2.19	2.14	2.01	1.91	1.55	1.03	.76
5.00	2.61	2 .57	2.45	2.35	1.99	1.42	1.09
Response to 1-quarter leads of π and y							
.05	−.27	−.22	−.14	−.11	−.05	−.02	−.01
.32	−.34	−.32	−.28	−.25	−.17	−.10	−.07
.50	−.37	−.36	−.33	**−.30**	−.23	−.14	−.10
1.26	−.48	−.47	−.45	−.43	−.36	−.26	−.20
1.99	−.55	−.54	−.53	−.51	−.45	−.34	−.27
3.15	−.64	−.63	−.62	− .60	−.55	−.44	−.37
5.00	−.74	−.73	−.72	−.71	−.66	−.56	−.48
Response to 4-quarter average leads of π and y							
.05	−.56	−.45	−.30	−.23	−.11	−.05	−.03
.32	−.73	−.69	−.61	−.54	−.37	−.20	−.14
.50	−.80	−.77	−.70	**−.64**	−.48	−.28	−.20
1.26	−1.01	−.99	−.94	−.90	−.75	−.53	−.40
1.99	−1.15	−1.13	−1.09	−1.06	−.92	−.69	−.55
3.15	−1.31	−1.29	−1.25	−1.23	−1.11	−.89	−.73
5.00	−1.50	−1.49	−1.46	−1.43	−1.33	−1.11	−.96

$$f_t - f_{t-1} = \alpha_\pi \pi_{t-1} + \alpha_y \tilde{y}_{t-1},$$

increases the sacrifice ratio by 1 to 100 basis points. For parameter values approximately like those in the estimated reaction function ($\alpha_\pi = .5$, $\alpha_y = .1$), the deterioration is relatively small, perhaps 40 basis points.

The next panel shows how much damage can be done by responding to smoothed averages of lagged quarterly data. In this panel, policy

responds to lagged four-quarter moving averages of inflation and the output gap:

$$f_t - f_{t-1} = \alpha_\pi .25 \sum_{i=1}^{4} \pi_{t-i} + \alpha_y .25 \sum_{j=1}^{4} \tilde{y}_{t-j}.$$

In this case, the sacrifice ratio deteriorates by as much as 2.6; at the estimated parameter values, the deterioration is a bit less than 1.0.

The bottom two panels display the advantages of responding to the expected levels of the target variables. In the third panel, policy responds to the one-quarter lead of both inflation and real output,

$$f_t - f_{t-1} = \alpha_\pi E_t \pi_{t+1} + \alpha_y E_t \tilde{y}_{t+1},$$

while in the bottom panel, the funds rate responds to the average expected level of inflation and output over the next four quarters,

$$f_t - f_{t-1} = \alpha_\pi .25 E_t \sum_{i=1}^{4} \pi_{t+i} + \alpha_y .25 E_t \sum_{j=1}^{4} \tilde{y}_{t+j}.$$

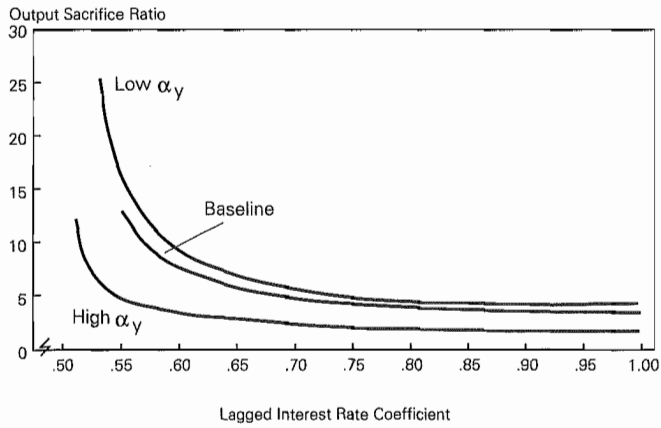
Improvements in the sacrifice ratio of 1.0 to 1.5 are possible, relative to the baseline of response to (expected) current targets. Overall, comparing a policy that responds to lagged, smoothed information to one that responds to expected four-quarter-ahead information, the sacrifice ratio can be improved by as much as 4.0; for parameters like those in the estimated reaction function, the improvement is about 1.5. Thus, the model implies that a more forward-looking monetary policy could lower the sacrifice ratio from a bit above 4.0 to a bit below 3.0.

Figure 2 displays the sacrifice ratio as a function of the lagged interest rate parameter in the reaction function, α_f, for fixed values of α_π and α_y.[11] The figure plots the relationship for three pairs of policy parameters: the baseline setting ($\alpha_\pi = .5$, $\alpha_y = .1$); a "low output emphasis" setting ($\alpha_\pi = .5$, $\alpha_y = .01$); and a "high output emphasis" setting ($\alpha_\pi = .5$, $\alpha_y = 1$). In each case, for a given emphasis on inflation and real output, a higher α_f almost always implies a lower sacrifice ratio. For the baseline and the "low output emphasis" cases, the function turns up slightly at $\alpha_f = .94$ and .93, respectively. The function declines monotonically for the "high output emphasis" case. As expected, the

[11] The model does not have a unique, stable solution for all values of α_f, α_π, and α_y. As α_f falls below about 0.5, the model requires much larger responses to inflation and output to remain stable.

Figure 2

Sacrifice Ratio as a Function of Interest Rate Smoothing Parameter



contour of sacrifice ratios for policies with high emphasis on output deviations lies strictly below the contour for the baseline and lower output emphasis policies.

These results suggest the following: (1) To the extent that monetary policy has responded to lagged and time-averaged observations on policy goals, it could improve the sacrifice ratio by responding more to expectations of its goals. (2) Making somewhat gradual changes in the operating instrument may be justified in that, given preferences over policy goals, increased interest rate smoothing generally lowers the sacrifice ratio.

Uncertainty in Estimates of the Sacrifice Ratio

This section will attempt to quantify the robustness of the model's sacrifice ratio estimates with respect to parameter uncertainty. Two related measures will be used. The first estimates the partial derivative of the sacrifice ratio with respect to the key structural parameters in the model, assessing the impact on the sacrifice ratio of a two-standard-error deviation of the parameter from its estimated value. The second measure computes approximate confidence intervals for the sacrifice ratio,

given the estimated covariance matrix of the estimated (non-policy) parameters in the model.

Partial Derivatives

An increase in the slope, s, of the contract distribution is expected to decrease the sacrifice ratio. An increase in the magnitude of the slope corresponds to a shortening of the average length of outstanding contracts. More rapidly expiring contracts make the real disruption of a contractionary demand policy smaller, so the sacrifice ratio should fall. Numerical derivatives of the sacrifice ratio with respect to s confirm this intuition: If the slope increased by two standard errors (0.02), the sacrifice ratio would decrease by 0.6.[9] Given the precision of the slope estimate and the influence of the slope on the implied sacrifice ratio, the slope is not an important source of uncertainty in the estimates of the sacrifice ratio.

An increase in the interest sensitivity of the I–S curve, a_ρ, is expected to increase the sacrifice ratio. For a given response of the short rate to policy targets during a disinflation, a higher interest rate elasticity translates into larger output disruption. The numerical estimate of the partial derivative suggests that a two-standard-error increase in a_ρ (about 0.19) will yield a 0.3 increase in the sacrifice ratio. Once again, this parameter appears not to be an important source of uncertainty in computing the sacrifice ratio.

Finally, an increase in the response of the real contract price to the output gap, γ, should lower the sacrifice ratio. If less downward demand pressure is required to lower inflation, then the output cost of a disinflation should diminish. The numerical estimate of the impact of γ on the sacrifice ratio implies that a two-standard-error increase in γ would yield a decrease of 3.0 in the sacrifice ratio. Thus, γ is the parameter that most contributes to uncertainty about the sacrifice ratio, given its estimation error and its effect on the sacrifice ratio.

Confidence Intervals

Uncertainty in the estimated sacrifice ratios at various policy parameter settings arises from the joint sampling error in the estimated non-policy parameters in the model, as well as from uncertainty about the form of the specification. The latter has been set aside as well beyond the scope of this paper; this section will concentrate on the former.

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[9] This estimate is based on two-sided numerical derivatives about the estimated parameters using a differencing interval of 1×10^{-4}. The estimate is insensitive to the particular differencing interval chosen.

Table 6
Confidence Intervals for Sacrifice Ratios

Policy Parameters		Percentile						
α_π	α_y	5	10	20	Median	80	90	95
.50	.10	2.16	2.42	2.78	3.73	5.54	7.31	9.62
.05	1.00	.47	.49	.52	.59	.75	1.16	1.42
5.00	.01	3.16	3.65	4.30	6.06	10.10	14.60	20.00

Assuming asymptotic normality, the distribution of the estimated parameters is

$$\beta \sim N[\hat{\beta}, \Omega]$$

where $\hat{\beta}$ is the vector of estimated parameter values and Ω is the estimated covariance matrix of the parameter estimates that underlies the standard errors presented in Table 3. The k percent confidence intervals for the sacrifice ratios can be estimated by repeatedly drawing the parameter vector from this distribution and computing the implied sacrifice ratio. In principle, the confidence intervals so obtained will depend on the setting of the policy parameters. The sensitivity of the confidence intervals will be tested by computing them at three different policy parameter settings.[10]

The percentile boundaries for the sacrifice ratio for three policy settings are displayed in Table 6. As expected, because the sacrifice ratio has a minimum of 0, the distribution of sacrifice ratios is skewed to the right. For the baseline case (approximately the estimated policy parameters), the median sacrifice ratio is 3.7, and the 60 percent confidence interval (20th percentile to 80th percentile) is [2.8, 5.5]. The 90 percent confidence interval (5th to 95th percentile) is [2.2, 9.6], suggesting considerable upside risk in the estimate of the sacrifice ratio. For the aggressive output response, the median sacrifice ratio is 0.59, with a 60 percent confidence interval of [0.52, 0.75]. The aggressive output response mutes the effect of parameter uncertainty on the implied sacrifice ratio, markedly compressing the confidence intervals. The lower end of

[10] The exercise uses 10,000 draws at each policy parameter setting to estimate the frequency distributions. Note that the model has no unique, stable solution for values of a_ρ or γ below zero; similarly, the admissible range for s is the interval [0, 1/6]. In the simulations, these parameters are forced to remain within the admissible range. The standard errors for a_ρ and s are small enough that the number of bound violations is quite small, about 1 percent for a_ρ and none for s. For γ, however, approximately 9 percent of the draws fall below the zero bound.

the 90 percent confidence interval differs only by 1 from the upper bound for this setting, compared with a range of about 7 for the baseline case. For the weak output response, the 60 percent confidence interval is [4.3, 10.1], centered about a median of 6.1.

Overall, these confidence intervals suggest that parameter uncertainty, largely attributable to uncertainty about γ, implies considerable uncertainty about the estimated sacrifice ratios. The effect of parameter uncertainty on sacrifice ratio uncertainty is amplified as the emphasis on output in the reaction function decreases—the 80 percent and 90 percent confidence ranges increase in absolute terms as α_y decreases. However, at the baseline policy parameter setting, even the 90 percent confidence interval includes sacrifice ratios only as low as 2.2; recall that these correspond to *high* draws for γ; the truncation of γ at zero truncates the mass in the high end of the sacrifice ratio distribution, not the low end.

The Optimal Policy Frontier

A second measure of optimality for monetary policy suggests that policy attempts to minimize the weighted average of the unconditional variances of inflation and output (or unemployment) around target values.[11] For many reasonable characterizations of the economy, an "optimal policy frontier" will exist that depicts the combinations of inflation variance and output variance attainable by policymakers. The policy frontier is generally expected to be convex to the origin; that is, one must trade higher inflation variance for lower output variance, and vice versa. The frontier describes the variance combinations that are possible; it says nothing about which combinations are desirable. However, any reasonable set of preferences over inflation and output variance will lead to an interior solution in which the policymakers accept some of both inflation and output variance.

Fuhrer (1994) addresses the characteristics required of a model to produce a plausible estimate of the optimal frontier and argues that the final specification detailed in Table 3 meets these criteria. In essence, the model fits the data quite well, accurately replicating the dynamic interactions that are found in the data. Thus, the model should yield a plausible estimate of the optimal policy frontier.

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[11] It may be that the monetary authority cares about the unconditional variance of its instrument as well. This concern does not enter the implicit objective function in this paper, in part because it is not clear why, given policies that yield stable economies, the variance of the instrument matters once the variances of the ultimate targets are minimized.

The Definition of the Optimal Policy Frontier

The optimal policy frontier is computed by tracing out the minimum weighted unconditional variances at different slopes along the frontier (implicitly, at different relative preferences for inflation versus output gap variance). Denote the relative weight attached to inflation variance as μ. Given the model specification described above, Fuhrer (1994) performs the following optimization

$$\min_{\theta} [\mu V(\pi - \pi^*, \theta) + (1 - \mu)V(\tilde{y}, \theta)] \tag{11}$$

over a grid for μ from 0.05 to 0.95 in increments of 0.05. θ includes all the parameters in the monetary policy reaction function (except the constant, which cannot affect the unconditional variances). While the estimated reaction function for the 1980s and 1990s indicates a funds rate response to the *growth rate* of output, a response to the output gap as well is allowed for in the optimal policy exercise. Note that because optimal combinations of inflation and output variances are attained by optimally choosing the reaction function parameters, the points on the frontier imply different values for the sacrifice ratio as well. The discussion will return to this connection below.

Results

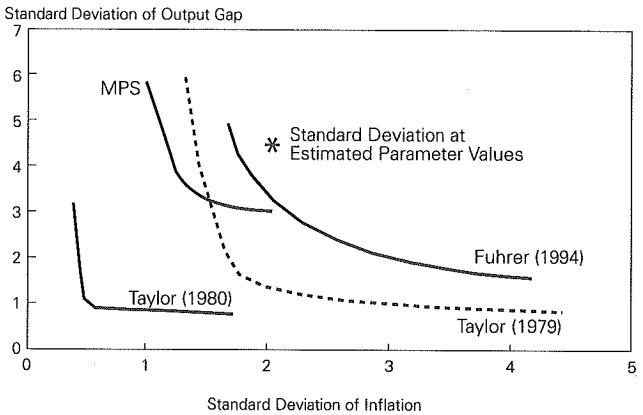
The line labeled "Fuhrer 1994" in Figure 3 displays the optimal policy frontier presented in Fuhrer (1994), computed from the estimated reaction function in Table 3, the full sample contracting specification, and the partially constrained I–S curve. The asterisk indicates the combinations of unconditional variances that arise for this model at the estimated parameter values. The estimated frontier has several interesting implications:

- The actual policy outcome, summarized by the combination of unconditional variances at the estimated parameter values, lies just outside the optimal frontier. Policy in the 1980s has not been far from optimal according to this metric.
- The actual policy outcome lies near the frontier at a point where the relative emphasis on inflation, μ, is about 0.8, thus implying a 4 to 1 distaste for inflation variability relative to output variability.
- Decreasing inflation variance (a move to the left and upward along the frontier) entails a substantial increase in the variance of the output gap.

As a check on this estimate of the locus and slope of the optimal policy frontier, the optimal policy frontiers computed in Fuhrer (1994)

Figure 3

Optimal Policy Frontiers



for structural models with different price specifications are reported. The first model uses the simple Phillips curve

$$\pi_t = \sum_{i=1}^{3} \delta_i \pi_{t-i} + \Gamma \tilde{y}_t + \varepsilon_\pi \qquad (12)$$

where $\Sigma\delta_i = 1$ is imposed. This is a simplified version of the type of expectations-augmented Phillips curve that appears in the MPS quarterly model (see Brayton and Mauskopf 1985). As shown in the line labeled "MPS" in Figure 3, the optimal frontier for this MPS-style model lies in about the same position as the frontier for the baseline model. The contours of the MPS frontier are a bit different from the real contracting model; the frontier flattens out at a higher output gap standard deviation, suggesting a less severe penalty in output variation for a decrease in inflation variation at that point. However, the output penalty for decreasing the standard deviation of inflation below 1.5 percent is severe, as it is for the relative contracting model.

The second model is the overlapping nominal contracts model of Taylor (1980). The policy reaction function and the I–S curve are held at their estimates from Table 3. As shown in the line labeled "Taylor

(1980)" in Figure 3, the policy frontier for the nominal contracting model lies well inside the frontiers for the Phillips curve and the real contracting models. The general contours are similar to the other models' frontiers.[15]

Finally, the line labeled "Taylor (1979)" in Figure 3 displays the policy frontier from a model developed in Taylor (1979). That frontier lies much closer to the MPS and real contracting frontiers. With the exception of the Taylor (1980) nominal contracting model, the other models imply similar estimates of the optimal policy frontier, suggesting that the estimate implied by the Fuhrer-Moore model is in the right ballpark.

What about the '90s?

At considerable econometric hazard, the reaction function for the period 1988 to the present can be estimated and the sacrifice ratio and unconditional variances implied by that policy response computed. The funds rate reaction function for this sample is well represented by (standard errors in [ ]):

$$f_t = 1.24[.120] * (1/4) \sum_{i=1}^{4} \pi_{t-i} + .52[.028]\tilde{y}_{t-1} + .028[.005].$$

Note that no evidence of interest rate smoothing is present (the lagged funds rate did not enter significantly in preliminary estimates of the equation), and the emphasis on inflation has more than doubled over the estimate for the period 1982–93. The funds rate appears to respond to a smoothed average of past inflation. The response to real GDP *growth* is not significantly different from zero, while the response to the output gap is higher than during the entire post-1982 period. The actual and fitted values for this equation appear in the top panel of Figure 4.

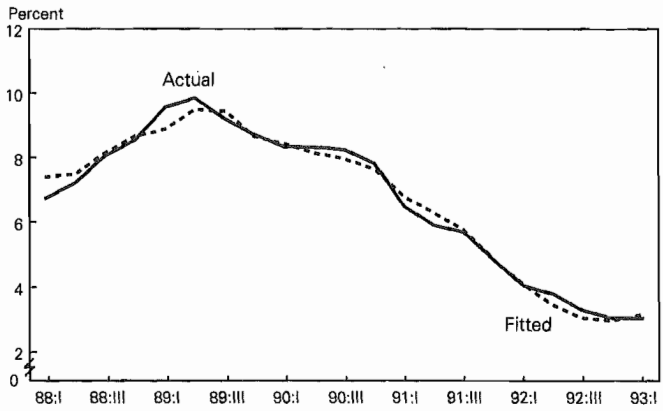
Given the estimates of the effects of higher relative emphasis on inflation, response to smoothed averages, and lack of interest rate smoothing, the sacrifice ratio implied by this more recent reaction function can be expected to be high. In fact, the sacrifice ratio implied by this policy is 7.2, nearly double the sacrifice ratio implied by the estimates for the entire post-1982 period. The bottom panel of Figure 4 shows the baseline optimal policy frontier from Figure 3, along with the estimate of the unconditional variance implied by the reaction function for the period 1988–93. The unconditional variance outcome implied by the model with the late '80s and early '90s reaction function lies yet a bit

[15] Taylor (1992) presents a similar juxtaposition of policy frontiers.

Figure 4

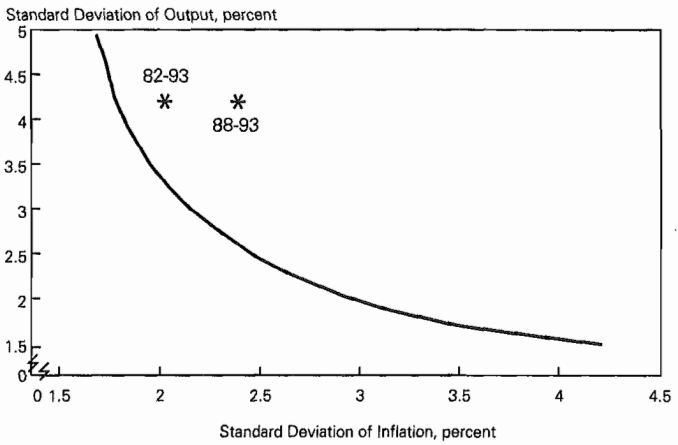
Federal Funds Rate

Actual versus Fitted, 1988:I to 1993:I



Policy Frontier, 1982 to 1993

with Unconditional Variances from Two Reaction Functions



further from the frontier than the outcome implied by the model for a fixed reaction function for the post-1982 period. Given the degrees of freedom available to estimate the three parameters of the reaction function, these results should be taken with a grain of salt. Still, they

suggest that recently the Fed has chosen a policy that has led to a modest deterioration in the *variance* measure of optimality and has markedly increased the sacrifice ratio.

Interaction of the Two Measures of Policy Performance

Table 7 presents the policy parameters that are required to attain the optimal policy responses for various preferences (various points along the frontier). The final row displays the sacrifice ratio implied by the model at those parameter settings. The results show the following:

(1) The policy responses required to attain the frontier are more vigorous than the estimated historical responses. The historical responses to inflation and output are smaller than *all* of the optimal frontier responses, regardless of the relative emphasis placed on inflation versus output variance.
(2) The sacrifice ratios entailed in moving to the frontier are *lower* regardless of preferences than the sacrifice ratio implied by the model at the historical estimates.

These results suggest that, while monetary policy behavior over the past 12 years has been reasonably "close to the frontier" when measured in (variance of inflation, variance of output) space, it may have been somewhat further from optimal in terms of the sacrifice ratio. The distance from the frontier and the level of the sacrifice ratio have been increased in the last six years. More vigorous responses to both inflation and real output would improve policy, whether measured by the weighted average of inflation and output variance (in which case the gain is relatively small) or by the sacrifice ratio (in which case the gain could be substantial).

Table 7
Sacrifice Ratios along the Optimal Policy Frontier, 1982 to 1993

		Reaction Function Parameters						
		Optimal parameter value for μ =						
Mnemonic	Estimated Value	.06	.22	.42	.54	.70	.82	.98
$\alpha_{\pi 0}$	.27	.40	.40	.41	.41	.40	.41	.48
$\alpha_{\pi 1}$	.14	.18	.24	.26	.27	.28	.29	.37
α_y	.11	2.91	1.56	.91	.67	.42	.28	.19
$\alpha_{\Delta y}$	.42	.57	.54	.52	.51	.50	.50	.48
α_r	.84	.76	.81	.83	.84	.85	.87	1.00
Sacrifice Ratio	**4.01**	1.26	1.70	2.18	2.46	2.89	3.23	3.86
1988 to Present	**7.20**							

A Three-Way Optimal Policy Frontier?

The foregoing results show that one can improve both the sacrifice ratio and the unconditional variances by moving onto the two-dimensional optimal policy frontier. Because *all* of the sacrifice ratios on the frontier displayed in Table 7 are *below* 4, all of the points on the frontier of Figure 3 are improvements relative to the asterisk, in all three dimensions. Thus, regardless of preferences over the objectives discussed here, actual policy performance cannot be on the surface of the three-dimensional frontier.

From the optimal three-dimensional frontier the maximum efficient sacrifice ratio can be determined for *any* preferences over the three objectives. Here, the three-dimensional frontier is computed for a variety of preferences (weights) over the two variances and the sacrifice ratio. Formally, the augmented optimization problem is

$$\min_{\theta} [\mu_1 V(\pi - \pi^*, \theta) + \mu_2 V(\tilde{y}, \theta) + (1 - \mu_1 - \mu_2)\Lambda(\theta)], \qquad (13)$$

where $\Lambda(\theta)$ summarizes the dependence of the sacrifice ratio, Λ, on the parameter settings in the model. The weights $(\mu_1, \mu_2, 1 - \mu_1 - \mu_2)$ take values on the unit simplex.

Interestingly, only for extremely imbalanced preferences does the sacrifice ratio exceed 4. A policy with 80 percent weight on inflation deviations, and a total of 20 percent weight on output deviations and the sacrifice ratio, yields a sacrifice ratio of 3.6. Even a policy that places 98 percent weight on inflation, and 1 percent each on output and the sacrifice ratio, implies an efficient sacrifice ratio of 4.6. Thus, only for policies that are extremely imbalanced in their concern for inflation would the efficient sacrifice ratio rise as high as 4; sacrifice ratios of 7 are almost certainly inefficient.[16]

Other Measures of Optimality

This paper ignores at least one other potential measure of optimality: the steady-state cost of nonzero rates of inflation. While this cost could be an important counterbalance to other costs discussed above, it has been omitted for two reasons. First, the evidence on the quantitative significance of such costs for low levels of inflation is mixed at best.[17]

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[16] Note that this minimization problem was not nearly as robust numerically as the two-dimensional optimal frontier problem described in Fuhrer (1994). The reason may be that, at least for this model and data set, concern for output variance is not sufficiently independent of concern for the sacrifice ratio. These two objectives are sufficiently correlated that it may not always be possible to precisely identify a well-defined minimum of the function.

[17] Motley (1994) and Lucas (1994) are typical of two different approaches to estimating the cost of positive inflation rates.

Second, the model used here has no explicit welfare function and, further, implies no effect of the level of inflation on real output in the long run.

Conclusions

The optimal policy frontier implied by the Fuhrer-Moore model indicates that the actual performance of the economy lies quite close to the frontier. In addition, the shape of the frontier implies that a reduction in the standard deviation of inflation below 2 percent entails an enormous increase in output variability. Similarly, reducing the standard deviation of output below 2 percent entails a large increase in inflation variability. Policy frontiers for alternative specifications—an MPS Phillips curve and a Taylor nominal contracting model—show that the qualitative feature of sharp trade-offs below a threshold for either inflation or output variability is preserved across models. This consistency was noted in Taylor (1992).

While recent monetary policy may have resulted in performance that is not too far from the two-dimensional variance policy frontier, policy may have been considerably less efficient with respect to the output sacrifice ratio. Estimates of the sacrifice ratio implied by the model using reaction functions estimated over the last 12 years run from moderate (about 4) to high (above 7).

Regardless of underlying policy preferences, monetary policy could have achieved a lower sacrifice ratio by responding more to *expectations* of policy targets, rather than to lagged and current observations on targets. The improvement in the sacrifice ratio ranges from about 1 to 4, relative to a lagged response reaction function.

Improvements in the sacrifice ratio and in the variability of inflation and output can be attained by moving closer to the optimal policy frontier. If the estimate of the most recent reaction function is taken literally, moving to the frontier would halve the sacrifice ratio and modestly decrease inflation and output variances. Regardless of preferences over inflation and output variability, improvements in either measure of optimality are obtained by more vigorous response to both inflation and real output.

The link between monetary policy and the sacrifice ratio in this paper arises through the overlapping contract structure in the model. Models in which credibility plays a central role may reach different conclusions. Models that employ a traditional Phillips curve will imply that monetary policy cannot affect the sacrifice ratio. Thus, all the conclusions reached here must be viewed as model-dependent.

Appendix

Computing the Sacrifice Ratio

All of the linear rational expectations models in this paper may be expressed as

$$\sum_{i=-\tau}^{0} H_i x_{t+i} + \sum_{i=1}^{\theta} H_i E_t(x_{t+i}) = \varepsilon_t \tag{A1}$$

where τ and θ are positive integers, x_t is a vector of variables, and the H_i are conformable square coefficient matrices.

The generalized saddlepath procedure of Anderson and Moore (1985) is used to solve equation (A1) for expectations of the future in terms of expectations of the present and the past. For a given set of initial conditions, $E_t(x_{t+k+i})$; $k > 0$, $i = -\tau, \ldots, -1$, if equation (A1) has a unique solution that grows no faster than a given upper bound, that procedure computes the vector autoregressive representation of the solution path,

$$E_t(x_{t+k}) = \sum_{i=-\tau}^{-1} B_i E_t(x_{t+k+i}),\ k > 0. \tag{A2}$$

In the models considered here, the roots of equation (A2) lie on or inside the unit circle.

Using the fact that $E_t(x_{t-k}) = x_{t-k}$ for $k \geq 0$, equation (A2) is used to derive expectations of the future in terms of the realization of the present and the past. These expectations are then substituted into equation (A1) to derive a representation of the model that is denoted the *observable structure*,

$$\sum_{i=-\tau}^{0} S_i x_{t+i} = \varepsilon_t. \tag{A3}$$

The model includes two auxiliary equations for computing the sacrifice ratio. The first simply allows for a shock, ψ_t, that causes a permanent shift in the steady-state value of the inflation rate, $\bar{\pi}$:

$$\bar{\pi}_t = \bar{\pi}_{t-1} + \psi_t.$$

In the reaction function, the funds rate responds to deviations of inflation from $\bar{\pi}$. The second equation implicitly defines Y_t as the expected discounted sum of the output gaps from the present to the infinite future:[18]

$$Y_t - 0.9924 * E_t Y_{t+1} = \tilde{y}_t.$$

The sacrifice ratio is then obtained by solving equations (A3) for the contemporaneous impact of a unit decrease in the steady-state inflation rate (a unit pulse in ψ_t) on the discounted sum of output gaps, Y_t. Thus, the sacrifice ratio, Λ, is the (i,j)th entry of S_0^{-1}, where S_0 is the contemporaneous coefficient matrix in equation (A3), i denotes the row of S_0 defining the sacrifice ratio, and j denotes the column corresponding to the shock ψ_t. The entry is divided by 4 to convert it to the appropriate units.

[18] Solving this difference equation forward yields $Y_t = \Sigma_{i=0}^{\infty} \delta^i \tilde{y}_{t+i}$.

References

Anderson, Gary and George Moore. 1985. "A Linear Algebraic Procedure for Solving Linear Perfect Foresight Models." *Economics Letters*, vol. 17, pp. 247–52.

Ball, Laurence. 1992. "Disinflation with Imperfect Credibility." National Bureau of Economic Research Working Paper No. 3983, February.

———. 1994. "What Determines the Sacrifice Ratio?" In N. Gregory Mankiw, ed., *Monetary Policy*, Chicago, IL: University of Chicago Press, pp. 155–82.

Brayton, Flint and Eileen Mauskopf. 1985. "The Federal Reserve Board MPS Quarterly Econometric Model of the U.S. Economy." *Economic Modelling*, July, pp. 171–292.

Fuhrer, Jeffrey C. "Optimal Monetary Policy in a Model of Overlapping Price Contracts. Federal Reserve Bank of Boston Working Paper 94-2, February.

Fuhrer, Jeffrey C. and George Moore. 1993a. "Inflation Persistence." FEDS Working Paper No. 93-17, May. Forthcoming, *Quarterly Journal of Economics*, February 1995.

———. 1993b. "Monetary Policy and the Behavior of Long-Term Real Interest Rates." FEDS Working Paper No. 93-16, May. Forthcoming, *The American Economic Review*, March 1995.

Gordon, Robert J. 1985. "Understanding Inflation in the 1980s." *Brookings Papers on Economic Activity*: 1, pp. 263–99.

Hall, Robert E. and N. Gregory Mankiw. 1993. "Nominal Income Targeting." National Bureau of Economic Research Working Paper No. 4439, August.

Lucas, Robert E., Jr. 1994. "On the Welfare Cost of Inflation." February. Prepared for March 1994 Stanford CEPC/SF Fed Conference on Monetary Policy in a Low-Inflation Environment.

McCallum, Bennett T. 1994, forthcoming. "A Semi-Classical Model of Price Level Adjustment." *Carnegie-Rochester Conference Series on Public Policy*, vol. 41.

Motley, Brian. 1994. "Growth and Inflation: A Cross-Country Study." February. Prepared for March 1994 Stanford CEPC/SF Fed Conference on Monetary Policy in a Low-Inflation Environment.

Roberts, John M. 1993. "Why Is Inflation Costly to Reduce?" Prepared for NBER Economic Fluctuations Research Meeting, July 17.

Taylor, John B. 1979. Estimation and Control of a Macroeconomic Model with Rational Expectations." *Econometrica*, vol. 47, (September), pp. 1267–86.

———. 1980. "Aggregate Dynamics and Staggered Contracts." *Journal of Political Economy*, vol. 88, no. 1 (February), pp. 1–24.

———. 1992. "The Great Inflation, the Great Disinflation, and Policies for Future Price Stability." In Adrian Blundell-Wignall, ed., *Inflation, Disinflation and Monetary Policy*. London: Ambassador Press Pty. Ltd.

Discussion

*N. Gregory Mankiw**

It is a rare pleasure to read a paper about the sacrifice ratio written by someone under the age of 50. The sacrifice ratio is one of those subjects in macroeconomics that is at the heart of many practical policy discussions but, at the same time, rarely finds its way into serious academic publications. It is good to see someone trying to be both practical and serious at the same time.

My comments on Jeffrey Fuhrer's paper are divided into three areas: motivation, methodology, and results. In each area, I have some disagreements with the author.

Before I launch into these disagreements, however, let me emphasize one point of agreement: This type of exercise is exactly what is needed if research is to help improve the conduct of monetary policy. In practice, the Fed follows a seat-of-the-pants approach to making policy. The Fed does not bind itself to any explicit monetary rule, and it probably will continue to exercise such discretion for the foreseeable future. But this kind of research on monetary rules is nonetheless useful. Even if a monetary rule is never adopted, research on alternative rules can potentially show the ways in which policy has overreacted or underreacted to economic conditions. In essence, this kind of research can improve seat-of-the-pants policymaking by raising the sensitivity of Alan Greenspan's posterior.

*Professor of Economics, Harvard University.

Motivation

Why do we care about the sacrifice ratio? The sacrifice ratio was a key issue in the late 1970s when prices were rising about 10 percent per year. Everyone wanted to reduce inflation, but people disagreed about how the large the costs would be in terms of lost output. Economists proposed various ways to reduce the cost of disinflation: gradualism, cold-turkey, wage-price controls, credibility, tax-based incomes policy, profit-sharing, and on and on. Yet everyone seemed to agree that a smaller sacrifice ratio was better than a bigger one. If we are going to reduce inflation from 10 to 3 percent, as we in fact did, it is better to lose less output than more in the process.

The question that this paper addresses, however, is different in a subtle but important way. Rather than discussing the one-time cost of a transition from a high-inflation policy to a low-inflation policy, this paper considers how the ongoing policy rule affects the sacrifice ratio. This rule has the Fed trying to achieve a target level of inflation, but sometimes the Fed changes the target for no good reason. The sacrifice ratio measures the cost in output when the Fed gets a negative 1-percentage-point shock to its target inflation rate.

It is not at all clear why we should care about the sacrifice ratio in this way. It is true that a larger sacrifice ratio means a larger output loss when the Fed's inflation target happens to fall, but it also means a larger output gain when the target happens to rise. As long as the natural rate of output is below the social optimum, as it probably is for various reasons, a larger sacrifice ratio is desirable during periods of rising inflation. We might suspect that a larger sacrifice ratio means more volatile output. But if this is the source of concern about the sacrifice ratio, then it is better to look at volatility directly, as in fact the paper does. At one point in this paper, the sacrifice ratio enters as an argument in the Fed's objective function, but its inclusion is not well-motivated. Holding the mean and variance of output and inflation constant, why should policymakers care what their policy rule implies for the sacrifice ratio? My guess is that they should not.

Methodology

The approach that the paper takes is to estimate a simple macroeconomic model of the economy—an I-S equation, an aggregate-supply equation, and the Fed's interest-rate reaction function—and then to simulate the model for alternative policy parameters. In this way, we can compute the policy frontier in terms of inflation and output volatility. We can then see the trade-off between volatility in output and volatility in inflation and how far actual policy has been from the efficient frontier.

The utility of this exercise, of course, depends on the credibility of the model and the estimation procedure. Both are open to dispute. Ever since Robert Lucas (1976) called attention to the neglected role of expectations, economists have been skeptical about macroeconometric models. The particular model in this paper does take a step in the direction of incorporating forward-looking expectations. But, nonetheless, the degree of forward-looking behavior is quite limited. Expectations enter the I-S equation, for example, only through long-term interest rates. Forward-looking consumers are completely absent. Those who found the Lucas critique compelling two decades ago will not find much solace in this paper.

In my view, Christopher Sims (1980) provided an even more important critique of macroeconometric models. Sims argued that these models were estimated with "incredible" identifying assumptions. This paper, for example, contains almost no discussion of the identification problem. A good rule of thumb is that when an author fails to mention his identifying assumptions, the reader should presume they are not appealing. In this particular paper, it is hard to find any variable in the estimated model that is exogenous. If this model is identified at all, identification must come from the tight structure that the model imposes on the data.

This brings me to my last concern about methodology—the particular theoretical structure. In some ways, I am quite sympathetic with the theory used here. It is a variant of a sticky-price model, in which long-term, staggered contracts cause the overall level of wages and prices to adjust only gradually to changes in aggregate demand.

Yet we must admit that we do not know very much about the details of aggregate supply. The theoretical literature on sticky prices does not point in a single direction about how to specify a price-adjustment equation. In some sticky-price models, firms adjust prices at periodic intervals; in others, firms adjust prices at any time by paying a fixed menu cost. In some models, firms set prices at fixed levels between adjustments; in others, firms specify a predetermined path of prices. In some models, firms face only aggregate shocks; in others, firms face idiosyncratic shocks as well. These details might seem quite secondary, but in fact they turn out to have important ramifications for the dynamics of the economy.

A paper by Andrew Caplin and Daniel Spulber (1987) shows how important subtle modeling issues can be. Caplin and Spulber examine a model in which firms adjust prices infrequently because they face menu costs. Nonetheless, in their model, the overall price level moves one-for-one with changes in the money supply, leading to monetary neutrality. Intuitively, the reason is that the few firms that do adjust prices change them by large amounts; moreover, the larger the change in the money supply, the greater the number of firms that choose to pay the

cost of adjustment. In this model, even though prices are sticky at the firm level, the overall price level appears quite flexible.

I bring up this theoretical result not because it has great practical relevance but because it sounds a warning for those who think we understand the right way to model the dynamics of the price level. Seemingly innocuous assumptions about the microeconomic price-adjustment process can lead to profound and surprising conclusions about macroeconomic dynamics in general and monetary policy in particular. Thus, any conclusions reached in this paper rest heavily on the Fuhrer-Moore model of price adjustment. Unless we are committed to that particular model, we should treat any policy conclusions with more than the usual dose of skepticism.

Where, then, does this ambiguity about modeling price adjustment leave those of us interested in serious, practical research on monetary policy? It leaves us in a position where we must admit the limits of our knowledge. In particular, three modest conclusions are warranted. First, we should acknowledge that many of the various models of monetary non-neutrality in the literature have some appeal. We have no reason to commit ourselves to any one of them. Second, we should avoid asking our models to answer very subtle questions, as this paper often does. The more subtle the question, the more likely the answer is to be model-dependent, and the more skeptical we have a right to be. Third, when evaluating rules for monetary policy, we need to admit our ignorance and try to find rules that are robust. That is, rather than trying to find the rule that is optimal in any single model, we should be looking for rules that are reasonably good across a wide variety of competing models.

Results

Having questioned this paper's motivation and methodology, let me now turn to my last topic—the results. One of the conclusions of this paper is that a slower disinflation is less costly than a rapid disinflation. In other words, as judged by the sacrifice ratio, gradualism is better than cold-turkey. This is, of course, one of the classic issues regarding disinflation. And I am deeply skeptical of Fuhrer's resolution of it.

In a recent paper, Laurence Ball (1994) addresses this question using an approach that imposes less theoretical structure. Ball identifies 28 episodes in OECD countries in which an economy experienced a large, sustained reduction in inflation. He then computes the sacrifice ratio for each episode. He shows that the more rapid the disinflation, the smaller the sacrifice ratio. This is just the opposite of what Fuhrer concludes. In my view, Ball's empirical regularity is more compelling than Fuhrer's model simulations. At the very least, to convince me that he is right, Fuhrer needs to explain how his model's simulations can be made consistent with Ball's finding.

Table 1
Expected and Actual Inflation: The Volcker Episode
Percent

Year	CEA Forecast January 1981	Actual
1980		12.5
1981	12.6	8.9
1982	9.6	3.8
1983	8.2	3.8
1984	7.5	3.9
1985	6.7	3.8

Note: CEA Forecast is from the *1981 Economic Report of the President*, p. 178.

A case in point is the Volcker episode. The early 1980s saw the most rapid disinflation in recent U.S. history. When I do a back-of-the-envelope calculation of the sacrifice ratio for this episode, I find that it was much smaller than most economists had predicted in advance (Mankiw 1994, p. 312). Certainly, the cost of this rapid disinflation was not much larger than had been predicted. Thus, this episode seems inconsistent with a key conclusion of this paper.

Finally, let me say something about credibility. In many models of aggregate supply, such as Stanley Fischer's (1977) model of nominal-wage contracts, policy has real effects by causing the price level to deviate from the price level that people expected at some point in the past. In this class of models, credibility is crucial for determining the sacrifice ratio in any particular episode of disinflation. Yet, in the introduction of this paper, Fuhrer dismisses credibility with the statement, "However, the importance of credibility in the conduct of monetary policy must be viewed as marginal at best. It is hard to argue that the high cost of the disinflation in the 1980s arose because monetary policy did not act credibly."

I do not think it is hard to argue that at all. Table 1 shows the inflation rates predicted at the beginning of 1981 by the Council of Economic Advisers. The table shows that the Volcker policy was not credible even to the Administration that had appointed Volcker. The Council forecast only a gradual reduction in inflation, whereas in fact Volcker oversaw a rapid reduction. If we add the first two forecasting errors, we find that the price level at the end of 1982 was 9 percentage points below the price level forecast at the beginning of 1981. These data are completely consistent with the view that monetary policy affects real output by causing the price level to deviate from the expected price level. In the end, it is hard to draw strong conclusions from the Volcker episode about the effects of credibility. The only sure lesson from this episode is that credibility is hard to establish.

References

Ball, Laurence. 1994. "What Determines the Sacrifice Ratio?" In N. Gregory Mankiw, ed., *Monetary Policy*. Chicago, IL: University of Chicago Press, pp. 155–82.

Caplin, Andrew and Daniel Spulber. 1987. "Menu Costs and the Neutrality of Money." Reprinted in N. Gregory Mankiw and David Romer, eds., *New Keynesian Economics, volume 1: Imperfect Competition and Sticky Prices*. Cambridge, MA: The MIT Press.

Fischer, Stanley. 1977. "Long-term Contracts, Rational Expectations, and the Optimal Money Supply Rule." Reprinted in N. Gregory Mankiw and David Romer, eds., *New Keynesian Economics, volume 1: Imperfect Competition and Sticky Prices*. Cambridge, MA: The MIT Press.

Lucas, Robert E., Jr. 1976. "Econometric Policy Evaluation: A Critique." *Carnegie-Rochester Conference on Public Policy*, no. 1, pp. 19–46 and 62.

Mankiw, N. Gregory. 1994. *Macroeconomics*, 2nd edition. New York: Worth Publishers.

Sims, Christopher. 1980. "Macroeconomics and Reality." *Econometrica*, vol. 48, pp. 1–48.

Summary Discussion

*Martin S. Eichenbaum**

The purpose of this session is to consider the question "How Efficient Has Monetary Policy Been?" Jeffrey Fuhrer and John Taylor attack this question within the confines of simple but explicit dynamic models that stress the importance of nominal rigidities in goods and labor markets. Indeed, the two papers share virtually identical views about the nature of the monetary transmission mechanism and similar predictions about the effects of changes in monetary policy. Roughly speaking, the Fuhrer paper can be thought of as a state-of-the-art econometric attempt to implement the qualitative vision embodied in the Taylor paper.

The Framework

The vision itself is elegant in its simplicity. To a first approximation, it can be summarized as follows.

1. Monetary policy actions induce changes in short-term nominal interest rates.
2. For various reasons, the inflation rate is "sticky" and does not respond immediately either to developments on the real side of the economy or to Federal Reserve actions.
3. Given an expectations model of the term structure and interest rate smoothing by the Federal Reserve, a policy-induced rise in

*Professor of Economics, Northwestern University. The author thanks Charles Evans for numerous conversations and help in preparing this comment.

the short-term nominal interest rate induces a rise in the long-term real interest rate.

4. The rise in the long-term real interest rate generates a fall in aggregate demand, which causes actual output to fall. By how much depends crucially on the extent to which the Federal Reserve can lower the long-term real interest rate and on the sensitivity of aggregate demand to changes in the long-term real interest rate.
5. With a lag, monetary policy affects inflation through its effect on deviations of actual from potential output.

Strikingly, this vision abstracts entirely from all other rigidities, such as the financial market imperfections that have been the focus of so much debate in the academic literature and—I might add—Chairman Greenspan's recent testimony to the House Banking Committee. Credit crunches, liquidity constraints, the deficit, and the collapse of traditional money demand, loan demand, and velocity relationships—all are simply absent from the framework. So the key questions are: Have the authors made the "right" decisions in modeling the monetary transmission mechanism, and how can we tell? That the answers matter for assessing the efficiency of monetary policy is obvious. Frankly, Chairman Greenspan's defense of recent monetary policy is simply incoherent from the perspective of the vision embodied in the Fuhrer and Taylor papers.

How convincing is the evidence presented by Fuhrer and Taylor for their vision? Not very. To begin with, neither paper offers any evidence whatsoever regarding the central implication of the model: the existence of a significant trade-off between the volatility of inflation and output. This is because no such evidence exists. Perhaps Fuhrer and Taylor could rationalize the absence of such a relationship as reflecting suboptimal behavior on the part of policymakers. But absent a convincing rationalization, the apparent lack of a trade-off must be viewed as a grave embarrassment for the model.

Next, neither paper offers any direct evidence on the plausibility of their view of the monetary transmission mechanism. Consider, for example, the key assumption that aggregate demand depends sensitively on long-term interest rates. Which rate? And where is the evidence that aggregate demand actually does depend on it? More fundamentally, what evidence do we have that the Federal Reserve can significantly lower the unnamed long-term real interest rate by lowering the current nominal federal funds rate? In fact, it is exactly the absence of such evidence that has led various researchers to look at alternative, perhaps complementary models of the monetary transmission mechanism that stress frictions in financial markets.[1] Perhaps these types of

[1] See, for example, Christiano and Eichenbaum (1992).

frictions could be incorporated into Fuhrer's and Taylor's models. But (almost) surely their quantitative characterization of efficient monetary policy would then change.

To be fair, Fuhrer has estimated his models in other papers, and the "fit"—for the limited number of variables that he looks at—is reasonably good. But given the level at which the model is formulated, it would be shocking if it was not. After all, if you start off by assuming that output is an unconstrained AR(2) about a deterministic trend (with a correction for a long-term real interest rate), how wrong can you go? Similarly, if you start off by assuming that the short-term interest rate is an unconstrained distributed lag of itself and current and lagged values of output and inflation, how wrong can you go?

If the issue is finding a way to statistically reject the model, that is easy. Just take a stand on what the mysterious long-term interest rate is and test the term structure theory embedded in the model. For any long-term interest rate I can think of, that theory is soundly rejected. In fact I would conjecture that if anyone ever constructs a "top 10" list of economic hypotheses that have been tested and rejected, the risk-neutral, expectations model of the term structure will surely be included. So overall tests of the model are not the issue. Relative to a small, selective number of variables, the fit is fine. But once we include other key variables whose behavior is central to the monetary transmission mechanism being considered, then the model is easy to reject.

A more interesting question is whether the evidence that is presented provides support for the Fuhrer/Taylor vision of how monetary policy works. The answer is no. McCallum (1994) shows this in a particularly dramatic way. One of the key parameters in Fuhrer's model is γ, which governs the sensitivity of contract prices to excess demand conditions (see equation 8). Fuhrer estimates γ to be small and statistically insignificantly different from zero. But if this parameter is equal to zero, then the model dichotomizes, prices are exogenous, and the nominal contracting features are simply irrelevant to the real side of the economy. So interpreted, Fuhrer's empirical work is stunningly supportive of a real business cycle view of the world. The claim that his model fits well is equivalent to the claim that a real business cycle model fits well. In this sense, Fuhrer's answer to the question "Has monetary policy been efficient?" is: "Who cares?"

A VAR Approach

I am not convinced by Fuhrer's evidence that we live in a real business cycle world. To ensure that readers of his paper do not develop an intense yearning for lakeside property, I will develop the connection

between the Fuhrer and Taylor papers and the recent vector autoregression (VAR)-based literature that tries to document what the effects of exogenous shocks to monetary policy are. This link will be used to do two things. First, I show that the current formulation of the Fuhrer/Taylor model—certainly as it pertains to the behavior of the Federal Reserve—is implausible, although fixable. Second, this link makes it possible to point to a literature that, in contrast to the Fuhrer and Taylor papers, provides strong evidence of monetary non-neutralities. While this literature has not yet resolved the nature of the monetary transmission mechanism, it is assembling a set of "facts" that any plausible business cycle theory ought to be consistent with.

Fuhrer's model and his identifying assumptions about the nature of shocks to monetary policy map perfectly into the VAR literature that focuses on the following simple question: How do monetary policy actions affect the economy? The central problem in answering this question is that monetary policy actions often reflect policymakers' responses to non-monetary developments. For the sake of precision, I will refer to the rule that relates policymakers' actions to the state of the economy as the feedback rule. To the extent that a policy action is an outcome of the feedback rule, the response of economic variables reflects the combined effects of the action itself and of the variables that policy reacts to. To isolate the effects of Federal Reserve policy actions per se, we need to identify the component of those actions that is not reactive to other variables. I refer to this component as the exogenous component of a monetary policy action. I call the realizations of this component exogenous monetary policy shocks. With this definition, monetary policy actions are the sum of two components: the feedback rule and the exogenous shock. The VAR literature focuses on the question: "How does the economy respond to an exogenous monetary policy shock?"

A harder and more interesting question is "What is the impact on the economy of a change in the monetary authority's feedback rule?" It is exactly this type of question that underlies Fuhrer and Taylor's characterizations of the optimal frontier between volatility in inflation and in output. But before we trust the models' answers to this type of difficult question, we should insist that those models give us the right answer to the simple question that is the focus of the VAR literature. Granted, giving the right answer to the simple question is not a sufficient condition for acting on the implications of a particular model. But this test does help narrow the field of choice and give guidance to the development of future theory.

To see the connection between the Fuhrer paper and the VAR literature, recall that Fuhrer characterizes monetary policy via a time invariant linear policy rule of the form:

$$f_t = \sum_{j=1}^{n} \beta_{f,j} f_{t-j} + \sum_{j=0}^{n} f_{\pi,j} + \sum_{j=0}^{n} \beta_{t,j} y_{t-j} + \varepsilon_{ft}. \quad (1)$$

Here f_t denotes the time t federal funds rate, π_t is the time t inflation rate, y_t is the time t deviation of the log of output from a deterministic trend, and n is a positive integer. The term ε_{ft} is the time t exogenous shock to policy. It is assumed to be orthogonal to the other variables on the right-hand side of equation (1). Broadly speaking, ε_{ft} can be interpreted as reflecting the fact that actual policy decisions are the outcome of the ongoing interaction of policymakers with different preferences and constituencies that have different political strengths at different times. In his Appendix, Fuhrer interprets ε_{ft} as reflecting exogenous shocks to policymakers' target rates of inflation. Similar interpretations can be derived from Taylor's model.

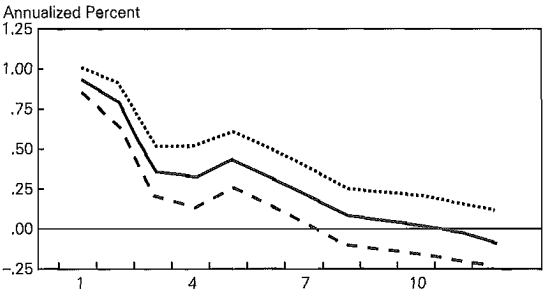
Under Fuhrer's assumptions, exogenous shocks to policy are easy to measure: They are just the residuals from equation (1). So the dynamic response of the economy to a policy action corresponds to the impulse response function from an exactly identified VAR in which we impose a particular Wold ordering on f_t, π_t, and y_t. The only aspect of the ordering that is relevant (for our purposes) is that f_t appears behind y_t and π_t. In simple English, this corresponds to two key assumptions: (i) policymakers set f_t on the basis of current and lagged values of output and inflation, as well as lagged values of f_t, and (ii) contemporaneous movements in f_t do not affect current output or the current inflation rate. Policy shocks affect these variables with at least a one-quarter lag.

Figure 1 displays the dynamic response functions of f_t, y_t, and π_t to a one-standard-deviation shock to ε_{ft}. This shock will be referred to as an FF policy shock. Solid lines correspond to point estimates, while the dotted lines denote a two-standard-deviation band about the point estimates. These were estimated from a trivariate VAR that included four lags of f_t, y_t, and π_t. The sample period was 1966:I to 1992:III. A number of interesting points emerge from Figure 1.

1. Consistent with the notion that the Federal Reserve smooths interest rates, positive FF policy shocks generate persistent but transitory movements in the federal funds rate (top panel).
2. Positive FF policy shocks are associated with persistent declines in aggregate output (middle panel), with the peak effect occurring roughly after one and one-half years. Assuming a discount rate of 3 percent per year, the discounted percentage-point loss in real GNP induced by a 100-basis-point shock to the federal funds rate is roughly 2.75. While the experiment underlying this statistic does not correspond to the one underlying standard

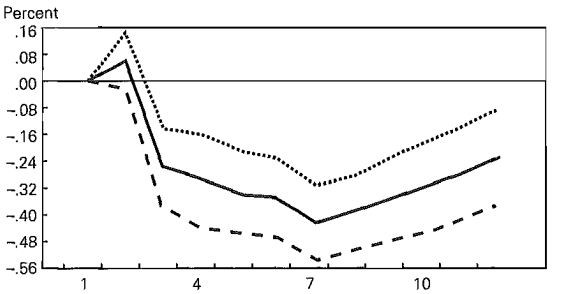
Figure 1

Effect of FF Policy Shock on Fed Funds Rate

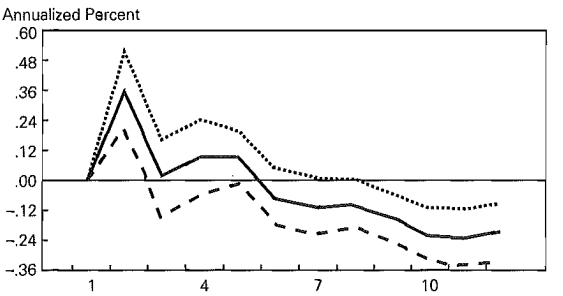


Effect of FF Policy Shock on Output

(Deviation from Trend)



Effect of FF Policy Shock on Inflation Rate



Note: Estimated over sample period 1966:I to 1992:III.

estimates of the sacrifice ratio, it is interesting that the number is in the ballpark of the sacrifice ratio reported by Fuhrer.

3. Finally, notice that the specification has very strange implications for the relationship between monetary policy shocks and movements in inflation (bottom panel). In fact, the infamous *price puzzle* emerges with a vengeance. This is the result that a positive shock to the federal funds rate is associated with a prolonged *rise* in the inflation rate.[2]

The problem is that the Federal Reserve reaction function used by Fuhrer (and Taylor) is overly parsimonious. Christiano, Eichenbaum, and Evans (1994) argue that the key variable that has been omitted from the reaction function is some measure of commodity prices, which acts as an indicator of future inflation. On several occasions in the postwar era, a rise in the inflation rate was preceded by a rise in the federal funds rate and in commodity prices. An example is the oil shock in 1974. Identification schemes that treat the federal funds rate as the Federal Reserve's policy instrument but that do not include commodity prices in the Fed's feedback rule have the perverse implication that contractionary policy shocks lead to a sustained rise in both the price level and the rate of inflation. Christiano, Eichenbaum, and Evans (1994) and Sims and Zho (1994) show that allowing for a measure of commodity prices in the feedback rule resolves the price puzzle. It is hard to say what the impact of this modification would be in Fuhrer's model. Still, it is clear that the current specification is troublesome, to say the least. Even researchers who have stressed the ability of monetary policy to shift the aggregate supply curve of output by affecting the price and quantity of working capital do not believe that contractionary policy actions are followed by prolonged rises in the inflation rate. On this basis, I conclude that while the reaction function used by Fuhrer and Taylor is useful for pedagogical purposes, it is misspecified for the purposes of empirical work.

An obvious question is whether the evidence for non-neutralities survives including commodity prices in the Federal Reserve's reaction function. The answer is yes. In contrast to Fuhrer's paper, the (recent) VAR literature provides strong, credible evidence that shocks to monetary policy have important effects on aggregate economic activity. In particular, according to this literature, contractionary policy shocks have the following properties: (i) they are associated with a rise in the federal funds rate and a fall in monetary aggregates like nonborrowed reserves, total reserves, and M1; (ii) they lead to persistent declines in real GDP, employment, retail sales, and nonfinancial corporate profits as well as

[2] See Christiano, Eichenbaum, and Evans (1994) and Sims and Zho (1994).

increases in unemployment and manufacturing inventories; (iii) they generate sharp, persistent declines in commodity prices; and (iv) the aggregate price level does not respond to them for roughly a year. After that, the price level declines. Given my space constraints, I refer the reader to Christiano, Eichenbaum, and Evans (1994) or Cochrane (1994) for discussions of these results. Ongoing work is aimed at using VAR methods in conjunction with sectoral and micro data to provide a more detailed view of the monetary transmission mechanism.[3] It is far from clear just what picture will emerge when all is said and done. It is clear that pure real business cycle theories cannot reproduce the patterns that have already been documented. Whether Fuhrer's model can do so is an open question. We won't know until the model is enriched to have a more realistic specification of the Fed's reaction function and we see the constrained impulse response functions.

If Fuhrer's model passes the impulse response function "test" and direct evidence is presented on the plausibility of the Fuhrer/Taylor view of the monetary transmission mechanism, then the answers these papers give us to the hard questions that ultimately interest us merit very serious consideration. But until then, their answers must be taken with a very large grain of salt.

Conclusion

Let me conclude by emphasizing that while I have criticized various aspects of the Fuhrer and Taylor papers, there is much to admire in them. Fuhrer in particular takes an explicit stand on the monetary transmission mechanism and ruthlessly pursues the logic of his model to tell us—bottom line—what he thinks the sacrifice ratio is and what different policy rules would imply for the operating characteristics of the economy. There just is not enough of this kind of work being done. To be useful in the policy process, researchers need to help policymakers understand the quantitative implications of their actions as well as the quantitative trade-offs involved in adopting different policy regimes. Granted, the costs of proceeding this way are high. But what is the alternative? The social marginal product of a researcher announcing that the Federal Reserve should push the LM curve to the right is about as high as that of praying for a positive technology shock. While I have reservations about the Fuhrer and Taylor papers, they're not just praying for good shocks.

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[3] See, for example, Gertler and Gilchrist (1991) on the role of financial market frictions and the impact of monetary policy shocks on large and small firms.

References

Christiano, Lawrence J. and Martin Eichenbaum. 1992. "Liquidity Effects and the Monetary Transmission Mechanism." *The American Economic Review*, vol. 82, no. 2, pp. 346–53.

Christiano, Lawrence J., Martin Eichenbaum, and Charles Evans. 1994. "The Effects of Monetary Policy Shocks: Evidence from the Flow of Funds." National Bureau of Economic Research Working Paper No. 4699. Forthcoming. *The Review of Economics and Statistics.*

Cochrane, John. 1994. "Shocks." National Bureau of Economic Research Working Paper No. 4698. Forthcoming, *Carnegie Rochester Conference on Public Policy*, vol. 41.

Gertler, Mark and Simon Gilchrist. 1991. "Monetary Policy, Business Cycles and the Behavior of Small Manufacturing Firms." National Bureau of Economic Research Working Paper No. 3892. Forthcoming, *Quarterly Journal of Economics.*

McCallum, Bennett T. 1994. "A Semi-Classical Model of Price Level Adjustment." Manuscript, Carnegie Mellon University. Forthcoming, *Carnegie Rochester Conference on Public Policy*, vol. 41.

Sims, Christopher and Tao Zho. 1994. "Does Monetary Policy Generate Recessions? Using Less Aggregated Price Data to Identify Monetary Policy." Manuscript, Yale University.

Comparing Direct and Intermediate Targeting

Monetary policy has often been characterized as attempting to maintain an intermediate target, such as a monetary aggregate, within a target range. However, changing financial markets have called into question the reliability of the relationships between intermediate targets and ultimate goals of monetary policy, and thus the ability of this strategy to attain ultimate goals. Should monetary policy abandon intermediate targets?

Monetary Aggregates Targeting in a Low-Inflation Economy

*William Poole**

The first Boston Fed conference, 25 years ago in June 1969, bore the title, *Controlling Monetary Aggregates*. The conference volume leads off with a panel discussion, begun by Paul Samuelson. He opened his remarks with a one-sentence paragraph: "The central issue that is debated these days in connection with macro-economics is the doctrine of monetarism" (Samuelson 1969, p. 7). The background of that conference was the rising rate of inflation and accumulating evidence that excessive money growth was the cause of the problem. The principal question debated was whether the Fed should adopt a monetary target and abandon tight control of the federal funds rate.

Today we are dealing with what appears to be the opposite problem. The inflation rate has fallen to levels not seen since the early 1960s, but experience over the past decade or so seems to show that inflation is no longer closely related to money growth. Nevertheless, the question concerning the best target for the Fed to pursue remains the same. The organizers of this conference have framed the topic for this session as follows: "Monetary policy has often been characterized as attempting to maintain an intermediate target, such as a monetary aggregate, within a target range. However, changing financial markets have called into question the reliability of the relationships between intermediate targets and ultimate goals of monetary policy. . . . Should monetary policy abandon intermediate targets?"

With all due respect to my friends at the Boston Fed, the question is misstated. The quoted passage should read, "Should monetary policy

*Herbert H. Goldberger Professor of Economics, Brown University. The author thanks Data Resources, Inc. for providing access to its data bank, from which many of the data used in this paper were drawn.

have abandoned monetary targeting? Is the federal funds rate a satisfactory monetary policy instrument?" I rephrase the question because there can be no doubt that over the past few years the Fed's policy has focused on setting the funds rate and that money growth, however defined, now plays at best a marginal role. Indeed, the significance of money stock data in policy decisions seems considerably less than that of aggregate data such as the industrial production index and the consumer price index. The Fed still believes that money stock data are somewhat more important than, say, Rhode Island retail sales data, but not much more important.

The Fed is obviously uneasy with this situation, as it should be. Nothing has changed to eliminate the potential perils in controlling the fed funds rate. Yet, who can quarrel with success? Following the 1982 recession the economy enjoyed an unusually long economic expansion, which ended in an unusually mild contraction. During the expansion, the core CPI inflation rate remained fairly steady at about 4½ percent per year, and last year inflation was below 3 percent. It is true that the expansion following the mild 1990–91 recession got off to a slow start, and perhaps the Fed could have done things a little differently. Perfection, though, is a damn tough standard; it makes much more sense to emphasize departures from historical experience than from the dream world of macroeconomic bliss. On the realistic standard of history, the Fed has performed well indeed in recent years.

How can monetary policy research contribute to maintaining the Fed's excellent performance in the years to come? Proponents of monetarist policy prescriptions—those who want the Fed to resume paying attention to money growth targets—have devoted their research to, among other things, the stability of the money demand function, the regularities of the cyclical behavior of monetary aggregates, and the principles of defining monetary aggregates. Opponents of monetarist policy prescriptions—those who argue the case for the fed funds policy instrument—have devoted their research to, among other things, the instability of the money demand function, the irregularities of the cyclical behavior of monetary aggregates, and the problems with all existing definitions of monetary aggregates. Strangely, those who advocate that the Fed control the fed funds rate base their case almost entirely on the case against monetary aggregates. The funds rate as a monetary target really has not received much academic study.

This imbalance of research effort is unfortunate, given that monetary policy ought to be based on a comparison of the relative advantages and disadvantages of various approaches. My first published paper on this subject, about 25 years ago (Poole 1970a), emphasized that the practical issue then facing the Federal Reserve was to choose between controlling some monetary aggregate and some interest rate, and that the choice should in principle depend on whether the money stock or

the interest rate would be the more reliable policy instrument. The issue today remains the same. The enormous literature on monetary policy has clarified many of the issues, but few of the protagonists who have been in this intellectual battle over the years have changed their minds on how the Fed should run its policy.

Part of the problem, as just suggested, is that most of the research has been focused on monetary aggregates and too little has been focused on how the Fed has, or should, employ an interest-rate instrument. The obvious problems in recent years in using monetary aggregates have permitted the federal funds rate to win the policy competition by default. This paper will review the major considerations involving the monetary aggregates, and then present some new findings concerning the role of interest rates in monetary policy.

Policy Goals, Policy Instruments, and Intermediate Targets

Policy analysis has long been based on a framework distinguishing policy goals, intermediate targets, and policy instruments. Despite the widespread use of this framework, those using it are not always very precise about exactly how they interpret the main concepts. Thus, this paper begins with a few comments on how I view this framework, and on which aspects of various disputes are relevant here.

Policy Goals

One issue that has been settled is that the structure of the economy does not contain a long-run trade-off between employment and inflation. Not settled is whether a short-run trade-off exists and, if it does, its nature and stability. Attitudes toward this issue do affect policy positions, but for the purposes of this paper the trade-off debate can be ignored. It will be assumed that the ultimate goal of monetary policy in the long run is to keep inflation low, and that the goal in the short run is to maximize an objective function that depends on the levels and stability of employment and inflation in the current and future periods. The connection between the short run and the long run depends on the Fed's discount rate and the risks it is willing to take, including political risks arising from pressures from the Congress and the Administration. The argument here will depend little on the precise nature of the structure of the economy within which the policy optimization takes place.

A common argument, but one that makes no sense to me, contends that the Fed should simply concentrate on achieving its ultimate goals. Some inflation hawks, for example, want the Fed to follow a "price rule." Others want the Fed to target nominal GDP growth "directly." Statements of this kind sweep under the rug the important problem of

how the Fed should adjust its policy instruments in pursuit of policy goals. Economists differ much less in their views on the goals they want to achieve than in their views on how to adjust policy instruments to achieve the goals. Some of the confusion arises because the issue of political control over monetary policy gets mixed up with technical issues concerning relationships between instruments and goals. Although the main purpose of this paper is to examine technical issues, a short digression on political control over monetary policy seems in order.

Political Control of Monetary Policy

A central bank is ultimately responsible to the voters, and economists have long been interested in the question of how monetary policy goals are and should be determined in a democracy. The issue is partly one of political economy and partly one of the effectiveness of monetary policy in terms of the behavior of the variables in the objective function —the level and stability of employment, inflation, interest rates, and whatever other variables might be considered.

Democracies exercise control over central banks in a number of different ways in different countries, and a lively literature exists on how best to organize this control. In some countries, the central bank reports directly to the treasury or finance ministry, and through that department to the president or prime minister. In other countries, the United States included, the central bank has a substantial degree of independence from the executive branch, and the objectives of policy are determined primarily by the appointed central bankers with a minimum of legislated guidance from the legislature. (Of course, legislative and executive branch commentary ranging from thoughtful analysis to political potshots is common, but commentary should not be confused with formal legislation.) In both sets of countries—those with relatively independent central banks and those with central banks controlled directly by the party in power—policy goals typically are vague and poorly defined. Political discourse focuses on inflation and unemployment, and other less important issues, but the emphasis changes over time and the goals are usually a little more or a little less, with substantial uncertainty over exactly what the operative goals are at any particular time.

The situation was quite different under the classic gold standard. The government, including the central bank, had as its primary monetary policy goal the maintenance of convertibility of the country's paper money into gold at a fixed price. That policy goal, for better or for worse, was very specific and widely supported within the gold-standard countries. New Zealand has recently taken a similar direction. Under the Reserve Bank of New Zealand Act of 1989, price stability is the sole objective of monetary policy (Fischer 1993, p. 2). The Reserve Bank of

New Zealand operates under a contract negotiated between the minister of finance and the Reserve Bank governor to achieve zero inflation, and the governor may be fired for failing to reach the target (pp. 8–10).[1]

Legislative determination of policy goals must take one of two forms: a *performance* standard or an *instrumental* standard. New Zealand has decided on a performance standard; the Reserve Bank of New Zealand has the task of determining how to adjust its policy instruments to achieve the legislated goal of price stability. Milton Friedman has long favored an instrumental standard in the form of a legislated target for money growth or the monetary base.[2] The issues in legislated standards will not be considered here, but rather the simple point that however the goals of policy are determined, the issue remains of how to control instruments to reach the goals. The legislature decides this question when it sets an instrumental standard; the central bank must decide the question when attempting to meet a legislated performance standard. In the absence of a clear legislated standard—the situation prevailing in the United States—the central bank must have some goal or other in mind, explicitly or implicitly, and must adjust policy instruments to best achieve that goal.

The instrumental issue would be irrelevant or uninteresting if the relationship between instruments and goals were so precise that errors in achieving goals were economically irrelevant. At the present state of knowledge, such errors are far from irrelevant. We simply do not know with much precision what the outcome will be of adjusting policy instruments in particular ways. Thus, no possibility exists that a "price rule" or "direct targeting" will make the instrumental question irrelevant in the foreseeable future. Arguing for such an approach ducks the key issue of how to achieve the goals of policy.

Intermediate Targets

It is conventional to define the instruments of Federal Reserve policy to be open market operations, the discount rate, and reserve requirements, and to treat the federal funds rate and some monetary aggregate as possible intermediate targets. This conventional taxonomy is more confusing than enlightening. From a control-theoretic point of view, an instrument is any variable that can be controlled without error or, more practically, with an error that is small relative to the error in controlling the ultimate goal variables. A narrow monetary aggregate (the monetary base, bank reserves, or M1) could be controlled with errors that are very small relative to the errors in controlling the price

[1] Canada also has a zero inflation target, but the arrangement is somewhat more vague and less formal than in New Zealand. See Fischer (1993).

[2] For an early statement of Friedman's views on this issue, see M. Friedman (1959).

level or nominal GDP. The Federal Reserve can also control the federal funds rate within a narrow range, day by day. Thus, a narrow monetary aggregate and the federal funds rate will be treated here as possible policy instruments rather than as intermediate targets.[3]

The problems of controlling M2 and other broad monetary aggregates are much greater than the problems of controlling narrow aggregates. M2 should not, I believe, be thought of as a policy instrument; if the central bank is to pursue an M2 target, it should be viewed as an intermediate target between policy instruments and policy goals. The problems of targeting intermediate variables were explained years ago by Benjamin Friedman (1975). Basically, pursuing an intermediate target adds a layer of control errors that makes control of the final goal variables less accurate than it could be by operating on policy instruments directly. Thus, from a technical point of view, there is every reason not to employ intermediate targets but to analyze policy in terms of the best settings for policy instruments to achieve the policy goals.

A possible argument for a role for intermediate targets is in explaining policy to the general public. The public might not understand the rationale for adjusting policy instruments in particular ways but might understand the significance of intermediate targets. For example, if open market operations are viewed as the instrument, then the Fed would surely lose its audience in explaining why $8.8 billion of 3-day matched-sale transactions were necessary this week to offset the net of float, changes in Treasury balances, and the reflux of currency after the Memorial Day weekend. It is much more insightful to say that the target is a particular federal funds rate, or a desired rate of M1 growth. However, if the federal funds rate, or M1 growth, can be achieved with a small margin of error, these variables might as well be called "policy instruments" in the first place.

If an intermediate variable cannot be controlled reasonably accurately, then the concept does not help to promote public understanding of monetary policy. Faced with large errors in controlling an intermediate variable, the Fed will get bogged down explaining the errors either as unavoidable control errors or as deliberate misses reflecting improved control of ultimate goals by appropriate settings of policy instruments. Both of these points are relevant to the Fed's attitude toward M2 in

[3] For those not used to thinking about policy instruments and intermediate targets in these terms, note that today the Fed can control the federal funds rate, which is usually considered an intermediate target, more precisely (as measured by the standard deviation of the actual rate as a ratio to the target rate) than it can its total assets, which are usually considered a policy instrument. The Fed's assets fluctuate as a consequence of such things as changes in bank borrowing at the discount window, transactions with foreign governments and central banks, and the speed of check-clearing, which affects items in the process of collection. If more accurate control of a particular instrument is desired, changes in Fed rules and procedures could deliver reduced control errors.

recent years. With the substantial change in bank behavior in bidding for small time certificates, the spread between the certificate yield and open market interest rates has changed. As a consequence, M2 has appeared less controllable than some had thought in the past and less closely related to nominal GDP. The Fed thought, correctly in my opinion, that it could do a better job of controlling the economy by controlling the federal funds rate appropriately than by targeting a predetermined path for M2.

Targets for Policy Instruments: Announce or Not?

The issue of the choice of the policy instrument should be kept separate from the issue of whether the Fed should announce and adhere to an annual target path for the chosen instrument. The case for announcing settings for policy instruments states that adhering to announced targets creates greater certainty about policy in the private sector and provides valuable policy discipline.

A policy of adhering to an announced path for a policy instrument requires that ultimate goal variables be related to the instruments in a reliable way. More precisely, it should not be possible to achieve significant gains in the performance of the goal variables by adjusting policy instruments continuously rather than adhering to predetermined paths for instruments. If large gains are possible, then the pressure on the Fed to grab those gains will be substantial. Clearly, if discipline over policy can be maintained some other way, as with performance standards enforced somehow or other, then there is every reason to improve policy performance by permitting departures of instruments from their planned paths.

As far as I know, no advocate of a funds rate target has ever called for the Fed to adhere to a target path for the funds rate announced a year in advance, or even three months in advance. The Fed's decision to abandon efforts to hit an announced money growth target need not have led to concentration on the fed funds rate; the Fed could have adopted a system of setting short-run targets for money growth or reserves growth in much the same way as it now sets short-run ranges for the fed funds rate.

A policy built around continuous adjustments of a policy instrument requires relatively little information about the relationship of the instrument to the goal variables. The Fed obviously needs to know the direction of the effect, all other things being equal, and needs some feel for the magnitude and timing of the effects. The information requirements are not really very different from those for the driver of a car. The direction of effects from applying accelerator and brake are known, and an ordinary driver quickly learns about how much of each policy instrument to apply in various situations. The control problem is fairly

robust to control errors; to slow down, apply the brake, and if the car is not slowing fast enough, apply a little more brake. The Fed in fact operates primarily by feeding back from current observations on the economy; on the basis of these observations and long experience, the Fed raises or lowers the fed funds rate a little more or a little less. If raising the funds rate over the first half of 1994 does not appear to be slowing the economy enough, then the Fed will raise the rate a bit more, and a bit more after that if necessary. This procedure certainly is not perfect, and occasionally the Fed has behaved about as predictably and competently as a drunken driver. But on the whole, the process has worked amazingly well in recent years.

The Fed could follow the same approach with an M1 instrument instead of with the fed funds rate; in fact, a strong case can be made for paying much more attention to M1 than has been true in recent years. To make that case, this paper will begin by reviewing some monetary regularities.

Understanding Monetary Regularities

Analysis of the relative advantages and disadvantages of targeting the money stock or the interest rate must begin with accumulated knowledge about gross monetary regularities concerning monetary aggregates and interest rates.

Monetary Aggregates Regularities

Perhaps the most important of monetary aggregates regularities is that large differences in rates of inflation are associated systematically with large differences in rates of money growth. Figures 1 and 2 tell a story that has long been well-documented.[4] These figures provide a cross-section view of the relationship between money growth and inflation for all countries reported in the tables in the back of the World Bank's *World Development Report, 1993*. Countries with a high rate of money growth experience a high rate of inflation. In a scatter diagram for a large sample of countries, the points lie approximately along the diagonal; the higher the rate of money growth, the higher the rate of inflation. This result conforms with standard monetary theory. All other things being equal, an exogenously higher rate of money growth yields a higher inflation rate; in equilibrium the inflation rate will equal the rate of growth of money per unit of real GDP.[5]

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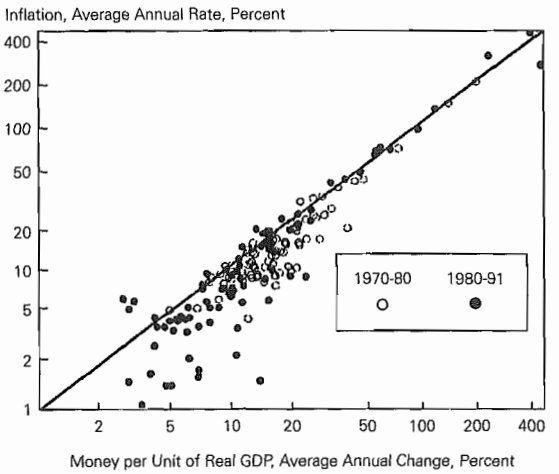
[4] Figures 1 and 2 are reproduced from Poole (1994a). For another recent study, see Duck (1993).

[5] Depending on tastes in macro theory, a few more conditions might have to be added to make this proposition airtight, but in practice failure to meet all the theoretical

Figure 1

Money Growth and Inflation: All Countries



Source: World Bank, *World Development Report 1993*, Tables 1, 2, and 13. Reproduced from Poole (1994a).

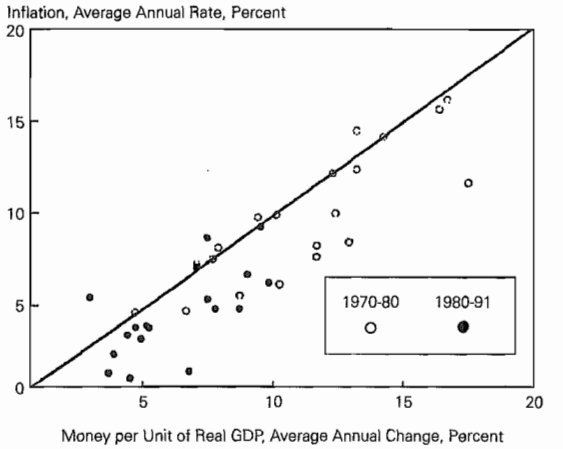
When dealing with rates of inflation of 20, or 50, or 200 percent per year, no one disputes that lower money growth is essential to reduce inflation. But in considering countries with lower and lower inflation rates, the relationship between money growth and inflation appears to be less and less reliable. In Figure 2, the points farthest off the diagonal are for countries with relatively low inflation rates. In Figure 1, the relationship between money growth and inflation seems quite loose for the 1980–91 period. The relationship between money growth and inflation (or nominal GDP growth) becomes less exact when inflation is lower, for two main reasons. One has to do with behavior in the private economy and the other with monetary policy.

When inflation is low, so also are nominal interest rates. In practice, a substantial part of the narrow money stock in most countries bears

conditions is of minor importance in explaining departures from the diagonal in figures such as these. Problems with the underlying data are surely more important.

Figure 2

Money Growth and Inflation: High-Income Countries



Source: World Bank, *World Development Report 1993*, Tables 1, 2, and 13. Reproduced from Poole (1994a).

little or no interest. When nominal interest rates are low, the opportunity cost to holding money is low, and people hold larger real balances. Moreover, the penalty for holding balances that are temporarily larger than they need to be is small. Thus, fluctuations in the amount of money created by the central bank (either purposely or inadvertently as a consequence of other policies) are largely absorbed in fluctuations in the amount of real balances held rather than in the rate of inflation. I know of no systematic study of how the lag between money growth and inflation depends on the rate of inflation, but my distinct impression is that the lag is short when inflation is high and long when inflation is low. In Cagan's (1956) classic study of hyperinflation, the lag between changes in money growth and changes in the inflation rate was measured in weeks. In the United States, the conventional view has been that the lag between money growth and inflation is approximately two years. It makes sense that the lag should be short when the cost of failing to adjust is high, and that the lag should be long when the cost of failing to adjust is low. A consequence of long lags is that the

year-to-year relationship between money growth and inflation will be more variable. Higher money growth may yield little inflation at first, and inflation may rise, perhaps in response to prior money growth, at a time when money growth is low.

A second consideration, one not well understood in today's debates over monetary policy, is that a predictable consequence of optimal monetary policy is that the correlation between monetary policy instruments and policy goals will be driven to zero. This issue is discussed in some detail in another paper (Poole 1994b), but the equations from that paper are reported here and the issue will be reviewed briefly.

Consider the following simple model:

$$Y = \alpha_0 + \alpha_1 X + \beta M + \varepsilon \tag{1}$$

with means $\mu_\varepsilon = \mu_X = 0$, variances σ^2_ε, σ^2_X, and covariance $\sigma_{\varepsilon X} = 0$. The central bank observes the vector X, and adjusts M to offset the effects of X on Y (GDP). The optimal M is

$$M^* = \frac{Y_f - \alpha_0 - \alpha_1 X}{\beta} \tag{2}$$

where Y_f is the target level of GDP. We can show that

$$\sigma_{YM} = 0. \tag{3}$$

Now suppose M is not set at M^* but instead at

$$M = \lambda M^*, \quad \lambda > 1, \ = 1, \quad \text{or } < 1. \tag{4}$$

Then,

$$\begin{aligned} \sigma_{YM} &= [\alpha_1 X(1-\lambda) + \varepsilon]\left[-\frac{\lambda}{\beta}(\alpha_1 X)\right] \\ &= -\alpha_1^2\left(\frac{\lambda}{\beta}\right)(1-\lambda)\sigma_X^2. \end{aligned} \tag{5}$$

$$\begin{aligned} &\text{If } \lambda = 1.0, \text{ then } \sigma_{YM} = 0 \\ &\quad < 1.0, \text{ then } \sigma_{YM} < 0 \\ &\quad > 1.0, \text{ then } \sigma_{YM} > 0. \end{aligned} \tag{6}$$

If monetary policy is optimal ($\lambda = 1.0$), then M and Y are uncorrelated. If monetary policy underreacts to information in X ($\lambda < 1.0$),

then money and GDP are *negatively* correlated. The intuition of this apparently strange result is straightforward. Suppose that X rises, which tends to push up Y, and that policymakers respond by reducing M. However, when policy underreacts, M does not decline by enough to offset the full effects of X and a negative correlation between M and Y is observed. If policy overreacts ($\lambda > 1.0$), then monetary disturbances dominate the outcome, yielding a positive correlation between M and Y.

The intuition of this result is clear, once intuition is developed by thinking through the common sense of the result. An optimal monetary policy makes use of all available information to produce the best possible result for the goal variables. To keep things simple, suppose the goal of policy is constant growth of nominal GDP.[6] Any correlation remaining in the data between the policy instruments (and any other variables known at the time the instruments are set) and growth in nominal GDP represents a lost opportunity to produce a better policy. If, for example, a positive correlation is observed between money growth and departures of GDP growth from its target rate, then the central bank could have produced a better result by raising or lowering money growth to keep GDP growth closer to target.[7] U.S. monetary policy really has been much better since 1982 than before, and that is the most important reason why the correlation between money growth and GDP growth has become so small, as documented by Friedman and Kuttner (1992).

An implication of this argument is that the search for a better monetary aggregate, as measured by its correlation to nominal GDP, is doomed to failure if the central bank is doing a good job. Suppose careful statistical analysis uncovers a better monetary aggregate. Then, once the central bank uses the aggregate optimally, the correlation between the aggregate and nominal GDP will be driven to zero. Given the aggregate, fluctuations in nominal GDP will reflect unavoidable random disturbances and measurement error. The important implica-

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[6] If the utility function of the policymakers depends on a number of variables, nominal GDP need only be replaced in this argument by the evaluated utility function. That is, take all the individual goals such as inflation, unemployment, and so forth, and then calculate the level of utility from realizations of the individual goals. In the general argument, this calculated level of utility replaces the growth rate of GDP in the argument in the text.

[7] For an everyday analogy, when driving on an interstate in the mountains, your car may travel at a nearly constant speed of 65 mph but the amount of gas being fed to the engine will vary greatly depending on whether the car is going uphill or down. If you are successful at keeping close to 65 mph, the correlation between gas flow to the engine and the speed of the car will be zero. Assuming the car has a large enough engine, any non-zero correlation between speed and gas flow to the engine during the period when the target speed is 65 mph would be evidence that you are not driving as skillfully as possible. Of course, this analogy assumes that the only goal variable is speed of 65 mph; however, the illustration could easily be extended to consider a more complicated utility function.

tion of this argument is that the Fed must choose its policy instruments largely on the basis of evidence from periods when policy was *not* optimal and from economic theory.[8] Practical experience in using policy instruments may also be important.

The same argument applies to the federal funds rate or any other instrument of policy. Optimal use of the instrument will destroy all simple correlations between the instrument and the goals of policy. In principle, causal mechanisms could be sorted out econometrically if good estimates were available of the shocks to which the central bank is responding as it adjusts its instruments. However, in practice the central bank responds to a wide and changing range of information, and there is little hope of untangling causal mechanisms with any degree of reliability in an optimal control environment. Indeed, it is in principle impossible to identify econometrically the Fed's response to one-of-a-kind disturbances such as the stock market crash; no estimation is possible with a sample of one in the period at issue. During the 1980s, the Fed reacted successfully to a variety of such disturbances.

If policy is optimal (or nearly so) over some period, a search for variables correlated with deviations of goal variables from their target levels may uncover spurious correlations.[9] With a short enough sample period and a long enough list of series, some series or other is bound to be suitably correlated. Once a reasonably successful policy regime is established, as I believe it has been since 1982, improvements will be difficult to come by. To avoid the problem of acting on the basis of spurious correlations, proposed improvements will have to be considered provisional until enough new data have arrived to show that the correlations are genuine rather than spurious.

Interest Rate Regularities

As for interest rates, an important regularity in the present context is that sustained higher inflation yields higher interest rates. A second is that, other things being equal, raising interest rates tends to depress

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[8] This point is quite general. For example, as a practical matter the characteristics of the long-run Phillips curve cannot be tested without observations of permanent, or long-lasting, changes in the rate of inflation, because inflation expectations cannot be observed without error. U.S. data did not fit the Friedman-Phelps argument for a vertical long-run Phillips curve until the sample included the higher inflation rates of the late 1960s. In the larger sample, the error in observing expectations was small relative to the variance in actual, and therefore expected, inflation over the sample period.

[9] For this reason, I have serious reservations about recent work constructing broader monetary aggregates by adding bond and stock mutual funds to the existing M2. No clear theoretical reason exists for constructing such an aggregate; although households with mutual funds can readily turn them into cash by making a phone call, businesses can do the same with all their liquid assets.

economic activity and inflation. These twin facts produce a problem for monetary policy and for public understanding of it. To lower interest rates over the long run, the central bank must first raise rates to reduce inflation. Stating the proposition in the other direction, a consequence of lowering interest rates too much (or failing to raise them enough in time) is that inflation rises and sooner or later interest rates rise more than they otherwise would have.

As a baseline prediction, raising money growth by a sustained rate of 1 percentage point will lead to a sustained increase in inflation of 1 percentage point. Such an increase in inflation will, as a baseline case, yield a 1 percentage point increase in the nominal rate of interest. Although the direction of effects outlined in the previous paragraph is clear, no baseline prediction exists to provide guidance as to how much or how fast inflation will rise if the central bank, say, lowers interest rates by 1 percentage point from an initial point of equilibrium. The problem is that an economic model with a permanently fixed nominal interest rate set by the central bank has no determined price level. A consequence of this fact is that a central bank cannot calculate the appropriate interest rate target but must instead adjust interest rates up or down, a little more or a little less, on the basis of its feel for the economy.

Of course, given a specific macro model, with fully specified structure and expectations mechanisms, the appropriate interest rate for the central bank to set can indeed be calculated. However, no model exists that commands general support as being reliable in this sense. In fact, it is fair to say that while models can be used to illustrate general principles, no advocate of interest-rate control by a central bank would want to use a model to calculate the appropriate interest rate and then adjust the rate as indicated by the model. Rather, what the Federal Reserve does, and what advocates of interest-rate targeting recommend, is to adjust rates up or down based on a wide variety of information about developments in the economy. This is not meant to imply that this process cannot work well; it is simply an attempt to understand what actually happens. As a driver, I may have no idea how to calculate how much pressure to apply to brake and accelerator, but I can drive quite successfully by applying a little more or a little less based on long experience.

To sum up these points, as a baseline case higher money growth can be expected to yield higher inflation, and the relationship will lie approximately along the diagonal of a diagram such as Figure 1. Further, higher inflation can be expected to yield higher nominal interest rates—in equilibrium, approximately one for one. Departures from these baseline cases, especially in the short run, will be more pronounced the lower the average rate of inflation. A central bank fixing the rate of interest permanently creates an economy without a well-defined

equilibrium; a monetary policy based on interest-rate control must constantly adjust rates up or down to keep the economy on track. With regard to interest-rate targets, no solid information is available to indicate how much up or down, or how fast or slow, is required for a satisfactory outcome.

Issues in Money Stock Targeting

Starting in the mid 1970s, the Federal Reserve increasingly supported a monetary policy placing substantial emphasis on achieving money growth targets. In the mid 1980s, the Fed switched its emphasis from M1, which it had traditionally favored over other monetary aggregates, to M2. Over the course of the late 1980s, the relationship between money growth however defined and nominal GDP seemed less and less reliable, and the Fed's attention to money growth targets waned to the point of nearly vanishing.

With regard to M1, the main issue is that the interest elasticity of demand for M1 is considerably higher than estimated in the mid 1970s. In first taking up this issue (Poole 1970b), I argued that estimates of income and interest elasticities from postwar data were not well determined because of the long, rising trends in both real income and interest rates. I now believe that economists made a mistake in attributing rising velocity of M1 between 1946 and 1980 to some combination of a real income elasticity below unity and an exogenous trend. The consequence of this mistake was an estimate of the interest elasticity that was much too low, in the neighborhood of -0.1 to -0.2. Current estimates of the interest elasticity of demand for M1 suggest a number in the neighborhood of -0.5 (see Hoffman and Rasche 1991).

A relatively high (in absolute value) interest elasticity creates a major problem for a predetermined target for M1 growth. A real disturbance, or a substantial change in inflation expectations, may require a large change in interest rates if the economy is to remain close to full employment or expand along the desired path for nominal GDP. To illustrate the magnitude of this problem, consider the transition from the inflation rate of the late 1970s to the lower inflation rate of the mid 1980s. In the late 1970s, rules advocates (myself included) typically argued for predetermined, announced gradual reductions in money growth. Reducing money growth by 1 percentage point per year was a common recommendation. Suppose the economy were initially fully adjusted to an ongoing inflation rate of 7 percent per year and nominal interest rates averaging 10 percent. Now suppose the goal of monetary policy is to reduce inflation and nominal interest rates by 5 percentage points. The new equilibrium will have a nominal interest rate of 5

percent. Assuming a conventional money demand function with a real-income elasticity of 1.0, then

$$\ln \frac{M}{P} = a + \ln \frac{Y}{P} + b \ln i \quad \text{(money demand function), and}$$

$$\Delta \ln M - \Delta \ln Y = b\Delta \ln i.$$

If the interest rate goes from 10 percent to 5 percent, then $\Delta \ln i \approx -0.7$. If the interest elasticity is low, say -0.1, then the gap between money growth and nominal GDP growth is 0.07. If money growth is constant at 3.5 percent, then two years of zero growth in nominal GDP will be adequate to create equilibrium in money demand. However, suppose the interest elasticity of money demand is -0.5. Then, the total gap between money growth and nominal GDP growth to be bridged is 0.35. If money growth is constant at 3.5 percent, it would take (0.35/0.035) = 10 years of zero growth in nominal GDP to restore equilibrium in money demand. To restore equilibrium faster would require some combination of GDP growth below zero and money growth above 3.5 percent. If money growth is higher, what happens to expectations of future inflation when the central bank has staked its reputation on achieving its M1 target? If the central bank sticks to its money growth target, what happens to unemployment if growth in nominal GDP is negative?

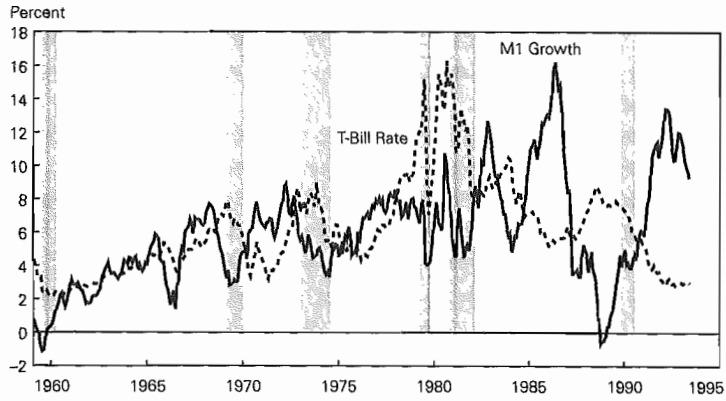
This simple arithmetic and the best current estimates of the interest elasticity of money demand have convinced me that a system of keeping actual M1 growth to targets announced a year in advance is not likely to work satisfactorily. Interest-rate fluctuations of several percentage points in a year are not uncommon even during periods in which the rate of inflation is changing relatively little. I believe that the increased volatility of M1 velocity after the 1980–82 period of disinflation was primarily a result of the Fed's greater success in permitting changes in interest rates and M1 growth that stabilized, or at least did not destabilize, the real economy and inflation rate.

That the typical cyclical pattern of money growth and interest rates changed after 1982 can be seen clearly in Figure 3. After 1982, large gyrations in money growth and interest rates occurred without a cyclical contraction until the one beginning in July 1990. M1 growth fell in 1984 as interest rates rose; M1 growth rose significantly in 1985 and 1986 as interest rates fell. Except for a few months' interruption following the stock market crash in October 1987, interest rates rose from late 1986 to March of 1989 and then fell almost every month before leveling out at about 3 percent in late 1992. For interest rates to start falling and M1 growth start rising well over a year before the cycle peak, as occurred before the peak in 1990, is unprecedented in U.S. history back to the first availability of monthly estimates of the money stock in 1907.

Figure 3

12-Month M1 Growth Rate and the T-Bill Rate

January 1960 to January 1994



The sustained and substantial short-run inverse relationship between M1 growth and the T-bill rate over the period after 1982 is also unprecedented in U.S. history, putting aside the periods dominated by world wars and the Great Depression.[10] The typical pattern before 1982, allowing for the lag of interest rates behind money growth, was a positive relationship reflecting the effect of money growth on inflation and interest rates, and the usual cyclical pattern. For monthly data from January 1960 through December 1982, the simple correlation between M1 growth and the T-bill rate is 0.53; for the period January 1983 through January 1994, however, the simple correlation is −0.45.

The change in the cyclical behavior of interest rates and money growth after 1982 must be attributed primarily to the Federal Reserve.

[10] The correlation between monthly data for the commercial paper rate and the 12-month growth rate of the Friedman-Schwartz M2 series was slightly negative for the period May 1908 to December 1960. This outcome is dominated by observations during the two world wars, the sharp recession in 1920–21, and the Great Depression. An examination of a graph of the data suggests that relatively normal subperiods are characterized by a positive correlation, but it would seem to be cooking the books to search too hard to find such periods for the purpose of reporting some positive correlations.

Except for the period from October 1979 to (about) October 1982, the Fed has always conducted policy by adjusting money market interest rates. Policy has focused sometimes on borrowed reserves, sometimes on free reserves, and sometimes on the federal funds rate, but these are minor variations on the basic theme of controlling money market interest rates. Experience after 1982 demonstrates that it is indeed possible for the Federal Reserve to base a successful policy on the federal funds rate, by adjusting that rate in a reasonably timely fashion to yield a satisfactory outcome for real GDP and inflation. The problem is how to sustain this good performance.

In principle, it might be possible to define a money growth target taking account of the interest elasticity of money demand. The announced target might take the form of a money growth range conditional on interest rates remaining in a certain range, and alternative higher (lower) money growth ranges conditional on lower (higher) interest rates. However, it is doubtful whether such an announced target would provide the predictability to the market and political constraint on the central bank that advocates of money growth targets have desired. It seems much better to emphasize a performance standard than a complicated instrumental standard.

The Federal Reserve adopted an M2 target in the mid 1980s when theory and evidence suggested that M2 velocity was likely to be more stable than M1 velocity. The argument was that the elasticity of M2 with respect to market interest rates would be much lower than that for M1 because a large fraction of M2 pays a market-sensitive rate. Moreover, observed M2 velocity was more stable than was observed M1 velocity. In the event, M2 velocity did not turn out to remain stable enough for M2 targeting to be satisfactory. The immediate source of instability in M2 velocity was a run-off of small time certificates in M2 after 1990.

The case is weak for aggregating time certificates, large or small, with currency and bank liabilities payable on demand. It is important to recognize that the extensive historical research of Friedman and Schwartz (1963a, 1963b) relies on a definition of M2 that does not match the current definition. Prior to 1960, bank liabilities in certificate form were of negligible importance. The concept corresponding to the Friedman-Schwartz M2 is what I have called MZM ("money zero maturity"); this measure includes currency plus all assets convertible to currency on demand at par (that is, without penalty). Without getting further into the debate on how to define money for policy purposes, it is fair to say that economists have not delivered a conceptual basis for defining money that commands general assent and has proven to be entirely satisfactory for policy purposes.

To summarize various strands in this discussion: When considering high rates of inflation and the problem of producing a modicum of financial stability in a country such as Russia today, emphasis on

controlling money growth is fully in order. The distortions and inefficiencies created by a high rate of inflation are so great that taking the first-order steps to bring down money growth is the major point that must be discussed with the interested parties. The same argument is relevant for the United States in the sense that the inflation of the 1970s could not have been reduced without a period of monetary stringency. Moreover, the relatively high rate of M1 growth from 1990 through 1993 could not be continued without inflation rising substantially at some point. In the first half of 1994, the Fed raised money-market interest rates and reduced M1 growth, adding another data point reinforcing the substantial negative correlation between M1 growth and interest rates after 1982.

Central banks in the United States and other high-income countries with well-developed financial markets have considerable room to permit substantial changes in M1 growth without adverse consequences. Indeed, changes in M1 growth in response to changes in interest rates and other factors can be positively beneficial. The problem is to find a way to ensure that the "can be" in the previous sentence is reliably translated to "are typically." The process is certainly not automatic and the risks of policy mistakes are substantial.

Issues in Interest Rate Targeting

The total absence of a model permitting calculation of the appropriate level for the federal funds rate creates a serious problem for the Fed, and for everyone else as well. Not only does such a model not exist, but also developing such a model may in principle be impossible. The Fed cannot set the federal funds rate without regard for market expectations about the future, as such expectations register in long-term interest rates. However, the problem is that long-term interest rates depend critically on market expectations about what the Fed will do in the future.

The Fed would have a downright easy job if designing monetary policy were equivalent to an engineering control problem, such as the design of an autopilot for a ship. In an engineering control problem, the mechanism to be controlled can be modeled as a system subject to external shocks. The autopilot monitors instruments showing the deviation from the desired course and speed, and then adjusts control instruments to keep the ship on its targeted track. Design of the autopilot must consider the characteristics of the ship and the nature of the disturbances pushing the ship off course, but the problem is easy compared to the monetary policy control problem. The wind and current are not watching the autopilot and trying to anticipate how the autopilot will adjust the rudder and throttle.

The Fed's job would be substantially equivalent to an engineering control problem if most of the shocks hitting the economy had little or nothing to do with expectations about Fed behavior in the future. Droughts, floods, OPEC oil shocks, Gulf Wars, and the like are examples of such shocks. How important are external shocks, compared to changes in expectations about Fed policy and endogenous business cycle processes?

To gain a feel for this question, it seems insightful to examine the behavior of the bond market, which is perhaps the most general and efficient aggregator of economic information. Large changes in bond yields presumably reflect new information in the market, or new assessments of existing information. I know no foolproof way of identifying the reasons for large changes in bond yields but have looked at reasons identified in the *Wall Street Journal* at the time of large changes in yields.

Table 1 (at the end of this paper) provides the results of this study.[11] The table is based on data on the weekly average index of the average yield on Treasury bonds with maturities of 10 years and over. The data series runs from 1963 through 1993. The standard deviation of percentage (not percentage point) changes in the weekly average yield for the entire sample is 1.4 percent. The volatility of interest rates is quite variable, and so a moving standard deviation was constructed covering 104 weeks. The table reports all changes larger in absolute value than two standard deviations as measured by the moving standard deviation. This procedure picks up all large changes in yields, where "large" is defined in the context of the market environment of the time. The table also includes all changes larger than 2.8 percent (twice the total sample standard deviation) on the assumption that changes this large are worth examining even if they occur in a volatile period with a moving standard deviation greater than 1.4 percent. At the beginning of each entry in the table, to explain what was going on at the time of a large change in the bond yield, is a code in parentheses: "R" indicates routine economic data; "M" indicates monetary policy news (either Fed action or speculation on Fed action); "F" indicates fiscal policy news, including news about regulations and controls; "V" indicates Vietnam-related news; "O" includes all other news, including news about oil-price changes.

The impression from reading the *Wall Street Journal*, both day by day over the years and from this recent ordeal at the microfilm machine, is that the overwhelming majority of large changes in bond yields arise in response to actions by the monetary authorities and to releases of routine economic data. Moreover, the effect of routine data on bond

[11] The author appreciates help from Arjan van den Born, Michael Crawley, John M. Frost, Rohit Malhotra, Todd C. Lee, Jeroen van Meijgaard, and Coenraad Vrolijk, who did much of the digging in the *Wall Street Journal* as part of their work in his graduate class during the spring of 1994.

yields often arises from speculation that the Fed will react to the data, or that the data change the odds on Fed action. The experience so far in 1994 is quite typical: The bond market has fluctuated in response to Fed policy actions, speculation on Fed policy, and release of new economic data. Over the entire sample, fiscal policy changes, including wage-price controls, have some effect on bond yields, as do foreign disturbances, but infrequently so. In fact, if reporters and the bond traders they talk with can be trusted, changes in interest rates are driven almost entirely by the internal dynamics of the economy and monetary policy, and hardly at all by exogenous shocks.

Before discussing the implications of Table 1, consider also the body of evidence from studies of announcement effects. A sample of relatively recent studies includes Cook and Hahn (1988, 1989); Cook and Korn (1991); Dwyer and Hafer (1989); Hardouvelis (1988); and Santomero (1991). These papers contain references to many other papers in this line of literature. My interpretation of this evidence is that the size of interest-rate responses to economic data depends primarily on the way the Fed is running its interest-rate policy.

In the late 1970s, and especially during the period from October 1979 to October 1982, interest rates responded in significant fashion to weekly data on the money stock (deviations of reported from anticipated data). The Fed was paying increasing attention to money growth, and so the market did too. After October 1982, the Fed paid less attention to money growth, and the market did too. The Fed responded to data on the real economy, such as employment and industrial production, and the market did too. In 1986 and 1987, the trade deficit was a contentious political issue. The trade deficit, especially that with Japan, had implications for U.S. interest rates because of Administration pressure on other countries to reduce their interest rates. Through the mechanism of foreign interest rates and their implications for the dollar exchange rate, U.S. monetary policy was indirectly affected by the trade deficit. Thus, U.S. interest rates responded to news on the trade deficit. As the 1980s wore on, the Fed responded less and less to the money data, and the money markets did too. Today, the Fed does not respond to money data, and neither does the bond market.

Considering the announcements literature and Table 1, it appears that the bond and money markets respond primarily to changes in Fed policy and to changes in expectations about Fed policy. The more confidence the market has in the Fed, the more the market will concentrate on what the Fed is doing and the less the market will concentrate on fundamentals other than the Fed. Consider an analogy: If you go to the horse track but know little about horse racing, it makes sense to place bets by watching what a bettor known to be well-informed does. The market watches the Fed because the Fed is well-informed, and because the Fed is the dominant player in the money market.

The more confidence the market has in the Fed's willingness to do what is necessary to maintain low inflation, the more sense it makes for the market to concentrate on what the Fed is doing. This situation poses several dangers. For one thing, the Fed cannot use the behavior of interest rates to provide useful information on how it should adjust the federal funds rate. The bond market today tells the Fed what the market thinks the Fed is going to do. If the Fed is slow to adjust the funds rate, for whatever reason, the bond market will not provide a clear, independent assessment of the appropriate interest rate. In this environment, it is easy for the Fed to make a mistake because the bond market will not provide a strong contrary signal.

Should the Fed look only at data on the real economy, and at goods and labor prices, in determining how to set the federal funds rate? If you believe that the money demand function is totally capricious, then monetary aggregates provide no useful information to supplement output and price data. I am convinced, however, that the Fed should not throw out the money data; monetary regularities are too well established for that to be sensible.

Over the past decade it has been shown that aggressive and skilled adjustment of the federal funds rate can yield a successful outcome. But what happens if the Fed gets caught in a political box and finds itself unable to move the funds rate enough? The answer is that in time inflation rises and the costly progress in reducing inflation is lost. What external standard can the Fed appeal to in building public support for responsible monetary policy? Given the lags, appeal to price performance itself is unsatisfactory. If the Fed does not tighten policy until inflation is clearly rising, then it is too late.

The Fed basically has been operating on an unemployment-rate standard. The Fed tightens if the real economy seems to be overheating, eases if the economy seems soft, and tries for a neutral stance in between. An unemployment standard is less than fully satisfactory, both because the short-run Phillips curve is of uncertain reliability and because policy designed to keep unemployment from falling is suspect politically.

Restoring a Role for Money Growth Targets

The issue is how the Fed can build on past successes and reduce the odds of policy mistakes. Greater short-run variability in money-market interest rates would not damage the economy and would, in my view, improve monetary policy. Note once again that before 1980, the Fed followed a procyclical policy by permitting money growth and interest rates to rise together during cyclical expansions and fall together during cyclical contractions. Since 1982, the Fed has confined the positive

correlation of money growth and the fed funds rate to the short run—periods over which the funds rate is fixed. Over longer periods, the Fed has adjusted the funds rate aggressively, yielding a negative correlation between money growth and the funds rate.[12]

The Fed should, I believe, allow the fed funds rate to vary within a considerably wider band, perhaps 100 basis points, between Federal Open Market Committee (FOMC) meetings. Open market operations should be designed to keep bank reserves on a steady path. In practice, the funds rate would often fetch up against one side or the other of the band, which might superficially make such a policy appear operationally equivalent to present policy. However, the market would know that the funds rate could move within the band, which would force the market to develop a view on future economic developments besides what the Fed was likely to do. At a time when economic conditions were changing, this policy would provide a smoother transition to higher or lower interest rates, and market responses to incoming data would help the Fed to determine the significance of the data. This information could be of significant benefit to the Fed. At present, recall from an earlier argument, bond market responses to incoming data primarily reflect market speculation on how the Fed will respond to the data.

For an illustration of the value of this approach, consider the situation the Fed faced as of mid May 1994. Weekly data on M1 suggested that the money stock was dropping rapidly (money growth was actually negative), indicating that the Fed had been successful in pushing up the funds rate enough to get ahead of the market. Suppose that the Fed, instead of pegging the funds rate in a 25-basis-point band around 4.25 percent, set a 100-basis-point band centered on 4.25 percent. Given that reserves growth was currently weak, the funds rate would settle temporarily at 3.75 percent. If the economy really was in danger of becoming overheated, incoming data on the real economy would lead the bond market to expect a resumption of reserves growth and a rising fed funds rate. The market would bid rates up, relieving the Fed of some of the responsibility for making the judgment and some of the political heat.

Closing Comments

The main issue today in monetary policy design continues to be the old one of the appropriate role in policy for interest rates and monetary aggregates. The Fed has been quite successful in recent years in aggressively adjusting the fed funds rate and has come to the point of essentially ignoring information from the monetary aggregates.

[12] This policy, by the way, is similar to the combination policy in Poole (1970a).

Ignoring the aggregates is a mistake. Evidence is overwhelming across the ages of the important role of money growth in causing inflation. The Fed has come to ignore the aggregates through a simple but understandable error of economic analysis. Fed policy has been so successful in offsetting disturbances and keeping the economy on a low-inflation track that the correlations between policy instruments and goal variables such as nominal GDP have disappeared. This outcome is a predictable consequence of optimal policy. In an optimal-control setting, the correlation between policy variables, or any other variables, and policy goals provides no information whatsoever on the structural relationships between the variables, all other things equal.

When I characterize U.S. monetary policy after 1982 as "optimal," I mean relative to prior experience. In two recent episodes, more attention to monetary aggregates would have yielded better results. Policy was too expansionary in the 1985–86 period, and this led to sharp increases in interest rates in 1987 and 1988 as the Fed worked to contain the effects of the expansionary policy. And although it is too early to assess the full consequences of very recent policy, I believe that M1 growth was too high in 1993, and that some of the surge in interest rates in the first half of 1994 could have been avoided if the Fed had started earlier to contain excessive money growth. These, though, are judgment calls, and others may judge differently.

The Fed's goal today should be to build on its record of success. Excessively tight control of the federal funds rate yields its own set of problems. Because of the Fed's success, the bond market runs off speculation about future Fed actions and little else, which is not a healthy state of affairs. The Fed is not omniscient; its job would be easier if it could make use of the information about the future course of the economy that is aggregated in the bond market. Moreover, with the bond market hanging on every Fed move, the Fed is in the tricky position of trying to provide direction to the market, and of trying to prove to the market that the direction is appropriate. The Fed is not in fact ultimately responsible for the level of real interest rates; real rates are determined by the fundamentals of fiscal policy, productivity, and thrift. But under its current policy the Fed *is* responsible for real interest rates in the short run, and that entangles the Fed unnecessarily in the politics of interest rates. These politics risk pressures to inflate that have in the past led to policy mistakes. More attention to money growth might help to reduce the probability of repeating those mistakes.

These are the reasons why the Fed needs to modify its policy of tight control of the fed funds rate. Current policy has been working too well for wholesale redesign to make good sense. A sensible evolution of policy would be to widen the fed funds band and restore some emphasis on M1 growth.

Table 1
Large Changes in Treasury Bond Yield, 1963 to 1993
Absolute value of changes > twice moving 2-year standard deviation or > 2.8 percent

Week Ending	Percentage Change	Explanation: R=routine economic data; M=monetary policy news; F=fiscal policy news; V=Vietnam-related; O=other
JAN 26 63	1.03	(RF) Dec. durable goods orders down 3%; Dec. CPI down; gold outflow and fear of inflation cited; Kennedy proposes corp. tax cut.
APR 20 63	.75	(RF) Mar. industrial production index, personal income, housing starts all up; Mar. durable goods orders steady; steel price increases—speculation on Kennedy response.
SEP 7 63	1.00	(F) Large Treasury advance refunding announcement surprised traders.
NOV 9 63	.73	(RM) Fed raises margin requirements; bullish business news.
DEC 21 63	.73	(M) Fed Ch. Martin warns that tax cut might mean higher interest rates.
NOV 6 65	1.16	(RM) Fears of tight money cited; Oct. unemployment rate down to 4.3% from 4.4%.
DEC 11 65	1.37	(MO) Discount rate increase; Fed conflict with Johnson Admin.
FEB 5 66	1.79	(RMFV) Renewed U.S. bombing of N. Vietnam; factory orders up; tax increase debate; Fed voluntary restraints on bank credit possible.
FEB 12 66	1.32	(RFV) Mortgage interest ceilings raised; optimism fades after Vietnam peace initiative; retail sales down.
FEB 19 66	1.52	(R) Industrial production index up; housing starts down; durable goods orders up.
MAR 5 66	1.07	(R) CPI flat; factory orders up slightly.
MAR 19 66	−1.07	(R) Housing starts down.
MAR 26 66	−1.30	(RMF) Industrial production up; Johnson says tax increases would be premature; tightening Fed policy noted.
MAY 14 66	−1.10	(R) Retail sales down; industrial production up; Fed favors tax increase.
MAY 28 66	1.31	(FO) Treas. Sec. Fowler suggests bond sales above the 4.25% ceiling; German bank rate up.
JUL 2 66	2.16	(RV) Fed raises reserve requirements; banks raise prime rate; Vietnam bombing.
JUL 16 66	1.26	(RFO) Speculation on discount rate increase; unemployment rate steady at 4%; British bank rate increase; industrial production up; Fed cut Regulation Q ceiling.
AUG 20 66	1.68	(RF) Industrial production up strongly; personal income up; banks increase prime rate; Fed raises reserve requirements; July housing starts "plunged"; new factory orders down.
AUG 27 66	1.24	(RV) CPI up; negative Vietnam news.
SEP 10 66	−2.28	(F) Tax increase speculation, especially suspension of investment tax credit (ITC); Johnson recommends ITC suspension, cuts in federal spending.
OCT 29 66	−1.93	(R) Signs of slowing economy cited; U.S. Steel dividend increase; better corporate earnings reports.
DEC 17 66	−2.34	(RF) Easing demand pressures—Nov. retail sales, industrial production down; Nov. housing starts up; easier Fed policy noted.

Table 1 *continued*
Large Changes in Treasury Bond Yield, 1963 to 1993
Absolute value of changes > twice moving 2-year standard deviation or > 2.8 percent

Week Ending	Percentage Change	Explanation: R=routine economic data; M=monetary policy news; F=fiscal policy news; V=Vietnam-related; O=other
DEC 24 66	−1.52	(RMF) Nov. durable goods orders down 3.1%, further reducing pressure for 1967 tax increase; Fed purchases coupon issues; small increase in Nov. CPI.
JAN 7 67	−1.78	(RO) Nov. new factory orders down; Bundesbank cuts discount rate.
FEB 18 67	1.80	(RM) Jan. retail sales edged down; Fed Ch. Martin states that economy may soon resume rapid growth, suggesting to market that Fed easing at an end; bullish capital spending survey; Jan. industrial production down due to snowstorms; large increase in personal income in Jan.; Jan. durable goods orders down 5.1%.
MAR 4 67	−2.67	(RM) Fed cuts reserve requirements—market sees this and other signs of Fed easing; Jan. new factory orders down 4.6%.
APR 22 67	2.00	(RMFV) Mar. industrial production up slightly; influential congressmen say income tax increases may be necessary; Mar. housing starts, personal income up; dealers believe Fed easing steps waning; Mar. durable goods orders down slightly; U.S. bombs Haiphong for first time; free reserves up sharply.
JUN 17 67	2.08	(R) May retail sales, personal income up; May industrial production down; May housing starts rose briskly.
OCT 21 67	2.71	(RMO) Sharp third-quarter GNP increase; Sept. industrial production down due to strikes; Sept. housing starts up 3.8% over Aug.; rise in rates attributed to tax increase delay, concern over Fed tightening; personal income up in Sept.; Bank of England raises discount rate from 5.5% to 6%; Fed extends 70% margin requirement to currently unregulated lenders.
JAN 6 68	−2.27	(RFV) Pres. Johnson imposes tight mandatory controls on corp. capital spending abroad, and reduced voluntary ceilings on bank lending abroad; Nov. new factory orders jumped up; Treas. reports U.S. gold stock fell; reports of peace feelers from North Vietnam.
MAR 16 68	3.90	(MO) Discount rate increase; heavy gold buying in London.
APR 6 68	−3.19	(VO) Pres. Johnson announces he will not run for another term; partial halt in bombing of North Vietnam.
MAY 25 68	2.57	(RMF) Apr. housing starts up 8% from Mar.; rate upsurge due to report that deficit-reduction legislation delayed; Fed credit-tightening noted; Apr. durable goods orders down.
DEC 28 68	2.79	(M) Tight money market conditions.
MAY 31 69	3.16	(M) Speculation on increase in prime rate.
OCT 11 69	−3.41	(RF) Sept. unemployment rate up sharply; rejection of bill that would have reduced tax-free status of munis.
OCT 18 69	−2.88	(RV) Sept. retail sales and housing starts up; heightened Vietnam peace hopes; small increase in Sept. personal income; Sept. industrial production down; third-quarter GNP up.

Table 1 *continued*
Large Changes in Treasury Bond Yield, 1963 to 1993
Absolute value of changes > twice moving 2-year standard deviation or > 2.8 percent

Week Ending	Percentage Change	Explanation: R=routine economic data; M=monetary policy news; F=fiscal policy news; V=Vietnam-related; O=other
NOV 1 69	4.04	(RV) Vietnam concerns; absence of slowdown in economy and inflation worries; oversupply in bond market.
FEB 14 70	−3.49	(R) Weak economic data.
FEB 21 70	−2.82	(R) Jan. industrial production down 0.7%; Jan. housing starts down 6.9%; Jan. CPI up 0.6%; Feb. durable goods orders up 1.4%; Feb. CPI up 0.5% over Jan.
MAR 28 70	−2.80	(RM) Fed Ch. Burns hints at easier policy; prime rate cut; leading indicators up slightly.
APR 25 70	3.65	(VO) Announcement of troop withdrawal from Vietnam; CEA Ch. McCracken says "worst of 1970 downturn is over."
MAY 30 70	4.69	(RO) Wholesale prices higher; threat of Soviet involvement in Egypt; Democratic leaders call for wage-price controls.
JUN 6 70	−2.96	(RV) U.S. announces withdrawal from Cambodia; lower capital spending plans; Feb. new factory orders down 0.4%; speculation on wage-price controls; May unemployment rate up to 5.0% from 4.8%.
JUN 27 70	−2.30	(RMO) May CPI up less than expected; Penn-Central bankruptcy suggests less restrictive Fed policy; Fed suspends interest ceilings on some large CDs; May leading indicators down.
NOV 21 70	−3.18	(R) Speculation on Fed easing; industrial production down.
NOV 28 70	−3.62	(RF) CPI up at 7.2% rate; bill approved to extend Presidential authority for wage-price controls.
DEC 26 70	3.02	(RM) CPI up less than expected; speculation on discount rate cut.
MAR 13 71	−2.90	(RF) Feb. unemployment rate down to 5.8% from 6.0%; Feb. WPI up at 8.4% annual rate; report on advocacy of wage-price controls by Fed Ch. Burns; prime rate cut.
JUN 19 71	2.85	(RM) Prime rate up; May industrial production, housing starts up; May retail sales down slightly; discount rate increase.
AUG 21 71	−4.51	(F) Wage-price controls imposed.
JAN 20 73	2.54	(RM) Discount rate increased; Dec. industrial production up 0.8%; Dec. housing starts up slightly; market believes Fed has raised fed funds rate range; real GNP for 1972:IV up at 8.5% annual rate.
JUL 28 73	2.13	(RM) June CPI + 7.2% annual rate; Fed Gov. Brimmer suggests that rates will keep rising; June leading indicators up 1.9%; prime rate to 8.75% from 8.5%.
AUG 4 73	3.84	(RM) Rising food prices, hoarding, shortages; July WPI down 1.4% (viewed as aberration due to export controls); July unemployment rate down slightly; Fed Ch. Burns says that Fed might have to take additional steps to slow money growth.
SEP 8 73	−2.60	(RF) Nixon rules out tax-change proposals; Aug. unemployment rate up slightly; Aug. WPI up by 6.2% from July (74.4 % annual rate), largest monthly increase since 1946 (large increase expected).

Table 1 *continued*
Large Changes in Treasury Bond Yield, 1963 to 1993
Absolute value of changes > twice moving 2-year standard deviation or > 2.8 percent

Week Ending	Percentage Change	Explanation: R=routine economic data; M=monetary policy news; F=fiscal policy news; V=Vietnam-related; O=other
SEP 29 73	−2.36	(R) Aug. CPI up at 22.8 % annual rate; explosive price rally on expectations of Fed easing; Aug. durable goods orders down 1.6%; Treas. Sec. Shultz says interest rates 'over the top.'
DEC 29 73	2.03	(RO) Oil price more than doubled to $11.651 a barrel by six Persian Gulf producing countries; Nov. CPI up at 9.6% annual rate; Nov. durable goods orders rose 0.3%.
APR 12 75	2.44	(M) Inflation fears due to easier monetary policy.
JUN 14 75	−2.18	(F) N.Y. City financial problems; lower than expected federal borrowing.
AUG 9 75	1.15	(R) July unemployment rate down slightly; strong employment report a surprise; July WPI up 1.2% from June.
AUG 23 75	1.84	(R) July industrial production up 0.5% from June; July housing starts up 14% from June; July CPI up at 14.4% annual rate.
SEP 13 75	1.95	(F) Increased Treasury bond sales.
JAN 15 77	3.07	(M) Large increases in M1 and M2.
JAN 29 77	2.20	(M) Large Treasury issue.
FEB 5 77	3.85	(RO) Major weather freeze may cause higher govt. spending; heavy bond calendar, inflation fears.
OCT 13 79	4.74	(RM) Sept. unemployment rate down slightly; Fed introduces new policy; Fed increases discount rate to 12% from 11%; money supply surge; Sept. retail sales up 2.2% from Aug.
OCT 20 79	2.45	(RMO) Sept. industrial production up 0.5% from Aug.; Sept. housing starts up 4% from Aug.; personal income up 0.6% from Aug.; M1, M2 up strongly; inflation fears from oil price increases; 1979:III real GNP up a surprising 2.4% annual rate; deflator up at 8.4% annual rate.
OCT 27 79	3.72	(RM) Prime rate increased; Sept. durable goods orders up 5.9%; decline in money supply; Sept. CPI up at 13.2% annual rate; some major banks increase prime rate.
DEC 1 79	−3.41	(RM) Prime rate cut; Oct. CPI up at 12% annual rate over Sept.; rally attributed to narrowing trade deficit, massive purchases of T-bills by Fed; Oct. leading indicators down 0.9%.
JAN 19 80	1.32	(RM) Dec. unemployment rate up slightly; Dec. retail sales up 1.1%, mostly due to price increases; Dec. industrial production, housing starts up; M1 fell less than had been expected.
JAN 26 80	2.68	(R) Dec. durable goods orders up 0.6%; Dec. CPI up 1.2%.
FEB 2 80	2.71	(R) Long Treasuries rise above 11% for first time in history; Dec. leading indicators unchg; Dec. new factory orders up 1.3%; Jan. unemployment rate up to 6.2%, from 5.9% in Dec.
FEB 9 80	4.48	(F) Large budget deficit; inflation fears.
FEB 16 80	2.61	(M) Discount-rate increase.
FEB 23 80	7.61	(M) Lingering effects of discount-rate increase.

Table 1 *continued*
Large Changes in Treasury Bond Yield, 1963 to 1993
Absolute value of changes > twice moving 2-year standard deviation or > 2.8 percent

Week Ending	Percentage Change	Explanation: R=routine economic data; M=monetary policy news; F=fiscal policy news; V=Vietnam-related; O=other
MAR 15 80	−2.36	(RF) Jan. PPI up at 18% annual rate; Feb. retail sales down 0.7%; bond market rally due to expectations of new Carter anti-inflation moves; capital spending survey shows 1980 up by slim 1–2% real; Feb. industrial production up 0.2%; Carter anti-inflation proposals (incl. credit controls) announced.
MAR 29 80	3.29	(RMO) Feb. durable goods orders, personal income, up; Venezuela cuts residual fuel oil prices; Feb. CPI up at 16.8% annual rate; market confused when Fed permits fed funds rate to rise to 25%; Treasury prices soar on flight to quality given problems in silver, stock markets; prime rate up.
APR 5 80	−2.09	(R) Feb. leading indicators, new factory orders, down; major banks raise prime rate.
APR 12 80	−5.04	(M) Unexpectedly low money growth.
APR 19 80	−5.87	(R) Manufacturing output down sharply.
MAY 10 80	−4.53	(M) Fed discontinues surcharge on discount rate.
JUN 14 80	−4.41	(M) Discount rate cut.
JUN 28 80	2.91	(R) May durable goods orders down 7.3% from April; May CPI up 0.9% (10.8% annual rate); less Fed easing expected; candidate Reagan proposes tax cut for next year.
JUL 5 80	3.04	(RMF) Large unexpected increase in M1; May leading indicators, new factory orders, down; House Speaker O'Neill says tax cut certain in 1981.
AUG 2 80	3.31	(RMF) Fed cuts discount rate to 10% from 11%; M growth strong in recent weeks; bond prices fall on fears of growing federal borrowing, rapid M growth; June leading indicators up 2.5%; fears that Fed tightening policy.
OCT 11 80	−3.06	(RM) Sept. PPI down 0.2%; M1-A down $3.4 bil; Sept. retail sales up 1.6%.
OCT 25 80	2.80	(RM) Real GNP up 1% annual rate in third quarter; Sept. housing starts up 9%; M1-A up $4.1 bil; bond traders startled by signs of economic recovery; bond prices plunge on strong durable goods orders, growing fears of inflation; Sept CPI up 1%.
NOV 1 80	4.62	(RMO) Unexpectedly high CPI; Venezuela raises oil prices; M1 up.
DEC 27 80	−6.55	(F) Reagan announces that his incoming administration considering announcing a "national economic emergency."
FEB 14 81	3.19	(RMF) Jan. unemployment rate down slightly; M1-A down a surprising $3.3 bil; rates up on fears of heavy federal financing; rates surged after unexpectedly strong retail sales report; Jan. PPI up at 10.8% annual rate.
MAR 14 81	−2.86	(R) Feb. PPI up at 9.6% annual rate; Feb. unemployment rate down slightly; prime rate cut; retail sales up 0.9%.
MAR 28 81	4.32	(RMF) Feb. durable goods orders up 0.4%; fed funds rate rises to over 14%; heavy Treasury financing.
MAY 9 81	2.98	(RM) M1-B up a surprising $4.3 bil; Fed raises discount rate; banks raise prime rate; Apr. PPI up 9.6% annual rate.

Table 1 *continued*
Large Changes in Treasury Bond Yield, 1963 to 1993
Absolute value of changes > twice moving 2-year standard deviation or > 2.8 percent

Week Ending	Percentage Change	Explanation: R=routine economic data; M=monetary policy news; F=fiscal policy news; V=Vietnam-related; O=other
JUL 25 81	3.37	(RM) June housing starts down 11%; large jump in M1-B expected to delay decline in rates; Fed lowers M growth targets for rest of 1981 and 1982; real GNP for 1981:II down at 1.9% annual rate; June durable goods orders down 0.8%; June CPI up at 8.4% annual rate.
AUG 29 81	4.06	(RFO) OPEC oil price cuts expected; July durable goods orders up 0.9%; July CPI up 1.2%; heavy supply of new Treasury bonds.
OCT 3 81	3.80	(RF) Major bank cuts prime rate; Aug. leading indicators, home sales, down; bond rally on signs of weakening economy; Sept. unemployment rate up to 7.5% from 7.2%; heavy supply of new Treasury bonds.
OCT 10 81	−4.19	(MO) Decreased surcharge on discount rate; fed funds rate down; Reagan pushes for less restrictive monetary policy; Sadat assassinated.
NOV 7 81	−6.40	(MF) Discount rate cut; banks cut prime rate; Treasury financing smaller than expected.
NOV 14 81	−4.66	(M) Negative money growth; speculation on discount-rate cut; Volcker says Reagan must cut deficit and Fed committed to tight policy.
NOV 21 81	−2.91	(RM) Oct. industrial production, housing starts, down; prime rate cut; Fed eliminates surcharge on discount rate.
DEC 12 81	3.19	(RF) Nov. unemployment rate rose to 8.4% from 8.0%; higher estimates of federal deficit from Reagan Admin.; Nov. PPI up at 6.0% annual rate; capital spending plans for first half 1982 show 1.8% rise (real) from second half 1981; Nov. retail sales up 0.8%, stronger than expected.
JAN 9 82	2.92	(RF) Nov. new factory orders up 0.2%; unexpected surge in M1-B; forecast of higher rates by Henry Kaufman; bond price rally on drop in fed funds rate; concern over federal deficit; Dec. unemployment rate rose to 8.9%, up from 8.4%.
FEB 20 82	−3.40	(RMO) Iran cuts oil price for second time in 10 days; Jan. PPI up 4.8% annual rate; M1 up surprising $2.3 bil, leading to expectations of Fed tightening; Jan. M1 up at 20.7% annual rate; Jan. industrial production down 3%; prime rate up; bond price rally on decline in fed funds rate; Jan. personal income up a slow 0.2%.
FEB 27 82	−3.34	(RMF) Iran cuts oil prices; real GNP for 1981:IV down at 4.7% annual rate; interest rates down sharply on decline in M1 and economic weakness; prime rate cut; Jan. durable goods orders down 1.5%; bond price rally on drop in fed funds rate; Jan. CPI up 3.6% annual rate; bond prices fall on increase in fed funds rate; Jan. trade deficit rose to $5.13 bil; less federal financing expected.

Table 1 *continued*
Large Changes in Treasury Bond Yield, 1963 to 1993
Absolute value of changes > twice moving 2-year standard deviation or > 2.8 percent

Week Ending	Percentage Change	Explanation: R=routine economic data; M=monetary policy news; F=fiscal policy news; V=Vietnam-related; O=other
JUN 5 82	2.80	(RMFO) Apr. leading indicators up 0.8%; sliding bond prices due to concerns over federal financing needs, increase in fed funds rate; Apr. new factory orders, sales of new single-family houses down; major bank lowers prime rate; May unemployment rate up slightly; Israel invades Lebanon.
AUG 21 82	−6.76	(F) Fed funds and discount rate cuts.
SEP 25 82	−2.84	(RM) Aug. housing starts down 16.2%; Fed tightening expected due to sustained high M growth, incl. M1 increase of $4.3 bil. latest week; Aug. personal income up slim 0.3%; growing belief that economy weak; drop in fed funds rate below 10%; Aug. durable goods orders down 4%; Aug. CPI up at 3.6% annual rate; Fed officials say they will tolerate above-target M growth for a time.
OCT 16 82	−7.00	(M) Fed abandons money growth targets; lower interest rates likely.
NOV 6 82	−4.01	(MO) Speculation on discount rate cut; better than expected showing by Republicans in election.
FEB 26 83	−3.06	(RMO) Jan. personal income up only 0.1%; Volcker testimony previous Wed. de-emphasizes M targets; OPEC oil price cuts appear likely; real GDP down in 1982:IV; Jan. durable goods orders up 4.5%; Volcker says oil price declines could help to lower interest rates; prime rate cut; Jan. CPI up 0.2%.
AUG 20 83	−3.23	(RM) July PPI up 0.1%; M1 up a "surprisingly modest" $400 mil. in latest week; July industrial production up 1.8%; July housing starts down 0.6%; signs of moderating expansion noted; July personal income up moderate 0.6%; real GNP for second quarter revised to 9.2% (from 8.7%) growth rate; July durable goods orders down 3.6%.
SEP 3 83	3.00	(RMO) Bond prices down on smaller than expected decline in M1; July new factory orders down 1.7%; July leading indicators up 0.3%; U.S.S.R. downs Korean jetliner; Aug. unemployment rate unchg.
JAN 5 85	1.87	(RMO) Nov. leading indicators, factory orders, up; Nov. trade deficit up; M1 down $200 mil. about as expected; Nov. sales of new single-family houses down 10.6% (considered a "fluke"); oil prices down sharply Fri.
JAN 26 85	−2.79	(RM) Dec. personal income up "solid" 0.5%; real GNP for fourth quarter up at 3.9% annual rate (revised from 2.8%); deflator up only 2.4% (revised from 2.9%); bond prices rally on low deflator; Dec. CPI up 0.2%; unexpectedly large $2.8 bil decline in money; Dec. durable goods orders down 2.1%.
FEB 23 85	2.82	(RM) Jan. PPI unchg; Jan. industrial production, housing starts, up; rapid M growth putting pressure on Fed to tighten; bond prices tumble following Volcker testimony; mkt. believes Fed has stopped easing; personal income up 0.5%; real GNP for fourth quarter revised up to 4.9% growth from 3.9%; M1 grew $2.2 bil leaving money above Fed target.

Table 1 *continued*
Large Changes in Treasury Bond Yield, 1963 to 1993
Absolute value of changes > twice moving 2-year standard deviation or > 2.8 percent

Week Ending	Percentage Change	Explanation: R=routine economic data; M=monetary policy news; F=fiscal policy news; V=Vietnam-related; O=other
JUN 8 85	−2.97	(RM) Fed easing expected given signs of weaker economy; bond prices decline on $2.6 bil. surge in money supply; bond prices down on strong employment report.
DEC 14 85	−3.06	(RMFO) Payroll employment up "modest" 182,000; bond prices surge on lower oil prices; interest rates down on signs of Fed easing; Nov. retail sales up 1.1%; tax reform effort seems in danger of collapse; Gramm-Rudman law challenged in lawsuit as unconstitutional; Nov. PPI up 0.8%; Nov. industrial production up 0.4%.
FEB 22 86	−2.95	(RMO) Jan. PPI down 0.7% led by oil prices; Jan. industrial production, housing starts, up; expectations of Fed easing, rumors of cut in Japan's discount rate soon; bond prices slump on Volcker testimony that Fed not about to ease further; fourth-quarter real GNP up only 1.2% annual rate; oil futures dip below $14 per barrel; Volcker urges tax law changes to discourage corp. borrowing; bond prices rally on good inflation outlook despite unexpectedly large $6.1 bil. increase in M1; Jan. personal income down 0.1%.
MAR 1 86	−5.12	(MO) Falling oil prices; speculation on discount rate cut.
MAR 8 86	−3.08	(RM) Discount rate cut; weak leading indicators.
APR 5 86	−4.62	(O) Oil prices down; Vice President Bush's trip to Saudi Arabia.
APR 26 86	3.59	(FO) Weak dollar; worry over large supply in bond market.
MAY 17 86	3.54	(F) Worry over large supply in bond market.
JUN 7 86	4.30	(MO) Volcker suggestion of discount rate cut; weak dollar; falling oil prices.
JUN 21 86	−4.11	(RM) Speculation on Japanese interest rate cuts, to be followed by U.S. rate cuts; low CPI increase.
AUG 16 86	−3.70	(RM) Decline in retail sales; discount rate cut speculation; weak leading indicators.
SEP 13 86	3.66	(RO) Norway cuts oil output; stronger economic data; Germany hesitant to cut its interest rates.
APR 4 87	3.34	(RM) Weak dollar leading to inflation fears; trade deficit concerns; Fed worries about weak dollar suggest higher interest rates.
APR 18 87	4.39	(RMO) Texaco files for Chap 11; Fed officials say rates may have to rise if dollar weakens further; Mar. PPI up 0.4%; rumor that trade deficit report would show large increase; speculation on Fed tightening; fed funds rate up; Feb. trade deficit up; Japan considering retaliation in trade dispute with U.S.; major industrial nations agree on intervention to support dollar; Mar. industrial production down 0.3%; Mar. retail sales up 0.2%; Mar. housing starts down 3.2%; bond prices up on Sec. Baker's speech suggesting that Reagan Admin. ready to take steps to bolster dollar.

Table 1 *continued*
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Week Ending	Percentage Change	Explanation: R=routine economic data; M=monetary policy news; F=fiscal policy news; V=Vietnam-related; O=other
MAY 23 87	3.04	(RMO) Banks raise prime rate; Apr. PPI up 0.7%; U.S. Navy ship hit in Persian Gulf by Iraqi air attack; Apr. industrial production down 0.4%; signs of credit tightening by Fed; Fed's main emphasis now on propping up dollar; Apr. housing starts down 2.9%; report that Volcker said that interest rates would edge up; rumors of major bank losses on Third World debt and possible major bank failure; world oil prices slumped; Apr. CPI up 0.4%; durable goods orders up 0.1%; dispute within Fed over Volcker's stand on keeping dollar from declining further.
MAY 30 87	−3.38	(RMO) Stronger dollar; weak economic news suggests Fed won't tighten; Reagan says he will veto any tax increase bill sent to him; senior White house official says Volcker likely to be reappointed if he wants another term; Apr. leading indicators down 0.6%.
SEP 5 87	3.37	(R) Weaker dollar, inflation worries.
OCT 17 87	2.81	(RM) Market encouraged by Greenspan speech saying that investors overly worried about inflation; disappointment in trade figures produced major decline in bond prices and largest-ever point loss in Dow industrial average; major bank raises prime rate; Sept. retail sales down 0.4%; Sept. PPI up only 0.3%; Sept. industrial production up 0.2%.
OCT 24 87	−6.23	(O) Treasury bonds safe haven after stock market crash.
OCT 31 87	−4.53	(MO) Lingering effects of crash; inflation expectations down; speculation on easier monetary policy in Germany and Japan.
JAN 23 88	−3.27	(R) Sharp narrowing of trade deficit in Nov.; Dec. PPI down 0.3%; Dec. industrial production up 0.2%; Dec. CPI up 0.1%; Dec. housing starts down 16.2%.
JUN 10 89	−2.92	(RMO) May unemployment rate down to 5.2% from 5.3%; May payroll employment up only 101,000; turmoil in China; bank prime rate cut; Fed easing clear from decline in fed funds rate; lower oil prices; 1989 capital spending plans up slightly from earlier survey; May PPI up 0.9%.
AUG 12 89	2.84	(R) Unexpectedly strong employment report; July PPI down 0.4%; July retail sales up 0.9%.
APR 21 90	2.60	(RO) Mar. PPI down 0.2%, core PPI up 0.3%; bond prices down on heavy selling by Japanese investors; CPI increase much larger than expected; Feb. trade deficit down sharply.
MAY 12 90	−3.90	(RM) Budget negotiations begin between Bush Admin. and congressional leaders; bond market rally on weak employment report and speculation that Fed might ease; Bush ready to accept tax increases other than income tax increases to obtain budget accord; Apr. PPI down 0.3%; Apr. retail sales down 0.6%.

Table 1 *continued*
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Absolute value of changes > twice moving 2-year standard deviation or > 2.8 percent

Week Ending	Percentage Change	Explanation: R=routine economic data; M=monetary policy news; F=fiscal policy news; V=Vietnam-related; O=other
AUG 11 90	4.47	(RO) Sharp increase in gasoline prices; July payroll employment down 219,000—weaker than expected; long rates higher on Iraqi invasion of Kuwait; fears of wider Mideast conflict; "rising oil prices ignite inflation worries";Saudi Arabia agrees to boost oil production; Iraq annexes Kuwait; U.S. sends first troops to Saudi Arabia; July PPI down 0.1%.
OCT 6 90	−2.99	(RMF) Budget negotiators agree on tax increases; Aug. leading indicators down 1.2%; oil prices plunge; Fed easing likely; payroll employ. down 67,000; Fed signals lower rates if Congress approves deficit reduction bill.
DEC 28 91	−2.67	(M) Discount and fed funds rate cuts.
JAN 18 92	2.71	(RM) Better than expected employment report; Greenspan testimony that Fed had done enough to stimulate recovery.
SEP 12 92	−2.40	(RMF) Interest rates down on unexpectedly weak jobs report; Fed cuts fed funds rate; Pres. Bush outlines economic plan with possible tax cuts; Aug. PPI up 0.1%.
FEB 27 93	−2.94	(F) Clinton economic plan for deficit reduction; Treasury report of budget surplus for January.
APR 17 93	−3.00	(R) Lower than expected PPI and CPI data.
NOV 6 93	2.96	(R) Strong economic data.

Source: Data on weekly average index of the average yield on Treasury bonds with maturities of 10 years and over. Explanations taken from *Wall Street Journal*. See the text.

References

Cagan, Phillip. 1956. "The Monetary Dynamics of Hyperinflation." In Milton Friedman, ed., *Studies in the Quantity Theory of Money*. Chicago: University of Chicago Press.

Cook, Timothy and Thomas Hahn. 1988. "The Information Content of Discount Rate Announcements and Their Effect on Market Interest Rates." *Journal of Money, Credit and Banking*, vol. 20 (May), pp. 167–80.

———. 1989. "The Effect of Changes in the Federal Funds Rate Target on Market Interest Rates in the 1970s." *Journal of Monetary Economics*, vol. 24 (September), pp. 331–51.

Cook, Timothy and Steven Korn. 1991. "The Reaction of Interest Rates to the Employment Report: The Role of Policy Anticipations." Federal Reserve Bank of Richmond *Economic Review*, September/October, pp. 3–12.

Duck, Nigel W. 1993. "Some International Evidence on the Quantity Theory of Money." *Journal of Money, Credit and Banking*, vol. 25 (February), pp. 1–12.

Dueker, Michael J. 1993. "Indicators of Monetary Policy: The View from Implicit Feedback Rules." Federal Reserve Bank of St. Louis *Review*, vol. 75 (September/October), pp. 23–39.

Dwyer, Gerald P. and R.W. Hafer. 1989. "Interest Rates and Economic Announcements." Federal Reserve Bank of St. Louis *Economic Review*, vol. 71 (March/April), pp. 34–45.

Fischer, Andreas M. 1993. "Inflation Targeting: The New Zealand and Canadian Cases." *The Cato Journal*, vol. 13 (Spring/Summer), pp. 1–27.

Friedman, Benjamin M. 1975. "Targets, Instruments, and Indicators of Monetary Policy." *Journal of Monetary Economics*, vol. 1, pp. 443–73.

Friedman, Benjamin M. and Kenneth N. Kuttner 1992. "Money, Income, Prices, and Interest Rates." *The American Economic Review*, vol. 82 (June), pp. 472–92.

Friedman, Milton. 1959. *A Program For Monetary Stability*. New York: Fordham University Press.

Friedman, Milton and Anna J. Schwartz. 1963a. *A Monetary History of the United States, 1867–1960*. Princeton: Princeton University Press.

———. 1963b. "Money and Business Cycles." *The Review of Economics and Statistics*, vol. 45 Supp. (February), pp. 32–64.

Hardouvelis, Gikas A. 1988. "Economic News, Exchange Rates and Interest Rates." *Journal of International Money and Finance*, vol. 7 (March), pp. 23–35.

Hoffman, Dennis L. and Robert H. Rasche. 1991. "Long-Run Income and Interest Elasticities of Money Demand in the United States." *The Review of Economics and Statistics*, vol. 73 (November), pp. 675–83.

Poole, William. 1970a. "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model." *Quarterly Journal of Economics*, vol. 84 (May), pp. 197–216.

———. 1970b. "Whither Money Demand?" In Arthur M. Okun and George L. Perry, eds., *Brookings Papers on Economic Activity*: 3, 1970, pp. 485–500.

———. 1994a. "Keep the M in Monetary Policy." *Jobs and Capital*, vol. 3 (Winter), pp. 2–5.

———. 1994b. "Monetary Policy Implications of Recent Changes in the Financial Systems in the United States and Europe." Prepared for a conference on *Financial Stability in a Changing Environment*, The Institute for Monetary and Economic Studies, Bank of Japan, 28–29 October 1993 (forthcoming in conference volume).

Samuelson, Paul. 1969. Panel discussion, "The Role of Money in National Economic Policy." In Federal Reserve Bank of Boston Conference Series No. 1, *Controlling Monetary Aggregates*, pp. 7–13.

Santomero, Anthony M. 1991. "Money Supply Announcements: A Retrospective." *Journal of Economics and Business*, vol. 43 (February), pp. 1–23.

Discussion

*Benjamin M. Friedman**

T. H. Huxley observed that new truths in science often begin as heresy, advance to orthodoxy, and end as superstition. It is doubtful that Huxley had explicitly in mind American monetarism of the latter half of the twentieth century (wholly apart from his being neither American nor an economist, he died in 1895), but his remark is apt to this discussion nonetheless. Monetarism, both as a positive theory of the U.S. economy and as a guide to U.S. monetary policy, has traversed just such an odyssey.

Advance to Orthodoxy

In the early years after the 1951 Treasury–Federal Reserve Accord first freed U.S. monetary policy from the wartime commitment to fix bond prices, monetary aggregates were far from the center of either mainstream macroeconomic thinking or Federal Reserve policymaking. Monetary policy in particular was still focused on fixing short-term interest rates, albeit at a value that was allowed to change from time to time. (Indeed, part of what it took to sell the Accord in the first place was a presumption that these required changes would not be sizable, and hence arguing that even small changes in interest rates could have major effects on nonfinancial economic activity was a major motivation underlying the "availability doctrine" advanced by Roosa and others at that time.) From the perspective of then-prevailing opinion, therefore, the frontal assault made by Friedman and Schwartz in their 1963 *Monetary*

*William Joseph Maier Professor of Political Economy, Harvard University.

History, and by Brunner and Meltzer in their 1964 attack on the Federal Reserve's use of an operating procedure based on free reserves (which amounted to roughly the same thing as short-term interest rates), did appear heretical.

Within an astonishingly short time, however, compared to the usual advance of intellectual ideas into the arena of practical affairs, not only academic economists but Federal Reserve officials as well came to place increasing weight on monetary quantities in their thinking. William Poole's classic paper, published in 1970 but available and widely discussed well before then, made a significant contribution to this process. So did the Boston Federal Reserve Bank's important 1969 conference. In 1970, the Federal Open Market Committee first began to refer explicitly to money growth objectives in its policy directives.

The emphasis placed on money growth as an explicit operating objective of U.S. monetary policy varied over the course of the 1970s, but the trend was clearly in the monetarist direction. In 1975 Congress adopted a resolution directing the Federal Reserve System to formulate such quantity objectives as explicit targets, and the 1978 Humphrey–Hawkins legislation required (and today still requires) the Federal Reserve to report these targets to Congress in advance and to report after the fact on its success or failure in achieving them. In a widely read 1975 paper, Sargent and Wallace reframed Poole's analysis of the money stock versus an interest rate as the instrument of monetary policy in such a way as to argue that the latter was not just inferior but impossible, indeed meaningless. In October 1979, Chairman Paul Volcker publicly announced that the Federal Reserve not only had adopted a new policy strategy centered on targeted rates of money growth but also would henceforth implement newly designed operating procedures intended to enhance its ability to achieve those targets. Just a decade and a half after Friedman and Schwartz and Brunner and Meltzer, monetarism had in fact advanced to orthodoxy in much of the academic world and among policymakers too.

Collapse and Retreat

The descent since that apogee has been even more rapid. In mid 1982, the Open Market Committee decided to allow substantially faster money growth than was consistent with its stated target, and in October of that year Chairman Volcker announced the abandonment of the money-oriented operating procedures adopted just three years earlier. Milton Friedman and other monetarist economists gained widespread attention by predicting that the resulting more rapid money growth would lead to renewed double-digit inflation, but experience falsified these claims and in time people mostly stopped voicing them (at least in

public). By contrast, the new academic growth industry became documenting the instability of money demand. Over the next decade, both internal and external views of Federal Reserve policymaking paid progressively less attention to money growth targets—or to money growth itself, for that matter. At the July 1993 Humphrey–Hawkins hearings, Chairman Alan Greenspan formally announced the "downgrading" of money growth targets as a focus of monetary policy. At the February 1994 Humphrey–Hawkins hearings, according to *The New York Times*, the one section of his written testimony that Chairman Greenspan did not bother to read aloud was the part dealing with money growth targets.

The well-known reason for this dramatic reversal is simply that the empirical relationships that once connected money growth to the growth of either income or prices in the United States have utterly collapsed. As Kenneth Kuttner and I have shown (1992), data for the most recent quarter-century of U.S. experience provide no evidence of any predictive content of money growth with respect to subsequent movements of either income or prices—or, for that matter, any other macroeconomic variables commonly taken to be of interest for purposes of monetary policy. The disappearance of these relationships is presumably due to a combination of factors including deregulation, financial innovation, globalization of financial markets, and no doubt others.

Unraveling and then quantifying the respective effects of these disparate influences is, to be sure, an appropriate and even important object of research for positive empirical economics. But too often the researchers who undertake such investigations appear to lose sight of their limited immediate relevance to monetary policy. The question that matters, for practical purposes of monetary policy, is not whether a sufficiently clever econometrician can suggest a new variable to include in the equation, or devise a new mathematical specification among the usual variables, capable of resuscitating some money–income or money–price regularity after it has collapsed, but whether it is possible to identify, *in advance*, relationships of sufficient stability and robustness to warrant using one or another measure of money growth as an explicit policy target. The Federal Reserve apparently believes the answer to this question is no. I agree. On the basis of William Poole's paper, it is not obvious that he disagrees either.

Is There a Model?

Poole offers a limited defense of monetary aggregate targets along two lines, one theoretical, the other statistical. The theoretical argument is that while we have a familiar and well understood model describing the consequences of a permanent increase or reduction of, say, 1 percent

per annum in the rate of money growth (however measured), there is no analogous baseline model describing the consequences of a permanent 1 percent increase or reduction in the nominal rate of interest. Exactly why the absence of such a model would constitute a valid argument for formulating month-to-month or even year-to-year monetary policy in terms of monetary aggregate targets is left unexplained. Indeed, Poole acknowledges that, "As far as I know, no advocate of a funds rate target has ever called for the Fed to adhere to a target path for the funds rate announced a year in advance, or even three months in advance." Yet he goes on to conclude that "no baseline prediction exists to provide guidance as to how much or how fast inflation will rise if the central bank, say, lowers interest rates by 1 percentage point from an initial point of equilibrium. The problem is that an economic model with a *permanently* (emphasis added) fixed nominal interest rate set by the central bank has no determined price level."

Fortunately, any reader who thinks the absence of a baseline model of *permanent* nominal interest rate changes is a matter of serious consequence for the conduct of monetary policy need only look as far as the papers in this volume by Jeffrey Fuhrer and by John Taylor, each of which lays out a simple variant of just such a model. Taylor's Figures 1, 3, and 4 do an especially good job of making this model intuitively understandable. Whether either Fuhrer's model or Taylor's is the best way to conceptualize the effects of monetary policy as implemented by the central bank's setting of interest rates is an empirical matter, of course, although Fuhrer's Figure 4 (upper panel) and Taylor's Figure 2 do suggest that these representations may not be far off the mark for recent experience.

By contrast, what Poole's paper does not acknowledge is that the central assumption of the baseline model based on money growth—namely, the existence of a stable long-run money demand function—is *not* supported by the U.S. data. Ryuzo Miyao (1994) recently completed what is probably the most comprehensive effort to date to test for money–income or money–price co-integration in any of the forms that would follow from stable long-run U.S. money demand. Miyao showed that even those few specifications that did appear to exhibit co-integration in recent years (the most notable examples are those based on M2 with an error correction term exploiting past residuals, as suggested by Feldstein and Stock 1993 and by Konishi, Ramey, and Granger 1993) fall apart when the sample is extended through 1993.

It is far from transparent, therefore, that the familiar baseline model with fixed money growth has more empirical support than the models of Fuhrer and Taylor with fixed interest rates. But regardless of how that comparison turns out—and we should frankly acknowledge that in policy-oriented monetary economics the empirical success of any given model can be a moveable feast—the more fundamental problem with

Poole's argument remains: Since nobody he knows (or anybody I know, either) has suggested that the central bank *permanently* fix nominal interest rates, even if it were true that there were no such model, why would its absence constitute a valid argument against using interest rates as the basis of monetary policy operations? And still more so, why would the absence of such a model constitute a valid argument *for* basing monetary growth policy on money growth targets?

Verification or Superstition?

The second part of Poole's limited defense of monetary aggregate targets is statistical. Eschewing the familiar but ever less credible effort to resuscitate a stable money–income or money–price relationship, Poole offers a statistical argument to the effect that the *lack* of such stability in the observable data is itself a sign of the success of monetary policy based on targeting money growth. The chief implication of this line of reasoning is that while the *presence* of empirical evidence relating money to either income or prices used to be the main argument for a policy of targeting money growth, today the *absence* of such evidence is an argument for this kind of policy—or at least grounds for not opposing it.

The very nature of this reasoning makes clear the extent to which, in the absence of supporting empirical evidence, the argument for money growth targets in the United States has today become a matter of simple faith. In the small child's version of familiar make-believe, the *double* magic is, first, that a toy stuffed animal comes to life and, second, that this transformation occurs in such a way as to escape ordinary human detection. According to Poole's argument, money does have a stable and reliable effect on income, but by the magic of optimal monetary policy this effect is not detectable in the observed data. As Huxley warned, here the discussion has clearly moved beyond the realm of economics as a science grounded in empirically verifiable propositions.

On closer inspection, however, Poole's statistical argument simply does not address the overwhelming bulk of the empirical evidence against a stable U.S. money–income or money–price relationship. Further, to the extent that this argument could in principle apply to one aspect of that evidence, a crucial (but unstated) assumption underlying the argument is itself contradicted by the data.

In his equation (1), Poole posits that income is subject to two separate influences: money and something else, labeled X. The argument is that the more nearly the central bank varies money so as to offset the influence of this X and thereby leave income unchanged over time, the smaller the correlation between money and income becomes. If the central bank were to vary money so as *perfectly* to offset the influence of

X on income, the correlation between money and income would become zero.

If money and income were the only variables we could observe, this line of argument would end here. But we can and do observe variables that are candidates for Poole's unspecified X. And once we do, we can move beyond this limited conclusion based only on the simple correlation of money and income as given in Poole's equation (5).

The main point of Poole's argument is that the *simple* correlation between money and income goes to zero with what he calls "optimal monetary policy." But optimal policy in this sense does not reduce, but rather *increases*, the *partial* correlation of money and income (which in the context of Poole's equation (1) just measures the relationship between money and income after allowance for the separate influence of X). It is this *partial* correlation, or its dynamic representation, that is the object of study in the multivariate regressions on which virtually the entire modern empirical money–income literature relies.

Poole is incorrect, therefore, in stating that this line of reasoning, directed toward the *simple* correlation between money and income, provides "the most important reason why the correlation between money growth and GDP growth has become so small, as documented by Friedman and Kuttner (1992)." Of the 210 separate regressions reported in that paper (not counting the co-integration tests, which are irrelevant to this argument), not one was a univariate regression. In every case, the test statistics at issue were dynamic analogs of *partial* correlations, not simple correlations. Similarly, every variance decomposition reported there was estimated from a system in which two or more variables (not counting lagged values of income itself) were potential influences on the variation of income. Here again, therefore, what was at issue was the dynamic analog of a *partial* correlation. Nor was Kuttner's and my work at all unusual in this regard. Just about all of the recent published work documenting the post-1970 collapse of money–income and money–price relationships in the United States has similarly relied on partial correlations. Poole's argument about simple correlations just does not address these results.

Further, in the absence of evidence of a nonzero partial correlation between money and income (or prices), this line of reasoning makes no sense even for the case of simple correlations. Although Poole never says so, a crucial assumption underlying his entire argument is that the partial correlation between money and income is nonzero. After all, it is this partial effect that the central bank supposedly exploits in order to pursue what the argument labels "optimal monetary policy." But this assumption of a nonzero partial correlation is just what so much of the recent U.S. evidence contradicts.

A Role for Monetary Targets?

In sum, a revival of monetary aggregate targets in the United States today would be largely an act of faith, unsupported by either theoretical or empirical argument. There *are* models of permanent interest rate changes, and as Bennett McCallum (1981) showed some years ago, their absence would not be relevant to the practical use of interest rates for monetary policy anyway. Poole's statistical argument about the simple money–income correlation proceeds from the assumption of a positive *partial* correlation and that is just what the voluminous (and constantly growing) empirical literature says is no longer present for the United States. Not surprisingly, Poole himself is appropriately cautious in his recommendations. The title of his paper and of the penultimate section notwithstanding, he does not actually call for "restoring a role for money growth targets."

Other parts of Poole's paper are interesting, but their connection to monetary aggregate targeting is at best remote and certainly unexplained. For example, the analysis of large movements in bond prices is a potentially very useful piece of work, and it may well become widely used and cited. It may be true, as Poole concludes, that "the bond and money markets respond primarily to changes in Fed policy and changes in expectations about Fed policy." But why does it then follow that, "The more confidence the market has in the Fed's willingness to do what is necessary to maintain low inflation, the more sense it makes for the market to concentrate on what the Fed is doing"? One can just as easily—I think more easily—argue that buyers and sellers of nominally denominated long-term obligations should pay more attention to the central bank's actions precisely when they are *unsure* of its commitment to maintain low inflation. More important for the purposes of this volume, why does this line of argument support an inference about the potential usefulness of money growth targets anyway?

The fact that U.S. monetary policy has been so successful over the past decade, by almost universal agreement, is not grounds for standing still. Policymakers should always try to do better, and the risks ahead are not necessarily well described by realizations in the past. Basing monetary policy on interest rates brings risks of its own (I have examined these elsewhere, for example in Friedman 1988), and complacency is always dangerous in any case. New thinking and research on how to improve monetary policy, and how to adapt today's interest rate approach to a rapidly changing economic and financial setting, is not just appropriate but necessary. To the extent that fluctuations in money growth contain useful information about subsequent movements of income or prices, the central bank should exploit that information. I have described elsewhere (most recently in Friedman 1993) an "infor-

mation variable" approach to monetary policy, which is a way of doing just that.

But all this is a far cry from explicit money growth targets. In the absence of cogent reasons grounded in either theory or the available empirical evidence, reinstituting monetary aggregate targets would not be a positive step for U.S. monetary policy—although I suspect Thomas Huxley would have understood the lingering desire to do so.

*References**

Brunner, Karl and Allan H. Meltzer. 1964. "The Federal Reserve's Attachment to the Free Reserves Concept." U.S. Congress, House of Representatives, Subcommittee on Domestic Finance, 88 Congress, May 7, 1964. Reprinted in K. Brunner and A. Meltzer, eds., *Monetary Economics*, pp. 21–96. Oxford: Blackwell.

Feldstein, Martin and James H. Stock. 1993. "The Use of a Monetary Aggregate to Target Nominal GDP." National Bureau of Economic Research Working Paper No. 4304 (March).

Friedman, Benjamin M. 1988. "Monetary Policy without Quantity Variables." *The American Economic Review*, vol. 78, no. 2 (May), pp. 440–45.

———. 1993. "The Role of Judgment and Discretion in the Conduct of Monetary Policy: Consequences of Changing Financial Markets." In *Changing Capital Markets: Implications for Monetary Policy*, Proceedings of a Symposium Sponsored by the Federal Reserve Bank of Kansas City, August 19–21, 1993, pp. 151–96.

Konishi, Toru, Valerie A. Ramey, and Clive W. J. Granger. 1993. "Stochastic Trends and Short-Run Relationships between Financial Variables and Real Activity." National Bureau of Economic Research Working Paper No. 4275 (February).

McCallum, Bennett T. 1981. "Price Level Determinacy with an Interest Rate Policy Rule and Rational Expectations." *Journal of Monetary Economics*, vol. 8, no. 3, pp. 319–29.

Miyao, Ryuzo. 1994. "Does a Long-Run M2 Demand Relationship Really Exist in the United States? Evidence from Cointegration Tests." *Essays in Money and Output*. Ph.D. Dissertation, Harvard University.

Sargent, Thomas J. and Neil Wallace. 1975. "Rational Expectations, the Optimal Monetary Instrument and the Optimal Money Supply Rule." *Journal of Political Economy*, vol. 83, no. 2 (April), pp. 241–54.

*This list is limited to references not included in the paper by William Poole.

Discussion

*Donald L. Kohn**

William Poole has written an interesting and provocative paper covering a number of aspects of monetary policymaking. His primary focus is on one key phase of the policy process—adjusting the instrument variable to get to ultimate objectives. He acknowledges that the Federal Reserve has done a pretty good job of this over the past decade or so, operating with a federal funds or closely related instrument and keying changes in that instrument to a wide variety of incoming information. In that information set, monetary growth has received decreasing emphasis as the character and demand properties of the aggregates have changed, loosening their ties to goal variables.

Despite the reasonably good record, Poole is concerned that this process is prone to error, partly because the tight focus on interest rates may tend to be associated with potentially constraining political pressures. Certainly the history from the late 1920s to the late 1970s of similar procedures produced enough examples of serious problems to warrant raising these questions. Too often, this procedure was characterized by policy that moved "too little, too late," failing to damp cycles and occasionally exacerbating them. The improved recent performance owes partly to factors outside the control of the Federal Reserve, and a central bank believing that it had learned sufficiently from its history to guarantee that it would not repeat its mistakes would be suffering a serious attack of hubris.

*Director, Division of Monetary Affairs, Board of Governors of the Federal Reserve System. The views are those of the author and do not necessarily reflect the views of the Board or its other staff.

Reserves Management and a Flexible Funds Rate

Poole has raised a legitimate and serious potential problem, but I do not believe he has come up with a legitimate and serious solution to that problem. He would re-insert the monetary aggregates into policy and inject a degree of flexibility into the funds rate by focusing between each FOMC meeting on the quantity of reserves, not the funds rate, allowing the funds rate to fluctuate over a fairly wide range in response to changes in the demand for reserves. In his view, these variations would allow underlying market forces to show through into interest rates and would make it easier for the Federal Reserve to shift its policy stance over time.

Even in its sketchy form, this plan seems to have a number of drawbacks. It would impose a considerable degree of volatility and uncertainty on financial markets. The short-run demand for reserves is highly variable, responding not only to changes in income and spending but also to a wide variety of special influences on transactions balances, and it is therefore very difficult to predict. Recent examples of special factors affecting reserve demand would include tax flows, which are never adequately accounted for in seasonal adjustment, and the changing volume of deposits associated with mortgage refinancing. I do not have data for inter-meeting periods as a whole, but our mean absolute forecast errors for changes in M1 three weeks ahead averaged over $4 billion in 1993, roughly equivalent to a $400 million error in reserve projections. Our one-week-ahead forecasts of required reserves in 1993 were off by an absolute average of more than $150 million, and demands for excess reserves can vary for reasons related to the distribution of reserves in the banking system, temporary clearing needs, and the like. This suggests that the federal funds rate would almost always be at one end or the other of the range—and mostly for reasons that had nothing to do with emerging economic conditions—and could well be at both ends within an inter-meeting period.

Any procedure imposing such costs would have to have a clear rationale and produce substantial benefits. Presumably, reserves are targeted because they are related to M1, but even over longer periods, as Poole notes, the tie between M1 and spending or prices is very loose for economies experiencing low or moderate inflation. The introduction of NOW accounts made this aggregate very interest-sensitive over the targeting interval of a year, and the result has been a highly variable velocity. As a consequence, the FOMC had to drop its practice of setting annual ranges for this aggregate. The lack of correlation of money and income in the 1980s that Poole discusses may reflect optimal policy, but it has also been the result of the changing character of "money" and the greater availability of close substitutes owing to deregulation and

innovation in financial markets. Tying open market operations to hitting a reserve path would seem to lack a fundamental rationale, beyond providing a cover for interest rate adjustments. Indeed, Poole's example from May 1994, in which he posits a drop in the funds rate as M1 weakened after the tightening of policy, suggests that his procedure could have the effect of damping—at least temporarily—the negative correlation between money and interest rates that he cites as evidence of the Federal Reserve's countercyclical monetary policy.

Nor would Poole's proposal be likely to allow market expectations about the economy or prices to show through more clearly to longer-term interest rates. First, I do not share his degree of pessimism about extracting useful information from financial market prices. To be sure, it is a tricky business, not only because those prices incorporate the expected actions of the central bank, but also because they tend to display considerable volatility and may not always reflect underlying fundamentals. Nonetheless, careful analysis using information across maturities from a variety of markets—including those for equities, foreign exchange, and even commodities—and together with data on money and credit flows, can tell the central bank something about real interest rates and inflation expectations, and about how it is viewed by market participants. In this regard, the expansion of derivative markets has provided new tools in helping to read market signals. Results are merely suggestive and often do not have clear implications for policy, but they can supplement other sources of information.

Moreover, under Poole's proposal, markets would still be trying to anticipate the movement of short-term rates, and they would have additional information—the likely course of reserve demand—to factor in. One lesson of the 1979–82 reserve targeting period was that volatility in short-term rates tends to feed through to long-term rates, despite economists' views that alternative operating procedures causing that volatility should reduce longer-term uncertainty. I suspect that publication of M1 and reserves data would once again be met with major adjustments in interest rates across the maturity spectrum—not because money or reserves held any more information about the economy than they now do, but because they portended movements in short-term rates.

The Current Procedure

I started by saying that Poole had raised an important issue—how to increase the odds on the Federal Reserve continuing to move its instrument in a stabilizing fashion. The obvious question is whether I have something better to offer—some way of giving Poole greater assurance that our praiseworthy behavior will persist. Unfortunately, I do not.

I see no clear alternative to the current practice of looking at everything and making discretionary changes in a federal funds operating target. Specific targets for final or nearly final objectives like nominal GDP or inflation, while quite important from some perspectives, as will be discussed below, have limited operational content, given policy lags. I expect that changes in financial markets will continue to undercut the utility of money and credit aggregates or interest rates or rate relationships as intermediate targets—though they will be important information variables. And while forecasts are useful and policy inherently forward-looking, policymakers correctly remain skeptical of these forecasts, whether they come from their own staffs or from private forecasters.

The Lessons of the 1970s

Nonetheless, I think the Federal Reserve can build on the factors that have contributed to its relative success since 1980. As a result of the experience of the late 1960s and 1970s, policymaking moved in two complementary directions, which helped to improve it. The first was towards a renewed commitment to a fixed longer-run goal, that of price stability. Emphasis on price stability as a long-term objective, even without a specific timetable toward that goal, has helped to discipline the policy process. When weighing a particular course of action, the public commitment to moving inflation down further will be on one side of the scale, perhaps counterbalancing some of the pressures on the other side.

Moreover, greater emphasis on price stability has led to increased attention to inflation expectations, recognizing the role such expectations play in inflation and the costs of reducing it. This lends a forward-looking cast to policy, and it helps to avoid some of the pitfalls of the past; whatever the drawbacks of real interest rates as intermediate indicators, they are better than attempts to judge the likely effects of policy from nominal rates alone.

The second, equally important lesson of the 1970s was the need for flexibility in changing instrument settings. Policymakers recognize the limits of their knowledge. One problem with the car metaphor for monetary policy is that we cannot see the road ahead, we steer by looking in the rearview mirror, and data lags and revisions obscure even what we see in that mirror. We have at best only a rough idea of the response of financial markets to policy actions and of the quantitative relationships of aggregate demand to its determinants, including the implications of various monetary policy instrument settings. Recent disputes about the level of the NAIRU (the non-accelerating-inflation rate of unemployment) suggest that even if we could predict aggregate

demand, serious questions would remain about its implications for inflation.

Conclusions for Policy Adjustment

Faced with a high degree of uncertainty, policymakers have drawn two conclusions concerning adjustments to their instrument. One is that they need to look at all kinds of data to assess their progress down the road. No one piece of information will likely provide a consistently reliable guide to what lies ahead. Policymakers must pay attention to indicators on the economy and prices for clues about underlying demands for goods and services and inflation pressures. They must also look at information from financial markets as key elements in the transmission mechanism and as indicators of private sector expectations.

The second conclusion policymakers have drawn is that they need to be ready to change instrument settings fairly promptly in response to new information, recognizing that if they wait until all the indicators are pointing in one direction, it will be too late. Flexibility implies a willingness to act in advance of problems, to take some risks, and to reverse field when necessary.

An overlooked element in maintaining flexibility is the nature of the decision itself and how it is made. Poole's monetary policy car is being driven by a committee, and it is filled with vocal backseat drivers. Over the years, the Federal Reserve has moved toward greater clarity, accountability, and transparency in its decisions about instrument settings. I refer not only to the publication of transcripts and announcement of decisions, initiated this year, but also to the tighter federal funds rate targeting that evolved over the 1980s and the more explicit confirmation of instrument settings in open market operations. These changes have contributed positively to the accountability of the Federal Reserve within the government and to reducing uncertainty in markets.

Some have wondered why these changes were not made sooner, or why additional steps along these lines have not been taken. The main reason has been concern about the feedback on the decision process itself, including the potential loss of flexibility. One can see this clearly in the debate about the borrowing allowance versus a federal funds objective, so prominent in the transcripts for the latter part of 1987 and 1988. Changes in discount window borrowing objectives filtered into the market slowly; the Federal Reserve really did have an instrument without an announcement effect, until shifts in borrowing behavior made this impossible to maintain. FOMC members are going to need to take care that the current focus on every small change in the federal funds rate—a focus made all the more intense by its announcement, which seems to elicit public comment from other addresses in Washing-

ton—does not detract from prompt adjustments in instrument settings. Concerns about maintaining flexibility also have arisen in considerations of releasing the language in the directive governing inter-meeting changes in instrument settings; immediate publication of such language, with the threat of attendant market reaction, could constrain the use of this source of flexibility. And feedback on the deliberative process has been a prominent point in discussions of transcript publication.

To date, the evolution of the Federal Reserve's decisions and announcements has not deterred needed actions. But reducing market uncertainty and increasing public openness and accountability may have subtle costs in terms of arriving at the right decisions, especially in terms of keeping flexibility in policymaking, an attribute Poole has quite correctly highlighted in his paper.

Lessons from International Experience

Many countries have conducted monetary policy quite differently from the United States. Foreign central banks differ greatly in the targets, indicators, and instruments that they use, and in the degree of independence that they maintain. The papers in this session cull the experience of policymakers abroad to determine what U.S. monetary policy can learn from the strategies pursued abroad.

Strategy and Tactics of Monetary Policy: Examples from Europe and the Antipodes

*Charles A.E. Goodhart and José Viñals**

Most central banks in Europe and elsewhere have been giving priority to the achievement of price stability for more than a decade.[1] In recent years, this effort has been reinforced by a marked trend toward giving central banks much more autonomy to pursue this goal. Both the objective of achieving price stability and such autonomy have, in a sizable number of countries, now been constitutionally incorporated in newly revised legislation. In countries where no such legislation has been enacted, such as the United Kingdom and Australia, proposals to do so remain very much on the present political agenda.[2]

Such legislative moves towards greater autonomy ("independence") have been so widespread and rapid that it appears worthwhile to try to document the present position. This paper will concentrate mostly on developments in Europe, since this is the region with which

*Professor of Banking and Finance, Financial Markets Group, London School of Economics and Political Science; and Head of Economic Studies, Bank of Spain, and the Centre for Economic Policy Research, respectively. The views expressed in this paper are solely those of the authors and do not necessarily represent those of any of the institutions with which they are, or have been, affiliated.

[1] See Appendix Table 1 at the end of this paper for a report on the current institutional features of central banks in the European Union. The *Annual Report* of the Committee of Governors of European Central Banks (1993) contains a detailed comparison of the institutional features of the central banks of the European Union.

[2] In the United Kingdom, proposals to introduce legislation for central bank independence were advocated in the Roll Committee Report (1993) and in the House of Commons Select Committee Report (1993); a private member's bill to that effect was introduced by Mr. N. Budgen in February 1994, but the government prevented it from becoming law. In Australia such independence for the Reserve Bank was part of the electoral program of the Liberal Party at the 1992 election, but this measure was not supported by the victorious Labour Party.

the authors are most familiar, but it will also refer to similar progress in the Antipodes and Canada. The same trend toward the enactment of legislation for greater central bank autonomy is also evident in a number of South American countries, such as Chile and Mexico.

The move toward granting greater central bank autonomy reflects to some considerable extent the power of academic ideas whose time has come. The time inconsistency hypothesis posits that governments with a high rate of time discount, particularly as elections approach,[3] and a natural concern about unemployment, are likely to have a bias towards generating a stable, expected rate of inflation, without any beneficial effect on *real* equilibrium (that is, medium- and longer-term) values. The implication is that more politically subservient central banks will have less credibility, and that in such countries average inflation will be higher. Such theoretical hypotheses have received some empirical support from studies of the correlations between central bank independence and both inflation (negative) and output (zero) (Alesina and Summers 1993; Cukierman 1992; see Posen 1993 for a critique). All this has spawned a large literature, with which it is assumed the reader is familiar, so this is not pursued further. The subject is also discussed in the paper in this volume by Debelle and Fischer.

Perhaps the most successful and probably the most admired central bank in Europe is the Deutsche Bundesbank. The Bundesbank has acted as role model for other aspiring European banks and has acted as the leader and contra-inflationary anchor in the Exchange Rate Mechanism of the European Monetary System. Even without academic analytical support for autonomous central banks, it is quite possible that the prospective European System of Central Banks, whose Protocols were established in the Maastricht Treaty, would have had its constitutional independence from government modeled on that of the Bundesbank in any case. Moreover, if the European System of Central Banks is to be thus independent, consistency and logic require that the member national central banks of the System should adopt the same constitutional structure. So, as will be discussed in more detail below, in Western Europe the prospective advent of economic and monetary union has provided another impulse toward the revision of central bank legislation in the direction of a stronger and more explicit mandate toward price stability, and greater autonomy and independence from government in the operation of monetary policy to that end. In Eastern Europe the expected date of accession to the European Union, and to

[3] The suggestion that governments would positively seek, and central banks acquiesce in, a conscious expansion in monetary growth, for example, prior to elections, is unduly cynical. Instead, the focus of political pressure will usually be to defer upward increases in interest rates, or to accelerate their downward movements, to some extent at all times, but especially at moments of political sensitivity.

economic and monetary union within it, is rather more distant, but the processes of economic reform that have followed the collapse of Communism provide both an occasion and a need for updating and revising their central bank legislation (Hochreiter 1994). Again, all this is assumed to be common knowledge.

The rest of this paper will concentrate on the way in which the strategy and tactics of monetary policy are now being articulated in this context. The next section documents the common adoption of price stability as the overriding priority. This does not, however, prevent the adoption of subsidiary objectives. While price stability has now been generally accepted as the dominant objective for central banks' monetary policy, the term "price stability" most often has *not* been defined, either legislatively or in practice. Some possible alternative definitions will be discussed along with the pros and cons of adopting them, including the choice of index and whether the objective should be expressed in terms of a price level or a specific rate of inflation (for example, zero).

Having thus discussed how the primary objective, price stability, may be defined, the paper then reviews certain strategic decisions about how to set about achieving this. Should there be a quantified, numerical target for price stability? If so, who should set it, the government alone, the central bank alone, or the two in conjunction? Should the government have the ability, unilaterally, to override that prior decision and, if so, through what processes? How long should the target period be? Should there be a point target or a band and, if the latter, how wide? Will a numerical target unduly constrain the ability of the central bank to react to unforeseen demand or supply shocks? What incentives are there, or should there be, for a central bank to achieve its announced targets? More broadly, what arrangements have been established to make an "independent" central bank accountable within the context of a democratic society?

Three main concerns are frequently expressed about the current penchant for mandating independent central banks to have overriding concern for the single objective of price stability. First, is this focus and mandate too narrow? Second, is the delegation of such powers to an 'independent' agent consistent with the obligations of government in a democratic society (another facet of the accountability question)? Third, is the transfer of power over monetary policy to a separate body consistent with the optimal coordination of macro-policy instruments, comprising fiscal policy, trade policy, exchange rate policy, and even incomes policy, as well as monetary policy?

The discussion then turns to tactical and operational issues. In particular, should a central bank use *intermediate* targets in its pursuit of price stability, whether or not the latter objective has also been quantified? If so, what intermediate targets are the main candidates for

adoption? In practice, monetary aggregates and exchange rates have been the two main alternatives. The relative advantages and disadvantages of both are discussed, as well as the operational difficulties of working either with intermediate targets or with none at all (that is, using monetary instruments directly for the achievement of the final objective of price stability).

The paper goes on to consider certain tactical and operational reforms and adjustments that will be required in the European Union in order to prepare for the advent of a single monetary policy, which will be carried out by the prospective European System of Central Banks within the economic and monetary union. While such reforms are, perhaps, not strictly a necessary adjunct of the move to central bank independence and enhanced autonomy as such, this latter step within Europe is going hand in hand with preparation for economic and monetary union. In particular, the paper reviews prospective changes in the form of money market operations and assesses the likely role of reserve ratios in the context of economic and monetary union.

Price Stability: The Overriding Objective for Central Banks

Since 1989, a large number of revisions have been made to central bank legislation (Table 1). Such revisions in most cases place price stability as the primary objective of monetary policy; indeed, having the opportunity to specify that requirement in legislation often was one of the main reasons for its enactment in the first place. This emphasis on price stability contrasts with earlier practice. Only in a few cases, such as the Bundesbank and the Swiss National Bank, was such legislative emphasis previously placed on price stability. In many cases multiple economic objectives were set down, and in others no explicit objectives were set. In the case of the Bank of England, for example, the Act did not mention what its economic objectives should be at all, a lacuna that Governor Towers at the time pointed out might represent a weakness for the Bank in arguing policy issues with the government, as turned out to be the case (Fforde 1992).

Given this emphasis on price stability as the overriding, primary, or in some cases sole objective of monetary policy, as laid down in (most) recent legislation, it is perhaps remarkable that only in a few cases (New Zealand and Canada, and the 1993 Swedish White Paper) is any definition given of what might be meant by that central concept. If the objective is not clearly defined, then it could be argued that it is more difficult to assess how well, or badly, the central bank is doing in achieving its objective. Moreover, many possible definitions of price stability exist, and some complex and fine technical issues are involved,

Table 1
Recent Central Bank Legislation: Actual or Prospective

Country	Date of Legislation	Objective Revised?	Primary Objective	Numerical target set for price objective?	Increase in institutional autonomy?	Increase in operational autonomy?
France	December 1993	Yes	Price stability	No	Yes	Yes
Spain	June 1994	Yes	Price stability	No	Yes	Yes
Italy	November 1993	No	Safeguarding the currency implicit	No	No	Yes (now can set reserve requirements up to a ceiling)
United Kingdom	Roll Report, 1993—Select Committee, 1993—Advocated, not accepted by Government	(Roll) Yes	(Roll) Price stability	Retail Price Index (1 to 4%)	(Roll) Yes: though slight	(Roll) Yes
Sweden	Act of 1989 and 1993 White Paper proposals (W.P.)	(W.P.) Yes	(W.P.) Price stability	Consumer Prices 2% ± 1% for 1995	(W.P.) Yes	(W.P.) Yes
New Zealand	1989	Yes	Price stability	Retail Price Index (0 to 2%)	Yes: though slight	Yes
Chile	October 1990	Yes	Internal and external stability of the currency system	—	Yes	Yes
Mexico	November 1993	Yes	Price stability	—	Yes	Yes
Czech Republic	December 1992	Yes	Stability of the currency	—	Yes	Yes
Hungary	October 1991	Yes	Safeguard internal and external value of the currency	—	Yes	Yes

Source: Central bank laws, present official proposals, U.K. Roll Report and Swedish White Paper.

for example, in deciding what index to use. So the question of definition has considerable substance, yet has been largely ducked. Nevertheless, though it has not been quantitatively defined, most central bankers reckon that they can tell *qualitatively* when such stability holds, and they frequently quote Alan Greenspan's well-known definition with approval and affirmation.

The Focus on Price Stability

At present, in only a few cases (for example, New Zealand and a proposal for the United Kingdom by the 1993 Roll Report) is the achievement of price stability (or some synonym) set out in central bank

legislation to be the sole macroeconomic objective for monetary policy. Usually the requirement is taken to be primary, or overriding, in the lexicographic sense that only when this objective is achieved can the central bank turn to its secondary objective(s). Most recent revisions of national central bank acts in Europe, and the Protocol of the European System of Central Banks, express this latter objective in a rather general fashion, "to support" and carry out its "duties within the framework of the government's overall economic policy." Since the requirement to support the overall economic policy of the current government might, taken by itself, be held to make the central bank subservient, the precise terms of the conditionality whereby price stability *must* have *first* priority, and be achieved before this secondary objective can be attempted, become important. The relevant clause in Article 105 (1) of the Maastricht Treaty and in the Protocol for the European System Central Banks and member national central banks (Article 2) reads as follows:

> Without prejudice to the objective of price stability, it shall support the general economic policies in the Community . . .

Besides their macro-objective of maintaining price stability, historically central banks also have, to some varying extent, assumed or been made responsible for the systemic stability and the successful workings of some central parts of the financial system, such as the payments system and the commercial banks that operate that system. While in some countries it is arguable that these micro-level objectives had historical and functional priority relative to the macro-level objective of maintaining price stability, in other countries supervisory powers over banks (and payments systems) are divided between the central bank and a separate agency for bank supervision, or even concentrated in the latter. The general question of whether such a split of responsibilities was beneficial or not has recently received much attention in the literature (see Bruni 1993, especially the paper by Goodhart and Schoenmaker; Chiappori and others 1991; and Folkerts-Laudau and Garber 1992). The division of views is reflected in the fact that, as shown in Appendix Table 1, three of the central banks do not have specific responsibility for the supervision of financial institutions, whereas nine do have such a responsibility.

The shift from the view that monetary policy was but one facet of general demand management whose objectives included real as well as nominal variables, to the view that monetary policy should have a single focus, to achieve price stability, has been quite remarkably widespread and rapid. It is perhaps not surprising that this change in viewpoint has been seized on quite enthusiastically by central bankers. A multiplicity of objectives implies trade-offs and choices that must be inherently political, while a single focus, or unambiguous bottom line, facilitates

central banks becoming independent, but accountable, agents of government.

But the ideas involved have also been quite widely accepted by governments and political parties of all tendencies. Right-wing parties tend to approve of the concept of an independent central bank in principle, particularly when the alternative is a central bank subservient to an opposition left-wing government. Left-wing parties are less keen on the concept itself, but recognize that the credibility gain in financial markets is important (more so than for right-wing parties). Accordingly, the most favorable condition for enacting central bank independence is when this is proposed by a left-wing government and supported by a right-wing opposition, as in New Zealand and Spain. Perhaps the most telling example is South Africa, where the African National Congress were keen to incorporate central bank independence in the interim constitution. Right-wing politicians in opposition tend to support central bank independence but often become less keen on the idea when in office, as in the case of Mrs. Thatcher in the United Kingdom.

A Variety of Objections

Much of the intellectual, academic basis for the case for an independent central bank has come from economists, building on the concepts of a vertical long-run Phillips curve, rational expectations, and time inconsistency. Yet a sizable fraction of economists, especially various brands of neo- or post-Keynesians, remain unhappy and unconvinced about such analytical concepts. Trying to provide an empirical fix for the NAIRU is often a very difficult task (see Côté and Hostland 1994 for Canada). Post-Keynesians, and others, would deny either the possibility or the practical relevance of rational expectations. The suggested behavior of governments, according to the time inconsistency argument, has only some rather limited empirical backing (Alesina 1989). Consequently, proposals for mandating central banks to focus solely on price stability have run into some opposition from economists, as was, for example, evidenced in Canada (Canadian Standing Committee on Finance 1992) and discussed in the subsequent Charlottetown Canadian Economic Association Meeting (Crow 1992).

Nevertheless, on the basis of casual empiricism, relatively little opposition has been raised to this general shift to a focus on price stability alone. One alternative frequently canvassed in the economic literature has been to target nominal incomes rather than price stability (see, for example, Hall and Mankiw 1993). This has several possible advantages. It gives some weight to deviations of output from its trend, though as Hall (1986) pointed out, the (one-to-one) weighting is arbitrary, rather than based on considerations of welfare maximization. Moreover, as Duguay notes (1994, p. 22):

There is an extensive pre-Keynesian literature arguing in effect that stabilization of nominal income would be preferred to price stability (Selgin 1990). That literature emphasized the two arguments of equity and efficiency. It pointed out that the transfer of resources between lenders and borrowers or between retired and active workers that is associated with cushioning supply shocks with price level shifts has the effect of spreading the shock more equally across individuals. A price level norm, in contrast, would shelter lenders and retired workers from adverse supply shocks, thus increasing the burden borne by debtors and active workers; it would also deny the former the benefits of favorable supply shocks. The efficiency argument stressed the short-run disruptions in economic activity associated with the nominal disturbance involved in maintaining a stable price level.

Nominal spending targets have been studied extensively in the last 10 to 15 years. Studies have shown that their adoption could have led to a considerable reduction in the variances of output and inflation from historical values; they have also consistently fared very well relative to other nominal anchors in terms of weighted average of the variances of output and inflation.

Despite these arguments for an objective defined in terms of nominal incomes rather than price stability alone, the revealed preference of most central bankers and legislators has been to specify a target purely in terms of price stability. Possibly these factors are among the considerations involved: (i) the difficulty of estimating potential trend output, and hence of deviations from that; (ii) the problems caused by the delays in, and revisions to, data on GDP and its real and deflator components; and (iii) the desire to emphasize that monetary policy and central banks are, or should be, responsible solely for nominal price variables, and not for real variables. Nevertheless, in the short run, in which contracts are fixed and expectations set, monetary policy actions do have real consequences. How far does this focus on price stability complicate and limit the short-run response of central banks to shocks of various kinds?

An argument often advanced in these instances is that some price level changes may occur whose first-round effect the central banks may want to absorb rather than reverse, for example, those caused by supply shocks of uncertain duration such as oil shocks. However, several of those countries with quantified numerical targets for retail and consumer price indices have escape clauses in the small print allowing them to disregard certain (supply) shocks such as oil/energy/food/terms-of-trade shocks (Canada and New Zealand), indirect taxes, and the direct effects on the price index of interest changes themselves. In the United Kingdom, a variety of price indices have been developed, such as RPIX and RPIY, which by construction exclude those items most subject to supply shocks. Thus, through qualifying clauses in the small print, the countries with numerical targets will usually escape any self-imposed requirement to offset through generalized deflation the direct, first-

round effect of large, specific adverse supply shocks. The possibility of adverse supply shocks affecting raw materials, oil, wheat, and the like is generally acknowledged, while the likelihood of severe adverse supply shocks to productivity in the secondary and tertiary sectors of the economy remains more contentious.

In addition, the relatively long time horizons of the inflation targets so far established give some leeway for the central banks involved to adjust their response to unforeseen supply shocks in the early years of the target period. Important issues remain: whether these factors, the small print in the contract and the long horizon, give too little or too much room to adjust to unforeseen supply shocks, and what might be the expected probability, size, and form of the shocks. We all know about oil shocks and harvest failures (and can guard against them in devising the precise form of the rule/target), but what form might adverse supply shocks take in the manufacturing or services sector? Simply specifying that there is an error term, a stochastic variable, in the aggregate supply function is not much practical use to central bankers.

Perhaps of more immediate concern, both to central banks and to politicians, is the question of coordination between policies; specifically, between the operation of monetary policy, increasingly to be delegated to autonomous central banks, and the conduct of exchange rate and fiscal policies. The political authorities have almost invariably, and certainly so in the European Union (Article 109 of the Maastricht Treaty), kept responsibility for strategic decisions about the exchange rate regime in their own hands, although tactical operations are usually delegated to the central banks (Appendix Table 1). The potential inconsistency of requiring that the central bank both achieve domestic price stability and also adhere to a *fixed* exchange rate is, however, widely understood. What is less clear is how far the central bank from the anchor country in a pegged exchange rate system, for example the Bundesbank, or the various central banks in a system of fuzzy exchange rate target bands (such as the G3 under Louvre), should adjust their open market operations or interest rates for external, as contrasted with domestic, objectives.

It remains a matter of both theoretical interest and practical concern whether central banks *can* achieve domestic price stability (even if granted complete independence from political control and autonomy over interest rate setting), should the government exhibit fiscal irresponsibility. Even so, the constitutional shift to central bank autonomy must be presumed to reduce somewhat the likelihood of such fiscal irresponsibility, because it would be more surely and quickly penalized by offsetting interest rate increases, thereby reducing the political temptation. If this is so, then while central bank independence may not be sufficient for price stability, given an irresponsible government, it must be a move in the right direction.

Strategy for Achieving Price Stability

Given this concentration on "price stability," it is somewhat surprising that this term is rarely defined, at least in the relevant Acts (Table 1). In practice, however, central banks appear to have a clearly revealed preference for the form of target for price stability that they adopt. In most cases where a numerical target has been set, whether jointly or unilaterally by government or central bank, this has been defined in terms of a band for the rate of inflation of the retail or consumer price index: for instance, the 1 to 3 percent objective for the CPI agreed between the government and the Bank of Canada and reaffirmed in 1994 for the period 1995–98 (see Freedman 1994); the 0 to 2 percent target for the RPI in New Zealand agreed between the government and the Reserve Bank, now extending to 1996; and the 1 to 4 percent target for the RPI in the United Kingdom set unilaterally by the government over the period till 1997.

In Continental Europe, however, the Exchange Rate Mechanism since its creation in 1979 has provided the main framework for the pursuit of price stability. Also, the central bank in charge of the anchor currency of the system, the Deutsche Bundesbank, has had a satisfactory experience with intermediate monetary targets, at least until very recently, sticking with these while they were being progressively abandoned or downgraded elsewhere. Consequently there has been little experience on the Continent with specific numerical targets for inflation, apart from Sweden in the 1930s and now prospectively since 1993 (Persson and Tabellini 1994). Thus, most of this section discusses issues, lessons, and questions arising from the experience of Canada, New Zealand, and the United Kingdom, countries that have adopted differing forms of such quantified inflation objectives.

Level or Rate of Change?

This revealed choice raises questions about why the target was set in terms of rates of change, rather than the price *level;* the use, and width, of bands rather than points; the choice of index; the horizon; and the identity of the target setter, government, and/or central bank. The first question, whether to set a target for rates of change rather than for levels, was probably largely decided in terms of the initial context of continuing, though falling, inflation. The objective of achieving a given price *level* during the transition toward obtaining virtually zero inflation just seemed too daunting and deflationary. Several recent papers (Lebow, Roberts, and Stockton 1992; Scarth 1994; Fillion and Tetlow 1994; Duguay 1994) present academic arguments for preferring a target in terms of levels rather than rates of change, as an equilibrium condition after the transition to approximately zero inflation has been

reached. Since bygones are bygones under the latter, the longer-term variance, and hence uncertainty, about prices is greater. The expectation that an unforeseen price change shock will be reversed in due course, once credibility in the regime of price level stability has been attained, would make the system more self-stabilizing.

Apart from the decisive argument about one step at a time in transition, arguments against moving to a constant price level target include the belief/argument that a small, but positive, bias exists in estimates of price inflation, perhaps some 0.5 to 0.6 percent per year, owing, for example, to systematic improvements in goods' quality (Crawford 1993; Hershey 1994). It is also argued that it may be better to err on the side of a small positive inflation, rather than an equally small deflation. This may be because of some extra rigidity over reducing *nominal* wages, or because the zero lower bound to nominal interest rates makes it more difficult to lower real interest rates at zero, or negative, inflation rates (see Lebow, Stockton, and Wascher 1994; Crawford and Dupasquier 1994). None of these arguments, however, really provides a good case for preferring *inflation* to price *level* targets, since the latter could be set in terms of a constant positive upward trend (with bands, perhaps) to take account of any argument about bias, lubricant, and the like.

Band Width?

As already noted, the inflation target is expressed in terms of a band, typically of a 2 or 3 percent width. This is small relative to the historical standard deviation of inflation in most countries, and it implies that targets could quite often be missed despite the central bank's commitment and best efforts. Of course, a disadvantage of a point target is that it is virtually certain to be missed, and the finer details of the extent of that miss may not be readily communicable to the wider public. Whether by luck or good management, numerical targets in the United Kingdom, New Zealand, and Canada have so far been met; it may be that changing the constitutional regime for monetary policy may also change the performance of the system. Be that as it may, the selection of band width involves a trade-off between the credibility-enhancing effects of choosing a quite demanding target and the credibility-damaging effects of failing to adhere to it.

Horizon

Monetary policy, in the guise of changes in interest rates, first affects financial variables and asset prices, then after a short lag financial flows, and next, output; finally it impinges on generalized current goods and services inflation, with this last link involving long and variable

lags, perhaps some six to eight quarters. Given such lags, a numerical target for price inflation, relevant to current monetary policy, has to be set some two years or more into the future. This has been the case in the United Kingdom, New Zealand, and Canada, with the additional twist that the target has been revised (extended in time, but not to date raised) by a newly elected government, in New Zealand with the election of the National Party in 1991 and in Canada with the election of the Liberals in 1993. Again, there is a trade-off between not having the target so close that monetary policy hardly has time, given the lags, to affect prices, and not having the target so far ahead that it ceases to seem immediately relevant to decision-makers. And again, the consensus seems to be that the minimum initial horizon should be at least two years, and the maximum some four or five years hence.

Given the lags involved, the central bank will need to know what its next target will be before the first expires. So a successor target needs to be set for the subsequent period at least a year before the first is completed. Nevertheless, the old target need not be dropped altogether, once the next target is set. It is desirable, in order to maintain accountability, that a central bank's success, or otherwise, be assessed regularly in terms of the outcome against the completed, full target objective. The relatively long length of the target period allows the central bank some flexibility to respond to unforeseen shocks in the early years, but the need to meet the final deadline target becomes increasingly constraining over time. Remember, however, that the small print in many cases allows central banks to avoid having to offset the direct effect of major adverse *supply* shocks (beneficial supply shocks being an uncovenanted benefit), while *unforeseen demand* shocks should be offset. Some of those who criticize this policy approach of giving overriding priority to price stability do so because they believe that it both results in unduly deflationary policy and prevents the central bank from responding to (downward) deviations of output from trend. Neither extending the target horizon nor rolling the target forward each year (so it is never completed) would much assuage their concerns, however, while it would potentially weaken the credibility and commitment of the central bank to beat inflation.

Which Index?

One of the technically more complex questions is which price index to use. Revealed preference to date indicates that this will be the RPI or CPI, both widely used and understood, promptly calculated, and rarely revised. On all these counts either is preferred to the GDP deflator. Nevertheless, concern with supply shocks, most likely to emerge in food and energy prices, and with indirect taxes and the effects on the index of changes in interest rates themselves (for example via mortgage

payments on housing), have led to a variety of alternative versions of the RPI being deployed (see the Bank of England "Inflation Report"). One concern, raised by Alchian and Klein (1973) and taken on by Shibuya (1992), Shigehara (1990), Schinasi and Hargraves (1994) and Goodhart (1993), is that the RPI/CPI covers only prices of the current flow of goods and services; it excludes any coverage of present changes in the prices of future goods and services. When housing and property prices, for example, went through their recent cycle of boom and bust, should not central banks have taken such asset price movement into account in their assessment of the underlying rate of inflation? At the Bank of Japan Conference (October 1993) when this subject was discussed, the consensus was that central banks *should* take asset price movements into account, but in a discretionary, qualitative manner, if only because asset prices tended to be more flexible than, and hence to lead, wages and prices of goods and services. But little support was voiced in that discussion for formally incorporating asset prices into an extended price index, in some cases because of theoretical objections, but more generally because such asset prices were so volatile and noisy, being subject to sharp shifts in tastes and preferences.

Who Sets the Target?

An important constitutional issue is who should be responsible for setting any quantified numerical target. For the government to do so unilaterally, as occurs currently in the United Kingdom, underscores the dependent position of the central bank and would, therefore, be inconsistent with a preference for a more autonomous and independent bank. But some well-balanced arguments have been presented both for having the numerical target jointly agreed, as in New Zealand and Canada, and for allocating that responsibility to the central bank alone. It was one of the key subjects of discussion in the Roll Committee Report in the United Kingdom, which finally came down in favor of having the central bank set its own targets unilaterally, largely on the grounds of the potential time inconsistency of politicians; thus, the Report states (1993, p. 32):

> [W]e believe that UK monetary policy needs greater independence than can be achieved through any system in which ministers have operational responsibility for framing targets. Our design attempts to achieve this by assigning ultimate responsibility for choice of targets to the Bank alone (though of course it would discuss, and normally agree, those with ministers), and by leaning as heavily as we can on transparency in two ways. First, although the government and Bank could announce that they believed different target ranges for inflation appropriate at any particular time, itself a signal likely to place government policy under close public scrutiny, the only recourse to a government determined to have its way would be the highly visible step of

suspending the Bank's sole objective; the Bank could not be undermined simply by the government's persistent challenge of its target settings.

In response it may be argued that, were the government in a position to query or criticize the bank's choice of target, it would seriously undermine the latter's credibility, since it would lead people to wonder whether the central bank's independence might be abrogated by a future revision to the law. What one government enacts, another can repeal. Having, instead, the government and central bank jointly set the target commits the former to the stated objective, and makes it harder for the government to criticize the means whereby the bank achieves the agreed end. So the joint nature of the target-setting process may enhance its credibility.

It is, however, arguable that, since an opposition party's task is to oppose, it may be *more* likely to commit itself against continuation of a policy of price stability if the latter is represented by the government's target than if it is the responsibility of the bank alone to set it. The point is debatable. Again, some may question whether the government, if party to the agreement, might not set the target too lax, on political time inconsistency grounds. On the other hand it would be difficult for a government publicly to raise the target inflation rate; even the newly victorious Canadian Liberal Party, who had had their reservations about Governor John Crow's policies, stuck to the same target rate when extending the period forward to 1998. Moreover, if the payment to senior bank officials, or their reappointment, were to rest on achieving their inflation target, they too could have an incentive to set numbers that were too easily achievable, rather than too demanding.

Incentives and Structure

In any case, this discussion raises the question of what the incentive structure for the governor and the board of the central bank should be. Under the Reserve Bank of New Zealand Act, it is implied that failure to achieve the agreed target would result in the Governor not being reappointed. While this may have some considerable incentive effect, it will be less so if the Governor is reaching retirement age. Moreover, the incentive/threat is not easily, or finely, calibrated; one would hardly dismiss for a miss of 0.1 percent, but then what extent of failure would justify refusal to reappoint? It would inevitably be both uncertain and arbitrary. Finally, this incentive is applicable only if final responsibility for central bank outcomes rests in the sole person of the governor. While this concentration of responsibility on one person has the benefit of transparency, it does make that individual the focus for personal and political pressure.

Such pressure can be much more easily deflected if responsibility

for decisions lies with a larger directorate, committee, or board. When the Banque de France was made independent (1993), responsibility for monetary policy-making was transferred from the Governor to a Monetary Policy Council. On the other hand, one can hardly sack a whole board. One could, perhaps, have the votes and decisions of individual board members publicly recorded, and then not reappoint those who had, ex post, been judged to have voted too often the "wrong" way. But that too would be an arbitrary and messy exercise.

A simpler alternative would appear to be to set the payment for those responsible for policy, for example the board members, dependent on their success in achieving the target. With the single focus on price stability, and its transformation into a numerical target, success and failure can be readily calibrated and (bonus) payments provided accordingly. This straightforward idea has now been granted academic support in several papers by Walsh (1993 and 1994a and b) and by Persson and Tabellini (1993 and 1994). The last two authors state (1994, p. 11) that "the optimal contract can be interpreted as a mandate to achieve price stability. The central bank is punished . . . for any percentage point of inflation. Essentially, by punishing *ex post* the central bank for realized inflation, this contract adds a cost that the central bank has "forgotten": the cost of higher expected inflation. . . . the inflation bias [of the central bank] . . . can be corrected simply by adding the correct marginal cost of inflation to the central bank's *ex post* social welfare function." Indeed, the authors castigate researchers in this field for not having seen this contractual approach before now, stating, "We find it remarkable that the contractual solution to the problem is so simple and that researchers, including ourselves, working in the field have failed to see it."

One of us, in 1989, when acting as an adviser to the Reserve Bank of New Zealand, had indeed advocated such a system of payment for the Governor, depending on results. For a time it was quite widely believed that such a bonus payment system had actually been adopted there, but it was in fact rejected during the preliminary discussions. The reason was primarily presentational. There was worry, especially at the Treasury, about the possibility of headlines representing that "Governor makes $500,000 by throwing 500,000 out of work." Perhaps, once again, this is an issue that may be reconsidered when the transition to (almost) zero inflation has been achieved, so that the balance of policy need not be quite so deflationary as during the transition.

An argument often given against central bankers being paid by their results is that the final outcome, and hence their payment, would be affected by various (short-term) shocks over which they have no control. Indeed so, but the impact of some supply shocks can be, and has been, expressly excluded from the contract, as has already been described. More generally, businessmen and company profits are similarly buffeted

by unforeseen and uncontrollable shocks, and no one suggests that this is a valid reason for dispensing with profit-related compensation for business leaders. Once the bottom line is clear and calculable, remuneration can be related to its achievement.

One possible concern, however, is that the inducement to hit the final numerical target is already so great, and the uncertainty of being able to achieve it so large, that central bankers may try to get inflation down to the target level in advance of the terminal year, to give themselves the best chance of a relatively easy run in the final year.[4] Thus, the incentives for central bankers may already be to shorten and tighten the transition period, possibly excessively so, once numerical targets are introduced, even without the bait of a bonus payment. Certainly the structure and design of incentive arrangements for central bankers in this new context need careful thought.

Accountability

This leads on to the rather wider question of how an independent central bank can remain democratically accountable. Once again it is the focus on a primary single objective, price stability, that enables accountability to be allied, as a complement rather than a contradiction, with "independence," especially if that price stability objective is expressed in a quantified numerical target, and the target to be achieved, or at least the procedures involved, have the blessing of the government. In such a case, choices between alternative objectives, which are inherently political choices, are minimized. Society, acting through its elected bodies, has specified quite closely what its agent, the central bank, is to aim to perform. All that remains is to report, usually to the legislative body, how well the bank has carried out this task.

In truth the democratic accountability of an "independent" central bank, mandated to the achievement of price stability as its overriding objective, is both far greater and much more transparent than that of a subservient central bank, charged with trying to make trade-off compromises between a variety of objectives under the tutelage of a political master. It is odd that the issue of accountability has been raised as an argument against such central bank "independence," whereas properly seen it is an argument in favor of such autonomy. The true, underlying issue is rather whether the single, overriding focus on price stability is, indeed, optimal.

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[4] Both Governor Don Brash of New Zealand and Governor John Crow of Canada brought inflation down rapidly to, or below, the rate specified in the agreement a year before that was required.

Strategic Issues in the Use of Targets

A subservient central bank does not need a target, at least on its own accord, since it will be carrying out the wishes of its political masters, who may or may not establish targets for themselves. An independent and autonomous central bank, on the other hand, has a greater need for some, preferably quantified, target objective, to provide both greater transparency and a basis for accounting for its actions as agent. Once again, we emphasize the close linkage between having a single main focus for monetary policy, price stability, and the case for making the bank into an independent agent. It is, therefore, assumed that an independent central bank will want a publicly announced target to be established for itself.

Such a target can be either for a final or for an intermediate objective. The final target now almost universally chosen by central banks is price stability and, for those banks directly targeting on this final objective, this has mapped into specific numerical targets for the inflation rate of the RPI/CPI. Few banks now target final objectives directly, with only one so far, Sweden, in Continental Europe. Instead, the majority of other central banks in this study's sample use intermediate targets, mostly pegging their exchange rate within the Exchange Rate Mechanism or prospectively so at some future date.

This section will first consider the comparative advantages and disadvantages of having a publicly announced target for the final objective rather than for an intermediate variable. Of course, central banks targeting directly on inflation, via the RPI or CPI, may also have subsidiary targets for intermediate variables such as exchange rates (New Zealand is an example), which may or may not be announced or otherwise publicly known. Equally, countries mainly targeting on intermediate variables, such as Germany or Switzerland, will adjust their response to the outcomes of those targets by their perceptions of the concurrent and future course of inflation itself. Nevertheless, it is usually clear enough which is the main target, and this is set out for the countries in this sample in Table 1 and in Table 2 (below). Next, the relative advantages and disadvantages among the possible intermediate targets will be considered, of which exchange rates and monetary aggregates have been the main, but not the only, candidates.

Final versus Intermediate Targets

Insofar as the final objective of almost all central banks is to achieve price stability, and this concept is capable of reasonable measurement, then the simplest and most obvious route would seem to be to target that objective directly. If this outcome is what we want central banks to achieve, then what can be done to set up a target system and an

incentive structure that will maximize the chance of them doing so? Proponents of this approach would argue that concentrating instead on some intermediate variable, such as the money stock, introduces complexity, since the links between monetary changes and price inflation are variable, and reduces transparency and understanding, since the relevance and significance of somewhat arbitrary monetary aggregates will be far less clear to the general public than the concept of inflation and price stability. Persson and Tabellini express the same thought, in more formal and rigorous terms (1994, pp. 14–15):

> [I]t is clear that the inflation contract is more direct and simpler to enforce [than an intermediate target]. . . . Hence, a contract based on an intermediate monetary target is much more demanding on the principal's information compared to an inflation contract. . . . Generally, the principal finds it easier to monitor the outcome rather than the policy instrument, because the optimal instrument choice depends on detailed information which may not be available to the principal. We are thus led to a general conclusion. An inflation contract . . . minimizes the informational requirement of the principal and thus generally dominates contracts based on intermediate monetary targets or directly on the policy instrument.

Yet despite such arguments, relatively few central banks employ direct inflation targets, and those, mostly recently. A much larger number of central banks employ intermediate targets, as Persson and Tabellini recognize. One reason for this may have been historical accident, depending on the actual temporal evolution of ideas and operations in the field. Thus, the widespread consensus on focusing on the single objective of price stability is quite recent. The adoption of such a single intermediate target, for the exchange rate or for monetary aggregates, may have allowed the central bank to work to a single target—and hence enhance its independence and autonomy—at an earlier date when the views of the general public, or of politicians, on the choice of final objectives made autonomy a more contentious matter.

A much more substantive argument in favor of intermediate targets, which Persson and Tabellini also note, is the much longer lag between policy action and inflation than between such action and effects in financial markets. Thus they ask (1994, p. 15):

> Why do we see exchange rate targets or monetary targets often imposed (or self imposed) on central bankers, but rarely see central bankers accountable for the rate of inflation? One reason[5] may have to do with the commitment

[5] They also propose a second reason. They suggest that the central bank may be risk averse, and therefore "clearly prefers a contract contingent on the money supply or some other easily [sic!] controllable nominal anchor, rather than an inflation target, which it will

> technology available to the principal. The effect of policy actions on asset prices or the money supply is readily observable. [This is an assertion that we would dispute, ourselves.] The effect on prices is observable only with substantial delay. It may thus be harder for society to commit to "punishing" a central bank for actions undertaken six months or a year ago. [Again, we regard this as an underestimate of the problem; the lag may be twice as long.] If the central bank deviates from a financial target the penalty is more immediately related to the policy actions. It may therefore be easier to sustain such penalties than in the case of inflation targets.

Such long lags between action and inflation outcome undoubtedly complicate the working of a direct inflation target. The case for an intermediate target is that this could provide a much earlier signal whether policy is being appropriately applied, as Benjamin Friedman has pointed out in earlier classic papers (and in Friedman 1990).

Given these long lags in the effects of monetary policy on the final objective, price stability, and the uncertainties thereby involved, central banks are bound to pay attention to the development of key intermediate variables such as monetary aggregates. But how much attention should be paid to each variable, and whether one or more should be elevated to the level of target, as contrasted with the rather more flexible concept of informational variable, will generally depend on the perceived constancy and reliability of the relationships involved. Such perceptions have varied over time, and between countries.

If an intermediate target is to be adopted, which might be best? Three possibilities will be reviewed: an interest rate target, an exchange rate target, and the best selection from a range of possible monetary aggregate targets.

Interest Rate Targets

The short-term interest rate has the advantage that it is the main policy instrument used by the central bank; changes in it are the result of policy decisions (primarily) and are instantaneously and accurately measured in nominal terms. But the problem is that the relevant measures for affecting the economy are real interest rates and some interest differentials. These either are measured very uncertainly because of the problem of observing heterogeneous expectations, or are subject, as in the case of interest differentials, to structural change; their

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miss more frequently." The validity of this argument is doubtful. First, the intermediate targets, either monetary aggregates or exchange rates, are not, and have not proved to be easily controllable. Indeed, actual experience with hitting inflation targets, to date, has been much better than with monetary targets; the Exchange Rate Mechanism has also had its difficulties. Second, it is doubtful whether central bankers, as a group, have withdrawn from accepting appropriate targets just because of the problems of hitting them.

effect on either financial flows or final expenditures is uncertain and time-varying. Here again, there is a general consensus that estimates of real interest rates and of certain key interest differentials (such as the slope of the yield curve) should be important information variables for central bankers, but that they are not well suited to act as intermediate targets.

Exchange Rate Targets

The intermediate target variable most commonly used in Europe has been the exchange rate. As shown in Table 2, most European countries have made this their sole or main target. The comparative success of the Exchange Rate Mechanism, at least until 1992 and 1993, and the aspirations of other European countries outside the Community to become full members in due course and in the meantime to peg their currencies to the ECU or the deutsche mark, have been responsible for the popularity of exchange rate intermediate targets.

They have many virtues as such. Exchange rates are accurately and immediately measured; they respond instantaneously to changes in interest rates; they are widely understood by the public; and they have a general and broad impact on the economy, depending on the degree of openness. By pegging to the currency of another country/central bank with credibility in the pursuit of price stability, the international commitment involved can lead to a quicker and greater transfer of anti-inflationary credibility than attempts to establish a domestic reputation singlehandedly. Even where a country has determined to follow a domestic price/inflation target directly, it may still, as in the case of New Zealand, regard the exchange rate as such an important determinant and signal of future inflationary pressures that it will establish an (informal) operational target for the exchange rate: Thus the Reserve Bank of New Zealand will vary interest rates up (or down) if a trigger point (which they decide for themselves) is reached. Such trigger points, one way or another, usually become known in markets.

Some versions of such intermediate targets, notably currency board systems, as in Argentina (since 1991), Estonia (since 1992), and Hong Kong (since 1983), may have the added advantage of distancing the determination of monetary policy from domestic political control. Such currency boards may be viewed as a way of transferring monetary policy to an independent central bank, in this case foreign rather than domestic.

The disadvantage, of course, as was clearly evident in Europe in 1992 and 1993, is that the monetary policy best suited to the leading, anchor country may not be appropriate, at any rate in the short run, to the countries pegging to it, for example, because of large real asymmetric shocks. The problems of the Exchange Rate Mechanism following

Table 2
Monetary Policy Strategies in the European Union

Present Intermediate Target	Comments and Recent Changes
A. Exchange rate–ERM	
Belgium/Luxembourg	—
Denmark	Supplemented by domestic credit target in 1991 and 1992.
Ireland	—
Netherlands	Supplemented by domestic credit targets in 1990–1992.
Portugal	Between 1987 and 1992 broad money targets set. The exchange rate became the only intermediate target following the entry of the escudo into the ERM in mid 1992.
B. Exchange rate–ERM supplemented by broad money	
France (M3)	The exchange rate has been the primary intermediate target since 1979 when the ERM was created.
Spain (ALP)	The exchange rate has been the primary intermediate target since 1989 when the peseta entered into the ERM. Before that, broad money had been the monetary target since 1977.
C. Broad money	
Germany (M3)	Monetary targets set since 1974. The exchange rate is an important policy indicator.
Italy (M2)	The exchange rate ceased to be the primary intermediate target following the exit of the lira from the ERM in September 1992.
Greece (M3)	The exchange rate is an important policy indicator.
D. None	
United Kingdom (Inflation targeted directly)	The exchange rate was the main intermediate target while the pound was in the ERM between October 1990 and September 1992. At present, monetary aggregates and the exchange rate are only used as information variables.

Source: Central banks' reports.

German reunification are well known. Another example has been the need for Hong Kong to keep low, U.S.-level nominal interest rates in order to maintain "the link," at a time when its participation in the surging economy of Southern China has led to a booming economy and moderate inflation.

Yet, as these examples also indicate, the advantages of an exchange rate link to a stable central economy are so considerable that, despite the manifold 1992–93 problems for the Exchange Rate Mechanism, most

countries in Europe retain that link as their main objective. Hong Kong also remains determined to keep the link with the U.S. dollar. And, of course, the advantages of proceeding from stably linked currencies to monetary union within Europe are still seen as a prize to be achieved as soon as practicable.

Some circumstances and conditions are conducive to the use of the exchange rate as an intermediate target (for example, for smaller, open countries with poorer reputations for price stability) and a desire for enhanced economic and political union with their neighbors. In other circumstances (such as larger, more closed economies subject to asymmetric shocks, with no expectation or desire for greater union) an exchange-rate intermediate target would clearly be inappropriate. This leads to a brief consideration of the use of monetary targets, primarily within the European context.

Monetary Targets

In line with what happened in other parts of the world, since the mid seventies a number of European countries have relied heavily on monetary aggregates to formulate their monetary policy. Monetary aggregates thus became the intermediate target of monetary policy. The best-known and paradigmatic example in using monetary targets is Germany, but other countries such as France, Italy, Spain, and the United Kingdom (until 1987) established and publicly announced annual ranges for the growth of a selected monetary aggregate—typically a broad aggregate.[6] The practice of publicly announcing monetary targets has continued to the present in the first four countries, including the periods when their currencies have formed part of the Exchange Rate Mechanism (Germany and France since 1979; Italy from 1979 to September 1992; and Spain since June 1989).

By European standards, these countries have relatively large and not so open economies (Table 3). In contrast, small open economies like those of Belgium, Luxembourg, Ireland, the Netherlands, and Denmark have relied primarily on the exchange rate as the intermediate target of monetary policy. Portugal set monetary targets in the 1987–92 period, but it has recently shifted exclusively to setting exchange rate targets, following the entry of the escudo into the Exchange Rate Mechanism in mid 1992. (Table 2 summarizes the monetary policy strategies currently adopted in the European Union.)

But why did Germany, France, Spain, and Italy adopt monetary targets in the first place? In the mid seventies, industrialized countries

[6] In addition to these countries, Greece has been setting monetary targets uninterruptedly since the mid eighties.

Table 3
(A) Economic Size of European Countries
in order of increasing percent of total GDP of European Union[a]

Luxembourg	.1
Ireland	.7
Greece	1.5
Portugal	1.6
Denmark	1.7
Belgium	3.2
Holland	4.7
Spain	9.0
United Kingdom	17.6
Italy	18.1
France	19.2
Germany[b]	22.7

[a] 1990 GDPs converted at PPP rates.
[b] Before unification.

(B) Degree of Openness in European Countries
in order of decreasing percent of openness

	Total[a]	Intra-European Union[b]
Belgium/Luxembourg	60	50
Ireland	52	50
Netherlands	49	40
Portugal	34	20
Denmark	26	14
Germany	25	16
Greece	21	12
United Kingdom	20	10
France	20	13
Italy	16	9
Spain	14	7

[a] (Imports + Exports/2)/GDP in 1990.
[b] Intra-European Union exports/GDP in 1990.
Source: Eurostat.

were going through a period of high inflation and inflationary expectations, following the occurrence of supply-side shocks. At the same time as inflation worries mounted, shifting inflationary expectations made nominal interest rates less useful as policy guides, and thus the attention of central banks turned to monetary aggregates. Central banks found that monetary targets provided a considerably simpler and more transparent way of formulating monetary policy, one that could limit the room for discretion within the year, favorably influence the inflationary expectations of the public by providing a medium-term reference, and permit the central bank a higher degree of de facto autonomy in pursuing the final goals of monetary policy.

More precisely, when reading through the many central bank reports and speeches given by officials over the years to explain this strategic choice, one comes up with several reasons why some European central banks have been using monetary aggregates as intermediate targets (see also Bernanke and Mishkin 1992). In particular, these rest on the following beliefs: Monetary aggregates are linked in a rather stable and predictable manner to the medium-term evolution of nominal variables. They can be controlled by central banks within reasonable limits, and they are helpful in conveying information to the public about the medium-term orientation of monetary policy. Since they are within the scope of monetary policy, they facilitate monitoring by the public, and they allow a better division of responsibilities between the central bank and the government, thus avoiding external political pressures on monetary policy.

From the above description, it is clear that the reasons behind the choice of monetary targets square well with those given by the models of optimal monetary policy in the tradition of Poole (1970). That is, monetary targets are suitable when the shocks affecting the economy come mainly from the demand for goods. In these cases, the evolution of monetary aggregates is more closely connected to that of the final variables, and by controlling money the deviations of final variables from their targeted values are minimized. Furthermore, it is only under these circumstances that the potentially favorable game-theoretic and expectational effects from setting monetary targets, described above, are also obtained. In particular, as Englander (1990) suggests, when the monetary aggregate chosen is not linked in a stable and predictable way to the final variables—as a result of unforeseen velocity shocks—this has very unfavorable effects on the public's expectations. In particular, a strategy of refusing to accommodate velocity shocks in order to earn anti-inflationary credibility would result in misses regarding the final objective; and full accommodation would run the risk of undermining the usefulness of monetary targets in the first place as a device to influence the public's expectations.

Over the years, and as economic integration progressed, many European central banks came to the view that membership in the Exchange Rate Mechanism could be an important way of fostering anti-inflationary credibility through the linking of their monetary policies to that of Germany, whose central bank enjoyed the best anti-inflationary reputation. As a result, in some European countries, generally those with smaller and more open economies, the exchange rate became the intermediate target for monetary policy. In larger, relatively less open economies like France, Italy, and Spain, while the institutional constraints associated with Exchange Rate Mechanism membership clearly placed the exchange rate at the center stage of monetary policy, thus becoming the primary intermediate target, monetary authorities

continued to set monetary targets. Therefore, it can be said that, in practice, these latter countries have set both exchange rate and monetary targets, although with the increase in international capital mobility the exchange rate has become the central target of monetary policy, as will be discussed in the next section.

Operational Issues for Targetry

The Operation of Direct Inflation Targets

The main problem in successfully managing a system of direct inflation targets arises from the combination of long lags in the effect of monetary policy and uncertainty, both about future shocks and, more importantly, about the structure of the economic system itself, especially the precise effects of changes in monetary policy instruments on the economy. Without such uncertainty, policy could be set now to deliver an expected future rate of inflation with some degree of confidence. Without the lags, policy could be varied, despite the uncertainty, until the designated inflation rate was achieved. Given such lags, the attempt to use monetary policy to the extreme to force a given change in inflation in the shorter run might prove impossible and would cause instrument instability whereby interest rates could become explosively unstable, as almost seemed at one time to be happening in the United States in the 1979–81 period. Many, and perhaps the most severe, of the problems of operating monetary policy are caused by such lags, especially in the case of direct price inflation objectives.

In these circumstances, an enormous weight of responsibility rests on the shoulders of the chief economic forecaster in the central bank, charged with the duty of forecasting what inflation rate could be expected, on an unchanged policy assumption. This responsibility will be even more onerous if the forecaster is also asked to project what policy change now will be needed to drive future inflation into line with the target. The accuracy of those forecasts will be crucial to the success of the central bank in meeting its mandate. Moreover, the standard problems of inflation forecasting almost certainly will be exacerbated by the Lucas critique in this case. The wage/price decisions of agents will be affected, in ways that are difficult to predict in advance, by their perceptions of how the new regime may itself operate. The role of chief economic forecaster in central banks adopting this regime is not enviable.

Perhaps because of these problems, some tendency has been apparent in both Canada and New Zealand for the central bank to press ahead with getting inflation down to, or below, the target level rather in advance of the agreed horizon. If the Bank of England were more autonomous, it might wish to do the same. Whereas the hypothesis

about the inflationary bias of the monetary authorities is well known from the time consistency literature, we would tentatively suggest that an independent central bank with an overriding priority to achieve a numerical target for inflation might have a transitional deflationary bias.

The Operation of Exchange Rate Targets

The main problem, of course, with exchange rate targets is that the nominal interest rates needed to maintain the exchange rate link may represent a real interest rate unsuited to the peripheral country, for example, because of asymmetric shocks. Indeed, when this syndrome becomes particularly acute, as in the Exchange Rate Mechanism in 1992 and 1993, adjustments in nominal interest rates may even become ineffective in influencing capital flows and maintaining the exchange rate, because the resulting real interest rate is perceived by markets as domestically unsustainable. There were even occasions during that prolonged crisis when increases (decreases) in interest rates had a perverse effect in causing depreciation (appreciation) in the exchange rate, for this reason.

The normal response in such cases, where one instrument, the interest rate, is asked to achieve two mutually inconsistent objectives, is to try to find another instrument. One proposal, by Eichengreen and Wyplosz (1993), has been to revert to some version of exchange controls in order to keep interest rates at levels more appropriate domestically. Another alternative is to try to offset the deleterious domestic effects of inappropriate real interest rates by other measures and instruments. However, the attempt to find alternative instruments to ease the policy strains has not been markedly successful. The conceptual and practical shortcomings of any attempted reimposition of exchange controls are well-known, and the attempt to offset inappropriate interest rate levels by an adjustment in fiscal policy (or by variations in direct credit controls) runs into other, again well-known, problems. It is such difficulties that make many commentators skeptical that a pegged, but adjustable, exchange rate regime can represent a stable equilibrium in a world of free capital movements, in the absence of close policy coordination. Such considerations are influencing views and attitudes toward both the speed of achieving, and the optimal transition path to, economic and monetary union.

The Operation of Monetary Targets

In practice, the main operational issues surrounding the implementation of monetary targets concern the choice of monetary aggregate; the reference period over which it is set; the speed with which deviations from target are corrected, if at all, during the year; and whether base

drift should be allowed. In order to guide their decisions concerning the above issues, central banks normally make use of the information contained in other monetary, financial, and economic variables. This tends to blur, in practice, the difference between the "one-step" and "two-step" approaches to monetary policy. In particular, by letting the growth of monetary aggregates differ from mid-point target ranges in response to well-identified disturbances, central banks can hope to conduct policy with few informational inefficiencies and nevertheless still benefit from favorable expectational effects but, to be successful, this depends greatly on their prior reputation and credibility.

Important operational issues also arise when central banks try to influence the course of monetary growth in the desired direction. For instance, the remuneration at market rates of certain components of the targeted monetary aggregate may make it difficult to reduce monetary growth, say, by increasing official interest rates, and may, at times, actually have the opposite effect. In addition, when international financial markets are closely integrated, countries in the Exchange Rate Mechanism trying to reduce monetary growth through contractionary liquidity operations may easily see their attempts frustrated by inward capital flows.

The economic effects of adopting monetary targets may thus depend significantly on how they have been implemented in practice. In order to assess how flexible the conduct of monetary targets has been in Europe, information on the targeted and actual money growth rates of Germany, France, Italy, and Spain is shown in Table 4. As is clear from the table, elements of short-run flexibility have been present in the management of monetary targets: Targets have generally been expressed as ranges rather than as a single value; on many occasions, the recorded monetary growth has been within the range but not close to the mid-point; at times, targets have been undershot or overshot; base drift has been significant; and the specific monetary aggregate playing the role of intermediate target has changed over time as financial innovation has evolved.

All in all, monetary aggregates have played a useful role in the pursuit of anti-inflationary monetary policies in the above countries during many years. However, their interpretation has become increasingly complex as a result of the ongoing processes of financial innovation and deregulation, and their controllability more precarious in an environment of exchange rate stability and free capital mobility.

As regards financial innovation, the new cash management techniques used by firms adapting to the possibilities of an increasingly sophisticated and deregulated financial environment, and the shift of household financial holdings towards remunerated liquid assets, have provoked important changes in the sectoral composition of monetary holdings. This has led to an increasing difficulty in interpreting the

Table 4
Targeted and Actual Money Growth

Germany					France				
Year	Variable	Target	Outcome	Comments	Year	Variable	Target	Outcome	Comments
1975	Central Bank Money	8	10.0	M+					
1976		8	9.2	H					
1977		8	9.0	H	1977	M2	12.5	13.9	H
1978		8	11.5	M+	1978		12	12.2	H
1979		6–9	6.3	H	1979		11	14.4	M+
1980		5–8	5.0	H	1980		11	9.8	H
1981		4–7	3.5	M−	1981		12 (rev)	11.4	H
1982		4–7	6.1	H	1982		12.5–13.5	11.5	M−
1983		4–7	6.8	H	1983		9 (rev)	10.2	H
1984		4–6	4.6	H	1984		5.5–6.5	7.6	M+
1985		3.5–4.5	4.5	H	1985	M2R	4–6	6.9	M+
1986		3.5–5.5	7.8	M+	1986	M3	3–5	4.6	H
1987		3–6	8.0	M+	1987	M2 (new)	3–5	9.2	M+
1988	M3	3–6	6.7	M+	1988		4–6	4.0	H
1989		5	4.7	H	1989		4–6	4.3	H
1990		4–6	5.6	H	1990		3.5–5.5	−.5	M−
1991		3–5 (rev)	5.2	M+	1991	M3 (new)	5–7	3.8	M−
1992		3.5–5.5	9.4	M+	1992		4–6	6.0	H
1993		4.5–6.5	7.5	M+	1993		4–6.5	−.9	M−
1994		4–6			1994		5		

Italy					Spain				
Year	Variable	Target	Outcome	Comments	Year	Variable	Target	Outcome	Comments
1975	Domestic Credit	13.9	12.5	H					
1976		16.7	18.8	M+					
1977		16.0	17.8	M+					
1978		19.5	20.8	H	1978	M3	14.5–19.5	20.3	M+
1979		18.6	18.7	H	1979		15.5–19.5	19.4	H+
1980		17.7	18.5	H	1980		16–20	16.1	H
1981		16.1	18.1	M+	1981		14.5–18.5	15.7	H
1982		15.5	20.9	M+	1982		13.5–17.5	15.3	H
1983		18.0	20.7	M+	1983		11–15	12.8	H
1984		15.9	19.7	M+	1984	ALP	11.5	14.5	H
1985		16.1	18.1	M+	1985		11.5–14.5	14.3	H
1986	M2	7–11	9.6	H	1986		9.5–12.5	12.4	H
1987		6–9	8.6	H	1987		6.5–9.5	13.1	M+
1988		6–9	8.9	H	1988		8–11	13.4	M+
1989		6–9	11.3	M+	1989		6.5–9.5	12.8	M+
1990		6–9	9.9	M+	1990		6.5–9.5	11.4	M+
1991		5–8	9.0	M+	1991		7–11	10.9	H
1992		5–7	5.9	H	1992		8–11	5.2	M−
1993		5–7	7.8	M+	1993		4.5–7.5	8.6	M+
1994		5–7			1994		3–7		

Notes: H/M: target hit/missed. When single-value target, it is assumed an implicit range of ± 1.5%; +/−: monetary above/below target; rev: target revised during the year.

Source: Central banks' reports.

evolution of monetary aggregates, as testified by the reduced stability of demand for money functions (see Fase 1993). Finally, in Europe, the process of financial innovation has been accelerated, most recently through the introduction of financial legislation associated with the establishment in 1992 of the Single Internal Market. In particular, banks from member states have been allowed to do business without restrictions throughout the European Union.

The other major development affecting the implementation of monetary targets in European countries has to do with the constraints imposed by the Exchange Rate Mechanism. As mentioned earlier on, Germany has traditionally played the anchor role in the System; that is, the Bundesbank has freely set German monetary policy, and the other countries have adapted their domestic monetary conditions so as to maintain exchange rate stability. But how much monetary autonomy has been left to those non-anchor countries like France, Italy, or Spain, which set monetary targets?

It is well known that when a country adopts a fixed exchange rate, the money supply becomes fully endogenous when the following conditions are simultaneously satisfied: The country does not exert a significant influence on the level of international interest rates; international capital mobility is perfect; and perfect substitutability exists between domestic and foreign bonds. In these circumstances, the domestic monetary authorities can only influence the breakdown of monetary growth between its domestic and external sources, but lose control of the total. And while the rate of monetary growth can be set ex ante so as to be compatible with the maintenance of exchange rate stability, the presence of shocks will, in general, make actual money growth differ ex post from the targeted value, if exchange rate stability is indeed preserved.

It is clear from the above that, other things equal, setting monetary targets outside Germany would make sense only if some of the previous conditions do not hold. In particular, the room for domestic monetary autonomy on the part of the non-anchor countries will tend to be larger when there is a band within which exchange rates can move, when central parities can be adjusted, when capital mobility is not perfect, and when domestic and foreign assets are imperfect substitutes.

From its creation in 1979 until 1987, the Exchange Rate Mechanism experienced frequent realignments which, coupled with the presence of exchange controls in the countries with relatively weak currencies, France and Italy, gave some room for maneuver to their respective monetary authorities as regards monetary control. In contrast, in the period from 1987 to September 1992, the Exchange Rate Mechanism experienced no general realignment and capital controls were eliminated in most member countries with a view to the establishment of the Single Internal Market. This made it increasingly difficult for non-anchor

countries to meet monetary targets while preserving exchange rate stability. Subsequently, the crisis from September 1992 to July 1993 led to the exit of the British pound and the Italian lira from the Mechanism; to the devaluation of the peseta, the escudo, and the Irish pound; and to the widening of the bilateral fluctuation bands to ± 15 percent after August 2, 1993.

As a result of the widening of the bands, the participating countries have now regained some margin of maneuver for adapting monetary developments to domestic conditions. In other words, while the exchange rate remains the fundamental variable as far as monetary policy is concerned, at least for most of the remaining Exchange Rate Mechanism countries, the recent changes in the Mechanism may have allowed the monetary authorities of countries setting monetary targets some room to improve their control over their national moneys.

All in all, however, even if at present it can be claimed that central banks have a better control over monetary targets than a couple of years ago, the ongoing process of financial innovation continues to pose serious problems regarding the effectiveness of such strategy. It is for this reason that we consider that those European central banks with a long tradition in setting monetary targets are becoming, with the passage of time, more pragmatic in the implementation of their monetary strategies, given the prevalence of the exchange rate target. Even in Germany, where the only target is the growth of M3, monetary growth has recently been allowed to be well in excess of the target range. The structural changes derived from unification, the processes of financial innovation and deregulation, and the foreign exchange interventions of the Bundesbank on behalf of other currencies during the Exchange Rate Mechanism crisis, are all factors that at least partly account for the excessive monetary growth recorded in Germany in past years and also at present. In spite of this, the Bundesbank has continued to pursue a cautious policy of interest rate reductions in the light of the diminishing inflationary pressures observed in the German economy, which suggests that monetary targets are being implemented in a pragmatic manner.

The Implications of Economic and Monetary Union for Monetary Strategy and Tactics in Europe

The Treaty on European Union, enacted on November 1, 1993, contemplates the creation of a Monetary Union in Europe within the present decade. According to the Treaty, the European System of Central Banks will formulate and implement the single monetary policy

in the Union. However, the Treaty does not allow for any gradual transfer of monetary sovereignty from national authorities towards the central institutions before the establishment of the Monetary Union. This means that a sort of "Big Bang" will occur on the very day when the Union is created, with a sudden shift from coexisting national monetary policies, formulated in the pursuit of national objectives and implemented through different procedures, to a single monetary policy, set by a supranational institution with Union-wide objectives and operated in a consistent way throughout the area.

While the future creation of the Monetary Union represents a shock of unprecedented magnitude, the anticipation of that shock gives time to prepare the regulatory and logistical framework necessary for the European System of Central Banks effectively to carry out the single monetary policy from the very first day. This preparatory work is a major task of the European Monetary Institute, an institution created January 1, 1994 as precursor of the future European Central Bank.

This section will describe the present nature of monetary operations in European countries, then proceed to examine briefly the objectives and nature of the European System of Central Banks, and conclude with a discussion of the main operational reforms and adjustments needed to prepare the future single monetary policy.

How Different at Present Is the Implementation of Monetary Policy in the Various European Countries?

Previous sections of this paper have already discussed a number of key issues concerning the final objectives of monetary policy and the various strategies available for achieving these objectives. With regard to European countries, the information contained in Appendix Table 1 suggests that while price stability constitutes de facto the final objective of monetary policy in most countries, national central banks vary quite considerably as regards their degree of formal and effective autonomy. In addition, Table 2 has indicated important differences in the monetary policy strategies followed in the various European countries to pursue the final objectives.

Not tackled yet are the more technical and operational issues concerning the execution of monetary policy in the various countries.[7] Recently, methods of executing monetary policy in European countries have converged in two main respects. First, open market operations increasingly have been used to regulate liquidity conditions, which has made them the main monetary instrument in most countries. And

[7] Consult the 1993 *Annual Report* of the Committee of Governors of European Central Banks for a clear description of national monetary policy instruments and procedures in the European Union. See also Padoa-Schioppa and Saccomanni (1992).

second, money market interest rates have become established as the main operational target in the daily conduct of monetary policy.

In spite of this, significant differences remain across countries concerning the use of other monetary policy instruments and procedures. Table 5 summarizes the respective national roles played by reserve requirements, standing facilities, and open market operations.

Reserve requirements are used to very different extents in the various countries in the process of regulating liquidity conditions. Indeed, in spite of the trend in recent years in the European Union toward lowering reserve requirements, which has taken place as a result of the desire to improve competition and efficiency in the banking industry, important national differences remain regarding the level and remuneration of reserve requirements, as can be seen in part A of Table 5. For example, while such requirements are not used for monetary policy purposes at present in countries like Belgium, Denmark, the Netherlands, and the United Kingdom, they are still used in the other countries, and in particular in Portugal and Italy. In the latter two countries, monetary authorities traditionally have employed reserve requirements to induce or enlarge the demand for bank reserves and, when coupled with averaging provisions, to allow the banking system to cope better with situations of excess or insufficient liquidity, thus reducing the need for direct central bank intervention in the market.

Standing facilities offered by central banks to financial institutions on a bilateral basis (discount window, other direct credit and deposit lines) constitute another instrument at the disposal of central banks to regulate liquidity conditions. As seen in part B of Table 5, while these facilities play little or no role in the majority of European countries, they are quite important in Italy and Germany and most important in the Netherlands, where they account for a significant part of the supply of liquidity.

In spite of the increasingly important role of *open market operations* in regulating liquidity conditions in all countries, only in the United Kingdom, Denmark, and Portugal are they the main instrument. In addition, part C of Table 5 shows the significant differences in the ways in which these operations are conducted in the various European countries (for example, types of assets used, frequency of operations, and procedures to auction liquidity).

Finally, it is important to mention that until recently a number of national central banks in Europe have been *financing the public sector*, although this is not specifically a part of monetary policy operations. However, with the enactment of the Treaty on European Union, central banks have been prohibited since January 1, 1994 from giving overdrafts or other types of credit facilities to the public sector and from purchasing public debt directly in the primary market. The purchasing of public debt in the secondary market is also forbidden for purposes other than regulating monetary conditions. As suggested by the various initial

Table 5
Monetary Policy Instruments and Procedures in the European Union

Item	Belgium	Denmark	Germany	Greece	Spain	France	Ireland	Italy	Netherlands	Portugal	U.K.
A. Permanent Reserve Requirements for Monetary Policy Purposes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No
—Size (% of GDP)[a]	—	—	2.7	3.9	2.0	.1	1.8	8.0	—	16.1	—
—Remuneration	—	—	No	Partly	No	No	Below market rates	Partly	—	Partly	—
B. Standing Facilities[b]											
—Lending facilities at below or close to market rate(s)	□ (below market)	—	◆	—	—	—	—	◆ (close to market)	■ (below market)	—	—
—Deposit facilities	□	□	—	—	—	—	◆	—	—	—	—
—Marginal refinancing	□	—	□	◆	□	□	◆	◆	□	□	◆
C. Open Market Operations											
1. Types[b]											
—Outright transactions[c]	□	■	□	◆	—	◆	—	◆	□	■	■
—Reserved transactions in domestic securities	■	■	■	□	■	■	■	■	■	◆	◆
—Foreign currency swap transactions	◆	□	□	□	□	—	■	◆	□	□	—
2. Frequency of operations[d]	■	◆	□	◆	◆	◆	■	◆	□	◆	■
3. Auction procedures[b]											
—volume tender	■	■	□	—	□	—	—	—	■	◆	—
—interest rate tender	□	—	■	□	■	■	■	■	—	◆	■

— = Not applicable or not used.

[a] Amount outstanding at the end of 1992.
[b] Importance in providing (or withdrawing) liquidity to (or from) the market: □ Low; ◆ Intermediate; ■ High.
[c] These include issues of certificates of deposit by the central bank in the cases of Denmark and Portugal, and unsecured overnight loans in the case of Greece.
[d] □ About once a week; ◆ Several times a week; ■ More than once a day.

Source: Annual Report of the Committee of Governors of European Central Banks, 1993.

national situations, the impacts of these recent legislative changes are likely to be felt rather differently across Europe.

The European System of Central Banks: Objectives and Autonomy

The Treaty on Economic and Monetary Union concluded at Maastricht sets *price stability* as the primary objective of the European System of Central Banks and establishes that the general economic policies in the European Union shall be supported only so long as this does not conflict with price stability. While the aim is to avoid the potential conflicts that arise when all the objectives are at par, no specific definition is given in the Statute of what constitutes price stability or of the criteria to assess when price stability enters into conflict with other policies. In practice, however, many central bankers would regard a rate of inflation between 0 and 2 or 3 percent as consistent with price stability.

In addition to a clear mandate to fight inflation, the future European System of Central Banks is equipped with a significant degree of *institutional and functional autonomy*. As concerns institutional autonomy, the Statute tries to ensure that governments will not interfere in the monetary decision-making process. The following statutory provisions are related to this goal: prohibition of seeking or receiving instructions from government bodies; the requirement that the statutes of the member central banks guarantee their respective institutional and functional autonomy; assured tenure for the members of the governing bodies of the System; and strict conditions on amending the Statute in any fundamental way. As concerns functional autonomy, the Statute gives the System full powers to use monetary policy instruments, subject to the constraint that they be compatible with market principles.

As indicated by the comparative analysis of Alesina and Grilli (1992), the European System of Central Banks will enjoy a very high degree of formal autonomy in monetary policy-making. Nevertheless, since the Treaty places decisions on exchange rate policy outside the System, the effective autonomy of the new institution might be compromised, as the monetary stance required to maintain price stability may conflict with exchange rate objectives. To minimize this risk, the Treaty states that exchange rate decisions will be taken only after consulting the System in an attempt to reach a consensus consistent with the objective of price stability.

The Single Monetary Policy

The Maastricht Treaty establishes that by the end of 1996 at the latest, the European Monetary Institute should have undertaken all the

necessary preparations needed for the European System of Central Banks effectively to carry out the single monetary policy. The scale and complexity of the task facing the Institute can be readily assessed from the following two considerations: On the one hand, the absence of any transfer of monetary power to the Institute makes it impossible to exercise, even on a small scale, the running of the future single monetary policy before the establishment of Monetary Union. Contrary to the spirit of some of the proposals made during the preparation of the Delors Report, the European Monetary Institute does not have *any* authority or instruments to influence the stance of European monetary policy—a task left for the System of Central Banks. On the other hand, while the Statute defines the broad principles that should guide the formulation and execution of the single monetary policy, many strategic and tactical issues are left fully open in the Statute and have yet to be addressed.

On the strategic side, an adequate framework must be developed for formulating monetary policy. This involves considering whether intermediate targets in general, and monetary targets in particular, might be useful in the conduct of the future monetary policy of the European System of Central Banks, as well as exploring which variable could best play this role. On the tactical side, the necessary infrastructure must be put in place to allow the proper execution of a single monetary policy. This means identifying the minimal requirements for guaranteeing the uniformity of monetary conditions throughout the Union, and exploring how to execute the single monetary policy with the optimal degree of decentralization. In what follows, the above issues are discussed in some greater detail, drawing in part on Monticelli and Viñals (1993) and Viñals (1994).

Strategic aspects: policy formulation. Concerning the strategic aspects of formulating a single monetary policy, it is likely that European central banks will settle for a framework that exhibits considerable simplicity and transparency and enhances the anti-inflationary credibility of the System. Although it is too early to tell which specific framework will be adopted, it is reasonable to assume that intermediate targets may be assigned an important role in the conduct of monetary policy, on the basis of the reasons discussed in the previous section. This impression is reinforced by the fact that some of the most successful and important central banks in the European Union now rely on intermediate monetary targets. Thus, the adoption of a similar monetary policy strategy by the System would allow a certain degree of continuity with present practices and, possibly, also the transfer of a certain degree of anti-inflationary credibility to the System. Nevertheless, the recent surge in M3 in Germany, at a time of declining growth in nominal incomes there, has led to some greater doubts about the value of intermediate monetary targeting.

On the other hand, insofar as the European Union follows a floating exchange rate policy vis-à-vis third currencies, the controllability of the money supply at the area level could be greater than some countries enjoy now at the national level because of the constraints imposed by the Exchange Rate Mechanism. Finally, the empirical evidence provided by Kremers and Lane (1990), Artis (1991), Monticelli and Strauss-Kahn (1991), and Cassard, Lane, and Masson (1994) suggests that a stable demand for money may exist for the European Union as a whole.

However, even if it were decided in principle to adopt monetary targets, severe problems still could arise in selecting the monetary or financial aggregate most suited to this role. The reason is simple: The passage to Monetary Union constitutes an unprecedented structural regime change, with major consequences that may alter in unknown ways the underlying relationships between the evolution of economic and financial variables and that of final variables. For this reason, much can be said in favor of a pragmatic policy strategy in the first years after the creation of the European Monetary Union. In particular, the System of Central Banks might do best to rely on a number of selected economic and financial indicators, no doubt including monetary and financial aggregates, in order to achieve its price stability objective during the first few years of Monetary Union. Only after things had settled down might it be possible to assess whether monetary targets were the best way of formulating the single monetary policy.

Tactical aspects: policy execution. It is not possible to predict with any great degree of accuracy what will be the full effect of the recent creation of the Single Internal Market on the future shape of the economic and financial framework of the European Union. Nevertheless, two questions must now be addressed regarding preparations for future monetary policy in Stage Three. First, what are the minimum requirements for the conduct of a single monetary policy? And second, what instruments can be used to execute monetary policy in a more or less decentralized setting?

These questions implicitly assume that monetary policy instruments and procedures will still differ across member countries when European Monetary Union is established, and that a non-negligible degree of decentralization will characterize the execution of the European monetary policy, at least in the early years. The first assumption is justified because differences in national policy instruments and procedures tend to be persistent and are unlikely to disappear in the next few years, despite the market forces towards greater competition unleashed by the Single Internal Market. Moreover, central banks feel comfortable with their own way of executing monetary policy, and thus they can be expected to maintain their customary practices, which reflect specific market and institutional features.

The second assumption rests on the fact that it is probably more

efficient to execute monetary policy in a somewhat decentralized way, so as to make use of the considerable human capital accumulated by central banks in terms of knowledge of national financial institutions. It also recognizes that the Treaty states that "to the extent deemed possible and appropriate . . . , the European Central Bank shall have recourse to the national central banks to carry out operations" (Article 12.1). These arguments can be expected to lose force with the passage of time, ultimately working towards greater centralization in the execution of monetary policy.

The Minimal Requirements for the Conduct of a Single Monetary Policy

Money market integration. The most important requirement is the integration of national interbank markets, so as to ensure that interest rate arbitrage brings about a single monetary stance throughout the Union, regardless of where any injection or subtraction of liquidity is made. For arbitrage to ensure the equalization of interbank interest rates, credit institutions must be able to transfer their interbank positions across borders. This, however, does not require the centralization of payment and settlement systems at the Union level. Instead, all that is required is that national payment systems are adequately linked to ensure that interbank funds can be transferred across borders and, once transferred, can be used for final settlements within the same day.

While these measures are sufficient to create an integrated interbank market and thus permit the conduct of a single monetary policy, unfortunately they do not ensure the safety of the interbank payment and settlement system. This requires specific measures to reduce risks, notably liquidity, credit, and systemic risks, as well as common legal provisions regulating the finality of payments and the revocability of payment instructions.

Harmonization. Is the harmonization of monetary policy instruments and procedures necessary for the achievement of a single monetary stance through the Union? At a macroeconomic level, this is not really required since, in theory, for any set of instruments it is always possible for the European System of Central Banks to hit its intermediate or final target through appropriate movements of the instruments. Nevertheless, two microeconomic reasons suggest that achieving a certain degree of harmonization among national instruments and procedures might be very desirable when the European Monetary Union is set up.

The first reason relates to the concern that regulatory arbitrage on the part of financial institutions could lead to major shifts in the location of financial activity within the Union, if differences in monetary policy instruments and procedures implied differences in the cost-subsidy mix involved in banking with the various members of the System. The case

of reserve requirements is the most obvious example. The conduct of a single monetary policy could be perfectly compatible with different reserve requirement provisions within the System (the "European" money multiplier would be given by a weighted average of "national" multipliers), as interest rate arbitrage would in any case lead to a single monetary stance throughout the Community. However, not all financial institutions would be on the same competitive footing, at least initially, and the ones penalized by regulation would tend to circumvent it, moving their activities to more favorable locations.

This line of argument supports the harmonization of reserve requirements (not excluding the zero option) and of the conditions on the standing facilities offered on a bilateral basis to financial institutions. Otherwise, the result would be regulatory arbitrage, which would entail inefficiencies and could lead to a perverse competition between national central banks. Furthermore, shifts in the location of financial activity could complicate the conduct of monetary policy, as they would increase the noise associated with monetary and financial developments. The signal extraction problem faced by the System of Central Banks would be exacerbated in a situation that will in any case be difficult, as a result of the regime change involved by the start of the European Monetary Union.

The second reason motivating a certain degree of harmonization in instruments and procedures is that it would facilitate the understanding of policy signals on the part of the market participants. Particular conventions (not always corresponding to the use of a specific set of instruments) have been established to clarify whether central bank operations are meant to maintain the prevailing policy stance in the face of shocks or whether a change in policy orientation is intended. The coexistence of several conventions would prove confusing. Appropriate actions on the part of the System, together with market trading and arbitrage, would eventually bring about the desired liquidity stance, but this process could give rise to misunderstandings, undesired volatility in interest rates, and other inefficiencies in the management of liquidity conditions. Once again, while this argument also suggests that harmonization would be desirable, it does not help to determine its specific terms.

These arguments suggest that a close harmonization of monetary policy instruments and procedures would be desirable in order to allow the European System of Central Banks to signal its policy intentions efficiently, and it would be necessary to avoid major shifts in the location of financial activities. Nevertheless, this line of reasoning only points to the benefits of harmonization on its own merits and leaves the terms of harmonization indeterminate.

Instruments and decentralization. Two final key issues need to be tackled in preparing the technical infrastructure for future monetary

policy: the choice of instruments (reserve requirements, standing facilities, and open market operations) and the degree to which policy execution can be delegated to national central banks.

Regarding the *choice of instruments*, as mentioned earlier, over the past years open market operations have generally become the main channel through which monetary conditions are influenced in European countries, and money market interest rates the principal operational target in the daily conduct of national monetary policies. Nevertheless, significant differences still exist in the use made by countries of two other channels for regulating liquidity conditions: reserve requirements and standing facilities. Thus, what should be the importance of these two instruments vis-à-vis open market operations in the execution of the single monetary policy is an important question.

The Statute of the European System of Central Banks contemplates the use of *reserve requirements* in the European Monetary Union, since it states that "the European Central Banks may require credit institutions established in Member States to hold minimum reserves on accounts with the European Central Bank and national central banks in pursuance of monetary policy objectives" (Article 19.1).

As is well known, reserve requirements are not necessary to control the evolution of monetary variables in the European Monetary Union, since this can be achieved through open market operations. Furthermore, when not fully remunerated, reserve requirements may encourage socially suboptimal financial behavior, since they constitute a distortionary tax on banking activities that drives a wedge between deposit and lending rates. Where reserve requirements could be useful is in facilitating the management of the money market (see Hardy 1993). In particular, when executed with averaging provisions, reserve requirements allow the banking system to "cope with temporary liquidity shortages or surpluses in the market without central bank intervention" (Committee of Governors 1993). This is found useful now by many central banks, because it gives them the freedom to choose how frequently they should be in the market to steer money market interest rates in the appropriate direction.

In principle, reserve requirements could be set in the European Monetary Union so that they facilitate money market management without creating excessive distortions on financial behavior. Specifically, a uniform zero average reserve requirement in the Union would accomplish these goals, provided banks find it costly not to meet the requirement and provided a large enough overdraft facility is available at the central bank.

Another potential instrument at the disposal of the System for use in regulating liquidity conditions are *standing facilities*. These are offered on a bilateral basis by the central bank to specific financial institutions to cushion their liquidity shortages or surpluses. In general, these facilities

play a role similar to that of reserve requirements; that is, to stabilize money market conditions and to lower the volatility of short-term interest rates. Thus, in this regard, their usefulness is to some extent contingent on the specific arrangements made regarding reserve requirements. In addition to the above, the pre-announced rates at which standing facilities are offered can be used—as is the case now in several European countries—to signal changes in the policy intentions of the monetary authorities. It is not obvious, however, why this latter function could not be exercised instead through open market operations.

Open market operations are the third instrument available to the System to execute the single monetary policy. Well-known efficiency reasons favor open market operations playing a central role in the execution of a single monetary policy, even though a number of important decisions will have to be made regarding the nature and frequency of operation, the eligible underlying assets, the number of counterparties, and the auction procedures.

Also to be considered is the potential role of open market operations vis-à-vis those of reserve requirements and standing facilities in the execution of future monetary policy. In practice, the choice of instruments should be made on grounds of economic and operational efficiency and, once a specific decision has been taken, the selected instruments should be varied over time to achieve the desired objectives. In the case of the European Monetary Union, however, the initial diversity of national monetary instruments and procedures and the provisions in the Statute are likely to imply that the centrally decided single monetary policy will be executed in a rather decentralized way, at least in the early years.

If, as seems likely, the issue of *decentralization* plays an important role in deciding how to execute future monetary policy, this could be crucial in determining the relative importance of the various instruments. The reason is that the management of both reserve requirements and standing facilities can be decentralized to a much greater extent than open market operations. On the one hand, provided reserve requirements are the same throughout the Union, management of this instrument can be delegated to national central banks without difficulty. In turn, since reserve requirements permit a lower frequency of intervention of central banks in the money market, this makes it easier to decentralize the execution of the single monetary policy.

Similarly, the decentralization of standing facilities has some operational advantages and would not seem difficult to reconcile with an overall control of central bank money injected or withdrawn through this channel. The European Central Bank would be relieved from the burden of maintaining accounts with all banks operating in the Union, while the human capital of knowledge on specific credit institutions that

national central banks have accumulated over the years would be better exploited.

In contrast to the above, the decentralized execution of open market operations is much more difficult to contemplate in practice. Indeed, as with foreign exchange operations, open market operations must be executed in a timely and flexible fashion to offset liquidity shocks. This suggests that such operations should be carried out in a centralized fashion, with their monetary effects nonetheless being uniformly spread through the Union.

To conclude, although complex technical issues are involved in comparing the merits of alternative models for the execution of future monetary policy, it is not unreasonable to expect that an evolutionary model will be chosen which, starting from a relatively higher degree of decentralization, can evolve over time towards a more centralized system. While open market operations are likely to be the main instrument for regulating liquidity conditions, as is now the case in most European countries, reserve requirements cum standing facilities could play a more important role in the early, rather than the later, stages of economic and monetary union.

Conclusions

This paper has examined a number of issues regarding recent developments in the formulation and implementation of monetary policy, with a strong, although not exclusive, European focus. In particular, it has concentrated, on the one hand, on describing recent constitutional changes as regards the objectives of monetary policy and the degree of political and functional autonomy of central banks; and, on the other, on exploring several key strategic and tactical questions concerning the implementation of monetary policy. While these issues are of importance in many countries, they are crucial in the European Union, where major changes in monetary policy are envisaged to take place following the establishment of European Monetary Union.

Admittedly, the paper has been primarily taxonomic and descriptive. This is, in large part, because the constitutional changes involved, more autonomous central banks and European Monetary Union, are either very recent or still ongoing. So there is, as yet, little room for econometric testing, insofar as that is ever possible, of whether such changes have improved the conduct of policy.

Some concerns have been voiced about whether similar changes have made policies in New Zealand and Canada too deflationary, initially. Yet it is remarkable how well the inflation targets in those countries, and in the United Kingdom, have so far been met. Skeptics would counter that neighboring countries without such direct inflation

targets, for example, Australia and the United States, have done broadly as well on this front.

So the jury is still out. Nevertheless, a strong ground swell of support continues for moving both to more autonomous central banks and, within the European Union, to European Monetary Union. The case for such autonomy is greatly enhanced if it is accepted that central banks have a single medium-term objective, price stability. Such an objective facilitates delegation and enhances accountability.

This notwithstanding, it must be acknowledged that the economically beneficial effects of clarifying the objectives of monetary policy and granting greater central bank autonomy will be all the greater, if fiscal policy is not at odds with monetary policy. Indeed, as established by economic principles and confirmed by experience, the anti-inflationary credibility of monetary policy depends not only on the autonomy of the central bank but also on the coherence and credibility of overall macroeconomic policy. For this reason, it is of fundamental importance that the policies of both the autonomous central banks and the fiscal authorities be closely coordinated, toward the pursuit of the overall goal of sustained, non-inflationary growth. Finally, judging by experience, the favorable impact of improvements in national monetary institutions has tended to be greater when such institutional changes have reflected society's concern about inflation and its awareness that high inflation is not conducive—but is actually detrimental—to economic growth.

Also discussed at some length are the alternatives between having as the primary target a direct inflation objective or an intermediate (monetary) target. We would not, however, want to leave the impression that the alternatives are either sharp or mutually exclusive. Indeed, any country pursuing a quantified objective will keep a close eye on a range of intermediate information variables: Any country choosing an intermediate target will be greatly concerned about the (time-varying) relationships between that target and the outcome for the final (inflation) objective.

Finally, we would like to mention that recent constitutional changes may increase flexibility concerning the adoption of specific monetary policy strategies and tactics, by providing a more solid and transparent medium-term framework for monetary policy where price stability is clearly established as its primary objective and where the ability of central banks to pursue this objective without political interference is enhanced. As has been pointed out recently (Crockett 1993), this new institutional framework could provide a useful synthesis between rules and discretion, and this could reinforce the medium-term, anti-inflationary credibility of monetary policy while allowing for the appropriate degree of flexibility in the shorter-term setting of targets and instruments.

Appendix Table 1
Institutional Features of Central Banks in the European Union

Item	National Bank of Belgium	Danmarks National Bank	Deutsche Bundesbank
Principal Statutory Objective	None, although safeguarding the currency implicit	To maintain a safe and secure currency system	To safeguard the currency
Legal Authority for:			
1. Exchange Rate Regime	1. Government	1. Government	1. Government
2. Setting targets for monetary growth	2. Central Bank (no target set at present)	2. Central Bank (no target set at present)	2. Central Bank
3. Changing key interest rates	3. Central Bank	3. Central Bank	3. Central Bank
Responsibilities:			
1. Execution of monetary and exchange rate policy	1. Yes	1. Yes	1. Yes
2. Issuance of currency	2. Yes	2. Yes	2. Yes
3. Payment system services	3. Yes	3. Yes	3. Yes
4. Bank of banks and government	4. Yes	4. Yes	4. Yes
5. Supervision of financial institutions	5. No	5. No	5. No
6. Safeguard financial stability	6. Yes	6. Yes	6. Yes
7. Official reserve management	7. Yes	7. Yes	7. Yes
Governing Bodies	–Governor –Board of Directors –Council of Regency –Board of Censors –General Council	–Board of Governors –Board of Directors –Committee of Directors –Royal Bank Commissioner	–Central Bank Council –Directorate –Managing Board of Land Central Banks
Appointment of Governor by:	–Crown on proposal of the Government	–Crown on proposal of the Government	–Federal president on proposal of Federal Government after consultation of Central Bank Council
Term:	–5 years (renewable)	–No fixed term	–Normally 8 years, minimum 2 years (renewable)
Recent and/or Planned Changes	Since March 1993, abolition of the previous "power of suspension and right to oppose" by the Government with respect to central bank's decisions and operations concerning its basic tasks	None	None

Appendix Table 1 (continued)
Institutional Features of Central Banks in the European Union

Item	Bank of Greece	Banco de España	Banque de France
Principal Statutory Objective	To control currency in circulation and credit	To achieve price stability	To assure price stability
Legal Authority for:			
1. Exchange Rate Regime	1. Government	1. Government	1. Government
2. Setting targets for monetary growth	2. Central Bank	2. Central Bank	2. Central Bank
3. Changing key interest rates	3. Central Bank	3. Central Bank	3. Central Bank
Responsibilities:			
1. Execution of monetary and exchange rate policy	1. Yes	1. Yes	1. Yes
2. Issuance of currency	2. Yes	2. Yes	2. Yes
3. Payment system services	3. Yes	3. Yes	3. Yes
4. Bank of banks and government	4. Yes	4. Yes	4. Yes
5. Supervision of financial institutions	5. Yes	5. Yes	5. Yes
6. Safeguard financial stability	6. Yes	6. Yes	6. Yes
7. Official reserve management	7. Yes	7. Yes	7. Yes
Governing Bodies	–General Council	–Governor –Deputy Governor –Governing Council –Executive Commission	–Governor –Deputy-Governors (2) –General Council –Monetary Policy Council
Appointment of Governor by:	–Government on proposal of General Council	–Crown on proposal of President of Government	–Council of Ministers
Term:	–4 years (renewable)	–6 years (non-renewable)	–6 years (renewable)
Recent and/or Planned Changes	Consideration of proposals to increase the independence of the central bank in the future and to make the Statute more compatible with the Maastricht Treaty	Autonomy Law of 1 June 1994, introducing all the provisions of the Maastricht Treaty relating to central banks	Law introducing all the provisions of the Maastricht Treaty relating to central banks enacted in December 1993

Appendix Table 1 (continued)
Institutional Features of Central Banks in the European Union

Item	Central Bank of Ireland	Banca d'Italia	Institut Monetaire Luxembourgeois
Principal Statutory Objective	To safegard integrity of the currency	None, although safeguarding the currency implicit	To promote the stability of the currency
Legal Authority for:			
1. Exchange Rate Regime	1. Government	1. Government	1. Government
2. Setting targets for monetary growth	2. Central bank (no target set at present)	2. Joint with Government	2. Not applicable
3. Changing key interest rates	3. Central Bank	3. Central Bank	3. Not applicable
Responsibilities:			
1. Execution of monetary and exchange rate policy	1. Yes	1. Yes	1. Yes (partly)
2. Issuance of currency	2. Yes	2. Yes	2. Yes
3. Payment system services	3. Yes	3. Yes	3. No
4. Bank of banks and government	4. Yes	4. Yes	4. No
5. Supervision of financial institutions	5. Yes	5. Yes	5. Yes
6. Safeguard financial stability	6. Yes	6. Yes	6. Yes
7. Official reserve management	7. Yes	7. Yes (together with the Italian Exchange Office)	7. Yes
Governing Bodies	–Board of Directors	–Governor, Director-General, 2 Deputy Director-Generals (Directorate)	–Management –Council
Appointment of Governor by:	President on proposal of Government	Board of Directors with approval of Government	Grand-Duke on proposal of Council of Ministers
Term:	7 Years (renewable)	–Life	–6 years (renewable)
Recent and/or Planned Changes	Prospective bill to suppress the power of the Government to be consulted by the Bank regarding the latter's general function and duty. Other institutional changes are now under discussion	–Since November 1993, the Bank has had the power to set the compulsory reserve ratio –Other institutional changes required to fulfill the Maastricht Treaty are under examination	–A draft bill to effect the changes in legislation required by the Maastricht Treaty is in preparation at the IML

Appendix Table 1 (continued)
Institutional Features of Central Banks in the European Union

Item	Nederlandsche Bank	Banco de Portugal	Bank of England
Principal Statutory Objective	To safeguard the value of the currency	To maintain internal monetary stability and the external solvency of currency	None, although safeguarding the currency implicit
Legal Authority for:			
1. Exchange Rate Regime	1. Government	1. Government	1. Government
2. Setting targets for monetary growth	2. Central Bank (no target set at present)	2. Central Bank (no target set at present)	2. Government
3. Changing key interest rates	3. Central Bank	3. Central Bank	3. Joint with Government
Responsibilities:			
1. Execution of monetary and exchange rate policy	1. Yes	1. Yes	1. Yes
2. Issuance of currency	2. Yes	2. Yes	2. Yes
3. Payment system services	3. Yes	3. Yes	3. Yes
4. Bank of banks and government	4. Yes	4. Yes	4. Yes
5. Supervision of financial institutions	5. Yes	5. Yes	5. Yes
6. Safeguard financial stability	6. Yes	6. Yes	6. Yes
7. Official reserve management	7. Yes	7. Yes	7. Yes (as agent for the Government)
Governing Bodies	–Government Board –Supervisory Board	–Governor –Board of Directors –Board of Auditors –Advisory Board	–Court of Directors
Appointment of Governor by:	Nominated by joint meeting of Governing Board and Supervisory Board and appointed by Crown on proposal of Council of Ministers	–Council of Ministers on proposal of Minister of Finance	–Crown on proposal of Prime Minister
Term:	–7 years (renewable)	–5 years (renewable)	–5 years (renewable)
Recent and/or Planned Changes		Amendment to prohibit the underwriting of Treasury Bills. Institutional changes required to fulfill the Maastricht Treaty currently discussed	None. Changes will be needed if U.K. participates in Stage Three

Note: All the national legislations that so required were changed in 1993 to be consistent with the Maastricht Treaty prohibition of public sector financing by the central bank.

Source: *Annual Report* of the Committee of Governors of European Central Banks 1993, central bank reports, and recent legislative proposals and laws.

References

Alchian, Armen A. and Benjamin Klein. 1973. "On a Correct Measure of Inflation." *Journal of Money, Credit and Banking*, vol. 5, no. 1, Pt. 1 (February), pp. 173–91.

Alesina, Alberto. 1989. "Politics and Business Cycles in Industrial Democracies." *Economic Policy*, vol. 8, Spring, pp. 58–98.

Alesina, Alberto and Vittorio Grilli. 1992. "The European Central Bank: Reshaping Monetary Politics in Europe." In Matthew B. Canzoneri, Vittorio Grilli, and Paul R. Masson, eds., *Establishing a Central Bank: Issues in Europe and Lessons from the U.S.* Cambridge: Cambridge University Press.

Alesina, Alberto and Lawrence H. Summers. 1993. "Central Bank Independence and Macroeconomic Performance: Some Comparative Evidence." *Journal of Money, Credit and Banking*, vol. 25, May, pp. 151–62.

Artis, Michael. 1991. "Monetary Policy in Stage Three: Targeting a Monetary Aggregate." University of Manchester, mimeo.

Bank of England. "Inflation Report." In *Bank of England Quarterly Bulletin*, quarterly since 1993. London: Bank of England.

Bernanke, Ben and Frederick Mishkin. 1992. "Central Bank Behavior and the Strategy of Monetary Policy: Observations from Six Industrialized Countries." National Bureau of Economic Research Working Paper No. 4082, Cambridge, MA, May.

Bruni, Franco, ed. 1993. *Prudential Regulation, Supervision and Monetary Policy: Theory, International Comparison and the ESCB Role*. Milan: Università Commerciale Luigi Bocconi.

Canadian Standing Committee on Finance. 1992. Eighth Report. "The Mandate and Governance of the Bank of Canada." Presented to the House of Commons, Ottawa, February 24.

Cassard, Marcel, Timothy Lane, and Paul R. Masson. 1994. "ERM Money Supplies and the Transition to EMU." Working Paper, International Monetary Fund. Washington, D.C., January.

Chiappori, Pierre-Andre, Colin Mayer, Damien Neven, and Xavier Vives. 1991. "The Microeconomics of Monetary Union." In *Monitoring European Integration: The Making of Monetary Union*, Centre for Economic Policy Research, London.

Committee of Governors of European Central Banks. 1993. *Annual Report*. Basle.

Côtè, Denise and Douglas Hostland. 1994. "Measuring Potential Output and the NAIRU as Unobserved Variables in a Systems Framework." In *Economic Behaviour and Policy Choice under Price Stability*. Proceedings of a Conference held at the Bank of Canada, 30–31 October 1993, pp. 403–68. April. Ottawa: Bank of Canada.

Crawford, Alan. 1993. "Measurement Biases in the Canadian CPI." Bank of Canada Technical Report no. 64. Ottawa.

Crawford, Alan and Chantal Dupasquier. 1994. "Can Inflation Serve as a Lubricant for Market Equilibrium?" In *Economic Behavior and Policy Choice under Price Stability*, pp. 49–80. See Côté and Hostland 1994.

Crockett, Andrew. 1993. "Rules vs. Discretion in Monetary Policy." Mimeo, Bank of England, London, September.

Crow, John W. 1992. "What to Do about the Bank of Canada." Lunchtime remarks to the Canadian Economic Association Annual Meeting, Charlottetown, P.E.I. Bank of Canada, mimeo, June.

Cukierman, Alex. 1992. *Central Bank Strategy, Credibility and Independence: Theory and Evidence*. Cambridge, MA: The MIT Press.

Debelle, Guy and Stanley Fisher. "How Independent Should a Central Bank Be?" This volume.

Duguay, Pierre. 1994. "Some Thoughts on Price Stability Versus Zero Inflation." Paper presented at Conference in Paolo Baffi Centre for Monetary and Financial Economics on March 4th, 1994. Forthcoming in Franco Bruni, ed., *Central Bank Independence and Accountability*. Milan: Università Commerciale Luigi Bocconi.

Eichengreen, Barry and Charles Wyplosz. 1993. "The Unstable EMS." *Brookings Papers on Economic Activity: 1*, pp. 51–143.

Englander, A. Steven. 1990. "Optimal Monetary Policy Design: Rules versus Discretion Again." Federal Reserve Bank of New York, Research Paper no. 9019. New York.

Fase, M.M.G. 1993. "The Stability of the Demand for Money in the G7 and EC Countries: A Survey." Working Document no. 81, Center for European Policy Studies. Brussels, November.

Fforde, John. 1992. *The Bank of England and Public Policy, 1941–1958*. Cambridge: Cambridge University Press.

Fillion, Jean-Francois and Robert Tetlow. 1994. "Zero Inflation or Price Stability." In *Economic Behavior and Policy Choice under Price Stability*, pp. 129–66. See Côté and Hostland 1994.

Folkerts-Landau, David and Peter M. Garber. 1992. "The ECB: a Bank or a Monetary Policy Rule?" In *Establishing a Central Bank: Issues in Europe and Lessons from the U.S.* See Alesina and Grilli 1992.

Freedman, Charles. 1994. "Formal Targets for Inflation Reduction: The Canadian Experience." In J. Onno de Beaufort Wijnholds, Silvester C.W. Eijffinger and Lex H. Hoogduin, eds. *A Framework for Monetary Stability*, pp.17–29. Dordrecht, Netherlands: Kluwer Academic Publishers.

Friedman, Benjamin M. 1990. "Targets and Instruments of Monetary Policy." In Benjamin M. Friedman and Frank K. Hahn, eds. *Handbook of Monetary Economics*, vol. 1. Amsterdam and New York: North-Holland.

Goodhart, Charles. 1993. "Price Stability and Financial Fragility." Paper presented at Bank of Japan Conference on October 28th–29th. Forthcoming in *Financial Stability in a Changing Environment*, ed. Bank of Japan. London: Macmillan.

Goodhart, Charles and Dirk Schoenmaker. 1993. "International Separation between Supervisory and Monetary Agencies." In *Prudential Regulation, Supervision and Monetary Policy*, Chapter 1. See Bruni 1993.

Hall, Robert. 1986. "Optimal Monetary Institutions and Policy." In Colin D. Campbell and William R. Dougan, eds. *Alternative Monetary Regimes*, Chapter 5. Baltimore: The Johns Hopkins University Press.

Hall, Robert and N. Gregory Mankiw. 1993. "Nominal Income Targeting." National Bureau of Economic Research Working Paper No. 4439. Cambridge, MA, August.

Hardy, Daniel C. 1993. "Reserve Requirements and Monetary Management: An Introduction." Working Paper, International Monetary Fund, Washington, D.C., April.

Hershey, Robert D., Jr. 1994. "An Inflation Indeed Is Said to Overstate the Case." *The New York Times*, January 11, p. D1.

Hochreiter, Eduard. 1994. "Central Banking in Economies in Transition: Institutional and Exchange Rate Issues." Paper presented on March 4th, 1994 and forthcoming in *Central Bank Independence and Accountability*. See Duguay 1994.

House of Commons, Treasury and Civil Service Committee. 1993. *The Role of the Bank of England, First Report*, 2 Vols. December. London: Her Majesty's Stationery Office.

Kremers, J. and Timothy D. Lane. 1990. "Economic and Monetary Integration and the Aggregate Demand for Money in the EMS." *IMF Staff Papers*, vol. 37, pp. 777–805.

Lebow, David E., John M. Roberts, and David J. Stockton. 1992. "Understanding the Goal of Price Stability." Board of Governors of the Federal Reserve System, Division of Research and Statistics, mimeo. Washington, D.C., October.

Lebow, David E., David J. Stockton and William L. Wascher. 1994. "Inflation, Nominal Wage Rigidity, and the Efficiency of Labor Markets." Board of Governors of the Federal Reserve System, Division of Research and Statistics, mimeo. Washington, D.C., March.

Monticelli, Carlo and Marc-Olivier Strauss-Kahn. 1991. "European Integration and the Demand for Broad Money." Working Paper no. 18, Bank for International Settlements, Basel.

Monticelli, Carlo and José Viñals. 1993. "European Monetary Policy in Stage Three: What Are the Issues?" Occasional Paper no. 12, Centre for Economic Policy Research, London.

Padoa-Schioppa, Tomasso and Fabrizio Saccomanni. 1992. "Agenda for Stage Two: Preparing the Monetary Platform." Occasional Paper no. 7, Centre for Economic Policy Research, London.

Persson, Torsten and Guido Tabellini. 1993. "Designing Institutions for Monetary Stability." *Carnegie-Rochester Conference Series on Public Policy*, vol. 39, December, pp. 53–84.

———. 1994. "Credibility and Accountability in Monetary Policy." Paper presented on

March 4th, 1994 and forthcoming in *Central Bank Independence and Accountability*. See Duguay 1994.

Poole, William. 1970. "Optimal Choice of Monetary Policy Instrument in a Simple Stochastic Macro Model." *Quarterly Journal of Economics*, vol. 84 (May), pp. 197–216.

Posen, Adam. 1993. "Central Bank Independence Does Not Cause Low Inflation: The Politics Behind the Institutional Fix." Mimeo, Harvard University, December.

Roll Committee. 1993. *Independent and Accountable: A New Mandate for the Bank of England*. Report of an independent panel chaired by Eric Roll. London: The Centre for Economic Policy Research, October.

Scarth, William. 1994. "Zero Inflation vs. Price Stability." In *Economic Behavior and Policy Choice under Price Stability*, pp. 89–119. See Côté and Hostland 1994.

Schinasi, Garry J. and Monica Hargraves. 1994. "'Boom and Bust' in Asset Markets in the 1980s: Causes and Policy Implications." Chapter 1 in *Staff Studies for the World Economic Outlook*, International Monetary Fund. Washington, January.

Selgin, George. 1990. "Monetary Equilibrium and the Productivity Norm of Price-Level Policy." *Cato Journal*, vol. 10, pp. 265–87.

Shibuya, Hiroshi. 1992. "Dynamic Equilibrium Price Index: Asset Price and Inflation." *Bank of Japan Monetary and Economic Studies*, vol. 10, no. 1, February, pp. 95–109.

Shigehara, Kumiharu. 1990. "Shisankakaku No Hendo To Infureshon (Asset Price Movement and Inflation)." *Kinyu Kenkyu*, vol. 9, no. 2, July.

Viñals, José. 1994. "Building a European Monetary Union." Forthcoming in *Frameworks for Nominal Stability*, International Monetary Fund, Washington, D.C.

Walsh, Carl. 1993. "Optimal Contracts for Independent Central Bankers: Private Information, Performance Measures and Reappointment." Federal Reserve Bank of San Francisco, Working Paper 93–02, May. Forthcoming as "Optimal Contracts for Central Bankers," *The American Economic Review*.

———. 1994a. "Is New Zealand's Reserve Bank Act of 1989 an Optimal Central Bank Contract?" University of California at Santa Cruz, Department of Economics, mimeo, March.

———. 1994b. "When Should Central Bankers Be Fired?" University of California at Santa Cruz, Department of Economics, mimeo, April.

———. 1994c. "Central Bank Independence and the Costs of Disinflation in the EC." University of California at Santa Cruz, Department of Economics, mimeo, June.

Discussion

*Richard N. Cooper**

Charles Goodhart and José Viñals have written a comprehensive and informative paper on central bank independence and the pursuit of price stability as the prime target of monetary policy, covering both recent developments and the arguments surrounding them. They typically exercise good judgment in their preferences among the arguments, or remain agnostic. But taken as a whole the paper left me distinctly uncomfortable, more for what it does not say than for what it does. I will try to explain why, under four headings.

Limited Coverage of the Study

First, it is a pity that the authors' coverage is limited to Europe with a few side comments on other countries, and in particular that they did not include Japan and the United States in their discussion. Had they done so, they would have discovered in the United States an independent central bank without quantitative targets (I do not count the obligation to report under Humphrey–Hawkins as serious targets) or even a primary objective, yet with a record of performance that is not obviously worse than that of most European countries; and they would have discovered in Japan a central bank subservient to the Ministry of Finance with an outstanding recent record measured by the consumer price index. These two examples suggest that the generality of some of their conclusions is not warranted: for example, the close link between independence and a primary target, or between independence and good anti-inflation performance.

*Maurits C. Boas Professor of International Economics, Harvard University.

They also fail to include developing countries except for an occasional reference. To include them would have led to much greater skepticism regarding intermediate monetary targets and, indeed, might have led them to question the desirability of the primacy of price stability as the objective of monetary policy, a point to which I return below.

On the first point, part of the process of development is evolution of the financial system and increasing monetization of the economy, that is, a downward trend in velocity on any given conventional measure of the money supply, but on paths that are not always regular or easily predictable. One recent study of developing countries has shown that against this downward trend, annual velocity actually increased by more than 5 percent—a substantial increase—20 percent of the time; some velocity increases clearly were associated with identifiable external supply shocks such as the two major increases in world oil prices (1974 and 1979–80), but the origins of many increases were not so readily identifiable or predictable (see Little and others 1993, pp. 328–32).

On the second point, moderate inflation in a country with poorly developed financial and tax institutions may be not only a very effective source of seigniorage revenue through the "inflation tax" on money balances, but also a relatively efficient tax, in the sense of giving rise to fewer distortions than alternative sources of revenue and reaching parts of the population otherwise difficult to tax. That fact makes the currency board experiments in Argentina and Estonia all the more remarkable, but they must be understood in the context of establishing a credible change in monetary regime rather than optimal management of a given monetary regime. Goodhart and Viñals might also have mentioned that Colombia in 1991 adopted an independent central bank, in that it cannot be instructed by the government (although the minister of finance chairs the independent monetary board, as he did in the early days of the U.S. Federal Reserve System) and it cannot lend to the government.

Price Stability as a Primary Target

My second unease about the Goodhart and Viñals paper is its implicit and uncritical acceptance of price stability as the primary objective of central bank action, with little discussion of when this target should be overridden (for example, in their brief discussion about whether to target the price level or the rate of inflation, or in their brief allusion to the possible need for modification in the presence of large supply shocks—possible modifications that incidentally greatly cloud the lack of ambiguity they prize for establishing accountability). In particular, they devote too little attention to assuring the smooth functioning of the financial system. All modern economies rest on an

extensive network of credit, and this network in some respects is a house of cards, resting on diverse expectations and on confidence by each agent in continuity. The financial system is therefore vulnerable to unexpected, large real or financial shocks. A lender of last resort is required to underpin the system. But to function properly, a lender of last resort for prudential reasons should also have some supervisory role—or very close liaison with those who have that responsibility—over the institutions with potential access to the lender of last resort.

Moreover, Goodhart and Viñals fail to consider the economic role that changes in price levels sometimes play in modern economies, for example in introducing a degree of real wage flexibility when for many reasons nominal wages are difficult to reduce. In the context of countries attempting to integrate, and therefore attempting to fix their exchange rates, national movements in price levels may be an essential element in adjusting to regional shocks. Concretely, unification of Germany on the terms on which it occurred called for a relative rise in prices in Germany relative to its neighbors. If, for whatever reason, the deutsche mark was not allowed to appreciate, attempting to prevent the German price level from rising relative to that of its major trading partners would then have thwarted an important mechanism of adjustment.

Coordination of Monetary and Fiscal Policy

Third, without developing the point, Goodhart and Viñals seem to accept the conventional European wisdom that having price stability as the prime objective *for central banks* will require close coordination of fiscal policy as well. This proposition has generated extensive discussion inappropriate to rehearse here, except to record my view that it would be undesirable to have too close coordination (through rules) of fiscal policy in a monetary union. More to the point of the paper, if price stability is to become the prime objective of governments, as a call for close coordination of monetary and fiscal policies suggests, it leaves the reader puzzled about why the independence of central banks is so important. But if price stability is not to be the primary objective of macroeconomic policy, why should fiscal policy be *coordinated* with monetary policy, as distinguished from taking into account the central bank's likely actions in pursuit of its primary objective, price stability?

Political Accountability of the Central Bank

Finally, the authors suggest that the arrangements in the Maastricht Treaty for the forthcoming European System of Central Banks are modeled on the German Bundesbank, and indeed are necessary in the

interests of central bank independence and pursuit of price stability after the formation of the Economic and Monetary Union. I strongly disagree with this formulation. It plays on an ambiguity in the word "independence." The German Bundesbank and the U.S. Federal Reserve System are independent of government in a meaningful sense of that term, one that contrasts with central banks, for example, in Britain, Japan, and France until recently. But they are not independent of the political process. The Maastricht Treaty comes as close as it can to making the European System of Central Banks independent of the political process, and that in my view is highly undesirable.

The central tenet of democratic government, the ultimate basis for its legitimacy, is accountability to the public by all officials who make policy decisions affecting public welfare. Democracies differ greatly in their detailed institutional arrangements for providing accountability, but all share that fundamental principle.

The Maastricht Treaty fails to satisfy this fundamental principle. It creates a body of Platonic monetary guardians, accountable to no one, to frame and execute one of the most important aspects of policy in modern economies, affecting tens or even hundreds of millions of people. This was done in the name of insulating monetary policy, and its primary objective of price stability, from political pressure, of endowing the new European central bank with political independence, as the German Bundesbank apparently has.

But Maastricht has taken the notion of central bank independence much too far. It is true that the central banks of Germany and the United States are independent of the sitting government, in that they cannot be given orders with respect to monetary policy. In particular, they cannot be required to finance government deficits. But they are certainly not independent of the political *process* in those countries, as any of their central bankers would testify. Both are created by simple statute, and a change in the statute could sweep away the independence. That is not so easy to accomplish under the separation of powers in the United States: Both houses of the Congress as well as the President would have to agree. Even so, members of the Board of Governors of the Federal Reserve System pay close attention to congressional sentiment, although they rarely yield to it.

Under Germany's parliamentary system, a Chancellor who felt thwarted by the Bundesbank could, with his parliamentary majority, simply change the central bank statute. Any Chancellor that tried to do so in recent years, however, would find himself fighting for his political life. It is laudatory German public opinion, not formal legal devices, that protects the independence of the Bundesbank. That is as it should be in a democratic society, the essence of which is full accountability of government to the general public.

Being embedded in the political process, even though independent of the sitting government, creates invisible but effective limits to the arbitrary exercise of power by these independent central banks; protecting their independence requires that their actions continue to command support, even if only grumbling support, by a majority of the public. And members of the governing bodies of these central banks are conscious of that important condition.

The Maastricht treaty ignores this fundamental point. Once the European Monetary Union is in place, only revision of the treaty, requiring ratification by all member country parliaments, could alter the decisions of the European System of Central Banks.

How could the European System of Central Banks be made politically accountable, yet retain its operating independence for monetary policy? One approach would be to give additional powers to the European Parliament to alter the statute of the European Central Bank; that is, by analogy with independent national central banks, make the statute subject to legislation (perhaps by special majority), rather than the much more arduous (and unanimous) process of treaty amendment. But that would imply a strong move toward a federal Europe, which Europeans do not seem ready to commit to now.

An alternative would be to permit the European Council by special majority to override actions by the European System of Central Banks, but only after debate in national parliaments. Alternatively, the European Parliament could be designated as the venue for the debate. The analogy here is the arrangement in the Netherlands, whereby in the final analysis the Minister of Finance can dictate policy to the Dutch central bank, but the Governor of the bank can insist on a parliamentary debate on the override.

Or the two possibilities could be combined, with the European Parliament having authority to initiate a change in the statute of the European System of Central Banks, but the change taking effect only with the approval of the European Council. Any of these arrangements would provide some measure of accountability, and would put the European System of Central Banks on notice that its actions must remain within the bounds of public acceptability.

Why did Maastricht go as far as it did to assure a very strong form of central bank independence and the primacy of price stability? The answer partly reflects the strong and sometimes helpful working hypothesis of the economics profession that, in the medium to long run, money supplies affect only price levels, not the real side of economies, so that central bank actions can only influence prices in the long run. This working hypothesis through repetition and use has come to be accepted as fact, as a structural characteristic of actual economies. It is a dangerous assumption, largely because it is rarely questioned. The

evidence is ample that it is false in a short run that runs for several years. The best that can be said about the empirical evidence over longer periods is that with sufficient imagination by the estimators, the hypothesis cannot be rejected—a very weak test on which to base important policy decisions.

An alternative interpretation that has come into favor among central bankers is that price stability facilitates increases in real income. That does not stand close empirical inspection, either. Successful attempts to find that inflation is costly in terms of growth in total output or in productivity derive their power from a few outlying observations. In cross-section analysis, Argentina plays this role. It is not difficult to agree that high rates of inflation—several hundred percent a year or more—are disruptive of society, including resource allocation in the economy. But that observation hardly applies, without independent supporting evidence, to differences between 4 and 2 percent a year, or between 2 and zero percent. In time series analysis, the two oil shocks play the role of the outliers, depressing output and raising prices at the same time. Big supply shocks indeed pose serious problems for macroeconomic management, but targeting price stability will not help solve those problems. And generalizations from such events should not be applied to other periods.

The other answer as to why Maastricht contains the provisions it does of course lies in a deep dissatisfaction with inflation in the 1970s and early 1980s, and a desire to ensure that the new European central bank can pursue a policy of price stability without political interference. That may be a legitimate reflection of the preferences of today's Europeans, and certainly of their political leaders. But that expression of preference should be subject to public review from time to time, since both people and circumstances change over time. In particular, an overwhelming preoccupation of European leaders with inflation today has the flavor of a general staff planning its force structure and operational doctrine to fight the last war. Inflation is not likely to be the principal problem of the world, or the European, economy during the next decade. On the contrary, the next decade may well be dominated by deflationary tendencies, owing to weak balance sheets in Japan and Europe, and residually in the United States, and to the extreme caution in lenders that events of the past five years have engendered. And, not least, to the deflationary convergence requirements of the Maastricht Treaty itself.

In my view, Maastricht would increase the democratic gap in the Community beyond the point of tolerability. Some modification of the arrangements for political accountability are almost certain to be made before the European Monetary Union comes into existence. Whether such modification marks a further step toward a unified Europe,

achieving accountability by enlarging the powers of the European Parliament, or whether it reverts to a community of nations, by giving the Council of Ministers some political override on the European System of Central Banks' decisions, is the critical question that Europeans must decide in the coming years.

Reference

Little, I.M.D., Richard N. Cooper, W. Max Corden, and Sarath Rajapatirana. 1993. *Boom, Crisis, and Adjustment: The Macroeconomic Experience of Developing Countries*. New York: Oxford University Press.

How Independent Should a Central Bank Be?

*Guy Debelle and Stanley Fischer**

The case for an independent central bank is increasingly accepted. The central banks of Chile, France, Mexico, New Zealand, and Venezuela have all had their independence enhanced; the Maastricht treaty requires national central banks participating in the European System of Central Banks to meet a prescribed standard of independence; and a lively discussion is under way in Britain of the desirability of making the Bank of England, now explicitly subservient to the Treasury, independent.[1]

This new orthodoxy is based on three foundations: the success of the Bundesbank and the German economy over the past 40 years; the theoretical academic literature on the inflationary bias of discretionary policymaking; and the empirical academic literature on central bank independence.[2] Every orthodoxy, even an incipient one, deserves to be questioned;[3] and there is indeed reason to be careful about the lessons

*At the time this paper was presented, Debelle was a Ph.D. student in the Department of Economics at the Massachusetts Institute of Technology, where Fischer was Professor of Economics. Debelle joined the Research Department of the Reserve Bank of Australia in September 1994; Fischer is on leave from MIT at the International Monetary Fund. The authors thank Rudiger Dornbusch and Peter Klibanoff for useful suggestions. This paper has also benefited from comments by participants at the Center for Economic Policy Research (Stanford)–Federal Reserve Bank of San Francisco conference in March 1994, and the Macroeconomics seminars at MIT and Harvard.

[1] See, for instance, Roll Committee (1993) and Vibert (1993).

[2] The analytic literature starts from Kydland and Prescott (1977); most recently, see Persson and Tabellini (1993) and Walsh (1993). The academic literature on central bank independence is comprehensively summarized in Cukierman (1992); see also Cukierman and others (1993).

[3] Hall (1994) questions the new conventional wisdom by focusing on the Bundesbank, arguing that its success is due more to the nature of wage bargaining in the German economy than to its independence.

drawn from recent work. In particular, the literature does not establish that more independence is necessarily better than less.

We examine each of the three legs of the current argument for central bank independence. First, while the Bundesbank has achieved an enviable record of producing price stability, it has done so in 1993–94, as in the early 1980s, at a high price in terms of forgone output. It is not self-evident that the Bundesbank's trade-off between inflation and output should be emulated in other countries. Indeed, it is puzzling that a central bank that supposedly commands massive credibility has, since 1980, presided over two big recessions in order to maintain low inflation.

Second, the academic literature on dynamic inconsistency does not point directly to an independent central bank as the solution to the inflationary bias of discretionary policy; rather, dynamic inconsistency was advanced originally as an argument for a monetary rule rather than discretion, and a monetary rule does not need an independent central bank. The more relevant game-theoretic argument derives from the work of Rogoff (1985) and suggests the appointment of conservative central bankers as a solution to the inflationary bias problem.[4] But the Rogoff approach also implies that a central bank can be too independent to be socially optimal.[5] Recently this literature has been taken in a new direction by Walsh (1993) and Persson and Tabellini (1993) to examine incentive contracts for central bankers, along the lines of the contract of the Governor of the Reserve Bank of New Zealand (Dawe 1990).

The empirical literature on central bank independence shows a significant negative correlation between average inflation over 10-year periods and a measure of independence (constructed from legal provisions) among developed countries. However, the coefficient on this measure is positive, although not significant, in a regression that also includes less developed countries (Cukierman 1992, p. 420). The negative correlation among industrialized countries may reflect merely the common influence of a national aversion to inflation that affects both inflation and central bank independence: As shown below, countries with less aversion to inflation will tend to have less independent central banks.[6,7] Cukierman and colleagues (1993), attempting to deal with reverse causation, show that growth and central bank independence

[4] Lohmann (1992) extends the Rogoff rule to allow the conservative central banker to be overruled by the government, at a cost; this produces a non-linear rule in which the central bank responds proportionately more strongly to large than to small disturbances.

[5] Freedman (1993) presents an interesting perspective on the increased interest in central bank independence, emphasizing the growing recognition of the need for a clear mandate for the central bank, and for central bank accountability.

[6] See Debelle (1994).

[7] Here the independence of the central bank is measured by the weight placed on inflation relative to that placed on output in the bank's loss function.

remain significantly positively correlated even when an instrumental variables procedure is used.

In discussing central bank independence, it is useful to draw a distinction between *goal independence* and *instrument independence*.[8] A central bank has goal independence when it is free to set the final goals of monetary policy. Thus, a central bank with goal independence could, for instance, decide that price stability was less important than output stability and act accordingly. Goal independence is related to the Grilli, Masciandaro, and Tabellini (1991) concept of political independence; however, by political independence they mean the central bank's ability to pursue the goal of low inflation free of political interference.[9] According to these authors, the German and Dutch central banks have the most political independence. A bank that has instrument independence is free to choose the means by which it seeks to achieve its goals.[10] The Reserve Bank of New Zealand, whose goals are precisely described in a contract with the government, has no goal independence; however, it has instrument independence since it chooses the method by which it tries to achieve the pre-assigned goals.[11] A central bank whose task was specified as attaining a given growth rate of the money stock would have neither goal nor instrument independence.[12]

In this paper we first review empirical evidence on the relationship between central bank independence and economic performance, in that context discussing the performance of the Bundesbank. Next a model developed by Debelle (1994) shows how to determine the optimal objective function for a central bank. We then discuss lessons of recent work on optimal incentive contracts for central banks and relate them to the distinction between goal and instrument independence for the central bank.

We will argue that industrialized countries face a real trade-off between the length and depth of recessions and the variability of inflation, and that the trade-off is not best left to a central bank that is isolated from political pressures. Rather, central banks need to be given a clear mandate and clear incentives to perform, and they must be *accountable* for their actions. Comparing the Federal Reserve and the

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[8] The distinction is related to that drawn by Grilli, Masciandaro, and Tabellini (1991) between *political* and *economic* independence.

[9] Although these authors state in their text that this is their criterion, all but one of the eight variables they include in their measure of political independence relate to freedom from government intervention in central bank decisions.

[10] The definition here differs slightly from that of Grilli and his colleagues, who define economic independence by the extent of government access to central bank credit, by whether the central bank sets the discount rate, and by whether it supervises banks.

[11] Grilli, Masciandaro, and Tabellini (1991) would describe the Reserve Bank of New Zealand as having complete political independence.

[12] A little ambiguity exists here, since technical decisions still have to be made in deciding how best to hit a given money supply target.

Bundesbank, we will argue that while the Bundesbank has successfully defined a clearer mandate for itself, the Fed comes closer to meeting the accountability criterion—and that each could benefit from moving in the direction of the other.

Empirical Evidence on Central Bank Independence

Although both the Barro and Gordon (1983) and the Rogoff (1985) articles are usually cited in any discussion of the case for central bank independence, they have different implications. Barro and Gordon argue that the inflationary bias of the discretionary equilibrium in their model is a case for a monetary rule. In their initial non-stochastic equilibrium, the optimal rule would fix the money stock or money growth rate. Once uncertainty is introduced and the level of output is affected by shocks, the case becomes one for a feedback rule, in which monetary policy responds optimally to shocks. This would be a rule without discretion, and an independent central bank would not be needed, just a technical institute to implement the rule.

Rogoff's solution to the need for flexibility in monetary policy to respond to shocks is to install a conservative central banker with the discretion to respond to shocks and the conservatism to keep the mean rate of inflation low. Because the central banker is conservative, the response to shocks is also conservative; the optimal central banker is chosen by trading off the reduction in mean inflation secured by conservatism against the less than optimal trade-off between inflation and output variability produced by that same conservatism. It is not optimal in the Rogoff model to appoint a central banker whose only concern is low and stable inflation.

Interpreted in terms of goal and instrument independence, the Rogoff central bank can be thought of as having no goal independence—its goals are those of the appointed central banker—and full instrument independence.[13] It is important to note that the Rogoff model implies that if countries have central banks with differing degrees of conservatism, but are hit by similar shocks, then a trade-off should be observed between the variability of output and that of inflation, across countries.

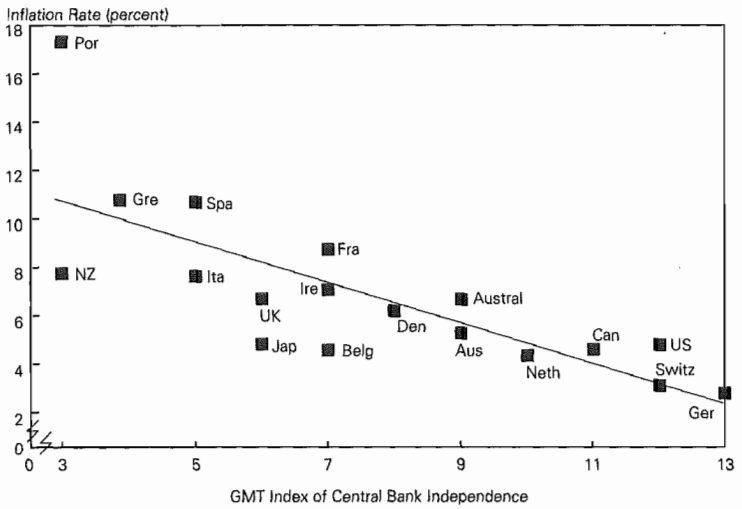
The Rogoff approach is the basis for the definition of central bank independence as the relative weight on inflation in the central bank's loss function: The more single-mindedly the law specifies that a central bank seek to preserve the value of the currency, the more independent

[13] Alternatively, one could say that instrument independence is not explicitly discussed in the Rogoff central bank model.

Figure 1

Inflation and Central Bank Independence[a]

Industrialized Countries



[a] As measured according to an index developed in Grilli, Masciandaro, and Tabellini (1991), here labeled GMT Index.

it is taken to be. This is the definition used in constructing most indices of central bank independence. It almost makes the basic empirical result of the independence literature, that central bank independence and inflation performance are negatively related (Figure 1), a tautology.[14] However, it is not a tautology, since the legal provisions on which most measures of central bank independence are based do not necessarily translate into effective action.[15]

The most striking result of the empirical work is that central bank independence appears to have *no* adverse consequences. Grilli, Masciandaro, and Tabellini (1991) show that the improved inflation performance associated with increased central bank independence for indus-

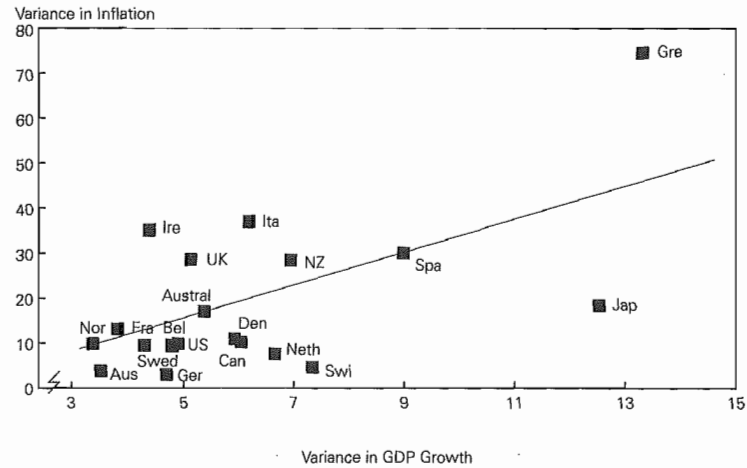
[14] In Figure 1 the inflation rate is plotted against the GMT (Grilli, Masciandaro, and Tabellini) index of central bank independence. Cukierman (1992), Chapter 19, compares the different indices.

[15] As noted above, the basic result does not apply when the sample is extended to include developing countries (Cukierman 1992).

Figure 2

Variance in Inflation and in Output Growth

Industrialized Countries, 1960 to 1992



trialized countries does not come at a cost in terms of forgone growth. Similarly, for a cross-section of countries including less developed countries (LDCs), Cukierman and others (1993) find that while legal independence is negatively related to growth, the coefficient is not significant; an alternative (inverse) measure of central bank independence, the frequency of turnover of the central bank governor, is negatively related to growth (and positively related to inflation). Thus, improved inflation performance does not seem to come at a cost in terms of lower growth.

Figure 2 shows the relationship between the variability of inflation and the variability of GDP growth over the 1960–92 period, for the countries for which Grilli, Masciandaro, and Tabellini constructed measures of central bank independence (the GMT index). The association between these measures of variability is positive and significant, though the statistical significance disappears if Greece is excluded from the sample.[16]

[16] Alesina and Summers (1993) and Eijffinger and Schaling (1993) examine the relationship between alternative measures of central bank independence and inflation and output growth variability. Eijffinger and Schaling find that inflation variability is significantly negatively related only to the GMT index (in two out of three decades), and that

The standard loss function in this literature penalizes deviations of the *level* of output from its target level, rather than the variability of output growth. Using measures of output deviations from linear and quadratic trends (of log output), we still find a positive but insignificant correlation between output and inflation variability.

These results could reflect either reverse causation from inflation aversion to central bank independence or, closely related, the presence of a third factor that produces both economic stability and independence. As noted above, Cukierman and others (1993) have investigated the reverse causation issue econometrically. Havrilesky and Granato (1993) include both measures of the extent of corporatism[17] and the index of central bank independence in a regression for the rate of inflation, and they find that none of the measures of corporatism, separately or all together, enter significantly. By contrast, Hall (1994) argues that centralized collective bargaining at the industry level (with IG Metall setting the pattern) is at least as much responsible for low inflation in Germany as is the independence of the Bundesbank.

On balance, the existing evidence suggests that central bank independence is a free lunch:[18] It brings lower inflation and lower inflation variability, at no cost in terms of lower output growth or greater output variability. We will investigate the relationship between legal independence and inflation in more detail below.

Nonetheless, an important anomaly remains. Recall the implication of the Rogoff model that a negative relationship would be expected between the variability of output and of inflation if countries were being hit by the same shocks, and if the central banks were efficient but differed in their relative tastes for inflation and output variability. At least three factors could account for the positive relationship that in fact obtains (Figure 2). If the variance of shocks differs systematically by country, then we would expect to find a positive relationship, with countries that are hit by bigger shocks[19] having greater variability of both inflation and GDP growth. Or, if some central banks are more efficient than others, they would do better at stabilizing on both dimensions. Or, if more independent central banks are also more credible on inflation,

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output growth variability is not significantly related to any of the measures of independence. Alesina and Summers find that inflation and inflation variability are negatively related to central bank independence, but that growth and the variability of growth are unaffected by it.

[17] They include three measures of the power of organized labor, two measures of the leftward leaning of the government, and two measures of the size of the public sector.

[18] This phrase was first used in the present context by Grilli, Masciandaro, and Tabellini (1991). See also Eijffinger and Schaling (1993) and Debelle (1994).

[19] These shocks could be self-inflicted: for instance, greater variability of government spending.

they may obtain a "credibility bonus" that makes the economy respond more rapidly to monetary policy changes.[20]

We are inclined to believe that the positive relationship between output and inflation variability shown in Figure 2 reflects both differences in the magnitude of shocks affecting different economies and differences in the efficiency with which policymakers respond to those shocks.[21] Countries with independent central banks are likely to be countries with more disciplined governments and thus are likely to suffer smaller self-inflicted shocks. Their central banks are likely to have better research staffs and abler and more experienced decision-makers. We suspect that the credibility bonus explanation would receive general support, but we are more skeptical and will return to the issue below.

The evidence reviewed here leaves little doubt that, on average, economic performance is better in countries with more independent central banks. But we will advance the view that, for the most sophisticated central banks, a trade-off remains between price level and output stability, and that a central bank can be too independent. We pursue the argument in a comparison of the Bundesbank and the Fed.

The Bundesbank and the Fed

Every central bank confronted with an inflationary shock has to decide how rapidly to try to reduce inflation; the more drastic the attempted correction, the larger will be the decline in output. To illustrate, by 1991 the Bundesbank knew that it faced rising inflation. It could at that point have tightened money and raised short-term interest rates to, say, 15 percent. Such a decision would have prevented some of the subsequent inflation, at a cost in terms of forgone output. Instead, it chose to fight the inflation more gradually. In the fall of 1993, it faced another decision, of whether to cut interest rates more rapidly, tending to increase output but at the cost of a slower decline in the inflation rate. It chose not to cut interest rates rapidly, thereby slowing the recovery from the recession.[22]

To return to the credibility bonus: It is widely agreed that the Bundesbank commands great credibility, as a result of both its indepen-

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[20] Kenneth Rogoff has pointed out that the relationship would also be positive if countries differ only in the wedge between the natural rate of unemployment and the socially optimal rate.

[21] Taylor (1982) argues that the trade-off between output and inflation variability can differ across countries due to "taste" or structural differences, but that a trade-off does exist.

[22] We take it for granted here that a short-run trade-off exists between output and inflation, and that every central bank believes that too.

Table 1
Estimates of the Sacrifice Ratio

Country	Disinflation Period	Length (Quarters)	Output Loss of GDP (%)	Initial Rate of Inflation (%)	Change in Inflation Rate (Percentage Points)	Sacrifice Ratio
United States	1969:IV–1971:IV	8	6.29	5.67	2.14	2.94
United States	1974:I–1976:IV	11	9.56	9.70	4.00	2.39
United States	1980:I–1984:III	15	16.20	12.10	8.83	1.83
United States	1989:IV–1993:I	13	6.05	5.02	2.03	2.98
Germany	1965:IV–1967:III	7	6.22	3.67	2.43	2.56
Germany	1973:I–1977:III	18	11.20	6.92	4.23	2.64
Germany	1981:I–1986:III	26	21.20	5.86	5.95	3.56
Germany	1992:II–			3.96		

Source: Output losses and periods of disinflation are taken from Ball (1993) with the inclusion of corrections from a later version of that paper, and the authors' calculations.

dence and its consistent anti-inflationary behavior. This credibility should have enabled it to deal with inflationary shocks at less output cost than less credible central banks, such as the Federal Reserve. Nonetheless, since 1980 it has had to produce two major recessions to keep inflation low. From 1980 to 1983, the German economy was in recession as the Bundesbank fought the consequences of the second oil shock. From 1992 to the present, mid 1994, the German economy has been in recession as it fights the consequences of unification.

In Table 1 we present estimates of the output costs (as a percentage of GDP) of recessions in Germany and the United States since the first oil shock in 1973. Surprisingly, the output cost of German recessions is higher than that of U.S. recessions. Indeed, the sacrifice ratio in Germany is generally larger than that for the United States for all recent recessions.

In Figure 3 we plot output losses in recessions since 1962 against the GMT Index measure of central bank independence.[23] The overall relationship is positive; it is also statistically significant. This implies that the output loss suffered during recessions has on average been larger, the greater the independence of the central bank.

Using an expectational Phillips curve

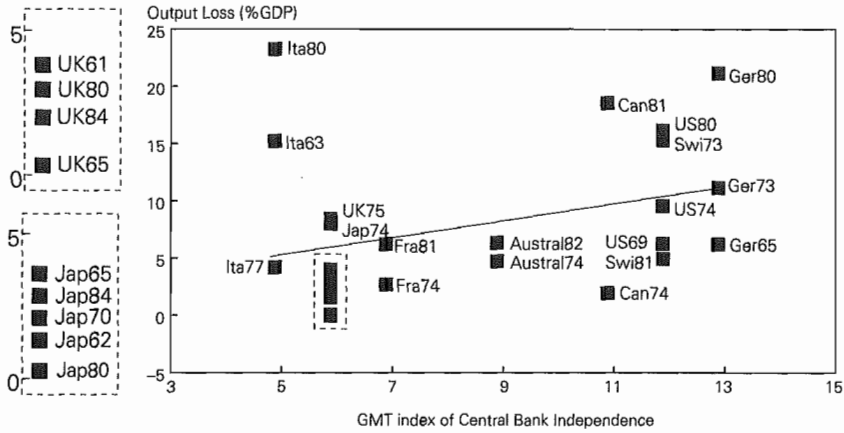
$$y_t = y^* + \beta(\pi_t - \pi_t^e) + \varepsilon_t \qquad (1)$$

[23] This relationship was discovered independently by Adam Posen (1993). The output loss measures are taken from Ball (1993) with the inclusion of corrections from a later version of that paper.

Figure 3

Output Loss and Central Bank Independence[a]

Industrialized Countries



[a] As measured according to an index developed in Grilli, Masciandaro, and Tabellini (1991), here labeled GMT Index.

where y^* is the full employment level of output, π is the inflation rate, π_t^e is the expected inflation rate, and ε_t is a supply shock, the cumulative output loss during any disinflation is

$$L = \sum_{t_0}^{T} [\beta(\pi_t - \pi_t^e) + \varepsilon_t] \tag{2}$$

where t_0 is the starting point and T is the end of the disinflation. The more credible the central bank, the larger is β, for reasons demonstrated in Lucas (1973). Thus, comparing output losses in two countries, one factor, β, would tend to make the loss larger in the country with the more credible central bank: The Phillips curve in that country would be flatter. If the sum of unanticipated disinflation and the supply shocks were the same in the two countries, then the output loss would be higher in the country with the more credible central bank.

However, there is no reason whatsoever to expect the amount of unanticipated disinflation to be the same: When the more credible central bank announces that it will reduce inflation, the expected

inflation rate should fall, and output should not. Thus, it is a puzzle for those who believe that the Bundesbank should have a credibility bonus that Germany has had to go through recessions at least as severe as those in the United States in order to secure reasonable price stability, particularly given Hall's (1994) argument that the pattern of wage bargaining in Germany is more conducive to low inflation.

Indeed, this evidence gives the clear impression that the Bundesbank's credibility is far greater in the asset markets—at least judging from the newspapers[24]—than in the labor markets. At present we have no satisfactory explanation for this difference, but as the positive slope in Figure 3 shows, the phenomenon extends beyond the United States–Germany comparison: Countries with greater central bank independence tend to have greater output losses during recessions. This suggests that no credibility bonus exists in the labor markets for more independent central banks: They have to prove their toughness repeatedly, by being tough.

Ball, Mankiw, and Romer (1988) show that the Phillips curve is steeper at higher rates of inflation; thus, the higher output cost in Germany (say) may be caused by the fact that it started disinflating from a lower initial level of inflation. However, controlling for initial inflation, the positive relationship seen in Figure 2 still remains. An alternative explanation for the relationship in Figure 2 is that different labor market features may affect the slope of the Phillips curve and hence the amount of unemployment and output loss necessary to achieve a given disinflation. Accordingly, we have run regressions that include a number of variables to capture labor market institutions, including the degree of wage flexibility, the degree of labor market unity, and the replacement ratio.[25] Only the replacement ratio entered significantly, but central bank independence remained significant in all cases.

In Table 2 we present the mean inflation rates and growth rates, as well as the variability of inflation and growth[26] for the United States and Germany for the period 1960 to 1992. Inflation in Germany was lower than that in the United States over the period, and growth rates were the same. The United States has more stable output and less stable inflation. No doubt the United States could have had more stable inflation, if its central bank had been more devoted to fighting inflation. Should it have had such a central bank? While the empirical results on central bank independence appear to say yes, since greater independence comes with lower inflation and no evident costs, the comparison with German

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[24] That is to say, it is generally believed by asset market participants that the Bundesbank is a tough inflation fighter.

[25] The labor market variables are from Havrilesky and Granato (1993) and from Layard, Nickell, and Jackman (1991).

[26] Similar results hold for the variability of output around linear or quadratic trends.

Table 2
Inflation and Growth Rates and Variability

Quarterly data, Estimated over 1960 to 1992/3	United States	Germany
Average inflation	1.19	.84
Variance inflation	.69	.43
Average real growth	.73	.73
Variance real growth	.88	1.42
Sum squared residuals of log output against:		
Annual data		
linear trend	.049	.080
quadratic	.023	.029
Quarterly data		
linear	.208	.347
quadratic	.101	.128

performance suggests that a trade-off exists and that we should investigate further the question of how independent (in the sense of anti-inflationary) the central bank should be.

How Inflation-Averse Should the Central Bank Be?

In this section we present a model, from Debelle (1994),[27] in which to consider the optimal degree of inflation aversion of the central bank. The model includes a central bank that sets the inflation rate and a fiscal authority that sets (distortionary) taxes and government spending and receives seigniorage from the central bank. Output is produced by labor, whose nominal wage is predetermined; firms maximize after-tax profits and can hire the amount of labor they demand at the predetermined nominal wage.[28]

Society's loss function, or the loss function of the social planner, is given by:[29]

$$V_S = \frac{1}{2}\left[s_\pi \pi_t^2 + s_x(x_t - x^*)^2\right]. \tag{3}$$

[27] The model draws on Alesina and Tabellini (1987).

[28] The single-period version of the model is presented here; the model is extended in Debelle (1994) to two periods, which allows the government to issue debt.

[29] In Debelle (1994) the social loss function also includes government spending, as in the fiscal loss function below (equation 5). No significant results appear to depend on the inclusion of g, which is omitted here for easier computation.

This loss function may be interpreted as reflecting the preferences of the society or those of the government. It differs from the loss function of the fiscal authority (equation (5) below), which includes also the level of government spending.

The social planner desires to have inflation as close to zero as possible and to minimize the deviation of output (x) from its target level x^*. We set the inflation target at zero, recognizing that measurement error and perhaps downward nominal price rigidities imply a slightly higher rate, say around 2 percent.[30] The target x^* is the one that would be chosen if non-distortionary taxes were available; s_π and s_x are weights on the inflation and output objectives.

The monetary authority is also assumed to be concerned only about the levels of inflation and output:

$$V_M = \frac{1}{2}[\pi_t^2 + \mu(x_t - x^*)^2]. \tag{4}$$

The parameter μ denotes the relative weight the central bank places on output relative to inflation. It is generally interpreted as the inverse of the extent of central bank independence, and will be used in that sense unless otherwise noted. However, measures of central bank independence in the empirical literature incorporate financial linkages between the central bank and the government, as well as μ, and the framework of this paper will allow us to distinguish these concepts. The (standard) loss function (4) is consistent with most central bank charters, although these generally also include responsibilities for the financial system.

The fiscal authority's loss function

$$V_F = \frac{1}{2}[\delta_\pi \pi_t^2 + \delta_x(x_t - x^*)^2 + \delta_g(g_t - g^*)^2] \tag{5}$$

includes government spending as well as inflation and output. We assume that $\delta_x/\delta_\pi > \mu$, that is, that the fiscal authority puts relatively more weight on output relative to inflation than does the central bank.

Distortionary taxes are levied on production and are the only tax available to the government. An increase in taxation reduces output (which in equilibrium is always below its target level). Output is produced by labor, L, and is subject to a white noise productivity shock, a_t.

$$X_t = L^\gamma e^{a_t/2}. \tag{6}$$

[30] Very little in this paper depends on the optimal inflation rate, though of course the evaluation of central bank independence, which assumes lower inflation is better, does.

Workers set the nominal wage, w (in logs), to achieve a target real wage w^*,[31] so that

$$w = w^* + p^e. \tag{7}$$

The representative firm's profit function is given by:

$$PL^{\gamma}e^{a_t/2}(1 - \tau) - wL. \tag{8}$$

Solving for the firm's labor demand, and assuming it can hire the labor it demands at the given nominal wage, gives (the log of) output supply:[32]

$$x_t = \alpha(\pi_t - \pi_t^e - \tau_t - w^* + \log\gamma) + \frac{a_t}{2(1 - \gamma)} \tag{9}$$

where $\alpha = \gamma/(1 - \gamma)$ and, for simplicity, we set $\gamma = 0.5$.[33]

The government budget constraint is given by[34]

$$g = \tau + \pi \tag{10}$$

where g and τ are expressed as a ratio to output. Although seigniorage is a non-linear function of inflation, it has been linearized here for simplicity; obviously, we assume that the economy is on the correct side of the Laffer curve.

Nash Equilibrium

The monetary authority chooses π_t and the government τ_t, taking expectations and each other's actions as given, after the workers have chosen the wage. Expectations are formed rationally. The reaction functions of the two authorities are as follows:

Monetary:

$$\pi = \frac{\mu}{1 + \mu}(\pi^e + \tau + C - g^* - a), \tag{11}$$

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[31] The target wage w^* may be explained by efficiency wage theories or an insider/outsider model. See the discussion in Alesina and Tabellini (1987), footnote 5, p. 621.

[32] Note that although the disturbance has been introduced in the supply function (6), it could as well have been incorporated directly as a demand shock in equation (9).

[33] Note from equation (10) that the problem of time inconsistency of optimal policy would disappear if the government had access to non-distortionary taxes, in this model as in Fischer (1980).

[34] As in Alesina and Tabellini (1987), the following assumptions are made. Money demand is given by $M_t = P_t + \bar{X}$ where $\bar{X}$ is independent of τ. Thus $\pi_t = m_t - m_{t-1}$. The government financing constraint is $G_t = \tau_t P_t X_t + M_t - M_{t-1}$ which when divided by nominal income gives $g_t = \tau + (M_t - M_{t-1})/M_t\bar{X}/X_t$ and hence approximates to equation (10).

Fiscal:

$$\tau = g^* + \frac{\delta_x - \delta_g}{\delta_x + \delta_g}\pi - \frac{\delta_x}{\delta_x + \delta_g}(\pi^e + C - g^* - a) \tag{12}$$

where $C \equiv (g^* + w^* - \log \gamma + x^*)$ is constant and independent of the policy weights.

These equations imply:

$$\pi_t = \frac{\mu\delta_g}{\delta_x + \delta_g + \mu\delta_g}C - \frac{\mu\delta_g}{\delta_x + \delta_g + 2\mu\delta_g}a_t, \tag{13}$$

$$x_t = x^* - \frac{\delta_g}{\delta_x + \delta_g + \mu\delta_g}C + \frac{\delta_g}{\delta_x + \delta_g + 2\mu\delta_g}a_t, \tag{14}$$

$$g_t = g^* - \frac{\delta_x}{\delta_x + \delta_g + \mu\delta_g}C + \frac{\delta_x}{\delta_x + \delta_g + 2\mu\delta_g}a_t, \tag{15}$$

$$\tau_t = g^* - \frac{\mu\delta_g + \delta_x}{\delta_x + \delta_g + \mu\delta_g}C + \frac{\mu\delta_g + \delta_x}{\delta_x + \delta_g + 2\mu\delta_g}a_t. \tag{16}$$

The key result is that, in contrast to the existing literature, inflation and output depend not only on the central bank's weight on output, but also on the fiscal authority's weights. They also depend on the parameters x^*, g^*, and w^*, which reflect the institutional and political structure of the economy.

The average level of inflation:

$$\bar{\pi} = \frac{\mu\delta_g}{\delta_x + \delta_g + \mu\delta_g}C \tag{17}$$

depends positively on the central bank's weight on output, μ. This is the standard time inconsistency problem: The more weight the central bank places on output, the greater the incentive to create surprise inflation. Since this is perceived by the workers, in equilibrium, higher inflation occurs but no gain in output. When the central bank's weight on output is zero ($\mu = 0$), then equilibrium inflation is zero.

Inflation depends positively on the spending target g^*, as an increase in the spending target requires more seigniorage financing. Inflation also depends positively on output and wages, as a higher output (employment) target or a higher real wage target increases the monetary authority's desire to inflate. Inflation depends negatively on

Table 3
Effects of Parameter Changes on the Economy

	$\uparrow \mu$	$\uparrow \delta_x$	$\uparrow \delta_g$	$\uparrow x^*$	$\uparrow g^*$
Inflation	↑	↓	↑	↑	↑
Output deviation $\lvert x - x^* \rvert$	↓	↓	↑	↑	↑
Govt. spending deviation $\lvert g - g^* \rvert$	↓	↑	↓	↑	↑

μ: monetary weight on output
δ_x: fiscal weight on output
δ_g: fiscal weight on government spending
x^*: output target
g^*: government spending target

the ratio of the fiscal authority's weights (δ_x/δ_g). An increased weight on the government spending target means that taxes are increased, thus reducing output and increasing the incentive of the monetary authority to inflate. An increased weight on output means that the fiscal authority reduces taxes to increase output, thus moving output closer to its target and reducing the incentive to inflate.

The average levels of output and government spending fall short of their respective targets, reflecting the trade-off the fiscal authority faces between spending and output. The difference between realized and targeted output is decreasing in μ, and decreasing in δ_x/δ_g. An increase in μ means that the central bank places more weight on the output objective, thus inflating the economy more and decreasing the level of distortionary taxes, while the opposite applies to the government spending gap. Table 3 summarizes these influences of the parameters on the economy.

The variance of inflation:

$$\sigma_\pi^2 = \left[\frac{\mu}{\delta_x/\delta_g + 1 + 2\mu}\right]^2 \sigma_a^2 \tag{18}$$

depends *positively* on μ and negatively on δ_x/δ_g.

The variance of output:

$$\sigma_x^2 = \left[\frac{1}{(\delta_x/\delta_g) + 1 + 2\mu}\right]^2 \sigma_a^2 \tag{19}$$

depends *negatively* on μ and δ_x/δ_g.

The increase in the variance of output when central bank independence is increased reflects the trade-off between flexibility and commitment highlighted by Rogoff (1985) and Lohmann (1992) and discussed at the beginning of this paper. When central bank independence is

increased to reduce the time consistency problem, the willingness to respond to shocks is decreased.

Inflation and taxation may be positively or negatively correlated. They respond in opposite directions to the productivity shock, but in the same direction to changes in the parameters (g^*, w^*). Optimal tax theory implies that inflation should be positively correlated with the level of other distortionary taxes, as each tax should be set such that the marginal distortion is the same. However, that assumes that the taxes are set by one authority. Here, the inflation tax is set by the monetary authority, which has different objectives from the fiscal authority. It prefers less seigniorage, whereas the fiscal authority always wants a higher level of seigniorage for a given level of government spending. Empirical examination shows no definitive relationship between inflation and taxation.[35]

The general presumption in the literature is that the decline in inflation as a result of increasing central bank independence must always decrease the value of the loss function (except in terms of the loss of flexibility discussed above). However, this relies on the specification of the loss function solely in terms of the central bank's objectives. Here, although the inflation rate is clearly zero when the central bank is fully independent, society is not necessarily better off in this case. The expected loss in each period is:

$$E[V_S] = E\left[\pi^2\left(s_\pi + \frac{s_x}{\mu^2}\right)\right] \tag{20}$$

$$= [\mathrm{Var}(\pi) + (E[\pi])^2]\left(s_\pi + \frac{s_x}{\mu^2}\right). \tag{21}$$

The first term is increasing in μ; however, the second term is decreasing in μ, because while more central bank independence reduces the level and variance of inflation, it also decreases output.[36]

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[35] See Grilli, Masciandaro, and Tabellini (1991), who found no systematic relationship across countries between the changes in the tax rate (expressed as the ratio of tax revenue to GDP) and changes in seigniorage (defined as the change in the money base relative to GDP).

[36] This conclusion may be overstated if further negative effects of inflation exist that are not captured in this simple model. For instance, inflation may have a negative effect on productivity (Selody 1990; Fischer 1993).

Optimal Aversion to Inflation by the Central Bank

Rogoff (1985) solved for the optimal degree of inflation aversion of the conservative central banker. His results were extended by Lohmann (1992), who shows that social welfare can be increased, at a cost, if the government retains the ability to override the conservative central banker. In equilibrium, the government does not overrule the central bank, but the threat of overruling ensures that the central bank follows a non-linear rule in which it responds more vigorously to large shocks than it otherwise would.

Implicitly, the social loss function in these articles is assumed to be that of the (original) central banker; it fails to be optimized only because of dynamic inconsistency. In our calculation of the optimal μ, we minimize (21) with respect to μ, thereby minimizing the social loss function (3).

While we do not obtain an explicit solution for μ (although it can be determined easily numerically), we can demonstrate the intuitive results that the optimal degree of central bank independence

- increases with society's aversion to inflation, and
- decreases with society's weight on output.

Thus, not surprisingly, the extent of central bank independence (defined as the central bank's aversion to inflation) may be determined by the country's underlying aversion to inflation. It remains true that for a given degree of inflation aversion, a country that institutes an independent central bank—with optimally chosen μ—will do better than one that simply endows the central bank with society's social welfare function. In this sense, the proposition that central bank independence enhances economic performance remains valid despite the endogeneity of central bank independence.

Stackelberg Equilibria

Although central bank independence is usually identified with μ in theoretical applications, empirical measures of it are closer to a more conventional sense of independence. By including provisions such as the term of central bank board members, and who chooses the governor, they come closer to measuring the central bank's ability to make decisions that are independent of those of the government.

The analytic model developed above does allow for independent decision-making by the central bank. It is conventional to examine the properties of only the Nash equilibrium, in which each actor takes the actions of the other as given. An alternative sense of the independence of the central bank relates to its need to accommodate the actions of the fiscal authority. To the extent that the central bank can fix its actions independent of the particular policy choice of the fiscal authority, it may

be said to be more independent. We examine the effects of independence in this sense by considering alternative Stackelberg equilibria.

Assume first that the fiscal authority moves first. The fiscal authority can be thought of as having the superior commitment technology in this case.[27] This yields the following inflation rate:

$$\pi_F = \frac{\delta_g \mu(1+2\mu)}{\delta_\pi \mu^2 + \delta_x + \delta_g(1+\mu)(1+2\mu)} C - \frac{\delta_g \mu(1+2\mu)}{\delta_\pi \mu^2 + \delta_x + \delta_g(1+\mu)(1+2\mu) + \delta_g(1+2\mu)\mu} a_t. \quad (22)$$

The Stackelberg equilibrium in which the fiscal authority leads has to be interpreted with care. In the equilibrium that underlies equation (22), the fiscal authority sets the level of government spending, but the monetary authority still gets to determine the inflation rate before the level of taxes is set. However, in choosing g, the fiscal authority takes into account the reaction of the monetary authority to the fiscal authority's choice of g. This equilibrium may be a more appropriate description of fiscal-monetary interactions in practice than the Nash equilibrium.

The fiscal authority may be the leader in another, more direct sense: It can set both τ and g and force the monetary authority to print whatever amount of money is needed to finance the deficit. This "fiscal domination" equilibrium, an equilibrium not unknown in the real world, is examined at the end of this section.

Alternatively, if the monetary authority is the leader, choosing π first and leaving the fiscal authority to specify g or τ, the inflation rate is:

$$\pi_M = \frac{2\mu\delta_g^2}{(\delta_x + \delta_g)^2 + 2\mu\delta_g^2} C - \frac{2\mu\delta_g^2}{(\delta_x + \delta_g)^2 + 4\mu\delta_g^2} a_t. \quad (23)$$

A solution like (23) is more likely to obtain if the central bank has set a money or inflation target path, from which it will deviate only under well-defined conditions.

First we examine the inflation rates under these assumptions. We would expect the inflation rate to be higher when the fiscal authority leads than in the Nash equilibrium, and to be lower than in the Nash equilibrium when the monetary authority leads. We can show

$$\pi_F > \pi_N \Leftrightarrow 2\delta_x > \delta_\pi \mu. \quad (24)$$

[27] This interpretation was suggested by David Laibson.

Since the fiscal authority is likely to place more weight on output relative to inflation (δ_x/δ_π) than the monetary authority (μ), we expect $\pi_F > \pi_N$.

Comparing the inflation rate when the monetary authority is the leader with the Nash inflation rate:

$$\pi_M < \pi_N \Leftrightarrow \delta_x > \delta_g. \tag{25}$$

Inflation is lower when the central bank leads if $\delta_x > \delta_g$, a condition that is likely to obtain.

Society's loss functions under the two different scenarios are given by:

Monetary:

$$E[V_S] = [\mathrm{Var}(\pi_M) + (E[\pi_M])^2]\left(s_\pi + \frac{s_x}{\mu^2}\left(\frac{\delta_x + \delta_g}{2}\right)^2\right), \tag{26}$$

Fiscal:

$$E[V_S] = [\mathrm{Var}(\pi_F) + (E[\pi_F])^2]\left(s_\pi + \frac{s_x}{\mu^2}\right). \tag{27}$$

Next, we could ask whether it is better, from the viewpoint of society, for the central bank to be a Stackelberg leader. Comparing the expected value of the social loss function when the central bank is a Stackelberg leader with its value at the Nash equilibrium, the loss function is smaller (that is, society is better off) when the central bank leads if condition (25) above holds and if $\delta_g < 1$ and $\delta_g + \delta_x < 2$.[28] Thus, provided the fiscal authority weights output losses at the margin more heavily than increases in government spending and does not place a very high weight on output and government spending, it is better from a social viewpoint for the central bank to lead.

We can interpret this result as stating that it is better for the central bank to precommit to an inflation path than to move simultaneously with the fiscal authority, provided that the fiscal authority will not impose excessively distortionary taxes in order to finance desired government spending. This is not a ringing endorsement for monetary precommitment: Monetary precommitment can be expensive if the fiscal authority is not responsible.

[28] This is a sufficient condition for society to be better off when the central bank is a Stackelberg leader. Note that the normalization in the loss functions is that the weight on inflation in the central bank's loss function is one. Further, it is assumed through the budget constraint (10) that one unit of g can be financed with one unit of inflation.

Society is always better off in the Nash equilibrium than if the fiscal authority leads, provided condition (24) holds, that is, provided the central bank is more inflation-averse than the fiscal authority.[39] Thus, independence of the central bank, in the sense that it is not required to finance a predetermined deficit, is desirable in this model.[40]

If the central bank is exceptionally weak, the fiscal authority may be able to force it to finance a pre-specified deficit. In this *fiscal domination* equilibrium, the fiscal authority in effect sets g, τ, and π, and the central bank is a cipher. If this happens, it appears likely that the inflation rate is higher than in the Nash equilibrium, and social welfare is lower.[41] This means that the Stackelberg equilibrium, in which the monetary authority leads, is preferable to fiscal domination—another argument for central bank independence, appropriately defined.

Summary of Findings

In the models in this section, as in Rogoff (1985), conservative central bankers underreact to output shocks. In addition, we have shown that:

- The optimal degree of conservatism of the central bank depends on the society's aversion to inflation and output fluctuations;
- Society will be better off if the central bank precommits to an inflation rate, provided the fiscal authority is reasonably well behaved;
- If the central bank is more inflation-averse than the fiscal authority, society will be worse off if the fiscal authority is able to determine the size of the deficit that must be financed by the central bank.

Optimal Incentive Contracts

Nothing in the above analysis points to the desirability of a central bank having unlimited independence. As in Rogoff's (1985) model, it is not optimal for the central bank to be monomaniacal about inflation; it should also react to output fluctuations.

But it is possible to do better than the "optimal" central bank of the preceding section. First, as previously noted, Lohmann (1992) shows in the context of the Rogoff model how a non-linear reaction function,

[39] This is a sufficient condition.

[40] Debt financing is not possible in this single-period version of the model. Debelle (1994) examines the effects of debt financing in a two-period set-up.

[41] That is, this result holds for all but unusual parameter values.

enforced by the threat of government overruling of the central bank, can improve economic performance.

More radically, Walsh (1993) and Persson and Tabellini (1993) have shown that a contract between the government and the central banker, in which the central banker's remuneration is tied linearly to the negative of the inflation rate, can attain the first best equilibrium. They model the relationship between the central bank and the government in a principal-agent framework.

The conservative central banker reduces the inflationary bias of monetary policy that results from dynamic inconsistency, but at the cost of responding too conservatively to output disturbances. As Walsh shows, in the standard central bank loss function, the inflationary bias is the *same* in each state of nature. Accordingly, appointing a central banker who has the same loss function as society (equation 3), and penalizing the central banker by an amount proportional to the inflation rate, enables society to obtain the first best solution.[42]

It should be emphasized that while, in this contract solution, the government directly rewards the central banker purely on the basis of the behavior of the inflation rate, the central bank is also concerned about the stability of output. Monetary policy accordingly responds actively to output disturbances.

If the central banker is not motivated by a combination of a penalty[43] and society's loss function, then the government can attempt to motivate through rewards or penalties based on the behavior of both output and inflation.[44] Once again, it is possible to attain the first best solution.

This analysis again assumes that the loss function of the central bank is that of society. If it were not, but was still known at the time of the contract negotiation, the transfer would include an extra term reflecting the difference between society's and the central bank's loss functions. However, if the loss function of the central bank was not known, the central bank might have an incentive to create *less* than the socially desirable rate of inflation, because its payment is linear in the inflation rate.

The principal agent framework developed by Walsh and by Persson and Tabellini allows one to examine the issue of accountability. The central bank is accountable to the government (and hence the public) to

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[42] This result is obtained by Walsh (1993) and also by Persson and Tabellini (1993). Walsh shows that the first best can also be obtained by penalizing the central bank by an amount proportional to the money stock—which is stochastically related to the inflation rate.

[43] Of course, it is only the marginal penalty that matters; the central banker has to be sufficiently well paid to want to take the job despite the risk of having to pay penalties.

[44] To obtain the first best outcome in this case, it is necessary to condition the central banker's penalty on the desired level of output. Walsh suggests this is difficult and that the first best solution may on this account be unattainable. It is not obvious why there should be any problem announcing a target unemployment rate, such as 5.5 percent.

achieve its inflation target. If it does not, then it is fined (which may in reality, take the form of dismissal). This issue is taken up in the next section.

The Central Bank Mandate and Accountability

The theories we have examined in this paper all imply that the central bank should have a clear mandate, whether in the form of a utility or loss function that specifies what it is to maximize, or in the form of a specific contract that penalizes inflation. In general, the contract instructs the central bank to minimize the social loss function plus the penalty for excess inflation. These theories are not equipped to deal with a fuzzy mandate or loss function, and it is difficult from the perspective of such theories to see the benefits of allowing the bank discretion as to its goals. That is, these theories all imply that central banks *should not* have goal independence.

The Reserve Bank of New Zealand has a clearly stated mandate to produce a particular path for or rate of inflation, one that is negotiated with the government. The agreement with the government allows for the inflation rate to be affected by supply shocks. The Federal Reserve has a vague mandate; that is, it has considerable goal independence. The Bundesbank is required both to maintain the value of the currency and to support the economic program of the government, provided that does not conflict with the goal of monetary stability. All three of these central banks have instrument independence.

The model in which the fiscal authority is a Stackelberg leader points to the importance of not leaving the fiscal authority with the power to fix the amount of deficit that must be financed by the printing of money. This type of central bank independence—freedom from having to finance the government—is likely to enhance economic performance.

The literature discussed in the previous section highlights the notion of *accountability*, emphasized by John Crow, former Governor of the Bank of Canada, and by the Roll Committee (1993). The central bank can be held accountable either in having to justify its behavior, or in having to pay a penalty for bad outcomes (or be rewarded for good outcomes). Accountability mechanisms differ. The Fed is accountable to the Congress, and to public opinion. The Bank of England is accountable to the Treasury. The Governor of the Reserve Bank of New Zealand is accountable to the government for meeting his contract. The Bundesbank has very little accountability: It does not have to account for its behavior to the legislature, though it could be argued that it is accountable to public opinion.

In an attempt to see which features of central bank structures

account for superior inflation performance, we use the Grilli, Masciandaro, and Tabellini (1991) data and a series developed by Cukierman, Webb, and Neypati (1992). Recall that Grilli and his colleagues create an index of political independence: an equally weighted sum of zero or one dummies for different aspects of, first, the appointment procedures of the governor and board members and, second, the extent of commitment to a target of monetary stability. Their index of economic independence includes zero or one dummies for the extent to which the central bank is required to finance the government, its freedom to set interest rates, and whether it supervises banks.

We have created three indexes from these measures. The first is the presence of a statutory requirement that the central bank pursue monetary stability among its goals; this is called *INFOBJ*. The variable *INFOBJ* is a measure, albeit an imprecise one, of the *lack* of goal independence of the central bank. The second is the Grilli, Masciandaro, and Tabellini (GMT) measure of political independence, but excluding *INFOBJ*. This variable, *POL7*, includes the legal provisions relating to appointments and the central bank's relationship with the government. The third is the GMT measure of economic independence, minus the bank supervision criterion. This variable, *EC6*, consists of those measures relating to the central bank's right not to finance the government and its right to set the discount rate. It is a measure of instrument independence.

Cukierman, Webb, and Neypati examined the objectives of central banks laid out in their charters and ranked them on a scale from 0 to 1, depending on whether price stability was mentioned and whether other potentially conflicting objectives were included. We called this index *CUK*.

We ran regressions of the inflation rate against these four variables for 17 industrialized countries in the Grilli, Masciandaro, and Tabellini sample. Table 4 shows that the two variables most closely tied to inflation performance are INFOBJ and EC6. The variables grouped into POL7, which relate to appointment procedures, are not significantly related to inflation. However, while the (0, 1) objective variable INFOBJ was significant, the more disaggregated variable *CUK* was not.

Table 4 implies that inflation performance is likely to be better if the central bank has a mandate for monetary stability, that is, no goal independence, and if it has instrument independence. From this perspective, the Fed needs a less vague mandate.

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We conclude by discussing accountability and output–inflation trade-offs. We do not, at this stage, have any quantitative measures of the accountability of the central bank. To a very limited extent, the

Table 4
Inflation and the GMT Index

Variable	(1)	(2)	(3)	(4)	(5)
INFOBJ	−1.76	−2.28	−4.27		
	(1.72)	(1.61)	(1.30)		
POL7	−.41				
	(.45)				
EC6	−1.02	−1.02		−1.53	
	(.55)	(.55)		(.42)	
CUK					−.68
					(1.75)
$\bar{R}^2$	.44	.44	.37	.42	−.06

Standard errors in parentheses.

significance of *INFOBJ* in the equations in Table 4 provides some support for the notion that accountability matters; the extent is limited because inclusion of an objective in the charter does not mean the central bank is actually held accountable for achieving that objective.

Nonetheless, we suggest that accountability must be an important mechanism to improve central bank performance, for two reasons: First, all institutions need to be held accountable for their actions, or their performance suffers. Second, the cult of central bank independence, the appointment of independent central bankers, and the emphasis on inflation in the incentive contracts seen so far, appear to lead to an excessive concentration on inflation prevention and insufficient acknowledgment of the short-run trade-offs between inflation and output. Without accountability to elected representatives, such as the Congress, central banks run a very good chance of becoming too conservative. That is the argument for greater Bundesbank accountability.

This view runs into the obstacle that the trade-offs between inflation and output, and between inflation and output variability, implied by most of the models in this paper, do not show up in practice. We have run regressions similar to those in Table 4, with the growth rate of output and inflation and output variability as dependent variables, and have found no evidence of a trade-off. However, both theory and the comparison between the Bundesbank and the Fed in Table 1 suggest that a trade-off does exist for countries with first-rate central banks. And if the trade-off exists, then the most independent central bank is not likely to be the socially optimal central bank.

References

Alesina, Alberto. 1988. "Macroeconomics and Politics." *NBER Macroeconomics Annual 1988*, pp. 13–52. Cambridge, MA: The MIT Press.

Alesina, Alberto and Lawrence Summers. 1993. "Central Bank Independence and Macroeconomic Performance." *Journal of Money, Credit and Banking*, vol. 25, pp. 151–62.

Alesina, Alberto and Guido Tabellini. 1987. "Rules and Discretion with Non-Coordinated Monetary and Fiscal Policies." *Economic Inquiry*, vol. 25, pp. 619–30.

Bade, Robin and Michael Parkin. 1988. "Central Bank Laws and Monetary Policy." Department of Economics, University of Western Ontario (October).

Ball, Laurence. 1993. "What Determines the Sacrifice Ratio?" NBER Working Paper No. 4306.

Ball, Laurence, N. Gregory Mankiw, and David Romer. 1988. "The New Keynesian Economics and the Output-Inflation Trade-off." *Brookings Papers on Economic Activity*, vol. 19, no. 1, pp. 1–65.

Barro, Robert and David Gordon. 1983. "A Positive Theory of Monetary Policy in a Natural Rate Model." *Journal of Political Economy*, vol. 91, no. 4 (August), pp. 589–610.

Cukierman, Alex. 1992. *Central Bank Strategy, Credibility and Independence: Theory and Evidence*. Cambridge, MA: The MIT Press.

Cukierman, Alex, Pantelis Kalaitzidakis, Lawrence Summers, and Steven Webb. 1993. "Central Bank Independence, Growth Investment, and Real Rates." *Carnegie-Rochester Conference Series on Public Policy*, vol. 39 (December), pp. 95–104.

Cukierman, Alex, Steven Webb, and Bilin Neypati. 1992. "Measuring the Independence of Central Banks and Its Effect on Policy Outcomes." *World Bank Economic Review*, vol. 6, no. 1, pp. 353–98.

Dawe, S. 1990. "Reserve Bank of New Zealand Act 1989." *Reserve Bank Bulletin*, vol. 53, no. 1, pp. 29–36.

Debelle, Guy. 1994. "Central Bank Independence: A Free Lunch?" Mimeo, MIT (February).

Eijffinger, Sylvester and Eric Schaling. 1993. "Central Bank Independence: Theory and Evidence." Tilburg University, The Netherlands (February).

Fischer, Stanley. 1980. "Dynamic Inconsistency, Co-operation, and the Benevolent Dissembling Government." *Journal of Economic Dynamics and Control*, vol. 2, pp. 93–107.

———. 1993. "The Role of Macroeconomic Factors in Growth." *Journal of Monetary Economics*, vol. 32, no. 3 (December), pp. 485–512.

Freedman, Charles. 1993. "Designing Institutions for Monetary Stability: A Comment." *Carnegie-Rochester Conference Series on Public Policy*, vol. 39 (December), pp. 85–94.

Grilli, Vittorio, Donato Masciandaro, and Guido Tabellini. 1991. "Political and Monetary Institutions and Public Financial Policies in the Industrial Countries." *Economic Policy*, vol. 13 (October), pp. 341–92.

Hall, Peter A. 1994. "Central Bank Independence and Coordinated Wage Bargaining: Their Interaction in Germany and Europe." Forthcoming, *German Politics and Society*.

Havrilesky, Thomas and James Granato. 1993. "Determinants of Inflationary Performance: Corporatist Structures vs Central Bank Autonomy." *Public Choice*, vol. 76, pp. 249–61.

Kydland, Finn and Edward Prescott. 1977. "Rules Rather than Discretion: The Inconsistency of Optimal Plans." *Journal of Political Economy*, vol. 85, no. 3 (June), pp. 473–92.

Layard, Richard, Stephen Nickell, and Richard Jackman. 1991. *Unemployment: Macroeconomic Performance and the Labor Market*. Oxford: Oxford University Press.

Lohmann, Susanne. 1992. "Optimal Commitment in Monetary Policy: Credibility versus Flexibility." *The American Economic Review*, vol. 82, no. 1 (March), pp. 273–86.

Lucas, Robert E. 1973. "Some International Evidence on Output-Inflation Tradeoffs." *The American Economic Review*, vol. 63, no. 3 (June), pp. 326–34.

Persson, Torsten and Guido Tabellini. 1993. "Designing Institutions for Monetary Stability." *Carnegie-Rochester Conference Series on Public Policy*, vol. 39 (December), pp. 53–84.

Posen, Adam. 1993. "Central Bank Independence Does Not Cause Low Inflation: The Politics Behind the Institutional Fix." Mimeo, Harvard University, December.

Rogoff, Kenneth. 1985. "The Optimal Degree of Commitment to a Monetary Target." *Quarterly Journal of Economics*, vol. 100, no. 4 (November), pp. 1169–90.

Roll Committee. 1993. *Independent and Accountable: A New Mandate for the Bank of England.* Report of an independent panel chaired by Eric Roll. London: The Centre for Economic Policy Research, October.

Selody, Jack. 1990. "The Goal of Price Stability: A Review of the Issues." Bank of Canada Technical Report No. 54.

Taylor, John B. 1982. "Policy Choice and Economic Structure." Group of Thirty Occasional Paper no. 9.

Vibert, Frank. 1993. "The Independence of the Bank of England and the Maastricht Treaty." London: European Policy Forum, May.

Walsh, Carl. 1993. "Optimal Contracts for Independent Central Bankers: Private Information, Performance Measures and Reappointment." Federal Reserve Bank of San Francisco, Working Paper 93-02, May. Forthcoming as "Optimal Contracts for Central Bankers," *The American Economic Review.*

Discussion

*Robert E. Hall**

Government performance follows worldwide fads. The big fad recently has been totally unsustainable fiscal deficits. The fad in the 1970s was inflation. For reasons that escape explanation from my understanding of political economy, the current fad among central banks is to keep inflation close to zero. Calvo, Kydland-Prescott, and Barro-Gordon convinced me that the central bank will always inflate, for the same reason that a judge will impose too lenient a sentence on a miscreant—the crime has already been committed and the sentence cannot deter it. I am not sure that I am satisfied with any explanation as to why central banks have not played out their inevitable role as inflators under received theory.

Commitment provides a good answer to the general class of problems of which monetary policy is one. The Sentencing Act was a natural way to harness commitment as a way to get optimal sentences. Judges today are denied the power to be rationally but perversely lenient.

A long-standing body of advocacy, led by Milton Friedman, would take the same approach to monetary policy. We should tie our central bank's hands in just the same way we tie our judges' hands. We could prescribe money growth or, better, prescribe a rule for the federal funds rate, as John Taylor advocates. Alternatively, as Kenneth Rogoff has pointed out, we could appoint central bankers with preferences unrepresentative of social preferences, who weight the inflation objective heavily. We would grant the central bankers the power to determine monetary policy independently. The corresponding approach to sentencing criminals is to appoint tough judges.

*Senior Fellow, Hoover Institution, and Professor of Economics, Stanford University.

Walsh and Persson-Tabellini have shown that a better answer is to appoint central bankers with preferences in line with social preferences, but to put a penalty on inflation so as to offset the inflationary bias inherent in making decisions on the spot. Tough central bankers are undesirable because they do not care about recessions, just as tough judges would not be a good idea because they might convict the innocent.

As Guy Debelle and Stanley Fischer stress in their paper, nothing in this line of thought says anything should be vague about the goals we assign to our central bankers. If we grant any independence, we should be sure that we set up incentives to see that social goals are properly served. Alternatively, we could treat our central bankers as technicians, charged with maximizing the objective function we assign them. Theory does not distinguish between these alternatives, so the paper does not really deal with the theory of central bank independence.

Another aspect of independence has received quite a bit of attention at this conference, but is not considered in Debelle and Fischer's paper: how the central bank executes the maximization of the designated objective function. We could dictate operating procedures in detail, going beyond Taylor's prescription of the federal funds rate to saying exactly what instruments should be devoted to pegging that rate. Or we could grant the central bank's technicians the right to use judgment, so long as they achieve the right combination of unemployment and inflation.

The contributions of the paper are in two distinct areas: First, new empirical results comparing the actual performance of economies with hawkish or dovish central banks. Second, the last word in modeling the monetary policy problem.

Figure 1 in the paper is the basic empirical result. Hawkishness is measured on the horizontal axis by the Grilli-Masciandaro-Tabellini measure of central bank responsibility for the price level alone. To an impressive extent, countries get what they ask for from their central banks. Hawkish policies should, as a matter of theory, deliver lower price volatility and higher output volatility—this proposition received a lot of attention in the first and second sessions of this conference. Debelle and Fischer do not look directly at the price volatility issue, but by combining data from their Figures 1 and 2, we can see that the variance of inflation is generally low for hawks and high for doves, in line with theory. The major exception is Japan, a dove by the Grilli-Masciandaro-Tabellini measure but with a record of low inflation volatility.

The paper is schizophrenic on the relation between hawkishness and output volatility. Again, the paper omits the figure that would show the relation between the Grilli-Masciandaro-Tabellini index and the variance of output. The discussion observes that there is no sign that hawkish policies adversely affect real performance. Greece, a real dove

according to the index, has the worst variance of real growth. And the real hawks—Germany, Switzerland, and the United States—have very low growth variance. On the other hand, Figure 3 shows that hawkish countries tend to have worse recessions, in line with standard theory. Two hawkish countries with low output growth variance have the largest output loss from recessions—Germany and the United States. Oddly, the paper reaches the grand conclusion that hawkish policies deliver price stability and no cost by way of increased output variability, *before* the presentation and discussion of Figure 3. The conclusion seems to depend critically on the measure of output volatility. I believe that the variance of the growth of real output is not a good measure, but I recognize that any measure is controversial that is based on deviations from a trend, "full-employment," "potential," or other attempt to separate a low-frequency element.

The third section of the paper looks closely at two conspicuous hawks, Germany and the United States. Implicit in the discussion is the proposition that the Bundesbank is even more of a hawk than the Fed, although the two differ by only a single point on the Grilli-Masciandaro-Tabellini scale. The puzzle is that the German sacrifice ratio is larger than that for the United States, even though the Bundesbank presumably enjoys higher credibility. To me, this finding confirms how little we know about the sources of monetary non-neutrality. It is true that virually every theory of non-neutrality implies that the anti-inflation efforts of a credible central bank should come at a lower real cost; the finding in this paper may just show that the received theories are on the wrong track.

The theoretical model in this paper is the ultimate development of the Calvo, Kydland-Prescott, Barro-Gordon line of research. The monetary authority is seen as the strategic opponent of the fiscal authority, and all three possibilities of sequence of play are considered.

The Debelle-Fischer model flagrantly offends Friedman's natural rate law, which holds that the level of output is invariant to parameters of the monetary policy rule. Chronic, fully anticipated inflation stimulates output. The mechanism is the following: Labor supply is perfectly elastic. The government imposes a commodity tax that shifts labor demand adversely. Seigniorage is modeled as a non-distortionary alternative to the tax. Hence, a policy of higher inflation lowers the distortionary tax and raises output. This property tilts the assessment of policies in favor of inflationary ones.

One of the most conspicuous differences between European and American macroeconomics is that the former is comfortable with perfectly elastic labor supply (real wage rigidity) whereas the latter is not. The polar alternative—a vertical labor supply curve derived from Cobb-Douglas preferences—would require development of a full general-

equilibrium analysis, because policy would shift labor supply as well as labor demand.

With respect to the order of play, the paper concludes that it would be better if the central bank moved first. The essence of the argument is that monetary policy in that case commits not to respond to fiscal policy. I do not see the point of this analysis. If monetary policy can commit not to respond to subsequent fiscal policy, it could commit not to respond to anything, in which case the entire issue considered in this literature—fundamentally rooted in the inability to commit—would disappear. Only the model with simultaneous play seems interesting to me.

I strongly agree with the basic conclusion of the paper, which I would summarize in the following way: We should not appoint central bankers who reflect our own preferences—they will be much too inflationary. It is better to appoint hawks, but they will deliver lower average rates of inflation only by under-responding to recessions. It is even better to appoint central bankers with our own preferences, but add a specific penalty against chronic inflation.

An alternative way to get the same policy is to demote central bankers to technicians and not worry about their preferences. We could simply tell the central bank that they must hold the unemployment rate at 5.5 percent plus one-sixth of the consensus forecast of the rate of inflation over the next two years. This rather dovish policy would keep the economy on a path of around 2 or 3 percent average inflation, but it would call for quite aggressive countercyclical action in the face of spending shocks. The central bank could decide independently how to achieve the target but would never struggle with the issues considered in this paper.

*References**

Calvo, Guillermo. 1978. "On the Time Consistency of Optimal Policy in a Monetary Economy." *Econometrica*, vol. 46, pp. 1411–28.

Friedman, Milton. 1968. "The Role of Monetary Policy." *The American Economic Review*, vol. 58, pp. 1–17.

*This list is limited to references not included in the paper by Debelle and Fischer.

Panel Discussion: How Can Monetary Policy Be Improved?

In light of the foregoing sessions, what improvements can we suggest for the conduct of monetary policy? How do we reconcile conflicts between the public's and the central bank's preferences over monetary policy goals?

Panel Discussion

*Paul A. Samuelson**

We academics hold at least two different views of central banking. The first looks on it as an arcane and mysterious craft—something really too dangerous to leave to central bankers. Only we dogmatic scholars can be entrusted to prescribe for it in our seminars. And in accordance with the dictum that nature abhors a vacuum, economists have rushed forward in great numbers to supply the nostrums we think the real world practitioners need to have prescribed to them. As will be enumerated, within my own lifetime as an economist, I have seen rule after rule prescribed. Each rule came and each rule went. One thing all the rule-makers have agreed upon is that, while each past rule was ill-conceived, now the correct one finally has been arrived at.

The second way of looking at central banking is almost the reverse of all that. It holds that what central banking requires is essentially a little good sense. Note that I did not speak of common sense, because good sense is anything but common. To run the Bank of England or the Federal Reserve, you must keep your focus on the time profiles of the price level and of real output–employment levels and be prepared to lean against the perverse winds affecting them. Notice that I specify two goals, and not simply the goal of the price level, as the concern of the central bank. God gave us two eyes and we ought to use them both—whatever the constitutions of the Bundesbank and the Bank of New Zealand say, and despite the rhetoric of recent presidents at some Ohio branch of the Federal Reserve System.

I personally incline toward this second view. My skepticism toward each new proposed nondiscretionary rule comes from their analyzed

*Institute Professor Emeritus, Massachusetts Institute of Technology.

non-optimality in achieving a tolerably satisfactory society with limited gyrations in price levels and in utilization of resources.

The independent central banks of the past and present, when we score them objectively, have not been doing very good jobs. It is ironical, therefore, that they enjoy such current popularity among people of affairs everywhere. Price levels are generally not stationary; and in those places where inflation rates have been somewhat tamed, this has *not* been the result of costless improvements in "credibility." The costs—both in Europe and Japan—have been intense in terms of lost output and productivity.

Our Fed, in my reading, has done a much better job than the Bundesbank, the Bank of Japan, the Bank of Canada, and the like. Two of its finest moments came first, when Paul Volcker helped bring down our stagflation; and then in 1982, when Volcker flouted Bundesbank dogmas and, in strong contradiction to the dicta of the Lucas-Sargent New Classicists, took an activist position promoting the desirable 1983-89 recovery. Alan Greenspan in turn earned his A in the handling of the October 1987 stock market crash.

From 1989 to 1991, the Fed was somewhat too late and too little in leaning against the wind of the 1990-91 recession. But in comparison with the Banks of France, Spain, and Italy, the Fed earned brownie points. If it had stuck to a goal of a stationary price level by 1995-96 (à la the Neal Amendment and much current dogma), its grade in my classroom would have fallen significantly—and so would have the U.S. Main Street economy.

For fifty years the Fed has not seemed to me mysterious or perverse. Like the old farmer who found his donkey by asking himself, "Where would I go if I were a jackass?" I could mostly guess in which direction the Fed would move. This despite its own talk. Who remembers "bills only" from Chairman Martin's days? Or 100 percent money from Chicago petitions and Irving Fisher books? Or the automatic gold standard along with money creation to meet the legitimate rediscounting demands of manufacturing, trade, and agriculture? Fixed gold reserve ratios? Or fixed marginal reserve ratios, for gold? Or separation of the Bank of England's sections for currency and credit lending? Or prefrozen rates of growth for M2, for M1, for high-powered M0, or for M17 1/2? Only we older economists remember them.

Only professors of the chair believe that a *sophisticated* group exists out there in the bond market who need to be coaxed into credibility. The truth is that the people out there primarily do not have independent judgments about the objective probabilities of inflation. What they do have is non-paranoid fears about what the Fed is going to do. A veritable terror used to occur every Thursday, when the M numbers came out. It cut short the Long Island weekends of the whole bond fraternity. A higher-than-expected rate of growth of M1 would cause a sell-off in

bonds. This was not because traders believed in monetarism. I knew those guys. What they believed (somewhat wrongly) was that the Fed believed in monetarism. And so it has been. When Dr. Greenspan says he must do this or that to be in accord with the bond market, I am reminded of a monkey who for the first time has seen a mirror. He sees an image of himself in the mirror and thinks that by looking at the reactions of that monkey—including its surprises—he is getting new information. Well, what Greenspan is getting from the market is what the market heard Greenspan say before, that the Fed is getting worried about inflation, independently worried. Now the truth is, those guys have a lot to lose on overnight decisions. And they are very worried about what the Federal Reserve is going to do.

Somebody, it could have been Charles Goodhart, enunciated a [Goodhart's] law. I will vulgarize it out of ignorance. "As soon as you identify a good rule, it self-destructs." Well, I think that chap had it almost right. The simpler fact, though, is that there was never any truth to self-destruct, to destroy itself, in *any* of the rules. All of the simple nostrums, things I have enumerated and the ones that I have spared you, failed as universal rules, being right only a small amount of the time. And in Darwinian fashion, we only stay with a fad while it is in phase with the moon. Each new fad is really like new Kleenex; it just has not yet been contaminated, and can get a short run for its money.

What alone is left? I think what is left is good sense—which, alas, is eclectic and very hard to recognize. Most of the discussions that I have heard here have to do with a fundamental distrust of democracy. A populist democracy is even more distrusted. We are looking for ways of putting into a constitution restrictions that shield the decisionmakers from populist democracy. In the end, that is not going to work; it is only going to make the constitution itself a yo-yo instrument in which amendment number 67 is going to repeal amendment number 55 in the fashion of one of our own amendments with respect to liquor. Bertold Brecht once said, "The government is displeased with the people. It's going to disband the people and get itself a new set of people." Actually, central bankers, like the rest of us, must live with the only political system we have or will ever have.

Panel Discussion

*James Tobin**

The question put to this panel was: How can monetary policy be improved? We are supposed to consider not only what improvements to recommend but also how to reconcile public and central bank preferences.

I agree with several previous speakers who have commented that monetary policy did pretty well in the Volcker era. I refer not just to the conquest of inflation between 1979 and 1982 but to the Fed's wisdom in declaring victory at the brink of an economic and financial abyss when inflation was still about 5 percent. If Senator Aiken's formula for ending the Vietnam War—declare victory and get out—had been adopted, the world would be a better place today.

In the 1982-83 period, Paul Volcker saved us from a prolonged and ever deeper recession. At the same time, Volcker's Fed interred intermediate monetary aggregates as a guide to policy. Thus were we spared unnecessary and wasteful fluctuations in economic activity due to shocks in the velocity of one or another M1. In their place, the Fed focused on intrinsically important macroeconomic objectives: real GNP and its growth, employment and unemployment, prices and inflation. The main operating instrument became the federal funds rate. As the Fed fine-tuned the 1983-89 recovery, unemployment fell below what had been regarded in 1980 as the lowest inflation-safe rate, yet inflation continued to subside.

*Sterling Professor of Economics Emeritus, Yale University.

Business Cycles Are Not Symmetrical Deviations from Equilibrium

Yesterday, several speakers described business cycles as symmetrical fluctuations of real GNP around its equilibrium trend. This symmetry was particularly explicit in John Taylor's ingenious circle diagram. I do not think it is realistically correct. I observe that the economy spends many more years with GNP falling short of potential GNP than with GNP exceeding potential. Full employment, as most economists estimate it, is not a central value but a ceiling seldom reached. Consider quarterly estimates of the "Okun gap" from 1946 to 1992. The average gap is 2.1 percent of potential per capita GNP if negative gaps are counted or 2.7 if they are counted as zeros. The task of macroeconomic policy is not just to moderate fluctuations around the mean but to raise the mean itself.

Some asymmetry is understandable. To bring inflation down a point may take a cut in aggregate demand bigger than the expansionary dose that previously raised it a point. Yet as the 1980s cycle shows, and probably the 1990s cycle also, a Federal Reserve-engineered recession cure for inflation seems to take a shorter time than a Fed fine-tuned recovery from that recession.

The misleading semantics of business cycles probably contributes to complacency about the pace of "recoveries." The NBER arbiters of cyclical dating use zero real growth as the dividing line between recession and recovery. Consequently, positive real GNP change is "recovery," even if it is less than the trend growth of potential and the GNP gap is thus increasing. Naturally, reporters and politicians follow the NBER practice, and pressure for expansionary policy on the Fed and the government in general vanishes once the quarterly real growth report is positive rather than negative. There were 34 recession quarters and 123 recovery quarters over the period 1955:IV to 1994:II by NBER reckoning, but 76 recession quarters and 81 recovery quarters by growth accounting. The NBER committee turns a deaf ear to my protestations.

The semantic illusion seems particularly costly in Europe. It is not too farfetched to say that Europe chose never really to recover from the two worldwide oil-shock, anti-inflation recessions of the decade 1973 to 1982. Europe seems content to return to sustainable growth rates at lower and lower rates of utilization, without ever recapturing the ground lost in those recessions. With chronic double-digit unemployment rates in several members of the European Union, the policy might be described as cutting out of the economy large fractions of the population, buying their acquiescence by welfare-state transfers, and then blaming the "structural" unemployment on the transfers.

I make this point to explain why I am not enthralled by the recommendations I heard this morning, that the United States follow

the European example and gear monetary policy exclusively to price stability. This orientation of monetary policy has been very costly in Europe, and it is likely to be even more costly if it is enshrined as dogma by the Maastricht Treaty.

Improving the Central Bank's Control of Aggregate Demand

I have some modest suggestions for improving Federal Reserve power to manage aggregate demand. Whatever its goals, the Fed can realize them only by affecting aggregate demand for goods and services. I wish the conference had discussed more fully the mechanisms of transmission of monetary policies these days.

The Fed has chosen the shortest interest rate as its operating instrument, presumably in order to minimize its interventions in the economic and financial markets. What is the linkage from the federal funds rate to aggregate demand? The funds rate itself has little direct impact. Its influence is indirect, via interest rates on assets of longer duration and maturity, bank loan rates and lending policies, and equity values. The funds rate seems to be a tiny tail wagging a huge dog. It often works, but how? and how reliably?

The term structure is a weak and erratic link, as illustrated earlier this year by the surprisingly large response of long rates to Fed increases in the funds rate. It seemed that the bond market was making monetary policy and the third and fourth moves by the Fed were just catching up. Cannot the Fed intervene closer to the points of meaningful contact between the financial and real economies?

With the help of the Treasury, the Fed could conduct open market operations in longer maturities. Private debtors have different expectations of inflation and of future interest rates from those of lenders, and certainly different views of the risks of movements in bond values. In symmetrical markets, debtors' views would be a counterweight to the expectations and fears of the lenders' side of the markets. For example, debtors could use opportunities to buy back their debts when bond prices are low. But one big debtor, the Treasury, is inert, and its passivity surrenders power to the lenders.

I would like to see the Treasury issue indexed bonds. They would be closer substitutes for equities and real capital than fixed-dollar securities, and the Fed could buy and sell them. My reason for favoring indexed bond issues is not the same as Alan Greenspan's. He thinks he would be able to read inflation expectations off the rate differential between indexed and ordinary bonds. The trouble is that those are the inflation expectations, along with the risk aversion premiums, of a very nervous group of people whose interests and worries do not coincide with those of ordinary Americans.

The Fed Must Have Discretion and Be Accountable for Its Use

Should the Fed commit itself to certain formal rules? I think not. The reason is that blind rules, like Friedman's k percent growth of M1, independent of the state of the economy and of events affecting the impacts of monetary operations, are bound to go wrong. If there are to be rules, they have to allow for feedbacks from observations and forecasts of economic circumstances. But you cannot hope to cover all contingencies. The central bank has to retain a good bit of discretion to decide how to meet unforeseen circumstances.

Neither is it possible to prescribe quantitative goals in legislation. The Humphrey–Hawkins Act does so, but since its unemployment and inflation goals are incompatible, they are simply ignored.

In practice, I think, we have no choice but to give the central bank a broad mandate, with considerable discretion about both goals and instruments. That makes the issue of accountability particularly acute.

The Humphrey–Hawkins reports include what are described as macroeconomic *projections* by members of the Federal Open Market Committee. The captain of a ship controls its course and speed. If he estimates the ship's position tomorrow noon, that is hardly a projection. It is a plan—subject, to be sure, to weather and other events beyond the skipper's control. It is disingenuous for the FOMC to forecast or "project" the economy, pretending that they have no control over it. I would like to see the report contain the consensus of the FOMC as to the macroeconomic path they will use their powers to achieve over coming quarters and years.

I also believe (1) that all voting members of the FOMC should be, like the Governors, federal officials appointed by the President and confirmed by the Senate; (2) that a President should have the opportunity early in his term to designate the Fed Chairman; and (3) that the Secretary of the Treasury and the Chair of the Council of Economic Advisers should be present at FOMC deliberations and allowed to express their views even if they do not have votes.

After all, it is the President who pays the political price for any adverse consequences of the central bank's management of the economy. The prospectus for this panel mentions the problem of reconciling public and central bank "preferences." I am not sure of the political legitimacy of central bank preferences.

The Fed Should Not Aim Solely at Price Goals, Certainly Not at Zero Inflation

I was appalled this morning at the support in this conference for central banks to ignore employment and real growth and to aim

single-mindedly at inflation stability or, what is more appalling, price level stability. Who, if not the central bank, is supposed to worry about real macroeconomic outcomes? Fiscal policy confronts increasing barriers to its use in management of aggregate demand. Insisting on fiscal prudence in bad weather and good, the Maastricht Treaty formally rules out the use of fiscal policy for macroeconomic stabilization. I do not see evidence that markets by themselves will do the job. The record of Europe in the 1980s is discouraging.

What is the desirable trend rate of price inflation? This is an old issue, and I would remind you of three arguments against literal zero inflation and in favor of a moderate positive trend of prices. We are talking, of course, about single-digit inflation rates, higher or lower or zero, not about choices between hyperinflation and one- or two-digit rates.

First, it is harder and more traumatic to reduce individuals' nominal salaries and wages than to keep them from rising. Maybe some irrationality is involved here, but an actual cut in dollar wages is an outright insult. If markets dictate a fall in the real salaries of some or all Harvard and MIT professors, I think less strain would be imposed on the social fabric if it happens by a bit of inflation than by cutting dollar salaries.

Second is a similar argument on adjustment of real interest rates. There are times, believe it or not, when the appropriate real rates on safe short assets are negative. But you cannot get there from here, given the floor of zero on nominal rates, if trend inflation, actual and expected, is zero or negative.

Third, considerable ambiguity remains about what price indexes measure, and how well they fit the motivations in the minds of advocates of zero inflation. Most economists agree, I think, that the U.S. Consumer Price Index overstates annual inflation by at least 2 percentage points, because of unmeasured quality improvements in existing goods and services. Taking account of additions to the menu of goods and services available is an even thornier problem. If the central bank tries to stabilize the CPI, it may actually be deflating indexes of product prices. It would not be wise to freeze into constitutions, treaties, or statutes any particular price index, statistical or conceptual.

One final comment: As Jacob Marschak gently reminded Henry Wallich in a memorable Yale seminar years ago, prices are not in anybody's utility function. Price or inflation stability is not an ultimate social good, but must be justified as an instrument that will deliver more utility-laden goodies to the society. The evidence that it will is weak. Recently Chairman Greenspan has suggested that lowering the trend inflation rate, presumably by monetary policy, will raise long-term productivity growth, a dubious hypothesis yet to be successfully tested.

Panel Discussion

*Robert J. Barro**

Monetary policy controls nominal variables—in level form, the price level, monetary aggregates, the exchange rate, and nominal GDP; in rate-of-change form, the inflation rate, nominal interest rates, and growth rates of money, exchange rates, and nominal GDP. Monetary policy has uncertain, and usually short-lived and minor, influences over the main real variables, such as real exchange rates, real GDP, and real interest rates.

The central bank's principal mission ought to be to control nominal variables so as to provide for a stable framework within which the private economy gets accurate signals and can therefore make efficient allocations of resources. Within this context, a promising, but not fully articulated, guideline is price stability. Charles Goodhart and José Viñals point out that many countries have adopted this goal, but typically have not detailed its meaning. One well-defined objective is the minimization of departures of an index of the general price level from a prespecified path, which could be a constant. Alternatively, the central bank can manage its monetary instruments to hold down surprise movements in the price level, while simultaneously targeting a nominal interest rate. Either objective implies accommodating movements of monetary aggregates to shifts in money demand, but the forms differ in the prescribed reactions to past price-level errors.

One issue that arises in any program of monetary policy is the mechanism to ensure a credible commitment to a particular course of action. In the absence of such commitments, the central bank tends to respond, each time, to the value that it places on surprise increases in

*Professor of Economics, Harvard University.

money and in the price level. Such increases may provide short-run stimuli to the real economy—to the extent that the expectational Phillips curve is valid—and surely provide public revenue if the government is a nominal debtor. In this last sense, nominal surprises are a form of capital levy, that is, a tax, ex post, on the assets that people accumulated based on prior expectations of policy.

If the monetary authority cannot commit itself to resist the temptations of nominal surprises, then one consequence is a high and variable rate of inflation. The economy's average real performance is likely to suffer, because the unpredictability of the price level interferes with the efficient allocation of resources.

Since the general nature of an ongoing monetary policy would be understood—for example, a tendency to be expansionary during recessions and contractionary in booms—it is unclear that attempts to use monetary policy to stabilize the real economy would succeed in equilibrium. This success does not materialize in some models that assume rational expectations and a simple form of the natural-rate hypothesis. Stabilization does arise in other models that incorporate rational expectations, including some presented at this conference. The key assumption here is that the government can react more quickly than the private sector when adjustments of nominal variables are required. This assumption conflicts with the usual and reasoned view that governmental action tends to be less efficient than private action, except in areas where failures of private markets are important. The source of market failure is often obscured in theoretical models by arbitrary assumptions about private mechanisms for adjusting prices. Perhaps the idea is that it is sometimes easier and clearer for the government to adjust one nominal instrument than for all private agents to change the nominal variables that they control.

One mechanism for implementing a commitment to price stability is the government's adoption of a formal rule of behavior. An example would be a promise to adhere to the gold standard or a fixed exchange rate. Other possibilities are a commitment to a particular plan for price stability or to a specific monetary rule. The seriousness of the government's commitment would, as in other policy areas, depend on its form. For example, simple promises of public officials differ from statutes, which differ from constitutional provisions. In any of these contexts, the weight of the commitment—that is, the penalty imposed on broken promises—likely depends on the social consensus about the importance of the transgression. For example, inflation surprises may be taken especially seriously in Germany because of the past experience with hyperinflation.

Another possibility, which is becoming increasingly popular, is to establish a central bank that is "guaranteed" to be independent of the government. The bank may come with a formal charter that commits it

to price stability or some related objective. Although the independence of the central bank from a sovereign government can never be complete, the degree of independence does vary across countries. Moreover, the empirical evidence for the developed countries suggests that institutional arrangements that provide for greater independence tend to generate lower average inflation without reducing real growth or raising unemployment. For a broader group of countries, a little evidence suggests that more central bank independence leads to lower inflation *and* higher real growth, perhaps because a more stable monetary framework promotes economic efficiency.

The personality of the central bank head may also matter within the context of a semi-independent bank. For example, an individual who detests inflation and cares little about unemployment is observationally equivalent to a person who is committed to low inflation. Such an individual can achieve good outcomes even if the expectational Phillips curve exists and even from the standpoint of an observer who cares deeply about the unemployed. Similarly, it can be desirable to choose a central bank head who places a lot of value on kept promises, someone who really means it when he or she commits to price stability no matter what.

The approach that stresses personality and character tends to give Paul Volcker and Alan Greenspan a lot of credit for the restoration of monetary credibility after the disastrous increases in inflation and nominal interest rates during the late 1970s. This approach also says that it will make a good deal of difference if appointments to the Federal Reserve Board, and especially to the chairman's position, are of softer individuals who are not strongly committed to low inflation. I did make this case in a recent *Wall Street Journal* column, but the argument has been challenged in a recent letter that I received from Milton Friedman. Milton says, in part,

> I am much less confident than you that the personality of the Chairman of the Fed and his demeanor makes much difference except as it is itself a reflection of the President's attitudes. I believe that Volcker was successful in the early 1980s in ending inflation not because of his demeanor, not because of his personal character, but because Ronald Reagan did not object and backed him.
>
> It is my conviction that when push comes to shove the President will always get his way regardless of who is running the Federal Reserve. If in late 1995 or early 1996 the economy is starting to look very shaky and threatening to interfere with Clinton's re-election prospects, I predict that we will have an inflationary monetary stimulus regardless of who is Chairman, regardless of whether Alan Greenspan is reappointed to another term or whether Alan Blinder becomes the Chairman. On the other hand, I also predict that if the economy continues to do very well, if its behavior along with low inflation

looks favorable for Clinton's re-election, there will be no such inflationary bursts, again regardless of who is Chairman.

I suppose that the key evidence I would cite for this conclusion is Arthur Burns. As you know, when he was named Chairman, I thought he was the right person in the right place at the right time as I wrote in the *Newsweek* column. I turned out to be wrong. It was not because Arthur was insufficiently dour; it was not because he did not understand what the effects of monetary growth would be. It was because President Nixon wanted badly to get re-elected and was willing to take whatever chances were necessary for that purpose. That was why Arthur went along with wage and price controls.

As indicated by the references to Arthur Burns, Milton has changed his views on the significance of the individuals who are the leaders of the Federal Reserve System. For example, in the *Monetary History*, Milton (and Anna Schwartz) argued that the death in 1928 of Benjamin Strong, the governor of the New York Fed, was an important contributor to the Great Depression. More generally, I think that monetary institutions place some constraints on the influence that any individual, whether the Federal Reserve Chairman or the President, can exert on outcomes. Probably economists can have their most productive influence by contributing to the effective design of these institutions.

Panel Discussion

*Lyle E. Gramley**

I would like to begin by picking up on a point made by William Poole, who noted that the results of monetary policy in the 1980s were remarkably good. That is particularly true during the period from 1983 on. The point gains significance in light of the obstacles to achieving a successful macroeconomic performance faced by monetary policymakers during that period. An enormous increase in the federal deficit occurred early in the 1980s, and as the decade went on the explosion of private debt led to a huge rise in the debt burdens of businesses and consumers, to a weakening in the condition of banks and thrifts, and ultimately to a credit crunch. Moreover, the cyclical behavior and the longer-term trend growth of M1 changed in 1981 when banks began to pay interest on the checking deposits of individuals, and in the latter half of the decade the historical relation between M2 and nominal GDP broke down.

Yet, despite these difficulties, monetary policy succeeded in keeping the economy reasonably on track. The reasons for this successful performance need to be studied carefully. One obvious reason for the achievement of low inflation during the 1980s was the elevation of price stability to a position of much greater prominence in the Federal Reserve's priorities. A second contributing factor to the achievement of both low inflation and a relatively low variability of output may have come from a more forward-looking monetary policy, as Jeffrey Fuhrer's paper suggests.

Three notable instances of forward-looking monetary policy occurred in the 1980s. The first was in 1983, when the Fed began to tighten

*Consulting Economist, Mortgage Bankers Association of America.

monetary policy when the economy was barely six months into a recovery from the deepest recession of the postwar period. That action was taken, not because inflation was accelerating, but because the economy was growing much too rapidly. The second instance was in the latter half of 1984, when growth slowed abruptly. While no immediate danger of recession was present, the Fed eased monetary policy to sustain the expansion—only the second time in the postwar period that monetary policy was eased before the onset of recession. The third case of forward-looking policy occurred from roughly mid 1989 through the middle of 1990, when the Fed lowered interest rates in an attempt to achieve a "soft landing." While the effort was not fully successful, and a mild recession began in the latter half of 1990, that downturn conceivably might have been avoided in the absence of the Gulf War and the jump in oil prices it occasioned.

My second point is that the Fed ought to adopt, and I would urge permanently adopt, a short-term interest rate as its instrument variable or short-term intermediate target. There are three reasons for this recommendation. First, it can work, as the experience of the 1980s indicates. Second, using a short-term interest rate as an instrument variable has an inherent advantage because it avoids the costs imposed on businesses and individuals by high variability of interest rates. Third, no practical alternative is available, a point that needs to be amplified.

Poole's paper points out clearly that M2 (and by extension broader monetary aggregates) do not serve well as intermediate targets of monetary policy. While he considers the possibility of using M1 as an intermediate target or instrument variable, he acknowledges that targets for M1 growth for, say, a year in advance would be impractical because of the high interest-elasticity of demand for M1. Another limiting characteristic of M1 for this purpose is a high short-run variability of demand, which leads to very large errors in short-run forecasts of reserve needs, as Donald Kohn pointed out. Moreover, the Goodhart-Viñals paper notes that lags are long in the adjustment of money demand, real GDP, and prices to changes in interest rates. Add a dollop of uncertainty to all of these relations, and the result is good reason to expect that efforts to target closely on M1 will produce wild fluctuations in interest rates, the monetary aggregates, and real output. That was the experience from October 1979 through August 1982, the only period in postwar history in which the Fed tried to target the short-run growth of M1.

However, some well-known problems are associated with using short-term interest rates as an instrument variable. Real interest rates are not measurable, and the appropriate level of real interest rates cannot be known in advance. Poole suggests that a strategy of continuous adjustments of the instrument variable can help to deal with that problem. But what should the Fed focus on to decide whether its instrument variable

needs to be changed? I strongly believe that the Fed should not shy away from judgments about the size of the gap between actual real output and its estimate of potential output, and about how fast actual and potential output are converging (or diverging). Such judgments are inherently imperfect, but they are essential to sensible policy decisions. I would far rather see the Fed make judgments of that kind than see it react to information about expectations of inflation read from the yield curve.

Whatever one may think of the particular decision rules implied by the John Taylor and Jeffrey Fuhrer papers, monetary policy decisions ought to be made with more conscious attention to the short-run trade-off between unemployment and inflation, as well as to the lack thereof in the long run. The Fed might experiment with specifying in advance (for internal purposes, not for publication) what its response function will be to deviations in output and inflation from targeted levels. I am not suggesting slavishly following a rule; but tentative decision rules could serve to focus attention on whether levels of the instrument variable are consistent with what is going on in the economy.

A second, perhaps larger, problem with a short-term interest rate as the instrument variable of monetary policy is that the central bank almost invites political criticism by accepting responsibility for interest rates when it has to raise them. For this problem, as well as the difficult decision of choosing the appropriate level of nominal short-term interest rates, letting a monetary aggregate like M1 play a role in the decision-making process can help. M1 growth provides useful clues about how stimulative or restrictive monetary policy is, and the growth of M1 may at times provide political cover when the Fed needs to boost interest rates.

For example, the Federal Reserve has explained its tightening actions this year mainly as a need to increase real short-term interest rates from abnormally low to "neutral" levels. It has taken a lot of political flak for its action. A strong case could have been made that growth of M1 in recent years was about double the rate consistent with avoiding an upturn in inflation as the recovery proceeded. That argument might have been easier to sell to the public and to politicians skeptical of the need for higher interest rates. But the Fed could hardly use it after a decade of largely ignoring the behavior of M1.

Turning to the issues highlighted in the Debelle-Fischer and Goodhart-Viñals papers, I would favor a legislated definition of the Fed's responsibilities—making the Fed goal-dependent, while leaving it free to use the instruments of monetary policy as it sees fit to achieve legislatively mandated goals. Identifying price stability as the Fed's principal goal would be a step in the right direction; it would increase the likelihood of extending the good inflation performance of the 1980s. The legislative mandate, however, needs to be stated in language that

recognizes that trade-offs exist in the short run between the variability of output and the variability of inflation. A sensible mandate should recognize that price stability is not a number, but a state of affairs in which economic decisions are little affected by expected price changes. It needs to recognize, also, that circumstances such as supply shocks or policy mistakes may lead to deviations from inflation targets, and that it takes time to get back on track.

Finally, two extremely important empirical issues were discussed at the conference that have been left largely unresolved. The first is the impact of inflation on long-run productivity growth and hence on growth of potential output. Obviously, that is a crucial question in deciding how tough a central bank should be in fighting inflation. While some interesting evidence suggests a significant negative relation between inflation and productivity growth, I share Richard Cooper's skepticism on how solid the evidence is. The second question is the issue of whether gradualism is a cheap or an expensive way of bringing down inflation. Here, too, the evidence is not terribly robust. Research in both areas ought to be very intense but also very skeptical.

Panel Discussion

*Bennett T. McCallum**

Given the assignment of discussing improvements in the conduct of monetary policy, my almost inevitable reaction is to turn to the particular policy rule that I have been promoting for several years. In just a minute, I will review the case for this rule and consider the main objections that have been raised. But first it is necessary to emphasize what I mean by adoption of a policy rule. A rule is (to me) a numerical formula specifying settings of a controllable instrument variable in response to macroeconomic indicator variables that can actually be observed. By adoption of such a rule I do not have in mind its imposition from outside, say by constitutional amendment or congressional directive, or by means of contract with the executive branch of the government. It is difficult to imagine any of those routes resulting in a sensible and operational formula in the United States. Instead, what I have in mind is that the central bank itself adopt some such formula, for internal use in determining a set of instrument settings to be used as the starting point in its decision-making process, presumably as one of the several inputs to this process. This concept of a rule is similar to that described by John Taylor in his recent Carnegie-Rochester paper (1993) on rule-like behavior.

The particular rule that I have studied and promoted treats nominal GNP as the target variable and the monetary base as the instrument, with base growth rates set each quarter so as to keep nominal GNP growth close to a steady, noninflationary pace. (Here "noninflationary" might mean 2 percent per year; this discussion will treat the target trend inflation rate as given.) There are feedback adjustments to past velocity

*H. J. Heinz Professor of Economics, Carnegie Mellon University.

growth and to recent GNP target misses. Objections can of course be raised concerning both the target and the instrument variables. Let me now discuss some of these objections in light of the papers presented at this conference.

Regarding the (nominal) GNP or GDP target, some critics would favor traditional monetary aggregates and others would prefer direct targeting of the price level—or some other weighted average of price level and output movements. I favor GDP because one can be confident that keeping its growth close to the target value will result in inflation close to the desired rate on average, over a span of years. Such is not the case for M1 or M2; the recent "stability" of M2 velocity is unlikely to obtain in the future.

And GDP growth seems preferable to a direct inflation target, even if inflation control is the main goal for the central bank, for three reasons. First, because prices react more slowly than output in response to monetary actions, cycling and instability are more likely with a price level (or inflation) target. Second, the output-stabilizing properties of a smoothed path for nominal GDP are probably better than for a smoothed path of the price level. About this we cannot be certain, because the profession has a very poor understanding of the short-run dynamic interactions between nominal and real variables (that is, of aggregate supply or Phillips curve behavior). But, third, this poor understanding implies that it is more difficult to design a rule for achieving inflation targets than a rule for achieving GDP growth targets.

Some economists (for example, Hall 1984) would prefer a target that gives more weight to output movements and less to inflation than does a GDP target, which weights them equally. My reaction is that choice of some "optimal" weights again relies on knowledge that the profession does not possess. This is not a claim that GDP targeting is optimal, but that it provides a simple measure that is very likely to work reasonably well under a variety of assumptions.

One practical objection is that GDP statistics are not produced often or quickly enough and are significantly revised after their first release. But the essence of this proposal is to use some comprehensive measure of nominal spending; it need not be GDP. Other measures could be developed on the basis of price and quantity data that are collected more often and more promptly.

Objections to the use of a monetary base instrument are at least as strongly held as those regarding the target. Most central banks utilize an interest rate instrument, of course, and some academic analysts suggest that this is desirable. I would admit that the variability of short-term interest rates would probably be substantially greater with the base kept at rule-specified levels week by week, and that banks would be forced to hold an increased volume of excess reserves. It is unclear to me, however, that the consequent social costs would be sizable.

In any event, I have recently (McCallum 1994) investigated the possibility of using an interest rate instrument—and smoothing its movements at the weekly frequency—so as to keep monetary base values close to "intermediate target" levels at the quarterly frequency, with these levels dictated by the monetary policy rule that is under discussion. This study is a rather crude one, but it does attempt to take realistic account quantitatively of shock variances and response magnitudes for the U.S. economy. And it suggests that this type of compromise scheme would be feasible—that the fed funds rate could be manipulated weekly to hit base targets designed to yield macro-desirable GNP targets at the quarterly frequency, with considerable funds rate smoothing and lender of last resort services at the weekly frequency and not too much more variability than at present.

But then, it will be asked, why not simply express the policy rule in terms of quarterly settings of an interest rate instrument? The answer has a theoretical and a practical dimension. First, interest rates have (as Poole's paper in this volume stresses) ambiguous meanings regarding the stance of monetary policy; the funds rate may be high because of current tightness or past looseness of monetary policy. Or, as I put it to my students, if the Fed wants interest rates to be lower, then it must raise interest rates. What this implies in practical terms is a more complicated policy feedback rule than one involving the monetary base. In my simulation studies, I have not yet been able to find a simple interest rate rule that performs nearly as well as a base rule. (I have not tried one of the form suggested in John Taylor's paper—that will be high on my agenda.)

The studies that I have conducted over several years have been designed mainly to determine whether a simple feedback rule, one that adjusts base growth settings in response to past long-term changes in velocity (reflecting institutional change) and recent GNP target misses, would keep GNP close to target paths when the system is being hit by shocks of the type that we have experienced historically. The main difficulty in conducting appropriate simulations is in choosing the correct model of the economy. My approach is to presume that we cannot be confident about the correct model, and so to proceed by finding whether the rule under study yields reasonably good results in a variety of different models. In studies of the U.S. and Japanese economies, a rule of the form just described has been found to perform quite well (see McCallum 1988, 1990, 1993, 1994). Valuable additional results have been provided by Judd and Motley (1991, 1992) and Duecker (1993) in work conducted at the San Francisco and St. Louis Federal Reserve Banks, respectively.

A challenge to the robustness of these findings was developed at the Board of Governors by Hess, Small, and Brayton (1993). One of their arguments is that the portfolio of models does not include any in which

the instrument-to-target linkage involves an interest instrument and an I-S-type explanation of aggregate (real) expenditure on current output, as in Fuhrer's and also Taylor's papers for this conference. That is a valid point that warrants future attention, although this is not to agree that theirs is necessarily the "correct" way; both kinds of models deserve consideration.

A second argument by Hess, Small, and Brayton was that even in my own models, a breakdown in performance has occurred in the years since 1985 (when my initial studies concluded). But to this argument the response is as follows. In their work, as in my earlier studies, the type of GNP target path involved was one of a growing-level type that calls for a return to a prespecified path after shocks have driven the system away from that path. But, as stressed by Goodhart and Viñals, many analysts would argue that *growth rate* targets would be preferable, in which case past misses are treated as bygones. If shocks hitting the economy are predominantly of the permanent or highly persistent type, instead of highly transitory, then it would be better to treat past target misses as bygones. But—to come to the point—with GNP growth rate targets, in fact, very little deterioration in performance occurs in the years since 1985, at least through 1992. These results are reported in my forthcoming Bank of Japan paper (McCallum 1994).

There are some reasons, of course, for favoring a target path for GNP or the price level that is of the growing-level type, which does not treat past misses as bygones. Consequently, I have also considered targets that are weighted averages of the two types just mentioned. I have found that a weighted average target, one that gives a weight of 80 percent to the growth rate path and 20 percent to the growing-level path, yields results that are quite desirable in the following sense. The root-mean-square (RMS) target misses relative to the growth rate target-path are virtually the same as when growth rate targets are aimed for, and the RMS behavior relative to a growing-level path is reasonably good. In particular, the simulated GNP values have a distinct tendency to return to the growing-level path, rather than drifting away arbitrarily far (as is the case when pure growth rate targeting is pursued). These weighted average targets therefore seem quite attractive. And the satisfactory results for the post-1985 period obtain for them, as well as for the growth rate targets. It is apparently the attempt to return to a growing-level target, after the shocks of recent years, that gives rise to the difficulties found by Hess, Small, and Brayton.

References

Duecker, Michael J. 1993. "Can Nominal GDP Targeting Rules Stabilize the Economy?" Federal Reserve Bank of St. Louis *Review*, vol. 75 (May/June), pp. 15–29.

Hall, Robert E. 1984. "Monetary Strategy with an Elastic Price Standard." In *Price Stability and Public Policy*, A Symposium Sponsored by the Federal Reserve Bank of Kansas City, pp. 137–59.

Hess, Gregory D., David H. Small, and Flint Brayton. 1993. "Nominal Income Targeting with the Monetary Base as Instrument: An Evaluation of McCallum's Rule." In Working Studies 1: Part 2, *Operating Procedures and the Conduct of Monetary Policy: Conference Proceedings*, edited by Marvin Goodfriend and David H. Small. Division of Monetary Affairs, Federal Reserve Board: Washington, DC, March.

Judd, John P. and Brian Motley. 1991. "Nominal Feedback Rules for Monetary Policy." Federal Reserve Bank of San Francisco *Economic Review* (Summer), pp. 3–17.

———. 1992. "Controlling Inflation with an Interest Rate Instrument." Federal Reserve Bank of San Francisco *Economic Review* (1992 no. 3), pp. 3–22.

McCallum, Bennett T. 1988. "Robustness Properties of a Rule for Monetary Policy." *Carnegie-Rochester Conference Series on Public Policy*, vol. 29 (Autumn), pp. 173–203.

———. 1990. "Targets, Indicators, and Instruments of Monetary Policy." In *Monetary Policy for a Changing Financial Environment*, edited by William S. Haraf and Philip Cagan, pp. 44–70 and 193–97. Washington, DC: The AEI Press.

———. 1993. "Specification and Analysis of a Monetary Policy Rule for Japan." *Bank of Japan Monetary and Economic Studies*, vol. 11 (November), pp. 1–45.

———. 1994. "Monetary Policy Rules and Financial Stability." National Bureau of Economic Research Working Paper No. 4692, April. To be published in Bank of Japan's conference volume.

Taylor, John P. 1993. "Discretion vs. Policy Rules in Practice." *Carnegie-Rochester Conference Series on Public Policy*, vol. 39 (Autumn), pp. 195–214.

About the Authors . . .

LAURENCE M. BALL recently was appointed Professor of Economics at The Johns Hopkins University. Previously, he taught at Princeton University and at the Graduate School of Business Administration at New York University. He has also been a visiting scholar at the Bank of Italy, the Board of Governors of the Federal Reserve System, and the Federal Reserve Bank of Philadelphia. Ball earned his undergraduate degree at Amherst College and his Ph.D. at the Massachusetts Institute of Technology. He is the author of numerous publications on monetary policy and inflation, and his works in progress include the studies "High Inflation in an Open Economy" and "Monetary Policy and Inflation Expectations."

ROBERT J. BARRO is a Professor of Economics at Harvard University. He earned an undergraduate degree in physics at the California Institute of Technology and his Ph.D. in economics at Harvard. Barro also serves as co-director of NBER's Program on Economic Growth, contributing editor of *The Wall Street Journal*, senior advisor to The Brookings Institution, and associate editor of the *Journal of Monetary Economics*. His text *Macroeconomics* is in its fourth edition and has also been published in Germany, France, Japan, Spain, and Italy, with a Chinese translation forthcoming. Barro has published many journal articles and is co-author (with X. Sala-i-Martin) of the forthcoming book *Economic Growth*.

RICHARD N. COOPER is Maurits C. Boas Professor of International Economics at Harvard University. He has also been Professor of Economics and Provost at Yale. Cooper served as Under-Secretary of State for Economic Affairs and Deputy Assistant Secretary of State for International Monetary Affairs. He was also Chairman of the Board of the Boston Fed and director of the Overseas Development Council, the Rockefeller Brothers Fund, the German Marshall Fund, and the World Peace Foundation. He is a member of the Trilateral Commission and the Aspen Strategy Group. Cooper was an undergraduate at Oberlin College and received an M.Sc.(Econ) from the London School of Economics and a Ph.D. from Harvard. Among his numerous publications are the books *Can Nations Agree?* and *Boom, Crisis and Adjustment: The Macroeconomic Experience of Developing Countries*.

GUY DEBELLE has just completed work for his Ph.D. in economics at the Massachusetts Institute of Technology, including his dissertation, "Central Bank Independence and Inflation." He was an undergraduate at the University of Adelaide. He has served as a research officer and economist at the Australian Commonwealth Treasury, Canberra, in both the Monetary Policy and the Balance of Payments Sections. Debelle joined the Research Department of the Reserve Bank of Australia in September 1994.

MARTIN S. EICHENBAUM is a Professor of Economics at Northwestern University. He is also Senior Consultant to the Federal Reserve Bank of Chicago. Eichenbaum did his undergraduate work at McGill University and received his

Ph.D. from the University of Minnesota. He taught for several years at Carnegie Mellon Graduate School of Industrial Administration and was a visiting professor at the Graduate School of Business, University of Chicago. He is the author of numerous journal articles on monetary policy, among them studies of the monetary transmission mechanism, the effects of monetary shocks, and central bank behavior.

STANLEY FISCHER is the Elizabeth and James Killian Professor of Economics at the Massachusetts Institute of Technology. He is currently on leave from MIT at the International Monetary Fund. He obtained his B.Sc.(Econ) and M.Sc.(Econ) from the London School of Economics, his Ph.D. in economics at MIT. He has taught at the University of Chicago, and he has held visiting positions at the Hebrew University, Jerusalem, and the Hoover Institution. Fischer has served as Vice President, Development Economics and Chief Economist at the World Bank, and he has held consulting appointments with the State Department, the U.S. Treasury, the World Bank, the International Monetary Fund, and the Bank of Israel. Fischer is the author of several textbooks and many journal articles and is currently the editor of the *NBER Macroeconomics Annual*.

BENJAMIN M. FRIEDMAN is the William Joseph Maier Professor of Political Economy and chairman of the Department of Economics at Harvard University. His most recent book, *Day of Reckoning: The Consequences of American Economic Policy Under Reagan and After*, has received wide attention. He also has written extensively on monetary economics, macroeconomics, and monetary and fiscal policy for economic journals. Before joining the Harvard faculty, Friedman worked with Morgan Stanley & Co., investment bankers, and also with the Board of Governors of the Federal Reserve System and the New York and Boston Federal Reserve Banks. He earned his undergraduate and graduate degrees at Harvard, and received the M.Sc. degree in economics and politics from King's College, Cambridge, where he was a Marshall Scholar.

JEFFREY C. FUHRER is an Assistant Vice President and Economist at the Federal Reserve Bank of Boston. He is a graduate of Princeton University and earned his Ph.D. at Harvard. He began his career at the Board of Governors of the Federal Reserve System, where he was a senior economist, and moved to the Boston Fed in 1992. Fuhrer is the author of numerous journal articles on monetary policy, interest rates, and consumer sentiment. His most recent papers include two written with George Moore: "Inflation Persistence" and "Monetary Policy and the Behavior of Real Long-Term Interest Rates."

CHARLES A.E. GOODHART occupies the Norman Sosnow Chair of Banking and Finance at the London School of Economics. He is a graduate of Cambridge University and received his Ph.D. from Harvard. He has taught at Cambridge as well as LSE, and also worked at the Bank of England as a monetary economist and, later, Senior Adviser. Goodhart was elected a Fellow of the British Academy in 1990. His early research was in monetary history, but he soon shifted his teaching and research to the study of contemporary monetary issues.

He has published a number of journal papers and several books, including a revised edition of his text *Money, Information and Uncertainty*. He is perhaps most widely known as the author of Goodhart's Law that "any observed statistical regularity will tend to collapse once pressure is placed upon it for control purposes."

LYLE E. GRAMLEY is a Consulting Economist with the Mortgage Bankers Association of America, in Washington. He also heads his own economic consulting firm. His fields of specialization include economic forecasting and monetary policy. Previously, he served as a member of the Board of Governors of the Federal Reserve System. Before that, he was a member of the President's Council of Economic Advisers, where he headed the Administration's forecasting team. Gramley spent many years with the Federal Reserve System, first at the Federal Reserve Bank of Kansas City and then at the Board, where he was Director of the Division of Research and Statistics. He did his undergraduate work at Aurora University and Beloit College and received an M.A. and a Ph.D. in economics from Indiana University.

ROBERT E. HALL is a Senior Fellow at the Hoover Institution and a Professor of Economics at Stanford University. Before that he taught at the Massachusetts Institute of Technology and at the University of California at Berkeley. He is Director of NBER's Research Program on Economic Fluctuations and a member of the Advisory Committe of the Congressional Budget Office. He has also served for many years as a member or senior advisor to the Brookings Panel on Economic Activity. Hall has written many journal articles and several books, the most recent being *Booms and Recessions in a Noisy Economy*. He did his undergraduate work in economics at the University of California at Berkeley and earned his Ph.D. at the Massachusetts Institute of Technology.

DONALD L. KOHN is Director of the Division of Monetary Affairs at the Board of Governors of the Federal Reserve System, where he coordinates staff resources for analysis of monetary policy and issues related to open market operations, reserve requirements, and discount policy; the monetary aggregates; the government securities markets; and related regulatory issues. In his career at the Board, Kohn served in the Government Finance and Capital Markets Sections, as Deputy Director for Monetary Policy and Financial Markets, and as Deputy Staff Director for Monetary and Financial Policy. He was also a financial economist at the Federal Reserve Bank of Kansas City. Kohn was an undergraduate at the College of Wooster, in Ohio, and received his M.A. and Ph.D. at the University of Michigan.

N. GREGORY MANKIW is a Professor of Economics at Harvard, where he has taught since 1985. He has also taught at M.I.T. and has served as staff economist at the Council of Economic Advisers. He earned his B.A. in economics at Princeton University and his Ph.D. at M.I.T. Mankiw is currently Director of the NBER Monetary Economics Program and Associate Editor of the *Journal of Economic Perspectives* and the *Review of Economics and Statistics*. He is also advisory editor of the McGraw-Hill advanced textbook series. His publications are

numerous, and this year they already include a second edition of his text *Macroeconomics*, which first appeared in 1992 and has been translated into six languages; a chapter in the book *Monetary Policy* (with Robert Hall); and several forthcoming journal articles.

BENNETT T. MCCALLUM is the H.J. Heinz Professor of Economics in the Graduate School of Industrial Administration of Carnegie Mellon University. He is a Research Associate of NBER and of the Georgetown University Program for International Studies, and he serves as a research advisor at the Federal Reserve Bank of Richmond. McCallum has also taught at the University of Sussex (U.K.) and the University of Virginia. He did his undergraduate work at Rice University in chemical engineering, earned an M.B.A. at Harvard after three years of engineering work, and returned to Rice for his Ph.D. in economics. McCallum is the author of *Monetary Economics: Theory and Policy* and has published over 100 papers on a variety of topics in monetary economics, macroeconomics, and econometrics. He is a Fellow of the Econometric Society.

WILLIAM POOLE is the Herbert H. Goldberger Professor of Economics at Brown University. He was a member of the Council of Economic Advisers and currently serves on advisory panels for the Federal Reserve Bank of New York and the Congressional Budget Office. He is a member of the Shadow Open Market Committee. Poole has also taught at The Johns Hopkins University, Erasmus University in Rotterdam, M.I.T., and Harvard, Georgetown, George Washington, and American Universities. Poole graduated from Swarthmore and received M.B.A. and Ph.D. degrees from the University of Chicago. He also holds an honorary degree from Swarthmore. Poole currently is revising his book *Principles of Economics* (with J. Vernon Henderson) and he is the author of *Money and the Economy: A Monetarist View*, along with many journal articles.

PAUL A. SAMUELSON is Institute Professor Emeritus at the Massachusetts Institute of Technology. He was awarded the Alfred Nobel Memorial Prize in Economic Science for 1970 and has received more than thirty honorary degrees from universities in the United States and abroad. Samuelson was an undergraduate at the University of Chicago and earned his M.A. and Ph.D. at Harvard University. His textbook *Economics* has sold more than three million copies and has been published in over 20 languages. Volume 6 of his collected papers is now in preparation. Samuelson has served as consultant or advisor to the U.S. Treasury, the Council of Economic Advisers, the Federal Reserve Board of Governors, and the Congressional Budget Office, as well as many other public and research organizations.

JOHN B. TAYLOR is a Professor of Economics at Stanford University, where he directs the International Trade and Macroeconomics Program at the Center for Economic Policy Research. He also taught at Princeton and Columbia. Taylor was a member of the President's Council of Economic Advisers from 1989 to 1991. He has written many articles and books on economic policy, international economics, and expectations, including a best-selling textbook in macroeconomics. He did his undergraduate work at Princeton and received his Ph.D. from

Stanford. Taylor has worked abroad as a research economist at the Bank of Japan and at the Bank of Finland, and has served as consultant or adviser to the Philadelphia Fed, the Federal Reserve Board, and the Congressional Budget Office.

JAMES TOBIN is Sterling Professor of Economics Emeritus at Yale University, where he has been on the faculty since 1950. He retired from teaching in 1988. He was an undergraduate at Harvard College and received his Ph.D. from Harvard University, where he was a Junior Fellow of the Society of Fellows for three years, one spent at the University of Cambridge, England. In 1955, the American Economic Association awarded him the John Bates Clark Medal, and he has been a member of the National Academy of Sciences since 1972. In 1961–62, on leave from Yale, he served as a member of the President's Council of Economic Advisers. In 1981 Tobin was awarded the Alfred Nobel Memorial Prize in Economic Science. He is author or editor of thirteen books and over three hundred articles, and he has written both for professional readers and for the general public.

JOSÉ VIÑALS is Head of Economic Studies at the Bank of Spain. He holds degrees in economics from the University of Valencia, the London School of Economics, and Harvard University. He taught at Harvard and at Stanford, then served in the Research Department of the Bank of Spain, where he became Deputy Chief in charge of international economics. He was seconded to the Research Department (Economic Unit) of the Committee of Governors of EC Central Banks and subsequently headed the Department until his return to the Bank of Spain. Viñals has published extensively in both Spanish and English. His most recent work has focused on monetary and exchange rate problems within the European Community and on the design of the transition to a single European monetary policy and its conduct by the European Central Bank.

Conference Participants

DANIEL AHEARN, Wellington Management Company
WILLIAM E. ALEXANDER, International Monetary Fund
JOHN ARENA, BayBank Harvard
CARLISS Y. BALDWIN, Harvard University
LAURENCE M. BALL, The Johns Hopkins University
ROBERT J. BARRO, Harvard University
JOHN H. BEEBE, Federal Reserve Bank of San Francisco
JOHN M. BERRY, *The Washington Post*
ZVI BODIE, Harvard University
FLINT BRAYTON, Board of Governors of the Federal Reserve System
FREDERICK S. BREIMYER, State Street Bank
ROGER E. BRINNER, Data Resources, Inc.
LYNN E. BROWNE, Federal Reserve Bank of Boston
KARL E. CASE, Wellesley College
THOMAS E. CIMENO, Federal Reserve Bank of Boston
RICHARD N. COOPER, Harvard University
J. DEWEY DAANE, Vanderbilt University
THOMAS E. DAVIS, Federal Reserve Bank of Kansas City
GUY DEBELLE, Massachusetts Institute of Technology
JAMES S. DUESENBERRY, Harvard University
MARTIN S. EICHENBAUM, Northwestern University
CHARLES EVANS, Federal Reserve Bank of Chicago
STANLEY FISCHER, Massachusetts Institute of Technology
JOHN E. FLYNN, The Quality Connection
PETER FORTUNE, Tufts University
DEAN FOUST, *Business Week*
DAVID R. FRANCIS, *The Christian Science Monitor*
CHARLES FREEDMAN, Bank of Canada
BENJAMIN M. FRIEDMAN, Harvard University
JEFFREY C. FUHRER, Federal Reserve Bank of Boston
ROBERT R. GLAUBER, Harvard University
CHARLES A.E. GOODHART, The London School of Economics and Political Science
LYLE E. GRAMLEY, Mortgage Bankers Association
ROBERT E. HALL, Stanford University
DALE HENDERSON, Board of Governors of the Federal Reserve System
JERRY L. JORDAN, Federal Reserve Bank of Cleveland
PATRICK KENNEDY, Board of Governors of the Federal Reserve System
DONALD L. KOHN, Board of Governors of the Federal Reserve System
CATHY KRISTIANSEN, Knight-Ridder Financial News
CHARLES LIEBERMAN, Chemical Securities
JAMES E. MAHONEY, Federal Reserve Bank of Boston
N. GREGORY MANKIW, Harvard University
BENNETT T. McCALLUM, Carnegie Mellon University
WILLIAM N. McDONOUGH, Federal Reserve Bank of Boston
STEPHEN K. McNEES, Federal Reserve Bank of Boston

RICHARD M. MILLER, Reuters
CATHY E. MINEHAN, Federal Reserve Bank of Boston
PATRICIA MOSSER, Federal Reserve Bank of New York
SCOTT PARDEE, Yamaichi International
NICHOLAS S. PERNA, Shawmut Bank
WILLIAM POOLE, Brown University
JOAN T. POSKANZER, Federal Reserve Bank of Boston
ARTHUR J. ROLNICK, Federal Reserve Bank of Minneapolis
PAUL A. SAMUELSON, Massachusetts Institute of Technology
ROBERT M. SILVA, The Citizens National Bank
ALLEN SINAI, Lehman Brothers and Brandeis University
JOHN B. TAYLOR, Stanford University
JAMES TOBIN, Yale University
GEOFFREY M.B. TOOTELL, Federal Reserve Bank of Boston
SHEILA L. TSCHINKEL, Federal Reserve Bank of Atlanta
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DAVID WARSH, *The Boston Globe*
WILLIAM H. WREAN, Sacajawea & Company

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