

THE FED'S ANTI-INFLATIONARY STRATEGY: IS IT ADEQUATE?

*Address by
Robert P. Black
President, Federal Reserve Bank of Richmond
to the
National Association of Business Economists
San Francisco Bay Chapter
June 18, 1987*

It's a pleasure to be with you this afternoon to discuss some of the longer-run issues the Fed is confronting in conducting monetary policy. I am particularly happy to have the opportunity to appear before a group of economists who are actively engaged in business and commerce. The monetary policy decisions we make at the Fed have important effects on all business firms—industrial and other non-financial companies as well as financial institutions. Consequently, it is important that executives and managers in all sectors of the economy be at least generally familiar with the principal continuing issues and problems with which the Fed is grappling.

This is, of course, a particularly interesting period in our nation's recent economic history. On the one side, we continue to face a number of serious economic difficulties. The federal budget deficit, the trade deficit, and the international debt problem are perhaps the most obvious of these, but there are several others as we are all aware. At the same time, I think most people would agree that we've made considerable progress on a number of economic fronts since the tumultuous early years of this decade. We are now midway through the fifth year of the current business upswing, which is well beyond the average length of postwar expansions. Approximately 14 million new jobs have been added to the employment rolls during this period, and the unemployment rate has declined 4.8 percentage points from its recession high of 10.8 percent to its present level of 6.0 percent. Further, after peaking somewhere in the neighborhood of 10 percent in 1980 and 1981, the underlying trend rate of inflation has declined to about 4 percent.

Inflation as a Problem

I would like to focus particularly on inflation today, because I believe that the System has a special

responsibility regarding the national goal of extending and then maintaining the recent progress against inflation. It is now almost universally agreed among economists that monetary policy has a substantial effect on the inflation rate over time, although there is still some disagreement over the significance of other factors. Moreover, many economists, including this one, believe that the inflation rate is the only economic variable the Fed or any other central bank can influence systematically over the long run and would therefore argue that price stability should be the preeminent goal of monetary policy.

Before we congratulate ourselves too vigorously about our success on the inflation front, let me make two points to help put this progress in perspective. First, even though the current underlying inflation of about 4 percent is certainly an improvement over the much higher rates of a few years ago, it is not a particularly admirable performance when judged against longer-run standards. Most of you probably recall that the Nixon Administration imposed a comprehensive wage and price freeze on the country back in 1971 when the inflation rate was actually a little less than 4 percent.

Second, and perhaps more importantly, there is no particular reason to expect this progress to continue automatically. Not too many months ago, it was not uncommon to hear some of the more optimistic in our midst proclaim that inflation had been conquered and was dead. It was as though the high inflation of the late seventies and early eighties had been some sort of exotic disease that had been eradicated by a new wonder drug. But clearly there is no good reason to believe that anything like this has happened. It doesn't matter whether one believes that inflation is caused by excessive growth in the money supply, or rising oil prices, or high labor costs, or whatever: there has been no fundamental

institutional change in our economy that would guarantee that inflation won't accelerate again. For example, if one believes that rapid money growth causes inflation, there has been no really basic institutional change in the monetary regime, such as a return to the gold standard or the adoption of some kind of Constitutional amendment, that might reduce the probability of sustained excessive monetary growth in some definitive way.

Some of the earlier apparent lack of concern about inflation has been replaced more recently with a rather sharp revival of concern, as evidenced by rising inflationary expectations in financial markets

“. . . this question of whether the longer-run strategy of monetary policy should be discretionary . . . or based on a rule of some kind is without any doubt the most important standing issue in the field of monetary policy today.”

and corresponding increases in long-term interest rates. Some observers think these worries do not reflect a true increase in the underlying rate of inflation and are instead a premature reaction to the recent upswing in oil prices and the short-run effects of the depreciation of the dollar. This may be right, but, quite frankly, I was happy to see this evidence that the earlier “inflation is dead” mentality is on the wane.

If I am right in my assessment that inflation is still a problem, what does this continuing risk of inflation imply? Well, obviously it means that we need to take whatever preventive steps are necessary to keep inflation under control. The correct steps to take, in turn, depend on what factors are most likely to cause another round of high inflation. Let me confess right up front that I'm one of those people who believes that the evidence supports Milton Friedman's famous dictum that inflation is always and everywhere a monetary phenomenon. Consequently, I think the most effective thing we can do to reduce the risk of inflation is to take a hard look at the present strategy of Fed monetary policy and determine what we can do to improve it and, if necessary, repair it. Against this background, I'll focus the remainder of my comments on our strategy

at the Fed. I'll begin with a brief description of the strategy. Then I'll make a few comments about things I personally believe might be done to make it more effective. I should emphasize that the views I'll express are my own and don't necessarily reflect the views of anyone else in the Fed.

Federal Reserve Operating Strategy

Let me begin with just a quick overview of the current strategy, which has been in place in one form or another since the mid-1970s. The essence of the strategy is that we try to control the growth of certain monetary aggregates over time in order to hold inflation in check and create the kind of stable monetary and financial environment that is conducive to high employment and steady growth in real economic production. As you know, the Federal Open Market Committee sets annual target ranges for the growth of several monetary aggregates—the familiar “M's” that get widespread attention in the financial media. The Committee establishes these ranges each year at its meeting in February for the year ahead. It then reevaluates the ranges at its meeting in July and makes any adjustments that appear appropriate in the light of events during the first half of the year. During the course of the year, the Committee seeks generally to hold the growth of the aggregates within their respective ranges, although the firmness of the Committee's efforts to achieve this objective may be affected by emerging developments in other areas of the economy. Because the Committee has no means of controlling the aggregates directly, it does so indirectly using certain short-run operating “instruments.” These instruments change from time to time, but they are all indicators of the relative ease or stringency with which the Fed is supplying reserves to depository institutions. Under the present procedure, which has been in place since the fall of 1982, the operating instrument has been the aggregate level of seasonal and adjustment borrowing at the discount window. The Committee sets a short-run objective for this instrument at each of its regular meetings, which are held at five- to six-week intervals.

That's a quick overview of the strategy. Now let me make three important points about the strategy, and then I'll go into a little more detail on each point in turn. The first point is that this procedure belongs to a particular class of strategies referred to as “intermediate target” strategies. In these strategies, as the name implies, the Fed does not set specific quantitative objectives for the final goal variables of economic policy, such as the rate of growth of real GNP, the price level, and the unemployment rate.

Instead, targets are set for variables that occupy an intermediate position between these goal variables and those we can control directly, such as the Federal funds rate or the rate of growth of reserves of depository institutions. The monetary aggregates the Fed currently targets are intermediate variables in this sense. We can't control them directly and precisely, nor are they final goal variables of monetary policy. I consider the use of monetary aggregates as intermediate targets especially appropriate because it is well established that there is a close relationship between the rate of growth of the money supply and the rate of inflation over the longer haul. Rapid money growth, in particular, leads to high inflation, while moderate growth is generally associated with low inflation.

The second point about the strategy is that we've been having some technical problems with it in recent years. The predictability of the statistical relationship between the key monetary aggregate known as M1, on the one side, and the growth of current dollar (or "nominal") GNP and the rate of inflation, on the other, has diminished significantly.¹ In any case, very rapid growth in M1 in both the 1982-83 period and more recently in 1985 and 1986 has not been followed—at least not yet—by the usual lagged rise in the rate of inflation. The reduced predictability of this relationship prompted the Fed to drop the M1 target in 1987, but I believe that this decision, even though it may be justified as a technical matter, has weakened the strategy because the M1 target has traditionally been one of the most important elements of the strategy.

The final point about the strategy is that it is and for many years has been a discretionary strategy as opposed to a strategy based on a rule, even though at a superficial level it has some of the appearances of a rule. It is discretionary in two senses. First, we do not use any predetermined mechanical formula in determining how to adjust the settings of our instrument variables to deviations of the monetary aggregates from their target ranges. Second, we do not give exclusive weight to such deviations in determining our instrument settings. On the contrary, we have taken into account the behavior of a number of other financial and economic indicators, including—at one time or another—long-term interest rates, foreign exchange rates, conditions in labor markets, and general business confidence. The relative weights we give the monetary aggregates and these other

¹ M1 includes the public's holdings of currency and coin, demand deposits, and interest-bearing transactions deposits such as NOW accounts.

indicators in making our short-run policy decisions vary over time in an ad hoc, discretionary way. Indeed, the degree of discretion used in conducting policy is so great at present that a case could be made that the monetary targeting procedure is now more a broad framework than a true strategy.

Implementation of the Strategy

Let me now elaborate a little on each of the three points I've just made.

Intermediate Target Strategies The first point was that targeting monetary aggregates is one of a class of intermediate target strategies. Some economists have argued that intermediate target strategies are inferior to other kinds of strategies because they insert a redundant intermediate target variable between the instrument variables that the Fed controls directly and the goal variables of policy in which we are really interested. Why not simply set a target for the unemployment rate, say, and then use an econometric model to determine what level of borrowed reserves is most likely to be compatible with that objective?

There are obviously several problems with such a strategy. At an operational level, the linkages between the Fed's instruments and the goal variables of policy are lengthy and complex. It is not at all clear that these relationships could be captured by econometric models accurately enough to make them operationally useful. The relationships between the instruments and the monetary aggregates, in contrast, are simpler and more direct, and they have been analyzed exhaustively over a long period of time.

“ . . . there is no compelling reason to believe that the deregulation of interest rates and the other developments of recent years have made it permanently and generally impractical to target monetary aggregates.”

More fundamentally, as I have already suggested, many economists believe that the Fed cannot systematically influence real variables like the unemployment rate and real GNP over time. Following this line of reasoning, the only goal variables the Fed can influence systematically over time are the price level and inflation. Building a strategy

directly around the relationship between instrument variables and the inflation rate is probably possible in principle, and it may well be the best strategy available in a period when institutional or other changes have temporarily reduced the effectiveness of other strategies. But such a strategy might be difficult to implement permanently in practice, since the lag between the time the Fed changes one of its instrument settings and the time the move affects the price level is long and variable. Viewed in this light, the introduction of intermediate variables such as the monetary aggregates has considerable appeal, both from an operational standpoint and from the standpoint of explaining the strategy to the public. My personal feeling is that, as a practical matter, our best option is to stick with some form of intermediate target strategy.

Recent Technical Problems in Targeting Aggregates
This brings me to the second point I mentioned above: the technical problems we've encountered recently with our strategy of targeting monetary aggregates. As I've already noted, the predictability of the empirical relationship between (1) the growth of M1 and (2) the growth of nominal GNP and inflation has diminished significantly in the 1980s. Another way of saying this is that the "velocity" of

“. . . important theoretical papers published by Robert Barro and David Gordon in 1983 . . . concluded that discretionary strategies are inherently inferior to those based on rules since they inevitably produce more inflation over time with no compensating reduction in unemployment.”

M1 has been behaving unpredictably. The velocities of the broader M2 and M3 aggregates have also been more difficult to predict, although the deterioration here has been less than in the case of M1. Considerable research has been done within the Fed and elsewhere to determine what has caused this problem. This research has not yet yielded definitive results, but it has produced several plausible partial answers. First, the removal of restrictions on the interest ceilings on most classes of deposits is believed to have increased, at least temporarily, the responsiveness or "elasticity" of the public's demand for money balances to changes in short-term market

interest rates. Thus, movements in interest rates now generate a proportionately greater change than earlier in the demand for money. Such changes in money demand affect the growth rates of the monetary aggregates resulting from particular settings of the Fed's instrument variables. Further, M1 now includes a large proportion of interest-bearing accounts that the holders probably use for saving and investment as well as transactions purposes. Consequently, the demand for M1 balances probably responds differently to changes in household wealth, interest rate spreads, and other variables now than it did a few years ago when M1 consisted primarily of currency and non-interest-bearing demand deposits and was therefore a fairly undiluted measure of transactions balances. Finally, the sharp and largely unanticipated reduction in inflation in the early eighties may have increased the public's appetite for money balances, in relation to its desire to hold other liquid assets, since lower inflation erodes the real value of money balances more slowly.

Any or all of these factors may explain at least in part the change in the observed relationships between the growth of the monetary aggregates and other economic variables. In any event, these developments raise pressing questions regarding the continued viability of our strategy of targeting the aggregates, at least in its present form. We obviously need to know whether the reduced predictability of the relationships between the aggregates we've been targeting and the economy is a temporary phenomenon that is part of the transition to a less regulated, less inflationary environment or a more permanent development. The answer to this question just isn't very clear yet. My personal guess, for whatever it's worth, is that the relationships will become more predictable again after the transition is further behind us. For example, the practices banks and other depository institutions follow in setting interest rates on interest-bearing transactions deposits are likely to become more settled and systematic in relation to movements in market rates than they are at present, which would increase the predictability of the reaction of the monetary aggregates to movements in market rates. In these circumstances, we should be able to continue focusing on the traditional monetary aggregates, including M1.

If I'm wrong, however, and the predictability of some or all of these monetary relationships remains low, we may have to make changes. This could occur in several ways. As I've already suggested, the reduced predictability of the relationship between

the narrow M1 aggregate and the economy has been especially troublesome. The decline in the predictability of relationships between the broader M2 and M3 aggregates and the economy has been less dramatic, presumably because some of the short-run shifting of funds between different classes of deposits and other liquid assets that affects the behavior of M1 washes out in the case of the broader measures. This is why the Fed has continued to target M2 and M3 this year, even though we've dropped the M1 target for the time being. If this situation continues, we could simply drop M1 permanently and focus henceforth on M2 and M3, although many of us would be disappointed by such a step since both M2 and M3 are rather amorphous collections of assets that lack the intuitive appeal of the less-cluttered M1 measure and are likely more difficult to control.

If all three of the aggregates on which we've traditionally focused continue to give us trouble, we may have to seek other alternatives. A number of possibilities exist. One is the monetary base, which is loosely the sum of currency and coin outside depository institutions and total reserves at the Federal Reserve. Another is what is now called M1A—non-interest-bearing demand deposits held by the public plus currency and coin outside depository institutions. M1A corresponds closely to what we used to call M1 before we redefined M1 a few years ago to include the interest-bearing transactions deposits that have become so popular in the 1980s. The predictability of the velocity of M1A, like that of the other aggregates, dropped sharply in 1981 and 1982, which was the period in which the initial deregulation of interest rate controls on transactions deposits occurred. There is evidence, however, that the velocity of M1A, unlike the velocities of M1, M2 and M3, has resumed a more normal and predictable pattern. My personal feeling is that this evidence suggests that we in the Fed should take a close look at the possibility of establishing a formal target for M1A.

The main point I want to make in this context, however, is not that one particular aggregate is better than another. The important point is that there is no compelling reason to believe that the deregulation of interest rates and the other developments of recent years have made it permanently and generally impractical to target monetary aggregates. The close positive relationship between the growth of the money supply and the rate of inflation over time is one of the longest-standing and most reliable relationships in economics. I see no reason to believe that this relationship has been destroyed in any permanent way by events in the 1980s. This implies

that even if M1, M2 and M3, as they are currently defined, have all been rendered less useful as monetary targets, there is still some monetary aggregate out there somewhere that we *will* be able to rely on once the dust settles. What we have to do is identify it, and I'm confident we have the means to do that.

The Discretionary Nature of Policy Let me turn now to the third point I made earlier about our present monetary policy strategy—its highly discretionary nature. This may surprise some of you mildly, since there has been a lot of loose talk in the financial

“My own feeling, however, is that the adoption of some form of rule, with the precommitment a rule would entail, would do more to improve our strategy, enhance our credibility as an inflation fighter, and maintain our recent progress against inflation than any other single change we might make.”

press in recent years about how the Fed has adopted a “monetarist” approach to policy, which would involve, of course, emphasis on adhering to pre-established rules in conducting monetary policy.

Much of this comment has been inaccurate or at least misleading. This is not the place to go into a detailed technical review of the recent conduct of monetary policy, but let me make a couple of quick comments that I hope will help clarify the situation in case any of you have been misled. All the talk about the Fed “going monetarist” started in October of 1979, when, in the face of rapidly accelerating inflation, rising inflation expectations, and deteriorating conditions in both domestic and international financial markets, the Federal Open Market Committee decided to change its operating procedures in order to improve its performance in controlling M1 and the other monetary aggregates. The basic change was to drop the Federal funds rate as the principal operating instrument for controlling the monetary aggregates and replace it with nonborrowed reserves. There's no doubt in my mind that the Committee made a more determined effort to control the growth of the aggregates in late 1979 and in certain periods during the early 1980s than it had earlier.

Further, the new operating procedure using nonborrowed reserves had some features that at times permitted money market conditions to tighten in a semiautomatic way in reaction to above-target growth in the aggregates. But these changes did not by any means amount to the adoption of a monetary policy rule in the sense in which monetarists, or other economists for that matter, use the term. Further, the semiautomatic features of the nonborrowed reserve operating procedures used between 1979 and 1982 are not present in the current operating regime, which, as I pointed out earlier, uses the level of seasonal and adjustment borrowing as the operating instrument.

Conclusion

Now let me say as clearly as I can that this question of whether the longer-run strategy of monetary policy should be discretionary, in the sense in which I defined the term earlier, or based on a rule of some kind is without any doubt *the* most important standing issue in the field of monetary policy today. Fed monetary policy has been essentially discretionary ever since the famous Accord between the Fed and the Treasury in 1951. This revealed preference for a discretionary strategy is easy to understand. In reality the Fed is under continuous pressure from the political establishment and other quarters to take or not take particular actions, despite the institutional safeguards designed to shield the Fed from such pressures. In this kind of environment the leadership of the Fed understandably finds useful the flexibility afforded by a discretionary strategy.

The case for the adoption of a rule, however, is growing stronger. A great deal of new research has been done on this rather old topic in recent years, and the results of a majority of these studies favor a rule. In particular, important theoretical papers published by Robert Barro and David Gordon in 1983, which built on earlier research by Finn Kydland and Edward Prescott, concluded that discretionary strategies are inherently inferior to those based on rules since they inevitably produce more inflation over time with no compensating reduction in unemployment. The general ideas underlying this result are, first, that discretionary policies affect the real economy only to the extent that policymakers are able to surprise the public—that is, take actions that the public doesn't anticipate—and, second, that the ability to surprise the public dissipates over time. Against this background, many economists believe that the contribution the Fed can make to the nation's economic stability would be enhanced by the

adoption of a rule, and I'm inclined to agree with this conclusion. Exactly what form such a rule should take and how it should be institutionalized, of course, are major practical issues that would have to be resolved before any rule could be adopted, and I have no quick and easy answers to these questions. I would point out, however, that the best rule might not necessarily be a constant money growth rule, which is what discussions of a rule often bring to mind. There are other kinds of rules, many of which permit more activist responses to deviations of important economic variables from their desired paths. For example, the rule might tell the Fed to adjust the target ranges for the aggregates if the inflation rate or some other important economic variable began to go off track. Whatever the form of the rule, it would be essential, of course, that it be built around and derived from our overriding objective of controlling inflation.

Let me just say that I've been intrigued by the issue of discretion versus rules in the conduct of monetary policy for many years. My instinct has always been that some kind of a rule would give us better results, no matter how noble our intentions might be in pursuing a discretionary approach, because of the precommitment a rule would involve and the beneficial impact this precommitment would have on the credibility of our anti-inflationary strategy. I don't pretend to comprehend all of the technical aspects of the recent research in this area, but I understand enough of it to be impressed by it, and what I do understand has reinforced my conviction that the adoption of a rule would be beneficial. I suspect the main problems in adopting and implementing a rule would not be technical but political. A procedural change of this magnitude would require at least the tacit support of a majority of the members of Congress as well as the key people in the Executive Branch. Getting this support would undoubtedly be difficult because the adoption of a rule by the Fed would almost certainly be seen as presenting political risks. In this bicentennial year of the Constitution, however, it is perhaps not yet unrealistic to believe, as I do, that our nation is still capable of putting institutional constraints on itself when they are clearly in the public interest. And, as I've indicated, the evidence is building that a monetary rule is in the public interest. I can think of no other reform that would do more to help us maintain the progress we've made in reducing inflation over the last five years.

Summary

That's all I wanted to say, so let me just briefly review the main points I've tried to make. First, I noted that the possibility of a revival of inflation is still a major risk in the economy. I concluded that this risk justifies a careful reevaluation of the strategy of Fed monetary policy to determine how it might be changed, if necessary, to ensure that it is an effective anti-inflationary weapon. Against this background, I then went on to describe the present strategy, and I discussed several of its important aspects. First, I pointed out that the present strategy is an intermediate targeting approach, and I expressed support for this general set of procedures despite its criticism by some economists. Second, I described some of the technical problems we are currently experiencing with the monetary aggregates we have been using as intermediate target variables, and I discussed some alternative variables we might con-

sider substituting for these aggregates if this becomes necessary. Finally, and perhaps most importantly, I pointed out that the current strategy is a discretionary one, as opposed to one based on a rule. I then concluded that recent research has strengthened the case for a rule, but I cautioned that any serious effort to institute a monetary policy strategy based on a rule would confront some thorny practical issues. My own feeling, however, is that the adoption of some form of rule, with the precommitment a rule would entail, would do more to improve our strategy, enhance our credibility as an inflation fighter, and maintain our recent progress against inflation than any other single change we might make. I personally hope that we shall begin to move in this direction soon. The time to confront the risk of another round of high inflation is now, when the rate is still relatively low. Once the rate begins to accelerate, it will be too late.

THE CASE FOR RULES IN THE CONDUCT OF MONETARY POLICY: A CONCRETE EXAMPLE

Bennett T. McCallum*

Introduction

The purpose of this paper is to provide a nontechnical but reasonably up-to-date description of the case for rules, as opposed to discretion, in the conduct of monetary and fiscal policy. Special attention will be paid to the current state of macroeconomic theory and to the experiences of developed economies in the postwar (i.e., post-World War II) era. A feature of the paper is the proposal of a specific rule for monetary policy, one that is not open to objections typically made by opponents of rules. Some evidence regarding the potential effectiveness of this particular rule is reported.

Basic Considerations

The first thing that needs to be emphasized is that the issue of rules vs. discretion is not the same as the issue of activist vs. nonactivist policy. That a policy rule can be activist—i.e., can be one that adjusts the value of a policy instrument in response to prevailing economic conditions—is a sufficiently elementary point that it has been clearly expressed in the widely used undergraduate macroeconomics textbook of Dornbusch and Fischer (1984) for almost a decade.¹ Yet it needs to be emphasized, as leading economists² and policymakers³ continue to argue

in a fashion that muddles together the two distinct issues, and sometimes even proceeds as if rules could be discredited in general by listing disadvantages of a particular type of rule that calls for a constant growth rate of the money stock.

What then is the nature of the rules vs. discretion distinction? It is I think widely agreed among macroeconomic researchers that the crucial distinction is the one illustrated in the seminal paper of Kydland and Prescott (1977)⁴ and elaborated upon by Barro and Gordon (1983a). But precisely how to characterize this distinction is not so clear. Many economists use the term “precommitment” to describe policymaking by rules,⁵ and often continue by discussing the difficulty or impossibility of achieving binding precommitment. Now in the context of monetary and fiscal policy, it would appear that literal and full precommitment is in fact virtually impossible. But it is not impossible for a monetary authority to select policy actions that conform to the “rule” sequence in the Kydland-Prescott example, so it must be concluded that precommitment cannot be the crucial characteristic. Instead, policymaking according to a rule exists when the policymaker chooses not to attempt optimizing choices on a period-by-period (or case-by-case) basis, but chooses rather to *implement* in each period (or case) a formula for setting his instrument that has been designed to apply to periods (cases) in general, not just the one currently at hand. Thus the policymaker’s efforts toward optimization enter in the *design of the formula* to be utilized in a large number of periods, not in the actions selected in each period.⁶

* H. J. Heinz Professor of Economics, Carnegie-Mellon University, and Research Advisor, Federal Reserve Bank of Richmond.

This paper was originally prepared for the Kiel Conference of June 1987, “Macro and Micro Policies for More Growth and Employment.” The author is indebted to Allan Meltzer for helpful suggestions and to Robert J. Gordon for constructive criticism.

¹ The example provided by Dornbusch and Fischer (1984, pp. 342-43) is a policy rule that sets the money-stock growth rate equal to $4.0 + 2(u - 5.0)$, where u is a recent unemployment rate. Both u and the (annualized) money-stock growth rate are here measured in percentage points.

² Tobin (1983) recognizes the analytical validity of the distinction, but refuses to accept it as a practical matter.

³ See, for example, Volcker (1983).

⁴ Which constitutes an application to macroeconomic policy of a point developed previously by Kydland (1975).

⁵ Examples are Barro and Gordon (1983b) and Grossman and Van Huyck (1986).

⁶ This characterization is consistent with Friedman’s (1962, pp. 239-41) analogy to the constitutional protection of free speech.

To provide an example of this distinction, and also to begin our analysis of the *advantage* of rules over discretion in the context of monetary policy, let us briefly review the basic model laid out by Kydland and Prescott (1977). In this setup, the monetary authority's objectives are represented by a loss function in which the arguments are the squared deviations of unemployment and inflation from values determined by considerations of allocational efficiency.⁷ It will simplify matters without distortion of the argument, however, to simply take the loss function to be decreasing in the current money-growth *surprise* (since unanticipated money growth reduces unemployment) and increasing in the square of money growth itself (since money growth induces inflation).⁸ There are also discounted values of similar terms for all future periods, but for present purposes these can be ignored. If, with this objective function, the monetary authority were to adopt a policy *rule* by choosing among constant money growth rates, he would recognize that with moderately rational agents the surprise values will average to zero whatever his choice; thus the chosen money growth rate would be zero. For the same reason, moreover, an *average* growth rate of zero would be implied by the optimal choice of a (possibly activist) rule when a broader class of rules is considered.

But suppose that, instead, the authority executes policy in a period-by-period or discretionary manner, i.e., by selecting each period's money growth rate on the basis of a fresh optimization calculation. Then in each period the prevailing *expected* money growth rate is taken by the authority as a given piece of

⁷ Our conclusions will depend upon the plausible assumption that deviations of inflation from the optimal rate are increasingly costly at the margin; use of the squared deviation reflects that requirement in a tractable manner. The unemployment term is of the form $(u_t - \bar{u})^2$, with \bar{u} , the natural-rate value of u , and with $k < 1$. The latter condition expresses the assumption that the monetary authority's target value for u , is below the natural rate. Barro and Gordon (1983a) interpret this as reflecting some externality and consequently claim that there is no discrepancy between the policymaker's objectives and private agents' preferences. The analysis would remain the same, however, if the $k < 1$ condition were interpreted as merely reflecting a desire by the policymaker for an excessively low rate of unemployment. Indeed, all that is necessary is that the policymaker values marginal reductions of unemployment in the vicinity of its natural-rate value.

⁸ In the cited literature, "money growth" and "inflation" are often used interchangeably. In my opinion, it is preferable to think in terms of money growth as unemployment is in fact more closely related to money than price level surprises. In addition, inflation actually responds to money growth only slowly, so current money growth affects expectations of future inflation. Recognition of this point overturns the argument of Grossman and Van Huyck (1986) to the effect that the Kydland-Prescott setup is misspecified.

data—a new "initial condition." The current surprise then appears to the authority to be under his control, so the loss-minimizing choice of the current money growth rate is that value which just equates the marginal benefit of surprise money growth to the marginal cost of money growth *per se*. With the objective function as described, this seemingly optimal value will clearly be positive. But since moderately rational private agents will come to understand this process, their expectations regarding money growth will be correct on average. Thus the surprise magnitude will be zero on average, over any large number of periods, even though the magnitude within each period is under the control of the monetary authority. Consequently, there will on average be no benefit—no extra employment—materializing from surprises. On average, then, the discretionary regime will feature more money growth (i.e., inflation) but the same amount of surprise money growth (i.e., unemployment) as with a well-designed rule based on the same objectives. Thus the objectives will be more fully achieved with the adoption of a rule than with period-by-period attempts at optimization.

It should be noted that the foregoing line of argument does not require that the economy actually be one in which monetary surprises induce temporary output and employment gains. Nor is it necessary that private sector expectations are fully rational. What is required is that the monetary authority *believes* that unusually rapid monetary growth will induce output/employment gains and that expectations are rational enough to avoid any permanent bias. Also, the economy must be one that satisfies the weak version of the natural-rate hypothesis: output and employment must be independent over long spans of time of the economy's average inflation rate.⁹

To this point it has been argued that the conscientious attempt to avoid both inflation and unemployment will lead to an excessive amount of the former, with no reduction in the latter, when monetary policy is conducted in a discretionary manner. Is there any empirical evidence to suggest that this theoretical proposition is in fact descriptive of the workings of actual central banks and actual economies?

To my mind, the most impressive evidence in this regard comes from straightforward examination of the postwar inflationary experience of the industrialized nations of Europe and North America. Specifically, price levels are now in all these nations several times as high as they were in 1950. Even in Germany the

⁹ For additional discussion of related issues, including reputational models, see McCallum (1987). Alternative surveys are provided by Barro (1986) and Cukierman (1986).

value of the currency is now less than a third of its 1950 level, while the comparable magnitude is less than one-tenth for France, Italy, and the United Kingdom. (A few figures are reported in Table I.) While there have been no episodes of extremely rapid inflation, price levels have risen steadily and substantially. The relevant question is, therefore, why has the experience been one of *positive* inflation in most years in all of these countries? The populations, governments, and central banks of these nations do not *enjoy* inflation—indeed, they regard it as something absolutely undesirable on its own. Also, there is little reason to believe that the policymakers in these nations are of the opinion that there is any *permanent* stimulative effect on employment or output of positive inflation rates. They know that employment and output growth were not enhanced by the inflation and rapid money growth of the 1970s. So why have price levels not moved downward about as often as upward, leaving current prices about the same as in 1950?

My suggestion, of course, is that the Barro-Gordon theory¹⁰ provides an answer to these questions, namely, that discretionary policymaking has been exercised in the postwar era by central bankers who wish to avoid inflation but who also have employment or output concerns. The plausibility of this suggestion is enhanced, I believe, by a comparison of the postwar experience with that of an earlier era in which monetary policy was circumscribed by formal rules. Here the reference is, of course, to the period before World War I when the countries under discussion maintained commodity-money standards. As all readers probably know, price levels at the start of World War I were roughly the same as they had been in the middle 1800s—or in the late 1700s, before the start of the Napoleonic Wars. For easy reference, a few relevant figures are reproduced in Table II.

A Specific Rule for Monetary Policy

Instead of continuing the discussion of rules vs. discretion in the abstract, let us now turn to the consideration of a specific rule for the conduct of monetary policy. Examination of a concrete proposal should help to reveal weaknesses in the rule-based approach, if they exist, or to attract support for the rule, if its desirable properties are convincingly impressive.

¹⁰ While the model outlined above was developed by Kydland and Prescott (1977), its use as a *positive* theory of policy behavior was pioneered by Barro and Gordon (1983a).

Table I
CONSUMER PRICE INDICES, POST-WORLD WAR II

Nation	CPI, 1950	CPI, 1985	Ratio
Belgium	30.1	140.5	0.214
France	15.6	157.9	0.099
Germany	39.2	121.0	0.324
Italy	13.9	190.3	0.073
Netherlands	23.9	122.7	0.195
United Kingdom	13.4	141.5	0.095
United States	29.2	130.5	0.224

Source: IMF, *International Financial Statistics*.

In previous writings, I have emphasized four principles that should be respected in the design of a monetary rule (McCallum, 1984, 1985), which are as follows. First, the rule should dictate the behavior of a variable that the monetary authority can control directly and/or accurately. To specify behavior of some magnitude that is not itself controllable—such as the M1 measure of the money stock, for instance—would be to leave the task of rule design seriously incomplete. Second, the rule should not rely in any essential way upon the presumed absence of regulatory change and technical progress in the financial industry. While these processes may not produce as much turmoil in the future as they have in the recent past, it would be unsafe to presume that they will not be present again to a significant extent. Third, neither money stock nor (nominal) interest rate paths

Table II
WHOLESALE PRICE INDICES, PRE-WORLD WAR I

Year	Belgium	Britain	France	Germany	United States
1776	na	101	na	na	84
1793	na	120	na	98	100
1800	na	186	155	135	127
1825	na	139	126	76	101
1850	83	91	96	71	82
1875	100	121	111	100	80
1900	87	86	85	90	80
1913	100	100	100	100	100

Sources: B.R. Mitchell, *European Historical Statistics*; Bureau of the Census, *Historical Statistics of the United States*.

are important for their own sake; these variables are relevant only to the extent that they are useful in facilitating good performance in terms of inflation and output or employment magnitudes. Fourth, a well-designed rule should recognize the limits of macroeconomic knowledge. In particular, it should recognize that neither theory nor evidence points convincingly to any of the numerous competing models of the interaction of nominal and real variables. The economics profession does not have a reliable quantitative or even qualitative model of aggregate supply (or "Phillips curve") behavior. In other words, the profession does not have accurate knowledge of the way in which changes in nominal GNP will be divided, on a quarter-to-quarter basis, between real output growth and inflation.¹¹ Thus any rule whose design depends upon some particular model of that division warrants very little confidence.

In one of these earlier papers (McCallum, 1984), I proposed in qualitative terms a rule that respects all four of these principles. My proposal began with the specification of a target path for nominal GNP that grows evenly at a prespecified rate that equals the economy's prevailing long-term average rate of real output growth. For the United States the appropriate figure is about 3 percent per year. Since this magnitude will be virtually independent of monetary policy over any extended period (say, 20 years or more), keeping nominal GNP growth at the appropriate value—henceforth assumed to be 3 percent per year¹²—should yield approximately zero inflation over any such period. Furthermore, the prevention of fluctuations in nominal GNP growth should help to prevent swings of real output from its trend path.¹³ While some output fluctuations would continue to occur even with a perfectly smooth growth path for nominal demand, they would probably be as small as can feasibly be obtained, given the absence of a reliable Phillips curve model.

¹¹ On this topic again see McCallum (1987).

¹² Designation of the trend value of real output growth is, of course, part of the rule's specification. It should be based on the economy's actual real growth record over the past several decades and should be changed very infrequently—say, once every ten years. Any error in setting this rate will obviously lead to an error of equal percentage magnitude (but of opposite sign) in the inflation rate induced by the rule. Fortunately, the conceivable magnitude of such errors is quite small—probably less than 1 percent per year—for developed economies.

¹³ The workings of the rule are independent of the currently prominent issue concerning the nature of output trends. Thus the target path for nominal GNP should be set to grow at the value γ whether real output growth occurs according to $y_t = \alpha + \gamma t + \epsilon_t$ or to $y_t - y_{t-1} = \gamma + \epsilon_t$. (Here ϵ_t denotes white noise.)

To complete the rule, an operational mechanism must be specified for keeping (nominal) GNP growth close to the prespecified 3 percent growth path.¹⁴ My 1984 suggestion was to adopt as an instrument the monetary base, a variable that can be accurately set on a day-by-day basis by the central bank of any political entity with a floating exchange rate. Specifically, the rule "would adjust the base growth rate each month or quarter, increasing the rate if nominal GNP is below its target path, and vice versa" (McCallum, 1984, p. 390).

The algebraic form implicit in this description is as follows, where b_t = log of monetary base (for period t), x_t = log of nominal GNP, and x_t^* = target-path value for x_t :

$$(1) \Delta b_t = \Delta b_{t-1} + \lambda_1(x_{t-1}^* - x_{t-1}), \quad \lambda_1 > 0.$$

In this formula, the magnitude of λ_1 would have to be chosen so as to (a) provide adequate responsiveness of base growth to departures of x_t from its target path but (b) without inducing dynamic instability of the type that can prevail when feedback effects are too strong. Presuming this value is satisfactorily chosen, one attractive feature of the scheme summarized in (1) is that it would automatically adjust the b_t growth rate, in a fashion that would yield zero inflation on average, in response to alterations in base "velocity" stemming from technical or regulatory changes. Even in the face of drastic changes of this type it would remain true that an increase in Δb_t would be expansionary, and a decrease contractionary, in terms of aggregate demand—and more knowledge than that is not required for the appropriate type of adjustment.

I have recently become persuaded,¹⁵ however, that a somewhat different specification would have better properties. Instead of (1), then, I would now

¹⁴ By virtue of its emphasis on this operational mechanism, the current proposal is quite different from other schemes involving "nominal GNP targeting" such as those of Gordon (1985), Hall (1983), and Taylor (1985). This difference is clearly exemplified by Gordon's (1985, p. 77) reference to "controlling growth in nominal GNP . . . rather than controlling the monetary base" (emphasis added). Much of Gordon's discussion, incidentally, is concerned with a difficulty not elsewhere discussed in the present paper, namely, that of *starting up* a rule like (2) from initial conditions with nominal GNP growth substantially different from 3 percent. In this regard my own inclination would be to begin with a path that adjusted gradually toward the 3 percent figure, attaining the latter after (say) three years. Another objective of Gordon's is to argue the desirability of *final sales* over GNP as a nominal demand variable; I have no desire to quarrel with that argument.

¹⁵ In part by discussions with Allan Meltzer.

like to propose the following rule for quarterly adjustments:

$$(2) \Delta b_t = 0.00739 - (1/16) [x_{t-1} - x_{t-17} - b_{t-1} + b_{t-17}] + \lambda_2(x_{t-1}^* - x_{t-1}), \quad \lambda_2 > 0.$$

Here the constant term 0.00739 is simply a 3 percent annual growth rate expressed in quarterly logarithmic units, while the second term subtracts from this the growth rate of base velocity, calculated as an average over the previous four years.¹⁶ Finally, the third term adds an adjustment in response to departures of GNP from its target path. Again the only parameter value to be determined is that for the response coefficient, in this case denoted λ_2 . Again it is possible to induce dynamic instability by setting the value of λ_2 too high. But as the response is now applicable to Δb , rather than its change, $\Delta b_t - \Delta b_{t-1}$, the danger of instability is lessened. My proposed value for λ_2 is 0.25, which implies an extra 1 percent base growth per *year* for each 1 percent deviation of nominal GNP from its target path.

Properties of the Proposed Rule

To determine how this rule would work, one needs to experiment with it. Since experiments with actual economies can be very expensive to the societies involved, such experimentation needs to be done with a model. The problem, of course, is that there is no agreement as to the appropriate model. My conjecture, however, is that rule (2) with $\lambda_2 = 0.25$ will perform well for a wide variety of quantitative models of developed market economies such as the United States, United Kingdom, Germany, Italy, France, or the Netherlands. Let me immediately be clear, however, about what is here meant by the term "perform well." Specifically, the criterion involves only the time path of nominal GNP; as we do not know how changes in GNP will be divided among inflation and output growth, the rule should not be judged on the basis of any particular model's predictions in that regard. Subject to that stipulation, it is my conjecture that application of the rule (2) in place of actual historical policy would yield simulated nominal GNP paths that are smoother than those actually experienced,¹⁷ as well as implying growth at noninflationary rates. This type of result

¹⁶ Note that $x_{t-1} - x_{t-17} - b_{t-1} + b_{t-17} = \sum_{j=1}^{17} (\Delta x_{t-j} - \Delta b_{t-j})$.

¹⁷ Here I am assuming simulations that feed in random errors of the same magnitude as seem to occur in actuality; see the discussion below.

will obtain, I believe, whether the models utilized are constructed along Keynesian or classical lines provided that they are not strongly inconsistent with the natural-rate hypothesis.

Such simulations with a wide variety of models have yet to be conducted. But I can report results based on two extremely simple models that are merely atheoretic regressions of nominal GNP on past values of itself and values of the monetary base.¹⁸ The first such model, pertaining to the U.S. economy for 1954.1-1985.4, consists of the following estimated regression equation:

$$(3) \Delta x_t = 0.00749 + 0.257 \Delta x_{t-1} \\ (0.0021) \quad (0.079) \\ + 0.487 \Delta b_t + e_t \\ (0.121)$$

$$R^2 = 0.23 \quad \hat{\sigma} = 0.010 \quad DW = 2.11$$

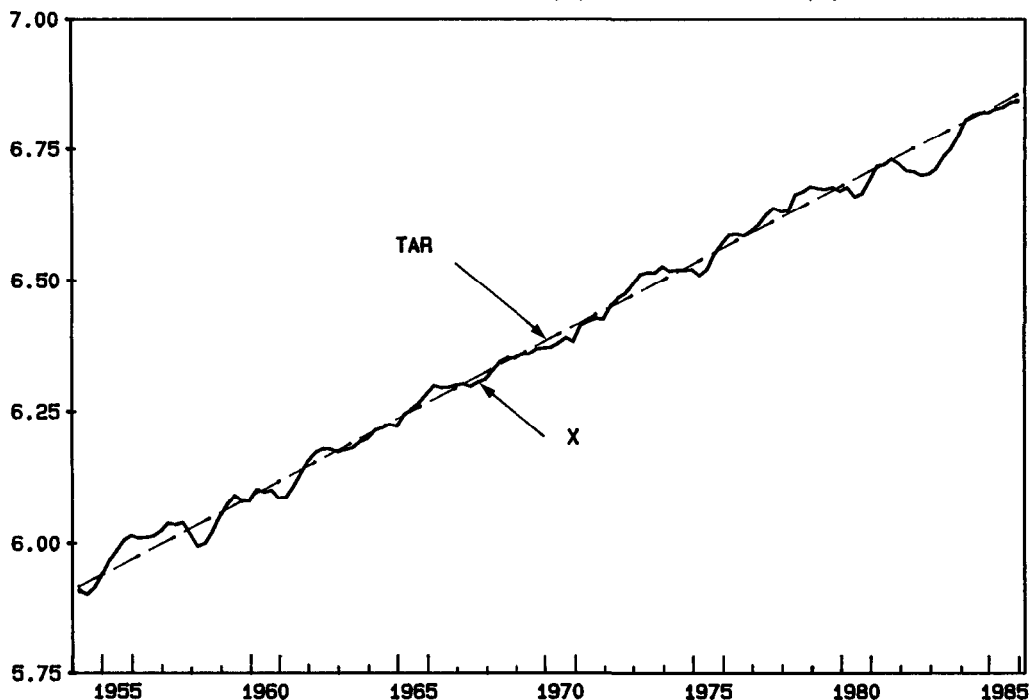
Here e_t denotes the residual, i.e., the estimated disturbance, for period t . Simulated values for b_t and x_t have been calculated for 128 periods by means of equations (2) and (3), with initial conditions corresponding to 1954.1 and with e_t residual values fed in each period as shock estimates. This procedure is analogous to one stochastic simulation of (2) and (3) with shocks drawn from a population with mean 0 and standard deviation 0.010.

Results of this simulation exercise are shown in Chart 1, where TAR denotes the target path x_t^* . Clearly the rule induces x_t to follow the target path quite closely. To put this behavior into perspective, the result of this simulation is compared with simulations using alternative policy rules in Table III. There the first numerical column reports root-mean-squared-error (RMSE) values—i.e., square roots of the mean over 128 simulated quarters of the squared deviations of x_t from x_t^* . The RMSE value of 0.0197 in line 1 indicates that the root-mean-squared deviation of nominal GNP from its target path is roughly 2.0 percent under rule (2), since log deviations are approximately equal to percentage deviations divided by 100. That figure can be compared with a RMSE value of about 22 percent when the policy rule is one that sets the monetary base growth rate at zero throughout the period (line 3). This surprisingly high

¹⁸ Since drafting this paper I have also obtained results for a model that consists of a 4-variable vector autoregression (VAR) system, the variables being four lags each of the 90-day Treasury bill rate and the logs of real GNP, the GNP deflator, and the monetary base. The RMSE value with $\lambda_2 = 0.25$ in rule (2) is 0.0219, almost the same as for model (4).

Chart 1

SIMULATION RESULTS FOR 1954 - 1985
WITH POLICY RULE (2) AND MODEL (3)



Note: The target path TAR increases by 0.00739 each quarter, starting from the actual value of 5.909 for 1953.4. Here 5.909 = log 368.3, while 368.3 is nominal GNP measured in billions of dollars (annual rate, seasonally adjusted).

magnitude obtains because base velocity has grown enough during the period 1954-85 that no growth in the base would have permitted a significant amount of inflation!¹⁹ The base growth rate needed to yield zero inflation—literally to yield 3 percent nominal GNP growth—with model (3) is $\Delta b_t = -0.0041$ (i.e., about -1.6 percent per year). With that rate held constant for 128 periods, the RMSE is about 3.6 percent (see line 4), which is only about twice as large as with policy rule (2). But it is important to recognize that the correct constant value of Δb_t embodied in the “rule” of line 4 could not have been known ex ante, before the experience of 1954-85 had been accumulated, for it is calculated on the basis of model

¹⁹ That this is the case can be seen from the model reported in equation (3). Setting both Δb_t and e_t at zero for all t yields $\Delta x_t = .00749 + .257 \Delta x_{t-1}$, which has a steady-state value of $.00749/(1-.257) = .0100$. Thus with zero base growth, nominal GNP would grow at about 1 percent per quarter or 4 percent per year. With 3 percent per year real GNP growth, we would then have about 1 percent per year inflation.

(3).²⁰ By contrast, our preferred rule (2) is not based on any parameter estimated in the model.

In response to the last claim, it could be said that—while not precisely based on model (3)—the parameter value $\lambda_2 = 0.25$ in rule (2) is to some extent based on ex post knowledge. Consequently, it is of interest to know how rule (2) would perform with different values used for λ_2 —in particular, with $\lambda_2 = 0$. Results for that case, which corresponds in spirit but not in detail to the rule proposed by Meltzer (1984, 1987), are reported in line 5. There we see that performance is less good than in line 1, but still rather impressive. Shifting λ_2 in the other direction, to a value of 0.5, yields results (not tabulated) that are even better than in line 1. Also reported in Table III is one result pertaining to the policy rule (1), which I had previously proposed. Specifically, line 6 shows that with $\lambda_1 = 0.02$ the RMSE would be about

²⁰ Specifically, by solving $\Delta x = .00749 + .257 \Delta x + .487 \Delta b$ for Δb with Δx set equal to .00739.

4.2 percent, which is not too bad. But using instead $\lambda_1 = 0.05$ would result in explosive fluctuations.

Finally, the foregoing RMSE figures can be compared to those that actually obtained during 1954-85, i.e., with actual Federal Reserve policy. Because of the substantial amount of inflation that occurred, the RMSE value is enormous in comparison—the value is .7711, over 30 times as great as in line 1. Perhaps more interesting, however, is the extent of actual nominal GNP *variability* about its (inflationary) trend path. Consequently, the RMSE value for x_t relative to a fitted linear trend is also reported in line 2. That value is 6.2 percent per period, somewhat higher than in lines 5 and 6, and just over three times as great as in line 1. Thus the first-column indications of Table III are that our proposed rule would not only prevent inflation but also yield less variability in nominal GNP growth than actual Fed policy.

The foregoing estimates are all predicated, however, on the “model” of GNP behavior given in equation (3). The extreme simplicity of this specification arguably tends neither to favor nor harm the simulated performance of our rule (2). But there is one aspect of specification (3) that is questionable and that works in our favor—namely, the inclusion of the current-period value of Δb_t as an explanatory variable. To some extent the estimated effects, a critic might claim, could be due to the sample-period response of Δb_t to Δx_t , rather than the causal direction presumed in (3). Consequently, results are reported in column two of Table III for simulations like those of column one except that the “model” is as follows:

$$(4) \quad \Delta x_t = 0.00506 + 0.199 \Delta x_{t-1} \\ (0.0020) \quad (0.083) \\ + 0.529 \Delta b_{t-1} + e_t \\ (0.127)$$

$$R^2 = 0.23 \quad \hat{\sigma} = 0.010 \quad DW = 2.05$$

Here, *none* of the current-period connection between Δb_t and Δx_t is attributed to the direction going from policy to GNP. This specification should be expected to sharply deteriorate the rule's performance, as it introduces a full two-quarter lag between target departures $x_{t-1}^* - x_{t-1}$ and corrective effects.

Indeed, as inspection of Table III will readily indicate, the performance of rules (2) and (1) both deteriorate. The former remains superior, nevertheless, to any of the other possibilities considered, and continues to yield substantially less GNP variability than observed in actual U.S. experience. Since there is probably some within-quarter response

Table III

SIMULATION RESULTS FOR ALTERNATIVE RULES

Policy	RMSE Model (3)	RMSE Model (4)
1. Eq.(2), $\lambda_2 = .25$	.0197	.0217
2. Actual historical	.7711 (.0616)*	.7711 (.0616)*
3. $\Delta b_t = 0$	.2258	.2302
4. $\Delta b_t = -.0041$	.0358	.0391
5. Eq.(2), $\lambda_2 = 0$	.0499	.0502
6. Eq.(1), $\lambda_1 = .02$	.0424	.0671

*This is RMSE relative to fitted trend rather than target path.

of Δx_t to Δb_t in actuality, this brief investigation suggests results intermediate to those of columns one and two. For rule (2), they are clearly excellent.

Criticisms

At this point it will be useful to consider some possible objections that might be raised by critics. Three that will be discussed in turn pertain to (i) the Lucas critique, (ii) the natural-rate hypothesis, and (iii) our neglect of open-economy considerations.

With respect to (i) the point is, of course, that the parameters of our models (3) and (4) might change with an alteration in policy from that actually experienced to that of the hypothesized rules. Since these “models” are not structural, this objection is in principle correct. I would suggest, however, that the Lucas critique is much more important quantitatively for equations relating real to nominal variables—e.g., Phillips curves—than for ones relating nominal demand to nominal policy variables. If this conjecture is correct, then equations (3) and (4) should be virtually immune to the critique, as it has been found to be rather hard to detect empirically even in Phillips-curve relations. [See, e.g., Gordon and King (1982).]

Next, there is the issue of the natural-rate hypothesis, which has recently come under attack as a result of extremely high and persistent European unemployment rates.²¹ But in the context of the present discussion, the issue is not whether unemployment promptly reverts following a shock to some “natural” level, but whether the trend growth rate of real output is essentially independent of monetary

²¹ See, for example, Fitoussi and Phelps (1986) and Blanchard and Summers (1986).

policy. If the recent experience is thought to provide evidence against this relevant proposition, it is unclear how the posited relationship would go. Proponents of the notion that nominal demand behavior affects the trend output rate usually hypothesize a positive relationship, i.e., that real output growth is stimulated by more rapid growth of nominal demand. But in fact nominal GNP growth has been *more* rapid in Europe during the 1970s and 1980s than it was during the 1950s and 1960s,²² yet it is the more recent period that has featured high unemployment and reduced real growth.

Finally, let us briefly address the issue of how our proposed rule should be modified to take account of open-economy considerations, i.e., large import and export sectors. In this regard the relevant principle to keep in mind is that the most constructive thing that monetary policy can accomplish is to induce nominal aggregate demand to grow smoothly and at a noninflationary rate. Thus the only modification required to our rule is the possible replacement of nominal GNP with some other measure of nominal aggregate demand. My first inclination would be to use real GNP multiplied by the consumer price index. But the main point is that steady growth in some such aggregate constitutes a more reasonable objective for the monetary authority than either maintaining a fixed exchange rate or following a target path for any measure of the money stock. These are variables that are neither instruments nor ultimate

²² For Europe as a whole, nominal GDP grew at an average rate of 14 percent over the period 1955-69 and 24.6 percent over 1969-83 (IMF, *International Financial Statistics*).

targets. While the same is true of nominal aggregate demand, it is a magnitude that is more closely related to output and inflation variables—which are ultimate targets.

Conclusion

Let us now conclude with a brief summary of the foregoing argument. The paper begins by reiterating that a policy rule can be activist; the distinction between rules and discretion depends upon the stage at which optimization calculations enter the policy process—in the design of a formula (rule) to be implemented each period or in each period's (discretionary) selection of a policy action. Next, the Kydland-Prescott (1977) example is used to illustrate the tendency for discretionary monetary policy to produce more inflation than would result from a rule, with no additional employment obtained in compensation. Then a specific monetary rule is proposed, one that sets the monetary base—a controllable instrument—each period in a manner designed to keep nominal aggregate demand growing smoothly at a noninflationary rate. Some simple simulations are conducted which suggest that this rule would have worked well in the United States, over the period 1954-85, if it had been in effect. The basic idea is that, since economists do not understand how nominal demand changes are divided between inflation and output growth, the most useful thing that monetary policy can accomplish is to keep nominal demand growing smoothly at a noninflationary rate. This can apparently be well achieved by means of a rule such as the one proposed.

References

- Barro, Robert J. "Recent Developments in the Theory of Rules versus Discretion." *Economic Journal* 96 (Supplement, 1986): 23-37.
- Barro, Robert J., and David B. Gordon. "A Positive Theory of Monetary Policy in a Natural Rate Model." *Journal of Political Economy* 91 (August 1983): 589-610. (a)
- _____. "Rules, Discretion, and Reputation in a Model of Monetary Policy." *Journal of Monetary Economics* 12 (July 1983): 101-21. (b)
- Blanchard, Olivier J., and Lawrence H. Summers. "Hysteresis and the European Unemployment Problem." In *NBER Macroeconomics Annual 1986*, edited by S. Fischer. Cambridge, Mass: The MIT Press, 1986.
- Cukierman, Alex. "Central Bank Behavior and Credibility: Some Recent Theoretical Developments." Federal Reserve Bank of St. Louis, *Review* 68 (May 1986): 5-17.
- Dornbusch, Rudiger, and Stanley Fischer. *Macroeconomics*, 3rd ed. New York: McGraw-Hill Book Company, 1984.
- Fitoussi, J.P., and E.S. Phelps. "Causes of the 1980s Slump in Europe." *Brookings Papers on Economic Activity* (2: 1986), pp. 487-513.
- Friedman, Milton. "Should There Be an Independent Monetary Authority?" In *In Search of a Monetary Constitution*, edited by L.B. Yeager. Cambridge, Mass: Harvard University Press, 1962.
- Gordon, Robert J. "The Conduct of Domestic Monetary Policy." In *Monetary Policy in Our Times*, edited by A. Ando, H. Eguchi, R. Farmer, and Y. Suzuki. Cambridge, Mass: The MIT Press, 1985.
- Gordon, Robert J., and Stephen R. King. "The Output Cost of Disinflation in Traditional and Vector Autoregression Models." *Brookings Papers on Economic Activity* (2: 1982), pp. 205-72.

- Grossman, Herschel I., and John B. Van Huyck. "Seigniorage, Inflation, and Reputation." *Journal of Monetary Economics* 18 (July 1986): 21-31.
- Hall, Robert E. "Macroeconomic Policy Under Structural Change." In *Industrial Change and Public Policy*. A symposium sponsored by the Federal Reserve Bank of Kansas City, 1983.
- Kydland, Finn E. "Noncooperative and Dominant Player Solutions in Discrete Dynamic Games." *International Economic Review* 16 (June 1975): 321-35.
- Kydland, Finn E., and Edward C. Prescott. "Rules Rather than Discretion: The Inconsistency of Optimal Plans." *Journal of Political Economy* 85 (June 1977): 473-91.
- McCallum, Bennett T. "Monetarist Rules in the Light of Recent Experience." *American Economic Review* 74 (May 1984): 388-91.
- _____. "On Consequences and Criticisms of Monetary Targeting." *Journal of Money, Credit, and Banking* 17 (November 1985, part 2): 570-97.
- _____. "Inflation: Theory and Evidence." NBER Working Paper No. 2312, July 1987. Forthcoming in *Handbook of Monetary Economics*, ed. by B.M. Friedman and F.H. Hahn. Amsterdam: North-Holland.
- Meltzer, Allan H. "Overview." In *Price Stability and Public Policy*. A symposium sponsored by the Federal Reserve Bank of Kansas City, 1984.
- _____. "Limits of Short-Run Stabilization Policy." *Economic Inquiry* 25 (January 1987): 1-14.
- Taylor, John B. "What Would Nominal GNP Targeting Do to the Business Cycle?" *Carnegie-Rochester Conference Series on Public Policy* 22 (Spring 1985): 61-84.
- Tobin, James. "Monetary Policy: Rules, Targets, and Shocks." *Journal of Money, Credit, and Banking* 15 (November 1983): 506-18.
- Volcker, Paul A. "Statement before the House Committee on Banking, Finance and Urban Affairs." *Federal Reserve Bulletin* 69 (August 1983): 617-21.

THE AUSTRALIAN MONEY MARKET AND THE OPERATIONS OF THE RESERVE BANK OF AUSTRALIA: A COMPARATIVE ANALYSIS

Michael Dotsey

I. Introduction

This paper provides a comparative analysis of monetary policy in Australia and the United States. It concentrates on the day-to-day conduct of policy and on the influence that the structure of overnight money markets has on the transmission of monetary policy through open market operations. The regulatory structure of any market affects the behavior of agents who trade in that market and, therefore, can also influence the results of government actions. In particular, the efficiency of monetary control may depend on the rules and institutional arrangements that characterize a country's overnight money market. The analysis indicates that there are significant institutional differences between the Australian and United States money markets and that these differences are important in determining the relative efficiency of monetary control under different operating procedures.

There are three major elements that differ between the United States and the Australian money markets. One is the nature of reserve requirements, while another involves the lending procedures used by the respective central banks. The third is that certain money market dealers bank at the Reserve Bank of Australia rather than with private banks. These differences affect monetary control. Further, the interaction between the structure of the money

The research for this paper was conducted while the author was visiting the Reserve Bank of Australia. I am deeply indebted to Ian Macfarlane, Ric Battellino, and Brian Gray for their help and encouragement. My colleagues Marvin Goodfriend, Tony Kuprianov, and Alan Stockman have also provided valuable comments. Colleen Mitchell and Peter Skib of the Reserve Bank of Australia and Rob Willemsen of the Federal Reserve Bank of Richmond provided expert research assistance. Needless to say, the opinions expressed in this paper are solely those of the author and do not necessarily express the views of the Reserve Bank of Australia, the Federal Reserve Bank of Richmond, nor the Federal Reserve System.

market and monetary control is influenced by use of the interest rate as the instrument of monetary policy in both countries.

To compare the overnight money markets, it is essential to define terminology and explain their structure. This is done in Section II. Since the structure of the U.S. money market is relatively familiar and is examined in depth elsewhere, the discussion will focus primarily on Australia.¹ Section III presents the mechanics of open market operations in Australia and describes the operating procedures of the Reserve Bank of Australia. Based on this description, a theoretical model examining the efficiency of monetary control is explored in Section IV. A brief summary is given in Section V.

II. The Official Money Market in Australia

Overview

This section describes the structure of the official money market in Australia. It also examines the roles of the major participants—dealers, trading banks, and the Reserve Bank—and describes how funds are distributed among them. Various similarities and differences between this market and the U.S. federal funds market are highlighted. A basic comparison in terminology is summarized in Table I, while the major institutional differences are summarized in Table II.

Market Structure

The official money market in Australia is basically analogous to the U.S. federal funds market. It allocates funds that receive same-day credit in

¹ For a detailed treatment of the U.S. money market, see Cook and Rowe (1986). In particular the article by Goodfriend and Whelpley makes an in-depth study of the federal funds and overnight RP market.

Table I
TERMINOLOGY

	Australia	United States
Market for funds receiving same-day credit in accounts held with central bank	Official money market	Federal funds market
Institutions that deal directly with the central bank	Authorized dealers and occasionally trading banks	Primary dealers, some of which are banks
Inventory of same-day funds	Bank loans to dealers	Excess reserves
Reserves held at central account	Statutory reserve deposits (SRD) and exchange settlement funds	Reserve bank balance
Methods of central bank lending	Rediscounting of government securities and lender-of-last-resort loans (LLR) to authorized dealers	Discount window borrowing

accounts held by trading banks and dealers at the Reserve Bank of Australia. These accounts, which are used for clearing funds, are called exchange settlement accounts. Australia also has an unofficial money market that handles all money market transactions in which banks do not receive same-day credit in their exchange settlement accounts.

In short, Australia has two types of funds. The first consists of same-day funds or exchange settlement funds that accrue to exchange settlement accounts at the Reserve Bank. These include direct dealings with the Reserve Bank, transactions with authorized dealers, and yesterday's check clearings. Funds of the second type are those transferred by bank checks. These are next-day funds because checks presented against banks in Australia are cleared through the Australian Clearing House and do not affect the exchange settlement accounts of banks until the following morning.

Participants in the Official Money Market

Dealers Dealers play a pivotal role in the daily functioning of the official money market. For one thing, the Reserve Bank deals almost exclusively with authorized dealers so that, with the exception of rediscounting, all movements in same-day funds are initiated through the accounts of dealers at the Reserve Bank of Australia. Another reason relates to the timing convention for debiting and crediting the exchange settlement accounts of dealers. These accounts are credited and debited on a same-day basis which gives dealers the central role in distributing exchange settlement funds throughout the banking

system. The interbank market also plays a role, but it is only through transactions with dealers that systemwide shortages or excesses can be transferred from one day to the next. That official money market dealers bank at the Reserve Bank of Australia and that their transactions receive same-day credit are the key features distinguishing the Australian from the U.S. money markets.

The timing convention of crediting exchange settlement accounts of dealers on the same day allows the banking system to transfer same-day funds from one day to the next through the use of interday float. This is done by holding a stock of loans with dealers. Because transactions with dealers receive same-day credit while checkable funds take one day to clear, loans to official money market dealers occupy a special place in the operation of the official money market. If the banking system as a whole has insufficient exchange settlement funds, it can call in loans to dealers. (Note that dealers cannot make loans to banks.) The banking system gets immediate credit on this transaction and the transaction also leaves dealers short of same-day funds. Unlike banks, however, dealers can sell a government security to the nonbank public and receive same-day funds. Although dealers receive same-day funds, the check written to the dealer will not be cleared until tomorrow and will not affect the balances in the banking system's exchange settlement accounts until then. Essentially, the timing convention allows the banking system to make use of float (that is, cash items in the process of collection) by transferring exchange settlement funds through time. This also implies that

Table II

MAJOR CHARACTERISTICS OF OVERNIGHT MONEY MARKETS FOR RESERVABLE FUNDS

Australia

United States

Reserve Requirements

Current reserve requirements are based on last month's deposits and are therefore lagged. These requirements are held in a special account called a statutory reserve deposit account (SRD) and earn a below-market rate of interest.

Reserve requirements in the United States are almost contemporaneous. Required reserves for a two-week maintenance period ending on a Wednesday are based on deposits for the two-week period ending on a Monday.

Clearing Balances

Balances held at the Reserve Bank for the purpose of clearing checks are called exchange settlement funds. The exchange settlement account pays no interest and can not be negative at the end of the day.

Banks clear funds through their reserve account at the Fed. This account can not have a negative balance at the end of the day.

Dealers

There are 9 authorized dealers in Australia. They bank at the Reserve Bank of Australia.

There are 37 primary dealers in the United States, some of which are banks. Nonbank dealers do not bank with the Fed.

Central Bank Lending

There are two forms of lending, one is to authorized dealers through a line of credit and is referred to as a lender-of-last-resort loan (LLR). The other is through rediscounting government securities (CGS). This is not technically a loan, but is analytically equivalent to a loan over the securities' remaining maturity. Both means of acquiring funds usually involve rates that are above market rates.

The Fed lends money to banks through its discount window. These loans are typically made at a subsidized rate and therefore involve some sort of rationing process.

bank loans to dealers are a source of same-day liquidity to the banking system and serve the same purpose as excess reserves do in the United States.

Trading Banks Trading banks in Australia are banks that are authorized to clear checks. Nonbanks are allowed only indirect access to the check clearing system either by holding accounts with trading banks or by having an agency arrangement with a trading bank. For understanding the workings of the official market, however, there is no loss in assuming that all checks are issued by trading banks.

The important regulations that affect bank behavior in the official market are the structure of reserve requirements, access to rediscounting (discussed later), and the same-day availability of funds lent to dealers. Banks maintain required reserves in a special

account called a statutory reserve deposit account (SRD). These reserves are based on last month's deposits and earn a below-market rate of interest, implying that the SRD requirement acts as a tax on the banking system. For check clearing purposes banks also maintain an exchange settlement account whose balance cannot be negative at the end of the day. This is equivalent to requiring that banks meet their reserve requirement on a day-to-day basis.

In the United States, banks need only meet their reserve requirements on average and, therefore, have some flexibility in determining the profile of their required reserve balances. In Australia, flexibility arises through the use of float produced by the differential timing in debiting and crediting the accounts of dealers and banks.

The Reserve Bank of Australia The monetary policy of the Reserve Bank of Australia is conducted through its exchange settlement position with the banking system. To influence the cash position of the banking system the Reserve Bank actively uses open market operations consisting of outright purchases and sales of government securities and repurchase and reverse repurchase agreements. As with most central banks that essentially use an interest rate instrument, the volume of trading is many times the actual change in portfolios. For example, in 1985/86 the Reserve Bank's gross purchases amounted to approximately \$29.7 billion while its gross sales were approximately \$28.4 billion, yielding only a small net increase in its portfolio. The same type of financial churning typifies U.S. experience. As documented by Friedman (1982) and by Levin and Meulendyke (1982), the Federal Reserve made gross transactions on its own account of \$393 billion while only adding \$4.5 billion to its portfolio.

Open market operations in Australia are almost exclusively implemented through transactions with authorized dealers, although in unusual circumstances the Reserve Bank may transact directly with banks. Unlike open market operations conducted by the Fed, those carried out by the Reserve Bank of Australia do not supply same-day funds to the banking system. This is a direct result of dealers banking with the Reserve Bank. In the United States the Fed's purchase of a security from a dealer immediately provides the dealer's bank with reserves. By contrast, in Australia the dealer receives funds immediately but the banking system only acquires funds on the next day when the dealer's check clears.

Most of the open market operations in Australia are defensive. That is, in order to maintain a desired interest rate the central bank attempts to offset flows of funds that, by affecting the cash position of trading banks, would otherwise cause rates to move. For conditions that are deemed to be short-term or seasonal, repurchase agreements are frequently employed, while outright purchases and sales are more often used to offset longer-term market conditions that do not accord with desired policy.

Central Bank Lending

Another major way for the banking system in Australia to acquire exchange settlement funds is through loans from the central bank. These funds can reach the banking system in two distinct ways. One, called a lender-of-last-resort loan (LLR), is indirect and occurs through a line of credit extended to authorized dealers. The other is through the redis-

counting of specific Treasury notes at the Reserve Bank.² Rediscounting is not a loan. However, it is analytically equivalent to borrowing at the effective rediscount rate (defined below) for the remaining term of the security rediscounted.

Lender-of-last-resort loans are made with a term of 7-10 days. The minimum term is seven days with dealers having the prerogative of choosing which day they will repay the loan (as long as it is repaid by the tenth day). The rate on lender-of-last-resort loans is usually above going market rates. However, since dealers can always acquire same-day funds by borrowing from nonbanks, dealers will borrow only if overnight rates are expected to rise to the level of the lender-of-last-resort loan rate. Also, since market rates fluctuate, the LLR rate is adjusted frequently. Because an LLR loan is for a minimum term of seven days, the decision to borrow depends not only on current market rates but on expected market rates over the term of the loan.

With respect to the rediscounting of government securities, the Reserve Bank stands ready to purchase securities at a price P , determined by

$$P = 100 (1 - nr/365)$$

where r is the rediscount rate and n is the number of days to maturity on the note. As Poole (1981) points out, this procedure produces an effective rediscount rate of r^* , commonly known as the "give-up yield," given by

$$r^* = (365/n) ((100 - P)/P) = r [1 - nr/365]^{-1}.$$

This formula states that the effective rediscount rate r^* is larger than the discount rate r and varies inversely with the number of days n to maturity on the rediscounted note. Like the LLR rate, the rediscount rate is usually above the market rate. The pattern of money market rates is shown in Chart 1.

Borrowing and rediscounting behavior by banks and dealers is depicted in Charts 2a and 2b and in Table III. The data show (1) that large volumes of rediscounting usually occur when unofficial market rates slightly exceed the rediscount rate, but (2) that the rediscount rate is usually above official market rates. The behavior of lender-of-last-resort loans is also similar with dealers borrowing when rates are expected to rise above the LLR rate. These lending methods differ significantly from the operation of the

² The rediscount facility is available to any noteholder but is primarily used by banks and authorized dealers.

Table III
**INSTANCES OF LARGE REDISCOUNTINGS FROM
 THE RESERVE BANK (1986)**

Date	Rediscounts	Rediscount Rate	Official Market Rate	Unofficial Market Rate
1/17/86	63	19.0	18.7	19.0
3/11/86	115	18.0	17.5	17.9
4/8/86	85	16.5	16.3	17.8
6/10/86	83	14.6	14.1	15.4
1/16/87	110	14.6	12.4	16.0

quantity of these loans implies that a substantial draining of reserves would be required in order to induce banks in Australia to use the rediscount facility.

Although the use of rediscounting and LLR facilities may not be as great as discount window use in the United States, they still strongly influence the behavior of banks and dealers. Since these facilities represent a cost of acquiring same-day funds, the rediscount rate and the rate on LLR loans play an important role in determining the supply of bank loans to dealers and the demand for short-term funds by dealers. In essence, the penalty rate charged for same-day funds represents the cost of being caught short of those funds and will therefore be an important determinant for banks in deciding how much of an inventory of same-day funds they should maintain.

III. The Operating Policy of the Reserve Bank of Australia

Before investigating the general operating strategy of the Reserve Bank of Australia, it is necessary to look at the mechanics of an open market operation. Doing so will help to clarify the important information contained in the level of bank loans to dealers, information similar to that communicated by the level of discount window borrowing in the United States.

Open Market Operations

The mechanics of open market operations can best be illustrated by means of a numerical example. Suppose that the exchange settlement accounts of banks have a zero balance and that banks have loans outstanding with dealers of \$900 million. Also, assume that taxes of \$600 million are being paid by the public to the Treasury. At approximately

9:30 a.m. the Reserve Bank announces the system's opening cash figure resulting from the previous day's check clearings. In this example the figure is zero. At the same time, the Bank also indicates its dealing intentions.

As mentioned, banks' loans to dealers represent an inventory of same-day funds available to the banking system. The greater this inventory the lower the probability that banks will be forced to rediscount government securities. Although banks are not short of exchange settlement funds today, they are aware that tax payments will be leaving the system and, as a result, they will have a cash deficit of \$600 million tomorrow morning. Reserves leave the system because the Treasury keeps all of its accounts with the Reserve Bank. Under the assumptions in this example, banks have enough loans outstanding with dealers to cover the shortfall, but the resulting loss in dealer loans would certainly be greater than banks desire at the existing interest rate. Therefore, individual banks will try to acquire next-day funds by bidding for deposits or selling securities to dealers or nonbanks and rates will rise. While any one bank can acquire funds in this manner, the system as a whole can only acquire funds (1) if the Reserve Bank provides accommodation by buying securities from dealers, (2) if dealers finance the purchase of securities through central bank borrowings, or (3) if someone uses the rediscount facility of the Reserve Bank.

If the Reserve Bank does not desire any upward pressure on rates, it can add funds today and allow the system to transfer the funds from today to tomorrow. The banks and dealers will make such transfers because exchange settlement funds do not earn interest. For example, suppose the Reserve Bank buys \$300 million in repurchase agreements from authorized dealers. Dealers' exchange settlement accounts will be up \$300 million, augmenting their ability to purchase interest-earning securities from nonbanks (or banks) either outright or under repurchase agreements.

Because dealers' accounts are debited (or credited) on the same day, their exchange settlement funds will now be square. Nonbanks will deposit the dealers' checks with a bank and the funds will be credited to the banking system's exchange settlement accounts on the next day. Therefore, although the accounts of dealers and banks at the Reserve Bank will not change as a result of the open market operation, float will increase by \$300 million, as will deposits held with the banking system. In effect, the \$300 million has spilled over to the next day so that banks will only have to reduce the net amount of

loans with dealers by \$300 million rather than \$600 million. In this case, the rise in the interest rate will be lessened.

It should also be noted that if the Reserve Bank does not provide additional funds on the day that tax payments leave the banking system, bank loans to dealers will continue to decline. As a result of the tax payment, banks have been forced either to reduce their loans to dealers by \$300 million or to rediscount \$300 million of securities. As long as the effective rediscount rate is above market rates, banks will call in dealer loans. Calling in a dealer loan results in \$300 million being credited to the banking system's exchange settlement accounts. The exchange settlement accounts of dealers are now deficient by \$300 million. Dealers must either take out an LLR loan or sell securities from their portfolio. The sale of securities results in immediate credit to the dealers' exchange settlement account even though the check will not be presented against the banking system until tomorrow. Float is, therefore, negative and the system has essentially borrowed money from the next day. On the next day the check clears and the banking system is once again short \$300 million and deposits have declined by \$300 million. The process will continue until banks' loans to dealers have been driven to zero. At this point, arbitrage implies that the official market rate will have reached the effective rediscount rate.

This transmission mechanism is quite different from that in the United States. In the above example, there has been no change in balances held at the Reserve Bank, since exchange settlement accounts are virtually zero-balance accounts. There is negative float, but the change in the portfolios of dealers and the banking system can be many times the initial \$300 million withdrawal of funds. In the United States, under lagged reserve requirements, there would be a once-and-for-all decline in free reserves (excess reserves minus borrowed reserves) without any need for continuing adjustments. The monetary base in the United States would have changed by \$300 million and the federal funds rate would have adjusted. In Australia, the \$300 million shortfall appears to set off a continual adjustment process without any continuing changes in the monetary base. This process occurs because loans to dealers change and these loans represent an inventory of funds that allow the banking system to postpone rediscounting. In the absence of any subsequent actions by the Reserve Bank, banks eventually must rediscount to keep their exchange settlement account from becoming negative. In U.S. terminology, holding loans with dealers is analogous to

banks postponing the need to satisfy reserve requirements with non-interest-bearing reserves.

There is also a similarity between excess reserves in the United States and bank loans to dealers in Australia. Both assets represent a source of same-day funds. In Australia, the greater the spread between the effective rediscount rate and the overnight interest rate, the greater the penalty of being caught short of same-day funds. As a result, banks will make more loans to dealers when the overnight rate is low. For given expectations of future open market operations, there will be a strong relationship between the amount of dealer loans and overnight rates.

Although the preceding example emphasized the difference in the transition path of bank balance sheet items in Australia and the United States, the steady-state equilibrium will be the same. At some point, say with a reserve requirement of 10 percent and no currency drain, a \$300 million contraction of central bank liabilities will lead to a \$3 billion decline in bank deposits, a corresponding \$300 million fall in required reserves, and a \$2.7 billion decline in bank assets. In order for the U.S. system to follow a transition path similar to that followed in Australia, the Federal Reserve would have to vary nonborrowed reserves so that excess reserves followed a qualitatively similar path to dealer loans in Australia. The bizarre nature of such a policy is one reason that the Reserve Bank of Australia does not sit on the sidelines for any extended period of time. Protracted contractions and expansions of bank loans to dealers are not usually allowed to occur.

The above example also highlights a particular feature of Reserve Bank behavior that does not seem to be fully appreciated. Specifically, maintaining the current level of short-term interest rates does not imply that the Bank should merely offset daily injections of funds into the system. Since bank behavior in bidding for funds depends on the expected flows of cash over subsequent days, the Reserve Bank's operations must also recognize likely flows of cash in the future. Otherwise, needless variations in interest rates would arise. Therefore, to ascertain whether the Reserve Bank is seeking to move market rates requires a detailed examination not only of conditions existing on the current day but conditions that are liable to arise in the near future.

The one-day lag between transactions that provide exchange settlement funds to banks reduces forecasting errors since banks start each day with a known cash position. If interbank settlement were on a same-day basis, the Reserve Bank would have

difficulty forecasting banks' needs for cash and this could lead to larger swings in overnight interest rates. Of course there is always the possibility that banks would just hold additional loans with dealers. However, an optimal inventory strategy would not cover all contingencies. Also, the ability to borrow and lend across days allows the system to adjust more gradually to movements, especially temporary ones, in settlement funds. Given that the Reserve Bank is averse to sharp swings in interest rates, this is a desirable characteristic. In the United States, the regulation that banks only need to meet their reserve requirements on average has much the same effect.

Although the accounting procedures in Australia provide the system with some ability to adjust to temporary reserve pressures without significant movements in rates, a concerted effort by the central bank to move rates will result in a gradual and continued change in loans to dealers. In the case of a tightening in policy, dealers will be forced to seek funds by borrowing from nonbanks or selling securities. These actions place upward pressure on rates. Eventually, the necessary exchange settlement funds can only come from two sources, lender-of-last-resort loans to dealers and the rediscounting of government securities.

Reserve Bank Policy

The major aim of the Reserve Bank's domestic market operations is to maintain the official market interest rate at a level consistent with the objectives of monetary policy. This type of policy, which uses the interest rate as an operating instrument, has been implemented since the floating of the exchange rate in December 1983. Note, however, that while the Reserve Bank uses an interest rate instrument, it does not peg the rate. Rather, its policy is similar to that of the Fed. The Reserve Bank basically tries to maintain interest rates within some desired band. Fluctuations within this band are tolerated while movements outside the band indicate a change in policy. Band widths vary, but are probably on the order of 100-200 basis points.

The daily volatility of both the official rate in Australia and the federal funds rate in the United States are displayed in Tables IV and V. The measure of volatility is the average squared first difference in daily rates. Table IV displays this measure for selective sample periods chosen so as to remove the contaminating influence of a general policy-induced trend in rates. Table V reports monthly averages. The message of the two tables is the same. Both central banks allow daily rates to fluctuate and the amount of fluctuation is roughly similar. Australian rates

showed more volatility in 1984, but that may have been due to a learning process on the part of the Reserve Bank staff. Currently, daily rate movements are on the order of 20-60 basis points in each country. The figures on daily volatility coupled with the large amount of financial churning in each central bank's portfolio constitutes strong evidence that both monetary authorities are using the interest rate as an instrument, but that the interest rate is allowed a certain amount of flexibility.

As a practical matter, one would like to know how the monetary authority is able to obtain a desired average value for the interest rate and yet allow for daily fluctuations. One would also like to know the economic effects of this type of policy as compared to a policy of adhering to an adjustable interest rate peg. In Australia, policy is achieved by targeting bank loans to authorized dealers, while in the United States the Fed targets the level of borrowed reserves. As shown below, both policies are essentially an indirect interest rate instrument (see also McCallum and Hoehn (1983) and Dotsey (1987a,b)). In practice, however, if hitting the targeted level of loans to dealers forces the interest rate outside its prescribed band, then the target is readjusted. The result is a discontinuity in policy. Loans to dealers are

Table IV
**VOLATILITY IN THE DAILY OFFICIAL RATE AND
THE DAILY FEDERAL FUNDS RATE**

(Measured by the average squared first difference
of daily rates over selected sample periods)

Australian Official Rate		
July 2, 1984	— Feb. 19, 1985	.72
Feb. 20, 1985	— Apr. 1, 1985	.40
Apr. 2, 1985	— Apr. 30, 1985	.04
May 1, 1985	— Nov. 11, 1985	.30
Nov. 12, 1985	— Feb. 24, 1986	.14
Feb. 25, 1986	— Apr. 28, 1986	.44
Apr. 29, 1986	— Jul. 28, 1986	.53
Jul. 29, 1986	— Oct. 30, 1986	.11
Oct. 31, 1986	— Dec. 30, 1986	.03
U.S. Federal Funds Rate		
Oct. 8, 1979	— Jan. 31, 1983	.61
Feb. 1, 1983	— Feb. 29, 1984	.08
Mar. 1, 1984	— Dec. 31, 1984	.18
Jan. 1, 1985	— Jan. 30, 1987	.25

Table V

VOLATILITY IN THE DAILY OFFICIAL RATE AND THE DAILY FEDERAL FUNDS RATE

(Measured by the monthly average squared first difference of daily rates)

	Australian Official Rate			U.S. Federal Funds Rate						
	1984	1985	1986	1980	1981	1982	1983	1984	1985	1986
Jan.	3.10	.24	.04	.38	1.03	.27	.28	.06	.06	.03
Feb.	2.97	1.78	.08	1.59	.87	.45	.04	.02	.06	.01
Mar.	1.58	.34	.23	.56	.30	.37	.14	.13	.11	.07
Apr.	1.16	.10	.74	2.24	.60	.66	.17	.23	.06	.05
May	.64	.16	.91	1.24	1.07	.17	.02	.21	.05	.01
Jun.	2.54	.73	.24	.54	1.11	.07	.16	.12	.05	.05
Jul.	.52	.50	.33	.18	1.21	.23	.04	.09	.10	.04
Aug.	.68	.17	.29	.37	.72	.15	.02	.04	.06	.01
Sep.	.85	.25	.03	.29	.42	.36	.09	.14	.08	.05
Oct.	.47	.04	.02	.43	.54	.19	.06	.55	.09	.06
Nov.	.50	.33	.04	.73	.24	.05	.02	.05	.17	.18
Dec.	.72	.12	.03	1.55	.11	.14	.13	.20	1.18	3.38
Average of monthly squared deviations										
	1.31	.40	.25	.85	.69	.26	.10	.15	.17	.33

only used as a guide when the interest rate produced by the procedure remains within specified bounds. The same is true of a borrowed reserve target in the United States.

Modeling this type of policy discontinuity would not be easy. Nevertheless, one can model the procedures that span it. These include an interest rate instrument that is varied only periodically and a policy of targeting either loans to dealers (Australia) or discount window borrowing (U.S.). A model of those procedures may tell us something about the effectiveness of monetary control.

IV.**The Economic Model****Overview**

The purpose of this section is to consider the effectiveness of two different operating procedures for controlling money. Given that the Reserve Bank employs lagged reserve requirements, the basic instrument of monetary control must be the official market rate. With lagged reserve requirements, today's required reserves are based on last period's deposits and there is no way for current policy to affect history. The control of the money stock must,

therefore, be accomplished through the interest rate. This rate can be used directly as an instrument or indirectly through the targeting of bank loans to dealers. Although actual policy does not exactly conform to either method, these methods seem to span policy. Therefore, an investigation of the effects that market structure has on the monetary-control powers of a direct versus an indirect interest rate instrument should reveal information regarding the effectiveness of actual policy. That different results are obtained for the United States and Australia shows that market structure is relevant when analyzing the efficiency of monetary policy.

The Market for Reserves

Capturing the major attributes of the Australian money market in an analytically tractable manner requires a degree of abstraction. It is, therefore, important to isolate the key features that characterize the market for reserves. These features include (1) the presence of lagged reserve requirements, (2) the requirement that exchange settlement accounts be nonnegative, and (3) the intertemporal decisions involved in rediscounting, lender-of-last-resort loans, and bank loans to dealers. The intertemporal nature of bank behavior can be illustrated by assuming that the average maturity of a rediscounted

security is two periods of a week each. Similarly, central bank loans to dealers are assumed to be for two periods. One may also wish to think of the reserve maintenance period as being two periods in length, although this is not crucial. It will be evident that, for the two alternative operating procedures analyzed, the particular reserve accounting regime is irrelevant.

The Demand for Money

The intuition behind the results concerning the effectiveness of monetary control (as measured by the squared deviation of money from its target value) can be understood without a detailed description of the economy.⁴ Since monetary control is being examined, it will be necessary to discuss the demand for money.

The real demand for money is assumed to be positively related to income and negatively related to the nominal interest rate. When output is high, individuals tend to spend more. The resulting increase in their transactions requirements implies that more real money balances are desired. Conversely, as nominal interest rates rise the opportunity cost of holding money balances increases and individuals economize on their money holdings. The demand for money also depends on a stochastic element that may be thought of as representing unobserved changes in transactions costs brought about by innovations in cash management procedures. This random element is assumed to show some persistence and for simplicity is characterized by an AR1 process. That is, the shock to money demand, x_t , is equal to $\rho x_{t-1} + v_t$, where $0 < \rho < 1$, and v_t is white noise. This means that any current disturbance to the demand for money will also affect the future demand for money, although the effect will dampen over time. Some element of persistence is needed to make interesting the comparison between targeting loans to dealers in Australia (borrowed reserves in the United States) and an interest rate instrument. Otherwise, an interest rate instrument would trivially dominate the loans-to-dealer target (and similarly a borrowed reserve target in the United States) as a means of controlling money (see McCallum and Hoehn (1983) and Dotsey (1987a, b)). An AR1 process for the money demand shock represents the simplest way of incorporating persistence and allows the analysis to proceed at an intuitive level.⁵

⁴ For a detailed presentation see McCallum and Hoehn (1983) or Dotsey (1987a, b). The model used represents a closed economy. Extending the result to open economy would be of interest but the basic mechanism that drives the results does not seem to be sensitive to such an extension.

⁵ A degree of permanence could be modeled for the other variables without affecting the qualitative results.

An Interest Rate Instrument

One basic means for controlling money is a policy of directly using the interest rate. The efficiency of this policy is measured by the expected squared deviation of money from its target, m_t^* . The targeted level of money could arise from some complicated feedback mechanism on past and expected values of various economic variables that are chosen to satisfy broader policy objectives. However, the actual choice of m_t^* is not crucial (see McCallum and Hoehn (1983)), and for simplicity it is assumed that the targeted level of money is a constant.

In order to use an interest rate instrument, the Reserve Bank would peg the current interest rate at a level that will produce an expected value of money equal to m_t^* . Graphically, the demand for money can be drawn as a negatively sloped curve with respect to the interest rate. This is depicted in Figure (1a), where m_t^e is the expected demand for money based on past information that includes observations on last period's economic disturbances. The Reserve Bank then chooses the interest rate r_t^* that it anticipates will equate current money demand with its targeted value.

If the economy does not encounter any shocks, then the demand for money will exactly equal its target. Disturbances, however, will generally occur. For example, the demand for money could be unexpectedly high or there could be a shock to aggregate supply that would affect income and consequently the demand for money. The dashed lines in Figure (1b) reflect two possible demands for money that could occur in the presence of unanticipated economic disturbances. If the demand for money were unexpectedly high, then actual money would be m_t^b and the Reserve Bank would miss its target. Similarly, if money demand were lower than anticipated, actual money would end up lower than the target.

Pegging the interest rate therefore does not produce perfect period-by-period control of the money stock. However, since the errors in controlling money are not systematic, the high and low misses will cancel out over a long enough period. The same is true when the variable targeted is loans to dealers. Thus, in comparing the effectiveness of the two operating procedures, one needs to examine the relative variability in money's deviation from target.

Targeting Bank Loans to Dealers

Alternatively, the Reserve Bank could attempt to achieve a desired level of money by aiming at a desired level of bank loans to dealers. As mentioned, this variable indicates the amount of same-day funds available to banks. For simplicity, it will be assumed that bank loans to dealers are supply-

Figure 1a

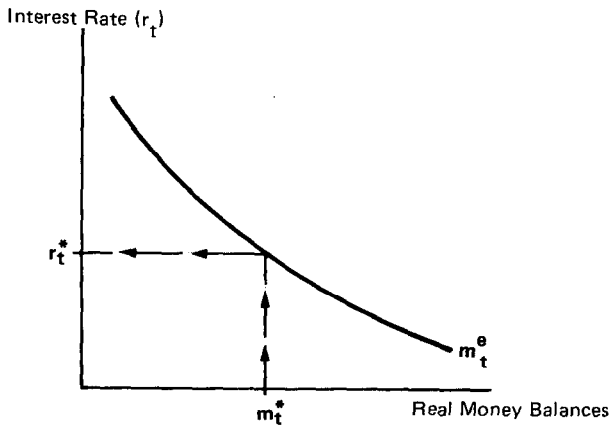


Figure 2a

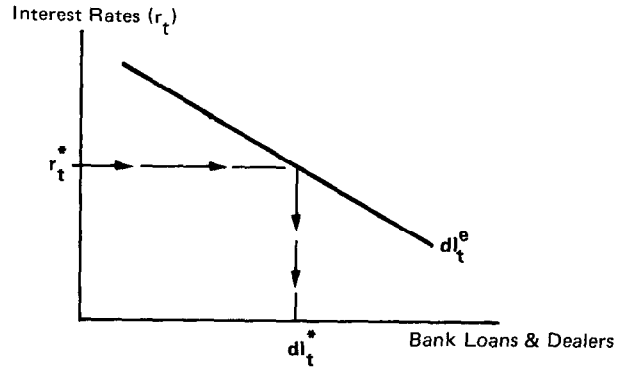


Figure 1b

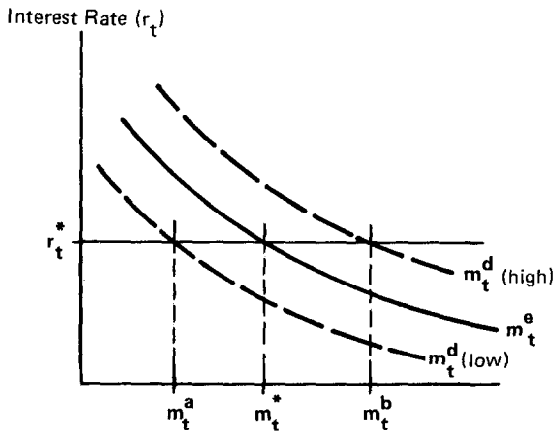
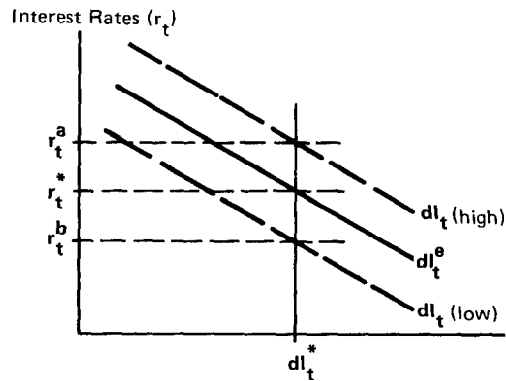


Figure 2b



determined with dealers accepting any amount of loans at the going rate. Banks hold loans with dealers because funds in exchange settlement accounts do not earn interest. The inventory of same-day funds will be based on the cost of running short. Specifically, if a bank must rediscount a two-period security in order to obtain exchange settlement funds, the cost is the effective rediscount rate minus the expected yield on the security rediscounted. In order to avoid this cost, banks will have a well-defined demand for an inventory of same-day funds. These funds are acquired by making loans to official money market dealers. As market rates rise to the level of the effective rediscount rate, there is no longer any advantage to holding loans with dealers since rediscounting no longer involves a penalty. Therefore, the supply of dealer loans is indirectly related to the official market rate.

Under lagged reserve requirements the procedure of targeting banks' loans to dealers amounts to an indirect interest rate instrument, as does targeting

borrowed reserves in the United States. This can be seen by examining Figure (2a). Figure (2a) represents the anticipated supply of loans, dl_t^e , as an inverse function of the interest rate. As interest rates rise and approach the effective rediscount rate, the penalty associated with rediscounting declines. There is, therefore, less reason for holding same-day funds with dealers.

How should the Reserve Bank choose a target for dealer loans, dl_t^* , given that it is interested in achieving a quantity of money equal to m_t^* ? As in the case of an interest peg, the Reserve Bank must choose r_t^* in exactly the same manner. Then, given r_t^* , it will choose dl_t^* at a level that it anticipates will be consistent with r_t^* . If there are no economic disturbances, using open market operations to induce banks' loans to dealers to equal dl_t^* will result in an interest rate of r_t^* and money demand equal to m_t^* . It is in this sense that using a reserve instrument amounts to using an indirect interest rate target.

Now assume that the supply of bank loans to dealers is also affected by a random component, and that no other random disturbance impinges on the economy in the current period. In this case, the actual supply of loans could be depicted by either of the dashed lines in Figure (2b). For the case in which the supply is unexpectedly high, maintaining the reserve target at dl_r^* results in an interest rate of r_r^* and money demand of m_r^* . With no disturbances to money demand, aggregate supply, or aggregate demand, the Reserve Bank would still miss its monetary target. The targeting of bank loans to dealers would be unambiguously worse than using the interest rate directly if there were no persistence in the economy.⁶

To see how persistence can potentially alter the analysis, one can examine the case of a positive money demand disturbance. Individual banks will perceive part of this disturbance by observing movements in the interest rate and an increase in money balances in its depositors' accounts which are positively correlated with aggregate movements in money. Because the money demand disturbance shows persistence, banks realize that next period's demand for money will be high and the next period's interest rate will have to rise if the Reserve Bank expects to achieve its monetary target. An expected rise in the interest rate will lessen the expected opportunity cost of rediscounting securities with maturities of two periods and longer and will, therefore, affect this period's supply of bank loans to dealers. Given the structure of the Australian market for reserves, the supply of loans will decline and today's interest rate will fall. The fall in the interest rate will work to further increase the money balances held by the public and exacerbate the deviation of money from target. This means that using bank loans to dealers is unambiguously worse than an interest rate instrument for controlling money in Australia.

The preceding analysis implies that, from the standpoint of monetary control, targeting bank loans to dealers is likely to be inferior to an interest rate target in Australia. The practical importance of this finding is that the Reserve Bank of Australia should be more concerned with the interest rate than with

⁶ Another necessary condition for a reserves instrument to potentially outperform an interest rate instrument is heterogeneity of information among agents (see Dotsey (1987a)).

bank loans to dealers. When applied to the United States the results may be different. This difference occurs because discount window borrowing is generally subsidized and thus must be rationed in some way.⁷ Banks attempt to take advantage of their borrowing privilege when rates are expected to be high. In the case of a partially perceived positive money demand disturbance, banks in the United States (as in Australia) expect that next period's interest rate will rise. Assuming an unchanged borrowing (discount) rate, they therefore attempt to postpone borrowing today with the result that a higher funds rate is required to induce them to borrow the targeted amount. This higher funds rate reduces the quantity of money demanded and causes the actual level of money to be closer to target than it would be under an interest rate instrument. Targeting borrowed reserves can, therefore, improve monetary control if the demand for borrowing is not too volatile.⁸

V. Summary

This paper presents a comparison between operating procedures and money market institutional arrangements in Australia and the United States. The conclusion is that, although the central banks of both countries use similar operating procedures, differences in institutional structure affect the relative efficiency of policy. The most important institutional differences are the administration of central bank lending and the fact that official money market dealers bank at the Reserve Bank. The use of lagged reserve requirements in Australia as opposed to contemporaneous reserve requirements is not an important difference under current operating procedures. The use of an interest rate instrument, either directly or indirectly, makes the reserve accounting regime irrelevant. Other aspects of the money market such as different rules for satisfying reserve requirements in Australia and the United States are likely to take on more importance under contemporaneous reserve requirements and reserve targeting.

⁷ For more detail see Goodfriend (1983).

⁸ For a more complete treatment see Dotsey (1987a).

References

- Cook, Timothy Q., and Timothy D. Rowe, eds. *Instruments of the Money Market*, 6th. ed. Richmond: Federal Reserve Bank of Richmond, 1986.
- Cukierman, Alex, and Allan H. Meltzer. "A Theory of Ambiguity, Credibility, and Inflation Under Discretion and Asymmetric Information." *Econometrica* 54 (September 1986): 1099-1128.
- Dotsey, Michael. "Japanese Monetary Policy, a Comparative Analysis." *Bank of Japan Monetary and Economic Studies* 4 (October 1986): 105-27.
- _____. "Monetary Control Under Alternative Operating Procedures." Federal Reserve Bank of Richmond, September (1987a). (Processed.)
- _____. "Open Market Operations in Australia: A U. S. Perspective." Reserve Bank of Australia Research Discussion Paper, (1987b).
- Farmer, David. "The Australian Interbank Money Market." *Bulletin of Money, Banking and Finance*, No. 46 (1984-85): 1-31.
- Friedman, Milton. "Monetary Policy: Theory and Practice." *Journal of Money, Credit, and Banking* 14 (February 1982): 98-118.
- Goodfriend, Marvin. "Discount Window Borrowing, Monetary Policy, and the Post-October 6, 1979 Federal Reserve Operating Procedures." *Journal of Monetary Economics* 12 (September 1983): 343-56.
- Levin, Fred J., and Ann-Marie Meulendyke. "Monetary Policy: Theory and Practice, a Comment." *Journal of Money, Credit, and Banking* 14 (August 1982): 399-403.
- Lucas, Robert J. "Some International Evidence on Output-Inflation Tradeoffs." *American Economic Review* 63 (June 1973): 326-34.
- McCallum, Bennett T. "Rational Expectation and Macroeconomic Stabilization Policy." *Journal of Money, Credit, and Banking* 12 (November 1980, pt. 2): 716-46.
- _____. "Price Level Determinacy with an Interest Rate Policy Rule and Rational Expectations." *Journal of Monetary Economics* 8 (November 1981): 319-29.
- McCallum, Bennett T., and James G. Hoehn. "Instrument Choice for Money Stock Control with Contemporaneous and Lagged Reserve Accounting." *Journal of Money, Credit, and Banking* 15 (February 1983): 96-101.
- Macfarlane, I.J. "Methods of Monetary Control in Australia." Paper presented at the New Zealand Association of Economists Annual Conference, Massey University, August 22, 1984.
- _____. "Open Market Operations Since the Float." Paper presented to Victorian Branch of Economic Society, Melbourne, November 26, 1986.
- Meek, Paul. "Open Market Operations—A Brief Comparative Study." Paper presented at Seminar on Central Banking International Monetary Fund, July 2, 1985.
- Poole, William. "Australian Monetary Policy: An Outsiders View." Paper presented at 51st Anzaas Congress, May 1981.
- Reserve Bank of Australia. "The Reserve Bank's Domestic Market Operations." *Reserve Bank of Australia Bulletin*, June 1985.
- _____. "Market Operations and Monetary Control: A Comparison of the U.S., U.K., and Australia." (Processed.)