Intermediate Targets and Indicators for Monetary Policy

A Critical Survey

Federal Reserve Bank of New York

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CONTENTS

FOREWORD

For nearly two decades after the Federal Reserve-Treasury Accord of 1951, U.S. monetary policy was viewed, both by its practitioners and by others, as mainly a matter of "leaning against the wind"--of tightening money market conditions when inflationary pressures threatened and easing them when the economy weakened. The 1960s, however, saw a gradual revival of interest in the possible role of the money stock in cyclical fluctuations and, especially, in the longer run behavior of prices. At the same time, the economy was experiencing a gradual, though irregular, acceleration in the trend rate of inflation, a development that was to reach its climax in the late 1970s and early 1980s.

Against this backround, the Federal Open Market Committee began to experiment more systematically with internal objectives for money and credit growth beginning around 1970. This was done in the belief that such targets could provide a better focus for the potential impact of policy on the economy and, in particular, on the longer run trend of inflation. Subsequently, a 1975 congressional resolution called on the Federal Reserve to report formally to Congress on its "plans and objectives" with respect to growth in money and credit. This requirement was reaffirmed and refined in the Humphrey-Hawkins legislation of 1978. Thus came into being a set of "intermediate targets" for monetary policy--intermediate, that is, between instruments such as open market operations and the discount rate and the broad objectives of policy with respect to economic performance.

The potential usefulness of such "intermediate targets" seemed--and continues to seem--substantial. At least in principle, targets for growth in financial aggregates such as money and broad measures of credit can provide an appropriate way of structuring the intermediate and longer run strategy of monetary policy, improving both the process of internal decision making and the communication of policy objectives to the Congress and to the public at large. Longer term objectives for money and credit growth can have an especially important role to play in ensuring that shorter term decisions are consistent over the long run with stability in the value of the nation's money, an objective that is uniquely a concern of the central bank.

The decade of the 1980s just passed, however, proved to be a particularly difficult period for the effective use of money and credit targets. A major wave of financial innovation and deregulation and a sharp reduction in the rate of inflation and the accompanying decline in interest rates, together with other factors not completely understood, have produced major changes in the relationship of the various measures of money and credit to economic activity. The Federal Reserve has found it necessary to adapt to these changing conditions by reducing or eliminating the use of some financial measures as intermediate targets while increasing emphasis on others and, more generally, by relying importantly on an eclectic and judgmental approach to policy making. Moreover, given the apparently impaired usefulness of the more traditional measures of money and credit as policy targets and indicators, some have sought to find new measures, such as commodity prices and the yield curve, to serve as guides for policy.

In these circumstances, it seemed useful to us at the Federal Reserve Bank of New York to review the evidence on the potential value of a range of financial measures as intermediate targets and/or indicators. The results of this review are contained in the studies that make up the present volume. The papers survey the vast literature that has grown up around these various measures while undertaking new research where that seemed to be needed. We hope that the results, as collected in one volume, will prove useful to all those concerned with issues of monetary policy.

Not surprisingly, given the experience of the 1980s, each of the measures examined in these studies is found to have serious limitations. Thus some of the measures are clearly unsuitable as intermediate targets, if only because they cannot be readily controlled with existing monetary instruments. Moreover, in varying degrees, all the measures prove to have only an imperfect relation to the broader economic measures policy seeks to influence.

Despite the problems that have emerged with the traditional money and credit measures in the 1980s, however, the Federal Reserve remains committed--not only as a matter of law but also as a matter of philosophy--to the formulation of money and credit objectives that will serve as a general guide to its longer run intentions. Paths for the downward adjustment of the longer run trend of money and credit growth are an essential element in any coherent long-run strategy for eliminating inflation as a significant factor in our economic life. The experience of the 1980s provides an important reminder, however, that such an approach to monetary policy must retain a great deal of flexibility, including the need to look at a wide variety of financial and nonfinancial indicators in framing judgments about policy. In any case, the Federal Reserve will undoubtedly continue to study the evolving performance of money and credit measures in an effort to find which of them may prove most suitable for framing the strategy of monetary policy in the conditions of the 1990s.

E. Gerald Corrigan

July 1990

INTRODUCTION

Richard G. Davis

Over the years, a broad array of mainly financial variables has been proposed for use in formulating and implementing monetary policy. This collection of papers examines the potential value of these various measures as intermediate targets and/or indicators of monetary policy. It includes a review of the Federal Reserve's evolving approach to the use of policy targets and operating guides in the postwar period. It also contains an analysis of the recent academic literature on the theory of policy rules that is relevant to the potential usefulness of intermediate targets.

Systematic analysis of monetary tactics and strategy in light of the relationships among policy instruments, a broad array of monetary and financial variables and measures of economic performance, began to expand rapidly in the late 1950s. Over the subsequent decades the subject has generated a large body of literature. One early source of motivation for this work was monetarist criticisms of the Federal Reserve's post-Accord procedures. In these procedures, the behavior of the money stock played, at most, only a limited role. Another impetus to the literature on monetary tactics was progress in modeling the markets for reserves and money. This work provided far greater analytical and quantitative detail on the connection between Federal Reserve actions and the response of the reserve and money aggregates than had previously been available.

Continuing controversy over the appropriate role of money stock targets sustained and intensified interest in the question of intermediate targets and their implementation in the 1960s and 1970s. Interest in the subject was especially intense in the period after the October 1979 announcement of a change in operating procedures designed to improve the implementation of targets for the monetary aggregates. By the early 1980s, signs of an emerging breakdown in the existing relationships of the money measures to the economy generated suggestions that money stock targets be augmented or replaced by broad measures of liquid assets and credit. As the extent of the shift in the relationship of <u>all</u> these various measures to GNP became more apparent, however, research interest in their use as intermediate targets or indicators waned and their role in policy making diminished. More recently, as discussed in the relevant papers in this volume, some interest has been expressed by economists and policy makers in possible roles for nominal GNP and/or for market measures such as commodity prices, the yield curve, and foreign exchange rates as policy targets and/or indicators.

In general, however, confidence that there exist financial measures that can replace in part or in whole a basically judgmental, pragmatic, and eclectic approach to policy seems currently (1990) at a rather low ebb. Virtually without exception, the results reported in this volume support such a skeptical attitude. Nevertheless, as argued below, the issue is far from closed. Indeed, interest in the problem of devising and implementing "intermediate" guides for policy is likely to prove a hardy perennial in the years ahead.

I. Some Terminology

One product of the debate on these issues has been the development of a useful and reasonably settled vocabulary to discuss them. One can imagine a spectrum of economic measures that has, at one end, the "ultimate targets" of monetary policy. These almost always include the price level and real output and sometimes also include the behavior of the balance of payments and the foreign exchange value of the dollar.

At the other end of this spectrum are the "instruments" of monetary policy. These include open market operations, the discount rate, and in earlier periods, required reserve ratios and Regulation Q ceilings on deposit interest rates. Just one step along the spectrum beyond these instruments are "operating targets," measures that can be controlled with a rather high degree of precision through manipulation of the policy instruments. Potential operating targets include measures such as nonborrowed reserves, the nonborrowed monetary base, and short-term money market rates, most notably the federal funds rate. Borrowings from the discount window clearly also constituted a potential operating target under the system of lagged reserve accounting that prevailed between 1968 and 1984, since the Trading Desk could take required reserves as predetermined within any reserve averaging period. Even under the present system of approximately contemporaneous reserve accounting, most people would probably still want to count borrowings as a potential operating target--though to achieve it in any given reserve maintenance period means that the Desk must correctly estimate required reserves in the current period as well as market factors supplying reserves and the levels of excess reserves.

"Intermediate" measures, whether considered as "targets" or as "indicators," are variables that, as the term suggests, are intermediate between (1) the instruments and operating targets that are capable of rather tight control and (2) the ultimate target measures that can only be influenced indirectly. Measures of the money stock are perhaps the classic examples of such "intermediate" variables, but as noted, the list includes other broad financial aggregates, such as credit extended to the nonfinancial sectors, as well as market measures, such as the foreign exchange rate, that are thought to be significantly influenced by movements in the operating targets.

Some measures, as discussed in more detail in the appropriate papers, are a little harder to classify. Thus, for example, short-term interest rates are usually treated as operating targets but may also be treated as intermediate targets. Conversely, the monetary base is most often discussed as an intermediate measure but sometimes, more controversially, is viewed as a potential operating target. Nominal GNP is sometimes treated as a potential intermediate measure, at one step removed from its ultimate target components of prices and real output.

The various intermediate measures may have the potential to serve as intermediate "targets" and/or as intermediate "indicators" of monetary policy. "Targets" are, obviously enough, objectives the Federal Reserve seeks to achieve over some time period with some degree of precision and under some particular set of circumstances. The concept acquired legislative status with the 1975 congressional resolution requiring the Federal Reserve to report on its "plans and objectives with respect to the growth of the monetary and credit aggregates over the coming year," language that was repeated in the Humphrey-Hawkins legislation of 1978. The concept of an "intermediate target" seems to imply that to qualify, a measure should be (a) reasonably subject to control by the Federal Reserve through adjustment of its operating targets and (b) reasonably closely (that is, predictably) related to the ultimate targets or, in practice, at least to nominal GNP. Consequently, the papers in this volume examine the various measures considered as potential intermediate targets from both points of view.

The concept of intermediate measures as monetary "indicators" is a bit more complicated because it is sometimes taken to mean a measure of the stance of monetary policy and is sometimes interpreted as an indicator of current or future developments in the economy. In much of the earlier literature (early 1960s), the term was interpreted in the sense of indicators of the stance of monetary policy--that is, as measures that could provide, in some sense, an index of monetary "ease" or "restraint." The attempt to pin down such an index produced, and indeed continues to produce, a certain amount of confusion and ambiguity. Consider, for example, a situation in which the Federal Reserve is using interest rates as an operating target and has no intermediate target objective for the money stock. Suppose on entering a recession, the policy makers progressively lower their interest rate target, but, owing to the recession-induced decline in the demand for money, the money stock falls (probably along with a drop in total reserves). Measured in terms of intentionality, policy has clearly "eased," because the declining short-term rates are, at least in large part, the direct result of policy decisions to ease. But if one believes that it is not intentionality but rather the impact of policy on the economy that matters, and if one also believes that this impact is best signaled by the money stock, then in this instance, the declining money stock indexes not an "easing" but a "tightening" of policy.

This may be a terminological problem in the sense that one may want to talk about an indicator of policy intentions or an indicator of policy impact and these may not be the same thing. But the distinction between measures of intention and measures of impact, if they are in fact different, may also raise an econometric issue: how to decide which intermediate measure, if any, should be treated as "predetermined" for estimating purposes. In this example, the money stock or short-term rates?

In any case, the recent technical literature has tended to focus on intermediate "indicators" (sometimes, in this context, also called "information variables") not as measures of the stance of policy, but as measures of the present or prospective state of the economy. This is the sense in which the term is generally used in the present volume. To be sure, there are places in the literature where the two senses of a monetary "indicator" are conflated. For example, a rise in commodity prices or a steepening of the yield curve may be taken as indicating *both* that the prospects are for rising inflation in the future *and* that policy has been "easy" or, perhaps, "too easy."

Clearly, the main requirement for a good intermediate indicator of the state of the economy is that it be reliably (predictably) related to the current or prospective behavior of ultimate goals such as inflation and/or real output. In practice, statistical tests have often been couched in terms of the relationship of the measure to nominal GNP.

A question arises whether a measure that has proved to be a good indicator in this sense can then be used as an intermediate *target* while still continuing to be a good *indicator*. It has sometimes been asserted that when a financial aggregate such as the money stock becomes an intermediate target, presumably chosen in part because of its good indicator properties, these properties will then be altered (for the worse?) by the very fact of its targeting by the authorities. This may or may not be a problem with respect to financial aggregates that are treated both as intermediate targets and indicators. It clearly could be a complicating issue, however, for such market measures as commodity prices, interest rates, and the foreign exchange rate. Knowledge in the market that the behavior of the measure is being used by the authorities to make policy decisions is very likely to alter that behavior. Partly for this reason, proponents of these latter measures have generally advocated them for only a single purpose: for example, commodity prices and the yield curve, simply as indicators; interest rates and the dollar, either as indicators or as operating or intermediate targets, but *not both* as indicators and as targets.

II. Is There a Case for Intermediate Targets?

It is clear that a coherent monetary policy requires a decision on operating targets. It is equally clear that "indicator" measures providing advance information about the current or prospective state of the economy are, almost by definition, of value. The usefulness of intermediate monetary *targets*, however, has always been more controversial. No measure selected for such a role will ever be perfectly predictably related to the ultimate targets that matter. At least *some* uncertainty, *some* short-term instability, and *some* longer term drift in the relationship of any intermediate target to final objectives seems inevitable.

It has therefore been argued that the use of intermediate targets will result in suboptimal decisions. Policy makers will adjust their operating targets, not directly in terms of the settings most likely to achieve their ultimate objectives, but instead in terms of the settings most likely to achieve the intermediate target. According to this line of thought, intermediate measures such as the money supply may be useful, at best, as variables that may shed light on (1) the current state of the economy, perhaps because of more prompt reporting, or (2) the economy's prospective future state, because of leading indicator properties. On the other hand, their use as intermediate targets is likely only to produce poorer control over ultimate targets than if instruments were adjusted directly in terms of objectives for these latter targets.

The logic of this criticism of intermediate measures as *targets* seems impeccable. Nevertheless, it misses the heart of the case for the use of such targets, a case that encompasses a much wider range of considerations. This broader case envisions a number of potential benefits from the use of intermediate targets. It has been argued, for example, that intermediate targets can usefully provide a means of communicating the central bank's intentions to the public. Moreover, such targets can provide a form of central bank accountability.

The ultimate target measures may not be well suited for these various purposes. Thus, as discussed in the paper on nominal GNP targeting, there may be real problems in having an independent central bank set or announce goals for *ultimate* targets. Equally to the point, actual economic performance over any given period is subject to many important influences in addition to monetary policy. Hence it may be quite inappropriate to judge the success of this policy by the actual performance of the economy--that is, by the ultimate target measures--given the role of nonmonetary influences. By contrast, an intermediate target--a goal for the rate of money growth, for example--can be judged in advance for its probable consistency with acceptable economic outcomes. Moreover, it can be used to judge, ex post, whether the central bank's day-to-day decisions have been appropriate to achieving its intermediate target objective. Moreover, the existence of an intermediate target, defined over a time period such as a year, can be useful to the central bank as an internal check on the appropriateness of the shorter term settings of its operating targets.[1]

But there are other fundamental arguments for the use of intermediate targets--provided suitable targets can be found. Thus it has generally been argued that over the long run, monetary policy can only affect nominal magnitudes. Its longer run influence over real growth, real interest rates, and employment mainly reflects its success or lack of success in achieving an environment in which economic decisions can be made with a minimum of concern and uncertainty about price level instability. If this view is correct, the appeal of intermediate targets in providing a "nominal anchor" for policy decisions is fairly clear. Such targets can provide, in principle, an indication that the longer run thrust of policy will be consistent with longer run goals for price behavior. In principle, at least, any one of the various monetary and credit aggregates could, if used as intermediate targets, provide this kind of "nominal anchor" for policy--as could nominal GNP.

Another role that has been suggested for intermediate targets is in dealing with the potential conflict that may exist between short- and long-run optimal policy, an issue known as the "time consistency problem" in the academic literature and in more informal discussions as the "credibility problem." A conflict between short-run and long-run optimizing can arise from the fact that in the short run, the monetary authorities can probably engineer some extra real output, at least up to a point. They can only do this, however, through an expansionary policy that yields more inflation than is built into the public's expectations. According to widely accepted theory, increases in wages and prices that are more rapid than expected will "fool" the public into supplying more labor and goods under the mistaken impression that the higher wages and prices represent higher *real* rewards.

In the short run, there may be pressure on the central bank to seek output gains through such "surprise" inflation. But once the public comes to recognize that the policy makers are operating in a way that accelerates inflation, the public will anticipate this acceleration. Put simply, the attempt to boost output through policies that create surprise inflation will be self-defeating. Over time, the public will catch on, and the higher inflation will no longer be a "surprise." Inflation that is anticipated will

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[1]These various arguments were cited in a speech, "The Contributions and Limitations of 'Monetary' Analysis," given by Paul A. Volcker in September 1976 and most recently reprinted in the 75th Anniversary issue of the Federal Reserve Bank of New York's Quarterly Review, May 1989.

have no power to induce higher output. Thus, over the longer run, the effort to induce higher output through excessively stimulative policies will fail. Output will be no higher than it otherwise would have been--trending at its potential rate over time--but the rate of inflation will be higher. Thus on balance, stimulative policies that seem attractive period by period will, over the longer run, simply result in higher inflation without any output gains--a result desired by no one.

An intermediate target, publicly announced and faithfully adhered to, could, in theory, avoid this kind of outcome. It could do so by effectively tying the hands of the authorities, preventing them from yielding to the temptation to seek short-run output gains in a process that over the longer run only guarantees higher inflation. Probably the best known prescription for using an intermediate target in this way is the constant money growth "rule" or, in some versions, money growth targets that settle down to such a rule after some period of accommodation to disequilibrium initial conditions.

Of course a monetary growth rule also has potential disadvantages. Thus while it may ensure reasonable long-run price stability, it makes no provision for accommodating shocks--whether from supply or demand--and thus may achieve long-run price stability only at the expense of unsatisfactory shorter run outcomes for both output and prices. It might be possible to design a more complex monetary growth rule that allows money growth to adjust to such short-run disturbances, but in a predetermined way that still prevents the authorities from seeking short-run output gains at the expense of higher average inflation. However, monetary rules that embody such automatic response features may themselves create credibility problems--as discussed in the paper in this collection that reviews the "time consistency" literature.

It has to be emphasized that all these various potential virtues of intermediate targets--improved accountability, improved communication with the public, provision of a nominal anchor, and prevention of short-run decisions that serve merely to raise inflation over the longer run--can be achieved only if *suitable* target measures exist. As noted earlier, "suitable" in this context means measures that are "sufficiently" controllable and "sufficiently" stable in their relation to the ultimate objectives. But this is not an all or nothing matter. *No* intermediate target will be perfectly controllable, even over a year. And no measure will be related in a perfectly predictable way to the ultimate targets. At least some slippage on both counts is inevitable. On the other hand, even if there is some slippage, the benefits derived from intermediate targeting may, over the longer run, outweigh the costs that arise as a result of this slippage. Clearly it is a matter of more or less--that is, a question of *how much* slippage can be expected from the use of intermediate targets, on the one hand, and *how much* one values their potential longer run benefits on the other. Typically, individuals most concerned with long-run inflation results have tended to minimize the problems with intermediate targets, while those most concerned with the shorter run real output consequences have tended to worry most about these problems.

III. Evaluating the Candidates

Eight papers in this volume examine individual candidates or groups of candidates--for example, the multiple measures of money and credit--as potential targets and/or indicators of policy. While the papers differ somewhat in organization and emphasis, they all touch on certain common issues. These include (1) the theoretical basis for believing that the particular measures in question might be useful targets or indicators, (2) the statistical evidence for believing a relationship to ultimate targets exists and evidence for the stability of any such relationship, (3) issues of central bank control, and (4) the question whether the measure, even if not used as a formal target, might be useful in a subordinate role. For example, the paper on interest rates considers the possibility that even if interest rates make little sense as an intermediate target, upper and lower bounds for real short-term rates might nevertheless be useful as "constraints" on settings for an interest rate operating target.

As noted earlier, the most frequently advocated measures for intermediate targeting over the past three decades have been the various measures of the money stock and the monetary base and, more recently, liquid assets and various credit measures. The statistical results for these measures form a vast literature varying in method, sophistication, periods covered, and conclusions. This literature is summarized and evaluated in some detail in the individual papers in this volume. It may be useful here, however, to give some crude sense of the problems that developed for these measures in the 1980s.

Charts 1 to 6 show the departure from trends of the GNP velocities of a number of potential intermediate target measures in the 1980s. These departures are clearly large in all cases--greatest for M1, the monetary base, and nonfinancial credit; less for M2, M3, and liquid assets. These departures from past experience are fairly easy to explain in some cases. Thus the velocity of narrow money (and the monetary base) almost certainly fell because of declines in inflation, nominal interest rates, and hence the opportunity cost of holding these measures. Explanations in the case of the broader measures that internalize the effects of market interest rate movements seem less clear.

In any case, the same pattern of major departures from earlier postwar relationships is evident in Table 1, showing regressions of growth in nominal GNP on current and lagged growth in these various financial measures. As the error measures suggest, equations estimated on data from 1960 to

Chart 1

Velocity of Monetary Base (GNP/Monetary Base)

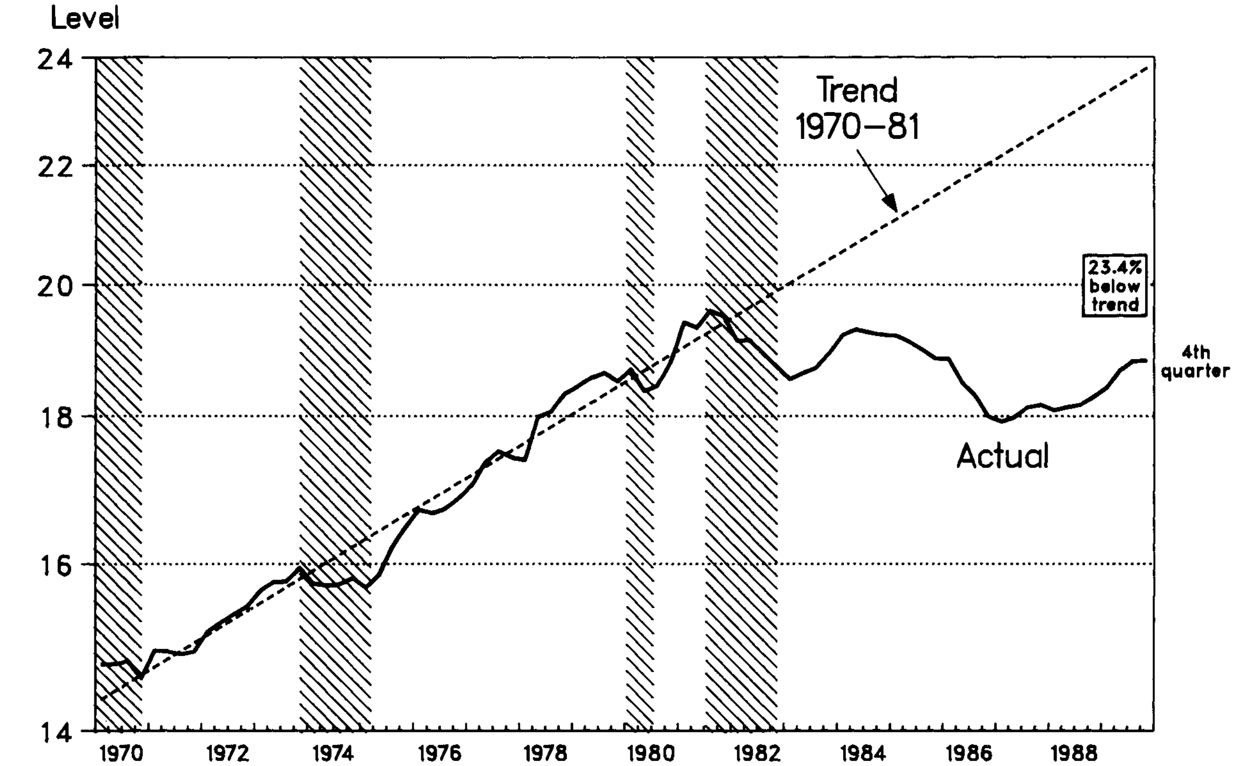

Chart 2

Velocity of M1 (GNP/M1)

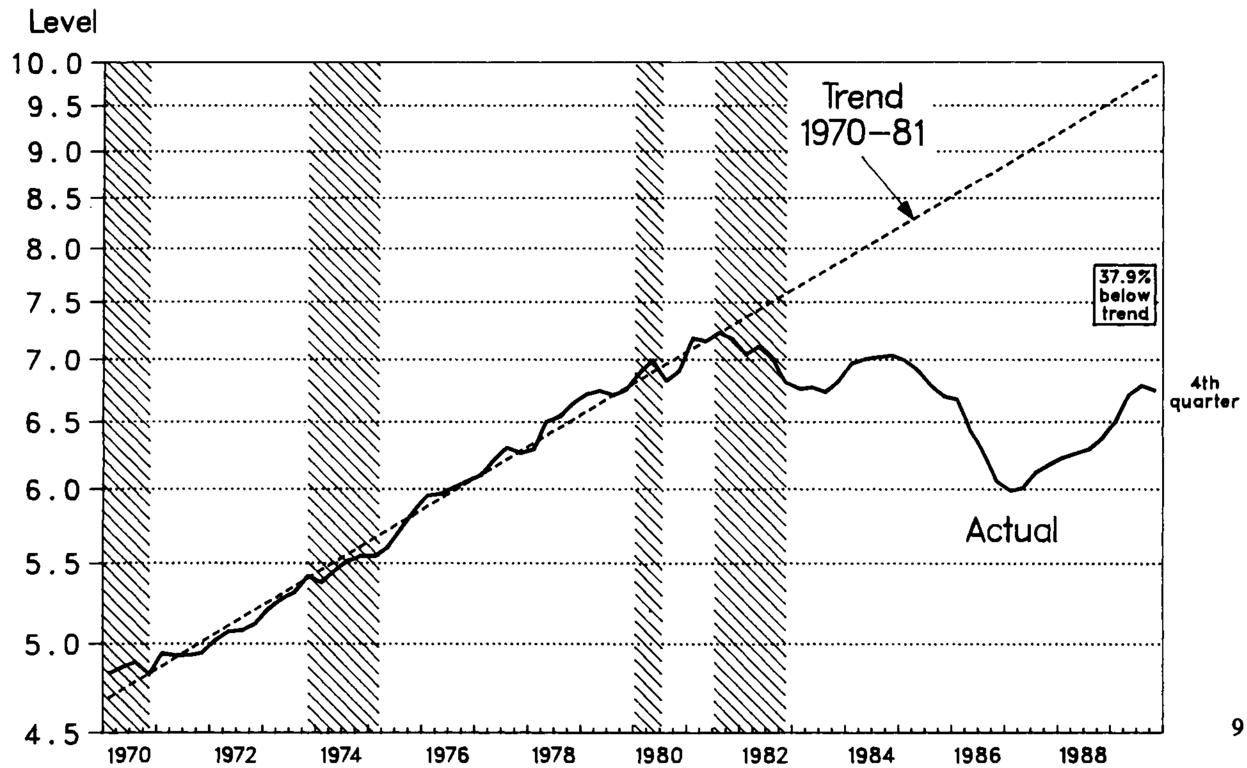

Chart 3

Velocity of M2 (GNP/M2)

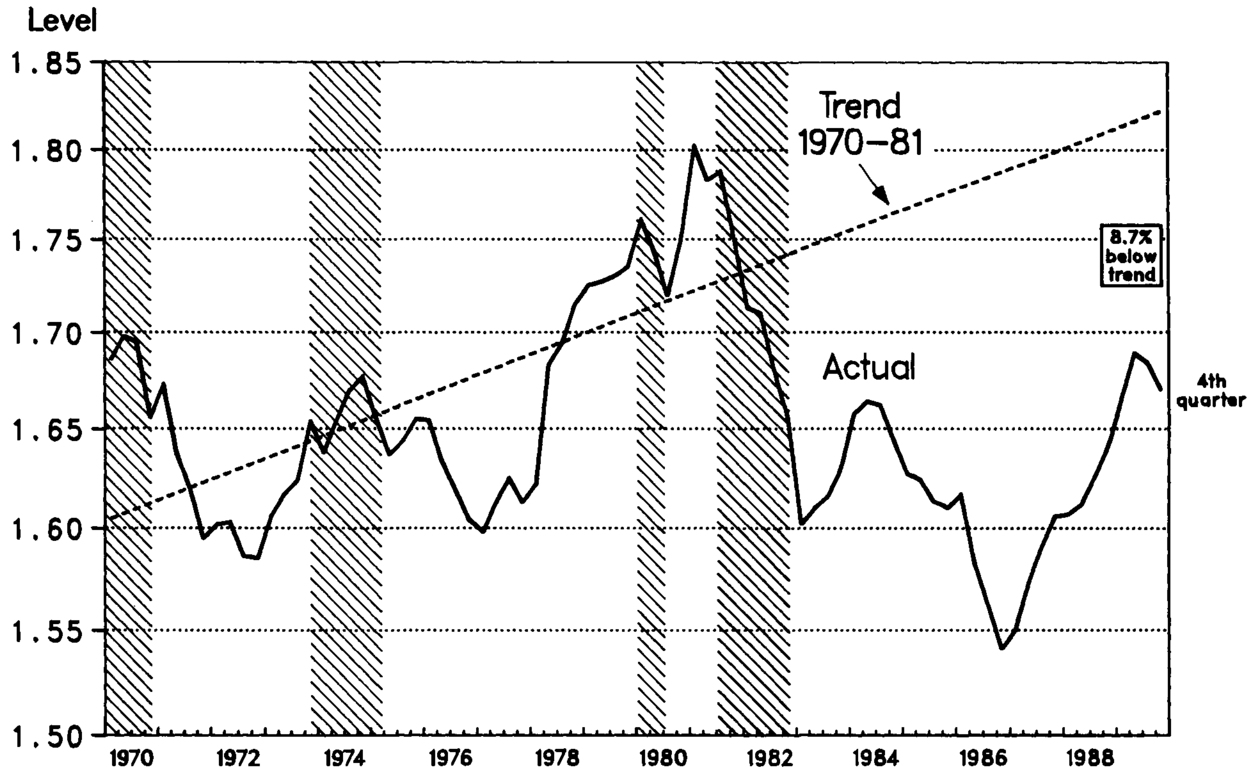

Chart 4

Velocity of M3 (GNP/M3)

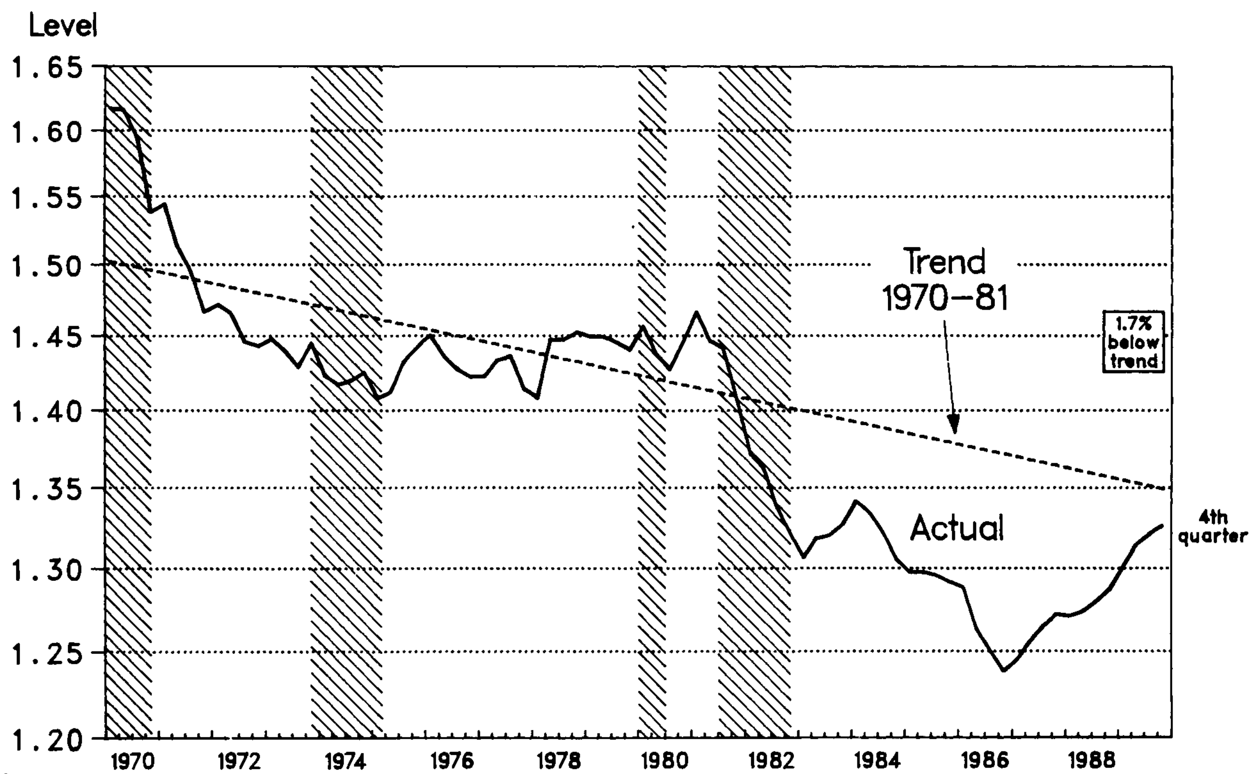

Chart 5

Velocity of L (GNP/L)

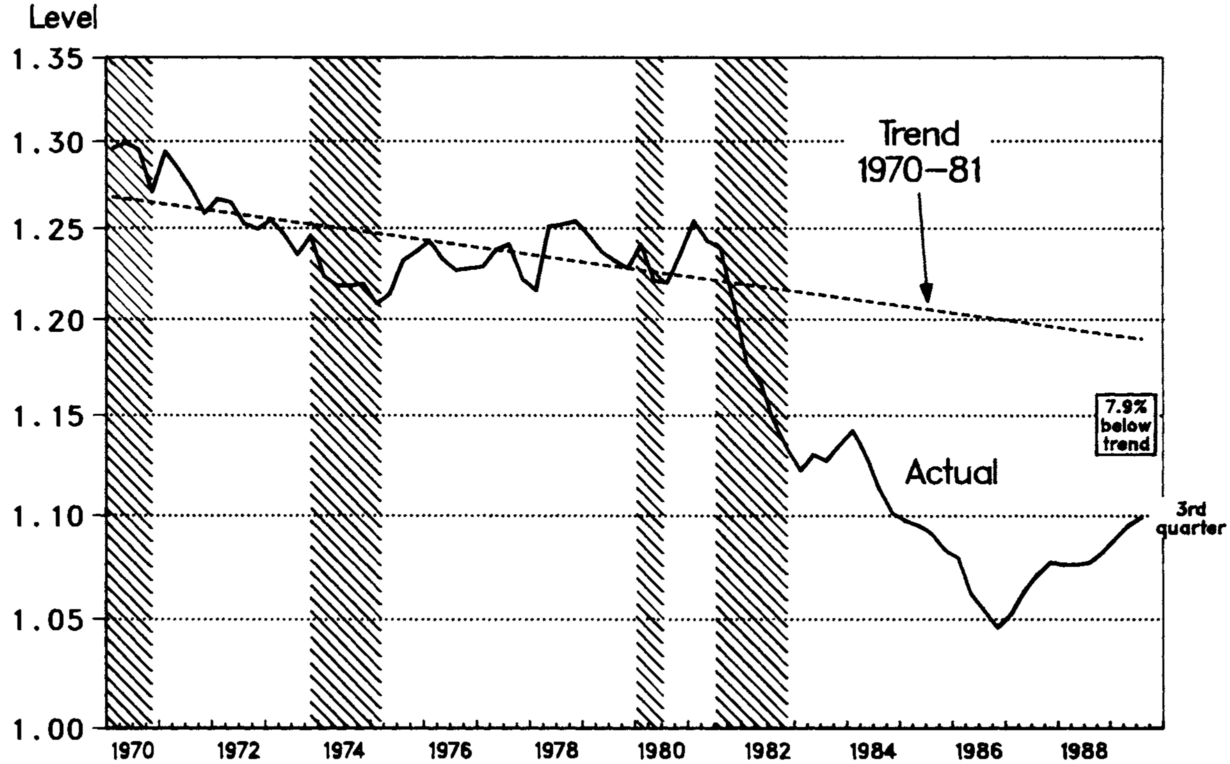

Chart 6

Velocity of Nonfinancial Debt (GNP/Debt)

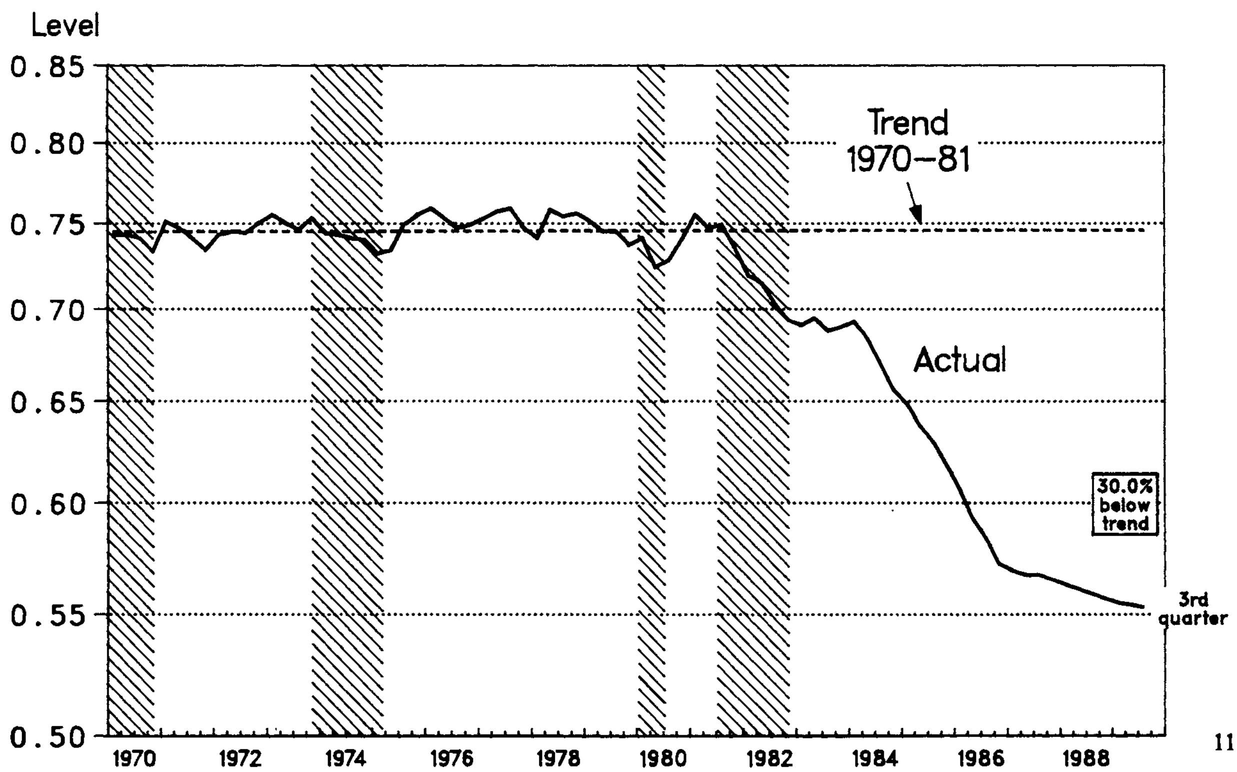

Table 1
Summary Statistics from Reduced Form Equations
1960-II to 1979-IV

	R^2	SEE	DW	Actual-Predicted for 1980-89: Average Error	Average Absolute Error	RMSE
Y = 2.49 + 1.18M1 (2.39)(6.29)	0.34	3.66	2.05	-4.13	5.72	6.16
Y = 1.43 + 0.85M2 (0.99)(5.19)	0.24	3.92	1.86	-0.38	3.55	4.48
Y = 1.57 + 0.75M3 (1.07)(5.07)	0.23	3.94	1.86	-0.55	3.40	4.49
Y = 0.37 + 0.93L (0.25)(5.69)	0.30	3.78	2.01	-0.97[1/]	3.67[1/]	4.54[1/]
Y = 1.00 + 0.87Debt (0.59)(4.54)	0.29	3.80	2.08	-2.65[1/]	4.35[1/]	4.77[1/]
Y = 2.72 + 0.98Base (2.34)(5.33)	0.27	3.85	1.92	-2.40	3.99	4.41

Notes: All equations regress the growth rate of nominal GNP on the current and four lagged growth rates of the financial aggregate. Figures in parentheses are "t" values. L represents the Federal Reserve Board's measure of liquid assets.
[1/] 1980-I to 1989-III

Table 2
Summary Statistics from Reduced Form Equations
1981-I to 1989-IV

	R^2	SEE	DW
Y = 5.85 + 0.16M1 (4.17)(1.03)	0.06	3.67	1.36
Y = 7.21 + 0.01M2 (2.88)(-0.02)	0.02	3.76	1.31
Y = 8.05 + 0.06M3 (3.16)(-0.21)	0	3.79	1.33
Y = 9.46 + 0.21L (3.33)(-0.21)	0.06[1/]	3.69[1/]	1.38[1/]
Y = 10.80 + 0.30Debt (2.85)(-0.90)	0.07[1/]	3.66[1/]	1.51[1/]
Y = 0.37 + .99Base (0.12)(2.56)	0.16	3.48	1.51

Notes: All equations regress the growth rate of nominal GNP on the current and four lagged growth rates of the financial aggregate. Figures in parentheses are "t" values. L represents the Federal Reserve Board's measure of liquid assets.
[1/] 1981-I to 1989-III.

1979 do a very poor job in estimating GNP growth in the 1980s. And as Table 2 shows, similar equations estimated over data from 1981 to 1989 have almost no explanatory power, with coefficients that are not significant (indeed usually negative!) for all measures except the monetary base. This kind of result makes clear the reasons for the growing disillusionment in recent years with the potential of these measures as intermediate targets or indicators.

The other property required of a potential intermediate *target* (as opposed to *indicator*) is of course controllability, and that poses a different set of problems. Some of the broader measures, such as total liquid assets and aggregate credit, are clearly not closely related to Federal Reserve operating targets. They can perhaps only be controlled indirectly--that is, by first controlling GNP! The narrower measures such as M1 and M2 have clearly retained substantial interest rate sensitivity for horizons out to a year or so because many of their component own-rates respond only slowly to changes in market rates. As a result, growth in such measures may be rather sensitive to changes in interest rate operating targets. That very sensitivity is itself a problem, however. Thus it makes the GNP outcome associated with any successfully achieved growth rate target for the aggregate quite sensitive to shifts in the demand for goods and services--at least over periods out to a year or so. Use of such targets, therefore, either will imply a wide range of uncertainty about the GNP outcome associated with a given money growth rate or will make it seem desirable to define targets in terms of broad ranges of growth rates. This latter approach, however, clearly weakens the usefulness of such targets for many of the purposes they are designed to serve.

The breakdown in earlier relationships between financial aggregates and nominal GNP in the 1980s has lead a number of academic writers to suggest that the velocity problem could be "solved" by targeting nominal GNP directly. Such an approach has some attractive features. A long-run nominal GNP growth rule set in light of the expected trend growth in real output would establish a "nominal anchor" for policy. Adhered to as a "rule," with or without automatic feedback mechanisms, it would solve the short run/long run inconsistency problem and would satisfy the other objectives of an intermediate target. In the short run, adherence to a nominal GNP target would automatically offset both the price and the real effects of demand shifts and would split the impact of supply shifts between real output and prices.

Unfortunately, the nominal GNP approach appears to have equally large problems. First, it "solves" the velocity problem only on the assumption that there exists a way of accurately achieving a nominal GNP target with the means at the disposal of the central bank. Obviously the method of choice would *not* be through intermediate money targets, for that would simply reintroduce the velocity problem. A different option would be to aim at GNP targets through constant resettings of an interest rate operating target. Clearly success with such an approach is far from assured.

A second difficulty is that to get a handle on final objectives with a nominal GNP target, you need to have a predictable relationship between nominal GNP and output in the short run--that is, you need to be able to predict the price/output split resulting from a given GNP result, at least to the extent that you have short-run output objectives. But of course this problem is shared with other potential intermediate targets such as money growth rates.

A third difficulty is that a fixed nominal GNP rule could, under quite plausible conditions examined in the GNP paper in this volume, generate problems of dynamic instability in the path of real output in the face of supply shocks and, apparently, in the face of prior misses in hitting the nominal GNP objective. Such problems can be avoided by resetting, on a discretionary basis, the nominal GNP target year by year. But this approach would create a very uncomfortable situation for a central bank that is "independent within the government." Year-by-year settings of GNP targets would come very close to setting year-by-year targets for real growth and inflation. Such a situation could well create pressures for precisely the kind of short-term optimization that produces the worst of all possible worlds over the long run--that is, it would seem to maximize the risks of creating the kind of "time consistency" problem cited earlier. Overall, it seems quite possible that as a practical matter, discretionary nominal GNP targeting could result in worse inflation outcomes than might exist in the absence of any intermediate target at all. In summary, the nominal GNP route appears, on closer examination, to be no panacea for the problems created by the velocity instabilities of the 1980s.

The remaining measures examined in this volume, commodity prices, the yield curve, and the foreign exchange value of the dollar, have generally been proposed as intermediate indicators that might be used to guide settings of the operating targets, rather than as intermediate targets themselves. Because these markets are often regarded as efficient in incorporating relevant economic information, they could perhaps signal changes in the economic outlook very quickly.

In the case of commodity prices, it seems likely that these prices could in fact be targeted through direct open market operations in commodity markets. Indeed, that is just what a "commodity standard," whether defined in terms of a basket of commodities or a single commodity such as gold, would involve. Instead of such operations, it has been suggested merely that commodity prices may represent sensitive advance indicators of changes in general inflation rates that can be used to signal the need to tighten or ease the conventional operating targets.

The results surveyed in the paper on commodity prices included in this volume suggest that movements in commodity price indexes do have a marginal contribution, but only a marginal contribution, to make in forecasting inflation. As leading indicators of turning points in broad movements in the overall inflation rate, commodity price measures, suitably averaged and smoothed, do have some predictive value. But they have also at times given false signals of turning points in the general inflation rate. In the case of correct signals, moreover, their lead times tend to be rather variable and there appears to be little relation between the *magnitude* of commodity price movements and the magnitudes of subsequent movements in overall inflation. On balance, it appears that commodity prices may be reasonable additions to the items the central bank "looks at" when it surveys the prospects for inflation. They do not, however, add much to more conventional methods of assessing the outlook for inflation.

Another market measure that has been proposed as an indicator but not as a target of monetary policy is the yield curve. In this case, the question whether the measure is to be thought of as an indicator of the stance of policy or an indicator of the future course of the economy is somewhat ambiguous. And this ambiguity is directly related to the theoretical assumptions underlying the attention sometimes given to the yield curve for either or both of these roles. Belief in the indicator properties of the yield curve appears to rest on the expectations theory of the yield curve--the view that longer term rates should be regarded as (weighted) averages of the market's expectations of the future course of successive short rates. While this theory has considerable intuitive appeal, empirical tests of its validity over the years have produced mixed results.

Even if the expectations theory of the yield curve is accepted as correct, moreover, the theoretical implications of particular yield curve configurations, as interpretations both of monetary policy and of prospective economic performance, appear to be ambiguous. This ambiguity stems in part from another widely accepted theoretical premise--that nominal interest rates reflect the sum of a real rate and an inflation premium that allows for the expected rate of inflation over the life of the instrument. Thus an upward rising yield curve, for example, could imply either that the market expects real short-term rates to rise in the future or that it expects the rate of inflation to rise.

Against this background, the paper on the yield curve in this volume points out that it would be very hard for a central bank to interpret the significance of, for example, a steepening of the yield curve on the basis of theoretical considerations alone. Such a steepening could mean that the market expects inflation to accelerate, which the central bank could interpret as a need to tighten. Alternatively, it could mean that the market expects a rise in the productivity of capital and hence a rise in real short-term rates and an acceleration of real growth. This cause of a steepening in the yield curve might or might not imply a need to change the settings of operating targets, depending on circumstances. A third possibility is that the steepening reflects a market judgment about the future of monetary policy itself--that is, that policy is expected to tighten, real short rates to rise, and therefore, quite possibly, real growth to slow. So a central bank looking at a change in the yield curve must try to sort out its possible meanings and then must decide what implications, if any, the change may have for policy.

Despite these interpretive ambiguities at the theoretical level, the yield curve paper gives some fairly concrete results. It suggests, for example, that the Federal Reserve does have significant power to affect the yield curve by changing the federal funds rate as an operating measure. Since no one proposes the yield curve as a *target*, however, this is of rather limited significance. But the paper goes on to suggest that the yield curve, simply as an empirical matter, has proved to have significant forecasting value for both real output and inflation, even in the presence of other forecasting variables such as short-term interest rates, the leading indicators, and the consensus of economists' forecasts. One has to wonder, however, how this forecasting value might be affected if the yield curve were to become a major forecasting tool for the authorities and if the market were to become aware of such a development and were to respond accordingly. A kind of "two-person game" situation between the market and the authorities might greatly distort the behavior of the yield curve relative to what it would be in the absence of a belief in its indicator significance.

Finally, the increasing sensitivity of the U.S. economy to international developments has led to growing interest in the use of the foreign exchange value of the dollar as a guide for U.S. monetary policy. However, the paper on this topic emphasizes that, because of important differences between exchange rates and more traditional variables, the systematic use of the dollar's value in U.S. monetary policy operations is likely to be highly problematic and would almost certainly raise considerations beyond those traditionally incorporated in U.S. policy deliberations. In particular, manipulation of policy instruments to regularly counter or "target" dollar movements could be destabilizing for the U.S. economy under a wide range of circumstances and could require a significant degree of international policy coordination. The paper does suggest that exchange rates can play a useful role as policy indicators but generally only under fairly limited circumstances. At times, for example, foreign exchange market conditions have proved helpful in gauging market perceptions and the likely reactions to policy changes. Beyond these circumstances, however, the evidence raises considerable doubts about the reliability of exchange rates as regular indicators of underlying inflation pressures or the monetary policy stance. Accordingly, on present knowledge, the case for upgrading the role of the dollar in U.S. monetary policy formulation appears questionable.

IV. A Future for Intermediate Targets?

The cumulative effect of the papers included in this volume is to leave one impressed with the limitations of *all* the various measures, certainly as intermediate targets and, for the most part, even simply as indicators. But if all potential intermediate targets have problems, it is also important to recall the many ways in which policy conducted without *any* such target is itself less than satisfying. In practice, conducting policy without reference to intermediate targets means setting operating targets directly in line with changing assessments of the likely outcomes for the ultimate goal variables. Perhaps most often, this will mean adjusting some money market rate in line with changing projections of the future behavior, under assumed paths for such a rate, of prices and real output.

The difficulties of this approach to policy making are numerous. Perhaps the most obvious problem is the need to assess correctly the future state of the economy under alternative assumptions about settings of the operating targets. Note that it is the *future* state of the economy that matters given the universally acknowledged existence of significant lags in the impact of policy on output and prices. While there is substantial evidence that experienced macro forecasters can improve significantly on naive extrapolative procedures in projecting the future, it is also clear that forecasting remains as much an art as a science. Macro forecasting normally reflects a blend of reliance on econometric models, interpretation of incoming information (both statistical and "anecdotal") on the current state of the economy, and the selective use of an array of leading indicator measures. While such forecasting is clearly useful--indeed, absolutely necessary given the lags of policy's impact--it is also obviously fallible. As a further complication, policy decisions must be based on *multiple* forecasts, implicit or explicit, that are conditional on multiple alternative settings of the operating variables under consideration.

The well-known limitations on the ability to forecast raise the risk, moreover, that policy makers will find themselves putting undue weight on the *current* state of the economy despite the acknowledged importance of lags in the process. And of course absent intermediate targets, policy-making procedures do not readily lend themselves to an "objective," quantitative way of communicating the intentions of policy to the public or of evaluating its success after the fact. Even more serious, an approach that relies on setting operating targets in light of projected future economic outcomes fails to provide a "nominal anchor" for policy and does nothing to solve the conflict between period-by-period and long-run optimizing in policy making.

So we have a real tension here. On the one hand, intermediate targets, if suitable ones exist, have the potential for improving the overall performance of monetary policy, especially over the longer run. But, to repeat, "suitable" means not merely controllable, but sufficiently tightly related to ultimate goals that slippages can be ignored and thus the forecasting problem bypassed. The experience of the 1980s has left serious doubts that such "suitable" target measures do in fact exist. Faced with this tension, the Federal Reserve has in practice compromised. It has continued to set intermediate targets for money and credit aggregates--as, indeed, it is required to do by law--but it has defined these targets in terms of rather wide ranges (generally 4 percentage points for annual growth rates). Moreover, on occasion the Federal Reserve has felt free to allow even these wide ranges to be violated when it has appeared likely that the targets could be achieved only at the expense of inferior economic outcomes--or at least outcomes that are "inferior" within the one-year time horizon of the current targeting process. The target measures have been given more attention when at the top or bottom of their ranges, with particular attention focused on the behavior of M2. In summary, intermediate targets have continued to exist, but only as rather wide ranges and without any clearly defined means of connecting them with day-to-day or month-to-month operational decisions. Even under these circumstances, the extant intermediate targets have had some value in providing a "nominal anchor"--though one that tends to drag a bit--and have provided a means of connecting, if somewhat loosely, short- to intermediate-run objectives with the longer run objectives for price performance. Nevertheless, it is apparent that their usefulness for these purposes falls far short of what, at least in theory, could be provided by more formal adherence to a *satisfactory* intermediate target.

The broad appeal of the intermediate target concept is such that interest in it seems bound to persist. Research on the subject has continued, both within and without the Federal Reserve System. In particular, some economists at the Federal Reserve Board have developed evidence to suggest that long-run M2 velocity may have retained enough stability to make M2 behavior a useful indicator of the longer run behavior of inflation. In the meanwhile, it is possible that after the major shocks to the monetary aggregates (and possibly also to broad credit measures) from financial innovation and deregulation in the 1980s, these aggregates may settle down to a pattern of behavior that, if changed from earlier decades, has nevertheless again become predictable enough to be useful. The future role of intermediate targets in the policy-making process is certainly likely to depend in part on such potential developments. But given the short-run slippages that would inevitably persist between intermediate targets and ultimate objectives even under the best of circumstances, the future role of intermediate targets probably also depends on the weight that is given to the objective of long-run price stability. It is in the context of such an objective that the potential usefulness of intermediate targets is particularly clear.

POSSIBLE ROLES FOR THE MONETARY BASE

Ann-Marie Meulendyke

The concept of the monetary base has a long history. In essence, the monetary base consists of currency issued by the monetary authority, primarily the Federal Reserve System in this country, and reserve balances held with the monetary authority by depository institutions. The most commonly used measures of the monetary base make an adjustment for reserve requirement changes (see appendix for definitions). Several names have been applied to what is now most often called the monetary base. A number of writers have used the term "high-powered money."[1] Gurley and Shaw (1960) introduced the term "outside money."[2] These names for the monetary base, perhaps, are more suggestive of why the concept has played a role in policy discussions. The monetary base consists of monetary instruments that can function as reserves of the banking system and are obligations of the government or the central bank. It is readily observable with a short lag. Furthermore, many economists have argued that it should be feasible to control the monetary base because its components are on the Federal Reserve's balance sheet. In addition, because of regulatory and behavioral linkages between the monetary base and various monetary aggregates that have been proposed as intermediate targets, the base's behavior has the potential to affect broader monetary and economic variables.

Three different roles have been proposed for the monetary base. The oldest use for the concept has been as *an analytical device* to explain relationships between gold flows and central bank actions and the behavior of money, credit, and prices. The second suggested use of the monetary base is as *an operating target of policy*, most commonly as a means of achieving desired behavior of an intermediate target such as a monetary aggregate. The third type of proposed use of the monetary base is as *an intermediate target* or as *an indicator* to guide the central bank in its efforts to achieve its long-run goals of sustainable economic expansion and price stability, especially the latter.

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[1]See, for instance, Burgess (1936), Friedman (1959), and Lothian (1976).

[2]They describe "outside money" as an obligation of the government (including the central bank) that is outside the control of the private sector. In contrast, "inside money" is as an obligation of the private sector.

The analysis of the possible roles for the monetary base has proceeded on more than one level. In concept, it has appeared in the context of models of money demand, business cycle determination, and the appropriate responsibilities of a central bank. The monetary base has had particular appeal to those economists who have pushed for limiting monetary expansion to promote price stability. Proponents of the quantity theory of money, the classical long-run neutrality of money, and rational expectations have all tended to give prominence to the notion of a long-run anchor for the price level. Many of them have supported the use of the monetary base in that role.

Other analyses have focused on more narrowly technical issues associated with using the base in one or another of its potential roles. Topics considered have included the definition of the monetary base, details of its controllability, and institutional and regulatory questions. Overlapping the conceptual and technical sides of the issue have been the questions whether the monetary base can be exogenously determined and whether estimated relationships between the base and intermediate or ultimate policy goals would be sustained if serious efforts were made to control the base. Many of the debates are affected by the time period considered relevant for achieving the goals. In some cases, failure to clarify assumptions on that question has complicated developing an understanding of the issues.

This paper examines the three proposed uses of the monetary base concept, considering both conceptual and practical aspects. It evaluates the components of the monetary base and the extent to which the base has the properties attributed to it. The paper then reviews the evidence from experiences with targeting the base or a related reserve measure.

In summary, the monetary base concept appears to be useful as a descriptive tool. Considered as a possible operating target, the base would seem to present some problems if efforts were made to control it directly over time periods shorter than one to two quarters. Considered as an intermediate operating guide, the base may be of some value, especially as a warning signal of potential inflationary policies, but the generally weak relationships between the monetary base and ultimate policy goals suggest that it should be used cautiously. A review of experience in Switzerland and West Germany with the use of measures similar to the monetary base as intermediate targets suggests some problems but also a measure of success.

I. The Monetary Base as a Descriptive Device

Early in the twentieth century, economists were making analytical use of the monetary base concept, although not by name. In 1911, Irving Fisher ([1911] 1963) described the role of currency as a circulating medium and as a major source of reserves to the banks. The other form of reserves was interbank deposits; small banks generally held balances at large banks. Fisher described changes in currency and reserves as the primary source of growth or decline in the quantity of money because, in normal times, the ratio of currency to deposits would be determined by payment practices and customs that did not change easily.[3] Furthermore, Fisher argued that prudent banking practice and the high cost to a bank of being unable to meet withdrawals would determine the ratio of reserves to deposits within a fairly narrow range. Fisher anticipated that disturbances to the ratios would occur during periods of transition to new institutional arrangements. He also expected the ratios to shift gradually over the business cycle in response to sticky adjustment of prices and interest rates.

Randolph Burgess (1936), an officer at the New York Federal Reserve's open market desk in the 1920s and 1930s, described in 1936 what then seemed to be a common view of the monetary base (which he called high-powered money) as follows:

> It may be said, from one point of view, that there are in any country two kinds of money, and for the sake of giving them names they may be called high-powered money and low-powered money. The central bank deals in high-powered money, the money which constitutes bank reserves. Historically, this high-powered money has been closely related to a country's basic reserves of gold and currency, though the specific form of this relationship shows wide variations under different banking laws. . . . When the amount of high-powered money increases, the amount of low-powered money tends to increase also, but in multiple relation to the high-powered money. (pp. 5-6)

Burgess presented high- and low-powered money as descriptive concepts to help explain how the purchase or sale of gold or securities would lead to growth or shrinkage of commercial bank deposits. Provision of high-powered money by the central bank makes it possible for the banks to create more low-powered money according to what has now become a familiar textbook multiplier model.[4] In that model, the creation of deposits is constrained by limits on the ratio of deposits to reserves. The ratio is partially determined by banking practices, as Fisher had suggested, but under the Federal Reserve, the relationship has also been importantly influenced by the reserve requirement ratios that are applied. The relationship further depends upon the ratio of currency to deposits.

These relationships can be expressed in equation form as $M=mB$, where M is the monetary aggregate in question, B is the monetary base, and m is the multiplier linking them. In addition, M is

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[3]Fisher defined money as currency and coin, but this analytical work was based on such money plus bank deposits.

[4]See, for instance, Mayer, Duesenbury, and Aliber (1987, pp. 161-70).

defined to equal C+D, where C is currency and D is deposits, and B is defined to equal C+R, where R is reserves in the form of vault cash or balances at the Federal Reserve. The multiplier can be expressed as a function of ratios linking deposits, reserves, and currency as follows: Let $k=C/D$ and $r=R/D$. Then $m=M/B=(C+D)/(C+R)$. Dividing the numerator and denominator by D and substituting gives $m=(k+1)/(k+r)$.

If underlying behavioral characteristics serve to make the ratios k and r stable, then the monetary base multiplier can be a useful device for relating central bank actions affecting reserves to the behavior of money. In that case, a change in the monetary base would be associated with a proportional change in money. If either of the ratios, k or r, shifts frequently, however, the multiplier will not be stable. Under these circumstances, money and the monetary base will not move closely together. Furthermore, the level of the reserve-deposit ratio, r, will have other effects. A low ratio implies that a low weight is given to deposits relative to currency in the monetary base, since only that fraction of deposits represented by reserves is counted. Many economists over the years have expressed unease over the implicit weighting scheme that gives relatively heavy weight to currency, because they believe that the behavior of deposits has a major role in influencing economic activity. Nonetheless, during long stretches of time, the two ratios have been sufficiently stable that many analysts have downplayed the worries about the low weight given to deposits.

The most dramatic exception to that pattern of stability occurred in the 1930s, at the time when Burgess was writing. Bank failures in the early 1930s periodically raised the demand for currency and made the ratio of currency to deposits highly variable. Moreover, by the time Burgess published his book, excess reserves had risen to unusually high levels; the ratio of reserves to deposits was higher than it had previously been and rather variable. Hence, it is not surprising that Burgess did not consider the possibility of using high-powered money as a guide to policy.

Henry Simons, writing in 1934 and observing the problems associated with fractional reserve banking, proposed that the variation in the multiplier could be eliminated if 100 percent reserve requirements were imposed. Under that arrangement, currency and deposits would receive equal weight and shifts between them would have no effect on the relationship between the monetary base and money. If the banks held 100 percent reserves against deposits, then r would presumably be around 1. The multiplier would be approximately $(k+1)/(k+1)$ or 1 regardless of the ratio of currency to deposits. Simons recognized that his proposal was radical. Nonetheless, he believed it would be feasible to separate institutions providing deposits from those providing credit.

Milton Friedman (1959) supported Simons' proposal although he believed it was necessary to address its primary weakness. Issuing deposits subject to 100 percent reserve requirements would be costly. Because the banks could not use those deposits as a source of funds for making loans and investments, they would have to charge large fees on deposits to cover the overhead costs associated with them. Alternative instruments that were exempt from the 100 percent reserve requirement would have to fund credit extension. Consequently, those instruments could pay interest instead of incurring charges. Given the relative attractiveness of these alternative liabilities, they would probably evolve into something that closely resembled money. Broader forms of money would then consist of deposits subject to very high and very low reserve requirements, and the high and stable ratio of reserves to deposits that the proposal was designed to achieve would be lost. Friedman recommended paying interest on required reserves to mitigate the cost disadvantage associated with deposits subject to the high reserve requirement. Nonetheless, the instruments funding credit extension would have to be priced attractively, and some risk would remain that they would take on some of the characteristics of money.

A less radical proposal for handling the problem of minimizing the variation of the ratio of reserves to deposits was to make reserve ratios uniform according to the nature of the deposit rather than the characteristics of the issuing institution. In the years since most of the literature on this subject was written, steps have been taken to make the ratios more uniform with respect to transaction deposits. However, time and savings deposits are subject to low requirements, and beginning in the 1980s, personal time and savings deposits have been exempt from requirements. For money definitions that include some of these deposits--M2 and M3--shifts between transaction and nontransaction deposits will affect the ratio of reserves to deposits and hence the monetary base multiplier. Whether the existence of low and differing reserve ratios for various types of deposits interferes with the usefulness of the monetary base in either of the roles proposed remains controversial.

One proposal has been made to create a monetary base measure that includes artificial reserve ratios higher than those that actually prevail. To a limited extent, the "St. Louis" definition of the monetary base in effect does that since it uses a 12 percent reserve ratio against transactions deposits (see appendix) rather than the actual reserve ratio, which has recently been around 8 percent. The German concept of the central bank money stock (discussed below) also uses a higher than actual reserve ratio. In neither case was the step taken explicitly for the purpose of raising the weight on deposits. The results fell out of efforts to minimize distortions imposed by changes in the level and structure of reserve requirement ratios.

II. The Monetary Base as an Operating Target

The case for using the monetary base as a tool in the policy process was made in the 1960s in a series of books and articles promoting the control of a monetary aggregate as a means of achieving the longer run monetary policy goals of price stability and an expanding economy. In this role, the monetary base is, in the terminology most commonly used in this literature, an operating target. The base would be controlled not for its own sake but in order to achieve desired behavior of another variable, usually a monetary aggregate.

By the 1960s, when monetary aggregate targeting became a popular objective, sufficient stability had returned to the ratios of reserves to money (Chart 1) and currency to money (Chart 2) to make the arguments for such an approach to targeting plausible, although many analysts remained skeptical. (See the paper by John Wenninger in this volume.) Milton Friedman (1959) proposed targeting a monetary aggregate and suggested that manipulating high-powered money might be a reasonably effective way to attain the monetary targets. Karl Brunner and Alan Meltzer (1968) made a similar proposal and explored several aspects of the multiplier relationship.

In several articles that appeared in the St. Louis Federal Reserve Review, Andersen and Jordan (1968a, 1968b) and Burger, Kalish, and Babb (1971) developed in some detail the suggestion to target the monetary base. The St. Louis articles presented multiplier relationships between the monetary base and M1 similar to those described above, although the relationship was more elaborately drawn.[5]

While the economists promoting control of the monetary base recognized the problems associated with the differential weights given to currency and deposits, they doubted that these difficulties would prove to be serious in practice. At the time they were writing, reserve requirements were high enough to discourage banks from holding large quantities of excess reserves. The economists believed that the presence of binding required reserve ratios would make the ratio of reserves to deposits relatively stable as long as adjustments were made whenever the Federal Reserve changed the specified ratios. Building on Fisher's arguments, they expected payment conventions and the absence of banking crises to provide stability to the ratio of currency to deposits. Empirical analysis of the data covering the 1950s and 1960s generally gave some support to their expectation. Burger, Kalish, and Babb presented such an examination and recommended a control procedure in

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[5]A variety of multipliers have been computed that make separate allowances for transactions deposits and time deposits. Johannes and Rasche (1979) built an elaborate multiplier model that has been regularly updated for Shadow Open Market Committee meetings. See also Rasche and Johannes (1987).

Chart 1
Total Reserves as a Percentage of M1

Note: Reserve data are seasonally adjusted and are adjusted for changes in reserve requirements. M1 values are seasonally adjusted. Ratios are plotted quarterly.

Chart 2
Currency as a Percentage of M1

Note: M1 values are seasonally adjusted. Ratios are plotted quarterly.

which the monetary base would be targeted to achieve desired growth in M1. They proposed estimating the multiplier from recent behavior of its constituent ratios. Then they compared their model forecasts of the multiplier with the actual values of the multipliers. They found the errors to be small in size and observed that they were not cumulative. They concluded that if the proposed monetary base targets were achieved and the multipliers were the same as those that actually occurred, then money growth would have deviated only slightly from a smooth path. From these results, they argued that following their procedures would produce a reduction in unwanted variation in money growth.

The Burger, Kalish, and Babb proposal would have required the central bank to control the monetary base. Most of the supporters of the proposal argued that the central bank could control the monetary base since the base consisted of items on the central bank's balance sheet that could be observed with at most a one-day lag (Balbach 1981). Others attacked the proposal, suggesting that the consequences of trying to control the base would be undesirable because the observed multiplier relationships on which such proposals were based were estimated when the monetary base was, in fact, determined endogenously. The critics predicted that the relationships would break down if the base were actually controlled. To explain the issues involved, it is helpful to review the potential methods for controlling the monetary base.

As the appendix indicates, the monetary base can be viewed as consisting of three elements: currency in circulation, total reserve balances of depository institutions at the Federal Reserve, and a factor that adjusts for the effects of changes in reserve requirement ratios. The adjustment factor does not introduce control problems, except possibly briefly at those few times that the Federal Reserve changes reserve requirement ratios.

Currency, the biggest component of the base, has been issued by the Federal Reserve to depository institutions on demand. The Federal Reserve debits the reserve accounts of a depository institution when it issues the currency. Limiting currency issuance would be a sharp break with a tradition that extends back to the beginnings of the Federal Reserve. Most of those proposing control of the base did not contemplate a limitation on Federal Reserve issuance of currency, but instead advocated offsetting undesired currency movements with increases in or restrictions on the provision of total reserves through open market operations (Burger, Kalish, and Babb 1971). The Federal Reserve would have precise knowledge of the amount of currency it had issued, and therefore would know the size of offsetting adjustments in reserves needed as soon as any unwanted currency movements took place.

In practice, the process is not so simple. Total reserves, the factor that would need to be manipulated to achieve a desired level of the monetary base, consists of reserves provided by open market operations--nonborrowed reserves--and reserves obtained at the discount window--borrowed reserves.[6] If, for example, the Federal Reserve attempted to control the monetary base by offsetting undesired expansion of currency through a reduction in nonborrowed reserves, depository institutions might borrow at the discount window to obtain the reserves lost, lifting total reserves back to the level where they stood before the reduction in nonborrowed reserves occurred. Consequently, it would not be possible to control the monetary base even though it would be possible to control what is often referred to as the nonborrowed base--the monetary base minus borrowed reserves.

Whether depository institutions would in fact borrow at the discount window to offset the reduction in nonborrowed reserves would depend upon their demand for total reserves. Depository institutions hold total reserves in order to meet reserve requirements on average over a reserve maintenance period (which has been two weeks long since 1984, but was one week long between 1968 and 1984, when much of the discussion of controlling the base took place). Some depository institutions may also choose to hold reserves in excess of requirements if day-to-day flows through reserve accounts are large relative to their reserve requirements.[7] The cost of close management of reserves to avoid being unexpectedly short may exceed the interest lost from holding some excess reserves.

If the total reserve component of the monetary base target is to be achieved, a decline in nonborrowed reserves cannot be offset by an increase in borrowed reserves. A reduction in nonborrowed reserves can only result in an equal decline in total reserves if the lower level of nonborrowed reserves is consistent with existing demands for reserves to meet requirements--because excess reserves are larger than depository institutions desire--or if depository institutions adjust loans and deposits to reduce required reserves by the full amount of the reduction in nonborrowed reserves.

In order to lower required reserves, deposits would have to fall by a multiple of the desired decline. Whether such sharp adjustments to deposits over a short time period are feasible has been

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[6]Technically, the Federal Reserve cannot, through use of open market operations, achieve desired nonborrowed reserve levels with precision because there are a number of factors on its balance sheet, such as Treasury cash and Federal Reserve float, that it does not control and can only observe after the fact. Most of the time, forecasts of those factors are sufficiently accurate that average errors in reserves for a reserve maintenance period are small. Occasionally, however, they are large.

[7]In equation form: total reserves = nonborrowed reserves + borrowed reserves = required reserves + excess reserves.

extensively debated. Those favoring short-run control of the base generally argued that depository institutions could make quick adjustments to deposits if they were given the incentive to do so. They believed that any additional nonborrowed reserves provided would quickly be lent or invested, setting in motion a multiple expansion process that would raise deposits until the unwanted excess reserves had disappeared. In a parallel fashion, they believed that depository institutions would respond to a shortage of nonborrowed reserves by contracting loans and deposits until required reserves had shrunk to the point that they were consistent with existing supplies of nonborrowed reserves. They argued that regulations that weakened the money multiplier process were serious impediments to such adjustments. In particular, they cited the relatively low discount rates (or alternatively the variable spread between the discount rate and the federal funds rate) and lagged reserve requirements that interfered with banks' ability to adjust required reserves within a reserve maintenance period.[8] (Between 1968 and 1984, there was a two-week lag between the reserve computation and maintenance periods. Since 1984, required reserves on transactions deposits have been quasi-contemporaneous, with a two-day lag at the end of the period.)

Another impediment to monetary base control was the way the discount window functioned. Many of the supporters of base control suggested that the discount window be closed or that the discount rate be set high enough to ensure that borrowing would be costly. The latter option would not make the monetary base precisely controllable, since banks still could borrow reserves in excess of those consistent with the target, but the high cost of doing so would discourage borrowing and make the monetary base approximately obtainable. The severe restrictions on borrowing would be presumed to limit deviations between the monetary base and the nonborrowed base.

Other analysts claimed that removing the impediments would not solve the problems of controlling the base. They argued that depository institutions could not easily make the large adjustments to loans and investments or to deposits needed to achieve the required reserve levels consistent with the desired monetary base. They reasoned, first, that each individual institution would have difficulty gauging whether an excess or shortage of reserves relative to its requirements resulted from a deliberate policy adjustment, from a poor distribution of reserves in the banking system--either among depository institutions or over the maintenance period--or from a Federal Reserve error in predicting reserve balances on the day. Only the first of those sources would induce depository institutions to consider taking the steps needed to change required reserves; changes in reserves from

[8]Thornton (1982) discusses these arguments.

the latter two sources would be quickly reversed, and banks would attempt to maintain existing levels of reserves and deposits. Each individual depository institution would have trouble discovering the true reserve picture from observing its reserve levels because flows of reserves are huge relative to average reserve balances. Many large banks routinely experience reserve positions that within a day range from being overdrawn to being substantially in excess, even when overall reserve levels are consistent with requirements.

Second, even when a depository institution correctly perceived a policy-based reserve shortage or excess, its most likely response would be to adjust its loan and deposit rates and fees gradually.[9] There are costs to making price changes because they have to be disseminated and because they may complicate efforts to achieve good relations with customers. In addition, customers would not respond immediately to the changes in pricing unless the short-run interest elasticity of demand for deposits was very great. But most observers have perceived the short-run interest elasticity of deposits to be relatively modest. In that circumstance, sharp swings in interest rates would have to occur to achieve the necessary changes in deposits. A depository institution facing a reserve shortage or excess might try to pass it to another institution by adjusting its activity in the federal funds market. If all depository institutions did that simultaneously, the federal funds rate would show large short-run movements.

Some observers argued that those large swings in rates would induce instability in the demand for money through a complex lagged adjustment mechanism. Thus, money would not respond as hoped to a reserve excess or shortage, but would exhibit a series of overshoots and reversals. Both the targeted monetary aggregate and interest rates would be subject to undesirable short-run volatility.

To the extent that the supporters of strict monetary base targeting addressed this issue, they suggested that depository institutions would respond by building up their normal holdings of excess reserves. Once the institutions held enlarged levels of excess reserves, they could allow excesses to vary in the short run whenever required reserves and nonborrowed reserves were inconsistent. Those excess reserves would serve as a shock absorber to mitigate the short-term fluctuations in interest rates.

If excess reserves became large and variable, those opposing monetary base targeting argued, the reserve-deposit ratio would become variable and the multiplier would cease to have the relatively stable relationship observed in the historical data generated when excess reserves were small and the

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[9]Demand deposits cannot pay explicit interest. Depository institutions may pay interest implicitly by extending services for which they do not charge. Since rates on NOW accounts were decontrolled in 1986, interest paid on them has been adjusted very slowly if at all.

monetary base was not a target. If the multiplier were unstable, controlling the base would not achieve desired money targets.[10] For the most part, the proponents of base targeting rejected these objections. They believed that the multiplier was structurally stable because of mandated reserve ratios and underlying customary behavior patterns and institutional structures. Hence, they anticipated that the ratios would either maintain or quickly return to their norms (Brunner and Meltzer 1983). If the ratio of currency to deposits is determined by the structure of payment practices, then currency will be induced to shift in the same direction as the change in deposits, taking some of the adjustment burden off reserves.

One issue rarely mentioned in the debate that probably deserved more attention was the appropriate time period over which it was desirable to achieve control of the monetary base. Very short-run control of the monetary base was never advocated for its own sake. Instead, it was seen as a means to achieve a desired path for money and in turn for economic activity and prices. Many of the supporters of a monetary base approach to money control argued for short-run targets for two reasons. First, they were afraid that if deviations were permitted, the central bank would allow misses of sufficient duration to affect adversely economic activity and prices. Second, they believed close control was feasible at low cost.[11] Their critics had a range of views with regard to the first point but, as indicated above, disagreed with the second. Many of the operational and stability concerns associated with monetary base targeting would be reduced if the time period for achieving the target were lengthened beyond the single reserve maintenance period cited in most of the control proposals. Presumably, the monetary base could be controlled with only modest errors over a one- to two-quarter horizon if nonborrowed reserves--or the federal funds rate--were manipulated to bring the monetary base back on track once evidence developed that it was deviating significantly from a desired path. Technical control should be easier than it is for M1 or M2 because the base does have a closer relationship to reserves and can be observed accurately with no lag. The more meaningful question is whether the monetary base can be controlled in a way that does not introduce short-run instability to interest rates and money demand. Without actual experience, it is difficult to answer that question.

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[10]Carlson (1981) describes the two viewpoints.

[11]Thornton (1983), generally a supporter of monetary base targeting, recognized that very short-term control was not feasible because loan and investment decisions, under any reserve accounting scheme, would not be closely linked with current reserve levels. Thus, the adjustment would not occur instantly. He did not think that the delays would be a problem because banks would adjust over meaningful periods. His arguments on this point are not typical of the literature supporting base targeting.

Nonetheless, the longer the control horizon, the more likely the answer will be that control of the base without unacceptable instability in rates and money demand is indeed possible.

Although most proposals concerning the monetary base made since the early 1980s have focused on its use as an intermediate target rather than as an operating target, one exception has been the work of McCallum (1987, 1988a, 1988b, 1988c). Influenced by the breakdown of the relationship between M1 and GNP in the 1980s, he suggested two modifications to the common monetary targeting proposal. First, he suggested that nominal GNP could serve as an intermediate target as long as it was chosen to ensure that inflation could not be rapid. Second, he advocated an adaptive policy rule that contained the means for the procedure to recover when underlying relationships between the base and GNP shifted as a result of deregulation or other developments. (See the paper by Spence Hilton and Vivek Moorthy in this volume.) McCallum suggested that the monetary base could serve as the operating instrument. He seemed to argue that the base could be controlled directly on a day-to-day basis, although he only advocated a quarterly average growth target. McCallum did not discuss his assertion that the monetary base could be controlled. His equation for quarterly target growth of the monetary base consists of three terms.[12] The first is a constant, equivalent to the desired trend growth in nominal GNP--in his preferred specification, 3 percent at an annual rate. The second term subtracts from the constant the average increase in monetary base velocity over the previous four years. This term introduces a gradual response to changes in monetary base velocity so that the model will adapt to changing trends. The third term provides for a partial response to deviations of GNP from its constant growth target. McCallum recommended a 25 percent per quarter adjustment factor in response to such deviations.

III. The Monetary Base as an Intermediate Target of Policy

The monetary base has been proposed as an intermediate target in place of a traditional monetary aggregate in order to resolve the possible short-run control problems associated with such an aggregate or to treat the monetary base itself as a narrow monetary aggregate. The idea that the monetary base could be considered a monetary aggregate developed gradually. Lothian (1976) found that the monetary base showed a more consistent relationship with net national product than did a broad monetary aggregate across groups of twenty-nine or forty countries (using two different

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[12]In equation form: $b_t - b_{t-1} = 0.00739 - (1/16)[x_{t-1} - x_{t-17} - b_{t-1} + b_{t-17}] + .25\ (x^*_{t-1} - x_{t-1})$, where b is the log of the monetary base and x is the log of GNP. An asterisk indicates a target value.

formulations). He posited that differential interest rates, inflation, and regulations such as interest rate ceilings and reserve requirements had a larger influence on the demand for deposits than they did on the demand for non-interest-bearing central bank monetary assets.

Drawing on the econometric techniques used to evaluate monetary aggregates as potential intermediate targets, analysts have tried to test empirically the ability of the monetary base to serve in the role of intermediate target for the United States. The traditional approach has been to estimate a model to see how well it predicts the behavior of economic activity or prices. Although one may question whether using a model built to accommodate the observed characteristics of one monetary variable is appropriate for evaluating monetary variables with a different set of characteristics, the approach has been widely used. Differences in methodologies and assumptions have yielded conflicting results.

A. Studies in Which GNP Is the Dependent Variable

A number of authors have estimated "St. Louis-type" models, substituting the monetary base for M1 or M2. Models of this type were developed at the St. Louis Federal Reserve in the late 1960s by Andersen and Jordan and updated and modified in subsequent years. In these models, a measure of nominal income (generally GNP) is regressed on a measure of money and a measure of fiscal actions (often high employment expenditures). Initially the models were estimated in first difference form, although later the variables were typically specified as rates of change. Sometimes variables have been added to allow for the effects of strikes and other shocks, such as the two large increases in oil prices in the 1970s. A series of studies were made in the late 1970s and early 1980s that compared the models' performance when the monetary base was used as the monetary aggregate with the models' performance when M1 was the aggregate. The models were estimated with data covering the previous twenty to thirty years. The models generally achieved better fits for M1 than for the monetary base, although the differences ranged from trivial to very large depending on specification and time period. A few of the authors offered simulations after the estimation period that tended to provide predictions of similar quality for the monetary base and M1. Andersen and Karnosky (1977) used a simplified version of the St. Louis equation from which they omitted the fiscal variable (because the sum of coefficients on the fiscal variable was usually insignificant). They estimated their model from 1952 to 1961, using quarterly data, and then extended it year by year through 1975. (They did not report their regression results.) In each case, they used the estimated model to simulate the next four quarters' GNP. They found that in the equations using Ml, the errors had modestly lower variance than the errors in the equations using the monetary base. However, the equations using the monetary base achieved lower mean errors and mean absolute errors. The authors concluded that it would be worthwhile to consider using the monetary base as an intermediate target because its forecasting performance was only slightly worse than Ml, and it was easier to control.

Davis (1979-80) ran similar simplified St. Louis model regressions, which also omitted the fiscal variable. His regressions used a sample period from 1961 to 1978 and two subperiods. He found significantly better fits for Ml than for the monetary base, using as measures of goodness of fit either R^2 adjusted for degrees of freedom or the standard error of the estimate. (Table 1 contains highlights of reported results for this and other studies.) He also estimated similar equations using either the currency component or the reserve component of the monetary base. The limited relationship he found between the monetary base and GNP seemed to derive from the currency component, not the total reserve component.

Cullison (1982) argued that the monetary base equation in Davis' formulation was misspecified because it contained the current value of the monetary base, which was largely endogenous over the sample period. He also criticized the choice of sample period, arguing that the starting and ending points should coincide with the same stage in the business cycle to allow for the cyclical pattern in the coefficients. His equations used 1959 as a starting point and ended in 1969, 1973, and 1979 (all cycle peaks). His results show much less of a gap between Ml and the monetary base, if judged by the values for adjusted R^2. His two formulations, with and without the current value of the monetary base, give similar results.

Gambs (1980) estimated somewhat different models from those used by Davis. He made his estimates over a longer time period (1953-78) and included a variable for high employment expenditures, an approach closer to the traditional St. Louis model. The monetary variables, especially the base, explained larger portions of the variation in GNP than they did in Davis' studies, but Gambs still observed a sizable differential between M1 and the monetary base.

Hafer (1984) made a study using a sample period running from 1960 to 1980. He used a more elaborate version of the St. Louis model that included high employment expenditures and special factor variables for oil price impacts, strikes, and wage and price controls. He allowed coefficients to vary over time. With GNP as the dependent variable, he achieved better overall results, presumably because additional variables were included. He found that the version using M1 showed only a slightly better fit than the version using the monetary base.

Benjamin Friedman and Kuttner (1989), using data available in 1988, reestimated equations

Table 1
Nominal GNP Equations: Selected Model Results

Davis (1979-80) and (1990)

$$GNP_t = a + \Sigma_i b_i m_{t-i} \quad \text{for } i = 0,\ldots,4.$$

	1961-I to 1978-IV		1961-I to 1969-IV		1970-I to 1978-IV		(Davis 1990) 1981-I to 1989-IV	
Financial Measure	$\bar{R}^2$	SEE	$\bar{R}^2$	SEE	$\bar{R}^2$	SEE	$\bar{R}^2$	SEE
M1	0.31	2.96	0.23	2.25	0.19	3.64	0.06	3.67
M2	0.25	3.07	0.27	2.19	0.08	3.88	0.02	3.76
MB-B	0.08	3.41	0.01	2.56	-0.06	4.16	0.16	3.48
Total reserves	-0.02	3.59	0.19	2.31	-0.11	4.26	--	--
Currency plus nonmember bank cash vault	0.11	3.35	0.13	2.40	0.01	4.03	--	--

Cullison (1982)

$$GNP_t = a + \Sigma_i b_{t-i} m_{t-i} \quad \text{for } i = 0,\ldots 4.$$

	1959-IV to 1969-IV		1959-IV to 1973-III		1959-IV to 1979-IV	
Financial Measure	$\bar{R}^2$	SEE	$\bar{R}^2$	SEE	$\bar{R}^2$	SEE
M1	0.360	0.0066	0.364	0.0072	0.371	0.0078
MB-SL	0.230	0.0072	0.280	0.0076	0.290	0.0083

$$GNP_t = a + \Sigma_i b_{t-i} MB_{t-i} \quad \text{for } i = 1,2.$$

	1959-IV to 1969-IV		1959-IV to 1973-III		1959-IV to 1979-IV	
Financial Measure	$\bar{R}^2$	SEE	$\bar{R}^2$	SEE	$\bar{R}^2$	SEE
MB-SL	0.270	0.0070	0.270	0.0077	0.260	0.0085

Gambs (1980)

$$GNP_t = a + \Sigma_i b_i m_{t-i} + \Sigma_i c_i E_{t-i} \quad \text{for } i = 0,\ldots,4.$$

	1953-I to 1978-IV		
Financial Measure	$\bar{R}^2$	SEE	$\Sigma_i b_{t-i}$
M1	0.41	3.74	1.18 (6.53)
MB-SL	0.31	4.04	0.94 (5.67)

Hafer (1984)

$$GNP_t = a + \beta_1 \Sigma_i b_{t-i} m_{t-i} + \beta_2 \Sigma_j c_{t-j} E_{t-j} + Z_t \quad \text{for } i,j = 0,\ldots,4$$

	1960-I to 1970-II			1970-III to 1980-IV		
Financial Measure	$\bar{R}^2$	SEE	$\Sigma_i b_{t-i}$	$\bar{R}^2$	SEE	$\Sigma_i b_{t-i}$
M1	0.479	2.320	1.142 (3.31)	0.469	2.992	1.361 (2.92)
MB-SL	0.468	2.345	0.955 (3.42)	0.460	3.018	2.191 (2.99)

Friedman and Kuttner (1989)

$$GNP_t = a + \Sigma_i b_i m_{t-i} + \Sigma_i c_i E_{t-i} \quad \text{for } i = 1,\ldots,4.$$

	1960-II to 1979-III	1960-II to 1986-IV	1970-I to 1986-IV
Financial Measure	$\bar{R}^2$	$\bar{R}^2$	$\bar{R}^2$
M1	0.32	0.11	0.02
MB-B	0.23	0.10	0.02
M2	0.27	0.19	0.06

Board Staff (1988)

$$GNP_t = a + \Sigma_i b_i m_{t-i} + \Sigma_i c_i E_{t-i} \quad \text{for } i = 0,\ldots,8 \text{ (or less).}$$

Financial Measure	1961-II to 1979-IV $\bar{R}^2$	SEE
M1	0.21	3.4
MB-B	0.06	3.7
M1-A	0.19	3.4
M2	0.18	3.5

Stone and Thornton (1988)

$$GNP_t = a + \Sigma_i b_i m_{t-i} + \Sigma_j d_j GNP_{t-j} \quad \text{for } i = 0,\ldots,4 \text{ and } j = 1,2.$$

	1961-I to 1980-IV	1961-I to 1987-II	1981-I to 1987-II[1]
Financial Measure	$\bar{R}^2$	$\bar{R}^2$	$\bar{R}^2$
M1	0.356	0.159	0.348
MB-SL	0.230	0.156	0.422
M1A	0.334	0.142	0.468
M2	0.199	0.179	0.295
Total reserves	0.204	0.132	0.320

[1] For this sample period, i = 0,1,2 and j = 1.

Naive Model

$$GNP_t = a + \Sigma_j d_j GNP_{t-j} \quad \text{for } j = 1,\ldots,7 \text{ (first two columns)}$$
$$\text{for } j = 1,\ldots,4 \text{ (third column)}$$

	1961-I to 1980-IV	1961-I to 1987-II	1981-I to 1987-II
	$\bar{R}^2$	$\bar{R}^2$	$\bar{R}^2$
	0.069	0.109	0.244

Notes: t-statistics are in parentheses. Notation changed from that of the author to make variables consistent.

GNP	=	annual rate of change in nominal GNP
m	=	annual rate of change in financial measure
E	=	annual rate of change in high employment expenditures
MB-SL	=	annual rate of change of monetary base--St. Louis measure
MB-B	=	annual rate of change of monetary base--Board of Governors measure
Z	=	energy and strike variables and price control dummies.

similar to those of Gambs for 1960 to 1979. They found a similar differential in the performance of M1 and the monetary base, but generally weaker relationships to GNP, presumably because of the different sample period.

In the early 1980s, the seemingly dependable relationships between the various monetary measures and GNP underwent substantial shifts. Two developments appeared to be primarily responsible. The first was the deregulation of interest rates applied to a variety of types of deposits. Such deregulation made it more attractive to hold wealth in money form and led to a downward shift in the velocity of money. The second development was the fundamental reduction in the trend rate of inflation, which also lowered velocity.

It was suggested that deregulation would have less effect on the monetary base than on Ml, since neither component of the base paid interest in the earlier years or in the 1980s.[13] Nonetheless, the monetary base was somewhat affected by deregulation since induced changes in transactions deposits affected its total reserves portion. While the currency component of the base might remain stable, any instability in total reserves would complicate targeting and control. Presumably, the reduction in the trend rate of inflation, which increased the demand for money generally, would affect the demand for the monetary base as well as M1 and M2.

In any case, as the 1980s unfolded, the data strongly suggested that structural shifts had in fact occurred. The shifts were most dramatic for M1, as the charts of income velocity in the introductory essay in this volume illustrate, but they also occurred in the monetary base velocity relationship. It would be hardly surprising in the face of such patterns that extending the observed log-linear relationships underlying the St. Louis equations would produce unsatisfactory results. Nonetheless, a number of authors pursued such an approach.

Friedman and Kuttner (1989) ran the same model cited above, extending the sample period to 1986. For sample periods running from 1960 to 1986 and 1970 to 1986, the proportions of the variation in GNP that were explained by either M1 or the monetary base were very low.

Staff members at the Board of Governors (1988) estimated reduced-form equations that included a monetary variable and a measure of fiscal stimulus for the period from 1961 to 1979. The sum of the coefficients on the monetary variable was constrained to equal one to be consistent with long-run neutrality of money. The estimates using the monetary base were considerably poorer than those for M1, M1-A, or M2. The staff then simulated the models for the postsample period from 1980 to 1988. The simulations showed large errors for all measures.[14] The monetary base showed bias, but the error statistics were better than those on the standard narrow money definitions and similar to those for M2 and a shift-adjusted version of M1-A.

Stone and Thornton (1988) used rates of change of various money measures and lagged values

[13]Gambs (1980) presents the argument without endorsing it. The Shadow Open Market Committee recommended monetary base targeting, partly to deal with deregulation.

[14]Summary statistics for Board staff simulations for 1980-I to 1988-III:

	M1	Base	M1-A	M1-ASH	M1SH	M2	M2SH
Mean absolute error	6.1	4.8	5.1	4.5	6.1	4.3	3.9
Root mean squared error	7.4	5.6	6.7	5.7	7.5	5.5	5.1
Bias (mean error)	-4.5	-3.3	-.2	-1.4	-4.1	-1.6	-1.2

SH=shift-adjusted

of GNP as independent variables and obtained results that were generally similar to those obtained by others over the initial sample period of 1961 through 1980. Extending the period of estimation to 1987 weakened the explanatory power but greatly reduced the differences among monetary measures. Furthermore, out-of-sample simulations from the first estimations, over the period from 1981 to 1986, showed considerable deterioration with respect to both M1 and the monetary base.

Stone and Thornton went on to reestimate the models, using data generated during and after the structural shifts described above. When the authors reestimated the model with 1981 as the starting date (and reduced the lags to gain degrees of freedom), the values for adjusted R^2 actually improved compared with those obtained for the earlier period, and the monetary base outperformed all of the other measures except M1A, to which it was a close second. They argued that the monetary base could appropriately play a role in the policy process.

In the introduction to this volume, Davis offers updated versions of some of his earlier equations, now estimated over 1981-89. He achieves the same ordering as Stone and Thornton, with the base improving and M1 deteriorating relative to the earlier period. But the values for adjusted R^2 and the coefficients are very different from those found by Stone and Thornton. While the time periods are not identical, the main source of the difference is the inclusion or exclusion of lagged values of nominal GNP with the independent variables. (The effects of alternative specifications are discussed below.)

Milton Friedman (Darby et al. 1987) performed a slightly different exercise and reached a similar conclusion. He calculated eight-quarter moving standard deviations of the quarterly change in income velocities of M1, M2, and the monetary base, both before and after the structural shift of the early 1980s. He found no increase in the size of the standard deviations of these measures in the 1980s, suggesting that velocity had not become more unstable. He claimed that monetary base velocity had the smallest standard deviation of the three measures, although the differences among them were not dramatic. (He presented his results in a graph. Visually, Ml appears to have deteriorated somewhat, while it is hard to tell about the other measures.) I repeated the calculations he described using data covering 1972-80 and 1982-89. The first time period is shorter than that examined by Friedman, who began his exercise with 1961. The second time period is longer; Friedman's sample ended in 1986. My calculations show some deterioration for the standard deviations of M1 and M2 velocity and some improvement for the monetary base.[15]

B. Studies in Which Prices Are the Dependent Variable

Another pair of studies (including one cited above) examined the impact of the choice of monetary variable on the rate of change in prices rather than on nominal income. Unfortunately, these studies only examined the relationships through the 1970s. Compared with the GNP equations over similar sample periods, the monetary base did relatively better, and in one of the studies it came out ahead of M1.

Hafer substituted the rate of change in prices for GNP in equations that included longer lags than his GNP equation. He observed a stronger relationship between the monetary variables and prices than between the monetary variables and GNP. M1 still outperformed the monetary base, but the difference narrowed (Table 2).

Fama (1982) used a different approach from the others, and concluded that the monetary base was superior to M1 as a monetary measure. Fama developed a model based on Fisher's work and various rational expectations models in which the long-run quantity theory was assumed to hold. He posited that the rate of change in the demand for real money was positively related to the rate of change in anticipated real activity and negatively related to the nominal interest rate (assuming money does not pay interest). He then made the assumption that real economic activity is determined outside the money sector (in keeping with the long-run neutrality of money hypothesis).

From these assumptions, he built a model to test the performance of alternative definitions of money. He ran a number of variants of the model, estimated from 1954 to 1976, first using annual data and then quarterly or monthly data. Inflation was expressed as a function of the monetary variable and nominal interest rates (both of which were expected to have positive coefficients) and as a function of actual and anticipated economic activity (expected to be negatively related). When the three-month Treasury bill rate proved insignificant, Fama dropped it. He used current money and money lagged one period. Initially, he tried money with a lead as well, on the assumption that it might serve as a proxy for the expected course of monetary policy, but dropped it when the

[15]Standard deviations of eight-quarter moving averages of logs of velocity of various monetary measures:

	M1	M2	MB-B	MB-SL
1972-80	0.02333	0.01388	0.01578	0.01663
1982-89	0.02587	0.01614	0.01238	0.01252

Table 2
Price Equations: Selected Model Results

Hafer (1984)

$$P_t = \Sigma_i b_i m_{t-i} + Z_t \quad \text{for } i = 0,\ldots,20$$

Financial Measure	1960-I to 1970-II $\bar{R}^2$	SEE[1]	$\Sigma_i b_{t-i}$	1970-III to 1980-IV $\bar{R}^2$	SEE[1]	$\Sigma_i b_{t-i}$
M1	0.737	0.896	0.942	0.681	1.278	0.972
MB-SL	0.671	1.002	0.848	0.504	1.593	0.749

Fama (1982)

$$P_t = a + \Sigma_i b_i m_{t-i} + \Sigma_j c_j A_{t-j} \quad \text{for } i = 0,1.$$

Financial Measure	Economic Activity Measure	$\bar{R}^2$	SEE	r_1[2]	r_2[2]	r_3[2]	$\Sigma_i b_t$	j =
M1	rIP	0.79	0.0130	0.42	0.11	-0.03	0.92	-1,0,1
M1	rGNP	0.80	0.0126	0.50	0.12	-0.07	0.90	-1,0
MB-SL	rIP	0.91	0.0083	0.06	-0.08	-0.01	0.71	-1,0,1
MB-SL	rGNP	0.95	0.0064	0.38	0.07	-0.12	0.72	-1,0
DD	rIP	0.65	0.0167	0.52	0.22	0.02	0.85	-1,0,1
DD	rGNP	0.65	0.0166	0.55	0.21	0.00	0.82	-1,0

Notes: Notation changed from that of the author to make variables consistent.

P	= annual rate of change in prices (Hafer: GNP deflator; Fama: CPI)
m	= annual rate of change in financial measure
Z	= energy and strike variables and price control dummies
M1	= annual rate of change in M1
MB-SL	= annual rate of change in monetary base--St. Louis measure
A	= annual rate of change in economic activity measure
rIP	= annual rate of change in real industrial production
rGNP	= annual rate of change in real gross national product
DD	= annual rate of change in demand deposits.

[1]SEE = standard error of the estimate.
[2]r_k = residual autocorrelation coefficient (k = 1,2,3).

coefficients proved insignificant. He measured economic activity alternately with industrial production and real GNP. Current economic activity was included along with activity with a one-period lag and a one-period lead. The leading variables (which had highly significant negative coefficients) were justified as proxies for anticipated real economic activity. Expecting objections to the use of leading variables, he also proxied anticipated activity with a stock price index, which gave a poorer fit but had the same sign and did not substantially change the coefficients of the other variables.

He ran the various models, alternately including the (St. Louis) monetary base, M1, or demand deposits as the monetary variable. In each model variant, the base dominated both M1 and demand deposits as measured by adjusted R^2, the standard error of the regression, and lagged residual autocorrelations. He reran some of the models using quarterly and monthly data and achieved the same ordering of results. Hence, he concluded that the monetary base was the appropriate monetary variable to follow to achieve a price goal. His model, which is complex, does not appear to have been updated to include the 1980s. McCallum cited Fama's work as justification for using the monetary base as a target variable. It is unfortunate that he did not offer an update of the price relationship.

C. Empirical Estimates of GNP and Price Relationships

To gain some additional insights into relationships using the rate of change in nominal GNP as the dependent variable in the 1980s, I estimated a variety of regressions similar in formulation to many of those reported here. Two time periods were used, 1972-80 and 1981-89. To allow for the observed structural shifts in the early 1980s, it was necessary to use relatively short time periods for this type of estimation. Hence, the results must be interpreted very cautiously. The exercises suggest some ratios arising from sensitivity to the specifications used. Including or excluding lagged GNP or the contemporaneous monetary variable made sometimes sizable differences in the results, as did specifications of the lag structure (Table 3).

Results can be judged by values of adjusted R^2 or by the plausibility of sums of coefficients (which for most of the monetary variables might be greater or less than one but which should not differ dramatically from one). In all specifications and under either definition of the monetary base, the base performed considerably better in the later period than in the earlier period. Indeed, it generally showed a better relationship to GNP in the later period than M1 showed in the earlier period. Ml was the only monetary variable tested that showed reasonable results in the earlier period. The deterioration in M1 as a predictor of GNP between the 1970s and the 1980s is dramatic if judged by sums of coefficients but modest if judged by error statistics. The M2 equations do not appear to be

Table 3

A Summary of Selected Regressions Using Nominal GNP as the Dependent Variable

Time Period of Estimate: 1972–80

Statistical Measure	Unconstrained Mon Variable with Lagged GNP; Contemp & Lagged Money	Unconstrained Mon Variable with Lagged GNP; Lagged Money Only	Poly Distr Lag Not Tied; with Lagged GNP; Contemp & Lagged Money	Poly Distr Lag Not Tied; with Lagged GNP; Lagged Money Only	Poly Distr Lag Not Tied; No Lagged GNP; Contemp & Lagged Money	Poly Distr Lag Not Tied; No Lagged GNP; Lagged Money Only	Poly Distr Lag Tied Far End; with Lagged GNP; Contemp & Lagged Money	Poly Distr Lag Tied Far End; with Lagged GNP; Lagged Money Only	Poly Distr Lag Tied Far End; No Lagged GNP; Contemp & Lagged Money
M1									
Adj R2	.38	.07	.41	.15	.40	.11	.37	.17	.38
St err regress	3.61	4.43	3.51	4.22	3.55	4.33	3.62	4.17	3.62
Sum coef	1.23	.62	1.28	.74	.87	.09	1.33	.78	.95
M2									
Adj R2	.05	.08	.09	.08	.11	.11	.11	.11	.13
St err regress	4.47	4.4	4.38	4.38	4.33	4.34	4.32	4.32	4.27
Sum coef	.58	.56	.56	.55	.49	.44	.57	.56	.50
Currency									
Adj R2	–.1	–.1	–.13	–.08	–.10	–.84	–.1	–.11	–.07
St err regress	4.81	4.83	4.88	4.77	4.81	4.78	4.80	4.82	4.74
Sum coef	–.03	–.46	–.19	–.46	–.26	–.50	–.18	–.53	–.25
Total reserves									
Adj R2	–.11	–.07	–.08	–.07	–.03	–.03	–.05	–.04	–.01
St err regress	4.84	4.75	4.77	4.75	4.65	4.65	4.70	4.67	4.60
Sum coef	–.15	–.15	–.15	–.15	–.15	–.13	–.15	–.14	–.15
Mon base—Board									
Adj R2	–.06	–.09	–.02	–.09	.03	–.04	.01	–.07	.06
St err regress	4.72	4.8	4.64	4.80	4.52	4.69	4.57	4.74	4.45
Sum coef	.02	–.67	.06	–.67	.06	–.71	.04	–.65	.04
Mon base—St Louis									
Adj R2	–.08	–.11	–.04	–.11	–.01	–.06	–.01	–.08	.02
St err regress	4.76	4.84	4.68	4.84	4.60	4.73	4.60	4.76	4.54
Sum coef	1.37	.41	1.39	.42	1.15	.20	1.37	.44	1.09

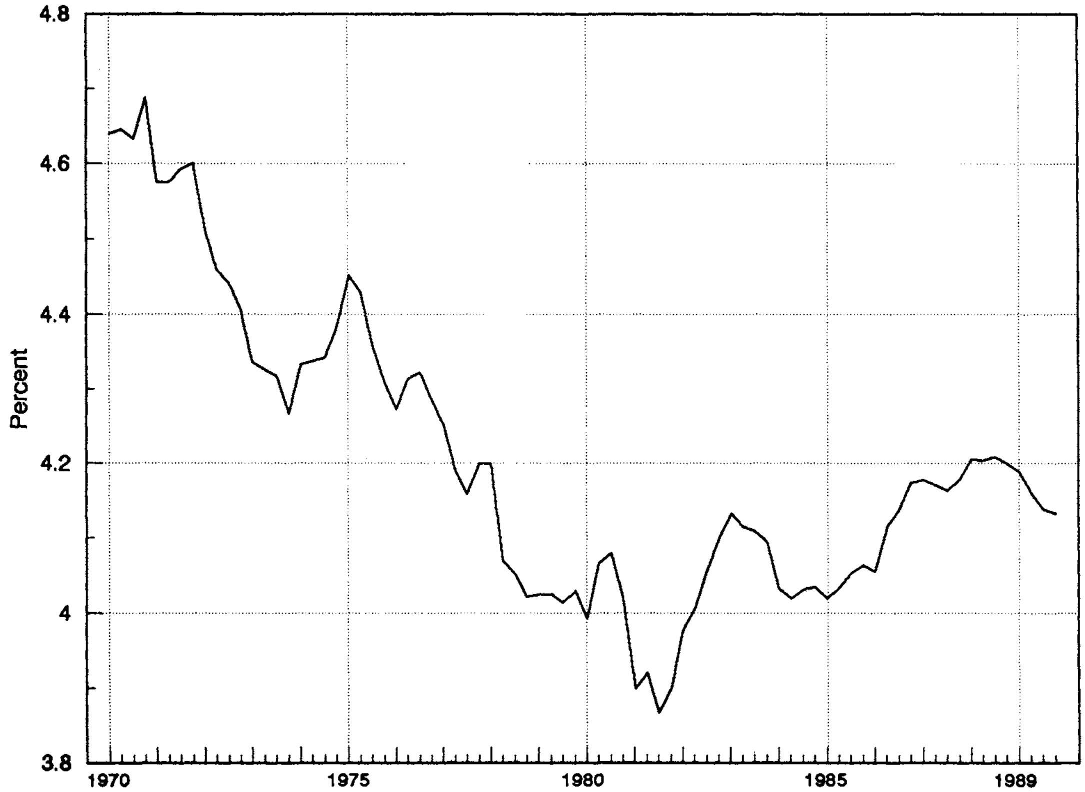
Note: Polynomial distributed lags are third order.

Table 3 – Continued

Time Period of Estimate: 1981–89

Statistical Measure	Unconstrained Mon Variable with Lagged GNP; Contemp and Lagged Money	Unconstrained Mon Variable with Lagged GNP; Lagged Money Only	Poly Distr Lag Not Tied; with Lagged GNP; Contemp & Lagged Money	Poly Distr Lag Not Tied; with Lagged GNP; Lagged Money Only	Poly Distr Lag Not Tied; No Lagged GNP; Contemp & Lagged Money	Poly Distr Lag Not Tied; No Lagged GNP; Lagged Money Only	Poly Distr Lag Tied Far End; with Lagged GNP; Contemp & Lagged Money	Poly Distr Lag Tied Far End; with Lagged GNP; Lagged Money Only	Poly Distr Lag Tied Far End; No Lagged GNP; Contemp & Lagged Money
M1									
Adj R2	.31	.29	.37	.31	.23	.10	.21	.19	.16
St err regress	3.15	3.19	3.00	3.13	3.31	3.58	3.37	3.40	3.46
Sum coef	.13	.21	.11	.23	.04	.22	.03	.22	0
M2									
Adj R2	.23	.20	.25	.20	.12	.05	.13	.19	.05
St err regress	3.34	3.39	3.27	3.37	3.54	3.69	3.53	3.40	3.69
Sum coef	.31	.44	.31	.43	.32	.47	.25	.41	.26
Currency									
Adj R2	.43	.44	.41	.43	.43	.43	.32	.45	.36
St err regress	2.87	2.84	2.89	2.85	2.85	2.84	3.11	2.81	3.02
Sum coef	1.62	1.66	1.71	1.66	2.00	2.16	1.77	1.64	1.86
Total reserves									
Adj R2	.19	.09	.12	.09	.05	–.05	.14	.06	.06
St err regress	3.41	3.61	3.54	3.60	3.70	3.87	3.51	3.67	3.68
Sum coef	–.04	–.02	–.05	–.01	–.11	–.07	–.05	–.01	–.11
Mon base—Board									
Adj R2	.31	.31	.21	.31	.17	.17	.17	.30	.13
St err regress	3.15	3.16	3.35	3.14	3.44	3.45	3.45	3.16	3.53
Sum coef	.85	.94	.90	.91	1.01	1.25	.78	.99	.92
Mon base—St Louis									
Adj R2	.36	.36	.36	.35	.30	.22	.24	.37	.24
St err regress	3.02	3.04	3.02	3.04	3.17	3.34	3.30	3.00	3.31
Sum coef	.71	.81	.76	.80	.89	1.11	.70	.78	.81

Chart 3
Currency as a Percentage of Nominal GNP



Note: Nominal GNP and currency values are seasonally adjusted. Ratios are plotted quarterly.

well specified in either period. They are poorer predictors than other work on M2 might suggest.[16] When currency was placed in the equations, the values for adjusted R^2 were much higher in the later period than in the earlier period--when there was no apparent relationship. During the 1970s, currency represented an expanding share of M1 (Chart 2) but declined relative to GNP (Chart 3). In the 1980s, currency's share of MI showed no trend, while currency as a percent of GNP rose modestly. The estimated coefficients for currency seemed implausibly high in the later period. The equations did not pick up a significant relationship between total reserves and GNP in either period. The behavior of total reserves was different in the two decades, with total reserves falling sharply as a share of M1 in the 1970s and more slowly in the 1980s (Chart 1). Movements in total reserves responded to both the behavior of reservable deposits and the shifts in the reserve ratios arising from sources other than

[16]See Wenninger (1990).

formal changes in requirements. Using the monetary base, which combines currency and total reserves, in the equation produced more plausible coefficients than using either currency or total reserves separately. These results give some support to the notion that the monetary base might have a role to play as an intermediate target or at least as an indicator. The important role of currency in the relatively good results achieved for the base in the 1980s means that one would want to know more about why currency behaved as it did and whether it was likely to continue to do so.

When prices were used as the dependent variable in empirical work covering the 1980s, the short estimation period was even more of a handicap than it was for nominal GNP. Results obtained for the earlier years suggested that the monetary variables affected prices with lags that were on average significantly longer than those observed for nominal GNP. Furthermore, the strong results obtained by Fama and Hafer were achieved with relatively complex models incorporating rather specific views of the relationships among economic variables and would be hard to replicate.

Nonetheless, while recognizing that the exercise was subject to many pitfalls, I estimated several regressions with rates of price change as the dependent variable.[17] Prices were defined alternately with the GNP deflator or the consumer price index (CPI). The two price measures produced some differences but a generally similar ordering of results. Table 4 presents selected results for regressions that used the implicit deflator as the dependent variable. Most of the equations also included lagged values of real GNP. Those without lagged real GNP generally had insignificant values for adjusted R^2 and less plausible coefficients. (When real GNP was included, the monetary coefficients could be expected to be modestly lower than one.) With the notable exception of currency, all of the monetary measures showed considerably poorer results for the 1980s than they did for the 1970s if judged by adjusted R^2. For the monetary base, the coefficients were more plausible in the 1980s than in the 1970s, although very low when real GNP was omitted. They nonetheless were more plausible than those on currency. The results for the 1980s were disappointing, although the short time period and the number of changes in money demand occurring in the early part of the decade were probably contributory factors.

More broadly, one could ask how much light any of these exercises, those with nominal GNP or those with a price index as the dependent variable, shed on the issues they are supposed to address, namely, the relative merits of these measures as intermediate targets of monetary policy. The basic

[17]To gain a few more observations, 1980 was chosen over 1981 as a starting date in these regressions, although the earlier date may have introduced more distortions from the transition period.

Table 4

A Summary of Selected Regressions Using the Implicit Deflator as the Dependent Variable

Time Period of Estimate: 1972–80

Statistical Measure	Unconstrained Mon Variable with Contemp & Lagged Real GNP; Contemp & Lagged Money	Poly Distr Lag Tied Far End; with Lagged Real GNP; Contemp & Lagged Money	Poly Distr Lag Tied Far End; with Lagged Real GNP; Lagged Money Only	Poly Distr Lag Not Tied; with Lagged Real GNP; Contemp & Lagged Money	Poly Distr Lag Not Tied; with Lagged Real GNP; Lagged Money Only	Poly Distr Lag Not Tied; No Lagged Real GNP; Contemp & Lagged Money	Poly Distr Lag Not Tied; No Lagged Real GNP; Lagged Money Only
M1							
Adj R2	.38	.35	.35	.39	.41	.32	.33
St err regress	1.88	1.92	1.93	1.86	1.83	1.97	1.95
Sum coeff	.78	.68	.65	.76	.77	.53	.53
M2							
Adj R2	.52	.58	.49	.59	.54	.54	.50
St err regress	1.65	1.54	1.71	1.54	1.62	1.62	1.69
Sum coeff	−.08	−.08	−.29	−.01	−.10	−.36	−.39
Currency							
Adj R2	.34	.38	.36	.36	.34	.26	.23
St err regress	1.94	1.87	1.91	1.91	1.94	2.06	2.09
Sum coeff	.90	.63	.84	.64	.84	.92	1.17
Total reserves							
Adj R2	.17	.19	.20	.16	.17	.02	.05
St err regress	2.17	2.15	2.13	2.19	2.17	2.36	2.32
Sum coeff	.02	.06	.07	.06	.07	.13	.13
Mon base—Board							
Adj R2	.57	.62	.59	.60	.58	.48	.46
St err regress	1.57	1.48	1.53	1.50	1.55	1.72	1.75
Sum coeff	1.64	1.97	1.92	1.96	1.94	2.45	2.42
Mon base—St Louis							
Adj R2	.56	.56	.56	.54	.54	.29	.30
St err regress	1.58	1.58	1.58	1.61	1.61	2.01	1.99
Sum coeff	1.92	2.24	2.22	2.24	2.22	2.75	2.73

Note: Polynomial distributed lags are third order.

Table 4 – Continued

Time Period of Estimate: 1980–89

Statistical Measure	Unconstrained Mon Variable with Contemp & Lagged Real GNP; Contemp & Lagged Money	Poly Distr Lag Tied Far End; with Lagged Real GNP; Contemp & Lagged Money	Poly Distr Lag Tied Far End; with Lagged Real GNP; Lagged Money Only	Poly Distr Lag Not Tied; with Lagged Real GNP; Contemp & Lagged Money	Poly Distr Lag Not Tied; with Lagged Real GNP; Lagged Money Only	Poly Distr Lag Not Tied; No Lagged Real GNP; Contemp & Lagged Money	Poly Distr Lag Not Tied; No Lagged Real GNP; Lagged Money Only
M1							
Adj R2	–.06	.10	.07	.08	.04	–.03	–.02
St err regress	2.71	2.49	2.54	2.53	2.58	2.67	2.66
Sum coeff	–.17	–.11	–.19	–.11	–.17	–.26	–.28
M2							
Adj R2	.25	.05	.08	.03	.05	–.04	–.03
St err regress	2.74	2.56	2.52	2.60	2.56	2.69	2.67
Sum coeff	–.01	–.36	–.06	–.04	–.06	–.21	–.13
Currency							
Adj R2	.76	.64	.63	.65	.65	.42	.43
St err regress	1.56	1.58	1.60	1.55	1.56	2.00	2.00
Sum coeff	2.44	2.32	2.24	2.40	2.34	2.19	2.23
Total reserves							
Adj R2	.46	.31	.32	.29	.30	.12	.09
St err regress	2.32	2.18	2.17	2.22	2.20	2.47	2.51
Sum coeff	–.06	–.03	–.04	–.03	–.04	–.02	–.04
Mon base—Board							
Adj R2	.15	.23	.15	.21	.12	–.08	–.08
St err regress	2.43	2.31	2.43	2.35	2.46	2.74	2.74
Sum coeff	.70	1.12	.90	1.11	.91	.45	.40
Mon base—St Louis							
Adj R2	.39	.21	.12	.19	.10	–.08	–.09
St err regress	2.46	2.34	2.47	2.38	2.50	2.74	2.74
Sum coeff	.54	.77	.67	.79	.70	.21	.21

model from which all of them were drawn was built to capture the behavioral characteristics that had been observed for M1 in the 1950s and 1960s. At the time, none of the components of M1 paid explicit interest, and interest sensitivity of the demand for money did not appear to be very large. The relationships have all changed in recent years, with short-run interest rate sensitivity increasing considerably, especially for M1. M2 has been sensitive to relative interest rate moves all along, although the patterns have changed as deregulation of rates has spread. Furthermore, since each of the monetary measures has different characteristics, it is doubtful that the same model would prove optimal for each of the monetary variables. Thus, there is no reason to believe that models developed in the 1960s to explain M1 behavior would reveal the correct relationship or even the correct ordering among monetary variables over the 1980s. It is possible that better relationships between the aggregates and the target variables could be found than any of these equations have discovered.

IV. Does the Concept of the Monetary Base Make Sense?

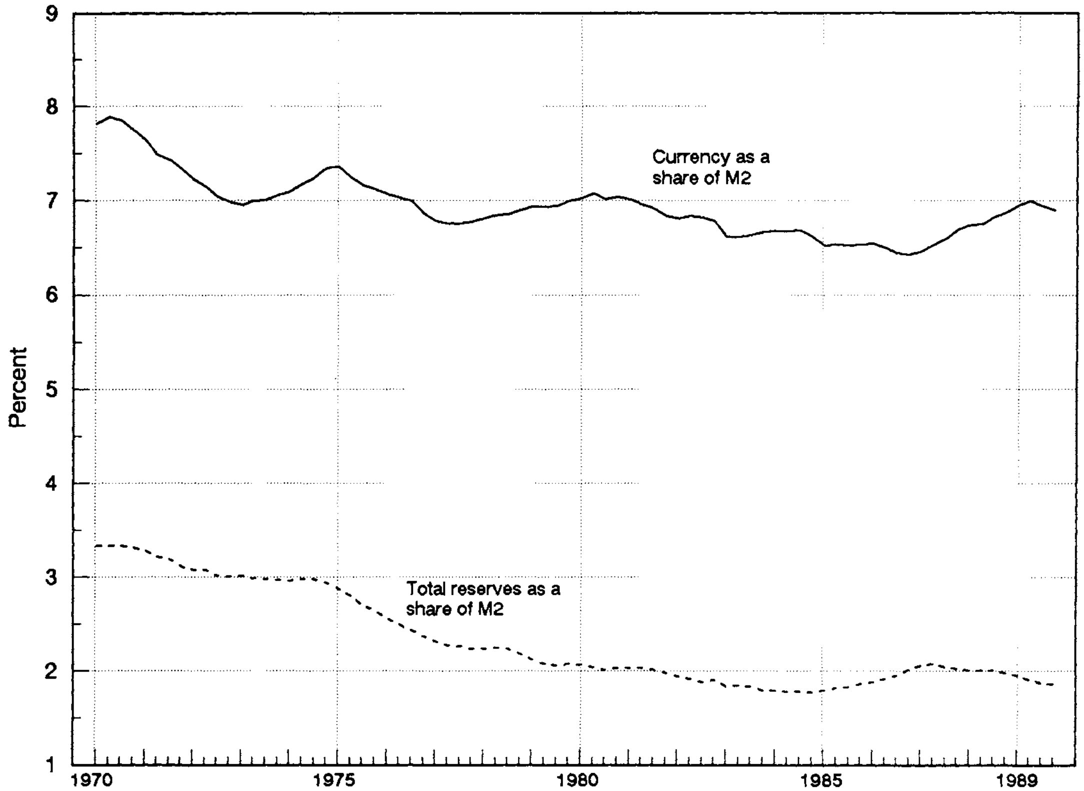
Benjamin Friedman (1988), commenting on McCallum's article (1988a), questioned the logic of using the monetary base as either an indicator or as an intermediate target. He had two basic criticisms. First, a large portion of the monetary base consists of currency, and the demand for currency is not well understood. He noted that currency outstanding as of the end of 1986 amounted to almost $900 for every U.S. citizen, far in excess of what surveys suggest most people hold.[18] Some currency is used for illegal transactions that are not captured by U.S. GNP statistics. A portion is used for transactions in countries where the local currency is not stable or is not freely convertible.

In addition, he simulated McCallum's equations for 1963-87, substituting alternately currency and total reserves for the monetary base. On the basis of root mean squared errors, currency outperformed the base while total reserves produced very large errors.

Friedman did not try to explain the poor relationship between total reserves and economic activity. One possibility was that the ratio of total reserves to M2, the aggregate with the best track record in the 1980s, might have been unstable. As Chart 4 shows, however, the ratio of total reserves to M2 was reasonably steady. Indeed, in the 1980s, the ratio of total reserves to M2 showed less quarterly variation than the ratio of total reserves to M1 (Chart 1), even though a large share of M2 deposits were not subject to reserve requirements. Friedman's poor results for total reserves may have reflected variations in the ratios of currency to deposits and reserves to deposits that were not picked

[18]The figure was around $900 million (not seasonally adjusted) at the end of 1989.

Chart 4
Currency and Total Reserves as Shares of M2



Note: Reserve data are seasonally adjusted and are adjusted for changes in reserve requirements. M1 and currency values are seasonally adjusted. Ratios are plotted quarterly.

up by the model. Some formulations of the St. Louis equations reported in the preceding section give slightly better results for total reserves than Friedman found (although they are still poor). Thus, on the basis of limited evidence, it is hard to make a choice between currency and the monetary base.

The validity of either currency or the monetary base as money measures was debated implicitly in the early twentieth century. The question was asked, Should deposits be considered "money," or should money be defined to consist only of gold and other government obligations? Irving Fisher and other economists argued persuasively that deposits performed essentially the same payment and accounting services as currency and coin. Therefore, ignoring them would lead to a serious understatement of existing monetary services. The subject was mostly left to rest until the 1970s.

Lothian (1976) presented a rationale for a narrow money measure such as the monetary base or currency. He argued that all financial assets provided a mix of money- and bond-type services.

Currency and non-interest-bearing reserves have little opportunity to provide bond-type services. Deposits, on the other hand, may pay interest either explicitly or implicitly, and the institutions accepting them may offer bond-type services to depositors. In an environment with variable regulations and inflation, the mix of money- and bond-type services provided by deposits may vary more than the mix provided by the non-interest-bearing monetary base. Consequently, Lothian concluded that the base was likely to be a better proxy for monetary services when deposit characteristics differed (over time or across countries). Lothian's cross-country empirical results were very similar for the monetary base and currency.

A reasonably strong relationship between currency and economic activity might be plausible. Currency is convenient for carrying out certain classes of transactions. If those transactions represent a relatively steady share of economic activity, then a close relationship might be expected. One might anticipate, however, that currency would perform a gradually declining share of monetary services whenever the number and sophistication of substitute means of payment grew. During the 1970s and early 1980s, rapid inflation stimulated efforts to find substitutes for non-interest-bearing currency. The pattern over that period did show a decline in currency relative to GNP (Chart 3), although currency was a growing share of M1. Countering that tendency in more recent years has been slower average inflation and the increased ease of obtaining currency from automated teller machines, developments which have raised the value of currency as a provider of payment services. The irregular but rising pattern for currency use during much of the 1980s may in part reflect those factors.

Nonetheless, Friedman's criticisms of currency as a potential intermediate target deserve attention. The use of U.S. currency for transactions that are not included in U.S. GNP statistics because they are illegal or take place in other countries would seem to be a serious problem only if the proportion of currency used for such transactions was variable. Limited direct information about variability over long periods of time is provided by two Board staff studies (Avery et al. 1986, 1987). The Board made surveys of cash holdings for transactions purposes by American adults in 1984 and 1986. Both surveys could account for about 11 to 12 percent of the cash outstanding. The 1987 article reported that the staff discovered a survey of cash holdings undertaken in 1944. That survey "accounted for a proportion of circulation currency that was remarkably consistent with the 1984 and 1986 data" (Avery et al. 1987, p. 191). Considering the numerous changes in payment practices and the rise of the illegal drug trade between the 1944 survey and the two more recent surveys, the similarity is surprising. In 1944, currency represented a share of Ml similar to its share in the mid 1980s, but it constituted a much larger share of GNP--on the order of 10 percent. (Of course 1944 was also a year of turmoil, and people in the war zones would most likely have sought to hold U.S. currency.) In any case, over short time periods U.S. currency can undergo significant unpredictable variations when developments abroad provoke large movements of currency outside the United States.

If one should wish to make currency the centerpiece of policy, one confronts the problem of how to control it. As long as currency is provided on demand, it is not directly controllable. Control would have to be achieved indirectly by influencing demand. Variables that act upon the growth of nominal economic activity, such as real interest rates and reserve provision, would influence currency over time. The authorities, therefore, would have a greater chance of success if they used currency as an intermediate indicator rather than as a target. They could use a procedure that adjusts for trend changes and large shipments of currency abroad.

V. Experiences with Monetary Base Targets

The United States has no direct experience with monetary base targeting, but the nonborrowed reserve targeting procedures employed between October 1979 and the autumn of 1982 have some features in common with a nonborrowed base operating target. In addition, Switzerland and West Germany have used measures similar to the monetary base in a role closer to an intermediate target than an operating target.

A. Reserve Targeting in the United States

Under the procedures followed between 1979 and 1982, the primary operating target was nonborrowed reserves. The procedures focused on intervals three weeks to five weeks in length, thus encompassing more than a single one-week reserve maintenance period. By averaging reserves over several weeks, the procedure avoided forcing offsets to very short-run deviations of reserves from the desired path--deviations which were thought likely to be self-reversing. In many ways, the procedure resembled one that could be used to target the nonborrowed base. No underlying growth rate objective was set for nonborrowed reserves (or any other reserve measure) over quarterly or annual time periods. Instead, the staff derived the targets for nonborrowed reserves by estimating the volume of total reserves believed to be consistent with desired M1. Under the procedure, the staff made estimates of currency and of reserve ratios expected to be associated with desired M1, two steps which were also recommended for developing an operating target for the monetary base. The nonborrowed reserve operating objective was derived from the total reserve target by subtracting an amount of borrowing believed to be consistent with interest rate levels that in turn would be consistent with the desired money growth. (In practice, the FOMC set the initial allowance for borrowing at a level close to that most recently in effect. It occasionally raised or lowered the allowance modestly if money growth had been more or less rapid than desired.) The operating targets were for nonborrowed reserves rather than total reserves because, as indicated earlier, existing institutional arrangements did not permit the Federal Reserve to control total reserves--or the monetary base--even if it had wanted to do so.

The degree of similarity between targeting a nonborrowed reserve or nonborrowed base measure and a total reserve or total base measure depends upon the way banks respond to the reserve shortages or excesses. As noted in the earlier discussion, differing views on that response mechanism lie at the heart of the debate about the controllability of the monetary base. Limited information from the 1979-82 experience suggested that the process of adjusting M1 deposits to changes in reserve availability began fairly quickly but continued over a period of several months. Thus, the nonborrowed reserve targeting procedure produced reserve and money adjustments in the desired direction within a reasonable time period, but the adjustments were not by any means instantaneous.

Even though the procedure allowed for some modest smoothing of the federal funds rate, the funds rate varied considerably more, on a day-to-day and week-to-week basis, than it had before the procedures were introduced (when deliberate actions had been taken to smooth the rate day to day). Some of the rate variation may have reflected specific features of the institutional reserve accounting structure, such as the length of the reserve maintenance period, the monetary authority's reaction when depository institutions failed to meet requirements, the presence of lagged reserve requirements, and the rules of access to the discount window. But much of this rate variation probably stemmed from the lags that must inevitably be part of the banks' adjustment process in a system involving many institutions, large flows, and a complex set of motivations for bank pricing policies.

The other notable feature of the period was that M1 growth slowed on average and came closer to its desired targets over extended periods of time, but it experienced considerable variability from month to month and even quarter to quarter--more than it had before. The variability is not completely understood, but the lags in the banks' response system could very easily have produced a damped oscillatory response in M1 to the changes in reserve pressures. Some of that variation might have been reduced through modifications to the targeting procedures, but there are limits to how much reduction could have been achieved in the face of delays in the adjustments undertaken by the commercial banks.

It appears that the nonborrowed reserve targeting procedure followed was able to bring M1 back on target when it veered off and to prevent an off-target trend. Nonetheless, it did introduce a substantial amount of short-run variability to both M1 and interest rates.

Monetary base targets abroad

For practical evidence using the monetary base as an intermediate target, one must look outside the United States. This section reviews the experiences of Switzerland and of West Germany, two countries that have made considerable use of monetary base targets. The Swiss National Bank (SNB) began targeting the monetary base in 1979, after having targeted M1 from 1973 to 1978. As described by Kohli and Rich (1986) and Rich (1987), the SNB considers the monetary base to be an intermediate target. The base is believed to be reasonably well linked over time with price stability and approximately controllable within a year's time frame through adjustments to reserves. The SNB sets annual target rates, which are chosen to be consistent with moving as close to its long-run goal of price stability as is considered feasible. The main restraint is that with heavy dependence on international trade, exchange market conditions must also be considered. The SNB does not view short-run manipulation of output and employment as appropriate activities for the central bank. It attempts to achieve price stability in a way that causes as little fluctuation in output as possible.

Rich and Kohli reported that the SNB judged its experience with monetary base targeting to have been largely successful, with a couple of notable exceptions. The SNB had its first problem with monetary base targeting in 1979. A strong exchange rate and trade pressures meant that the SNB was unable to shield the country successfully from the inflationary impulse of that year's oil price shock. It temporarily set aside its monetary base target that year, permitting an overshoot, but then accepted shortfalls in the next two years that offset the overshoot. Then in 1987, strength of the Swiss franc in the exchange markets and concerns that such strength was damaging the export sector led the SNB to try to discourage franc appreciation by pursuing a somewhat more expansionary policy than it would have preferred.

During the 1980s, the SNB ran into some problems with shifting money demand (Belognia 1988). In contrast to most other western countries, Switzerland experienced a significant fall in the demand for M1 early in the decade, apparently in several steps, and a more modest reduction in the demand for the monetary base. As the SNB observed the shifts, it lowered its targets for the monetary base. Because of these shifts, the SNB increased the attention paid to money market rates in order to obtain early indications of possible money demand shifts. In 1988, the SNB introduced revised liquidity requirements and a new interbank payments system. Both factors acted to lower the demand for Ml. In response, the SNB deliberately undershot its base target in that year and again in 1989. Undershooting was also deemed consistent with handling the inflationary impulse that had developed in response to the earlier accommodative posture.

Targets for the monetary base apply only to the year as a whole. The growth of the base is monitored during the year. Deviations from the target are tolerated if special factors suggest that they are likely to be self-reversing. Otherwise the degree of reserve provision is adjusted to ensure that the base will be brought back on target. Rich and Kohli reported that the SNB had the ability to control the monetary base within what had been judged to be acceptable limits. In most years the actual figure was within 1 percentage point of the target, and often it was closer. A miss of 1 percentage point or less is not believed to do serious damage to the drive for price stability. The exceptions have been years when a deliberate decision was made to miss the target because of an observed special factor.

The SNB achieves the targets by adjusting reserve availability through temporary repurchase operations against foreign currencies (known as swaps) and by placing limits on the commercial banks' access to the discount and Lombard windows. The banks are required to report in advance any planned large takedowns of discount or Lombard credit, giving the SNB room to offset the reserve effects. This restriction in borrowing access has led the banks to hold more than minimal levels of excess reserves. It has also led to occasional wide fluctuations in the overnight money market rates on the last day of the month, when reserve requirements must be met, although these fluctuations have little or no effect on longer term rates. Variations in excess reserves arise in the adjustment process, since banks cannot instantaneously adjust their deposits when the base level is changed. The SNB has judged monetary base targeting to have been largely successful, both because unplanned extended misses have been small and because average price inflation has been considerably lower than in other countries. Control of the base was credited with limiting the potential for inflation. Others have challenged that view, suggesting that the determination to control inflation and a conservative fiscal policy established a climate where almost any technique could have worked (Wenninger 1983). Although the policy climate was obviously helpful, monetary base targeting has served as a visible sign of the central bank's efforts to contain inflation. Consequently, monetary base targets in Switzerland appear to have played a useful part in bringing about the desired results.

Like Switzerland, West Germany appears to provide an example of relatively successful use of the monetary base as a policy target. The West German Bundesbank targeted a measure called the central bank money stock (CBM) from 1975 through 1987, setting annual target ranges. The measure, still in use today as an indicator, closely resembles the monetary base. CBM consists of currency plus compulsory cash reserves held by the banking system at constant January 1974 reserve ratios, and thus is essentially a monetary base measure adjusted for reserve requirement changes. Articles by Bundesbank staff raised objections to equating CBM with the monetary base (Dudler 1980, 1982). The articles indicated that Bundesbank policy makers disliked identifying CBM with the base for two reasons. First, they wanted to distance their approach from that of using CBM as an *operating* target; when CBM targeting began, most of the discussion of the monetary base in the literature focused on direct short-run control. Second, they viewed CBM as a proxy for a broad money measure, M3. M3 consists of currency plus sight deposits and time deposits of less than four years and deposits at statutory notice. Throughout the time the Bundesbank targeted CBM, data were available much more promptly for CBM than for M3. Most of the time, the two measures tracked each other's behavior fairly closely. The Bundesbank manipulated interest rates when it observed CBM going off track, and although it did not set a formal target for M3, it assumed that efforts to bring CBM into line with the target would also lead to appropriate behavior for M3 (Deutsche Bundesbank 1985).

In 1988, the Bundesbank changed its monetary target to M3 (Deutsche Bundesbank 1988). In making the change, it again pointed out the similarities between longer run movements of M3 and CBM. It indicated that both aggregates had shown fairly stable positive relationships to the growth of nominal production potential and negative relationships to interest rates. Movements in both measures led movements in economic activity. The change in the target variable was made because CBM had been tending to move in an exaggerated fashion, overstating swings in money growth rates in preceding months. At the time, currency was expanding disproportionately because interest rate levels were low. Because CBM's movements were often dominated by fluctuations in currency, CBM was responding too much, in the Bundesbank's view, to movements in interest rates. In other words, CBM was not serving as a good proxy for M3. The Bundesbank also cited some past episodes of divergence, but reported that those episodes had generally not lasted overly long.

Another motive for changing the target was some discomfort with the abstract nature of the reserve component of CBM. Actual required reserve ratios were very different (and generally lower) in 1988 than they had been in 1974. Furthermore, several components of broad money were not subject to minimum reserve requirements. Nonetheless, the data delays that had previously led the Bundesbank to target CBM rather than M3 continued after 1988, and for this reason the Bundesbank retained CBM as an early indicator of changes in M3 growth.

The Bundesbank over the years took its targets, whether for CBM or M3, seriously. It was often successful in achieving them, but it also experienced a number of misses both planned and unplanned.[19] In choosing its annual monetary target, the Bundesbank made estimates of the growth rate of the target variable likely to be consistent with desired nominal GNP. It took account of what it considered to be unavoidable inflation, likely prospects for real economic expansion, and forecasts of velocity. Consequently, it varied the targeted growth rate range for CBM significantly from year to year as its estimates of appropriate economic activity and velocity changed. Sometimes it chose to miss a target during the year because of conflicts with desired developments in the foreign exchange markets or because of unanticipated shifts in the behavior of velocity. The Bundesbank was generally pleased with this flexible use of monetary targets. Like Switzerland, West Germany generally achieved inflation rates below those in most other industrialized countries. It is of course true that the anti-inflation policy in West Germany, as in Switzerland, had strong internal support that greatly increased the likelihood it would succeed. Nonetheless, the CBM targets made a contribution to achieving the price objective.

Appendix: Definitions of Monetary Base and Reserve Measures

The Monetary Base

There are a number of possible approaches to defining the monetary base. Two definitions are widely available, one prepared by the St. Louis Federal Reserve, which pioneered the empirical work, and the other prepared by the Board of Governors. The base concept can be developed from either the sources side or the uses side of the balance sheet. The results should be equivalent, although details of timing and treatment of seasonal adjustment issues can introduce slight differences.

The St. Louis staff has approached the construction of the base conceptually from the sources side. It describes the base as consisting of Federal Reserve credit--holdings of securities in the portfolio, loans by the discount window, and other balance sheet items, as well as the gold stock, Special Drawing Rights, and Treasury currency. Several categories of liabilities are subtracted, namely, Treasury and foreign deposits at the Federal Reserve, Treasury holdings of currency, and certain miscellaneous items. When staff members actually construct what they call the source base,

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[19]See articles entitled "The Economic Scene in the Federal Republic of Germany" in various issues of the Monthly Report of the Deutsche Bundesbank.

however, they define it as currency in the hands of the public plus required reserves plus excess reserves. In other words, they define the source base in terms of its uses, although they treat vault cash contemporaneously rather than in lagged form. For dates before 1984, when contemporaneous reserve requirements (CRR) were introduced, the staff has allowed for the lag structure on reserve requirements.

The Board staff defines the base in terms of its uses, as consisting of currency and total reserves held by depository institutions. More specifically, its definition of the base before adjustment for reserve requirement changes consists of (1) total reserves, (2) required clearing balances and adjustments to compensate for float at Federal Reserve Banks, (3) the currency component of the money stock less the amount of thrift institutions' vault cash holdings normally included in the currency component of the money stock, and (4) the excess of current vault cash over the amount applied to satisfy current reserve requirements at insitutions not having required reserve balances.

For dates after the introduction of CRR in February 1984, the Board measures currency and vault cash over the two-week computation period ending Monday, two weeks and two days before the two-week reserve maintenance period begins. Before CRR, all components of the monetary base other than excess reserves were seasonally adjusted as a whole, rather than by component, and excess reserves were added without seasonal adjustment. Since CRR, the seasonally adjusted series has consisted of seasonally adjusted total reserves, which include excess reserves on a not seasonally adjusted basis, plus the seasonally adjusted currency component of the money stock plus the remaining items seasonally adjusted as a whole.

The major difference between the two definitions arises from the adjustment procedures to handle changes in reserve requirement ratios. The Board's "break adjustment" method allows for discontinuities arising from regulatory changes in reserve requirements by taking the new ratios, calculated for different classes of institutions, and applying them to the actual historical deposit series for each banking group. The annual indexing of low reserve tranches is applied to the reserve ratios as if the change were phased in over the whole year instead of being applied in the first maintenance period of each year. It includes the 3 percent requirement on nonpersonal time and savings deposits but ignores the requirement on Eurodollar deposits.

The St. Louis reserve adjustment magnitude (RAM) employs a different approach. Instead of using current reserve ratios to define the monetary base, the RAM uses hypothetical reserve requirements. For years since 1980, the RAM has set the reserve ratio on transactions deposits equal to 12 percent, the marginal reserve requirement on such deposits. (The actual average reserve ratio has recently been about 8 percent because there are zero and 3 percent reserve tranches.) The RAM measure assumes a zero reserve requirement for other types of deposits, even though some of them are actually subject to a 3 percent ratio. For years before 1980, it uses a ratio equal to member bank deposits and only applies the ratio to such deposits. It applies separate ratios for time and savings deposits. Interim techniques were used between 1980 and 1987 when new reserve requirements were being phased in. For a more detailed description of the techniques of reserve adjustment, see Gilbert (1980, 1984, 1987).

Studies have suggested that it makes an important difference whether the base is adjusted for reserve requirement changes (Haslag and Hein 1989). However, the different techniques of adjusting for reserve ratios are of limited importance over most time periods. The St. Louis base measure is higher than the Board base since it uses a higher reserve ratio, and it thus gives more weight to deposits relative to currency. For brief time periods, the movements of the two bases often differ. However, the differences in rates of growth are generally slight for periods of a quarter or more.[20]

Other Measures

Total reserves consist of reserve balances with Federal Reserve Banks, excluding required clearing balances and adjustments to compensate for float, plus vault cash held during the lagged computation period by institutions having required reserve balances at Federal Reserve banks, plus the amount of vault cash equal to required reserves during the maintenance period at institutions having no required reserve balances.

Nonborrowed reserves consist of total reserves less those reserves borrowed by depository institutions from the Federal Reserve's discount window.

Borrowed reserves consist of those reserves acquired from the Federal Reserve's discount window. For some purposes, extended credit borrowing by banks in financial difficulty is treated as part of nonborrowed reserves.

Required reserves consist of reserves that depository institutions must hold against deposits. Requirements are based upon deposit levels during various computation periods according to the type of deposit and the size of the institution.

Excess reserves consist of total reserves not needed to meet reserve requirements.

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[20]None of the studies cited in the text reported results for both base measures in the regressions. In the equations I ran, the measures of significance differed somewhat for the two base measures, although the sums of the coefficients were generally similar.

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MONETARY AGGREGATES AS INTERMEDIATE TARGETS

John Wenninger

The Federal Reserve began to use monetary aggregates as intermediate targets in the mid-1970s. Increasing recognition of the drawbacks to relying on interest rates and the growing need to formulate a long-run strategy for containing inflationary pressures were the main reasons for adopting monetary targets. The experience gained in using the monetary aggregates in the policy process was in many respects the precipitating force behind much of the work that has been undertaken over the years on the general topic of using intermediate variables to attain ultimate policy goals. And the difficulties encountered in using monetary targets provided much of the impetus to search for alternative intermediate variables for policy such as total credit and liquid assets initially and commodity prices and the yield curve later on.

This paper reviews the recent experience with using monetary aggregates as intermediate targets. It begins with a brief overview of the improvements in the policy process that were expected from formulating policy with monetary targets and the many practical problems that developed in using the monetary targets.

The second section presents some of the theoretical arguments for and against using money as a target. A simple IS-LM model is used to illustrate the conditions under which money would be a good target variable as well as the conditions under which money could be readily controlled using the monetary base (as opposed to using interest rates).

The third section of the paper provides some perspective on the stability of the money-income and the base-money relationships by presenting simple extrapolations of velocity and money multiplier trends. These simple techniques show that prior to the mid-1970s a strong empirical case for using monetary targets could be made, particularly for M1. Both velocity and the money multiplier seemed to follow stable trends. Since the mid-1970s, however, the velocity link has become considerably less stable, and there is also some evidence that the relationship between M1 and the base has deteriorated as well. For the broader aggregates, while the multiplier relationships were not as tight as those for M1 even before the mid-1970s, the changes in velocity relationships have not been as pronounced as those for M1. These results suggest that the broader aggregates are currently better suited for policy purposes.

The fourth section confirms these conclusions using money-income and base-money reduced form equations. The final section explores the reasons behind the recent instability in M1 relative to economic activity by focusing on the effects of innovation and deregulation on the public's demand for money. The way banks adjust the rates on various types of deposits as market rates change in a deregulated environment appears to have made the use of M1 as an intermediate variable more problematic than the use of the broader aggregates.

The first appendix to this paper describes the breakdown in the relationship between narrow money and inflation. This appendix also contains a discussion of recent research on using M2 in combination with the level of unused capacity in the economy as a long-run leading indicator of inflation (often referred to as p*). The second appendix examines the operating procedures the Federal Reserve has used over the years in attempting to keep money on target.

I. Circumstances Leading to the Adoption of Monetary Targets

By the mid-1970s, the problems with using nominal interest rates as policy guides when inflationary expectations were shifting became increasingly apparent. Increases in inflation and inflationary expectations could cause real rates to fall even while nominal rates held steady or rose. Although real rates were difficult to measure, they were generally accepted as the important variables for spending decisions. It was also recognized that interest rates could give the wrong impression about the posture of monetary policy over time if interest rates were changing because of a shift in aggregate demand. To indicate more clearly whether policy had eased or tightened, policy makers should pay attention both to the movements in interest rates and to measures of bank reserves and/or the money stock.

Around that same time, it also appeared increasingly important to establish a longer run strategy for lowering inflation.[1] Control of the money supply, because of its presumed long-run relationship to inflation, was viewed as a key variable to attain price stability over time. In addition, monetary targets came to be seen by many as an approximate means to communicate longer run policy objectives to Congress and the general public, to establish central bank credibility and thus lower inflationary

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[1]For a discussion of the monetary aggregates as practical guides for policy, see Paul Volcker, "The Role of Monetary Targets in an Age of Inflation," Journal of Monetary Economics, vol. 4, no. 2 (April 1978), pp. 329-39.

expectations, and ultimately to hold the central bank accountable for its policies. Finally, monetary targets could provide a more enduring standard against which shorter run policy decisions could be evaluated over time. Monetary targets might also expedite policy decisions because some empirical work had suggested that movements in money led movements in nominal GNP and inflation by several months. Overall, many analysts believed that monetary targets could provide a nominal anchor for policy, both for internal operational purposes and for external communications.

Monetary targets, however, were far from a panacea for policy. Establishing monetary targets also required dealing with many practical problems. These problems included:

--choosing the monetary aggregate or aggregates to be targeted and the appropriate definitions of the monetary aggregates during a period of innovation and deregulation;

--establishing the time period over which targets should be set, how frequently they should be reset, how much they could reasonably be changed from year to year, and whether the previous target value for money or the actual value should be used as the base for the target in the next period (base drift);

--deciding how quickly a deviation in money from target should be corrected to avoid overshooting the target and needing to reverse policy;

--determining whether reserves or short-term interest rates would be better instruments to attain monetary targets;

--exercising judgment in interpreting deviations in money from target as economically significant or insignificant; and deciding whether the policy process should focus only on money or on a broad range of indicators to ensure that money was giving the correct signal;

--deciding how to identify and then deal with shifts in the trend of velocity and the demand for money, particularly when inflation and inflationary expectations dropped sharply following a period of monetary restraint, thereby changing the relative demands for financial and real assets.

II. Theoretical Considerations in Using Money as a Policy Guide

The theoretical reasons for and against using monetary aggregates as intermediate targets were debated long before many of the practical problems mentioned above became apparent. Readers already familiar with these arguments can skip to Section III where the empirical results begin.

At a theoretical level, two models that represent extreme and opposite possibilities can be used to illustrate the circumstances under which the money supply would or would not be useful as an intermediate target. In the first model, money plays a key role as an intermediate target. Causation flows from an exogenously determined supply of high-powered money (reserves and currency) to the money stock, with a stable or predictable money multiplier serving as the link. The money stock, in turn, determines the level of nominal spending, this time with a stable, predictable velocity providing the link. The observed correlation between money and income occurs because money induces changes in nominal spending. In addition, since the demand for money is viewed as being stable and relatively insensitive to changes in interest rates, changes in exogenous expenditures will not cause income to deviate from the desired path. Hence, managing the monetary base in such a way that money grows at a moderate rate would also achieve a noninflationary path for nominal spending. In other words, monetary control is the key to preventing inflation in the longer run.

In the other model, monetary aggregates as intermediate targets or indicators would have a much reduced role, if any. In this model, causation runs from shifts in exogenous spending to changes in total nominal spending and then to increases or decreases in the quantity of money demanded. The changes in the quantity of money demanded in turn lead to changes in the demand for the monetary base, changes which are passively accommodated by the central bank. In other words, money is endogenously rather than exogenously determined, and the correlations between money and income and between money and the monetary base result from changes in spending that induce changes in the demand for money and the demand for the base. Even if the central bank attempted to restrain the monetary base and therefore money, the high interest rate sensitivity of the demand for money and the instability in the money demand function would make control of the money stock as an intermediate target a difficult exercise. In this model, money might serve as an early indicator of changes in spending (only because money data are available before GNP data), but there would be little value in controlling money because keeping money on a steady path would not prevent changes in autonomous expenditures from affecting GNP.[2] In this model, inflation would not occur so much because of changes in the money supply, but rather because of changes in autonomous expenditures that pushed aggregate spending beyond the economy's capacity to produce. In other words, a sensible fiscal policy

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[2]For good textbook presentations of alternative approaches to stabilization policy, see Thomas Mayer, James Duesenberry, and Robert Aliber, Money, Banking and the Economy (New York: W.W. Norton and Company, 1987); and Lawrence Ritter and William Silber, Principles of Money, Banking and Financial Markets (New York: Basic Books, Inc., 1989).

Table 1

Basic IS-LM Model[1/]

(1) $Y = -cr + X$
(2) $M = -ar + bY + Z$
(3) $M = R/m + dr + K$

M = narrow money supply
r = the interest rate
Y = income
Z = money demand shift
X = autonomous expenditures
R = monetary base
K = money supply shift
m = money multiplier
a,b,c,d = structural parameters

Reduced Form Multipliers

	R	K	Z	X
Y =	$+\frac{c}{m(a+d+bc)}$	$+\frac{c}{a+d+bc}$	$-\frac{c}{a+d+bc}$	$+\frac{a+d}{a+d+bc}$
r =	$-\frac{1}{m(a+d+bc)}$	$-\frac{1}{a+d+bc}$	$+\frac{1}{a+d+bc}$	$+\frac{b}{a+d+bc}$
M =	$+\frac{a+bc}{m(a+d+bc)}$	$+\frac{a+bc}{a+d+bc}$	$+\frac{d}{a+d+bc}$	$+\frac{bd}{a+d+bc}$

[1/]Prices are assumed constant in the short run so that nominal and real values are the same.

would be the key to price stability.[3]

In practice, however, causation in the economy does not flow in just one direction, as portrayed in these extreme models. The basic IS-LM model can be used to illustrate some of the complexities facing policy makers in deciding whether to use money as an intermediate guide. The first table shows the basic IS-LM model and the derivation of the reduced form multipliers.

[3]For overviews of the theoretical arguments for intermediate targets, see Edward Kane, "Selecting Monetary Targets in a Changing Financial Environment," Money Policy Issues in the 1980s (Proceedings of a symposium sponsored by the Federal Reserve Bank of Kansas City, August 1982), pp. 181-206; Benjamin Friedman, "The Value of Intermediate Targets in Implementing Monetary Policy," Price Stability and Public Policy (Proceedings of a symposium sponsored by the Federal Reserve Bank of Kansas City, August 1984), pp. 169-91; and Richard G. Davis, "Monetary Aggregates and the Use of 'Intermediate Targets' in Monetary Policy," New Monetary Control Procedures, vol. 1, Board of Governors of the Federal Reserve System Staff Study, February 1981, pp. 1-44.

For the Federal Reserve to control money and GNP with a great degree of precision, it would be necessary to know the structural parameters of the model (a, b, c, and d) and the source and size of other exogenous shocks to the economy (K, Z, and X) in order to offset their impacts on money and GNP. If the Federal Reserve cannot anticipate and offset these shocks, both money and GNP will be affected. For shifts in the expenditure function (X) and shifts in the supply of money function (K), the impacts on money and GNP will have the same signs. Therefore, by looking at money, the Federal Reserve can at least discern whether it needs to contract or expand the supply of reserves to stabilize GNP. However, for money demand shifts (Z), the multipliers have opposite signs and the Federal Reserve could destabilize GNP by attempting to keep money on target when the demand for money changes.

Finally, even if the demand for money were stable and the Federal Reserve only needed to respond to shifts in the expenditure function (X), stabilizing money would not necessarily stabilize GNP entirely. Only in the special case when the interest elasticities of the supply of and demand for money (a and d) were equal to zero would keeping money on target ensure that the desired performance of GNP would be attained. In this case, neither money nor GNP would be affected as a result of shifts in the expenditures function (X). In the other extreme case, however, when the interest elasticity of the demand for money (a) would be very large, shifts in autonomous expenditure would have small effects on money but relatively large impacts on GNP. Money might therefore stay quite close to target even while GNP deviated substantially.

Clearly, even a very simple model underscores the need for caution in using money as an intermediate target. Unanticipated shifts in the demand for money, of course, appear to be the most serious difficulty that could arise. In this case, a reduction (increase) in the demand for money, without any change in the supply of money, could create inflationary (recessionary) pressures. In addition, a very large money demand interest elasticity could also be a significant drawback to monetary targeting. An increase (decrease) in autonomous expenditures could create inflationary (recessionary) pressures, by pushing GNP growth beyond (below) its potential, without appreciably more (less) rapid money growth.[4]

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[4]For more background, see William Poole, "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Model," Quarterly Journal of Economics, May 1970, pp. 197-216; John Wenninger, "Financial Innovation, A Complex Problem Even in a Simple Framework," Federal Reserve Bank of New York Quarterly Review, Summer 1984, pp. 1-8; and James Tobin, "Monetary Policy: Rules, Targets, and Shocks," Journal of Money, Credit, and Banking, November 1983, pp. 506-18.

In general, the following conditions would favor monetary targeting when the monetary base is the policy instrument:

--a low interest rate elasticity in the supply of money function (d) and small values of shifts in the supply of money (K). These conditions would tighten the linkage between the base and the money stock. The ratio of the money stock to the base (the money multiplier) could be used to determine how much monetary base the Federal Reserve should supply to attain its monetary objectives.

--a low interest rate elasticity in the money demand function (a) and small values of shifts in the demand for money (Z). Under these circumstances, the money stock would largely determine the level of income, and any shifts in the expenditures function (X) would mainly affect interest rates. Money and income would move together in a predictable way (stable velocity), and velocity could be used to calculate the target path for money consistent with a desired GNP objective.[5]

III. Predictability of Velocity and Multiplier Trends

This section uses extrapolations of velocity and money multiplier trends to illustrate the predictability of these trends with straightforward and transparent techniques. The analysis reveals that for M1, in particular, the predictability of these monetary relationships has deteriorated considerably.

The recent breakdown in the money-income (GNP-M1) relationship has been well documented in numerous other studies.[6] To illustrate the timing and relative magnitudes of this breakdown, the

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[5]It is, of course, also possible to control the money stock using the interest rate. In this case, the reduced form for money is $M=(-a-bc)r+bX+Z$. When M is controlled using the interest rate, shifts in money demand (Z) and autonomous expenditures (X) would have larger impacts on M than when the base is used, but shifts in the supply of money function (K) would not have any effect. Hence, the choice of instrument--the base or the interest rate--would depend in part on the relative sizes of the shift parameters in the IS-LM model.

[6]For overviews of the breakdown from the monetarist and nonmonetarist perspectives, see Benjamin Friedman, "Lessons on Monetary Policy in the 1980s," The Journal of Economic Perspectives, Summer 1988, pp. 51-72; and William Poole, "Monetary Policy Lessons of Recent Inflation and Disinflation," The Journal of Economic Perspectives, Summer 1988, pp. 73-100. Some analysts, however, do not agree that a breakdown in the relationship of money and GNP occurred in the 1980s. They find that an alternative definition of M1 that excludes NOW accounts has tracked

(continued...)

second table shows the annual errors in forecasting the growth of M1 velocity (as well as the velocities of M2 and M3) as an average of the previous ten years. This approach allows changes in the trend of velocity to be gradually reflected in the forecast without putting too much weight on any given year. While any such naive approach to forecasting velocity is somewhat arbitrary, it is sufficient to show the relative stability of these velocity trends over time. Indeed, monetary targets appealed to policy makers because the techniques used to project velocity could be simple and could easily be explained to Congress and the public. That is, elaborate econometric models were not required for selecting the monetary targets and making them understood as long as the econometric evidence suggested a low interest rate elasticity and stability in the demand for money function.

From the early 1960s to the mid-1970s, the average error in forecasting M1's velocity was zero, while the root mean squared error (RMSE) was about 2 percentage points. Errors of this size were interpreted as meaning that the monetary authorities should use a range about 3 percentage points wide rather than setting a single numerical target for M1. From the mid-1970s to 1988, however, the average error was -1.5 percentage points and the RMSE more than doubled to 4.4 percentage points.[7]

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[6](...continued)
economic activity fairly well. For more detail, see Michael Darby, Angelo Masarco, and Michael Marlow, "The Empirical Reliability of Monetary Aggregates as Indicators," Economic Inquiry, October 1989, pp. 555-85. For a wide range of views on the behavior of velocity in the 1980s, see Michael Darby, William Poole, David Lindsey, and Milton Friedman, "Recent Behavior of the Velocity of Money," Contemporary Policy Issues, vol. 5, no. 1 (January 1987), pp. 1-33.

[7]Unusual movements in the actual M1 velocity statistics relative to expected velocity occurred in two subperiods of the interval from the mid-1970s to the late 1980s. The first was 1972 to 1978, when velocity (except for one year) was unusually strong, most likely as a result of increased emphasis on cash management as nominal rates rose to extremely high levels. For more detail, see Stephen Goldfeld, "The Case of the Missing Money," Brookings Papers on Economic Activity, 3:1976, pp. 683-739; and Thomas Simpson and Richard Porter, "Some Issues Involving the Definition and Interpretation of the Monetary Aggregates," Controlling Money Stock III, Federal Reserve Bank of Boston, October 1980, pp. 161-233. Other analysts argued that the demand for money had been stable but the function had not been properly specified. See, for example, Michael Hamburger, "Behavior of the Money Stock: Is There a Puzzle?" Journal of Monetary Economics, July 1977, pp. 265-88. The second period of instability was from 1982 to 1986, when velocity declined sharply. This decline probably stemmed from the sharp drop in interest rates at a time when the deregulation of deposit interest rates had made the demand for M1 more interest sensitive, at least in the shorter run. For more detail, see John Wenninger, "Responsiveness of Interest Rate Spreads and Deposit Flows to Changes in Market Rates," Federal Reserve Bank of New York Quarterly Review, Autumn 1986,
(continued...)

In the mid-1980s, the extremely large errors prompted the Federal Reserve to drop its target range for M1.

The velocities of the broad aggregates in the earlier time period were not as predictable as M1's velocity, with RMSEs 1/2 to 1 percentage point greater than for M1. However, the velocities of the broader aggregates did not become as unpredictable as M1's in the later period. For M2, the RMSE increased from 2.5 to 3.3 percentage points, whereas for M3 the velocity forecast errors declined slightly to 2.5 percentage points. This change in the relative predictability of the velocities of M1 and the broader aggregates was a major factor in persuading the Federal Reserve to place greater emphasis on the broad aggregates during the 1980s and to cease setting targets for M1.[8]

Table 3 contains some additional information on velocity growth since 1961. The left side shows maximum and minimum values for velocity growth on an annual basis, while the right side shows the maximum and minimum values on a ten-year moving average basis. Whether calculated on a year-to-year basis or on a ten-year moving average basis, M1's velocity looks the least stable. On a ten-year moving average basis, M3's velocity looks the most stable, while on a year-to-year basis M2's velocity appears the most stable. Again, when looked at in this light, the broad aggregates appear to be better suited for policy purposes than M1. Not only are the RMSEs smaller on average, but they also have narrower ranges of extreme values.

Next, we turn to the stability over time of the relationship between the money supply and the monetary base.[9] Some analysts have raised serious questions about using the base as a policy

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[7](...continued)
pp. 1-10; and Courtney Stone and Daniel Thornton, "Solving the 1980s' Velocity Puzzle: A Progress Report," Federal Reserve Bank of St. Louis Review, August-September 1987, pp. 5-23. Also see references cited in footnote 4.

[8]There was also evidence that the demand functions for the broad aggregates had been more stable than the demand for M1. For more detail, see John Wenninger, "Money Demand--Some Long-Run Properties," Federal Reserve Bank of New York Quarterly Review, Spring 1988, pp. 23-40.

[9]We use the St. Louis adjusted monetary base (adjusted to neutralize the effects of changes in reserve requirements) because it has been used extensively in earlier empirical work and is available for a long time period. For a detailed review of the relationship between M1 and the base focusing on the effects of deregulation, see Michelle R. Garfinkel and Daniel Thornton, "The Link Between M1 and the Monetary Base in the 1980s," Federal Reserve Bank of St. Louis Review, September-October 1989, pp. 35-52.

Table 2
Errors in Predicting Velocity
(Using Simple Velocity Trends)

	GNP/M1	GNP/M2	GNP/M3
1961	1.7	0.6	-0.2
1962	1.0	-1.4	-1.9
1963	-0.4	-0.8	-1.5
1964	-1.6	-0.9	-1.6
1965	2.8	3.2	2.6
1966	1.8	3.9	4.0
1967	-3.9	-2.5	-2.9
1968	-1.0	2.3	2.1
1969	0.1	2.9	6.1
1970	-3.2	-1.2	-3.7
1971	-0.3	-3.7	-4.1
1972	0.7	-0.3	-0.7
1973	3.2	4.5	1.0
1974	-0.5	1.0	-0.8
1975	2.5	-2.0	1.7
1976	0.6	-3.4	-0.8
1977	0.6	0.9	0.4
1978	2.9	6.2	3.3
1979	-2.0	0.6	-0.4
1980	-1.1	0.5	1.4
1981	0.2	-0.5	-2.0
1982	-8.9	-6.4	-5.7
1983	-2.8	-2.1	1.4
1984	0.8	1.1	-0.8
1985	-7.2	-1.9	-0.2
1986	-10.8	-4.0	-2.9
1987	1.8	4.5	4.1
1988	2.7	1.5	1.6
1961 to 1988			
Mean =	-0.7	0.1	0.0
RMSE =	3.5	2.9	2.7
1961 to 1974			
Mean =	0.0	0.5	-0.1
RMSE =	2.1	2.5	3.0
1975 to 1988			
Mean =	-1.5	-0.4	0.1
RMSE =	4.4	3.3	2.5

Table shows errors resulting when each year's velocity growth (fourth quarter to fourth quarter) was predicted as the average growth rate over the previous ten years.

Table 3
Range of Values for Velocity Growth
(1961 to 1988, in Percent)

	Yearly (Fourth Quarter to Fourth Quarter)			Ten-Year Moving Average		
	Minimum	Maximum	Range	Minimum	Maximum	Range
M1	-9.4	6.2	15.4	0.0	3.8	3.8
M2	-5.4	4.3	9.7	-0.9	1.0	1.9
M3	-6.1	5.3	11.4	-0.3	-1.3	1.0

instrument.[10] Over the years, other reserve aggregates such as total reserves, reserves on private deposits (RPDs), nonborrowed reserves, and the nonborrowed base have been studied. In addition, some analysts who accept the notion that it would be desirable to control money have left open the question whether it should be done through a reserve aggregate or through a short-term interest rate. When controlled with an interest rate variable, the money demand function often has been viewed as the reduced form equation for money.[11] Whether some reserve measure or interest rate should be used in practice depends upon the properties of the money demand and supply functions, that is, their interest rate sensitivity and relative stability. The Federal Reserve has at different times used both short-term rates and reserves aggregates in its attempt to control money (Appendix 2 examines this topic in more detail). The empirical work in this paper focuses only on the monetary base because other papers in this volume will deal with alternative reserve measures and interest rates in the policy

[10]Benjamin Friedman, "Conducting Monetary Policy by Controlling Currency Plus Noise," Carnegie-Rochester Conference Series on Public Policy, no. 29 (1988), pp. 205-12. The main problem with the base is that it consists of 75 percent currency and 25 percent reserves, and the Federal Reserve has usually provided an elastic currency. It is not clear that the Federal Reserve could control the entire base as an instrument simply by adjusting the relatively small reserves portion.

[11]James L. Pierce and Thomas D. Thomson, "Some Issues in Controlling the Stock of Money," in Controlling Monetary Aggregates II: The Implementation (Proceedings of a conference sponsored by the Federal Reserve Bank of Boston), September 1972, pp. 115-36. See also Richard G. Davis and Frederick C. Schadrack, "Forecasting the Monetary Aggregates with Reduced Form Equations," Federal Reserve Bank of New York, Monetary Aggregates and Monetary Policy, October 1974, pp. 60-71.

process.

Tables 4 and 5, similar in format to Tables 2 and 3, respectively, assess the predictability of the money multiplier (ratio of a monetary aggregate to the monetary base) using the naive model of a ten-year moving average as the projection of the growth rate of the multiplier for each year. Like velocity, the money multiplier would be a much more useful policy tool if relatively simple techniques could be used to predict its performance, not only in terms of clearly expressing the intent of policy but also in terms of attaining monetary objectives. Not all those who would advocate using the monetary base would agree with such an approach, but some have pointed out the relative ease with which the trend in the multiplier might be predicted.[12]

In Tables 4 and 5, the annual data (fourth quarter to fourth quarter) are used to correspond to the framework typically used for setting the longer run monetary targets (see footnote 12 for references on short-term multiplier forecasts). Table 4 shows that the M1 multiplier was the most predictable over the 1961 to 1974 period, with a RMSE (1.1 percentage points) about half as large as the RMSEs for the M2 and M3 multipliers. However, over the 1974 to 1988 period the RMSE for the M1 multiplier more than doubled and the RMSEs for the multipliers of all three aggregates were in the 2.0 to 2.5 percentage point range in the later period. Hence, it would appear that the links between the monetary base and all three monetary aggregates are currently not very tight.[13]

Table 5 shows the range of values taken on by these multipliers. On a year-to-year basis, the M1 multiplier shows the most extreme values, whereas on a ten-year moving average basis, the

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[12]Some earlier analysts went beyond simple extrapolations of past trends to estimate the money multiplier. In addition to using lagged values of the multiplier, they used interest rates and seasonal dummy variables. But their studies, unlike this paper, were not aimed at establishing the long-run trend relationship between the base and M1. That relationship was taken as established. Rather, they were concerned with forecasting the money multiplier a few months ahead to achieve precise monetary control over the short run. See, for example, Albert E. Burger, "Money Stock Control," in Controlling Monetary Aggregates II: The Implementation (Proceedings of a conference sponsored by the Federal Reserve Bank of Boston), September 1972, pp. 33-55. For a more recent empirical analysis concluding that the money stock is controllable using the base, see James Johannes and Robert Rasche, "Predicting the Money Multiplier," Journal of Monetary Economics, July 1979, pp. 301-25. Our effort here to extrapolate annual trends is more in the spirit of the work of Anton Balbach, "How Controllable is Money Growth?" Federal Reserve Bank of St. Louis Review, April 1981, pp. 3-12.

[13]For a detailed explanation using the money multiplier framework, see Albert E. Burger, "The Puzzling Growth of the Monetary Aggregates in the 1980s," Federal Reserve Bank of St. Louis Review, September-October 1988, pp. 46-60.

Table 4
Errors in Predicting the Money Multiplier
(Using Simple Multiplier Trends)

	M1/Base	M2/Base	M3/Base
1961	-0.1	1.0	1.8
1962	-1.6	0.7	1.3
1963	-1.1	-0.7	0.0
1964	-1.2	-1.9	-1.1
1965	-0.9	-1.5	-1.0
1966	-1.2	-3.5	-3.6
1967	0.5	-0.9	-0.4
1968	0.9	-2.4	-2.3
1969	0.4	-2.5	-5.5
1970	-0.6	-2.7	0.0
1971	-0.2	3.4	3.9
1972	1.0	2.1	2.5
1973	-1.2	-2.6	0.8
1974	-2.8	-4.3	-2.6
1975	-1.3	3.2	-0.7
1976	-0.3	3.9	1.2
1977	0.8	0.5	1.0
1978	0.0	-3.3	-0.6
1979	0.7	-1.9	-0.9
1980	0.3	-1.4	-2.3
1981	2.0	2.7	4.5
1982	1.5	-0.9	-1.5
1983	1.7	1.0	-2.5
1984	-1.1	-1.4	0.5
1985	4.5	-1.0	-2.8
1986	6.6	-0.8	-1.8
1987	0.1	-2.4	-2.1
1988	-3.2	-2.0	-2.1
1961 to 1988			
Mean =	0.2	-0.7	-0.6
RMSE =	2.0	2.2	2.2
1961 to 1974			
Mean =	-0.6	-1.1	-0.4
RMSE =	1.1	2.2	2.5
1974 to 1988			
Mean =	0.6	-0.5	-0.8
RMSE =	2.5	2.4	2.0

Table shows errors resulting when each year's multiplier growth (fourth quarter to fourth quarter) was predicted as the average growth rate over the previous ten years.

Table 5
Range of Values for Multiplier Growth
(1961 to 1988)

	Yearly (Fourth Quarter to Fourth Quarter)			Ten-Year Moving Average		
	Minimum	Maximum	Range	Minimum	Maximum	Range
M1	-3.5	6.6	10.1	-1.3	0.8	2.1
M2	-2.5	5.5	8.0	0.7	4.2	3.5
M3	-2.2	7.5	9.9	1.8	4.4	2.6

broader aggregates show more extreme values. If the objective is to identify the aggregate most susceptible to control, the predictability of the relationships between the base and the three definitions of money would not suggest a clear-cut decision for narrow or broad aggregates.

In general, based on the large size of RMSEs and the extreme values taken on at times for both velocity and multiplier growth, it would appear that considerable slippage can be expected in both the links between the amount of high-powered money supplied by the Federal Reserve and the ultimate objective variable, GNP. In terms of change since the 1960s and early 1970s, the data clearly suggest that the M1 relationships have undergone the greatest deterioration.

IV. An Econometric Evaluation

Much of the early impetus for monetary targeting using the monetary base as the instrument came from reduced form equations relating (1) GNP growth to current and lagged values of M1 growth, and (2) M1 growth to current and lagged values of monetary base growth.[14] This section assesses the stability of these econometric relationships by estimating these two relationships for successive ten-year periods, dropping and adding one quarter's observation in each successive

[14]For some early analysis of these relationships, see Leonall Andersen and Jerry L. Jordan, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," Federal Reserve Bank of St. Louis Review, November 1968, pp. 11-24; and Karl Brunner, "The Role of Money and Monetary Policy," Federal Reserve Bank of St. Louis Review, September-October 1989, pp. 4-22 (reprinted from the July 1968 Review).

regression. The sum of the coefficients and the intercept term were recorded for each time period and plotted over time so that it would be possible to see whether these coefficients have tended to be stable. Stable coefficients, of course, would suggest that these reduced form equations would be useful guides for policy, whereas coefficients varying over wide ranges would suggest that these equations would be of only limited use for policy purposes. In addition, the equations were estimated over the entire time period and the residuals were plotted to examine whether the results would suggest the same deterioration in stability of the M1 relationships since the 1970s as the tables in the first section had indicated.

Table 6 contains the estimated equations for the money supply-GNP relationships and for the base-money supply relationships over the entire 1952 to 1988 period. In all cases, significant relationships emerge between money growth and GNP growth and between base growth and money growth. The relationships between base growth and money growth appear to be tighter than the relationships between GNP growth and money growth. In particular, the coefficient on M1 growth in the GNP relationship, while significantly different from zero, is also significantly below one. A value of one is generally the value expected, that is, a 1 percentage point increase in money growth should lead to a 1 percentage point increase in nominal spending if velocity growth is constant. The lower value no doubt reflects the sharp decline in velocity during the 1980s.[15] For the relationship between base growth and M1 growth, however, a coefficient not significantly different from one is obtained, suggesting that M1 and base growth have about equal trends in the long run. This result does not appear to hold for M2 and M3, however.

To explore how stable the coefficients have been over time, the six equations in Table 6 were run for successive ten-year periods, with one quarter added and one quarter dropped each time. The constant terms and sum of coefficients on current and lagged values were recorded for each regression and plotted in Charts 1 and 2 for the money-GNP relationships and in Charts 3 and 4 for the base-money relationships.

The results in Charts 1 and 2 suggest considerable variation in the coefficients in the

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[15]In these regressions, the constant term can be interpreted as the average growth rate of velocity during the sample period, while the coefficient can be interpreted as the increase in GNP growth per percentage point increase in M1 growth. In the regressions for M1 and the monetary base, the constant term can be interpreted as the average growth rate in the money multiplier, while the coefficient represents the increase in M1 growth per percentage point increase in the base.

Table 6

Long-Run Relationships
Money and GNP
Base and Money
(1952-I to 1988-IV)

Growth of GNP as a Function of Current and Lagged Money Growth

	Constant Term	Sum of Coefficients	$\bar{R}^2$	Standard Error
M1	4.7 (6.4)	0.57 (4.7)	0.14	4.5
M2	0.4 (1.2)	0.95 (6.2)	0.20	4.3
M3	1.1 (0.9)	0.80 (5.9)	0.19	4.4

Money Growth as a Function of Current and Lagged Base Growth

	Constant Term	Sum of Coefficients	$\bar{R}^2$	Standard Error
M1	0.19 (0.3)	0.92 (10.4)	0.50	2.9
M2	4.8 (10.1)	0.51 (6.4)	0.31	2.6
M3	4.7 (10.5)	0.65 (8.7)	0.42	2.4

regressions for money and GNP over time. In particular, the substantial change in the M2 and M3 constant terms from the 1960s to the 1970s and the large increase in the M1 constant term in the 1980s suggest underlying instability at times (Chart 1). There were gradual declines in all coefficients on money growth (M1, M2, and M3) from the early 1960s to the early 1970s. During the 1970s, the coefficient on M1 remained close to one, then it declined to zero in the 1980s. The M2 coefficient has remained at around 0.5 since the early 1970s, while the M3 coefficient has moved close to zero in the late 1980s (Chart 2). In general, for the money-income relationships, the total period results in Table 6 tend to mask considerably variation in the coefficients in subperiods.[16]

Next we turn to the subperiod coefficients in the base-money relationships shown in Charts 3 and 4. The constant term for the M1 equation has remained near zero for the most part, and the sum of the coefficients on base growth, except for a few brief periods, has remained fairly close to one. The most striking feature of the two charts is the extreme fluctuation in the M2 and M3 constant terms and coefficients in the late 1970s and early 1980s. Indeed, the M2 and M3 regressions suggest that there has not been a significant relationship between base growth and M2 or M3 growth since the late 1970s. Earlier studies, using reduced form equations of this type, also concluded that the relationship between M1 and the base was superior to the relationships incorporating M2 and M3.[17]

The next step in the evaluation of the monetary aggregates as intermediate variables was to plot the in-sample errors for the reduced form equations estimated over the entire period (Charts 5 and 6). Chart 5 contains the errors (on a four-quarter moving average basis) in estimating GNP growth with money growth. The results from the chart suggest rather large errors in the late 1950s and early 1960s and a high degree of correlation during that period in the errors from the M1, M2, and M3 equations. From the mid-1960s to the mid-1970s, the errors tend to diminish somewhat and to become less

[16]There has been some investigation of the reasons for the instability in the M1-GNP reduced form relationship. Explanations advanced include the introduction of nationwide NOW accounts and the large international capital flows that occurred in the 1980s. For more detail, see John Wenninger, "The M1-GNP Relationship: A Component Approach," Federal Reserve Bank of New York Quarterly Review, Autumn 1984, pp. 6-15; and John Wenninger and Thomas Klitgaard, "Exploring the Effects of Capital Movements on M1 and the Economy," Federal Reserve Bank of New York Quarterly Review, Summer 1987, pp. 21-31.

[17]R.W. Hafer, "Much Ado About M2," Federal Reserve Bank of St. Louis Review, October 1981, pp. 13-18; John Tatom, "Money Stock Control Under Alternative Definitions of Money," Federal Reserve Bank of St. Louis Review, November 1979, pp. 3-9.

Chart 1

Constant Terms for Money–GNP Reduced Form Equations
Estimated over Successive Ten–Year Periods from 1961 to 1988

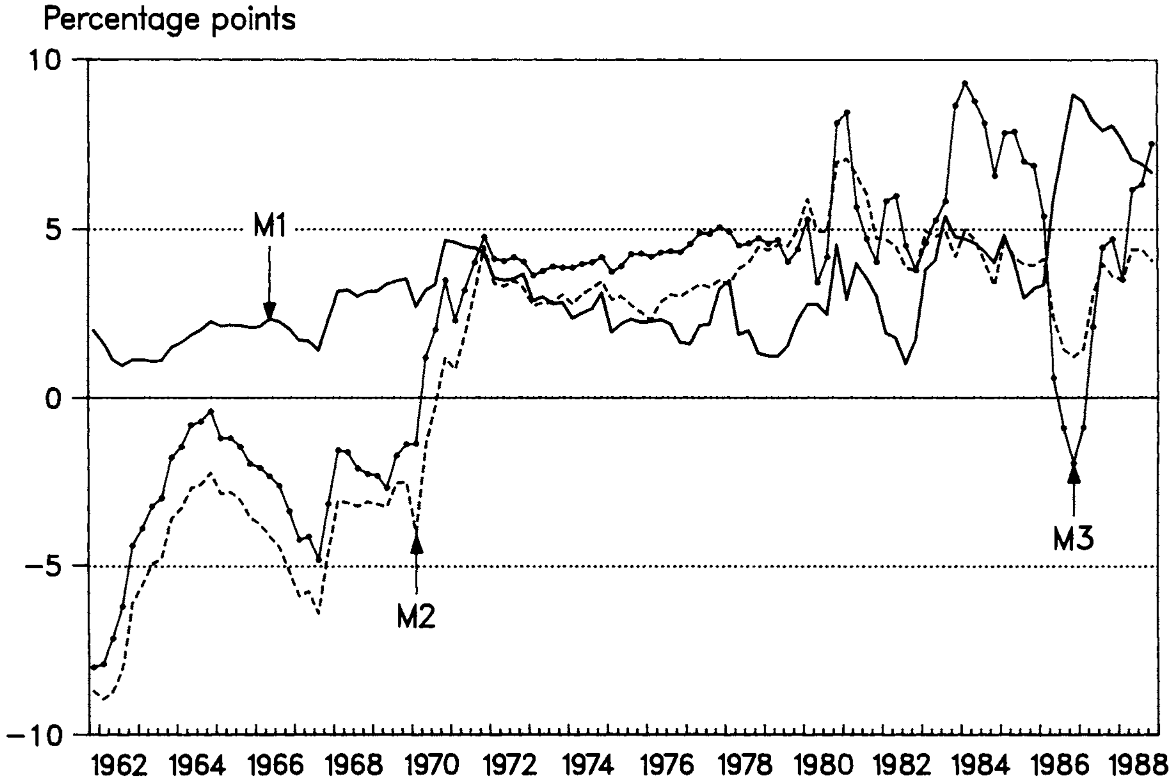
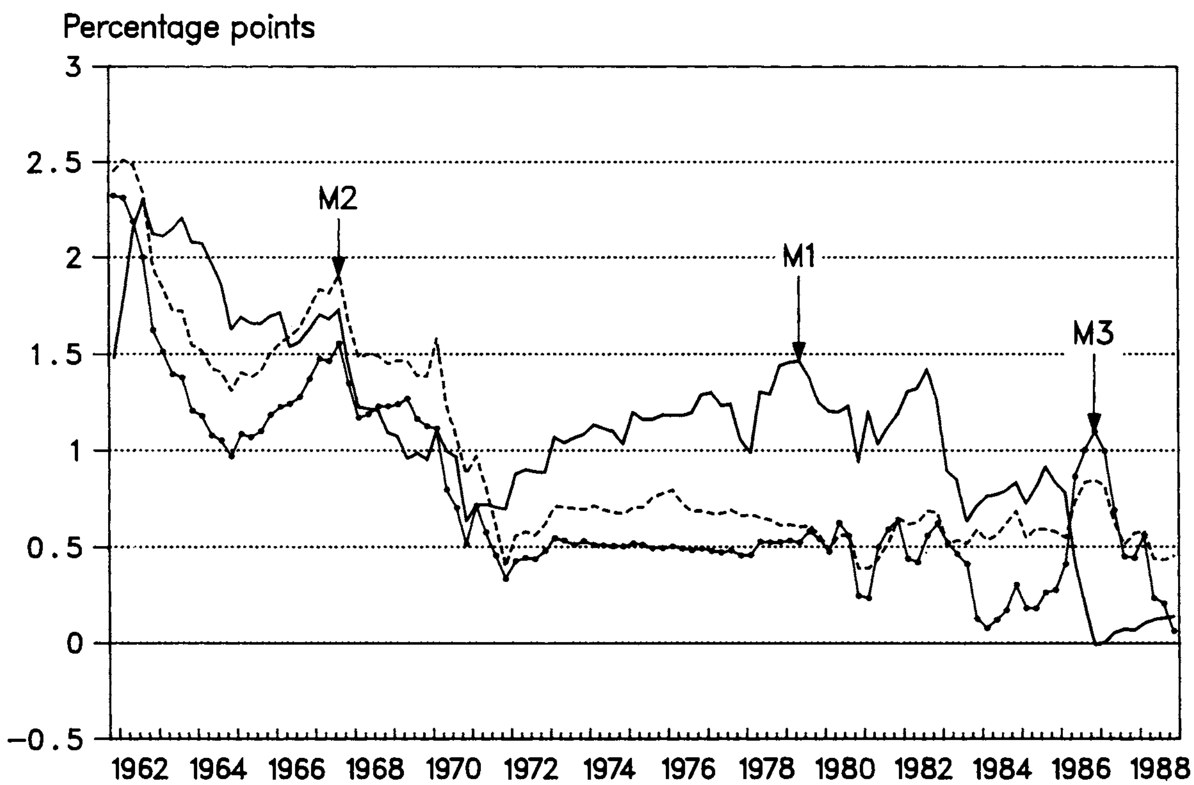


Chart 2

Sum of Coefficients for Money–GNP Reduced Form Equations
Estimated over Successive Ten–Year Periods from 1961 to 1988



Note: Current and lagged four quarters.

Chart 3

Constant Terms for Monetary Base—Money Equations
Estimated over Successive Ten-Year Periods from 1961 to 1988

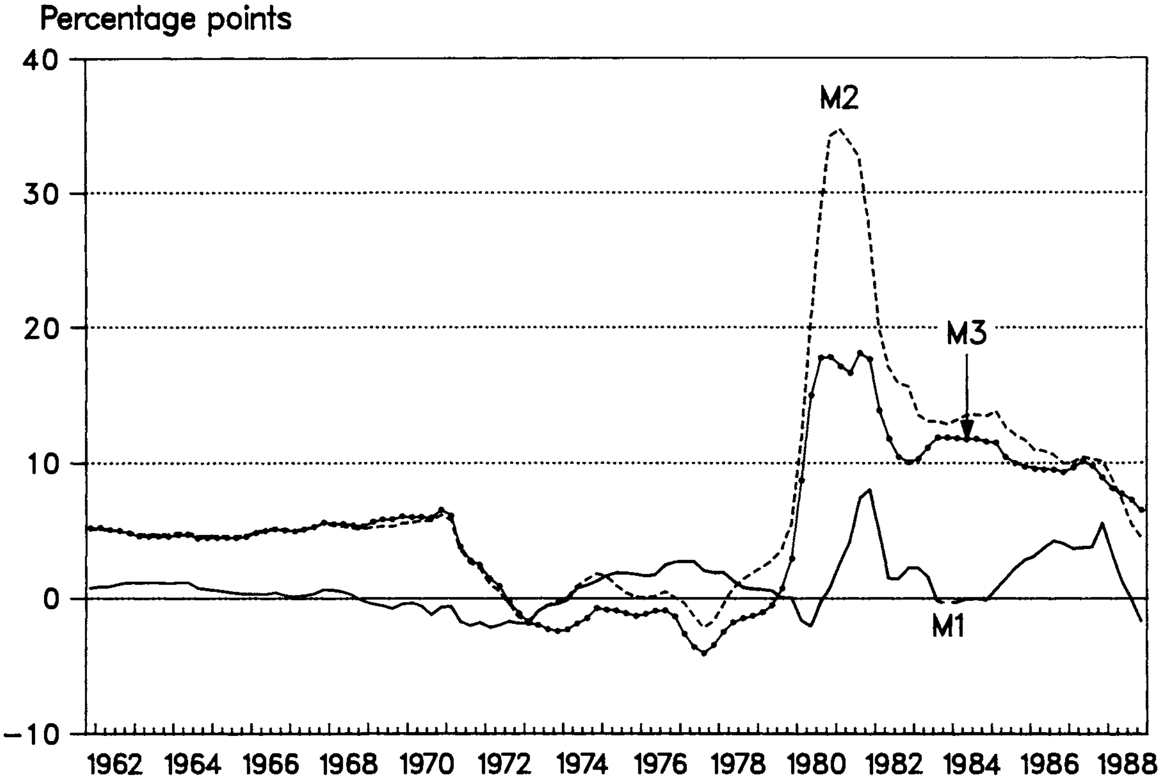
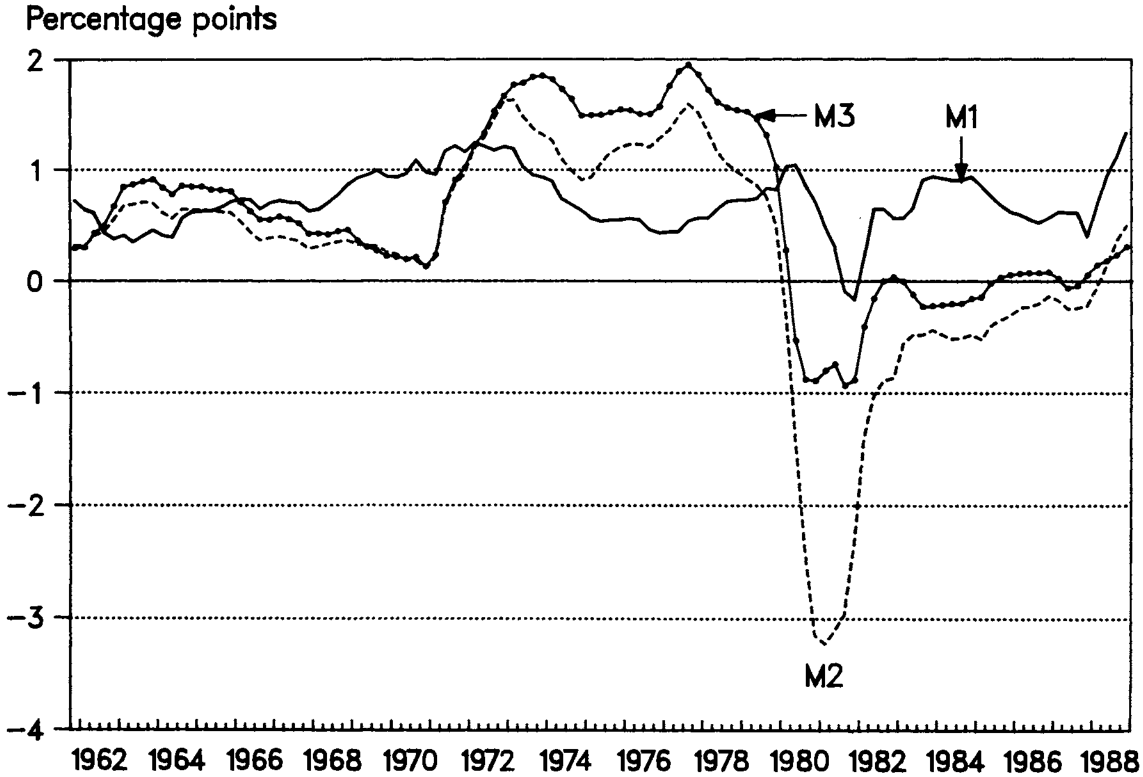


Chart 4

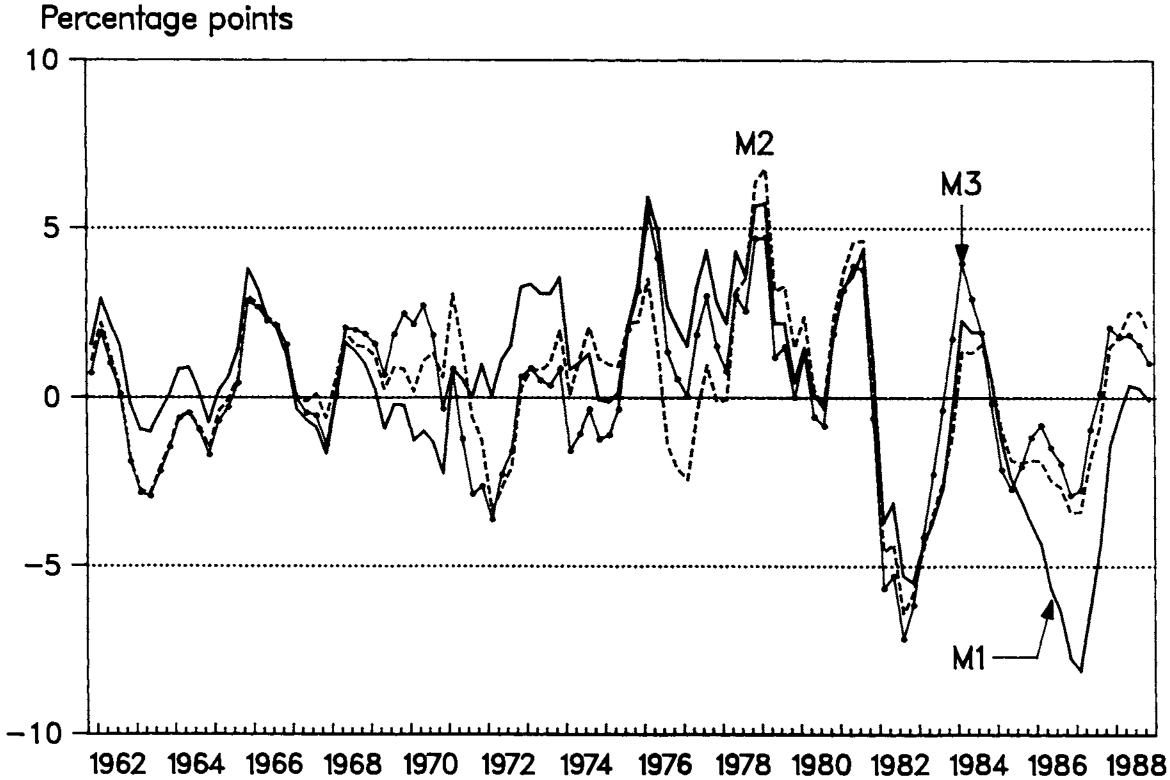
Sum of Coefficients for Monetary Base—Money Equations
Estimated over Successive Ten-Year Periods from 1961 to 1988



Note: Current and lagged four quarters.

Chart 5

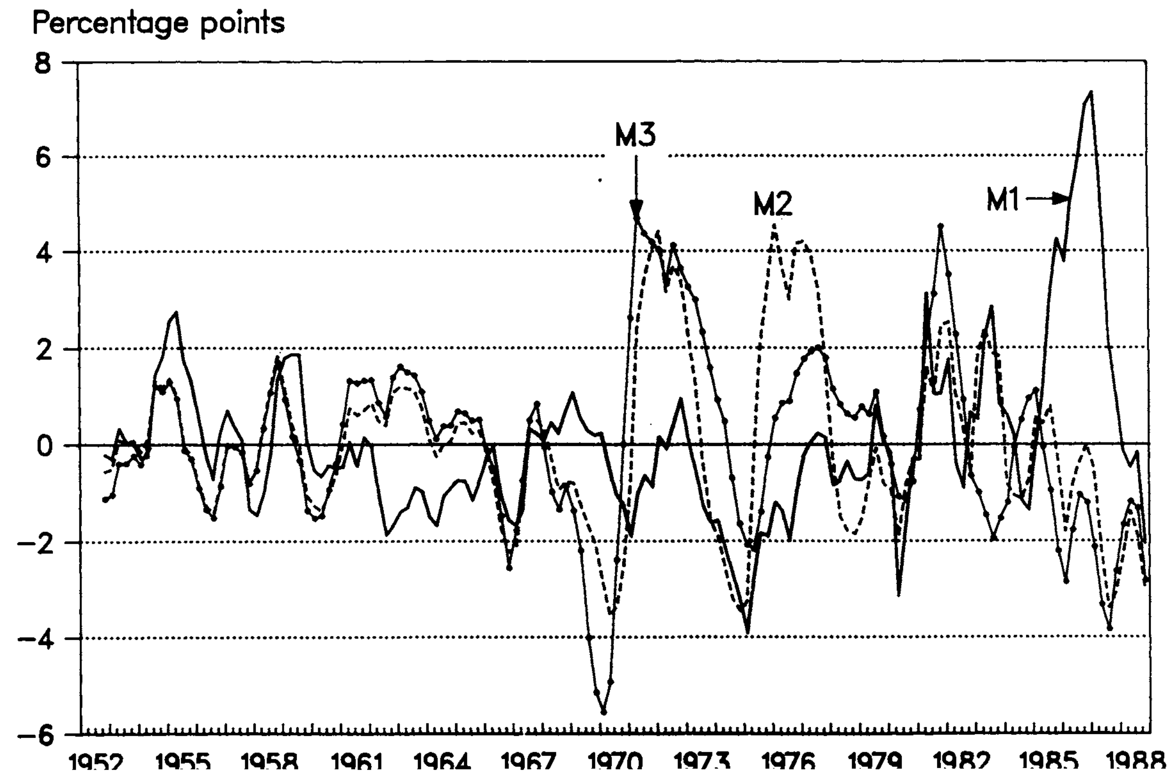
Money–GNP Relationships
Four–Quarter Moving Average of In–Sample Errors*



* Equation estimated 1952 to 1988

Chart 6

Monetary Base–Money Relationships
Four–Quarter Moving Average of In–Sample Errors*



correlated across equations. From the late 1970s to the late 1980s, the errors become quite large again, especially for M1. All three equations show large negative errors in 1982, and the M1 equation shows another large negative error in 1986. Overall, the 1980s have been dominated by negative errors on average, while from the mid-1970s to the late 1970s the errors tended to be positive. These results are generally consistent with those shown in Table 2.

Chart 6 contains the comparable errors for the reduced form equations relating the growth of M1, M2, or M3 to current and lagged values of base growth. Until the late 1960s, the errors tended to be rather small. Since that time, however, the errors have been quite large--especially for M2 and M3 in the 1970s and for M1 in 1985 and 1986. By and large, these results confirm the results shown earlier in Table 4 that indicated some slippage in recent years in the relationships between the monetary base and the monetary aggregates.

V. Recent Problems with Money as an Intermediate Target

The Federal Reserve's difficulties with the monetary aggregates, particularly M1, since the mid-1970s illustrate in general the problems of using intermediate targets when the financial structure is rapidly changing as a result of innovation and deregulation. These difficulties have been well documented in other studies and will be only briefly discussed here.[18]

In the mid-1970s, when the Federal Reserve was beginning to set money targets, M1 growth became considerably weaker than would have been expected from most econometric relationships. Considerable research was undertaken to explain this unusually weak growth in M1. By and large, it was concluded that the high interest rate levels of the early 1970s had spurred increased emphasis on cash management by the corporate sector.[19]

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[18]For detailed discussions of this subject, see Stephen Axilrod, "Monetary Policy, Money Supply and the Federal Reserve's Operating Procedures," Federal Reserve Bulletin, January 1982, pp. 13-24; Stephen Axilrod, "U.S. Monetary Policy in Recent Years: An Overview," Federal Reserve Bulletin, January 1985, pp. 14-24; and Donald Kohn, "Monetary Policy in an Era of Change," Federal Reserve Bulletin, February 1989, pp. 53-7.

[19]For a detailed discussion of this downward shift in money demand and possible explanations, see Thomas Simpson and Richard Porter, "Some Issues Involving the Definition and Interpretation of the Monetary Aggregates," Controlling Monetary Aggregates III (Proceedings of a conference sponsored by the Federal Reserve Bank of Boston), October 1980, pp. 161-234; and Richard Porter, Thomas Simpson, and Eileen Mauskopf, "Financial Innovation and the Monetary Aggregates," Brookings Papers on Economic Activity, 1:1979, pp. 213-29.

By the late 1970s, it appeared that the next source of distortion for the money supply was likely to come from the consumer sector. Some individual states were allowing interest-earning checking accounts (NOW accounts), and it appeared that NOW accounts eventually would be offered nationwide. Since consumers would most likely combine savings and transactions balances in their NOW accounts because NOW accounts paid the same rate as savings accounts, it was not clear whether these accounts should be part of M1 or M2. This uncertainty raised the general question whether the monetary aggregates needed to be redefined in light of past and pending changes in the banking system.[20]

Ultimately, NOW accounts were defined as part of M1. However, during the period when consumers were shifting funds into their NOW accounts from sources other than demand deposits (1981 and early 1982), the Federal Reserve used a "shifted adjusted" version of M1 that assumed that something on the order of 25 percent of the balances in NOW accounts were transferred from savings balances, and hence tended to overstate the growth of narrowly defined money.

In 1983, so-called Super NOWs--accounts not subject to the 5.25 percent ceiling rate affecting conventional NOW accounts--were authorized. And by 1986, all NOW accounts were completely deregulated. Many observers at first argued that the demand for M1 would become less interest-sensitive with deregulated NOW accounts. They reasoned that the rate on M1 balances would tend to move with market rates, thereby providing no varying incentives to economize on cash balances. As it turned out, however, banks were very slow in adjusting the rates on NOW accounts when market rates changed, and as a result the demand for M1 retained a significant interest elasticity. Nonetheless, considerable uncertainty about the interest responsiveness of the demand for M1 made it necessary for the Federal Reserve to exercise flexibility and judgment in using M1 as an intermediate target. In addition, the combining of savings and transactions balances in M1 also raised questions about the stability of the income elasticity in the demand for M1 function.[21] Thus, M1 appeared to be an unsatisfactory intermediate target for both reasons cited in the theoretical discussion in Section I. The demand for M1 seemed likely to be unstable and unpredictable because it depended on the pricing policies of the banks that set the rates for M1 deposits and because the continued high interest rate

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[20]For more detail, see Thomas Simpson, "The Redefined Monetary Aggregates," Federal Reserve Bulletin, February 1980, pp. 97-114.

[21]For more detail, see John Wenninger, "Financial Innovation, A Complex Problem Even in a Simple Framework," Federal Reserve Bank of New York Quarterly Review, Summer 1984, pp. 1-8.

elasticity made it difficult to determine an appropriate target value in the face of possible shifts in aggregate demand.

Overall, the increased emphasis on cash management by the corporate sector and the additional savings balances held in M1 by the consumer sector have greatly altered the sectoral composition of M1. In the early 1970s, about 33 percent of transactions balances were held by the consumer sector, and 50 percent by the corporate sector. Now the reverse is true (see Chart 7). With such dramatic shifts in the sectoral composition of M1 holdings, it is not surprising that M1's relationship to economic activity has not been stable.

For M2 and M3, the shifting of funds from time deposits and savings accounts into and out of NOW accounts as rate spreads changed did not create as much of a problem because the shifts, for the most part, were internalized. Only in 1983 did the Federal Reserve need to make some adjustments to its M2 target to allow for possibly large inflows from outside M2 into the newly created money market deposit accounts (MMDAs).

Even though the flows among accounts were internalized, the interest elasticities of the broad aggregates seemed likely to decline as more and more deposits became deregulated.[22] Again, some analysts expected that this elasticity would eventually approach zero. As it turned out, however, the demand for M2 retained a significant elasticity over the short and intermediate terms (see Chart 8) because banks only partially adjusted the rates on NOW accounts, savings accounts, and MMDAs to increases in market rates.[23] Apparently, banks preferred to see a fraction of these deposits flow out as market rates increased rather than pay higher rates on the entire stock of these liquid instruments. They seemed to believe it would be less costly in the short run to replace the outflow of consumer

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[22] For a detailed discussion of the phaseout of Regulation Q, see R. Alton Gilbert, "Requiem for Regulation Q: What It Did and Why It Passed Away," Federal Reserve Bank of St. Louis Review, February 1986, pp. 22-37.

[23]The opportunity cost in Chart 9 is the three-month bill rate less the weighted average of interest rates (by dollar volume in each component of M2) on the various components of M2. In estimating how sensitive M2 is to changes in interest rates, one should keep in mind that a 1 percentage point increase in the bill rate will not necessarily result in a 1 percentage point increase in this spread. How much the spread increases depends on how bankers adjust the interest rates on the various components of M2 in response to the increase in market rates and what shares of M2 these various components happen to represent when the Treasury bill rate increases.

Chart 7

Changing Composition of Checkable Deposits

As Percent of Total

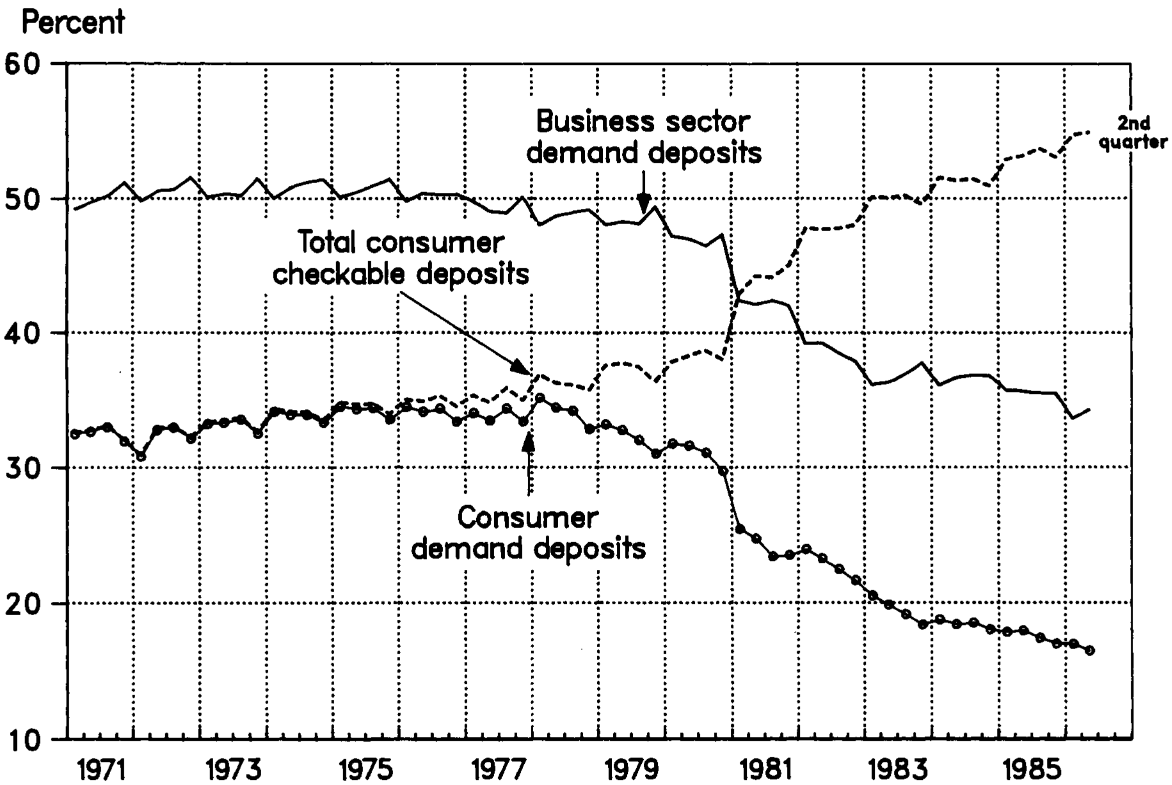
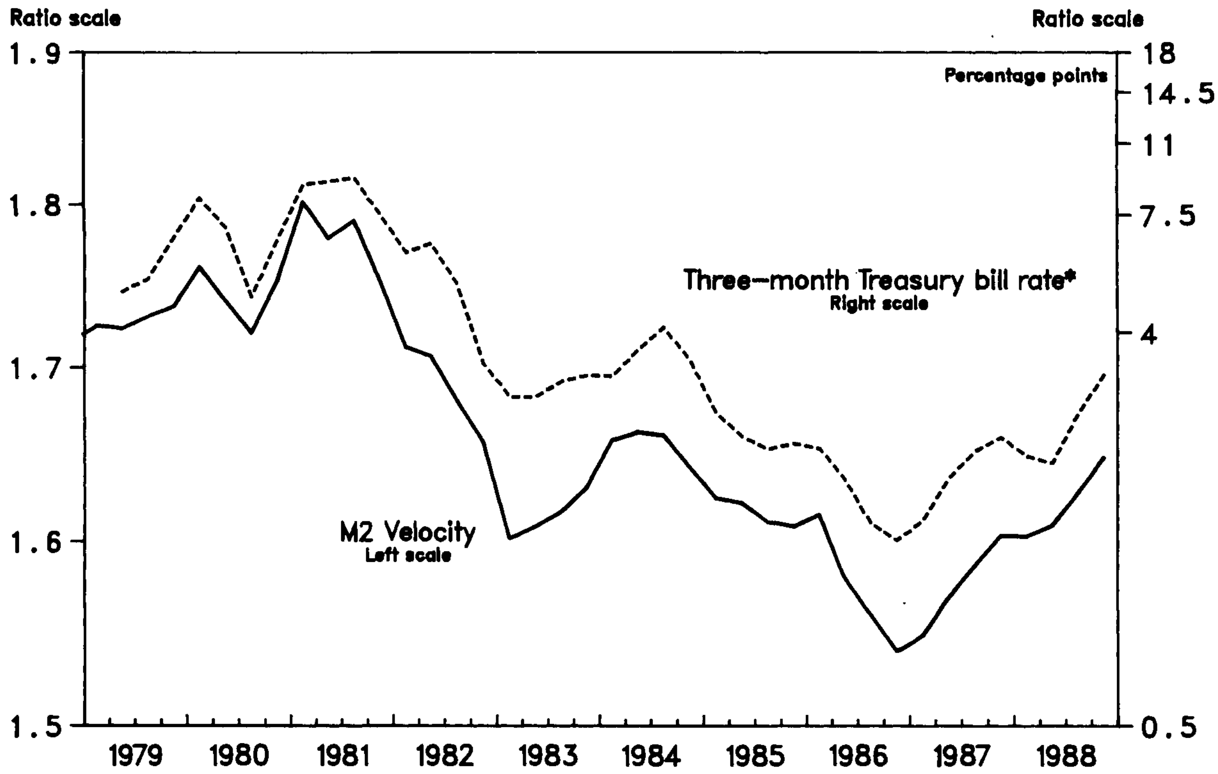


Chart 8

M2 Velocity and Average M2 Opportunity Cost



* Two-quarter moving average.

deposits with wholesale managed liabilities such as large CDs.[24] In any case, the uncertainty about how responsive M2 and M3 would be to changes in market rates limited the usefulness of the broad monetary aggregates for policy purposes during much of the 1980s.

Overall, for both the narrow and broad aggregates, it appears that much of the instability during the 1980s resulted from the fact that in a deregulated banking system, bank pricing policies can affect the monetary aggregates. If banks quickly change deposit rates on all deposit categories to match movements in market rates, the monetary aggregates should not be affected by the movements in market rates. If the banks fully respond on some deposit categories but not others, however, there can be deposit flows that affect both M1 and M2. And if banks tend to behave differently when rates are falling than when rates are rising, it could be very difficult to estimate the interest responsiveness of the monetary aggregates. This last outcome seems to have characterized much of the 1980s.

With Chart 9, the effects of banks' pricing policies on M1 can be illustrated. As rates fell in 1984, 1985, and 1986, banks moved the time deposit rate in step with market rates but only changed the NOW account rate very slowly. As a result, the spreads between the market rate and the NOW account rate and between the time deposit rate and the NOW account rate narrowed significantly. Consumers responded to the narrower spreads by increasing more rapidly their holdings of liquid NOW accounts and reducing the rate at which they increased their holdings of time deposits. As a result, M1 grew very rapidly.

In contrast, from early 1987 to early 1989, market rates and the rate paid on time deposits generally increased, while the NOW account rate remained virtually unchanged. Wider spreads between market rates and the NOW account rate and between the time deposit rate and the NOW account rate opened up. In response, consumers rapidly increased their holdings of time deposits and sharply reduced the rate at which their NOW account balances increased. As would be expected, M1 growth declined sharply.

Hence, in a deregulated system the pricing decisions of commercial banks can have a strong influence on monetary growth as consumers respond to changing interest rate spreads. And since

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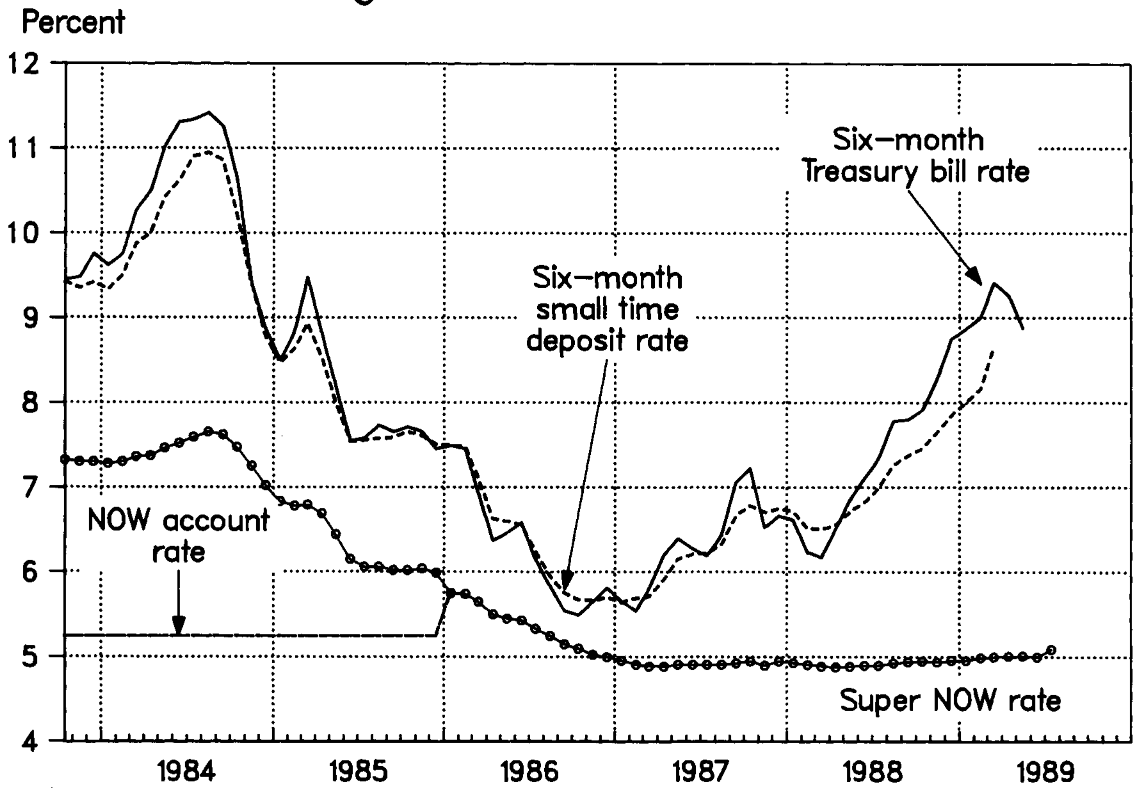
[24]For more detail, see Richard Davis, Leon Korobow, and John Wenninger, "Bankers on Pricing Consumer Deposits," Federal Reserve Bank of New York Quarterly Review, Winter 1986, pp. 6-13; reprinted in the American Banker, September 28, 1987. In the long run, the interest elasticity of the demand for M2 could be close to zero if banks even very gradually adjust deposit rates to match changes in market rates.

Chart 9A

Bank Offering Rates and Market Interest Rates



Note: As of January 1986, Super NOW rate reflects all NOW accounts.

Chart 9B

M1 Growth
Change from Twelve Months Earlier

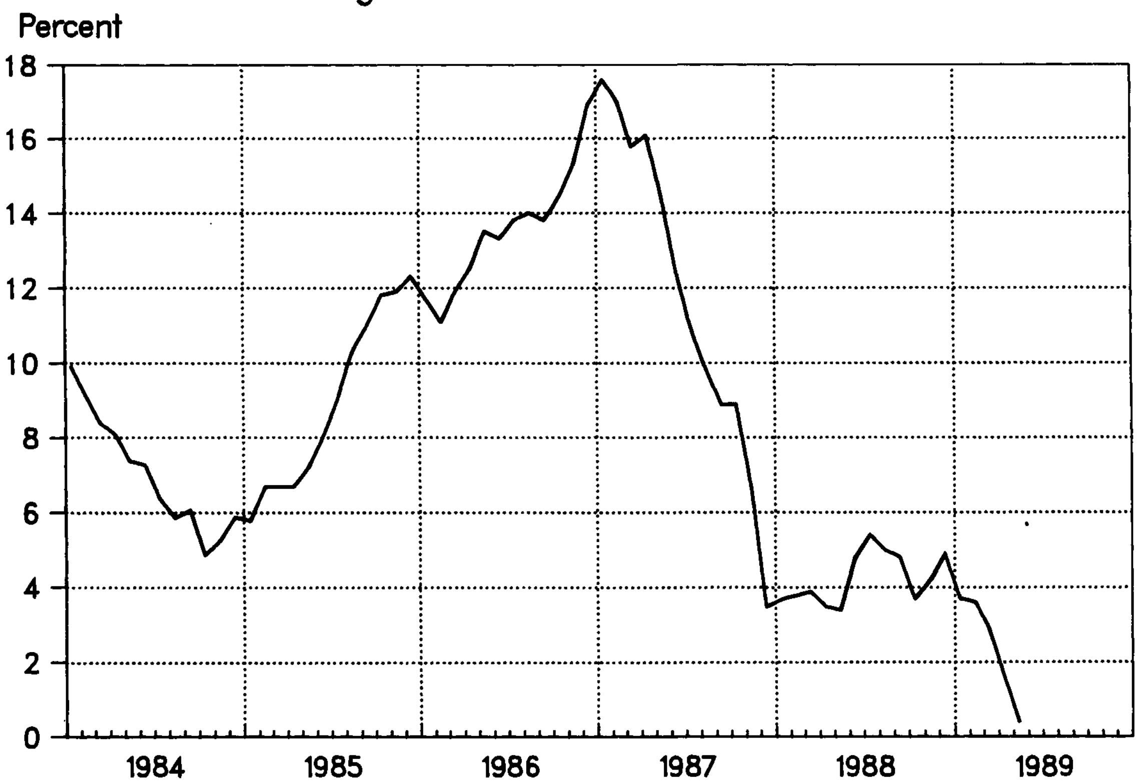


Chart 9C

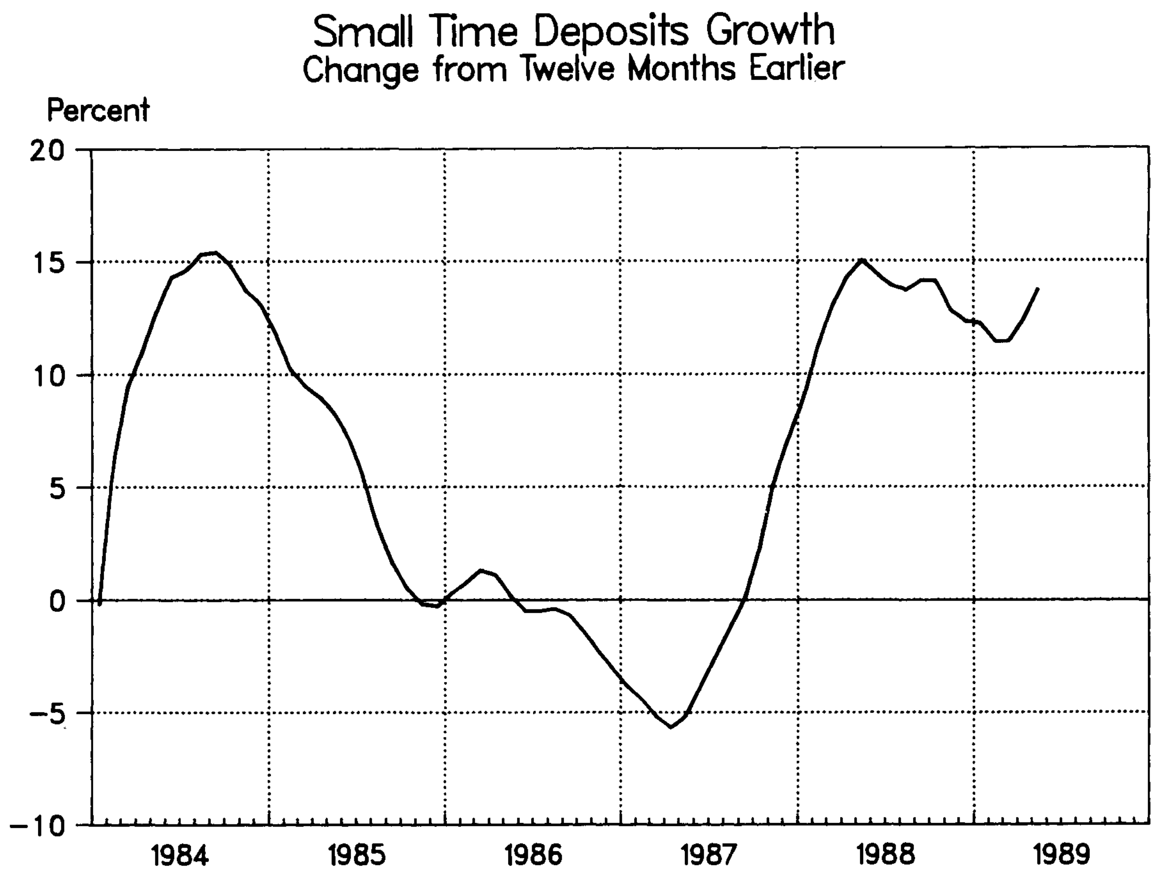
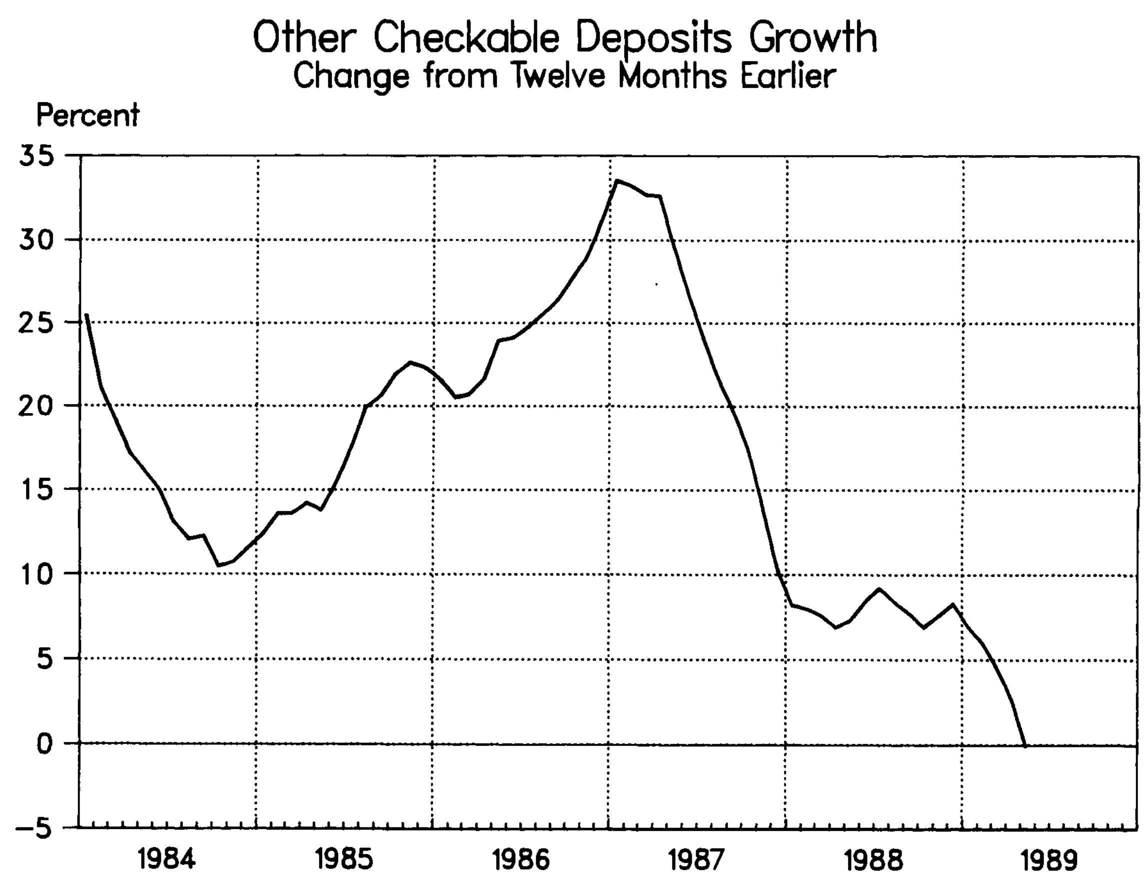


Chart 9D



banks have left the NOW account rate virtually unchanged during the more recent period of rising rates, while they reduced it somewhat in the earlier period when rates were falling, it could turn out that the interest rate elasticity of M1 demand will vary with the rise or fall of market rates.

In sum, it appears that the recent deregulation and innovation in the financial system have reduced the usefulness of monetary aggregates as intermediate targets for policy. M1, in particular, has suffered from these changes. Nevertheless, it still appears that the broader aggregates can be used to some extent as guides for policy.[25]

Appendix 1: Money and Inflation

Although most of the empirical work has addressed the relationship between M1 and nominal income, a few studies have focused on the relationship between M1 growth and inflation.[26] Generally, these studies have found rather long lags from M1 growth to prices, with a mean lag of about 2 1/2 years in the earliest studies and 1 1/2 years in the later studies that include price control dummies and energy price shocks in the reduced form equations.

As the first chart in this appendix shows, the relationship between M1 growth and inflation has completely broken down during the 1980s (Chart 10). On the basis of past relationships, inflation should have averaged around 10 percent during the 1980s, about 5 percentage points higher than the actual outcome thus far. Food and energy and other price shocks cannot account for the large errors, and the breakdown may be due to several factors, including international price competition.[27]

Recent work at the Board of Governors of the Federal Reserve System suggests that in forecasting inflation, analysts should use M2 growth rather than M1 growth (because of M2's more

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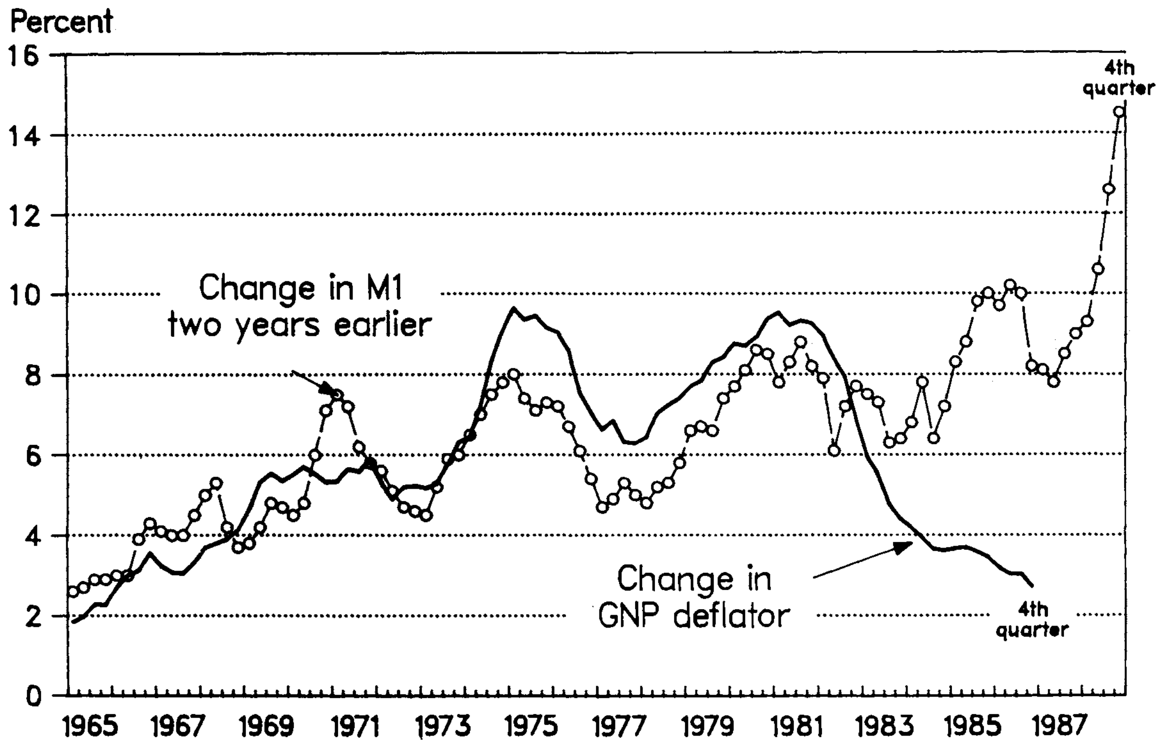
[25]Other analysts have reached similar conclusions. For example, see W. Michael Cox and Harvey Rosenblum, "Money and Inflation in a Deregulated Financial Environment: An Overview," Federal Reserve Bank of Dallas Economic Review, May 1989, pp. 1-19.

[26]See, for example, Keith Carlson, "The Lag from Money to Prices," Federal Reserve Bank of St. Louis Review, October 1980, pp. 3-10; and Denis Karnosky, "The Link Between Money and Prices," Federal Reserve Bank of St. Louis Review, June 1976, pp. 17-23.

[27]For more detail, see John Wenninger and Thomas Klitgaard, "Exploring the Effects of Capital Movements in M1 and the Economy," Federal Reserve Bank of New York Quarterly Review, Summer 1987, pp. 21-31.

Chart 10

Money and Price Changes in the Long Run
Change at Annual Rates, Measured from Eight Quarters Earlier



stable velocity) and also allow for the amount of unused capacity in the economy.[28] In other words, if unused capacity was high, a given growth rate of money would have different implications for inflation than if resources were fully employed.

Since this approach to using money as an intermediate variable is rather recent, the remainder of Appendix 1 contains a brief discussion of the theory behind the approach. The Board staff begins with the basic equation of exchange:

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[28]Jeffrey Hallman, Richard Porter, and David Small, M2 Per Unit of Potential GNP as a Price Level Anchor, Board of Governors of the Federal Reserve System, Staff Studies, forthcoming.

$$(1)\quad P = \frac{M*V}{Y},$$

where P = the price level
M = M2
V = M2 velocity
Y = real GNP.

They then use equation 1 to calculate a measure of potential inflationary pressures (PN) by setting V equal to its long-run average (AV), and real GNP equal to its potential level (Y_p).

$$(2)\quad PN = \frac{M*AV}{Y_p}.$$

The ratio of (or the difference between) PN (equation 2) and P (equation 1) is then used as a measure of inflationary pressures. When PN exceeds P, for example, inflation can be expected to accelerate. If we divide equation 2 by equation 1 to solve for this measure of inflationary pressure (PN/P), we can isolate the factors that cause PN to deviate from P.

$$(3)\qquad \frac{PN}{P} = \frac{M*AV}{Y_p} * \frac{Y}{M*V} = \frac{Y}{Y_p} * \frac{AV}{V}.$$

Equation 3 shows that M drops out of this measure of inflationary pressure. Hence, two factors remain that could contribute to PN's rising above P and therefore to a forecast of greater inflation. One would be an increase in Y relative to Y_p; the other would be a reduction in V relative to AV. In addition, a combination of these two factors could result in a forecast of higher inflation. If velocity was stable (AV/V = 1), of course, then forecasts of inflation would depend only on where actual real GNP stood relative to potential GNP, and this approach would not be conceptually different from other approaches that look at the amount of slack in the economy as an indicator of future inflation trends. Hence, weighting the Y/Y_p ratio by the AV/V ratio is the feature of the Board staff's approach that differentiates it from more conventional approaches.

How should this measure of inflationary pressure be interpreted when V is not equal to AV? For a given ratio of Y to Y_p, if the Federal Reserve was easing policy by increasing the money supply relative to the average need for money as GNP grew, then V would be falling relative to AV and the ratio of AV to V would be increasing. Hence, the given ratio of Y to Y_p would be associated with more than normal potential inflationary pressures because the money supply had been increased. Alternatively, if the Federal Reserve was reducing the money supply relative to the average need for money as GNP grew, the ratio of AV to V would be falling because V would be increasing. This would indicate less inflation for the given Y to Y_p ratio. Hence, at a theoretical level a case could be made for also looking at the ratio of AV to V in predicting the inflation that is likely to be associated with a given potential GNP gap.

However, if V shifts for reasons not associated with policy, then using this ratio could be misleading. This would have been particularly true during the 1980s, when a sharp fall in inflation and inflationary expectations caused interest rates to fall sharply and M2's velocity to decline. It would seem that under those circumstances the ratio of AV to V would not add anything to our ability to track inflation because it would be increasing in response to a decline in inflation, not to a change in policy per se.

It is also possible to look at this indicator from a slightly different perspective. If PY/M is substituted for V on the right side of equation 3, the following relationship results:

$$(4) \qquad \frac{PN}{P} = \frac{AV^*M}{Y_p^*P}.$$

Equation 4 suggests that this inflation index is a nominal approach to using the potential GNP gap to forecast inflation, with a monetarist twist. AV*M in the numerator is the basic monetarist approach to forecasting nominal GNP (or nominal demand) as the product of average long-run velocity and M2. Y_p*P in the denominator represents potential real GNP converted into nominal terms by using the current price level. Hence, equation 4 suggests that when nominal GNP, calculated by AV*M, exceeds nominal potential GNP as calculated by Y_p*P, prices will increase over time to make up the difference because PN exceeds P. This approach is not greatly different from conventional monetarist equations that simply relate P to M. The only difference is that for P to increase, M must increase by enough so that AV*M exceeds the critical value of Y_p*P. In other words, nominal demand generated by the increase in M2 must exceed potential output of the economy evaluated in nominal terms by using the current price level. If the economy was coming out of a recession, such that AV*M was considerably less than Y_p*P, P would not be expected to rise, even though nominal demand might be increasing. This result occurs because nominal demand would still be below "nominal capacity." Hence, the inflationary consequence of an increase in M depends on where the current level of economic activity stands relative to its long-run potential.

Chart 11 shows the recent track record of this inflation indicator. By and large, it appears that this indicator would be useful in projecting longer run trends in inflation but might not be very useful

Chart 11A

Inflation Indicator Based on M2

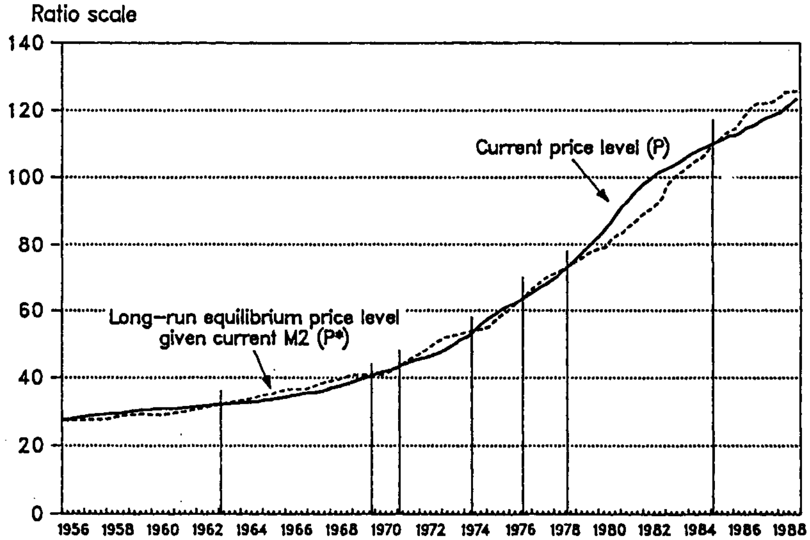
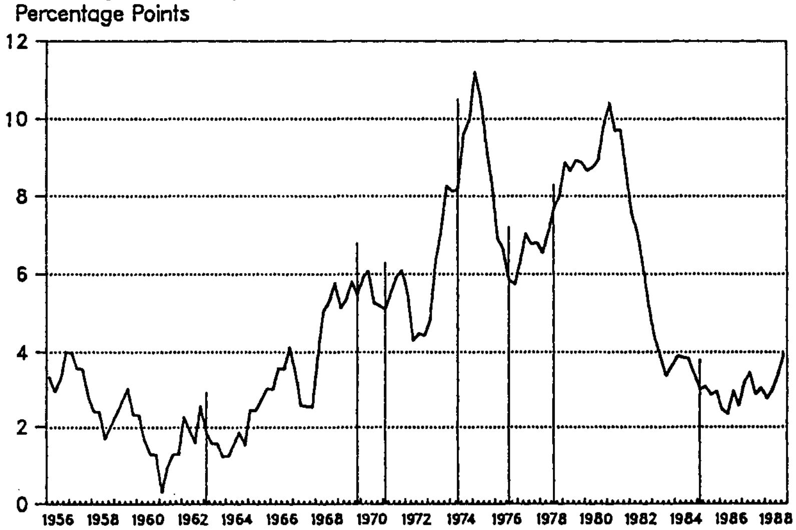


Chart 11B

Inflation

Change in the Implicit GNP Deflator from Four Quarters Earlier



The current price level (P, the solid line in the top panel) is the implicit GNP deflator, which is set to 100 in 1982.

The long-run equilibrium price level given current M2 (P*, the dashed line in the top panel) is calculated as P* =(M2 x V*)/Q*, where V* is an estimate of the long-run value of the GNP velocity of M2--the mean of V2 from 1955-I to 1988-IV--and Q* is a Federal Reserve Board staff measure of potential real GNP.

The vertical lines mark the quarters when the difference between the current price level (P) and the long-run equilibrium price level (P*) switches sign, and thus when inflation, with a lag, tends to begin accelerating or decelerating.

Inflation (bottom panel) is the percentage change in the implicit GNP deflator from four quarters earlier.

For more details, see Jeffrey Hallman, Richard D. Porter, and David H. Small, M2 Per Unit of Potential GNP as a Price-Level Anchor, Board of Governors of the Federal Reserve System, Staff Studies, forthcoming.

The model for this chart and its accompanying commentary was taken from Federal Reserve Chairman Alan Greenspan's statement before the Committee on Banking, Housing and Urban Affairs of the U.S. Senate on February 21, 1989.

in the shorter run.[29]

Appendix 2: Federal Reserve Operating Procedures

The Federal Reserve has attempted to control the money stock in different ways over the last twenty years. Several recent articles provide excellent overviews of the Federal Reserve's techniques since the early 1970s.[30] More detailed and technical analysis can be found in the Federal Reserve's two-volume study, New Monetary Control Procedures, published in 1981.[31] Because a great deal of material is already available on this subject from both general and technical perspectives, this appendix will simply highlight some of the more important changes in the Federal Reserve's operating procedures.

Analysts of U.S. financial markets divide the Federal Reserve's operating procedures into three distinct periods. The first, prior to October 1979, was characterized by relatively stable interest rates and low real rates of interest. The second period, from October 1979 to about October 1982, showed high real rates and extreme volatility of interest rates. The last period, October 1982 to the present, has had continued high real interest rates but with much less volatility of interest rates than the previous period (about as much volatility as in the first period).

Before October 1979, the Federal Reserve attempted to keep M1 within its target ranges by

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[29]For an econometric analysis that supports this conclusion, see Kenneth N. Kuttner, "Inflation and the Growth Rate of Money," Federal Reserve Bank of Chicago Economic Perspectives, January-February 1990, pp. 2-11.

[30]Stephen Axilrod, "U.S. Monetary Policy in Recent Years," Federal Reserve Bulletin, January 1985; Henry C. Wallich, "Recent Techniques of Monetary Policy," Federal Reserve Bank of Kansas City Economic Review, May 1984. See also Stephen Axilrod, "Monetary Policy, Money Supply and the Federal Reserve's Operating Procedures," Federal Reserve Bulletin, January 1982; and Stephen Axilrod and David Lindsey, "Federal Reserve System Implementation of Monetary Policy: Analytical Foundations of the New Approach," American Economic Review, vol. 71, no. 2 (May 1981). For an international perspective, see Changes in Money Market Instruments and Procedures: Objectives and Implications, Bank for International Settlements, March 1986. This appendix is adapted from my contribution to this volume. For a historical perspective, see Ann-Marie Meulendyke, "A Review of Federal Reserve Policy Targets and Operating Guides in Recent Decades," Federal Reserve Bank of New York Quarterly Review, Autumn 1988, reprinted in this volume.

[31]Board of Governors of the Federal Reserve System, New Monetary Control Procedures, Staff study, February 1981.

gradually changing short-term interest rates. In essence, the Federal Reserve was operating through the demand-for-money function, supplying whatever quantity of reserves was demanded at the interest rate level estimated as most likely to hit the M1 target. The obvious problem with such an approach was that changes in the demand for reserves, until they were recognized, were fully accommodated in the short run by changes in the supply of reserves, with no automatic response in interest rates (see Figure 1).

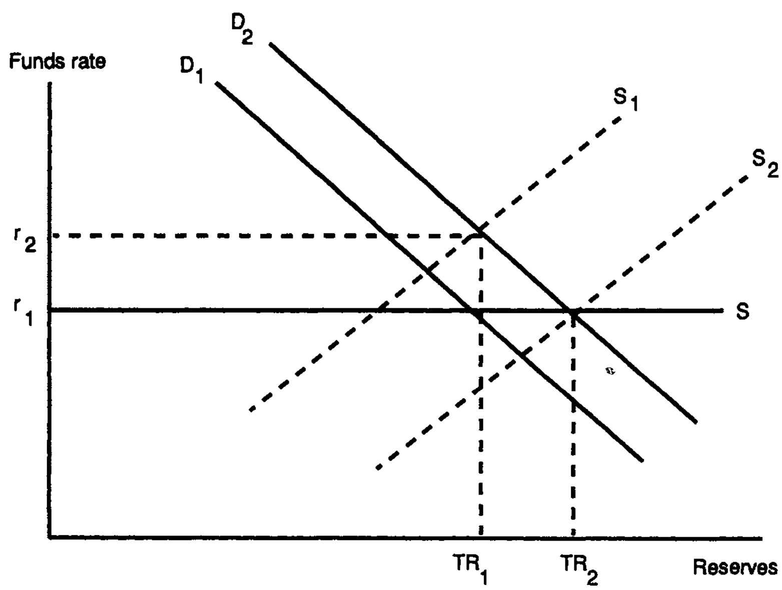
In October 1979, the Federal Reserve began to place less emphasis on short-term interest rates and more emphasis on the supply of reserves to control M1. This shift in emphasis meant, in effect, that interest rates would change automatically to help balance the supply and the demand for money. Because the Federal Reserve controlled only nonborrowed, not total, reserves in the short run, total reserves still responded to changes in the demand for reserves, although not as much as in the earlier period (see Figure 2). Interest rates, of course, were not completely ignored. The Federal Reserve still set consulting ranges for the federal funds rate. If the funds rate appeared likely to go beyond these ranges, the FOMC would discuss adjusting the range in the light of economic developments.

Since the autumn of 1982, the Federal Reserve has focused less on the supply of reserves and more on the amount of pressure on banks' reserve positions, as measured by the quantity of borrowed reserves. If the Federal Reserve maintains the same borrowing target when the demand for reserves shifts, then the procedure is similar to the pre-October 1979 approach because the level of borrowing is related to the spread between the funds rate and the discount rate. (Compare Figure 3 with Figures 1 and 2. Figure 4 shows the determinants of open market operations under current procedures.) Under current procedures, however, the funds rate could fluctuate more in the very short run (compared with the period before October 1979) because the relationship between the funds rate and the level of borrowing is not exact and because the Federal Reserve attempts to attain its objective for borrowing on average for a two-week period rather than on a day-to-day basis.

Figure 1

Example of Operating Procedures before October 1979

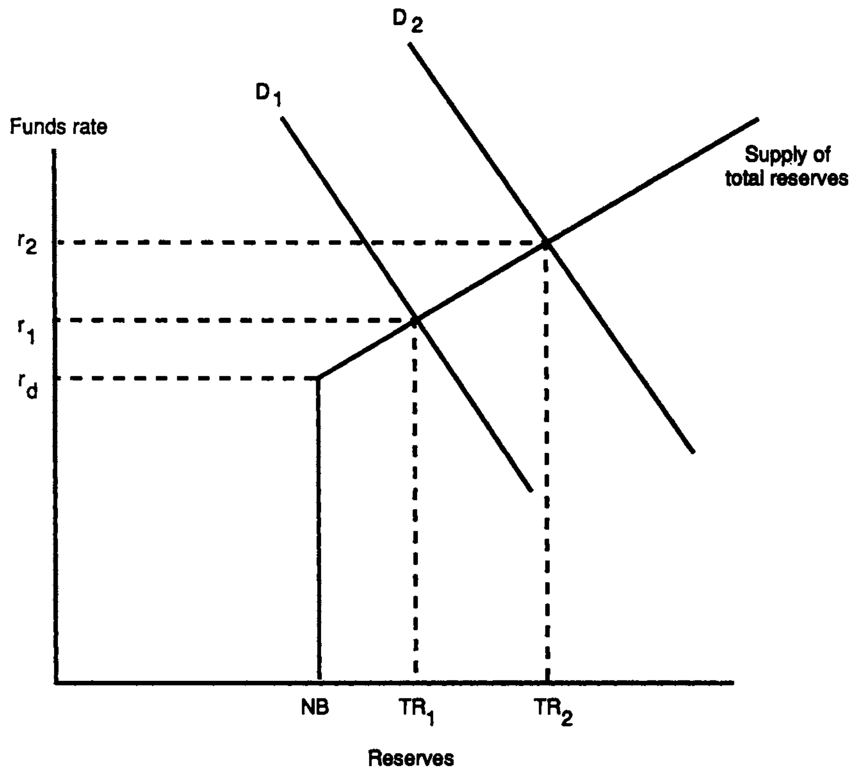
The demand for total reserves is determined by: (1) the demand for required reserves that banks must hold against transactions deposits and certain other liabilities, and (2) the demand for excess reserves, which is largely seasonal in nature. Excess reserves are a very small percentage of total reserves. The quantity of total reserves demanded increases as interest rates decline because the demand for transactions deposits (and hence for the reserves required for them) increases as interest rates decline. The supply of reserves consists of two components, borrowed reserves and nonborrowed reserves. Nonborrowed reserves are equivalent to the sum of several technical factors and open market operations. Borrowed reserves tend to increase as the spread between the federal funds rate and the discount rate widens. Hence the overall supply of reserves increases as the funds rate increases. (For a more formal model of the supply and demand for reserves, see the paper by Brian F. Madigan and Warren T. Trepeta in Bank for International Settlements, Changes in Money Market Instruments and Procedures.)



Before October 1979, the Federal Reserve would tend to stabilize the funds rate in the very short run. This, in effect, made the supply of reserves (S) a horizontal line at the desired funds rate level. If the demand for total reserves increased from D_1 to D_2, there would be no automatic upward pressure on the funds rate (r_1). If the shift from D_1 to D_2 was ascribed to excessive money growth, the Federal Reserve would undertake operations to raise the funds rate from r_1 to some higher level (r_2).

Figure 2

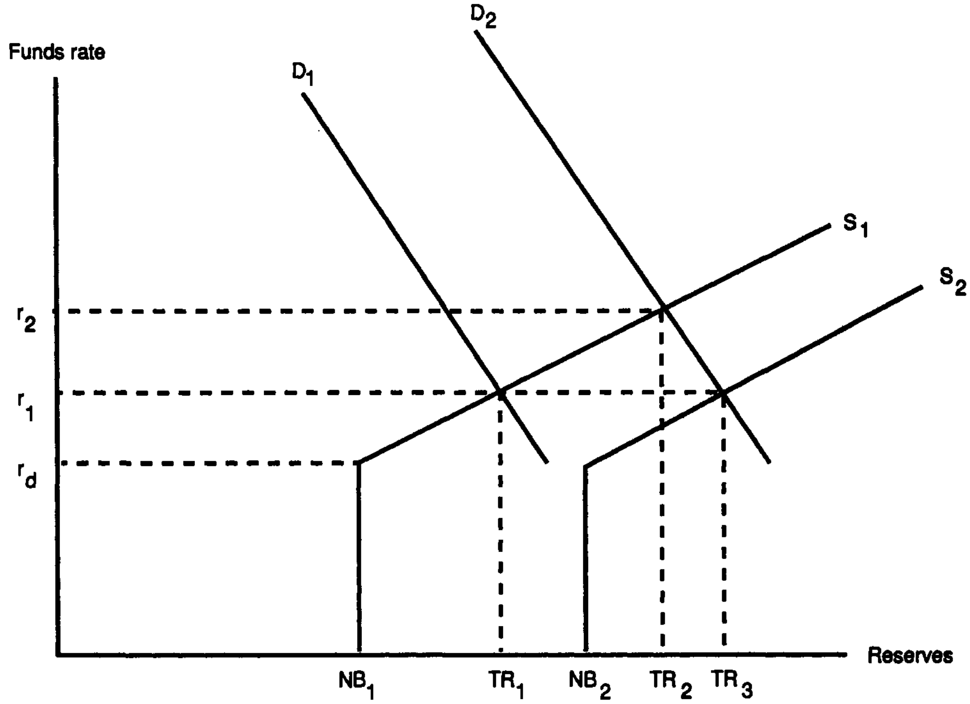
Example of Operating Procedures from October 1979 to Autumn 1982



During this period, the Federal Reserve would set the level of nonborrowed reserves (NB) in line with its desired growth rate for M1 and associated required reserves. If the demand for reserves (D_1) was greater than the supply of nonborrowed reserves, the fund rate (r_1) would exceed the discount rate (rd) and banks would borrow the difference between total reserves (TR_1) and nonborrowed reserves. If the demand for reserves increased because of growth in M1 (D_1 to D_2) that was more rapid than desired, the funds rate would increase automatically (r_1 to r_2), and borrowed reserves would increase (TR_1 - NB to TR_2 - NB) because the spread between the funds rate and the discount rate would increase (r_1-rd to r_2-rd). Over a longer period, the rise in rates could be expected to exert restraint on the excessively rapid growth in M1.

Figure 3

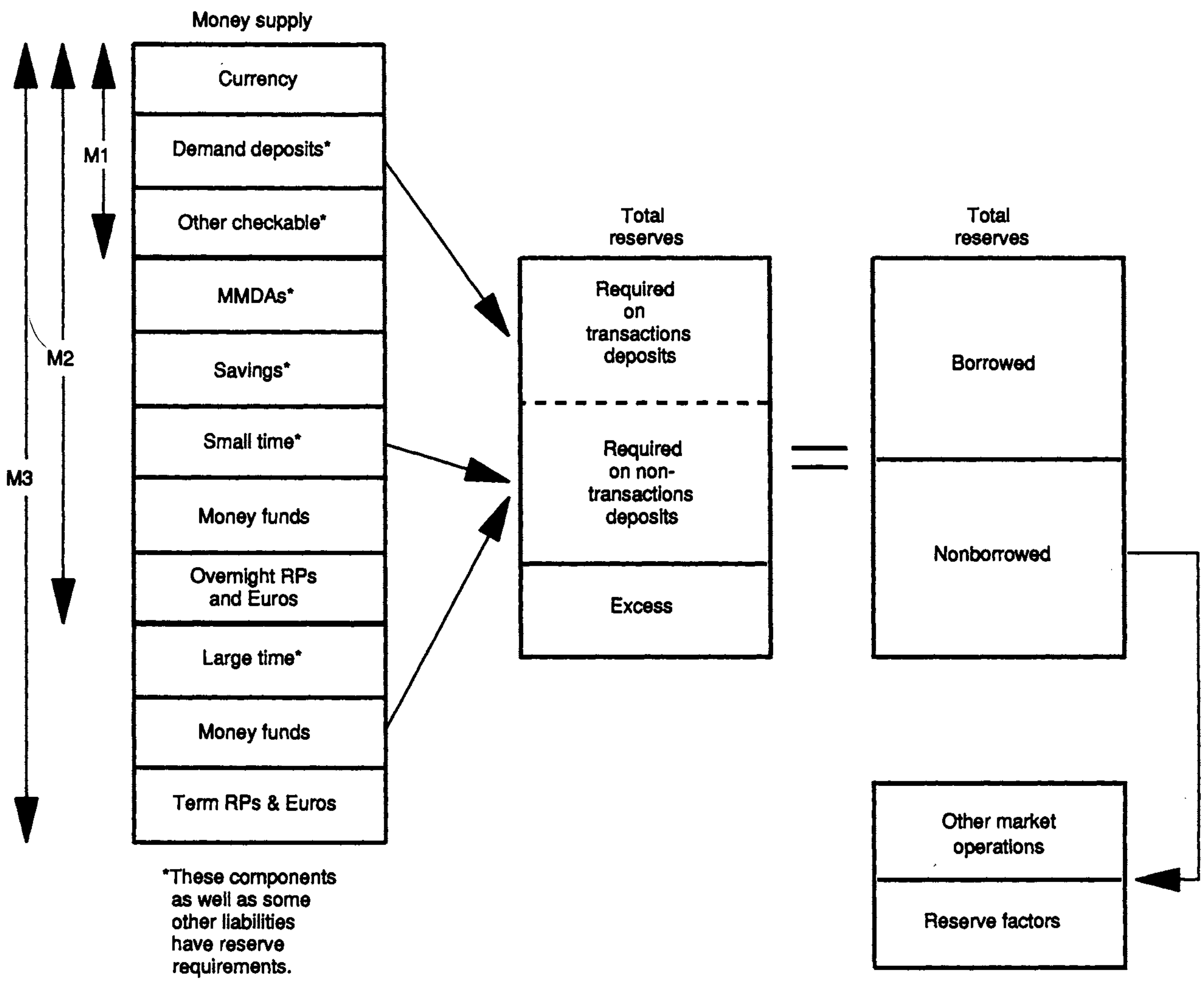
Example of Operating Procedures since Autumn 1982



During this period, the Federal Reserve has set the supply of nonborrowed reserves (NB_1) to achieve a certain degree of pressure on the banks' reserve positions (TR_1-NB_1). Since TR_1-NB_1 = borrowings (B) and B responds in a loose way to the spread between the funds rate (r_1) and the discount rate (rd), increases in the desired level of pressure on the banks' reserve positions put upward pressure on the funds rate. If the demand for reserves increases from D_1 to D_2, the funds rate will not necessarily increase from r_1 to r_2 (as in the previous example) if the Federal Reserve has kept the desired level of B the same. If the Federal Reserve wants to keep the level of borrowing constant, it increases the supply of reserves from S_1 to S_2 by increasing nonborrowed reserves from NB_1 to NB_2. The degree of pressure on the banks' reserve positions will be unchanged because TR_3 - NB_2 = TR_1 - NB_1. Hence the funds rate will not automatically increase when the demand for reserves increases from D_1 to D_2.

Figure 4

The Determinants of Open Market Operations



At the start of each two-week maintenance period, a forecast of required reserves is made on the basis of expected movements (largely seasonal) in the components of the monetary aggregates and other liabilities that have reserve requirements. This forecast for required reserves is then added to the expected demand for excess reserves (also largely seasonal) to obtain a forecast for total reserves. Given the FOMC's objective for borrowed reserves, this forecast of total reserves implies a target for nonborrowed reserves. Nonborrowed reserves, in turn, consist of two components: open market operations and the net reserve impact of several factors such as currency, float, and the Treasury's balance at the Federal Reserve. The Open Market Desk undertakes open market operations equal to the difference between the target for nonborrowed reserves and the net reserve impact of these other reserve factors. These estimates are revised daily, and at times the volume of open market operations called for by the forecasts can change appreciably over the course of a two-week period.*

* For more detail, see John Partlan, Kausar Hamdani, and Kathleen M. Camilli, "Reserves Forecasting for Open Market Operations," Federal Reserve Bank of New York Quarterly Review, Spring 1986, pp. 19-33.

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LIQUID ASSET MEASURES AS INTERMEDIATE TARGETS AND INDICATORS FOR MONETARY POLICY

Gabriel S. P. de Kock and Lawrence J. Radecki

This paper reviews the potential use of aggregate measures of liquid assets in formulating monetary policy. It addresses the rationale for using aggregate measures of liquid assets as targets or indicators of monetary policy, the appropriate definition of a liquid asset aggregate, and the empirical evidence in favor of the Federal Reserve's monetary aggregate L as an informative indicator or reliable target for monetary policy. Finally, practical issues relating to implementing a liquid asset target, including controllability and the timely availability of data, are discussed.

Three main rationales can be advanced to justify the use of liquid asset measures as indicators or intermediate targets for monetary policy:

- A broad monetary aggregate includes all assets yielding monetary services and internalizes possible changes in their relative attractiveness and functions; thus it should have a more stable relationship with policy objectives.

- The existence of capital market imperfections implies that firms' and households' portfolio and spending decisions cannot be separated and that they may be liquidity constrained. Thus, liquid asset aggregates may be stably related to private sector spending decisions and plans as well as to the ability of firms and households to finance spending. A related justification is that liquid asset measures provide timely information about lending to households and firms by financial institutions.

- It has been argued that there is no a priori reason to presume that a single monetary aggregate or asset price would capture all the information pertinent to monetary policy decisions. Policy makers can minimize the risk of policy errors by diversifying over a number of policy indicators/intermediate targets, including a broad liquid assets measure.

We review a number of recent studies that have provided empirical evidence on capital market imperfections and thus indirectly favor the use of liquid asset aggregates. We point out, however, that the relationship between a liquid asset aggregate and spending need not be stable if the proportions of households and firms that are liquidity constrained change over time. Furthermore, we note that there is considerable ambiguity whether capital market imperfections constitute a rationale for the use of liquid asset aggregates or credit aggregates in the formulation of monetary policy.

Two measurement problems complicate the practical definition of a liquid asset measure: identifying (1) the assets that should be included in a liquid asset measure and (2) the aggregation principle that should be used in compiling the aggregate. We discuss three potential shortcomings of the Federal Reserve System's liquid asset aggregate, L:

- L overlaps considerably and is highly correlated with other high-level financial aggregates and is unlikely to convey much information that is not provided by these aggregates.

- If a liquid asset aggregate is to measure readily available spending power in the economy, a potentially serious measurement error arises from the exclusion of prearranged lines of credit from L.

- L is calculated as a simple-sum aggregate. If the assets included in an aggregate are imperfect substitutes, both the demand for the aggregate and its relationship with economic activity will not be independent of its composition; consequently, it may be of limited value to policy makers.

We also review the conceptual case for and experience with monetary-services, or Divisia, indexes that have been proposed as alternatives to the conventional simple-sum aggregates, and we conclude that Divisia aggregates are subject to different, but equally serious, measurement problems.

A liquid asset aggregate can play a role in the formulation of monetary policy in three conceptually different roles, as an intermediate target, an indicator conveying information about future economic events or the current stance of policy, and a constraint. A successful intermediate target is related in a stable and predictable manner to both policy objectives and policy instruments. To assess whether a liquid asset measure would satisfy these requirements, we review earlier empirical research and present the results of our own empirical analysis using the liquid asset measure, L. Our findings are as follows:

- There is a stable long-run demand for real L.

- L adjusts very slowly to changes in its determinants.

- The relationship that describes the dynamic adjustment of L in response to changes in its determinants is difficult to capture statistically, as evidenced by poor out-of-sample simulation results, and it has shifted in 1980.

- The monetary base L multiplier is less volatile and marginally easier to forecast than the M2 multiplier. However, it is not clear that this advantage will be of practical consequence or can be exploited by a policy regime in which the base is adjusted to hit an intermediate target for L.

The evidence on the relationship between L and policy goal variables does not suggest the use of L as an intermediate target. Since L responds slowly to changes in its determinants, policy makers may have to accept long-lasting deviations of L from its intermediate target path. Moreover, control over L may offer only imprecise control over final objectives of policy, because the short-run relationship between L and goal variables is difficult to predict and subject to unpredictable shifts. Finally, the long time delay in the availability of data on L compared with that for other monetary aggregates would make an L intermediate target difficult to implement.[1]

A liquid asset measure can be used as a monetary policy indicator in two conceptually distinct roles: first, as a predictor of future economic developments or an "information variable" that is used to signal the need to change instrument settings; second, as a measure of policy stance that is used to indicate the need to change an intermediate target path that has become inappropriate. L holds little promise as an information variable, although it fares somewhat better than M2. A vector autoregression analysis of data from 1959 to 1989 shows that once the commercial paper rate is included in the information set, L has only marginal predictive value for nominal GNP, none for real GNP, and more surprisingly, none for the GNP deflator.

Finally, we do not foresee a role for L as a constraint in the policy process. It seems implausible that one could specify ex ante a level or rate of change for L that, if breached in one direction or the other, will signify an unambiguous policy error.

I. Rationale for Liquid Asset Measures

There are three possible motivations for using a broad measure of liquid assets in the formulation of monetary policy. First, there may be no well-defined set of financial assets that corresponds to the theoretical concept of money. Different assets with varying degrees of moneyness exist, and it can be argued that a "money" aggregate used as an intermediate target or indicator for monetary policy should include all these assets. Secondly, capital market imperfections imply that private agents may often be

[1] Final data for L are available one month after the monetary aggregates for the same date.

liquidity constrained[2] and that their spending and portfolio decisions cannot be separated. Thus, liquid asset holdings may be stably related to private sector spending decisions and plans as well as to the ability of firms and households to finance spending. Finally, there is no a priori reason to presume that any single financial aggregate accurately captures the influence of financial decisions on real economic activity; thus it can be argued that policy makers should use a liquid asset measure as one of the targets/indicators of monetary policy.

In this section we review the conceptual case for using a liquid asset measure in the monetary policy process. We also survey the empirical evidence on the existence of liquidity constraints and discuss the ambiguities arising from the fact that the rationale for a liquid asset aggregate proves, on examination, to be fundamentally the same as the rationale for credit measures.

A. The Conceptual Case for Liquid Asset Measures

An argument for specifically using broad financial aggregates or measures of liquid assets to guide monetary policy decisions rests on the *close substitutability* of different financial assets. The theoretical distinction between transactions assets and investment media has no real-world counterpart. Private agents economize on transactions balances by substituting higher yielding liquid assets for them. Hence, failing to consider substitution in and out of transactions money in a world where financial intermediaries create assets that increasingly blur the distinction between transactions and investment balances will, in general, lead to failures in judging the stance of policy. Thus, a reliable measure of "the quantity of money" or spending power should include the close substitutes for checkable deposits offered by both banks and nonbank financial intermediaries. However, there exists a virtual continuum of assets of varying degrees of moneyness or substitutability for transactions balances, and consequently the set of assets that should be included in the measures intended to guide monetary policy has no clearly defined boundary.

One solution is to choose a broad liquid asset aggregate and thereby to ensure that all relevant assets are included. But this introduces a new problem: how to aggregate the relevant assets into a single quantity. A proposed solution to this problem, discussed in greater detail in the section dealing with measurement issues, is to use an aggregate with components weighted to reflect their "moneyness" or the monetary services that they provide and thus to capture the implications of both

[2] The terms "liquidity constrained" and "credit rationed" are used interchangeably in this paper. In the literature, the term "liquidity constraint" is often used when referring to consumers and "credit ration" when referring to firms.

shifts in quantities and composition. The use of broad aggregates weighted to measure the quantity of "money" accurately can also be justified as a useful simplification--a substitute for the complex disaggregated models of the financial industry favored by, for example, James Tobin and his associates.[3]

A related argument in favor of broad liquid asset aggregates relies on the recent experience with financial innovation and its implications for a long-run strategy of monetary targeting.[4] After the "missing money" episode of the mid-seventies, a long-run intermediate targets strategy still seemed feasible to many.[5] It was argued that although the demand for a particular monetary aggregate may be unstable in the short run, such instabilities are bound to be reversed and therefore less important in the longer run. Thus, economists who held this view concluded that an intermediate targets strategy could be used to foster long-run objectives, even if not to fine-tune the economy. However, the financial innovations of the early eighties have cast considerable doubt on this presumption, at least as far as an intermediate target strategy based on narrow financial aggregates is concerned. Financial innovations have rendered the demand for narrow aggregates even more unstable in the long run than in the short run by changing the economic roles of the assets encompassed by these aggregates. Such changes largely involve changes in the rates of return of different liquid assets and therefore affect narrow monetary aggregates much more strongly than broad aggregates.[6] On these grounds it might

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[3] See, for example, James Tobin, "A General Equilibrium Approach to Monetary Theory," Journal of Money, Credit, and Banking, vol. 1, no. 1 (1970); and James Tobin and Donald Hester, Financial Markets and Economic Activity (New York: Wiley, 1967).

[4] Benjamin Friedman summarizes this line of reasoning in his discussion of the paper presented by Simpson and Porter at the 1980 Boston Fed conference on the control of monetary aggregates. See Thomas D. Simpson and Richard D. Porter, "Some Issues Involving the Definition and Interpretation of the Monetary Aggregates," and Benjamin M. Friedman, "Discussion," in Controlling Monetary Aggregates III, Federal Reserve Bank of Boston, Conference Series no. 23, 1981.

[5] Friedman, in his discussion of Simpson and Porter, characterizes this view as held by the majority of macroeconomists. An example is the paper by Karl Brunner, "The Control of Monetary Aggregates," in the same volume.

[6] A recent example of this phenomenon is the slowing of M1 and M2 growth from the third quarter of 1988 to the second quarter of 1989, which occurred partly in reponse to changes in bank deposit pricing policies. Banks allowed the differential between market rates such as the three-month Treasury bill yield and the rates on their NOW accounts, savings accounts, and MMDAs to increase sharply. For example, in the first quarter of 1989, Treasury bills yielded 398 basis points more than NOW accounts, 360 basis points more than savings accounts, and 62 basis points more than small six-

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seem advisable to base a long-run intermediate target strategy on a broad concept of total liquid assets rather than a narrow concept of money.

Many observers point to the existence of capital market imperfections as diverse as transactions costs and information asymmetries and emphasize that households' and firms' responses to income shocks and financial incentives are significantly different from those predicted by theories predicated on the existence of perfect capital markets.[7] The existence of capital market imperfections modifies standard theory in two ways; on the one hand, households' and firms' anticipated spending will be reflected in the *maturity composition* of their portfolios while, on the other hand, economic agents' responses to income and interest rate changes will depend on their holdings of liquid assets. Thus, liquid asset aggregates may provide policy makers with information about planned spending and may have a stable relationship to aggregate expenditures.

Pissarides provides a theoretical analysis of the interrelationship between a consumer's portfolio decisions and consumption spending that arises from transactions costs and differences between borrowing and lending rates.[8] He shows that precautionary balances and funds earmarked for spending in the near future are held in the form of liquid assets because liquid assets have investment characteristics but also allow resources to be transferred to transactions media easily and at low cost. Furthermore, consumption is more sensitive to current income than predicted by the permanent income hypothesis because transitory decreases in current income lower consumption if the household has insufficient liquid assets.[9] Consequently, the information in current income flows and portfolio

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[6](...continued)
month time deposits, compared with differentials of 68, 50, and -8 basis points, respectively, in the first quarter of 1987.

[7] For examples of this line of thought, see James Tobin and Walter Dolde, "Wealth, Liquidity and Consumption," in Consumer Spending and Monetary Policy: The Linkages, Federal Reserve Bank of Boston, Conference Series no. 5, 1971; and Richard Jackman and John Sutton, "Imperfect Capital Markets and the Monetarist Black Box," The Economic Journal, March 1982, pp. 108-28.

[8] Christopher A. Pissarides, "Liquidity Considerations in the Theory of Consumption," Quarterly Journal of Economics, May 1978, pp. 279-96. In particular, Pissarides assumes that the costs of transactions in long-term assets exceed those of transactions in short-term assets and that the interest rate at which consumers can borrow exceeds the rates on both the short- and long-term investment media available to them.

[9] Empirical evidence on the "excess sensitivity of consumption to current income" is provided by Marjorie Flavin, "The Adjustment of Consumption to Changing Expectations About Future Income,"
(continued...)

composition (for example, the ratio of liquid to illiquid assets) may predict consumption better than measures of human and nonhuman wealth calculated on the basis of market interest rates.[10]

Credit rationing can occur because financial intermediaries cannot monitor perfectly borrowers' income prospects and spending while borrowers' potential liability is limited by the possibility of bankruptcy.[11] The existence of a limit to the amount that a firm or household can borrow will, in general, raise the true cost of borrowing above the interest rate at which financial institutions lend and, by implication, above the opportunity cost of the firm's or household's own funds. This may occur even if such a liquidity constraint is not strictly binding, simply because current borrowing reduces the amount of funds available for future borrowing. Thus, households' consumption spending will be more sensitive to current income than predicted by the life-cycle hypothesis. Similarly, firms' investment spending will be more sensitive to current cash flows than predicted by neoclassical models that assume perfect capital markets. To assess the influence of liquidity constraints on consumption behavior, Tobin and Dolde used simulations of a simple macroeconomic model.[12] They assumed that liquidity constraints bind for younger and poorer segments of the population and that these economic agents cannot borrow at all against future labor income. They found that, at realistic parameter values, liquidity constraints raise the marginal propensity to consume out of resources (nonhuman wealth plus the present value of future labor income) from 0.055 to between 0.09 and 0.12.

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[9](...continued)
Journal of Political Economy, vol. 89 (1981), pp. 974-1009; "Excess Sensitivity of Consumption to Current Income: Liquidity Constraints or Myopia?" Canadian Journal of Economics, February 1985, pp. 117-36; and Robert E. Hall and Frederic S. Mishkin, "The Sensitivity of Consumption to Transitory Income: Evidence from Panel Data," Econometrica, vol. 50 (1982), pp. 461-81.

[10] Scheinkman and Weiss obtain similar results with a general equilibrium model in which individuals face borrowing constraints and incomplete insurance markets. The model reproduces some of the qualitative features of real-world business cycles that cannot be generated by models with complete markets. See Jose A. Scheinkman and Laurence Weiss, "Borrowing Constraints and Aggregate Economic Activity," Econometrica, January 1986, pp. 23-45.

[11] The standard reference on credit rationing is Joseph E. Stiglitz and Andrew Weiss, "Credit Rationing in Markets with Imperfect Information," American Economic Review, vol. 71, no. 3 (June 1981), pp. 393-410. For a readable discussion of the macroeconomic implications of credit rationing, see Mark L. Gertler, "Financial Structure and Aggregate Economic Activity: An Overview," Journal of Money, Credit, and Banking, vol. 20, no. 3 (August 1988), part 2, pp. 559-88.

[12] Tobin and Dolde, "Wealth, Liquidity and Consumption," in Consumer Spending and Monetary Policy: The Linkages.

In recent years, a number of authors have documented the existence of liquidity effects in consumption and investment behavior. In particular, liquidity constraints have been advanced as a convincing explanation for the empirical failure of the life cycle/permanent income theory of consumption and the neoclassical theory of investment. Regression results from quarterly data on aggregate consumption of nondurables and services reported by Campbell and Mankiw indicate that consumers earning about one-half of disposable income are liquidity constrained.[13] Auerbach and Hasset extend Campbell and Mankiw's results to provide further support for the liquidity constraints hypothesis.[14] Their model, estimated with annual data, indicates that liquidity constraints are particularly significant in explaining aggregate consumption in periods characterized as credit crunches. Moreover, Auerbach and Hasset also find that about one-half of households are liquidity constrained when the economy is in a credit crunch. Zeldes uses panel data on food consumption to compare the behavior of households holding low levels of liquid assets with those holding high levels of liquid assets.[15] His results show that households with high levels have spending patterns consistent with unconstrained consumption choices. The consumption behavior of households with low levels of liquid assets, by contrast, is inconsistent with unconstrained choice but consistent with the existence of liquidity constraints. Researchers have also had success using proxies such as the unemployment rate and the nominal interest rate on auto loans to measure the effects of liquidity constraints.[16] Similar proxies also play an important role in the consumption functions of Ray Fair's midsize macroeconometric model.[17] Fair's work establishes that taking account of liquidity effects improves the predictive power of econometric models. It is not clear, however, that the predictive value of his

[13] See John Y. Campbell and N. Gregory Mankiw, "Consumption, Income, and Interest Rates: Reinterpreting the Time Series Evidence," Princeton University, April 1989, mimeo.

[14] See Alan J. Auerbach and Kevin Hasset, "Corporate Saving and Shareholder Consumption," University of Pennsylvania, February 1989, mimeo.

[15] See Steven P. Zeldes, "Consumption and Liquidity Constraints: An Empirical Investigation," Journal of Political Economy, vol. 97, no. 2 (April 1989), pp. 305-46.

[16] See James A. Wilcox, "Consumption Constraints: The Real Effects of 'Real' Lending Policies" (Paper presented at the spring 1989 meeting of the Federal Reserve System Committee on Business Conditions); and Flavin, "Excess Sensitivity of Consumption to Current Income: Liquidity Constraints or Myopia?"

[17] Ray C. Fair, The Specification, Estimation, and Analysis of Macroeconometric Models (Cambridge: Harvard University Press, 1984).

proxy for liquidity constraints is due solely to the existence of such constraints.

Recent work on investment spending parallels the research on liquidity effects and consumption. The most extensive paper, by Fazzari, Hubbard, and Petersen, explores several financial factors and their impact on investment spending.[18] The authors find that for large mature firms liquidity variables (cash flow and initial stocks of cash on hand) do not help explain investment spending. But liquidity does have a significant role in explaining investment spending in the case of medium-size firms and especially small firms in the same industry. The authors interpret this result as indicating that financial constraints are binding for a significant segment of the nonfinancial business sector and thus may have an important role in macroeconomic fluctuations. Similarly, Gertler and Hubbard, using cross-sectional time-series data, show that cash flow is an important factor determining investment spending by manufacturing firms.[19] In general, the finding that financial factors such as liquidity or cash flow are important for investment spending by the individual firm seems to be in accord with an inability to find an important interest rate effect on aggregate investment spending.

The empirical research on liquidity constraints reviewed here has used diverse techniques to establish the relevance of liquidity effects in a variety of settings. Thus, the existence of liquidity constraints appears robust, a result which lends credence to the presumption that spending should be closely related to agents' holdings of liquid assets. But research to date has focused on testing whether liquidity effects influence spending; thus, it is still too early to judge whether this strand of research would significantly improve the predictive power of macroeconometric models. Moreover, it should be emphasized that the existence of liquidity effects on consumption and investment spending does not imply a stable relationship between broad liquid asset aggregates, however defined, and aggregate spending in the economy. First, the pool of liquidity-constrained households and firms may change over time and in response to changes in economic conditions, rendering simple relationships between aggregate economic activity and any particular liquid asset measure unstable. Second, and potentially more damaging to the the use of a broad measure of liquid assets in the formulation of monetary policy, financial innovations that change borrowers' access to credit will bring about permanent shifts in the relationship between aggregate spending and the liquid asset measure.

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[18] Steven M. Fazzari, R. Glen Hubbard, and Bruce C. Petersen, "Financing Constraints and Corporate Investment," Brookings Papers on Economic Activity, 1:1988, pp. 141-206.

[19] Mark L. Gertler and R. Glen Hubbard, "Financial Factors in Business Fluctuations," in Financial Market Volatility, a symposium sponsored by the Federal Reserve Bank of Kansas City, August 1988; also, First Boston Working Paper Series, no. FB-88-37, September 1988.

However, in principle, it may be possible to design a measure with more restricted scope, such as the liquid assets of low- and middle-income households and small and medium-size firms, that performs better than economy-wide totals.

The final argument for the use of liquid assets in judging monetary policy actions simply states that policy makers should diversify their use of policy indicators. Financial variables--the structure of rates of return and the quantities of assets outstanding--are determined in general equilibrium by the interaction of supplies of and demands for financial assets. Specific financial assets have special characteristics tailored to particular financing requirements, but no asset or subset of assets is special for the interaction of real and nominal quantities.[20] In a world of certainty the monetary authorities can control nominal income by controlling any one financial aggregate and one rate of return.[21] However, in an uncertain world there is no reason to presume that any specific financial aggregate or interest rate would fully capture the implications of financial decisions for real economic activity, or provide all the information pertinent to monetary policy decisions. On this view, an exclusive focus on any particular monetary aggregate is inappropriate. Instead, in making decisions on monetary policy, the authorities could use a very broad measure of the money supply, an aggregate of liquid assets, along with other financial aggregates and rates of return.

Measures of liquid assets may also have another, very different, value for policy makers. The holdings of liquid assets by households and firms calculated relative to their income or indebtedness may give an indication of the economy's ability to withstand economic shocks. Benjamin Friedman, for example, has interpreted the decline of the household and nonfinancial business sectors' holdings of liquid assets relative to total financial assets and net worth as increasing appreciably the threat of financial instability.[22]

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[20] For statements of this viewpoint, see Tobin, "A General Equilibrium Approach to Monetary Theory"; and James Tobin and Donald Hester, Financial Markets and Economic Activity (New York: Wiley, 1967).

[21] For example, control of any monetary aggregate and the zero rate of return on currency is sufficient. See James Tobin, "Money and Finance in the Macroeconomic Process," Journal of Money, Credit, and Banking, vol. 14, no. 2 (May 1982), pp. 171-204; and Franco Modigliani and Lucas Papademos, "The Structure of Financial Markets and the Monetary Mechanism," in Controlling Monetary Aggregates III, Federal Reserve Bank of Boston, Conference Series no. 23, 1980.

[22] Benjamin M. Friedman, "Increasing Indebtedness and Financial Stability in the United States," in Debt, Financial Stability, and Public Policy, Federal Reserve Bank of Kansas City, 1986, pp. 27-53.

B. Liquid Asset Measures Compared with Credit Measures

The main arguments for using liquid asset measures in the formulation of central bank policy--the instability in the money-income relationship resulting from financial innovation and deregulation, the existence of liquidity or borrowing constraints on the budgets of individual households and business firms, and the diversification of indicators from the financial side of the economy--apply equally well to the use of credit aggregates.[23] The ambiguity between liquidity and credit can be traced back to the earliest thinking on measures of credit and liquid assets, as exemplified by the "Radcliffe view."[24] The Radcliffe Report obscures the distinction between liquidity and credit and offers an ambiguous account of the channels through which monetary policy affects the economy. It downplays the role of interest rates in the transmission of monetary policy and emphasizes the availability of credit--to the point of recommending the use of selective credit controls. In the appendix we argue that although the Radcliffe Committee used the term "liquidity" to indicate the broadest possible measure of the availability of financing, committee members may primarily have been concerned with credit.[25]

More recently, Modigliani and Papademos have argued that changes in broad monetary aggregates are correlated with changes in real economic activity not because they change the "liquidity" of the economy or because some of the assets in the aggregate are endowed with "moneyness" properties (and hence may be a better measure of true "money" than narrow aggregates) but because they are the unavoidable accompaniment of credit expansion.[26]

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[23] For more details on the case for using credit aggregates in the formulation of monetary policy, see Lawrence Radecki, "Credit Measures as a Policy Variable," in this volume.

[24] See the Report of the Committee on the Working of the Monetary System, Cmnd. #827, Her Majesty's Stationery Office, August 1959; R S. Sayers, "Monetary Thought and Monetary Policy in England," Economic Journal, December 1960, pp. 710-24; and Nicholas Kaldor, The Scourge of Monetarism (New York: Oxford University Press, 1982).

[25] The Radcliffe Committee and commentators such as Gurley and Shaw were also concerned with the monetary policy implications of the substitutability of the liquid liabilities of nonbank financial intermediaries for those of commercial banks. The current definitions of the monetary aggregates, which treat similar liabilities of nonbank intermediaries and banks as perfect substitutes, reflect their thinking.

[26] Modigliani and Papademos, "The Structure of Financial Markets and the Monetary Mechanism," in Controlling Monetary Aggregates III. Recently, Joseph Stiglitz has taken a more extreme position, arguing that money affects real economic activity not because it is used as a transactions medium but (continued...)

In a pair of articles that reflected the conceptual and empirical overlap of the credit and liquid asset aggregates, Frank Morris, the former president of the Federal Reserve Bank of Boston, suggested in 1982 and 1983 that the Federal Open Market Committee (FOMC) should move away from money supply targets and adopt *either* a liquid asset aggregate or a total credit aggregate.[27] He had a weak preference for a liquid asset measure because the collection of credit data presented more of a problem.

The fact that capital market imperfections underlie both liquidity and credit effects on aggregate demand does not preclude liquid asset measures and credit aggregates from having different information. The investment properties of liquid assets do provide some independent rationale for the use of liquid asset measures for the formulation of policy. In fact, Pissarides' analysis shows why consumers' and firms' portfolios should provide information independent of that contained in, for example, credit measures.[28]

II. The Appropriate Definition of a Liquid Asset Measure

The appropriate definition of any monetary aggregate involves two potentially controversial issues: Which assets should be included in the aggregate? What weights should be given to the various assets in compiling the aggregate? The choice of assets determines whether the aggregate corresponds to the theoretical rationale for its use in the formulation of policy. The weights given to the constituent assets in an aggregate should depend on their degree of substitutability; for example, giving equal weights to the components of an aggregate requires in principle that the assets be perfect substitutes, a condition that is particularly stringent in the case of high-level aggregates such as L or M3.

In this section we discuss alternative definitions of liquid asset aggregates that have been proposed, especially the Federal Reserve System's current measure L and the Divisia (or monetary-services) index of total liquid assets. This second measure was constructed by the staff of the Board of

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[26](...continued)
because the creation of money is the counterpart of the creation of bank credit. See Joseph E. Stiglitz, "Money, Credit and Business Fluctuations," National Bureau of Economic Research, Working Paper no. 2823, January 1989.

[27] Frank E. Morris, "Do the Monetary Aggregates Have a Future as Targets of Federal Reserve Policy?" New England Economic Review, March-April 1982, pp. 5-14; and "Monetarism without Money," New England Economic Review, March-April 1983, pp. 5-9.

[28] Pissarides, "Liquidity Considerations in the Theory of Consumption."

Governors as part of its effort to apply well-founded aggregation procedures to broad measures of the money supply.

An issue closely related to the selection of assets for a liquid asset aggregate is the proper treatment of prearranged lines of credit. If a liquid asset aggregate is a measure of the dollar volume of assets that serve as a "temporary abode of purchasing power," credit lines are not relevant. But if an aggregate of liquid assets is intended to be a measure of readily available spending power in the economy, then established lines of credit might properly be included. One quickly sees the logic of including them, but it is unclear how they should be incorporated.

A. The Composition of a Liquid Asset Measure

The definitions and magnitudes of the major financial aggregates reported by the Federal Reserve System are shown in Table 1. The liquid asset aggregate, L, is defined to include the assets in the M3 measure of the money supply plus the nonbank public's holdings of U.S. savings bonds, short-term Treasury securities,[29] commercial paper, and bankers' acceptances (net of money market mutual fund holdings of these assets). Several other assets might be included, but for various reasons they are not. For instance, some assets can be sold quickly but at a relatively high transactions cost or significant price risk.[30] A no-load mutual fund holding long-term bonds reduces the transactions costs, but its combined market value still fluctuates. Savings held in an employer-sponsored thrift plan may have stable value and could be liquidated with no transactions costs, but the number and timing of withdrawals are typically quite limited and one's funds are only available after a substantial delay.

A liquid asset aggregate, however defined, must have considerable overlap with two other high-level financial aggregates, M3 and Total Nonfinancial Sector Debt, as is evident in Table 1. The dollar value of L, as it is currently defined, is six times as large as that of M1, one and a half times as large as that of M2, and exceeds that of M3 only by about 20 percent. In contrast, Total Nonfinancial Sector Debt is about twice as large as L. One cannot help but question whether augmenting M3 by this modest amount provides any substantial additional information about developments on the financial side of the economy. It is the case, however, that the growth rates of M3 and L do diverge

[29] This category comprises marketable Treasury obligations with less than eighteen months to maturity.

[30] The price of a bond with a long term to maturity fluctuates markedly.

Table 1
Money Stock, Liquid Assets, and Debt Measures
(Billions of Dollars)

Component	August 1989 Total
Currency	218.4
Travelers' checks	7.1
Demand deposits	277.5
Other checkable deposits	274.4
M1	777.4
Overnight RPs	59.7
Overnight Eurodollar deposits	15.2
Money market deposit accounts	465.4
Savings and small time deposits	1534.2
Money market mutual funds	285.5
M2	3136.5
Large denomination time deposits	569.0
Term RPs	105.3
Term Eurodollar deposits	97.6
Institutional MMMFs	100.6
M3	4009.0
Public's holdings of U.S. savings bonds	114.7
Short-term Treasury securities	286.4
Commercial paper	353.1
Bankers' acceptances	42.7
L	4812.7
U.S. government debt	2199.9
Private nonfinancial sector debt	7395.0
Total Nonfinancial Sector Debt	9558.9

at times; L may grow more rapidly than M3 when the public is holding a larger proportion of its liquid assets as directly owned market instruments. But what is gained by knowing when and the extent to which this is happening is unclear.

Before adopting the current definitions of the monetary aggregates in February 1980, the Board of Governors considered greater differentiation between M3 and L. According to a September 1979 memorandum that amended the definitions proposed in January of that year, M3 was to include small time deposits but not large time deposits, term repurchase agreements, or Eurodollar deposits.[31] Under this scheme L would have been considerably larger than M3. Subsequent revisions to the proposed definition of M3 reduced the degree of differentiation.

Although the quantitative difference between L and Total Nonfinancial Sector Debt is larger, the two aggregates still overlap in that they both include savings bonds, Treasury securities, commercial paper, and bankers' acceptances. These assets represent 20 percent of L and 9 percent of Total Debt. If the long-term component of Total Debt (mortgages and Treasury, corporate, state, and municipal bonds) were removed, the overlap between the remainder, total short-term debt, and L would obviously be much greater and the aggregates would be considerably closer in size.

Over the past thirty years, L has grown at an average rate of 9.0 percent, not quite as rapidly as M3 and Total Debt, which averaged growth rates of 9.3 percent and 9.4 percent, respectively. (The annual growth rates of the monetary and credit aggregates are plotted in Chart 1.) L's annual growth rates are a little more stable than the growth rates of the other monetary aggregates and a little less stable than those of Total Debt when variability is measured by the standard deviation. But L's growth rate is noticeably more stable than the other monetary aggregates', but still less stable than that of Total Debt when variability is measured by the absolute percentage change from one year to the next. The growth rate of L is highly correlated with that of M3 (the simple correlation coefficient is 0.87); indeed, no other pair of financial aggregates has a higher correlation over the 1960-88 period. (See Charts 2 through 5 and Tables 2 and 3.) Nevertheless, the data reject at the 1 percent level the hypothesis that the correlation between M3 and L growth rates is perfect.[32] The correlation between the growth rates of L and Total Debt over the past thirty years, when quarterly data are used, has been

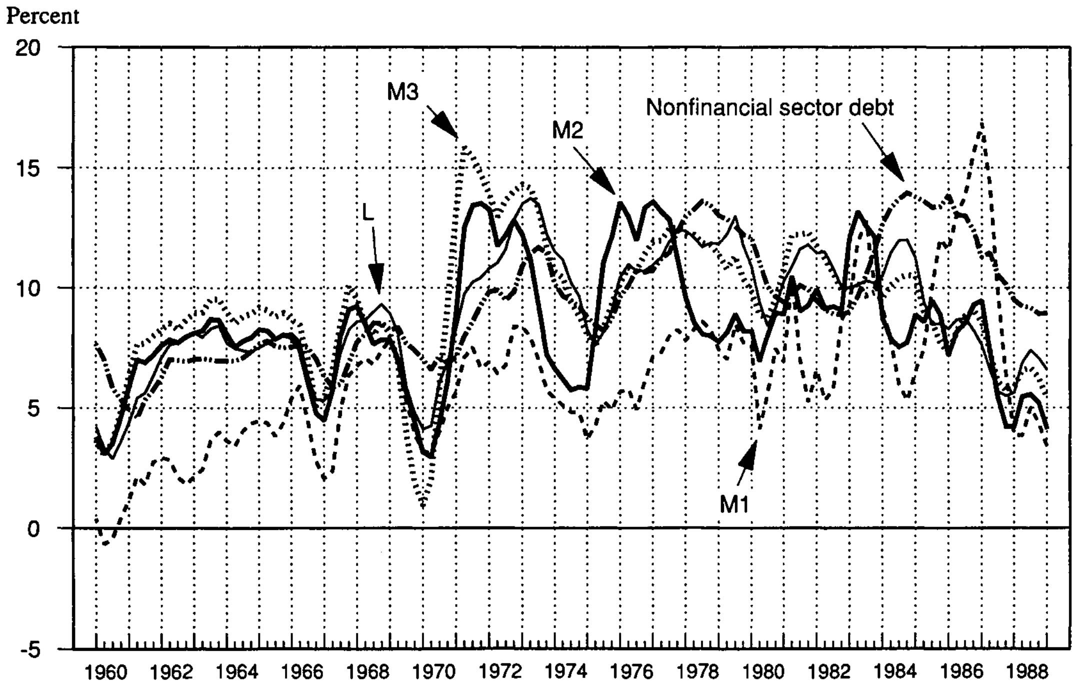
[31] The contents of the memorandum are discussed in Neil G. Berkman, "Abandoning Monetary Aggregates," in Controlling Monetary Aggregates III, Federal Reserve Bank of Boston, Conference Series no. 23, pp. 76-100.

[32] However, as noted above, it is not clear whether differences in the growth rates of L and M3 convey information that is of potential use to policy makers.

Chart 1

Money Stock, Liquid Assets, and Debt

Change from Four Quarters Earlier



0.62--rather high compared with the other correlations found.

B. The Application of Aggregation Theory

The money supply has conventionally been measured by calculating the simple sum of the dollar volume in each component (currency, demand deposits, savings account deposits, and so forth). Economic theory points out, however, that a necessary and sufficient condition for justifying the use of a simple sum as the method of aggregation is that all the components be perfect substitutes for one another.[33] The broader an aggregate, the less substitutable are its components and hence the less suitable is the simple sum method.

The current definition of L, as well as virtually any conceivable liquid assets aggregate, can be

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[33] See William A. Barnett, "Economic Monetary Aggregation: An Application of Aggregation and Index Number Theory," Journal of Econometrics, 1980, pp. 11-48, for a formal discussion of assumptions required for the validity of different aggregation schemes.

Chart 2

L and M1

Change from Four Quarters Earlier

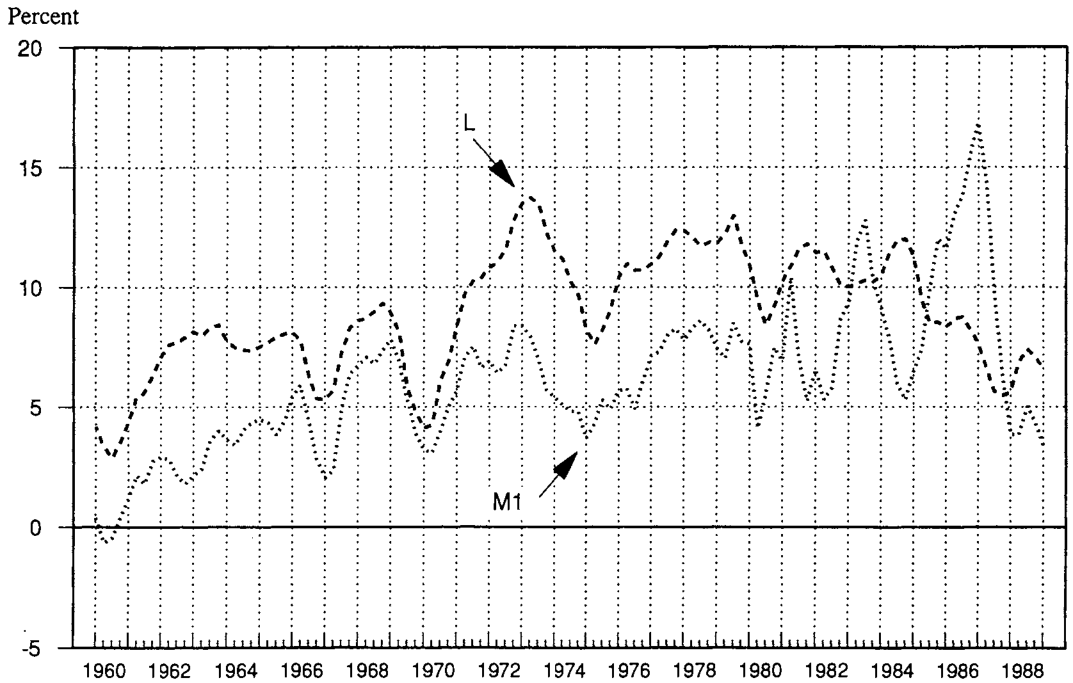

Chart 3

L and M2

Change from Four Quarters Earlier

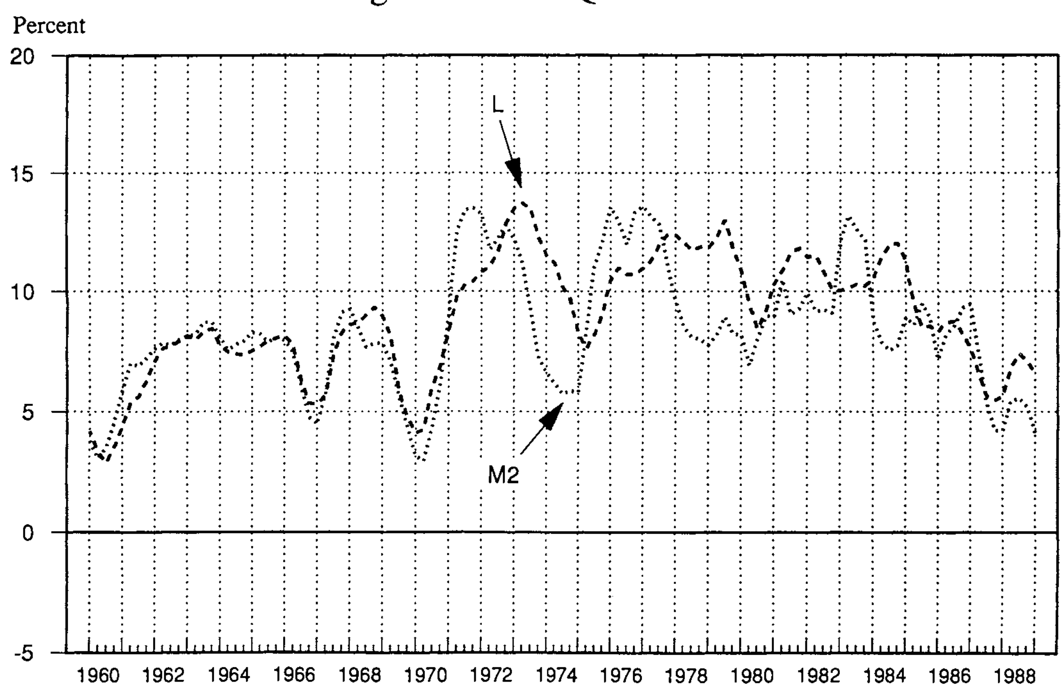

Chart 4

L and M3

Change from Four Quarters Earlier

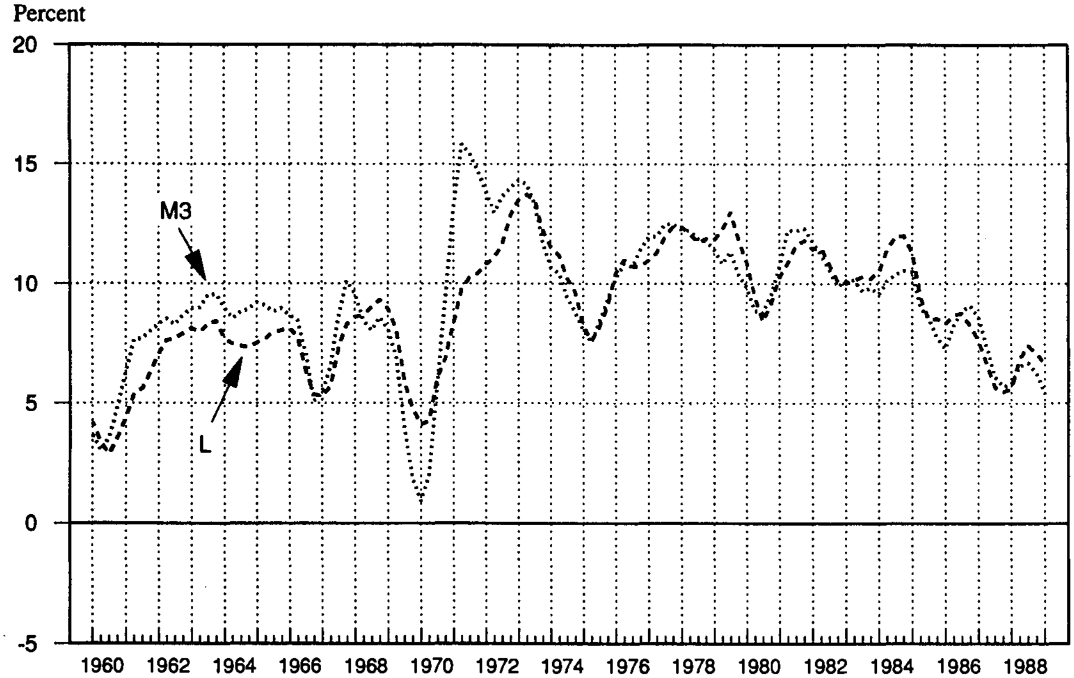

Chart 5

L and Nonfinancial Sector Debt

Change from Four Quarters Earlier

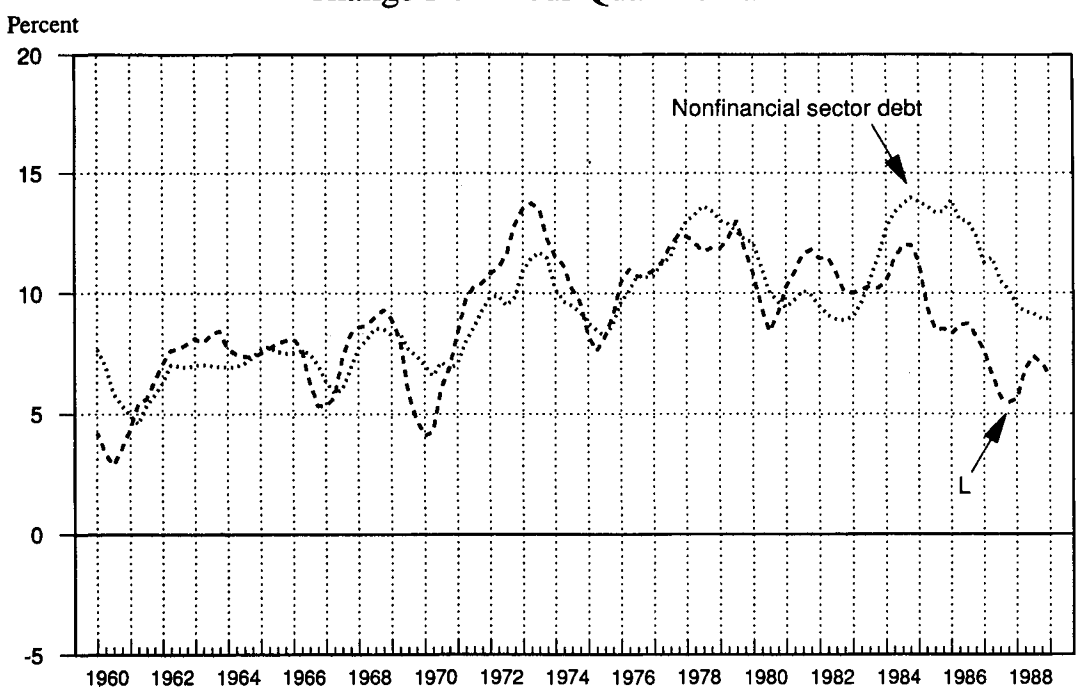

Table 2
Major Financial Aggregates: Descriptive Statistics

Relative Sizes of Financial Aggregates (As of June 1989)

	Dollar Volumes (In Billions)	Size in Relation to L (In Percent)
M1	770.8	16.3%
M2	3090.0	65.2
M3	3975.0	83.9
L	4739.3	100.0
Total Nonfinancial Sector Debt	9339.5	197.1

Annual Growth Rates (In Percent; 1960-88)

	Mean	Standard Deviation	Minimum	Maximum	Mean Absolute Change[1]
M1	6.2	3.1	0.4	15.6	2.2
M2	8.4	2.6	4.2	13.5	2.3
M3	9.3	2.8	1.9	14.7	2.2
L	9.0	2.5	3.6	12.8	1.8
Total Nonfinancial Sector Debt	9.4	2.4	5.3	13.9	1.2

Simple Correlations among the Annual Growth Rates of the Financial Aggregates (1960-88)

	M1	M2	M3	L	Total Nonfinancial Sector Debt
M1	1.00				
M2	0.44	1.00			
M3	0.35	0.78	1.00		
L	0.44	0.65	0.87	1.00	
Total Nonfinancial Sector Debt	0.71	0.34	0.43	0.69	1.00

Note: Annual growth rates are measured from fourth quarter to fourth quarter.

[1] This is the average change in the annual growth rate from one year to the next regardless of sign.

Table 3
Correlations among the Monetary and Credit Aggregates

1960-II to 1989-I	Monetary Base	M1	M2	M3	L	Total Nonfinancial Sector Debt
Monetary base	1.00					
M1	0.67	1.00				
M2	0.36	0.54	1.00			
M3	0.41	0.40	0.75	1.00		
L	0.57	0.43	0.61	0.83	1.00	
Total Nonfinancial Sector Debt	0.70	0.48	0.20	0.35	0.62	1.00

1960-II to 1974-III	Monetary Base	M1	M2	M3	L	Total Nonfinancial Sector Debt
Monetary base	1.00					
M1	0.74	1.00				
M2	0.38	0.69	1.00			
M3	0.52	0.63	0.87	1.00		
L	0.74	0.74	0.71	0.84	1.00	
Total Nonfinancial Sector Debt	0.79	0.56	0.37	0.49	0.78	1.00

1974-IV to 1989-I	Monetary Base	M1	M2	M3	L	Total Nonfinancial Sector Debt
Monetary base	1.00					
M1	0.63	1.00				
M2	0.29	0.46				
M3	0.20	0.30	0.68	1.00		
L	0.15	0.17	0.49	0.88	1.00	
Total Nonfinancial Sector Debt	0.35	0.24	-0.06	0.27	0.41	1.00

criticized on the grounds that it violates sound aggregation principles.[34] It has been argued that the components of L are not uniformly close substitutes because they serve different purposes for different groups in the economy. For example, repurchase agreements and overnight Eurodollar deposits may be close substitutes for large firms but not for households or small firms. Thus, shifts in the composition of L will tend to change its relationships with important macroeconomic variables. In this regard, economic research on the elasticities of substitution between monetary assets heavily supports the conclusion that substitutability between many of the components of the monetary aggregates is low.[35] In sum, it has been argued, the standard method of measuring may be seriously flawed when applied to broad measures of the money supply such as L. This criticism applies equally well to M3 and M2, although it is potentially more damaging for L.

In response, economists on the staff of the Board of Governors have tried to apply index number and aggregation theory rigorously to the measurement of the money supply. One specific approach they have taken has been to construct a monetary index based on money defined as the medium of exchange. This transactions-money-stock index is an alternative to the conventionally measured M1 and M2, the narrower definitions of the money supply.[36] A second approach has been to construct an index based on money defined as providing a broad range of services, including liquidity and store of value as well as means of payment.[37] This monetary-services (or Divisia) index for a particular aggregate is meant to capture the value of all services provided by the monetary assets in the aggregate. The Divisia aggregates are intended primarily as alternatives to M3 and L, because the assumptions required for simple-sum aggregation of these broad measures of the money supply are

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[34] Berkman, "Abandoning Monetary Aggregates."

[35] Barnett formally tested the suitability of the simple-sum approach and rejected it; see Barnett, "Economic Monetary Aggregation." An alternative, nonparametric test is reported by Michael T. Belongia and James A. Chalfant, "The Changing Empirical Definition of Money: Some Estimates from a Model of the Demand for Money Substitutes," Journal of Political Economy, vol. 97, no.2, pp. 387-97.

[36] Paul A. Spindt, "Money Is What Money Does: Monetary Aggregation and the Equation of Exchange," Journal of Political Economy, February 1985, pp. 175-204.

[37] The monetary services index is based on Friedman's restatement of the quantity theory of money, which defines money as providing a broad range of services rather than as transactions medium only. See Milton Friedman, "The Quantity Theory of Money: A Restatement," in Friedman, ed., Studies in the Quantity Theory of Money (Chicago: University of Chicago Press, 1956).

unlikely to be satisfied in practice.[38]

A monetary services index of L is constructed by giving a weight to each component of L equal to the value of monetary services provided per dollar by that component.[39] In turn, the monetary services provided per dollar by each component should be equal to the opportunity cost of holding the monetary asset instead of a higher yielding asset that provides absolutely no monetary services, such as a corporate bond. That is, the monetary services gained per dollar equals the difference between the expected total return from nonmonetary assets and the expected total return on that particular monetary asset, both calculated over the same holding period. In practice, opportunity cost has been measured by the difference between the market yield of a benchmark asset, such as the Baa rated corporate bond rate, and the actual or realized yield of the monetary asset.

In general, the growth rate of a monetary aggregate, to a first approximation, is equal to the weighted average of the growth rates of its components. For a conventionally computed measure of the money supply, the weight given to the growth rate of each component equals its dollar share of the total. For a monetary services index, the weight given to the growth rate of each component is approximately equal to its share of total monetary services provided, which in turn is proportional to the product of its dollar volume and its opportunity cost.[40] Hence, the growth rate of NOW account deposits is given less weight than money market mutual fund shares in calculating the growth of the simple sum measure of L since the dollar volume of deposits in NOW accounts is smaller ($273 billion for NOW deposits and $374 billion for money fund shares, as of July 1989). But NOW account deposits currently have a significantly higher opportunity cost than do money market mutual fund shares, and hence the growth rate of NOW account deposits would receive more weight in the monetary services index of L than would the growth rate of money market mutual fund shares.

A monetary services index of L (as for the other aggregates) has proven tricky to develop in practice. The basic problem is the correct measurement of the opportunity cost of the components of L. As mentioned above, the opportunity cost of holding a particular monetary asset, as well as the monetary services gained, is the difference between the expected total return from nonmonetary assets

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[38] William A. Barnett, Edward A. Offenbacher, and Paul A. Spindt, "New Concepts of Aggregated Money," Journal of Finance, May 1981, pp. 497-506.

[39] The practice has been to use chain index numbers, not weights fixed at a particular year.

[40] Strictly speaking, the weight of asset i is given by $s_i = (R-r_i)V_i/\{\sum(R-r_j)V_j\}$, where R is the expected return on the benchmark asset, r_i is the expected return on asset i, and V_i is the dollar value of the i-th asset in circulation.

(capital gains plus interest payments) and the expected total return of the monetary asset, both measured over the same holding period. In practice, it has been measured by the difference between the actual yields. Hence, a serious problem develops when the yield curve inverts such that the bond rate is below money market rates and the measured opportunity cost of components of L is negative. As a quick fix when this occurs, the highest rate posted by any of the components of L is used instead of the corporate bond rate so that the opportunity cost of the other components and the value of monetary services they provide are measured as positive.[41] But this is unsatisfactory and merely highlights the fundamental problem in trying to compute monetary-services indexes when reliable data on expected yields on nonmonetary assets are not available.

The experience with the monetary-services measure of L

From the first quarter of 1970 to the first quarter of 1988, the last full quarter for which Divisia L was calculated, the average annual growth rate of conventional L was 10.2 percent, compared with 7.3 percent for the monetary-services measure of L. Consequently, while the velocity of conventional L has declined about 1 percent per year, the velocity of monetary-services L has risen at an average rate of between 1.5 and 2 percent. Almost all of the velocity growth of the monetary-services index occurred in the four years 1978 to 1981.

As discussed in greater detail below, the Divisia index measures for L and the lower level aggregates did not live up to their theoretical promise, presumably because of the measurement problems cited. As a result, the staff of the Board of Governors abandoned this theoretically attractive approach to the compiling of monetary aggregates in May 1988.

C. Measurement Issues: Lines of Credit

We observed earlier that at least part of the rationale for focusing on a measure of liquid assets is the notion that the amount of liquidity, or readily accessible purchasing power, held by households and firms at least indirectly limits their spending. Households must hold liquid assets in reserve against the possibility of unemployment or an unexpected expense; business firms against the possibility of an unexpected expense or disappointing sales. If liquid reserves are not held in desired amounts, households and firms will presumably cut back their spending on goods, services, and inventories to

[41] The opportunity cost and hence the monetary services provided by the component of L serving as the benchmark asset will be zero in this situation--a result which is wrong but cannot be helped.

build up their liquidity. The dollar volume of liquid assets held by households and firms would seem, however, to be an inadequate measure of the amount of liquidity at their disposal. Many households and firms add to the readily available purchasing power at their disposal by establishing a line of credit, usually from a commercial bank,. The widespread use of prearranged lines of credit documented below not only indicates that liquid asset aggregates mismeasure the amount of liquidity in the economy, but also casts some doubt on the importance of liquidity constraints as a justification for using liquid asset aggregates in the formulation of monetary policy.

For business firms, the line of credit is usually provided by a commercial bank to finance inventories of materials and goods at the various stages of production. For households, the line of credit may be established to finance a major expense, such as college tuition or an addition to a house, or to consolidate small debts. Such credit lines can take several forms:

(i) unsecured, provided by a bank, and intended to give overdraft protection for the customer's checking account;

(ii) unsecured and accessible through a credit card or other means; or

(iii) secured by home equity.

The unused portion of a household's or firm's line of credit would seem to be a near-perfect substitute for holdings of liquid assets. That is, if a household's credit line were increased by $1000 and simultaneously its liquid assets were reduced by the same amount (and its total net wealth held constant), one would not expect the household's consumption behavior to be affected very much. In this case, the household's available liquidity is the sum of liquid assets it does hold *and* unused amounts of its credit lines.[42] Similarly, a firm with relatively little cash on hand is not truly constrained if it also has large unused amounts on its prearranged lines of credit.

Little can be done about this measurement problem at present. The data available on credit lines is limited, and certainly far too modest to establish whether and how aggregate measures of liquid assets should be adjusted for unused credit lines. Nevertheless, some information is available which gives a rough indication of the size of the measurement problem.

The Survey of Currency and Transactions Account Usage (1986) provides information on the

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[42] The individual's available liquidity would be close to, if not exactly equal to, the sum of liquid assets held and unused lines of credit, because unused lines of credit and liquid assets are unlikely to be perfect substitutes.

amount of credit available to households through their credit cards.[43] From the survey results, we would estimate that at the time of the survey each American family held an average of four credit cards.[44] If each card has an average unused credit line of $500, then there is $2000 of credit available from credit cards per family. Using an estimate of 125 million American families, we calculate that there is in the aggregate about $250 billion of unused credit card lines outstanding. This figure compares with $128 billion of consumer installment debt outstanding at the end of 1986, and with L measured at $4112 billion as of November 1986.

Open-end revolving lines of credit secured by home equity are also held by a significant number of American households. Another recent survey (1988) indicated that 5.6 percent of homeowners held (or had applied for at the time of the survey) a home equity line of credit.[45] Since about 60 percent of American families owned their own homes, about 3 percent of all families held (or had applied for) a home equity line of credit. The median amount of the line is around $31,250; the median proportion used is only 32 percent. From reports obtained from banks and other financial intermediaries, Canner, Luckett, and Durkin estimate the total debt outstanding on home equity lines of credit at $74 billion as of the end of December 1988. Taking the survey's finding that typically about one-third of the available credit line was used, we calculate that the total amount of credit still available from unused home equity lines would be around $150 billion--and growing rapidly.

In comparison with the estimated $400 billion of unused credit lines available to the household sector ($250 billion from credit cards and $150 billion from home equity lines), the business sector has about $625 billion of unused formalized loan commitments from insured commercial banks (as of December 1988). The data, collected from banks on the quarterly Reports of Conditions and Income, show that unused formalized commitments grew at a 9.2 percent annual rate from 1983 to 1988.[46] L

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[43] R B. Avery, George E. Elliehausen, Arthur B. Kennickell, and Paul A. Spindt, "Changes in the Use of Transactions Accounts and Cash from 1984 to 1986," Federal Reserve Bulletin, March 1987, pp. 179-96.

[44] The survey found that 71 percent of all families held at least one credit card, and among these families the mean number of cards per family was six.

[45] George C. Canner, Charles A. Luckett, and Thomas A. Durkin, "Home Equity Lending," Federal Reserve Bulletin, May 1989, pp. 333-44; and George C. Canner, Thomas A. Durkin, and Charles A. Luckett, "Recent Developments in the Home Equity Loan Market," Journal of Retail Banking, Summer 1989, pp. 35-47.

[46] The Federal Reserve System also collected data on unused formalized loan commitments from 112 large commercial banks beginning in July 1973, but the survey was discontinued in June 1987.

grew at a similar annual rate, 8.6 percent over the same period. The data also show that unused loan commitments increased more rapidly than commercial and industrial loans outstanding, which grew at an annual rate of 3.4 percent over the same period.

Combining the household and business sectors yields roughly $1 trillion of unused prearranged credit, compared with a volume of L on the order of $4 trillion. It is clear that the amount of available but unused credit is large enough to affect the relationship between the dollar volume of L and economic activity. Furthermore, unused credit lines may also alter the length of the lag between changes in Federal Reserve policy instruments and the effect on the volume of credit outstanding. If households and firms have prearranged credit lines, a tightening of Federal Reserve policy may induce firms and households to make initial use of their lines of credit as sales or personal income falter, and only sometime later would the demand for credit slow or contract.

The widespread use of lines of credit shows that a significant fraction of households and firms are not liquidity-constrained. This raises the question whether liquidity effects are sufficiently pervasive for measures of liquid assets to be of practical use in the formulation of policy. The existence of unused lines of credit will obviously weaken liquidity effects, but it is not sufficient to rule them out. As noted earlier, liquidity effects in consumption and investment may arise even if households and firms are not up against their liquidity constraints. The possibility of future rationing can be sufficient to induce current liquidity effects. The data on unused lines of credit also imply that a large share of firms and households, presumably those without collateral, do not necessarily have access to lines of credit. Thus, we can conclude that very broad liquid asset aggregates may not be very good measures of liquidity effects because they include liquid asset holdings by households and firms that are unlikely to be constrained in financial markets. It may be possible to define narrower liquid asset measures that correspond more closely to the theoretical rationale for their use, or to combine the amount of unused credit lines with the dollar volume of liquid assets to form a more accurate measure of liquidity. But how such measures could be constructed is an insoluble problem given the limited data we have at present. In the final analysis, whether broad liquid asset measures as currently defined are useful for the formulation of monetary policy can only be settled on empirical grounds. We review the empirical evidence in a later section.

D. Summary

In this section we have reviewed issues related to the measurement of a liquid asset aggregate. The Federal Reserve System's broadest liquid asset measure, L, is only 20 percent larger than and so highly correlated with M3 that it is not clear that it would provide significant additional information to policy makers. Simple sum monetary aggregates from M1 to L are subject to the criticism that their constituent assets are imperfect substitutes. Thus, on a priori grounds, one would not expect them to have stable relationships with macroeconomic variables of interest to policy makers. Nevertheless, efforts to apply aggregation techniques based on index number theory to the monetary aggregates were abandoned in 1988 because the Divisia aggregates, after considerable initial promise, proved to be no more reliable than the simple sum aggregates in the 1980s.

We estimated that unused prearranged credit lines of households and nonfinancial firms represent about one-quarter of L. The widespread availability of lines of credit indicates that L, or for that matter M3 or M2, may not capture liquidity effects in consumption and investment spending very well.

III. An Empirical Assessment of Liquid Asset Measures as Intermediate Targets

There are two crucial requirements for the use of a financial aggregate as an intermediate target:

(i) stability and predictability of the relationship between the intermediate target and macroeconomic goal variables such as the inflation rate or unemployment, and

(ii) stability and predictability of the relationship between policy instruments and the intermediate target.

In addition, data needed to construct the aggregate should be available promptly so as to allow timely adjustment of policy instruments in light of macroeconomic developments. The longer the delay in the availability of data, the more important the predictability and stability of these relationships become.

In this section we review the empirical evidence relevant to the use of a liquid asset aggregate as an intermediate target. We summarize earlier studies and also report the results of empirical work that we undertook to update the earlier studies. We find that the relationship between L and the monetary base is marginally more stable and predictable than that between M2 and the monetary base. Our results indicate that there is a stable long-run demand for L, suggesting that L could be used as a long-run nominal anchor for policy. The dynamic process whereby L adjusts to its long-run equilibrium value is slow, however, and is also subject to considerable uncertainty, as evidenced by poor out-of-sample simulation results and a structural break associated with the financial innovations and deregulation of the early eighties. Thus, we conclude that targeting L would not be a viable strategy. The slow adjustment of actual to desired holdings of liquid assets implies that policy makers may have to tolerate large and sustained deviations of L from its target path. Furthermore, setting target paths for L over short- and medium-term horizons would be difficult given the risks in forecasting the demand for L and the delays involved in collecting data on some components of L.[47]

A. L and Policy Objectives

It has become standard practice to evaluate the stability of the relationships between monetary aggregates and goal variables in one or more of three ways:

(i) the analysis of the behavior of the aggregate's income velocity using summary statistics such as growth rates and deviations from trend,

(ii) the statistical stability of estimated demand equations for the aggregates, and

(iii) reduced-form regressions, either of the form popularized by Anderson and Jordan[48] or vector autoregressions, a simple generalization of the Anderson-Jordan reduced-form methodology introduced into monetary analysis by Sims.[49]

In our analysis of the potential of L as an intermediate target we concentrate on velocity analysis and the stability of an estimated demand equation. The use of reduced-form regression results to draw policy conclusions--for example, conclusions about the potential value of a particular monetary aggregate as an intermediate target--is subject to two criticisms. First, the results can be interpreted in conflicting ways on the basis of different structural models and, second, the estimated relationships cannot be exploited by policy because the parameters are not independent of the policies in place.[50] But vector autoregressions are a convenient means of summarizing the predictive content of economic

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[47] The data lag is about one month, primarily because of the delay in obtaining data on offshore deposits.

[48] See Leonall C. Anderson and James L. Jordan, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," Federal Reserve Bank of St. Louis Review, vol. 50 (1968), pp. 1-24.

[49] Christopher A. Sims, "Money, Income and Causality," American Economic Review, vol. 62 (1972), pp. 540-52.

[50] See Albert Ando and Franco Modigliani, "The Relative Stability of Monetary Velocity and the Investment Multiplier," American Economic Review, September 1965, pp. 693-728, for a statement of the first point; and Robert E. Lucas, Jr., "Econometric Policy Evaluation: A Critique," in Karl Brunner and Alan Meltzer, eds., The Phillips Curve and Labor Markets, for the classic statement of the second. Thomas F. Cooley and Stephen Leroy, "Atheoretical Macroeconometrics: A Critique," Journal of Monetary Economics, vol. 16, pp. 283-308, discuss the limitations of vector autoregression methodology.

variables. Therefore, vector autoregression results are presented later when we discuss the use of L as an indicator. We should note, however, that the use of estimated demand equations to derive conclusions about intermediate targeting is subject to the Lucas critique--that the demand equation is not a true structural form and is therefore unlikely to be invariant to changes in policy regime.[51] Thus, our results are merely suggestive and do not represent firm conclusions.

The behavior of velocity and the demand for L

The relationship between monetary aggregates and nominal GNP over the medium-term horizon remained relatively stable from the end of World War II until 1980, with the GNP velocity of M1 rising steadily at a rate of about 3 percent per year and that of M2 declining at about 0.1 percent. The velocity of L showed a tendency to contract slowly (less than 1 percent per year), similar to the trend of the other broad financial aggregates (see Table 4). The velocities of L and Total Debt tended to be the most stable.

During the 1970s, debates over the advisability of monetary targeting were largely concerned with the behavior of velocity (or the demands for different monetary aggregates) over higher-than-business-cycle frequencies. Short-run instabilities in the money demand function became more pronounced during the mid-1970s, prompting the redefinition of the monetary aggregates in 1980. However, in retrospect, these instabilities appear minor compared with the dramatic breakdown, from 1980 onwards, of the long-run relationship between monetary aggregates and income. Structural change in financial markets, brought about by financial innovation and deregulation in the early eighties, has reversed the previous steady rise in the velocities of the financial aggregates (Charts 6 and 7). The most dramatic decline in the velocities of the major financial aggregates occurred from 1982 to 1987. During this period, M1 velocity declined at an annual rate exceeding 2.4 percent, while the velocities of M2 and L declined by about 1.7 percent and 1.4 percent, respectively. The trend towards lower velocities was reversed in 1988; all the aggregates posted modest increases thereafter.[52]

Table 5 reports velocity trends and deviations from trend for L and M2 from the first quarter

[51] Lucas, "Econometric Policy Evaluation."

[52] The annual rates of change of velocity for the major aggregates from 1981-IV to 1987-IV were as follows: -2.44 percent for M1, -1.44 percent for M2, -1.67 percent for M3, and -1.91 percent for L. From 1987-IV to 1989-III the annual percentage changes were 4.43 percent for M1, 1.99 percent for M2, 2.09 percent for M3, and 1.11 percent for L.

Table 4
Velocity Growth Rates: Major Financial Aggregates

Aggregate	Mean	Annual Growth Rates: 1960-88 (In Percent) Standard Deviation	Minimum	Maximum	Mean Absolute Change[1/]
M1	2.0	3.5	-9.4	6.2	3.2
M2	-0.1	2.8	-5.4	6.3	3.1
M3	-1.0	2.6	-6.1	5.3	3.0
L	-0.6	2.1	-6.3	2.7	2.6
Total Nonfinancial Sector Debt	-1.0	2.4	-6.8	3.1	2.3

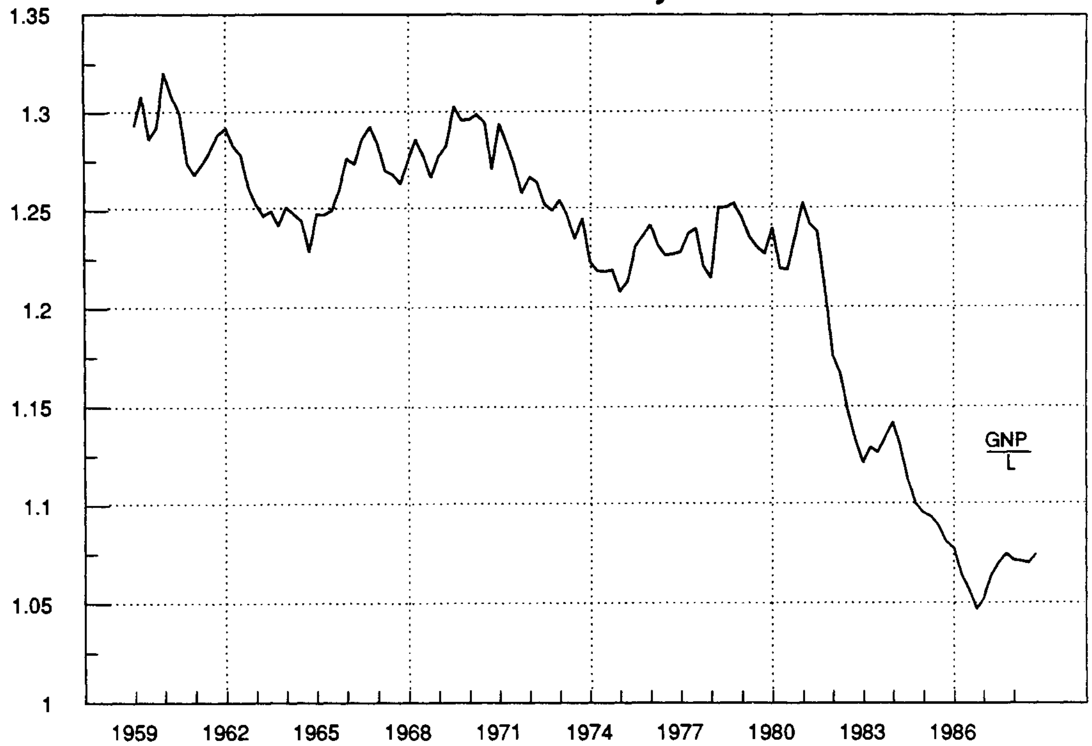
Note: Annual growth rates are measured from fourth quarter to fourth quarter.
[1/] This is the average change in the annual growth rate from one year to the next regardless of sign.

of 1959 to the first quarter of 1989. The results were obtained by fitting time trends, both with and without correction for serial correlation, to quarterly data. Average deviations from trend were calculated by expressing the standard error of the regression as an annualized percentage growth rate.[53] The table shows that the velocity of L declined at an annual rate of about 1.5 percent since 1979. Although this rate of decline is substantially higher than the average annual rate of decline of 0.6 percent over the whole period, the difference is not statistically significant. M2 velocity, by contrast, has not exhibited a statistically significant trend over the 1959-89 period or, more surprisingly, from 1979 to 1989. When serial correlation is taken into account, deviations from trend velocity are smaller for L than for M2 over the sample, despite the rapid contraction of L velocity during the eighties and the absence of such a tendency in M2 velocity. But we should not give too much weight to this result, because the available evidence suggests that deviations from M2 trend velocity are eliminated over time while those for L are not. The Said-Dickey test statistics (S-D) in

[53] Thus, the deviation calculated from a regression with correction for serial correlation is a measure of the variability of the uncertain component of velocity--the component that cannot be forecast by a time trend and serial correlation. It is naturally much smaller than the deviation calculated from a trend regression without serial correlation correction.

Chart 6

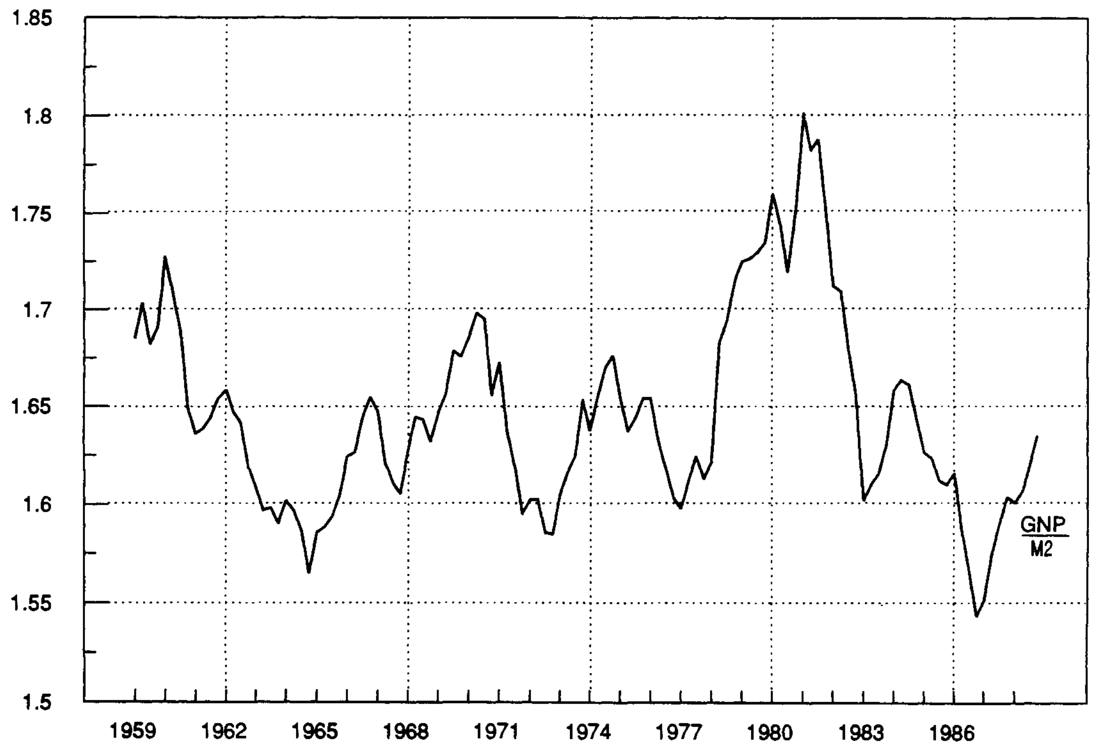
L Velocity



Note: Quarterly observations for L are averages of monthly data.

Chart 7

M2 Velocity



Note: Quarterly observations for M2 are averages of monthly data.

Table 5

L and M2 Velocities: Descriptive Statistics

Period	Trend	Deviations from Trend: Average	Maximum	Minimum
L Velocity				
1959-I to	-0.60**	14.45	31.88	-26.54
1989-I	-0.58^{s**}	3.87^{s}	13.19^{s}	-9.32^{s}
1959-I to	-0.19*	6.25	12.31	-12.76
1969-I	-0.16^{s}	3.56^{s}	9.63^{s}	-6.63^{s}
1969-II to	-0.54**	6.06	11.34	-11.11
1979-I	-0.44^{s*}	3.73^{s}	11.34^{s}	-7.07^{s}
1979-II to	-1.85**	9.12	22.29	-12.15
1989-I	-1.44^{s**}	4.08^{s}	8.47^{s}	-8.59^{s}
SD	-1.44			
M2 Velocity				
1959-I to	0.01	12.86	41.36	-23.49
1989-I	-0.01^{s}	4.61^{s}	15.31^{s}	-12.46^{s}
1959-I to	-0.39**	8.17	16.97	-15.18
1969-I	-0.30^{s}	3.86^{s}	10.21^{s}	-8.07^{s}
1969-II to	0.01	9.27	20.54	-13.80
1979-I	0.26S^{s}	4.71^{s}	13.93^{s}	-7.98^{s}
1979-II to	-1.14**	10.52	26.49	-17.51
1989-I	-0.65^{s}	5.33^{s}	14.04^{s}	-12.66^{s}
SD	-3.11*			

Notes: Measures are expressed as annual percentage changes.
Statistics are based on trend regressions.
A superscript "s" indicates that first-order serial correlation correction was used.
SD is the Said-Dickey statistic to test for a unit root.

** indicates significance at the 1 percent level.

Table 5 confirm this pattern. The hypothesis that velocity is a random walk with drift can be rejected at the 5 percent level for M2 but not for L.[54] However, as shown in Charts 8 and 9, movements in the velocities of L and M2 relative to trend correlate closely with movements in interest rates on alternative assets, so that this conclusion may be reversed when the demands for L and M2 are modeled more explicitly.[55]

The demand for liquid assets

Earlier studies. When the monetary aggregates were redefined in 1981, the Board staff economists did a comprehensive study of the econometric properties of the new and old aggregates.[56] To analyze the broad monetary aggregates, a portfolio model was used to specify the public's demands for M2, M3, and L. (An inventory model was used to specify the demand for M1.) In the demand equation for L, the share of nominal household net worth held in L was determined by the three-month Treasury bill rate, the commercial bank passbook rate, the maximum rate on commercial bank time deposits, the ratio of nominal GNP to household net worth, and the share of household net worth held in L the previous quarter. The results obtained from estimating this model were somewhat unsatisfactory, as were the results from the estimation of comparable models for M2 and M3. The coefficient estimates were very sensitive to the sample period, they sometimes had the "wrong" sign, and the t-statistics often indicated coefficients insignificantly different from zero. Nevertheless, in a postsample simulation, the demand equation for L did relatively well. These results quickly became outdated, however, when the ceilings on the interest rates banks could pay depositors were removed.

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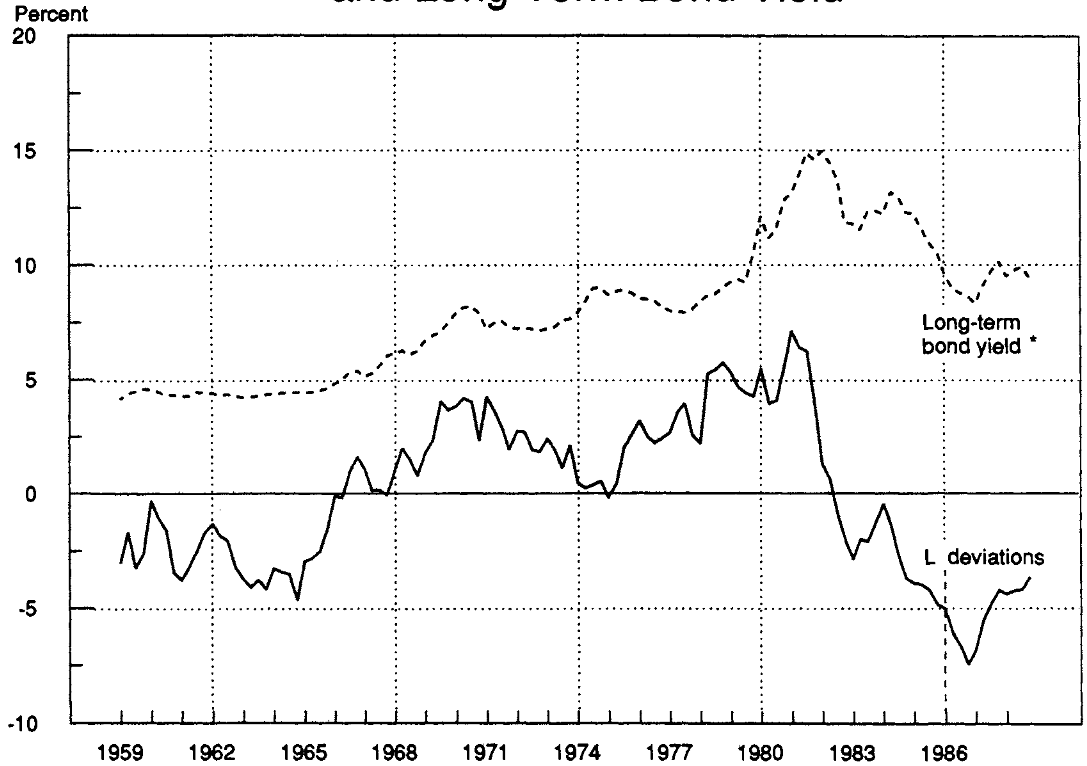
[54] The Said-Dickey statistic is used to test whether a general autoregressive moving average process has unit roots. See Said E. Said and David A. Dickey, "Testing for Unit Roots in Autoregressive Moving Average Models of Unknown Order," Biometrika, vol. 71 (1984), pp. 599-607. This statistic is more commonly used in tests for cointegration and known as the augmented Dickey-Fuller statistic after the terminology used by Robert F. Engle and Clive W. J. Granger, "Cointegration and Error Correction: Representation, Estimation and Testing," Econometrica, vol. 55 (1987), pp. 251-76. The result that L velocity is not trend-stationary should be interpreted with some caution because of the poor power of the Said-Dickey test.

[55] The relevant interest rate for L is taken to be Moody's AAA corporate bond yield, and for M2 we use the six-month commercial paper rate.

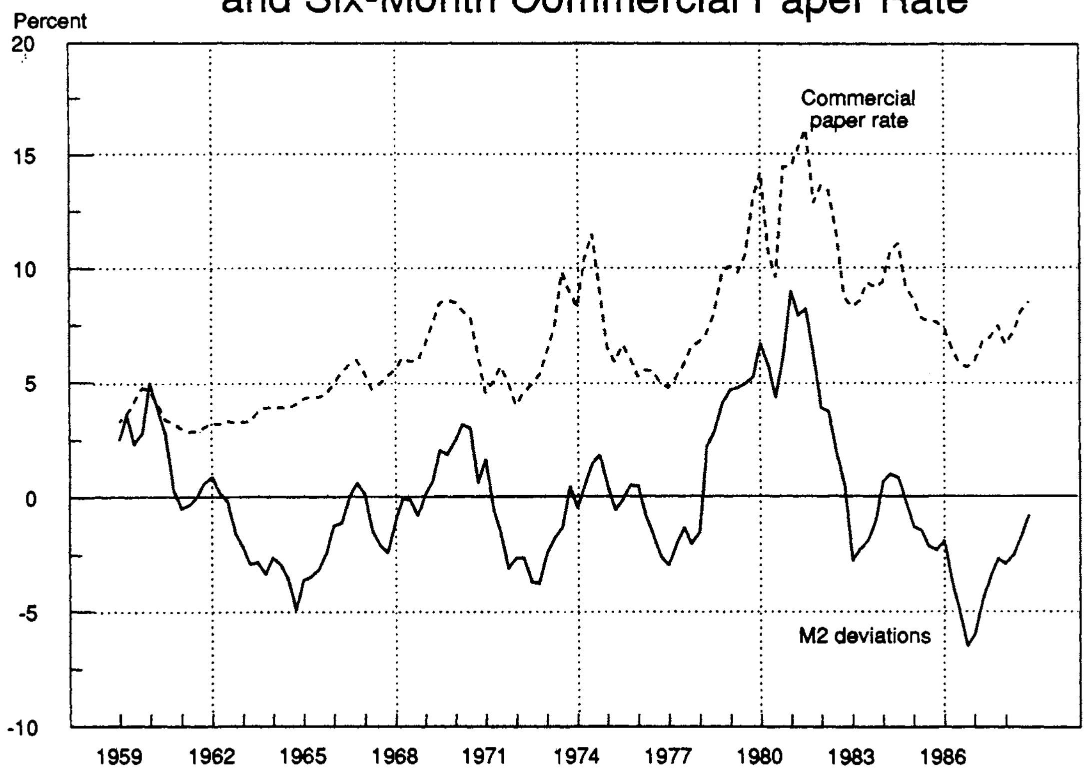
[56] David C. Bennett, Flint Brayton, Eileen Mauskopf, Edward K. Offenbacher, and Richard D. Porter, "Econometric Properties of the Redefined Monetary Aggregates," Board of Governors of the Federal Reserve System memorandum, February 1980. Some of the estimation results are also reported by Berkman, "Abandoning Monetary Aggregates."

Chart 8
L Velocity Deviations from Trend and Long-Term Bond Yield



* Moody's AAA corporate bond yield.

Chart 9
M2 Velocity Deviations from Trend and Six-Month Commercial Paper Rate



The passbook savings rate became essentially irrelevant, and the rates paid on small time deposits adjusted to Treasury bill rates with only minor time lags.

Reduced-form equations for the monetary aggregates were also estimated. The explanatory power of L for nominal GNP was greater than that of M1 or M3, but less than that of M2. In out-of-sample simulations, L again did well relative to the other aggregates, providing slightly more accurate forecasts of nominal GNP growth than M1 and M3 and slightly less accurate forecasts than M2.[57]

Besides the work of the Board staff economists, Frank Morris reports the results of estimating the public's demand for M1, L, and total debt.[58] All three econometric equations have the same inventory-theory specification and use the same explanatory variables. The equations are estimated over the period 1959-73 and are then used to predict the aggregates' income velocity from 1974 to 1981. The annual forecasting errors of L are not quite as good as those of total debt, but both L and total debt perform far better than M1.

Most other econometric studies of liquid asset measures have attempted to apply aggregation methods more refined than those used in the construction of L. The early findings of Barnett, Spindt, and Offenbacher on a monetary-services index of L were encouraging. They used data covering the 1960s and 1970s and applied several methodologies: Granger causality, stability of velocity, simulation performance of demand equations, and stability and simulation performance of both portfolio allocation equations and reduced-form equations. In nearly all cases, a monetary aggregate measured by a monetary-services index was superior to a simple sum aggregate; the advantages of Divisia aggregation appeared more evident the more broadly money was defined. These results promised that more rigorous aggregation methods would in fact provide more informative measures of the money supply.[59]

Unfortunately, later results for the Divisia aggregates, obtained by adding data from the years

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[57] Berkman also ran reduced-form equations explaining the growth of real GNP and the inflation rate. L performed relatively poorly in forecasting real growth and relatively well in predicting prices, although Berkman felt the differences in performance of different aggregates were not economically meaningful. See Berkman, "Abandoning Monetary Aggregates."

[58] See the Appendix to Morris, "Do the Monetary Aggregates Have a Future as Targets of Federal Reserve Policy?"

[59] William A. Barnett, Paul A. Spindt, and Edward K. Offenbacher, "Empirical Comparisons of Divisia and Simple Sum Monetary Aggregates," Board of Governors of the Federal Reserve System, Special Studies Paper no. 158, July 1981.

1980-85, were judged by Lindsey and Spindt to be quite disappointing.[60] Standard demand functions were estimated for the conventionally measured aggregates and for monetary services L by using, for each aggregate, an average opportunity cost.[61] For each conventionally measured aggregate, the opportunity cost was the difference between the three-month Treasury bill rate and its weighted-average offering rate; for monetary-services L, the opportunity cost was the index of "user cost" used to construct the monetary-services index. The estimated income elasticity of the demand for Divisia L was found to be negative, although insignificant. (The regression equations were estimated from 1971 to 1979.) In simulations over the period 1980-85, the prediction errors of monetary-services L were unacceptable, larger than the errors of each conventionally defined monetary aggregate. The poor performance of monetary-services L was attributed to mismeasurement of opportunity cost. In simple reduced-form equations relating the growth of nominal GNP to fiscal policy and growth of monetary services L, the R-bar squared was actually negative.

Recent experience with the demand for liquid assets. To explore the stability of the demand for liquid assets, we specify a quasi-reduced form demand equation for L.[62] In principle, the demand for L depends on factors such as real income, real wealth, and the opportunity cost of holding each of its components. However, the own rates of return on assets included in L are not exogenous and respond to changes in the yields on alternative assets. Similarly, real wealth holdings depend on income and real interest rates. Thus, a model of the demand for L that uses opportunity cost measures and real wealth as explanatory variables is incomplete without models explaining the interrelationships among the own rates of return on assets in L, the interrelationships between own rates and yields on alternative assets, and the relationship between real wealth, real GNP, and interest rates. We do not model these relationships explicitly. Rather, to simplify the analysis we substitute them into the demand for L to obtain a conventional specification of the demand as a function of rates of return on

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[60] David E. Lindsey and Paul A. Spindt, "An Evaluation of Monetary Indexes." Earlier results were reported in Paul A. Spindt, "Money Is What Money Does: Monetary Aggregation and the Equation of Exchange."

[61] See Appendix D of the Lindsey and Spindt paper.

[62] For an example of this approach applied to the demand for M2, see John P. Judd, Brian Motley, and Bharat Trehan, "The Demand for Money: Where Do We Stand?" Federal Reserve Bank of San Francisco, Working Paper no. 88-02, July 1988.

alternative assets, real income, and the inflation rate.[63] This strategy naturally implies shifts in the demand for liquid assets, as we specify it, when the relationships among own rates and between own rates and the rates on alternative assets change, as they did in the wake of financial deregulation and innovation in the early eighties.

We model the demand for liquid assets in a cointegration-error correction framework.[64] That is, we use two equations to represent demand. The first, or cointegrating equation, captures the long-run relationship between the real value of L demanded and its determinants. The dynamic process whereby the real quantity of L outstanding adjusts to its long-run equilibrium value is captured by the second equation, or error correction model. The cointegration-error correction framework is appropriate because the variables used to explain the demands for financial asset aggregates are generally nonstationary. This framework is also intuitively appealing. It is not difficult to imagine a stable long-run demand for liquid assets, despite a changing institutional and regulatory environment. Financial institutions respond to regulations governing interest payments on deposits, for example, by devising new instruments or providing services that provide asset holders with nonpecuniary interest payments. Thus, the removal of interest rate regulations may change the form but not the value of interest payments to deposit holders, and therefore may leave the long-run demand for liquid assets unaffected. At the same time, we would expect the removal of interest rate regulations to affect the dynamic adjustment of the value of liquid assets outstanding, because it allows financial institutions to change interest rates on their deposits quickly in response to changes in the yields on alternative assets, rather than changing over time the services that provide implicit interest payments to deposit holders.

The long-run demand for, or desired, real L is based on an equation of the form

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[63] Formally, we assume a demand of the form

$$L/P = F\{Y, W/P, R_A, r_L, \pi\},$$

where L/P is real L, Y is real income (GNP), W/P is real wealth, and π is a measure of inflation. Interest rates on assets included in L are denoted by the vector r_L, while R_A represents nominal interest rates on alternative assets L. We then substitute the equilibrium relationships between the own rate of return on L and the return on alternative assets,

$$r_L = H(R_A),$$

and between wealth, real GNP, nominal interest rates and inflation,

$$W/P = G(Y, R_A, r_L, \pi),$$

into this demand equation to get the semireduced form

$$L/P = M(Y, R_A, \pi).$$

[64] See Engle and Granger, "Cointegration and Error Correction."

(1) $\log_e(L_t/P_t) = \gamma_0 + \gamma_1 T_t + \gamma_2 \log_e(Y_t/P_t) + \gamma_3 LBR_t + \gamma_4 \pi_t + \varepsilon_t,$

where P is the GNP deflator, T is a time trend, Y/P is real GNP, LBR is a long-term bond rate, π is the inflation rate,[65] and ε an error. The dynamic adjustment of real L to its desired value is modeled as an error-correction equation of the form

$$(2)\ \Delta\log_e(L_t/P_t) = \delta_0 + \delta_1 e_{t-1} + \sum_{j=1}^{n} \delta_{2,j}\Delta\log_e(Y_{t-j}/P_{t-j}) + \sum_{j=1}^{n} \delta_{3,j}\Delta LBR_{t-j}$$

$$+ \sum_{j=1}^{n} \delta_{4,j}\Delta\pi_{t-j} + \sum_{j=1}^{n} \delta_{5,j}\Delta\log_e(L_{t-j}/P_{t-j}),$$

where e denotes the residual from the long-run demand equation, equation (1), and Δ is the difference operator. That is, the rate of change of real L depends on its own past, the lagged deviation of the actual from the desired level of real L, lagged rates of change of real GNP, and lagged changes in the levels of long-term interest rates and inflation.

Estimation results for the demand for liquid assets are given in Table 6. In the table we present three regressions:

(i) an estimated long-run demand for L (equation 1),

(ii) the estimated error-correction model (equation 2) governing the adjustment of liquid assets to their desired level implied by the long-run demand equation, and

(iii) an augmented Dickey-Fuller regression for testing the hypothesis that the long-run demand equation is a cointegrating regression.

After some experimentation with different long-term bond yields and holding-period returns, Moody's AAA corporate bond yield was chosen as the relevant long rate. Inflation is measured by the annualized quarterly rate of change of the GNP deflator.

The estimated long-run income elasticity of the demand for L, 0.57, is surprisingly low. But this result is not inconsistent with the postwar decline in L shown in Table 4 and Chart 6; both GNP and

[65] The inflation rate enters the demand equation for two reasons: to capture substitution between money and commodity holdings, and because we have written the relationship between real wealth and its determinants in terms of nominal interest rates.

Table 6
Demand for L

Cointegrating Regression
Dependent Variable: log(L/P)

Regressors

Constant	Trend	log(Y/P)	LR	π
-1.671	0.006	0.573	-1.059	-0.453
(0.386)	(0.0004)	(0.052)	(0.122)	(0.074)

$R^2 = 0.997$
DW = 0.37

Error-Correction Model
Dependent Variable: $\Delta\log(L/P)$

Regressors

Constant	$\Delta\log(L/P)_{-1}$	$\hat{e}_{-1}$	ΔLR_{-1}	$\Delta\pi_{-1}$	$\Delta^2\log(Y/P)_{-2}$
0.004**	0.616**	-0.059*	-0.336**	0.062**	0.078*
(0.001)	(0.073)	(0.031)	(0.116)	(0.027)	(0.041)
$(0.001)^W$	$(0.078)^W$	$(0.029)^W$	$(0.096)^W$	$(0.024)^W$	$(0.035)^W$

$R^2 = 0.49$
DW = 1.95
Durbin t = 0.138

Augmented Dickey-Fuller Regression
Dependent Variable: $\Delta\hat{e}$

Regressors

Constant	$\hat{e}_{-1}$	$\Delta\hat{e}_{-1}$	$\Delta\hat{e}_{-2}$	$\Delta\hat{e}_{-3}$	$\Delta\hat{e}_{-4}$	$\Delta\hat{e}_{-5}$
-0.00003	-0.218**	0.006	0.028	0.055	0.142	0.137
(0.0009)	(0.067)	(0.101)	(0.101)	(0.099)	(0.099)	(0.097)

$R^2 = 0.12$
DW = 1.97
Durbin t = 0.044

Notes: Sample period: 1959-I to 1989-I.
$\hat{e}$ denotes the residuals from the cointegrating regression.
Standard errors are given in parentheses; those superscripted by a "W" are based on White's heteroskedasticity-consistent estimate of the covariance matrix.
T-statistics for the cointegrating regression do not have the standard distribution.

* indicates significance at the 5 percent level.
** indicates significance at the 1 percent level.

the demand for L have strong trend components. A 1 percentage point increase in the corporate bond yield lowers the demand for real liquid assets by about 1 percent in the long run, and a 1 percentage point increase in inflation lowers it by about 1/2 of 1 percent. Including rates of return on assets in L (for example, the three-month Treasury bill rate and the six-month commercial paper rate) does not add significantly to the explanatory power of the long-run demand equation.[66]

The cointegration tests discussed below indicate that the estimated equation is in fact a stable long-run relationship. This relationship may be stable because, as we speculated earlier, the supply of liquid assets is demand determined in the long run. Alternatively, we can interpret its stability as an ex post property generated by the redefinition of financial asset aggregates. The estimated coefficients in the long-run demand for real L are consistent estimates of the long-run responses of real liquid asset holdings to changes in right-hand side variables despite the endogeneity of the regressors. The usual simultaneity problems do not arise because the variables in the regression are not stationary. However, for the same reason, the ratios of estimated coefficients to their standard errors do not have the usual t-distribution.[67] The explanatory variables are nevertheless clearly significant.

The estimated error correction model indicates that 6 percent of the discrepancy between actual and desired real liquid asset holdings is eliminated each quarter if lagged values of real income, nominal interest rates, inflation, and real liquid assets are held constant. Adjustment is more rapid if the deviation between actual and desired liquid asset holdings is attributable to changes in long-term interest rates or real GNP; adjustment is slower if the deviation is due to a change in inflation. Note, however, that real L responds much more rapidly to interest rate changes than to real GNP or inflation rate changes. For example, 2/5 of the 1 percent decrease in the long-run demand for real L in response to a 1 percentage point increase in the nominal long-term corporate bond yield occurs within one quarter. By contrast, only 6 percent of the change in real L in response to a real GNP change occurs in the first quarter; another 14 percent occurs in the second quarter after the shock.[68] As in the case of the long-run demand for L, yields on assets included in L do not add significantly to the

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[66] For space considerations these results are not shown.

[67] See Clive W. J. Granger and Paul Newbold, "Spurious Regressions in Econometrics," Journal of Econometrics, vol. 2 (1974), pp. 111-20, for a discussion of the "spurious regressions" problem that arises when a relationship between nonstationary variables is estimated by ordinary least squares.

[68] These calculations are only first approximations; we can obtain more accurate responses by calculating total multipliers taking both the long-run demand equation and the error-correction models for all four variables into account.

explanation of the adjustment dynamics of holdings of L.[69]

Real L, as well as the variables in the long-run demand for L, is nonstationary. Thus, to test whether the estimated long-run demand for L does in fact represent a stable long-run relationship--that is, whether the variables in the equation are cointegrated--we test whether the residuals from the cointegrating regression are stationary. The null hypothesis of nonstationarity is tested by the augmented Dickey-Fuller test, which establishes whether the lagged level of the residual enters with a significantly negative coefficient in a regression of the change of the residual on lagged changes and the lagged level of the residual. Two difficulties are associated with the augmented Dickey-Fuller test: the critical values for the test are very sensitive to the number of parameters estimated in the cointegrating regression, and the test has very low power.[70] The test rejects at the 1 percent level the null hypothesis that the residuals from the long-run demand equation are nonstationary if Fuller's critical values are used and at the 5 percent level with the Granger and Engle critical values. However, when Engle and Yoo's critical values are used, we can only reject the null hypothesis in a one-tailed test at a confidence level between 5 percent and 10 percent. Thus, the evidence in favor of the existence of a stable long-run relationship is not unambiguous. An alternative test, the cointegrating regression Durbin-Watson (CRDW) test, rejects the null hypothesis of nonstationarity if the Durbin-Watson statistic is large enough. In this case, it rejects nonstationarity at a significance level greater than 5 percent but less than 10 percent.[71] However, this test is known to be sensitive to the parameters under the null. Whether a cointegrating relationship is found is asymptotically independent of the normalization of the long-run relationship. However, nonstationarity of the

[69] Results are not shown.

[70] Critical values are obtained by Monte Carlo experiments. The most commonly used critical values are those given in Wayne A. Fuller, Introduction to Statistical Time Series, p. 373 (values which, strictly speaking, should only be used in testing for unit roots) and those given in Granger and Engle, "Cointegration and Error Correction" (which assume that there are only two variables in the cointegrating regression). Robert F. Engle and Byung Sam Yoo, "Forecasting and Testing in Cointegrated Systems," Journal of Econometrics, vol. 35 (1987), pp. 143-59, provide critical values for some cases where more than two variables are included in the cointegrating regression. A quick perusal of Engle and Yoo's Table 3 reveals, surprisingly, that the critical values do not decrease monotonically in the number of observations in the sample. For this reason, we decided not to base our inferences on this table of critical values alone.

[71] To reject at the 5 percent level the null hypothesis that the residuals from the cointegrating regression have a unit root, the Durbin-Watson statistic for the cointegrating regression must exceed a critical value of 0.386. The critical value at the 10 percent level of significance is 0.322. Thus the true P-value for this test is much closer to 5 percent than to 10 percent.

residuals cannot be rejected when the corporate bond yield is chosen as the left-hand-side variable, but this result may be attributable to the size of the sample. Thus, on this evidence, and taking into account the power properties of tests for nonstationarity, we tentatively conclude that the estimated long-run demand equation captures a stable long-run relationship.

Error correction equations for the other variables in the long-run demand for liquid assets are shown in Table 7. For each of these equations we derived the residuals for the estimation of the error correction term, which indicates the speed of adjustment of the dependent variable towards the long-run equilibrium relationship captured by the cointegrating regression, from a renormalized long-run relationship with the same left-hand-side variable.[72] Three results are worth noting: Real GNP adjusts very slowly--the coefficient on the error correction term is not significantly different from zero. The effects on the adjustment process of changes in real L are largely reversed after four quarters. Finally, the inflation rate adjusts surprisingly rapidly, a quarter of the deviation between the actual inflation rate and the equilibrium inflation rate is eliminated each quarter, and adjustment in response to changes in real liquid assets is particularly rapid.

Stability. It is not possible to test directly whether the parameters in the long-run demand for L were stable over time, but cointegration is in itself evidence of long-run stability. It is reasonable, however, to expect the dynamic adjustment of the demand for L to have changed as a result of the financial innovations and deregulation of the early eighties and to test for such a change. Liquid financial assets introduced in the early 1980s, such as money market mutual funds, money market deposit accounts, and time deposits with resettable or guaranteed minimum interest rates, yield returns that respond quickly and flexibly to movements in market-determined rates on alternative assets. These assets serve to tie the own return on L more closely to long-term free market rates. Because the own rate of return on L can respond more flexibly to movements in long-term free market interest rates, we would expect a greater share of the response to such movements to take the form of changes in the rates of return on liquid assets rather than expansion or contraction of the volume of liquid

[72] The cointegrating equation only captures a statistical long-run equilibrium relationship. We chose to interpret this relationship as a demand for real liquid assets. However, it could as well be interpreted as a model of the equilibrium inflation rate. Associated with the cointegrating relationship are error corrrection equations for each of the included variables. Together, these equations capture the adjustment process whereby the long-run equilibrium is attained.

Table 7
Estimated Coefficient Values of the Error Correction Models

Regressors	Dependent Variable		
	$\Delta\pi$	ΔRL	$\Delta\log(Y/P)$
Constant	-0.007*	0.0003	0.006**
	(0.003)	(0.0004)	(0.002)
	$(0.003)^W$	$(0.0004)^W$	$(0.002)^W$
$\hat{e}_{-1}$	-0.268*	-0.137**	-0.039
	(0.115)	(0.039)	(0.040)
	$(0.122)^W$	$(0.043)^W$	(0.045)
$\Delta\log(Y/P)_{-1}$			0.193*
			(0.091)
			$(0.085)^W$
$\Delta^2\log(Y/P)_{-2}$			0.154*
			(0.066)
			$(0.062)^W$
ΔLR_{-2}			-0.472*
			(0.185)
			$(0.178)^W$
ΔLR_{-5}			-0.642**
			(0.196)
			$(0.154)^W$
$\Delta\log(L/P)_{-2}$	0.684*		0.578**
	(0.289)		(0.173)
	$(0.308)^W$		$(0.197)^W$
$\Delta\log(L/P)_{-3}$			-0.370**
+			(0.111)
$\Delta\log(L/P)_{-4}$			$(0.117)^W$
$\Delta\log(L/P)_{-5}$			0.271*
			(0.136)
			$(0.122)^W$
$\Delta\pi_{-1}$	-0.355**		
	(0.117)		
	$(0.105)^W$		
$\Delta\pi_{-2}$			0.151**
			(0.051)
			$(0.051)^W$
ΔLR_{-1}		0.276**	
+		(0.059)	
ΔLR_{-3}		$(0.104)^W$	

Table 7

Estimated Coefficient Values of the Error Correction Models *(Continued)*

Regressors	Dependent Variable		
	$\Delta\pi$	ΔRL	$\Delta \log(Y/P)$
ΔLR_{-1} + ΔLR_{-4}	0.541^{*} (0.246) $(0.308)^{W}$		
R^2	0.29	0.20	0.35
DW	2.05	1.94	1.88
Durbin t	-0.98		0.89

Notes: Sample period: 1959-I to 1989-I.

$\hat{e}$ denotes the residuals from the cointegrating regression.

Standard errors are given in parentheses; those superscripted by a "W" are based on White's heteroskedasticity-consistent estimate of the covariance matrix.

T-statistics for the cointegrating regression do not have the standard distribution.

* indicates significance at the 5 percent level.
** indicates significance at the 1 percent level.

assets held by the public. Consequently, we would expect the demand for L to respond less strongly and less rapidly to movements in long rates as a result of the financial changes of the early eighties. Table 8 provides empirical support for this view.

The second column of Table 8 shows estimates of the shifts in the parameters of the error correction model after 1979. Two sets of standard errors are shown; the second set is based on White's heteroskedasticity-consistent estimate of the residual covariance matrix.[73] The hypothesis that all the parameters have remained constant is rejected at the 5 percent level by the likelihood ratio test and the Wald tests based on ordinary least squares (OLS) residuals and by the Wald and F tests

[73] See Halbert White, "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity," Econometrica, vol. 48, pp. 817-38.

Table 8

Stability Tests: Error Correction Model

Dependent Variable: $\Delta\log(L/P)$

Regressors	Coefficients	1980-89 Dummies
Constant	0.005^{**}	-0.003
	(0.001)	(0.002)
	$(0.001)^W$	$(0.002)^W$
$\Delta\log(L/P)_{-1}$	0.490^{**}	0.307^{*}
	(0.086)	(0.180)
	$(0.086)^W$	$(0.146)^W$
$\hat{e}_{-1}$	-0.051	0.018
	(0.036)	(0.098)
	$(0.032)^W$	$(0.080)^W$
$\Delta^2\log(Y/P)_{-2}$	0.096^{*}	-0.049
	(0.048)	(0.089)
	$(0.045)^W$	$(0.062)^W$
ΔLR_{-1}	-1.201^{**}	1.053^{**}
	(0.313)	(0.337)
	$(0.375)^W$	$(0.385)^W$
$\Delta\pi_{-1}$	0.058^{*}	0.007
	(0.029)	(0.070)
	$(0.026)^W$	$(0.053)^W$

$R^2 = 0.546$
DW = 2.04
Durbin t = -0.559

$LR = 13.61^{*}$
$W = 12.96^{*}$
$F = 2.16$

$W^W = 13.98^{*}$
$F^W = 2.33^{*}$

Notes: Sample period: 1959-I to 1989-I.
Standard errors are given in parentheses.
F, W, and LR are F, Wald, and likelihood ratio statistics for the hypothesis that parameters are the same before and after 1980.
A "W" superscript indicates a statistic based on White's heteroskedasticity-consistent covariance matrix estimator.

* indicates significance at 5 percent level.
** indicates significance at 1 percent level.

based on the White standard errors.[74] The regression results suggest that this rejection is due to less marked adjustment to changes in long-term bond yields from 1980 onwards, and to slower adjustment in general. The coefficient on the long-term bond yield declines in absolute value by more than seven-eighths, and the decline is significant at the 1 percent level regardless of which standard error was used. The coefficient on the lagged dependent variable increases by 60 percent after 1979, indicating a generally slower adjustment of L.[75] However, this increase is only significant if judged by the White standard error.

Forecasting performance. Despite a reasonable in-sample performance, the cointegration-error correction model in Table 6 performs disappointingly in out-of-sample forecasting. Table 9 documents the results of some relatively undemanding forecasting experiments. These experiments were performed as follows: The cointegration model was estimated over the whole sample (1959-I to 1989-I) to generate a vector of residuals. The error correction model, estimated with data up to and including the first quarter of 1987, was then used with actual data on its right-hand-side variables and the residuals from the cointegrating regression to generate static and dynamic forecasts of the annualized percentage rate of growth of real liquid assets for the period from the second quarter of 1987 to the first quarter of 1989.

The model overpredicts the rate of real L growth over the simulation period by about 40 percent in the static simulation and more than one-half in the dynamic simulation. Overprediction occurs in periods of both low and high liquid asset growth, as the maximum and minimum values of actual and predicted growth rates suggest. The root mean squared prediction error exceeds 2.4 percent for the static forecast and 2.7 percent for the dynamic forecast compared with a standard error of real L growth of 1.85 percent. The mean absolute forecast errors for the both the static and dynamic forecasts are large enough to exceed the actual annual growth rate of real L of 2.2 percent. Finally, it is clear that the model does poorly at predicting turning points in L growth. The static predictions are

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[74] It is not possible to calculate a straightforward likelihood-ratio test of parameter stability for the model with "White standard errors." Such a test would necessitate the specification of a model of the heteroskedasticity of the errors.

[75] Further evidence of slower adjustment after 1980 is provided by the increase in the coefficient on the error correction term ($\hat{e}$), but this increase is not statistically significant. Note also that no specific conclusions can be drawn from the fact that neither of the coefficients on the error correction term is individually significant.

Table 9
Forecasting Performance: Error Correction Model

Growth of Real Liquid Assets: 1987-II to 1989-I (Percent per Annum)

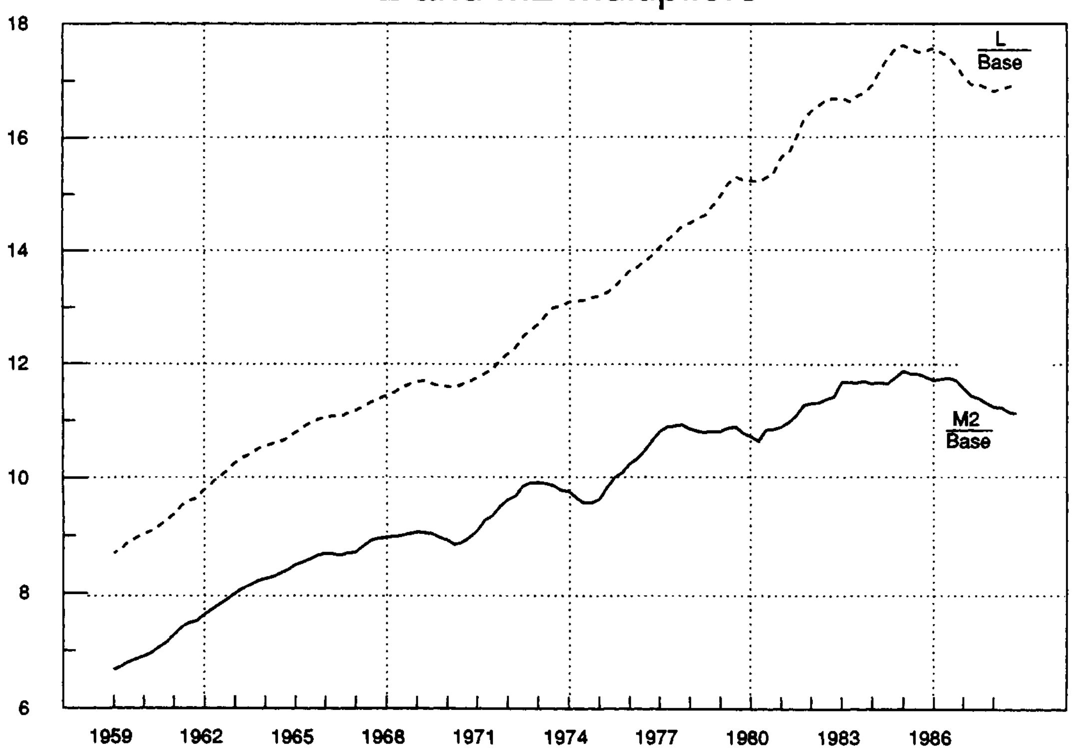
Parameter	Actual	Static Forecast	Dynamic Forecast
Average	2.21	3.05	3.38
Standard deviation	1.85	1.56	1.02
Maximum	4.93	5.85	4.74
Minimum	-0.08	0.51	1.90

Measures of Forecast Accuracy

Measure	Static Forecast	Dynamic Forecast
Root mean squared error	2.41	2.77
Mean absolute error	2.25	2.43
Mean error	-0.82	-1.14
Correlation coefficient (actual/forecast)	-0.002	-0.73

Notes: Estimation period: 1959-I to 1987-I.
Forecast error statistics are calculated as annualized values of quarterly rates of growth.

Chart 10
L and M2 Multipliers



virtually uncorrelated with growth of real L, and the dynamic predictions are strongly negatively correlated with real L growth. Thus, one could make better forecasts by betting against the model! Moreover, these results are little affected by changing the period over which the error correction model is estimated or by allowing for shifts in the parameter values after 1980.

B. The Relationship between L and Policy Instruments: The L Multiplier

The L and M2 multipliers (ratios of L to the monetary base and M2 to the base) are shown in Chart 10. Descriptive statistics obtained by fitting time trends, with and without correction for serial correlation, to quarterly data are given in Table 10. The L multiplier grew at an average annual rate of 2.4 percent from the first quarter of 1959 to the first quarter of 1989; the M2 multiplier grew at about 1.8 percent over the same period. These trends consist of growth, at 2.5 percent for L and 2 percent for M2, until the end of 1985 and declines thereafter at rates of 1.4% and 2.2% per year.

To explore the stability of the L and M2 multipliers, we calculate deviations from trend by expressing the standard errors of the regressions as annual percentage growth rates. The deviations from trend indicate that both the L and M2 base multipliers have been more volatile in the last decade than in the two preceding ones. The deviations of the L multiplier are notably smaller than those of M2, and the estimated trend growth rate of the L multiplier varies less over time than that of the M2 multiplier.

The Said-Dickey statistics reported in Table 10 indicate that we cannot reject the hypothesis of nonstationarity for either the L multiplier or the M2 multiplier. However, we were unable to find simple long-run relationships that linked the L and M2 multipliers with potential determinants such as the federal funds rate, own rates of return on assets included in L and M2, GNP, and the inflation rate. To evaluate the predictability of the L and M2 multipliers, we performed the following experiment: We used data from the first quarter of 1959 to the first quarter of 1987 to estimate simple autoregressive models for the rates of change (log differences) of the L and M2 multipliers and then used these models to forecast the rates of change of the L and M2 multipliers for the period from the second quarter of 1987 to the first quarter of 1989.[76] Statistics summarizing static and dynamic forecasts are given in Tables 11 and 12. The simple models tended to underpredict the rates at which the L and M2 multipliers declined over the forecast period. Moreover, in the dynamic simulations the

[76] The model for the L multiplier included a constant trend and ten of its own lagged values; the model for the M2 multiplier, a constant and nine lagged values.

Table 10
The L and M2 Multipliers: Descriptive Statistics

		Deviations from Trend		
Period	Trend	Average	Maximum	Minimum
L Multiplier				
1959-I to	2.4^{**}	8.9	19.2	0.33
1989-I	1.7^{S}	6.1^{S}	0.01^{S}	
1959-I to	3.0^{**}	5.9	10.6	0.30
1969-I	3.0^{**S}	1.1^{S}	3.5^{S}	0.03^{S}
1969-II to	2.9^{**}	3.1	12.3	0.02
1979-I	2.7^{**S}	1.5^{S}	3.9^{S}	0.14^{S}
1979-II to	1.5^{**}	10.6	20.2	1.91
1989-I	1.2^{**S}	2.2^{S}	7.2^{S}	0.06^{S}
SD	2.17			
M2 Multiplier				
1959-I to	1.8^{**}	12.3	40.4	0.02
1989-I	1.8^{**S}	2.5^{S}	7.9^{S}	0.01^{S}
1959-I to	3.2^{**}	7.7	14.6	1.63
1969-I	3.1^{**S}	1.5^{S}	4.0^{S}	0.49^{S}
1969-II to	2.3^{**}	7.2	16.7	0.04
1979-I	2.0^{**S}	3.0^{S}	6.8^{S}	0.04^{S}
1979-II to	0.7^{**}	9.6	20.1	1.48
1989-I	0.3^{**S}	2.3^{S}	9.7^{S}	0.14^{S}
SD	2.80			

Notes: Measures are expressed as annual percentage changes.
Statistics are based on trend regressions. An "S" superscript indicates that first-order serial correlation correction was used.
SD is the Said-Dickey statistic to test for a unit root.

** indicates significance at the 1 percent level.

Table 11
Forecasting Performance: L Multiplier

Changes in L Multiplier: 1987-II to 1989-I (Percent per Annum)

Parameter	Actual	Static Forecast	Dynamic Forecast
Average	-0.40	0.31	0.92
Standard deviation	1.46	1.20	1.16
Maximum	1.21	2.13	1.79
Minimum	-2.89	-1.49	-1.49

Measures of Forecast Accuracy

Measure	Static Forecast	Dynamic Forecast
Root mean squared error	1.67	1.75
Mean absolute error	1.47	1.42
Mean error	-0.72	-1.31
Correlation coefficient (actual/forecast)	0.28	0.60

Notes: Estimation period: 1959-I to 1987-I.
Forecasts are based on a tenth-order autoregression.
Forecast error statistics are calculated as annualized values of quarterly percentage changes.
The rate of change of the multiplier is forecast using a fifth-order autoregression, with trend, for its level.

models predicted increases in the multipliers, rather than the declines that occurred in fact. When evaluated in terms of standard measures of forecast accuracy--root mean squared error, mean absolute error, and mean error, relative to standard error--the rate of change of the L multiplier appeared more predictable than that of the M2 multiplier. On the other hand, the L multiplier was somewhat more volatile than the M2 multiplier over the forecast period, but the errors that occurred in forecasting it appeared smaller in absolute magnitude. It was not clear whether the turning points of the L multiplier were easier to forecast: static forecasts for the M2 multiplier were more highly correlated with actual values than were forecasts for the L multiplier, but the reverse was true for the dynamic forecasts. Thus, we tentatively concluded that the L multiplier could be forecast more accurately than the M2 multiplier, but that this advantage was probably too small to be of practical significance. Furthermore, neither the L or M2 multiplier was predicted accurately on the basis of its past values; for both, the root mean squared errors exceeded their standard deviations over the forecast period.

Table 12
Forecasting Performance: M2 Multiplier

Change of M2 Multiplier: 1987-II to 1989-I (Percent per Annum)

Parameter	Actual	Static Forecast	Dynamic Forecast
Average	-2.19	-0.34	1.32
Standard deviation	1.27	0.80	1.56
Maximum	-0.36	0.25	2.66
Minimum	-4.37	-1.93	-1.93

Measures of Forecast Accuracy

Measure	Static Forecast	Dynamic Forecast
Root mean squared error	2.17	3.79
Mean absolute error	1.88	3.56
Mean error	-1.85	-3.46
Correlation coefficient (actual/forecast)	0.44	0.56

Notes: Estimation period: 1959-I to 1987-I.

Forecasts are based on a ninth-order autoregression.

Measures other than the correlation coefficient between actual and predicted changes in the M2 multiplier are measured as annualized values of quarterly percentage changes.

The rate of change of the multiplier is forecast using a ninth-order autoregression, with trend, for its level.

C. Implications for Intermediate Targeting

Our comparison of the velocity behavior of L and M2 proved inconclusive, because judgments on the stability of velocity depend on the volatility measure used. Thus a more in-depth study of the demand for liquid assets is needed to decide whether L can be used as an intermediate target. Recent studies on monetary targeting have concentrated on lower level aggregates; earlier studies of L undertaken by the staff of the Board of Governors and by Neil Berkman and Frank Morris of the Federal Reserve Bank of Boston produced mixed results and, in light of the financial changes of the eighties, are probably too out of date to be used with confidence. Our econometric work, undertaken to update the earlier work, yielded four main findings:

(i) There is a stable long-run demand for L.

(ii) The adjustment of L to its long-run level is slow, with only 6 percent of the deviation of

L from its long-run equilibrium value eliminated each quarter.

(iii) The adjustment process underwent significant structural change as a result of the financial innovations and deregulation of the early 1980s.

(iv) The short-run behavior of L is difficult to predict out of sample; it may in fact pay to bet against a simple model of this adjustment process.

We also analyzed the behavior of the L and M2 multipliers to evaluate the feasibility of a strategy of targeting L. This work led to two conclusions:

(i) The estimated trend growth rate of the L multiplier is less variable than that of the M2 multiplier, and deviations from trend of the L multiplier are smaller than those of the M2 multiplier.

(ii) Time series forecasting experiments favor, albeit weakly, the conclusion that the L multiplier is more predictable than the M2 multiplier.

These results suggest that control over L need not be more difficult to achieve than control over M2, but that any advantage of L is probably too small to be of practical significance.

The evidence on the relationship between L and variables of policy interest leads us to conclude that targeting L is not a viable strategy. The existence of a stable long-run demand for L suggests that L may be useful as a long-run nominal anchor for monetary policy. However, the slow adjustment of actual to desired holdings of liquid assets implies that policy makers may have to tolerate large and sustained (up to three quarters or longer) departures of L from its predetermined intermediate target path.[77] Furthermore, even if L is kept on a track, goal variables may deviate from desired paths for even longer periods when L is used in this role. This appears to be the case for real GNP, which was shown to adjust very slowly to its long-run equilibrium value, but not necessarily for the inflation rate, which adjusts surprisingly rapidly. Finally, the structural break in, and poor forecasting performance of, the error correction model for L does not augur well at a time when policy involves more active adjustments of intermediate targets. The poor forecasting performance is all the more damaging because some elements of L (primarily offshore deposits) are subject to long reporting lags.

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[77] If the Fed could control long-term nominal interest rates precisely, L could be brought back on track in three quarters. Imperfect control would probably lengthen the interval between policy actions and the desired result.

IV. Liquid Asset Measures as Indicators

An indicator can be useful in the formulation of monetary policy in two conceptually distinct roles: It can be used as an indicator of the state of the economy as a whole, that is, as a source of information on current and potential future developments in the economy that may require changes in policy. Alternatively, it can be used as a measure of the current stance of monetary policy, that is, as an independent indicator that tells policy makers whether policy is, or has been, loose, tight, or neutral. The authorities will not rely solely on indicators of policy stance in deciding whether policy should be changed. Rather, policy decisions are made on the basis of both the stance of monetary policy and the state of the economy. Unlike an intermediate target, an indicator variable need not be under the control of the central bank. This section explores the potential of a liquid asset aggregate as an indicator in these two roles.

An information variable must satisfy two requirements. It should bear a stable relationship to target or goal variables and it should provide information about the state of the economy early enough for policy makers to respond to ongoing or prospective developments. To evaluate the potential of L as an information variable, we use simple vector autoregressions (VARs) to determine whether L has marginal predictive power for movements in goal variables once other readily available sources of information have been taken into account.

There is no conceptually unambiguous measure of the stance of monetary policy comparable to the structural deficit for fiscal policy. Thus policy makers are faced with a choice between financial prices and quantities, both of which tend to be procyclical. However, a variable will still be useful as a measure of the stance of policy if it provides reliable information about the impact of monetary policy on the economy. In this case, the variable need not lead economic activity, but it is of the utmost importance that it be reliable and timely. The value of a particular aggregate or price as a measure of the stance of policy will also depend on the specifics of the policy-making setup: the intermediate target(s), information variables, and other indicator variables used, and the precise rules chosen to signal the need to reset the target path for the intermediate target. Given such a set of specifics, the usefulness of L as an indicator of the stance of monetary policy can be evaluated in two ways. First, one can study episodes in the past when policy errors may have occurred to determine whether the use of a liquid asset indicator would have enabled policy makers to avoid mistakes. Alternatively, one could evaluate the usefulness of L by simulating the effects of combining an intermediate target with an indicator and a decision rule in a simple macroeconomic model. We shall not follow either of these approaches since both require more information about the policy framework than we can assume here.

In principle, broad financial aggregates are less likely to provide misleading signals about the stance of policy because they are less susceptible to financial innovations and interest rate changes, but in practice, long reporting lags may limit the aggregates' usefulness. The experience with financial aggregates in the early eighties suggests that neither broad nor narrow aggregates would be reliable indicators of the stance of policy in times of uncertainty. For example, L growth measured on a four-quarter basis accelerated from the fourth quarter of 1980 to the third quarter of 1981, a period during which an inverted term structure of interest rates, as measured by the difference between the nominal yields on ten-year government bonds and three-month Treasury bills, indicated a monetary tightening.[78] Thus, the evidence suggests that L need not, in fact, be a more reliable indicator of the stance of monetary policy than narrower aggregates.

A. The Information Content of L: A VAR Analysis

VAR models provide a simple way of capturing the contribution of an indicator to the policy maker's information about future developments in the economy. Interpreted in this way, rather than as a means to capture causation, VAR models are uncontroversial. To evaluate the information content of L, we regressed the quarterly rate of change (log difference) of each of three variables of policy concern--nominal GNP, real GNP, and the GNP deflator--on four lags of itself and four lags of the rate of change of L. To test whether L would have predictive power in a broader information set, we successively added four lags of changes of the six-month commercial paper rate and four lags of Cohen's[79] structural deficit measure to the regression. M2 is used as the benchmark against which L is evaluated.

Tables 13 and 14 show the regression results when nominal GNP is the dependent variable. Table 13A shows that four lags of the growth rate of L jointly have significant predictive power (at the 5 percent level) for nominal GNP growth, although no single lagged value does. When the commercial paper rate is added to the regression, L has predictive power for nominal GNP two periods ahead at the 5 percent level, as does the commercial paper rate (at the 1 percent level). However, as Table 13B

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[78] The L growth rate measured on a quarterly basis declined in the fourth quarter of 1980 and increased thereafter.

[79] See Darrel Cohen, "A Comparison of Fiscal Measures Using Reduced-Form Techniques," Board of Governors of the Federal Reserve System, Division of Research and Statistics, 1989, mimeo.

Table 13A
"Causality" Tests: Nominal GNP

Lags	Nominal GNP	L
1	0.16	0.20
	(0.10)	(0.26)
2	0.05	0.60
	(0.10)	(0.32)
3	-0.06	-0.32
	(0.10)	(0.31)
4	-0.01	-0.02
	(0.10)	(0.24)
F	0.87	2.81*
LR	3.69	11.59*

Table 13B
"Causality" Tests: Nominal GNP

Lags	Nominal GNP	L	CPR
1	0.19	-0.03	0.001
	(0.10)	(0.26)	(0.0010)
2	0.12	0.64*	-0.004**
	(0.11)	(0.31)	(0.001)
3	0.003	-0.32	0.0003
	(0.11)	(0.31)	(0.001)
4	0.07	0.02	-0.001
	(0.10)	(0.24)	(0.001)
F	1.28	1.67	3.57**
LR	5.63	7.28	15.08**

Notes: Sample period: 1959-I to 1989-I.
Variables other than the commercial paper rate are measured as quarterly rates of change.
The figures in brackets are standard errors.
F is the F-statistic and LR the likelihood ratio statistic for the hypothesis that four lags of a variable are insignificant in explaining changes of nominal GNP.

* indicates significance at the 5 percent level.
** indicates significance at the 1 percent level.

Table 13C
"Causality" Tests: Nominal GNP

Lags	Nominal GNP	L	G	CPR
1	0.19	-0.02	0.001	0.001
	(0.11)	(0.27)	(0.001)	(0.001)
2	0.12	0.65*	-0.003	-0.004**
	(0.11)	(0.32)	(0.003)	(0.001)
3	0.005	-0.36	0.003	0.0003
	(0.11)	(0.31)	(0.003)	(0.001)
4	0.05	0.05	0.001	-0.001
	(0.11)	(0.25)	(0.003)	(0.001)
F	1.22	1.69	0.64	3.41*
LR	5.69	7.65	2.96	14.97**

Table 14A
"Causality" Tests: Nominal GNP

Lags	Nominal GNP	M2
1	0.12	0.33*
	(0.10)	(0.14)
2	0.13	0.19
	(0.10)	(0.17)
3	-0.02	-0.04
	(0.94)	(0.17)
4	0.03	0.11
	(0.09)	(0.15)
F	0.98	4.23**
LR	4.16	17.06**

Notes: Sample period: 1959-I to 1989-I.
Variables other than the commercial paper rate are measured as quarterly rates of change.
The figures in brackets are standard errors.
F is the F-statistic and LR the likelihood ratio statistic for the hypothesis that four lags of a variable are insignificant in explaining changes of nominal GNP.

* indicates significance at the 5 percent level.
** indicates significance at the 1 percent level.

Table 14B
"Causality" Tests: Nominal GNP

Lags	Nominal GNP	M2	CPR
1	0.11 (0.10)	0.23 (0.19)	0.002 (0.001)
2	0.14 (0.11)	0.16 (0.19)	-0.002 (0.001)
3	-0.03 (0.11)	0.05 (0.19)	0.0009 (0.001)
4	0.06 (0.11)	0.05 (0.16)	-0.0005 (0.001)
F	0.84	1.16	1.70
LR	3.71	5.10	7.42

Table 14C
"Causality" Tests: Nominal GNP

Lags	Real GNP	M2	G	CPR
1	0.11 (0.11)	0.23 (0.19)	0.001 (0.003)	0.0017 (0.0011)
2	0.14 (0.11)	0.18 (0.20)	-0.003 (0.003)	-0.0022 (0.0014)
3	-0.03 (0.11)	0.04 (0.20)	0.003 (0.003)	0.0009 (0.0014)
4	0.04 (0.11)	0.06 (0.16)	0.001 (0.003)	-0.0002 (0.0013)
F	0.78	1.22	0.66	1.70
LR	3.61	5.56	3.06	7.73

Notes: Sample period: 1959-I to 1989-I.
Variables other than the commercial paper rate are measured as quarterly rates of change.
The figures in brackets are standard errors.
F is the F-statistic and LR the likelihood ratio statistic for the hypothesis that four lags of a variable are insignificant in explaining the rate of change of nominal GNP.

* indicates significance at the 5 percent level.
** indicates significance at the 1 percent level.

shows, the other lags of the growth rate of L fare so poorly that, in contrast with the commercial paper rate, we can reject the hypothesis that four lags of L jointly have significant predictive power for nominal GNP growth. These results do not change when the structural budget deficit measure is added to the regression in Table 13C. Table 14A shows that M2 growth does somewhat better than L growth in a bivariate model; it helps to predict nominal GNP one period ahead at the 1 percent level. However, M2 loses its predictive value completely when lagged values of the commercial paper rate are added to the regression, as Tables 14B and 14C show.

Tables 15 and 16 show the regression results when real GNP is the dependent variable. Both L and M2 are useful in predicting real GNP growth one period ahead. However, neither of the monetary aggregates nor the structural budget deficit measure significantly improves predictions based on an information set restricted to real GNP and interest rates. The commercial paper rate is significant at the 1 percent level.

Finally, Tables 17 and 18 summarize the regression results when the inflation rate, measured by the GNP deflator, is the dependent variable. Surprisingly, neither L nor M2 has any predictive power for future inflation. Only lagged inflation and the commercial paper rate are significant in predicting inflation, both at the 1 percent level of significance. This result could be explained by the fact that the inflation rate is nonstationary in the sample.[80] One would not expect the growth rates of L and M2, both of which are stationary, to predict the inflation rate, or for that matter, the growth rate, of nominal GNP. But as Table 7 illustrates, the growth rate of L does predict changes in the inflation rate two quarters ahead, even when lagged values of the change in inflation are taken into account.

The econometric results of this section, based on data spanning the period from the first quarter of 1959 to the first quarter of 1989, cast doubt on the value of monetary aggregates as information variables. Neither L nor M2 has significant predictive power for quarterly rates of change of nominal or real GNP and of the GNP deflator once lagged values of the relevant variable and short-term nominal interest rates are taken into account.[81] But L does seem to contain information about future

[80] Once again we should caution that this result may simply reflect the low power of tests for unit roots. Tests based on larger data samples than are used here may indicate that the (log of the) price level is difference-stationary.

[81] Different results may be obtained when variables are measured as four-quarter rates of change, because measuring variables as four-quarter rates of change may induce correlation between lagged regressors and the residual of a time-series model. If this is the case, regressions based on four-quarter rates of change will tend to exaggerate the information content of the right-hand-side variables in the regression.

Table 15A
"Causality" Tests: Real GNP

Lags	Real GNP	L
1	0.22**	0.01*
	(0.10)	(0.24)
2	0.15	0.46
	(0.10)	(0.30)
3	-0.05	-0.42
	(0.10)	(0.29)
4	0.01	-0.19
	(0.09)	(0.23)
F	2.48	1.80
LR	10.29*	7.54

Table 15B
"Causality" Tests: Real GNP

Lags	Real GNP	L	CPR
1	0.17	-0.13	-0.00002
	(0.10)	(0.23)	(0.0009)
2	0.19	0.47	-0.004**
	(0.10)	(0.29)	(0.0009)
3	0.06	-0.36	-0.0004
	(0.10)	(0.28)	(0.0010)
4	0.11	-0.06	-0.002*
	(0.09)	(0.22)	(0.0010)
F	3.67**	1.02	5.89**
LR	15.46**	4.51	23.89**

Notes: Sample period: 1959-1 to 1989-I.
Variables other than the commercial paper rate are measured as quarterly rates of change.
The figures in brackets are standard errors.
F is the F-statistic and LR the likelihood ratio statistic for the hypothesis that four lags of a variable are insignificant in explaining changes of real GNP.

* indicates significance at the 5 percent level.
** indicates significance at the 1 percent level.

Table 15C

"Causality" Tests: Real GNP

Lags	Real GNP	L	G	CPR
1	0.16	-0.12	0.002	0.0001
	(0.10)	(0.23)	(0.003)	(0.0001)
2	0.18	0.47	-0.002	-0.004**
	(0.10)	(0.29)	(0.003)	(0.001)
3	0.05	-0.38	0.003	-0.0003
	(0.10)	(0.28)	(0.003)	(0.001)
4	0.09	0.06	0.002	-0.0019
	(0.10)	(0.23)	(0.003)	(0.0010)
F	2.79*	1.02	0.80	4.57**
LR	12.37*	4.69	3.68	19.65**

Table 16A

"Causality" Tests: Real GNP

Lags	Real GNP	M2
1	0.17	0.28*
	(0.10)	(0.14)
2	0.21*	0.12
	(0.10)	(0.16)
3	-0.04	-0.11
	(0.10)	(0.16)
4	0.006	0.06
	(0.09)	(0.14)
F	2.46	2.36
LR	10.20*	9.81*

Notes: Sample period: 1959-I to 1989-I.

Variables other than the commercial paper rate are measured as quarterly rates of change.

The figures in brackets are standard errors.

F is the F-statistic and LR the likelihood ratio statistic for the hypothesis that four lags of a variable are insignificant in explaining changes of real GNP.

* indicates significance at the 5 percent level.

** indicates significance at the 1 percent level.

Table 16B
"Causality" Tests: Real GNP

Lags	Real GNP	M2	CPR
1	0.14	-0.01	-0.0002
	(0.10)	(0.16)	(0.0009)
2	0.21*	0.08	-0.004**
	(0.10)	(0.18)	(0.001)
3	0.06	-0.12	-0.0009
	(0.10)	(0.18)	(0.001)
4	0.11	0.14	-0.003*
	(0.09)	(0.15)	(0.001)
F	3.24*	0.33	4.48**
LR	13.74**	1.50	18.61**

Table 16C
"Causality" Tests: Real GNP

Lags	Real GNP	M2	G	CPR
1	0.14	-0.02	0.0015	0.0001
	(0.10)	(0.16)	(0.0027)	(0.001)
2	0.20	0.01	-0.0019	-0.0038**
	(0.10)	(0.18)	(0.0027)	(0.0011)
3	0.04	-0.12	0.0037	-0.0008
	(0.10)	(0.18)	(0.0027)	(0.0012)
4	0.08	0.15	0.0021	-0.0022*
	(0.10)	(0.15)	(0.0028)	(0.0011)
F	2.36	0.40	0.84	3.32*
LR	10.56*	1.88	3.88	14.62**

Notes: Sample period: 1959-I to 1989-I.

Variables other than the commercial paper rate are measured as quarterly rates of change.

The figures in brackets are standard errors.

F is the F-statistic and LR the likelihood ratio statistic for the hypothesis that four lags of a variable are insignificant in explaining changes of real GNP.

* indicates significance at the 5 percent level.

** indicates significance at the 1 percent level.

Table 17A
"Causality" Tests: GNP Deflator

Lags	GNP Deflator	L
1	0.38*	0.06
	(0.10)	(0.11)
2	0.19	0.07
	(0.10)	(0.13)
3	0.12	0.06
	(0.10)	(0.13)
4	0.11	-0.02
	(0.09)	(0.10)
F	28.91**	1.29
LR	85.00**	5.46

Table 17B
"Causality" Tests: GNP Deflator

Lags	GNP Deflator	L	CPR
1	0.35**	0.03	0.001**
	(0.10)	(0.11)	(0.0004)
2	0.22*	0.10	-0.0002
	(0.10)	(0.13)	(0.0004)
3	0.06	0.05	0.0004
	(0.10)	(0.13)	(0.0004)
4	0.16	-0.04	0.0006
	(0.09)	(0.10)	(0.0004)
F	28.59**	1.13	2.66*
LR	86.63**	4.98	11.42*

Notes: Sample period: 1959-I to 1989-I.
Variables other than the commercial paper rate are measured as quarterly rates of change.
The figures in brackets are standard errors.
F is the F-statistic and LR the likelihood ratio statistic for the hypothesis that four lags of a variable are insignificant in explaining changes of the GNP deflator.

* indicates significance at the 5 percent level.
** indicates significance at the 1 percent level.

Table 17C
"Causality" Tests: GNP Deflator

Lags	GNP Deflator	L	G	CPR
1	0.34**	0.034	-0.0006	0.001*
	(0.10)	(0.11)	(0.001)	(0.0004)
2	0.22*	0.095	-0.0002	-0.0003
	(0.10)	(0.14)	(0.001)	(0.0004)
3	0.06	0.048	-0.0003	0.0003
	(0.10)	(0.13)	(0.001)	(0.0004)
4	0.17	-0.03	0.0001	0.0006
	(0.10)	(0.11)	(0.0013)	(0.0004)
F	24.92**	1.04	0.07	2.36
LR	80.79**	4.79	0.32	10.55*

Table 18A
"Causality" Tests: GNP Deflator

Lags	GNP Deflator	M2
1	0.42**	0.02
	(0.10)	(0.07)
2	0.22*	0.03
	(0.10)	(0.08)
3	0.14	0.009
	(0.10)	(0.08)
4	0.11	-0.02
	(0.10)	(0.06)
F	46.88**	0.21
LR	117.45**	0.90

Notes: Sample period: 1959-I to 1989-I.
Variables other than the commercial paper rate are measured as quarterly rates of change.
The figures in brackets are standard errors.
F is the F-statistic and LR the likelihood ratio statistic for the hypothesis that four lags of a variable are insignificant in explaining changes of the GNP deflator.

* indicates significance at the 5 percent level.
** indicates significance at the 1 percent level.

Table 18B
"Causality" Tests: GNP Deflator

Lags	GNP Deflator	M2	CPR
1	0.35**	0.09	0.002**
	(0.10)	(0.08)	(0.0004)
2	0.23*	0.03	0.0002
	(0.10)	(0.08)	(0.0005)
3	0.07	0.09	0.0008
	(0.10)	(0.08)	(0.0005)
4	0.17	-0.10	0.0009
	(0.09)	(0.07)	(0.0005)
F	37.08**	1.33	4.03**
LR	103.48**	5.86	16.87**

Table 18C
"Causality" Tests: GNP Deflator

Lags	GNP Deflator	M2	G	CPR
1	0.35**	0.09	-0.0004	0.0013**
	(0.10)	(0.08)	(-.0013)	(0.0004)
2	0.23*	0.02	0.0001	0.0002
	(0.10)	(0.09)	(0.0013)	(0.0005)
3	0.07	0.09	-0.0002	0.0008
	(0.10)	(0.09)	(0.0013)	(0.0005)
4	0.17	-0.10	0.0004	0.0009
	(0.01)	(0.07)	(0.0013)	(0.0005)
F	33.82**	1.23	0.06	3.64*
LR	99.92**	5.63	0.28	15.93**

Notes: Sample period: 1959-I to 1989-I.

Variables other than the commercial paper rate are measured as quarterly rates of change.

The figures in brackets are standard errors.

F is the F-statistic and LR the likelihood ratio statistic for the hypothesis that four lags of a variable are insignificant in explaining the rate of change of the GNP deflator.

* indicates significance at the 5 percent level.

** indicates significance at the 1 percent level.

inflation. These results document a significant deterioration in the predictive power of the monetary aggregates that occurred in the early eighties, at the same time that money demand equations were breaking down. Before that time, M1 and L, and to a lesser degree M2, did convey significant information about future movements in nominal GNP, while the commercial paper rate did not.[82]

V. Liquid Asset Measures as Constraints

A variable can play a role as a constraint in the policy process if it is possible to specify ex ante a level, ratio, or rate of change for the variable that if breached in one direction or the other will signify an egregious policy error. For example, consider ex post real short-term interest rates: negative real rates are taken to signal unambiguously that policy is too expansionary.[83] In general, "price variables" show more promise than quantity variables in this role. A liquid asset measure may be useful as a nominal anchor for monetary policy, but it is doubtful that one could find upper and lower limits for its rate of growth that should never be violated.

VI. Conclusion

Three main rationales can be advanced to justify the use of liquid asset measures as indicators or intermediate targets for monetary policy: First, it can be argued that the theoretical concept of money has no well-defined empirical analogue. There exists a wide variety of financial assets that provide monetary services, some of which are close substitutes for traditional transactions assets. Consequently, policies aimed at controlling a narrow monetary aggregate may be ineffectual in controlling final objectives, and policy makers may be misled in judging the stance of policy on the basis of a narrow aggregate. Moreover, over time, financial innovations change the relative attractiveness of different monetary assets and the extent to which particular assets provide monetary services. Thus, since the set of assets that constitutes money is not clearly delineated and could change rapidly over time, it would be prudent to use a broad monetary aggregate that internalizes changes in the relative attractiveness and functions of different monetary assets. Second, capital

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[82]The F-statistic for the null hypothesis that four lags of (the rate of change of) a monetary aggregate do not contribute significantly when added to a regression of four lagged changes in nominal GNP itself and the six-month commercial paper rate is 4.54 for M1, 4.38 for L, and 2.72 for M2, compared with a critical value, at the 5 percent level, of less than 2.53.

[83] It is not intuitively obvious, however, that a symmetrical upper bound for real rates can be specified.

market imperfections imply that private agents' portfolio and spending decisions cannot be separated and that households and nonfinancial business firms may be liquidity constrained. Thus, households' and nonfinancial businesses' liquidity positions may provide information, which is not captured by market interest rates and wealth positions, about their planned spending and their ability to finance spending out of their own resources and through borrowing. A related justification for the use of liquid asset measures may be that they may provide information about spending decisions, not because liquid assets provide monetary services, but because the aggregates provide timely information about lending to households and firms by financial institutions. Finally, some observers have argued that there is no a priori reason to presume that a single monetary aggregate or asset price will capture all the information pertinent to monetary policy decisions. Thus, policy makers can reduce the risk of policy errors by using a number of policy indicators and intermediate targets, including a broad liquid asset measure.

Recently a number of studies have provided empirical evidence for the existence of liquidity constraints/credit rationing. Such constraints appear to play a significant role in explaining the empirical failures of the permanent income hypothesis and the neoclassical theory of investment. Moreover, for individual firms and households, credit rationing is closely correlated with liquidity positions, while in the aggregate, the extent of credit rationing seems to be closely related to the stance of monetary policy. The existence of capital market imperfections that give rise to credit rationing and liquidity constraints could motivate the use of either liquid assets or credit aggregates or both in the formulation of monetary policy. There is, nevertheless, no a priori reason to expect credit aggregates and liquid asset measures to convey the same information; holdings of liquid assets may convey information about spending decisions even when firms and households are not rationed. Whether a credit aggregate or a liquid asset aggregate would be more useful is an empirical matter.

The Board's liquid asset measure, L, is currently defined to include the assets in M3 plus the nonbank public's holdings of U.S. savings bonds, short-term Treasury securities, commercial paper, and bankers' acceptances. There is considerable overlap between L and other high-level financial aggregates, both quantitatively and in terms of the rationale for their use in the formulation of monetary policy. L is only 20 percent larger than M3 and essentially represents the liabilities associated with the short-term component Total Nonfinancial Sector Debt. Consequently, L is highly correlated with these aggregates and may convey little information not provided by these aggregates.

Two measurement problems complicate the definition of a liquid asset aggregate corresponding to the theoretical motivation for its use in formulating policy: the assets to be included in a liquid asset measure and the aggregation principle to be used in compiling the aggregate. If a liquid asset aggregate is to measure readily available spending power in the economy, a potentially serious measurement error arises from the exclusion of prearranged lines of credit from L. Exploratory calculations indicate that unused lines of credit currently amount to about 25 percent of L and that this percentage is growing. However, we do not have sufficient data to assess whether unused lines of credit have a stable relationship with L and with plausible determinants or whether their increased use might limit the usefulness of L.

Currently, L is calculated as a simple sum aggregate; that is, the aggregate is compiled by adding the dollar values of holdings of its component assets. Simple sum aggregation is, strictly speaking, only a valid procedure if assets are perfect substitutes. If the assets included in an aggregate are imperfect substitutes, both the demand for the aggregate and its relationship with economic activity will not be independent of its composition--consequently, it may be of limited value to policy makers. The Board's staff has experimented with monetary-services, or Divisia, indexes as alternatives to the conventional simple sum aggregates. In a Divisia index each asset is weighted proportionately to the value of the monetary services that it provides. The value of the monetary services equals the opportunity cost of holding the asset rather than a higher yielding benchmark asset. Although theoretically elegant, Divisia aggregation has foundered on practical problems associated with the measurement of the (unobservable) ex ante return on the benchmark asset. The Divisia measure of L performed well in comparison with various simple sum aggregates in empirical tests based on data from the 1970s, but this promising performance was not maintained with post-1980 data. In fact, the Divisia aggregates fared so poorly compared with simple sum aggregates that the Board has discontinued their compilation.

A successful intermediate target is related in a stable and predictable manner to both policy objectives and policy instruments. To assess whether a liquid asset measure would satisfy this requirement, we conducted an empirical analysis using the Board's liquid asset measure L. We found a stable long-run demand for real L as a function of real GNP and the Moody's AAA corporate bond yield. The relationship that captures the dynamic adjustment of L to changes in its determinants, in contrast, has shifted in 1980. The nature of this shift accords well with our priors about the potential effects of the financial changes that occurred in the early eighties: the volume of L outstanding adjusts less rapidly than it did earlier, especially to changes in long-term interest rates. Our interpretation is that financial deregulation and innovations have freed own rates on liquid assets to equate supply and demand, thus requiring less pronounced quantity adjustment. Since we cannot rule out further financial innovation, we cannot rule out future shifts in this relationship. A disappointing out-of-sample simulation performance indicates that the short-run dynamic relationship between real L and its determinants is captured poorly. This poor performance, the likelihood of future shifts in the dynamic relationship, and the one-month time lag in the availability of data on L are probably sufficient to preclude its use as an intermediate target.

The L multiplier is less volatile and seems easier to forecast than, for example, the M2 multiplier. It is not clear, however, that this advantage will be of practical consequence or can be exploited by a policy regime in which the base is adjusted to hit an intermediate target for L.

A liquid asset measure can be used as a monetary policy indicator in two conceptually distinct roles: (a) as an indicator of the state of the economy, that is, as a source of information on current and potential future economic developments that may necessitate policy changes, and (b) as an indicator of the stance of monetary policy. The potential usefulness of a measure such as L in the latter role would depend on the specifics of the monetary policy-making setup in place, but evidence from the period of monetary tightening in 1980 and 1981 suggests that L may at times provide misleading signals about the stance of policy. L also does not seem to hold much promise as an information variable: In vector autoregressions, four lagged values of L have only marginal predictive value for nominal GNP once the commercial paper rate is included in the information set. L does not predict real GNP or the general price level once lagged values of the dependent variable and of the commercial paper rate are taken into account in making forecasts. L's poor performance in the VAR tests, at least as far as nominal GNP and the price level are concerned, may be attributable to the fact that the GNP deflator and L have different time series properties. Tests conducted in a cointegration-error correction framework do indicate that L improves predictions of both real GNP and the inflation rate, although the improvement in predictive ability is rather small.

Appendix: The Radcliffe View on Monetary Policy

The findings of the Radcliffe Committee are often invoked to justify the use of liquid asset measures in designing monetary policy. On a closer reading, however, the "Radcliffe view" could as easily be construed as a justification for using credit measures or interest rates. Ironically, the Radcliffe Committee findings bearing most directly on liquid assets, those that relate to the substitutability of the liabilities of bank and nonbank liabilities, have already been incorporated in U.S. monetary policy through the redefinition of the monetary aggregates. In this appendix, we provide a summary of some of the main conclusions of the Radcliffe Report to support our interpretation of it.

Five elements are central to the "Radcliffe Committee view" of the role of money and financial institutions in a modern industrial economy:

(i) Monetary policy is transmitted to demand through the availability of financing, not through interest rates: "In theory, monetary action works upon total demand by changing the interest incentive; we believe that only very limited reliance can be placed on this" (paragraph 397); "The monetary authorities may bring to bear another influence which can be altogether more peremptory. This is the availability of funds through particular channels" (paragraph 387); "We may call the first effect the interest incentive effect, and the second the general liquidity effect" (paragraph 385).

(ii) The control of the (narrowly defined) money supply is of secondary importance because private agents can easily substitute credit for money and because nonbank financial institutions create credit on the basis of interest-bearing near-money deposits: "It is the whole liquidity position that is relevant to spending decisions, and our interest in the supply of money is due to its significance in the whole liquidity picture. A decision to spend depends not simply on whether the would-be spender has cash or money in the bank. . . . There is the alternative of raising funds either by selling an asset or by borrowing. . . . The ease with which money can be raised depends on the one hand upon the composition of the spender's assets and on his borrowing power and on the other upon the methods, moods and resources of financial institutions and other firms which are prepared . . . to finance other people's spending" (paragraph 389).

(iii) Control over the (narrowly defined) quantity of money outstanding is ineffective, because nonbank financial institutions create credit on the basis of interest-bearing near-money deposits: "We would nevertheless emphasize that the amount of money, in the sense of the amount of notes and bank deposits, is of considerable significance. The other classes of liquid assets . . . are inferior in convenience to the holders, and this inferiority will have to be compensated by the payment of interest. If there is less money to go round. . . , rates of interest will rise. But they will not have to rise by much, because in a highly developed financial system . . . there are many highly liquid assets which are close substitutes for money, as good to hold and only inferior when the actual moment of payment arrives" (paragraph 392).

(iv) Because the structure of interest rates has an important influence on the lending behavior of financial institutions and hence on the institutions' overall liquidity position, it should be the focus of monetary policy. "A rise in interest rates, quite apart from any direct effect it may have on the demand for investment goods, may have appreciable effects on the behavior of financial institutions. . . . A movement of interest rates implies significant changes in the capital values of many assets held by financial institutions. A rise in rates makes some less willing to lend because capital values have fallen, and others because their own interest rates are sticky. A fall in rates, on the other hand, strengthens balance sheets and encourages lenders to seek new business. This is an important conclusion for policy, for it implies . . . that movements in interest rates have an effect apart from any influence they have on the incentive to hold capital goods" (paragraph 393). As this passage illustrates, the committee implicitly argues that credit is not rationed by interest rates alone and that some borrowers may be constrained by the willingness of financial institutions to lend. Indeed, the Committee goes on to emphasize the importance of bank credit: "In the liquidity structure as we have described it, the banks have a special position, in that they are, for most borrowers and for most purposes, much the most convenient institutional source of funds and often the only source" (paragraph 395).

(v) Finally, the Committee advocates the use of selective credit controls--primarily on banks, because of the perceived importance of the banks in providing credit that would otherwise be unavailable--as a means of monetary control for emergency situations. "In times of emergency they [the monetary authorities] may choose to exercise a direct control over the lending operations of the banks. We emphasize that any such special concern, and any such extreme measures, are to be aimed at the banks as key lenders in the system, and not at the banks as creators of money. It is the level of bank advances rather than the level of bank deposits that is the object of this special interest; the behavior of bank deposits is of interest only because it has some bearing, along with other influences, on the behavior of other lenders."

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A REVIEW OF CREDIT MEASURES AS A POLICY VARIABLE

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This paper will review the potential usefulness of measures of credit in formulating and communicating Federal Reserve policy. To do so efficiently, the research on credit measures must be divided at the outset into two groups. One group is focused on *broad measures of credit*; the analyses and proposals of Henry Kaufman and Benjamin Friedman, among others, fall into this group. The second is focused on *bank credit*; the work of Ben Bernanke, Mark Gertler, and Joseph Stiglitz is representative of this second group.

The research on credit by both groups breaks from the tradition of focusing on money or money and interest rates. The motivation for turning to credit measures is somewhat the same whether a broad credit measure or a bank credit measure is the proposed alternative to the money supply. Among the reasons given for moving to credit measures are: diversification of the financial quantities on which to focus, instability in the money-income relationship, and a belief that financial markets originate or amplify disturbances that subsequently affect the macroeconomy. Despite these common reasons for studying credit measures, macroeconomic analysis utilizing broad measures of credit is quite different in several regards from analysis utilizing bank credit. In the body of this paper these areas of difference will be fully delineated. They include:

1. The basic rationale for considering credit:

   - *Broad credit measures* are an alternative or supplement to monetary aggregates, on which inordinate emphasis has been placed in theoretical and applied economic research.

   - *Bank credit* is "special" in the sense that it is pivotal in the transmission mechanism for monetary policy and very useful in explaining macroeconomic fluctuations.

2. The definition of the most relevant credit measure:

   - It must be *broad* because credit is fungible, that I, one form easily substitutes for another.

   - It must be narrow and focused on *bank credit*, the portion of total credit which is special and vitally important. For some sectors of the economy, bank credit is the only type of credit available to finance spending plans.

3. The role of credit in the formulation of central bank policy:

   - Total credit warrants equal weight with monetary aggregates in policy decisions, either as an indicator for policymakers or as an intermediate target.

   - Bank credit may be a good leading indicator of business cycle turning points, particularly of downturns. It may be, however, too narrow to serve as an intermediate target. Besides, the use of nonprice devices to allocate credit may be prevalent and thus may introduce nonlinearities into the relationship between the volume of bank loans and economic activity.

4. Credit measures and the level of economic activity:

   - Total debt has been shown to have had as tight a relationship with nominal GNP as money. Moreover, the demand for money has been distorted by innovations and deregulation. Thus, it may be a better financial quantity on which to base long-run policy decisions.

   - The availability of bank credit may be a crucial factor in the amplification of disturbances originating elsewhere in the economy, and crucial in transforming a mild recession into a deep downturn. But it may be a poor variable to focus on for the purpose of long-term control of inflation.

Not all economists who stress the role of the credit markets in the business cycle fit neatly into either of the above groups. Some fit into neither, others straddle the two groups. Among these somewhat harder-to-classify economists, Charles Kindleberger has analyzed the tendency of financial markets to engage in speculation resulting in a subsequent crash.[1] Hyman Minsky has emphasized the fragility of the banking system and the pyramidal structure of debt.[2] Albert Wojnilower has described the role of credit "crunches" in the postwar economy.[3] While these three economists have attached great importance to the performance of the financial markets for the real sector of the economy, they do not recommend reliance on credit quantities in formulating central bank policy.

It should be noted that the Federal Open Market Committee (FOMC) has at times during the past thirty years used credit quantities in its policy making.[4] At the strategy level of policy, the

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[1]Charles Kindleberger, Panics, Manias, and Crashes (New York: Basic Books, 1978).

[2]Hyman P. Minsky, John Maynard Keynes (New York: Columbia University Press, 1975).

[3]Albert M. Wojnilower, "The Central Role of Credit Crunches in Recent Financial History," Brookings Papers on Economic Activity, 1:1980, pp. 277-326.

[4]Ann-Marie Meulendyke, "A Review of Federal Reserve Policy Targets and Operating Guides in Recent Decades," in this volume.

Committee has been setting a monitoring range for a broad credit aggregate, Total Domestic Nonfinancial Debt, since 1983; for a period in the 1970s it set a range for a proxy measure of bank credit. And at the tactical level, during a period in the late 1960s the domestic policy directive to the Federal Reserve Bank of New York contained a proviso clause stating that open market operations should be conducted somewhat differently depending on the growth of bank credit. For example, directives from late 1966 state:

> To implement this policy, . . . System open market operations . . . shall be conducted with a view toward maintaining firm but orderly conditions in the money market; provided, however, that operations will be modified in the light of . . . any apparently significant deviations of bank credit from current expectations.
>
> To implement this policy, System open market operations . . . shall be conducted with a view toward somewhat easier conditions in the money market, unless bank credit appears to be resuming a rapid rate of expansion.[5]

I. Broad Measures of Credit

A. The Rationale for Their Use

There are several reasons why economists have argued for giving more consideration to broad measures of credit in their applied research on macroeconomics. The reasons are interrelated and not always easily distinguished from one another, and they represent a mixture of theoretical and empirical justifications. Nevertheless, we will try to identify five separate reasons.

First, some economists argue that there is no indisputable justification for focusing on any particular financial quantity to the exclusion of others in the modern economy (with the possible exception of the monetary base). Financial instruments--including money--are privately issued and their dollar volumes are determined jointly by the actions of the financial sector and the public in a general equilibrium setting. They are all subject to the influence of the central bank, but none is under its tight control. A particular monetary aggregate represents one specific collection of the numerous financial instruments currently in use; a credit aggregate represents a different collection of instruments. Neither is inherently superior regarding the information it provides concerning

[5]Minutes of the Federal Open Market Committee, October 4, 1966, and November 12, 1966.

developments in the financial markets or about the direction of central bank policy.[6] Thus, the emphasis on money in economic analysis and policymaking seems unwarranted.

The notable exception to this general argument is the monetary base, or outside money. In contrast to inside money or credit, this financial quantity is under the nearly complete control of the central bank. Its potential usefulness for central bank policy is examined in one of the other papers written as part of this study.[7]

Second, specific arguments have been made that credit quantities should be given equal importance with monetary quantities in macroeconomic research. In the context of a short-run macroeconomic model with a simple financial structure, "the determination and control of nominal income can be achieved without exogenous control of the money supply and require only exogenous control of some financial aggregate, or of some linear combination of such aggregates."[8] In other words, control by the central bank over any one of several financial aggregates would seem to be sufficient to control nominal GNP--money is not crucial for this purpose. The variable the central bank uses could be narrowly or broadly defined money, but it could also be the monetary base, total debt, or bank credit. Which would be best among the financial aggregates for policy purposes would depend on the exact structure of the financial system, key parameter values in the economy, and the relative uncertainty among behavioral relationships.[9]

Third, there is considerable skepticism that a single quantity can sufficiently capture most of the relevant information on developments in the financial markets, or that the dollar volume of either the assets or liabilities of commercial banks is sufficiently comprehensive. This skepticism is based in part on the obvious complexity of the domestic and international financial systems and their

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[6]Warren L. Smith, "A Neo-Keynesian View of Monetary Policy," Controlling the Monetary Aggregates, Federal Reserve Bank of Boston, Conference Series no. 1, 1969, pp. 105-26; and Benjamin M. Friedman, "The Role of Money and Credit in Macroeconomic Analysis," in James Tobin, ed., Macroeconomics, Prices, and Quantities: Essays in Honor of Arthur M. Okun (Washington, D.C.: Brookings Institution, 1983), pp. 161-99.

[7]See Ann-Marie Meulendyke, "Possible Roles for the Monetary Base."

[8]Franco Modigliani and Lucas Papademos, "The Structure of Financial Markets and the Monetary Mechanism," Controlling Monetary Aggregates, Federal Reserve Bank of Boston, Conference Series no. 23, 1980, p. 129.

[9]See Ben S. Bernanke and Alan S. Blinder, "Credit, Money, and Aggregate Demand," American Economic Review, May 1988, pp. 435-39; and Friedman, "The Role of Money and Credit in Macroeconomic Analysis," p. 182.

connections with the real side of the economy. It is also based in part on experience and intuition regarding the importance of financial developments for the performance of the real sector. For example, Paul Volcker explicitly stated:

> More broadly, I think the intellectual emphasis on monetary aggregates that developed in the 1960's threatened to--and in some occasions did--go too far in implying that credit markets--broadly defined--"don't count"--that they are never or seldom a source of disturbance in the economy or a legitimate concern of policy. Indeed, I suspect little attention directed toward serious and systematic analysis of the role of the credit markets, toward the financial complexities of the economy generally, and toward their disruptive potential is a common failing of most modern theorizing, regardless of the intellectual starting point.
>
> We have had many occasions in the 1970's to pay the closest possible attention to particular financial problems and to the potential vulnerabilities of various credit markets. I would remind you of the recurrent concerns about thrift institutions and the mortgage market, Penn Central and commercial paper, Herstatt and the Euro-dollar market, New York City and the municipal bond market, and the rising commercial bank loan losses a year ago.[10]

The perceived importance of developments on the financial side of the economy is also reflected in the construction of large-scale econometric models of the U.S. economy, in which several financial variables are typically included. And the collapse of the banking system has long been thought to have played a significant role in the Great Depression.

Fourth, the instability in the demand for various monetary aggregates during the past fifteen years has reduced their value as an intermediate target for monetary policy and spurred interest in exploring other financial quantity variables. At this time we cannot tell when or whether this instability in money demand might end. The abrupt and sharp slowing of the growth of the money supply (M1 and M2) during 1987 and the first half of 1988 was not soon thereafter followed by a recession in 1988 or 1989.[11]

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[10] Remarks by Paul A. Volcker, "The Contributions and Limitations of Monetary Analysis," before the Joint American Economic Association and the American Finance Association Luncheon, September 16, 1976. Reprinted in the Federal Reserve Bank of New York Quarterly Review, 75th Anniversary Issue, pp. 35-41.

[11] M1 grew at a rate of 13.1 percent over the four quarters ending 1986-II and at a rate of 14.3 percent over the four quarters ending 1987-II. M1 growth slowed markedly to 3.8 percent over the next four quarters, a signal of an imminent recession. M2 showed a similar pattern. It grew 9.0 percent and 9.3 percent over the four quarters ending 1986-IV and 1987-IV, respectively. It then grew only 4.2 percent in the following four quarters.

Fifth, for determining aggregate demand, some economists conclude that the availability of credit is crucial, not the availability of money.[12] That is, a constraint placed on the quantity of credit would be more disruptive than a restriction on currency holdings or checking account deposits. Aggregate demand was adversely affected when the ceilings imposed by Regulation Q on the interest rates banks could pay on savings and time deposits became binding at various times in the 1960s and 1970s. The effect of deposit rate ceilings was substantively similar to a credit supply stoppage.[13]

In sum, there are several good reasons to pay closer attention to broad credit aggregates and maintain a balance between money and credit in macroeconomic analysis. Why then has so much attention been paid to money and relatively little to credit? There seem to be several factors:

- In widely used macroeconomic models, the market for money appears in the foreground and the market for credit in the background. The credit market can be set aside by virtue of the balance sheet constraint on total financial assets.

- The money supply and interest rates are more readily observable than credit quantities.

- There is less ambiguity as to what should be included in a narrow monetary aggregate, defined in terms of the payments function of money.

- Money is thought to be exogenous to some degree and more readily under the control of the central bank, whereas credit is unquestionably an endogenous variable.

B. Measurement Issues

Since credit is highly fungible, there is widespread agreement with the notion that a broad measure of credit must be genuinely comprehensive to be useful in macroeconomic analysis. It should definitely include all the short-term and long-term credit extended to domestic nonfinancial private economic units (households and nonfinancial businesses) and to most if not all public economic units. As such it would consist of the dollar volume of outstanding government securities, corporate bonds, mortgages on residential, commercial, and farm properties, bank loans, consumer credit, and commercial paper. Although the aim is to be comprehensive, certain exclusions are almost always still

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[12] Alan S. Blinder and Joseph E. Stiglitz, "Money, Credit Constraints, and Economic Activity," American Economic Review, May 1983, (Papers and Proceedings), pp. 297-302.

[13] The relevance of the economy's behavior following the implementation of the Credit Control Program of 1980 is questionable. The program did not directly impinge on consumer credit, but consumption spending collapsed soon after its implementation as households seemed to cut back voluntarily their demand for credit.

made. Total debt is netted for financial intermediation; that is, total debt excludes instruments issued by banks, insurance companies, financial subsidiaries of nonfinancial corporations, and federally sponsored credit agencies. Total debt is not usually netted, however, for the financial assets held by individual households, businesses, and governmental units; therefore, gross liabilities are counted. Total debt also usually excludes credit extended to foreigners since their borrowing is not directly related to U.S. economic activity.

Applying these principles, but also making certain other judgments, the staff of the Board of Governors developed the definition of Total Nonfinancial Sector Debt. As of the first quarter of 1989, it was measured to be $9209.4 billion, of which 70 percent was the debt of the private sector and 30 percent was the debt of the public sector. As such, it was about six times as large as M1, somewhat more than double the size of M3, and almost exactly twice as large as L. If the debt of the federal government is excluded, the resulting measure, nonfederal debt, is considerably smaller, standing at $7053.7 billion (as of the first quarter 1989). Table 1 shows the composition of Total Nonfinancial Sector Debt.

Two issues regarding the measurement of total debt are somewhat open. First, should the aggregate include the debt issued by all levels of government (federal, state, and local), or should the debt of the federal government be excluded? The exclusion of the federal portion of government debt can be justified on the grounds that federal spending is unrelated to the cost of raising funds and that the U.S. Treasury's ability to raise funds in the credit markets is virtually unbounded.[14] Conversely, it could be argued that the debt of state and local governments should be included since their spending is constrained by both their ability to raise funds and the cost of borrowing. Despite the apparent soundness of these a priori arguments, conclusions have generally been reached on empirical grounds. Friedman pointed out that the credit-to-income ratio is much more stable when total debt is defined to include federal as well as state and local government debt.[15] It has since been customary to include the debt of the federal government, as discussed further in the next section.

The second measurement issue is: Is a simple sum aggregate adequate for measuring total debt? Total debt comprises an even more heterogeneous collection of assets than does M3. Economists have doubted the usefulness of combining with equal weights the quantities of various bank deposits

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[14] Richard G. Davis, "Broad Credit Measures as Targets of Monetary Policy," Federal Reserve Bank of New York Quarterly Review, Summer 1979, pp. 13-22.

[15] Friedman, "The Role of Money and Credit in Macroeconomic Analysis."

Table 1

Credit Market Debt Outstanding

	Levels at the End of the First Quarter of 1989 (In Billions of Dollars)
Total Nonfinancial Sector Debt (Total credit market debt owed by domestic nonfinancial sectors)	9,209.4
Alternative broad credit measures	
Nonfederal Debt (Total Nonfinancial Sector Debt less the credit market liabilities of the federal government)	7,053.7
Private debt (Nonfederal debt less the credit market liabilities of state and local government units)	6,458.5
By sector	
U.S. government	2,155.7
State and local governments	595.2
Households	3,183.8
Nonfinancial businesses	3,274.6
Farm	140.1
Nonfarm noncorporate	1,213.6
Corporate	1,920.9

Source: Board of Governors of the Federal Reserve System.

(and their near substitutes) in a monetary aggregate and have tried instead more careful methods of aggregation.[16] These doubts concerning aggregation would have to be even stronger in the case of broad debt measures, but there has been little discussion of the matter.[17] The aggregation problem is probably too complex to resolve; besides, the application of sounder aggregation methods has not apparently led to greater usefulness of the monetary measures.[18] Moreover, there are deeper questions surrounding a broad credit aggregate, such as those raised by the new, complicated financial contracts: Has credit in fact been extended?[19] It is not always possible to tell in the case of certain innovative interest rate swaps.

C. Empirical Research

The existence of an apparently stable relationship between a broad credit measure and nominal GNP was first identified by Kaufman.[20] He used a chart to illustrate a close relationship over the period 1950-77 between nominal GNP and credit, measured by a proxy for total debt (as defined in footnote 17). Soon thereafter, Richard Davis published a study applying statistical analysis to investigate the relationship.[21] (A brief summary of the specifications, econometric techniques, and

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[16] See William A. Barnett, "Economic Monetary Aggregation: An Application of Aggregation and Index Number Theory," Journal of Econometrics, September 1980, pp. 11-48; William A. Barnett, Edward Offenbacher, and Paul Spindt, "New Concepts of Aggregated Money," Journal of Finance, 1980, pp. 497-505; and William A. Barnett and Paul A. Spindt, "The Velocity Behavior and Information Content of Divisia Monetary Aggregates," Economic Letters, 1979, pp. 51-57.

[17] There is also the issue of the timeliness of credit data. Because they are collected from several sources, credit data have a greater time lag than the monetary data. To shorten the time lag, Kaufman suggested using a proxy, that is available earlier, namely the credit market instruments and deposits held by the private domestic nonfinancial sector (households, businesses, and state and local government). See the testimony by Henry Kaufman before the Committee of the Budget, U.S. House of Representatives, February 6, 1978.

[18] David E. Lindsey and Paul Spindt, "An Evaluation of Monetary Indices," Board of Governors of the Federal Reserve System, Special Studies Paper no. 195, February 1986.

[19] Shiller raised some additional questions regarding measurement, including whether market values ought be used instead of par values, and whether preferred stock ought to be included. See the comments of Robert J. Shiller, following Friedman, "The Role of Money and Credit in Macroeconomic Analysis."

[20] See the testimony of Kaufman before the House Committee on the Budget.

[21] Davis, "Broad Credit Measures as Targets of Monetary Policy."

Table 2

Summary of Statistical Findings on Broad Credit Measures

Author	Definitions of Credit Used	Statistical Techniques	Sample Period	Main Results
Davis (1979)	Total nonfederal Debt proxy	Reduced-form	1961-77	Over the whole period, money and credit are equally correlated with nominal GNP; over subperiods, correlations vary widely. In regressions with both money and credit, credit is insignificant.
Friedman (1983)	Total Total nonfinancial Total nonfederal Private nonfinancial	Reduced-form, St. Louis approach, VARs	1953-78	Total nonfinancial debt is as closely related as the monetary aggregates to nominal GNP.
Brittian (1981)	Bank deposits and credit market instruments (United States, Japan) Total financial instruments (Germany) Total internal credit (Italy)	Reduced-form	1951-75 (United States) 1960-76 (Germany) 1964-76 (Italy) 1967-76 (Japan)	Money is the most suitable intermediate target in the United States and Germany, credit is slightly more suitable in Italy, and inconclusive results are found for Japan.
Islam (1982)	Total financial institutions Total private (Germany, Japan) Total (United States)	Reduced-form	1960-80 (United States) 1964-80 (Japan) 1969-80 (Germany)	Only moderate differences in fit and out-of-sample forecasts, but total credit in the United States and total private credit in Japan are among the most successful.

Table 2

Summary of Statistical Findings on Broad Credit Measures (continued)

Author	Definitions of Credit Used	Statistical Techniques	Sample Period	Main Results
Friedman (1982)	Total nonfinancial	Reduced-form	1959-80 (United States) 1962-80 (Canada) 1962-80 (Germany) 1964-80 (Japan) 1963-79 (United Kingdom)	Total nonfinancial debt has the most stable contemporaneous relationship with nominal income, while the narrow money supply has the most stable dynamic relationship.
Offenbacher-Porter (1983)	Total nonfinancial	VAR	1954-82	The results favor monetary aggregates over credit aggregates but are highly sensitive to slight modifications in specifications.
Hafer (1984)	Total nonfinancial	St. Louis approach	1960-81	Total debt makes no marginal contribution in an equation that already includes M1.
Fackler (1985)	Total nonfinancial	VAR	1962-80	In a VAR system with money, credit, and interest rates, neither money nor credit is significant; only interest rates are significant for explaining nominal GNP.
Friedman (1986)	Total nonfinancial	Bivariate regressions	1891-82 (annual) 1952-82 (quarterly)	Overall, a lack of persistence over time in these simple relationships.

findings of the several papers to be covered in this section is contained in Table 2.) Regressing quarterly percentage changes in current dollar GNP from 1961 to 1977 on current and lagged percentage changes in various monetary and credit aggregates, he found that the relationship between a broad credit measure and GNP is roughly as close as the relationship between a monetary aggregate and GNP.[22] Davis' other results were less favorable to total debt. He found that in regressions omitting the current value of the financial aggregate and using only lagged values, the explanatory power of total debt falls to zero. And when he ran equations including both a monetary aggregate variable and a credit aggregate variable, credit measures were not able to make a statistically significant contribution to the explanatory power of the equation.[23]

A few years later Friedman published a more extensive study of broad credit aggregates.[24] He looked at several definitions: total nonfinancial debt, nonfederal debt, private debt, total debt (which includes the credit market debt of U.S. financial intermediaries), and bank credit. Of these, total nonfinancial debt was Friedman's preference. (This is the definition refined and adopted later by the Board staff.) He produced a chart showing the ratio of total nonfinancial debt and its components to nominal GNP over the 1946-80 period. The ratio of total nonfinancial debt to GNP, its income velocity, shows surprising stability at a level just below 150 percent of GNP. The sector components are, however, much less stable over the period as a whole. Most pronounced is the trend in federal government debt, falling from about 100 percent of GNP in 1946 to around 25 percent in the first half of the 1970s. The other components, in order to keep total debt near 150 percent of GNP, rose over the same period from 50 percent of GNP to 125 percent. Friedman also noticed that bulges in federal debt issuance during recessions have usually been accompanied by an abatement of private borrowing.

Friedman then investigated the relationship between the economy and total nonfinancial debt. The statistical approaches used included estimating regressions similar to those run by Davis but using

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[22] He also uses bank credit, which will be discussed later.

[23] Davis also ran the regressions over the subperiods 1961 to mid-1969 and mid-1969 to 1977 and found for most of the monetary and credit aggregates that the closeness of their relationship to GNP varies considerably between the two subperiods.

[24] Friedman, "The Role of Money and Credit in Macroeconomic Analysis." Some of the regressions were rerun over a later time period, see the results presented in "Monetary Policy with a Credit Aggregate Target," Money, Monetary Policies and Financial Institutions, Carnegie-Rochester Conference Series on Public Policy, Spring 1983, pp. 117-47.

data over a longer time period, regression equations based on the St. Louis reduced-form approach, and vector autoregressions (VARs). Friedman summarized his findings in this way:

> Results based on a variety of methodological approaches consistently indicate that the aggregate outstanding indebtedness of all nonfinancial borrowers in the United States bears as close and as stable a relationship to U.S. nonfinancial activity as do the more familiar asset aggregates like the money stock (however defined) or the monetary base.[25]

These results were not accepted uncritically. The most troublesome issue was whether the observed constancy of the total debt-to-income ratio was a fluke, or whether it was the product of economic forces and hence could be explained. Friedman offered three possible explanations for the link between total debt and nominal income:

- An ultrarationality hypothesis: the public tries to maintain constant indebtedness relative to its income, and in its calculations private debt substitutes perfectly for government debt.

- A capital leveraging hypothesis: because of constraints imposed by the credit markets, the private sector can increase its total liabilities only to the extent that it has accumulated tangible assets with which to back them.

- An asset demand hypothesis: the public tries to maintain a stable ratio of total financial asset holdings to income, such that a relative decline in the supply of government debt is offset by an increase in the demand for private liabilities.[26]

Robert Shiller was among those who were not convinced that the total debt-to-income ratio would remain constant. He pointed out that the relative decline in government debt since World War II was the consequence of a return to peacetime levels of defense expenditures.[27] He did not see a connection between lower defense spending and less federal government borrowing, on the one hand,

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[25] Friedman, "The Role of Money and Credit in Macroeconomic Analysis," p. 165. Using a different econometric approach, Kopke showed that the velocity of total debt was more stable around its trend over the period 1960 to 1982 than were the velocities of the monetary aggregates around their trends. See Richard W. Kopke, "Must the Ideal Money Stock Be Controllable?" Federal Reserve Bank of Boston New England Economic Review, March-April 1983, pp. 10-23.

[26] Benjamin M. Friedman, "The Relative Stability of Money and Credit 'Velocities' in the United States: Evidence and Some Speculations," National Bureau of Economic Research, Working Paper no. 645, 1981.

[27] See the comments of Robert J. Shiller and Philip Cagan following Friedman, "The Role of Money and Credit in Macroeconomic Analysis."

and higher private-sector spending and greater individual and corporate borrowing, on the other. If the decline in federal government borrowing coincided, for example, with a curtailment of highway and transportation expenditures by the public sector, offset by increases in private sector spending on transportation facilities financed by borrowing, Friedman's argument would have been more persuasive. Also skeptical was Philip Cagan, who thought that even if the capital stock-to-GNP ratio were constant there was no reason to presume that the debt markets would provide a constant fraction of the financing of capital expenditures. Thus the total debt-to-GNP ratio need not be constant.

Later studies of broad credit measures

Whatever the merits of these criticisms, interest in broad credit aggregates remained high. Bruce Brittain and Shafiqul Islam extended the econometric work of Friedman on the U.S. economy by comparing the money-to-income and credit-to-income relationships in other major economies. Applying criteria of closeness-of-fit and exogeneity with respect to income, Brittain found mixed results: in Germany and the United States broad money is the superior intermediate target, in Italy total credit is marginally superior to broad money, and in Japan no firm conclusion can be drawn.[28] In contrast, Islam's analysis of U.S., German, and Japanese data was more favorable to credit. He found that credit aggregates in all three countries are as good as or slightly better than conventional monetary aggregates in the stability and predictability of their relationships with nominal GNP.[29]

Taken together, the findings of Kaufman, Davis, Friedman, and Islam generally seemed to support the view that broad credit aggregates should be given at least some weight in economic research and central bank policy. And in 1983, amid deregulation of bank deposits and instability in the demand for money, the Federal Open Market Committee (FOMC) began to set a monitoring range for Total Domestic Nonfinancial Sector Debt. The Federal Reserve's decision to supplement the monetary aggregates with a credit aggregate in its reports to Congress instigated further research on

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[28] Bruce Brittain, "Choosing between Money Targets and Targets for Credit," in Brian Griffiths and Geoffrey E. Wood, eds., Monetary Targets (New York: St. Martin's Press, 1981), pp. 62-80.

[29] Shafiqul Islam, "Monetary and Credit Aggregates and Economic Activity: Evidence from Germany, Japan, and the United States," Federal Reserve Bank of New York, Research Paper no. 8203, January 1982. Friedman also analyzed data from foreign countries: Canada, Germany, Japan, and the United Kingdom. Benjamin M. Friedman, "Money, Credit and Nonfinancial Economic Activity: An Empirical Study in Five Countries," National Bureau of Economic Research, Working Paper no. 1033, November 1982.

broad credit aggregates. None of the succeeding studies, however, proved to be particularly supportive of total debt.

Edward Offenbacher and Richard Porter found that Friedman's empirical results are sensitive to slight changes in data construction and the specifications of the VAR model.[30] They concluded that their estimates using the VAR methodology favor money aggregates over credit aggregates. Moreover, they concluded that results from VARs cannot show the effects of the monetary authorities adopting a specific policy for debt expansion.[31]

Friedman himself put his earlier work on credit in better perspective by extending the period of his analysis back into the late ninteenth century.[32] From this long-run study he confirmed that economic fluctuations are reflected in the financial side of the economy. Financial quantities clearly show procyclical behavior and have the tendency to lead turning points in the business cycle. But the theme of his paper is that the quantitative relationships connecting monetary and financial variables to the business cycle are not truly invariant. There appear to be strong and persistent regularities, but on closer inspection the relationships turn out not to be so persistent or regular. The reasons he offered were the evolution of monetary policy, changes in banking and securities regulations and in the tax code, and financial innovations. Friedman felt that the implication for central bank policy was clear: it is dangerous to base macroeconomic policy on the presumption that an observed ten- or twenty-year regularity in the relationship between one or more financial variables and economic activity will continue.

In 1985 it became clear that the previously observed relationship between credit aggregates and

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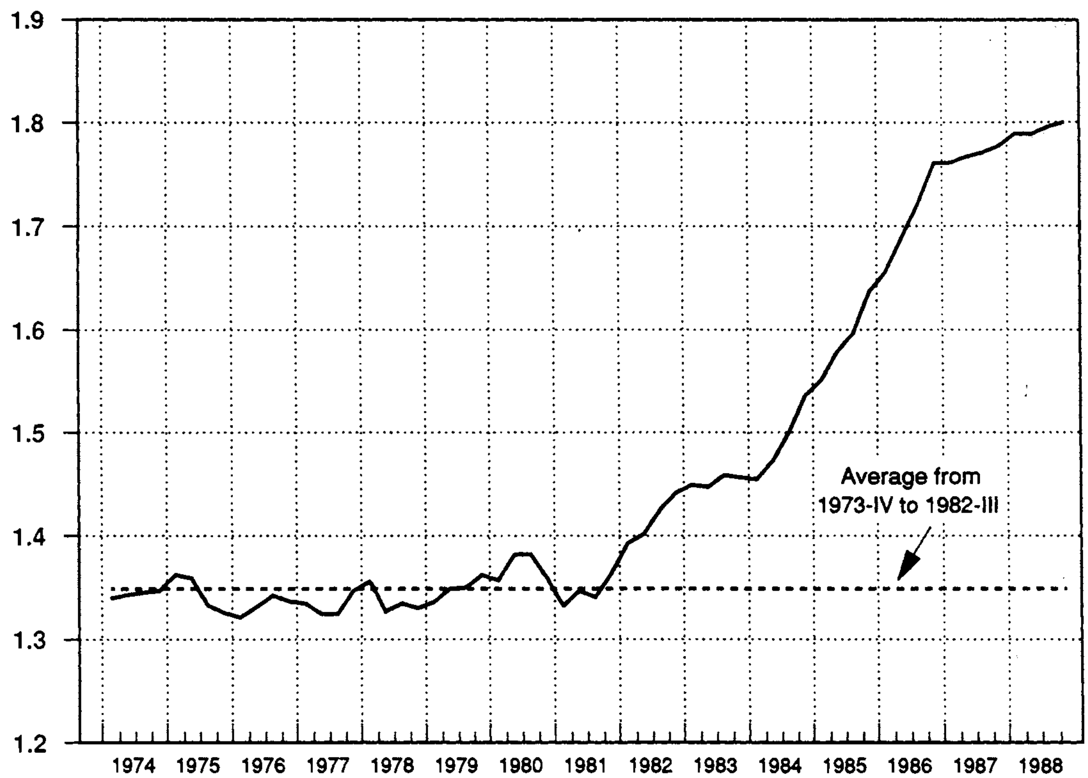
[30] Edward K. Offenbacher and Richard D. Porter, "Empirical Comparisons of Credit and Monetary Aggregates Using Vector Autoregression Methods," Special Studies Paper no. 181, August 1983; and Federal Reserve Bank of Richmond Economic Review, November-December 1983, pp. 16-29.

[31] Others also showed the sensitivity of the results on broad credit aggregates: James S. Fackler, "An Empirical Model of the Markets for Goods, Money, and Credit," Journal of Money, Credit, and Banking, February 1985, pp. 28-42; and R.W. Hafer, "Money, Debt, and Economic Activity," Federal Reserve Bank of St. Louis Review, June-July 1984, pp. 18-25, and "Choosing between M1 and Debt as an Intermediate Target for Monetary Policy," Understanding Monetary Regimes, Carnegie-Rochester Conference Series on Public Policy, Spring 1985, pp. 89-132.

[32] Benjamin M. Friedman, "Money, Credit, and Interest Rates in the Business Cycle," in Robert Gordon, ed., The American Business Cycle: Continuity and Change (Chicago: University of Chicago Press, 1986), pp. 395-458.

Chart 1

Ratio of Total Nonfinancial Sector Debt to GNP



Source: Federal Reserve System.

nominal GNP had deteriorated badly (Chart 1).[33] Beginning in the second quarter of 1983, the ratio of Total Nonfinancial Sector Debt to nominal GNP rose rapidly after exhibiting no trend previously. The next year Kaufman listed the "close correlation between the growth of debt and the growth of nominal GNP" as one of seven "fallen financial dogmas and beliefs."[34] Friedman subsequently remarked, after having seen the money-income and credit-income relationships deteriorate, that both money and credit had become irrelevant for monetary policy.[35]

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[33] See John F. Wilson, Elizabeth M. Fogler, James L. Freund, and Guido E. van der Ven, "Major Borrowing and Lending Trends in the U.S. Economy, 1981-85," Federal Reserve Bulletin, August 1986, pp. 511-24.

[34] Henry Kaufman, Interest Rates, the Markets, and the New Financial World (New York: Times Books, 1986), chap. 10.

[35] Benjamin M. Friedman, "Monetary Policy Without Quantity Variables," American Economic Review, May 1988, pp. 440-45.

The earlier doubts as to the constancy of the total debt-to-nominal GNP ratio appear to have been correct. Changes in the banking system and the financial markets, related to both innovations and deregulation, seem to have facilitated a financial deepening and widening--a rise in the amount of marketable debt instruments plus credit created by financial intermediaries relative to income and wealth in the economy. Hence the ratio has risen significantly since 1983. Instability in the demand and supply of credit appears to have been as severe as instability in the demand and supply of money.

Updating the econometric results

To round out this review of broad credit aggregates, we repeat some of the earlier econometric analysis, making use of additional years of data. Table 3 reports simple correlation coefficients between the one-quarter growth rates of the monetary and financial aggregates over the period 1960 to 1989. The growth of Total Nonfinancial Sector Debt is less closely related to each of the monetary aggregates during the second half of the period than in the first. Thus, the information on the financial markets and the economy contained in total debt may have increased relative to the information contained in the money supply. But the lower correlation could simply reflect instead a looser relationship between total debt and the level of economic activity.

Table 4 reports the results from two sets of regressions. In the first set the growth of nominal GNP is explained by current and lagged growth rates of a single financial aggregate *and* lagged values of nominal GNP; in the second set only lagged growth rates of the financial variable are used. After the regressions are run, a test of the significance of the coefficient estimates for the financial variable is performed. Passing the test implies that the financial variable is able to make a statistically significant contribution to the explanation of the movements in nominal GNP unaccounted for by past movements in GNP itself.

Total debt does contribute to the explanation of nominal GNP over the entire period and over both subperiods if its current value is included in the equation. However, if the current value of the financial aggregate is dropped from the equation, total debt does rather poorly relative to the monetary aggregates, a result similar to that found earlier by others. These findings are not particularly favorable to total debt, but they are not favorable to the monetary aggregates either. The monetary and credit aggregates are uniformly better at explaining nominal GNP over the 1960-74 period than

Table 3

Correlations among the Monetary and Credit Aggregates

1960-II to 1989-I	Monetary Base	M1	M2	M3	L	Tot Nonfin Sec Debt
Monetary base	1.00					
M1	0.67	1.00				
M2	0.36	0.54	1.00			
M3	0.41	0.40	0.75	1.00		
L	0.57	0.43	0.61	0.83	1.00	
Total Nonfinancial Sector Debt	0.70	0.48	0.20	0.35	0.62	1.00
1960-II to 1974-III						
Monetary base	1.00					
M1	0.74	1.00				
M2	0.38	0.69	1.00			
M3	0.52	0.63	0.87	1.00		
L	0.74	0.74	0.71	0.84	1.00	
Total Nonfinancial Sector Debt	0.79	0.56	0.37	0.49	0.78	1.00
1974-IV to 1989-I						
Monetary base	1.00					
M1	0.63	1.00				
M2	0.29	0.46	1.00			
M3	0.20	0.30	0.68	1.00		
L	0.15	0.17	0.49	0.88	1.00	
Total Nonfinancial Sector Debt	0.35	0.24	-0.06	0.27	0.41	1.00

Table 4

Regressions of Nominal GNP on Various Money and Credit Aggregates

Nominal GNP Explained by Current and Four Lagged Values of the Financial Aggregate.

Variable	R-Bar Squared (1960-II to 1989-I)	R-Bar Squared (1960-II to 1974-III)	R-Bar Squared (1974-IV to 1989-I)
Monetary base	0.11***	0.24***	0.03
M1	0.08**	0.30***	-0.01
M2	0.16***	0.21***	0.03
M3	0.14***	0.22***	0.17**
L	0.20***	0.29***	0.17**
Total nonfinancial sector debt	0.19***	0.33***	0.12**

Nominal GNP Explained by Four Lagged Values of the Financial Aggregate Only.

Variable	R-Bar Squared (1960-II to 1989-I)	R-Bar Squared (1960-II to 1974-III)	R-Bar Squared (1974-IV to 1989-I)
Monetary base	0.11***	0.17***	0.05
M1	0.08**	0.25***	0.01
M2	0.16***	0.22***	0.05
M3	0.14***	0.23***	0.10**
L	0.12***	0.30***	-0.02
Total nonfinancial sector debt	0.05***	0.19***	-0.04

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

over the 1975-89 period. Innovation and deregulation have apparently had roughly parallel effects on all the financial aggregates.

D. The Potential Usefulness of Broad Credit Measures

Few economists who investigated broad credit aggregates argued that they should simply replace the money supply in the Federal Reserve policy process. Instead, they suggested two ways in which a broad measure of credit could be incorporated in Federal Reserve policy-setting procedures. Total credit could be used as an intermediate target by the FOMC along with one or more measures of the money supply.[36] Or, if the FOMC did not adopt intermediate targeting, total debt could be one of the key financial quantities, along with the money supply, on which the FOMC bases its decisions--that is, it could be treated as an important indicator, either a "monitoring" or "information" variable. Both Kaufman and Friedman at one time argued that their findings supported the use of a broad credit measure in either of these policy frameworks, although they were skeptical of a mechanical approach to intermediate targeting. Either way, the use of total debt was consistent with the position that central bankers should lengthen the list of financial variables they take into consideration to include more than the monetary aggregates.

To evaluate the potential usefulness of a broad credit aggregate for Federal Reserve policy, Fackler and Silver estimated the marginal contribution that total nonfinancial debt would have made to Federal Reserve policy during the period 1970 to 1982 if the FOMC had given equal weight to total debt and the money supply.[37]

They attempted to identify those occasions when total debt signaled, rightly or wrongly, the need for a policy different from that indicated by the money supply. They compared the signals given by the growth of total debt with those given by the growth of the M1 money supply, noting when the two signals differed markedly. There were three such instances: late 1973, mid-1980, and late 1980-early 1981. Fackler and Silver concluded that the signal from total debt was not unambiguously more accurate than that given by money in these instances.

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[36] Benjamin M. Friedman, "Time to Rethink the Monetary Targets Framework," New England Economic Review, March-April 1982, pp. 15-23; and Henry Kaufman's discussion in Controlling Monetary Aggregates III, Federal Bank of Boston, October 1980, pp. 66-68.

[37] James Fackler and Andrew Silver, "Credit Aggregates as Policy Targets," Federal Reserve Bank of New York Quarterly Review, Winter 1982-83, pp. 2-9.

The issue of controllability

An evaluation of a broad credit aggregate as an intermediate target for policy must also take into consideration the degree of control the central bank can exert over credit aggregates. One could argue that the Federal Reserve can maintain no more or less control over total debt than it can over almost any other financial aggregate (with the exception of the monetary base). Financial quantities are endogenously determined, with Federal Reserve actions only one of many forces working on the total dollar volume of M1, bank credit, or total debt. Thus, the FOMC has limited ability to control the growth of financial aggregates. In this context, total debt has nothing in principle to recommend for or against it relative to other financial quantities.

One could also argue, though, that M1, and possibly M2, is under greater control than total debt. Reserve requirements are imposed on demand deposits and other checkable deposits, thus potentially allowing tighter control over M1.[38] Moreover, demand-for-money and supply-of-money functions have been specified and estimated to some degree of satisfaction. The implication is that economists have a better understanding of the factors determining the growth of the monetary aggregates and that the Federal Reserve can use this knowledge to gain greater control over the growth of the money supply. Similar equations have not been developed for total debt, one reason being the difficulty of identifying the principal factors determining its growth.

Friedman tried to estimate the degree of control the Federal Reserve is likely to have in practice over money and total debt. He related changes in these financial quantities to changes in two Federal Reserve instruments, the federal funds rate and bank reserves.[39] Total debt is significantly related to both; in fact, it is more closely related to the federal funds rate than money is. The real question, however, is whether the Federal Reserve has sufficient control over monetary and credit aggregates to use them as an intermediate target, especially when slippage in the relationship between the intermediate target and economic activity is taken into account.

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[38] But by calculating "shadow" reserve requirements, the tactics of open market operations can also accommodate the use of credit aggregates at the strategy level of policy. See Marcelle Arak, "Control of a Credit Aggregate," Federal Reserve Bank of New York Quarterly Review, Winter 1982-83, pp. 10-15.

[39] Friedman, "Monetary Policy with a Credit Aggregate Target."

Summary

Beginning in the latter half of the 1970s, economists took a greater interest in using broad measures of credit in macroeconomic analysis. Theoretical arguments for these measures had considerable appeal. Econometric studies, particularly those by Friedman, generally showed the relationship between total nonfinancial sector debt and economic activity to be comparable, in terms of stability and predictability, to the relationship between the money supply and economic activity. These studies were used to support the position that a broad credit aggregate could be used jointly with a monetary aggregate in setting central bank policy.

The theoretical arguments and empirical findings on total debt were well received by many economists and central bankers. They had been facing instability in the demand for money since the mid-1970s, if not earlier; and besides, some were skeptical of basing Federal Reserve policy too heavily on a single financial variable. Nevertheless, enthusiasm for using broad measures of credit as a policy variable was tempered by the lack of a convincing explanation of the observed stability of the total debt-to-income ratio.

Since 1983, the potential value seen in using a broad measure of credit in formulating policy has diminished markedly. Around that time, the previously observed relationship between a broad credit measure and nominal GNP, which was stable over much of the postwar period, began to deteriorate badly. The ratio of Total Nonfinancial Sector Debt to nominal GNP has risen rapidly since then. Financial innovations and deregulation seem to have facilitated a rise in the amount of marketable debt instruments and credit created by financial intermediaries relative to income and wealth in the economy. Additional research on broad credit aggregates has also subsequently shown that the relationship between the aggregates and economic activity is not as tight or as stable as the earlier studies had led people to believe; the econometric results are sensitive to changes in the time period studied and to seemingly minor changes in the specification of the statistical tests. Nor can it be firmly established that total credit can make a significant marginal contribution to the explanation of variation in GNP left unaccounted for by the growth of the money supply. Total debt thus does not seem to be a suitable intermediate target for policy.[40] But even if the relationship between total debt

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[40] In speaking of total debt as an intermediate target, we mean that the authorities would aim at this target instead of the goal variables of Federal Reserve policy, real growth and price stability. To use total debt as an intermediate target, the FOMC would establish a growth rate for total debt that promises to lead to desirable outcomes for the goal variables. Then the Committee's decisions concerning the discount rate and the open market directive would be designed to achieve the established growth rate for total debt.

and output were tighter, the degree of control over total debt might well be inadequate for it to serve as an intermediate target. While the money supply is thought to be under some degree of control by the central bank, no convincing argument has been made that total debt could be placed under its direct influence. This would appear to be true whether the tactics of policy are characterized by either automatic or discretionary adjustments to instrument settings in response to growth of total debt that is deemed too fast or too slow.[41]

The odd behavior of total debt during the past few years does not automatically rule out using its growth, along with other financial variables, as an indicator of the need for a change in policy.[42] While its overall relationship with nominal GNP is neither stable nor close, regression analysis does indicate that a relationship exists, and it may well have a degree of reliability comparable to the relationship between M1 or M2 and nominal GNP. Furthermore, it is still uncertain whether the period of instability in the demand for money is over.

As for measuring the thrust of Federal Reserve policy, growth of total debt is flawed in the same way that nominal interest rates and other financial variables are flawed. Total debt is an endogenous variable and hence is procyclical; it cannot serve the same role that, for example, the full-employment surplus can in analyzing fiscal policy. In any case, if there were a way to make a measure of total debt exogenous, shifts in the demand and supply of credit seen in recent years might defeat its usefulness.

All things considered, rapid acceleration or deceleration in the growth of total debt would still seem to signify the need for a policy change in the context of confirming signals from other financial market indicators. There is information to be gained by monitoring the growth of total debt as well as

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[41] Nor does there seem to be a way to devise a "fail-safe mechanism" for central bank policy based on the growth of total debt. What is meant by a "fail-safe mechanism" is some self-imposed constraint on the policy makers' decision set intended to prevent them from ever making a serious error in setting policy. For instance, the imposition of a floor on the real federal funds rate at 2 percent (but in effect only during periods of economic expansion) would be a fail-safe mechanism.

[42] One specific definition of "indicator" variable states that Federal Reserve policy *must* be adjusted when designated indicators are unanimously signaling that the economy is either much too strong or much too weak, or when price pressures are building. The indicator variables would be chosen so that together they reliably convey the full range of information coming out of the financial markets. The indicators are not chosen, however, on the basis of their incremental predictive abilities and then used to help forecast the economy. They are of little value in forecasting when the usual information set is available. See Bennett T. McCallum, "Targets, Indicators, and Instruments of Monetary Policy" (Paper presented at the American Enterprise Institute Conference "Monetary Policy in an Era of Change," November 16-17, 1988).

the money supply. Moreover, the theoretical arguments in favor of total debt continue to have appeal and remain relevant. In all, there still seems to be a good case for maintaining a balance between the use of money and credit measures in making policy.

II. Bank Credit

A. The Rationale for Its Use

A number of economists have maintained over the years that bank credit is "special" and more important than money for understanding macroeconomic fluctuations. They argue, moreover, that bank credit, rather than the money supply, is pivotal in the transmission mechanism of central bank policy. The research of Ben Bernanke, Mark Gertler, and Joseph Stiglitz, whose approach to macroeconomics is sometimes referred to as the New Keynesian Economics, has advanced such ideas during the past ten years.[43] But Robert Roosa stated the position almost forty years ago:

> "It is principally through effects upon the position and decisions of lenders, and only secondarily through effects upon the decisions of borrowers and savers, that central bank action affecting interest rates achieves its significance."[44]

The recent interest in bank credit has been motivated by some of the same factors that have spurred the interest in broad credit measures, such as the need for alternatives or supplements to the poorly performing monetary aggregates. But this research also represents in some respects a revival of an earlier interest in bank credit. In studies of the relationship between the money supply and nominal GNP done almost twenty years ago, measures of bank credit were tried as an alternative to the conventionally defined monetary aggregates. Bank credit was used because it was thought that the items appearing on the asset side of the balance sheet could be measured more reliably than the monetary assets appearing on the liability side. As such, bank credit was defined to be the sum of

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[43] Other economists working outside the framework of New Keynesian macroeconomics have also proposed that bank lending is special and merits careful consideration. Fama concluded that since the "tax" imposed by reserve requirements is paid by borrowers, meaning that they pay a higher interest rate on a bank loan than they would on a loan from some individual or institution that did not pay reserve requirements, there must be something unique about bank loans. Eugene F. Fama, "What's Different about Banks?" Journal of Monetary Economics, 1985, pp. 29-39.

[44] Robert V. Rosa, "Interest Rates and the Central Bank," Money, Trade, and Economic Growth (New York: Macmillan, 1951), p. 293.

loans and investments. The current rationale for focusing on bank credit, however, is somewhat different. This new rationale will be outlined in the rest of this section, followed by a section on the measurement of bank credit.

The case that bank credit is "special"

Underlying the renewed emphasis on bank credit are two observations. First, as a practical matter, households and most small and medium-size business borrowers have no access to the open market for credit. For such borrowers, banks are likely to be by far the most important source of credit, though other sources such as finance companies and, for small firms, trade credit are likely to exist as well.[45] If banks are unwilling to finance these borrowers' plans for purchasing inventory, equipment, housing, or automobiles, aggregate spending is likely to be curtailed.[46]

The second observation is that bank credit is not allocated to potential borrowers simply according to who is willing to pay the highest interest rate. Banks do not attempt to maximize their return by lending to whoever walks into the lobby, applies for a loan, and promises to pay the highest rate of interest. Instead, banks follow a strategy of charging a lower interest rate and using several tactics each of which increases the likelihood of repayment.[47] They screen loan applicants, monitor borrowers, require collateral, give preference to long-term customers of the bank, make mostly short-

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[45] Bank lending can also be viewed as "special" because it serves as the backup source of liquidity for both financial and nonfinancial businesses in the event of disruptions in the payments system, the clearing of securities, or the financial markets. E. Gerald Corrigan, "Are Banks Special?" Federal Reserve Bank of Minneapolis Annual Report, 1982.

[46] Exactly the same argument has been made in a different context. Analyzing the effects of both direct controls on bank credit and indirect control stemming from Regulation Q ceilings, Davis contends that . . ."some small business and consumer borrowers are unlikely to be able to substitute fully nonbank credit or other financial sources for the now unavailable bank credit. . . .Therefore, there will be at least some cuts in total credit flows and in spending on output by businesses and consumers whose access to bank borrowing has been reduced." Richard G. Davis, "An Analysis of Quantitative Credit Controls and Related Devices," Brooking Papers on Economic Activity, 1:1971, pp. 75-76.

[47] For related reasons, there are very few long-term bonds issued with a resettable interest rate. They are unpopular because a rise in the interest rate reduces the firm's ability to pay and puts a bond's principal at greater risk. In fact, although the bond's interest rate is supposed to be reset annually so that the bond trades at par, there may be no interest rate that will get the bond's price to par. See The Wall Street Journal, May 2, 1989, p. C2.

term loans, and so forth.[48] In sum, banks allocate credit or restrict its availability through various means, creating an excess demand for credit at the prevailing interest rate.[49]

The fundamental reasons giving rise to these banking practices will not be reviewed here in detail. They have been analyzed by economists interested in explaining the origins of various credit instruments, the widespread use of particular practices in finance, and the existence of financial intermediaries.[50] We will simply mention that imperfect information about the probability of a borrower defaulting is a major factor underlying the existence of banks. These institutions specialize in lending to small and medium-size firms and households, two groups whose creditworthiness is difficult to assess.[51] Problems of adverse selection and incentives are fundamental to the adoption of many of the bank lending practices mentioned.

An implication of widespread use of the practice of setting more restrictive loan terms rather than raising the interest rate to allocate credit is that short-term bank lending rates may be a very unreliable guide to policy. The noninterest rate terms of credit (collateral, maximum time length of a loan, conditions for rolling over the loan, acceptable uses of the loan) would seem to be as important in their ultimate effect on aggregate demand as the level of the interest rate. These terms either raise the effective cost of the loan well above the interest charges or cause the small business firm to be

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[48] Several studies have attempted to show that banks actively use nonprice devices to allocate credit. See Stephen R. King, "Monetary Transmission: Through Bank Loans or Bank Liabilities?" Journal of Money, Credit, and Banking, August 1986, pp. 290-303; Dwight M. Jaffee and Franco Modigliani, "A Theory and Test of Credit Rationing," American Economic Review, December 1969, pp. 850-72; and William R. Keeton, "Deposit Deregulation, Credit Availability, and Monetary Policy," Federal Reserve Bank of Kansas City Economic Review, June 1986, pp. 26-42.

[49] We are deliberately avoiding the use of the word "ration," which many associate with government-imposed and administered ceilings on interest rates.

[50] For an analysis of the role of banks, see Joseph E. Stiglitz and Andrew Weiss, "Banks as Social Accountants and Screening Devices for the Allocation of Credit," National Bureau of Economic Research, Working Paper no. 2710, prepared for A. Courakis and C. Goodhart, eds., The Monetary Economics of John Hicks (London: Macmillan, 1988). For a partial survey of the work on credit rationing, Stiglitz and Weiss cite: D.M. Jaffee and J.E. Stiglitz, "Credit Rationing," in F.H. Hahn and B. Friedman, eds., Handbook of Monetary Economics (New York: North-Holland, forthcoming).

[51] In the case of households, another way of stating this is that the bank cannot estimate a family's permanent income, it can only verify its current income. Hence, it imposes a ceiling on the ratio of loan repayment to income. This argument is made by James A. Wilcox, "Consumption Constraints: The Real Effects of 'Real' Lending Policies," Federal Reserve Bank of San Francisco Review, Autumn 1989, pp. 39-52.

disqualified. For those households that, like small firms, are heavily dependent on banks for credit, the availability and all-in cost (interest rate charges plus costs imposed by the other terms of the loan) are again relevant, perhaps for home mortgages in particular. In contrast, only for large established firms that have ready access to both bank and nonbank sources of credit at all times, even during periods of tight money and great economic uncertainty, is the interest rate sufficient for assessing credit conditions. Interest rates by themselves may thus be an acceptable indicator of the effect of central bank policy on the corporate business sector, but a poor indicator outside that sector.

Several issues discussed in this section and in the next were raised nearly twenty years ago in connection with the Federal Reserve's Regulation Q. At that time, the substitutability of nonbank sources of credit for bank sources and the usefulness of the money supply, credit quantities, and interest rates in policy making were also analyzed against a background of fluctuations in credit availability. It was pointed out then that a serious weakness in any argument that bank credit is "special" is the fact that banks are not the sole source of credit available to households and small businesses. Significant nonbank alternatives exist for households seeking a home mortgage or an automobile loan; and finance company loans and trade credit from suppliers provide inventory financing for small firms, as discussed further in a later section.

Research supporting the view that bank credit is "special"

Before examining the link between bank credit and the macroeconomy, it may be useful to review some evidence that bank lending is a determinant of spending in the economy. Several studies show that the nonprice terms of home mortgage loans have had a very significant effect on the housing market, although innovations in housing finance may have made those findings obsolete.[52] For consumption spending, Duca produced evidence that he found to be a clear indication that the availability of bank credit has been influential.[53] He showed that an index of banks' willingness to lend to households, derived from the Senior Bank Officer Lending Survey, is a statistically significant factor determining durable goods demand. The results indicated to him that in the past (the study covered the period 1966-86) households could not readily switch to alternative lenders when commercial banks were unwilling to lend to them.

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[52] See the references in Keeton, "Deposit Deregulation, Credit Availability, and Monetary Policy."

[53] John Duca, "The Effects of Credit Availability on Consumer Durable Expenditures" (Paper presented at a meeting of Federal Reserve System economists, October 1987).

In the business sector, Fazzari, Hubbard, and Petersen maintain that investment spending by small firms is generally more sensitive to internal financial positions than investment spending by large firms in the same industry.[54] The explanation they give is that smaller firms face more financial constraints than do larger firms. Consistent with this point, Gertler and Hubbard show by using cross-sectional time-series data that cash flow is a factor determining investment spending by individual manufacturing firms.[55]

Notwithstanding these findings, it has yet to be established that loan availability is important for the working of the macroeconomy, or even that smaller businesses as a group can have a significant effect on aggregate demand.[56] How large is the small business sector and does it produce a significant portion of GNP? Is the dollar volume of investment spending conducted by small-to-medium size firms a major portion of total business fixed investment?

We can strengthen the case that a significant volume of bank credit is still special by drawing on Commerce Department data collected from manufacturing firms on their short-term borrowings, those with original maturities of one year or less. As of the third quarter of 1988, these data show that manufacturing corporations with assets of less than $250 million are highly dependent on bank loans; they obtain an insignificant amount of funds from the commercial paper market (Table 5.) Firms holding assets of more than $1 billion have good access to the commercial paper market, using the commercial paper market much more than their banks. Firms holding between $250 million and $1 billion of assets have limited access to the commercial paper market.

On the basis of these data we would estimate that between $26 billion and $32 billion of bank loans, out of $46 billion of loans outstanding to manufacturing firms, is "special" in the sense that the

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[54] Steven M. Fazzari, R. Glenn Hubbard, and Bruce C. Petersen, "Financing Constraints and Corporate Investment," Brookings Papers on Economic Activity, 1:1988, pp. 141-206.

[55] Mark L. Gertler and R. Glenn Hubbard, "Financial Factors in Business Fluctuations," Financial Market Volatility, a symposium sponsored by the Federal Reserve Bank of Kansas City, August 1988; also, First Boston Working Paper Series FB-88-37, September 1988.

[56] At the macro level, the business fixed investment equation developed by Eckstein and Siani gives an important role to the financial health of the business sector. This econometric equation is consistent with the idea that bank credit is special, although it does not directly test the hypothesis that firms face financial constraints. See Otto Eckstein and Allen Sinai, "The Mechanisms of the Business Cycle in the Postwar Era," in Robert Gordon, ed., The American Business Cycle: Continuity and Change" (Chicago: University of Chicago Press, 1986).

Table 5

Distribution of Short-Term Borrowing by Manufacturing Corporations according to Firm Size

Firm Size, as Measured by the Total Assets of the Corporation	Borrowings as of 1988-Third Quarter (In Billions of Dollars)		
	Loans from Commercial Banks	Commercial Paper	Other Borrowings
$250 thousand to $25 million	14.9	-----	2.7*
$25 million to $50 million	3.8	#	0.3
$50 million to $100 million	3.8	#	0.7
$100 million to $250 million	3.4	0.2	0.8
$250 million to $1 billion	6.4	1.4	1.2
More than $1 billion	13.8	25.9	13.9

Source: U.S. Department of Commerce, Bureau of the Census, Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations, third quarter, 1988.

* "Other borrowings" include commercial paper for the category $250 thousand to $25 million.

\# Less than $50 million.

borrower may not have a good substitute available. By dollar volume, between 56 percent and 70 percent of bank loans to manufacturing firms is "special." We also see that the net sales revenue of those firms apparently dependent on bank lending is between 32 percent and 44 percent of the sales revenue of all manufacturing firms. Thus the portion of the business sector relying on banks for credit may be sufficiently large to matter for macroeconomic analysis.[57]

The link between bank credit and the macroeconomy

Bank credit is supposed to play a prominent role in the economy because the cost and availability of bank credit can directly and substantially affect aggregate demand and the level of real economic activity. A shift in the supply of bank reserves is usually thought of as the principal underlying cause of exogenous changes in the price and availability of bank credit, but there are two other ways such changes can come about. First, a softening of the real economy, or the expectation of a softening, not only lowers the value of collateral that a business firm can offer, but also raises the probability that a firm will be unable to repay. In response, banks may reduce their exposure by shrinking the credit lines of their business borrowers. Then the volume of bank loans would contract or its growth would slow, causing capital spending and inventory investment to slacken and possibly to decline.[58] Movements in interest rates and the money supply may not give signs of the developing weakness in aggregate demand.

Second, a financial disruption, such as a bank failure or disintermediation caused by deposit rate ceilings, reduces the flow of bank credit from the affected banks to their customers, causing their investment spending to decline. Again, interest rates and the money supply may not warn of the effects on aggregate demand. This is precisely the finding of Bernanke: the collapse of the banking system disrupted the flow of credit to a large segment of the economy and contributed to the decline

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[57] Keeton pointed out, however, that the nonprice terms of a loan seem to be used to a lesser degree by banks for the purpose of allocating credit during the past several years, as might be expected with less regulation of the banking sector. From the Loan Officer Survey he found that since 1978 there has been relatively more variation in bank lending rates and less variation in the credit standards for new customers. This may indicate that banks are relying more on the loan rate to allocate credit--and by doing so bank credit would no longer be so special. See Keeton, "Deposit Deregulation, Credit Availability, and Monetary Policy."

[58] The farm and energy sectors are specific examples from the 1980s of small business borrowers facing reduced credit availability. The fall in the prices of farm land and drilling equipment reduced the value of the collateral that farmers and oil companies could offer creditors. The problems of banks and other lenders to these sectors compounded the reduced credit availability.

in aggregate demand during the Great Depression, and interest rates and the money supply failed to indicate the extent to which this was occurring.[59]

Thus the volume of bank loans may provide additional information concerning the impact of the financial sector on the real economy. Interest rates are important; as borrowing costs rise, consumption spending is deferred and investment projects are postponed. Moreover, a wealth effect from the stock market may be felt. But the impact on aggregate demand of policy moves by the central bank may be better gauged by watching bank loans as well as the money supply since it may matter *how* banks create additional deposits and thus additional money. The growth of bank loans could indicate that the effect of policy on the economy was greater or less than indicated by the money supply.

If loan growth is stronger than money growth, banks have probably responded to a gain of reserves from open market operations by making credit more available. Aggregate demand would then be bolstered by more than the money supply or interest rates indicated because bank credit would become available to finance spending that otherwise would not occur. In contrast, if loan growth is weaker than money growth, banks have probably responded to the increase in bank reserves by adding securities to the asset side of their balance sheets and have not made credit more available to small business customers. Thus the impact on domestic aggregate demand would be weaker.

To demonstrate these points, Bernanke and Blinder built a small macroeconomic model in which money and bank loans have separate roles.[60] Their model, a variant of the textbook IS-LM model, is specified to include three financial instruments: money, bonds, and bank loans. There are two interest rates, one on bonds and another on loans. Shocks to aggregate demand affect the quantity of loans and the quantity of money in the same direction. An autonomous fall in aggregate demand would cause both quantities to shrink, and the signals from the financial aggregates to policy makers would be the same. Suppose instead that a more expansionary central bank policy is implemented, shifting the LM curve to the right. This will have the usual effects on money, the interest rate, and output; and because the volume of credit demanded is endogenous, the volume of bank loans will expand accordingly. Here too the signals from the financial aggregates would be the same.

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[59] Ben S. Bernanke, "Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression," American Economic Review, June 1983, pp. 257-76.

[60] Ben S. Bernanke and Alan S. Blinder, "Credit, Money, and Aggregate Demand," American Economic Review, May 1988, pp. 435-39.

More revealing than these cases is that of a shift in the loan-demand or the loan-supply functions. Suppose that, coincident with looser policy, loan supply shifts because of an anticipated increase in the profitability and hence creditworthiness of the small business sector. Because of greater availability of credit to bank borrowers and greater ability to finance inventories and capital spending, the IS curve also shifts to the right.[61] This would cause the level of output to rise further than indicated by the shift of the LM curve alone. In this case, the impact of policy, not in direction but in magnitude, depends on a reinforcing shift in loan supply. The impact will be stronger than indicated by the money supply if bank loans become available such that more firms can now borrow and proceed with their planned spending.

The Bernanke-Blinder model also implies that incorrect policy moves may be avoided by taking into consideration the growth of bank loans. For example, suppose that there is a shift in money demand. As a result, the money stock, endogenously determined and not under the complete control of the central bank, would increase. If the policy makers' goal were to hit a money supply target, policy would have to be tightened to prevent an undesired expansion in the money stock. If policy makers were also watching the volume of bank loans, however, they would see it contract or its growth slow as the money stock expands. If appreciable weight were given to the growth of bank loans as well as money, the policy makers' response to the increase in the money stock would be tempered.[62]

B. Measurement Issues

Measures of bank credit are readily available; the Federal Reserve System collects extensive data on credit extended by commercial banks. The data are similar in coverage and timeliness to the monetary data, and they are collected by category: real estate, commercial and industrial, securities,

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[61] Stiglitz and Weiss make this point in "Banks as Social Accountants and Screening Devices for the Allocation of Credit," p. 27.

[62] Bernanke and Blinder show how the optimal combination interest rate-money supply policy is a function of the elasticities of credit demand and supply and the variance of their disturbance terms. Duca and VanHoose also use this model to show how the optimal policy is affected by the prevalence of floating rate loan commitments. See John V. Duca and David D. VanHoose, "Loan Commitments and Optimal Monetary Policy," Board of Governors of the Federal Reserve System, Finance and Economics Discussion Paper no. 44, August 1988.

individual, agricultural, and so on.[63] A problem occurs, however, in obtaining data on that portion of bank credit that is "special"--those bank loans made to households and businesses that either have no alternative source of financing or have only alternatives more costly than bank loans. As mentioned earlier, it appears that the size of a business firm for which bank credit is special is one whose assets are less than $250 million. The Federal Reserve does not request that banks report loan data according to the size of the borrower and, of course, certainly not by the degree of access the bank perceives that the borrower has to the credit markets. Hence, no currently available measure of bank credit directly corresponds to the concept of "special" bank credit.

Another problem in measuring the dollar volume of credit that is "special" arises from the use of lenders other than the commercial banks. Small businesses also borrow from nonbank depository institutions, finance companies, and other nonfinancial firms. Table 6 shows that finance companies make a significant amount of credit available to small firms.[64] Some finance companies concentrate on lending to firms considered to be too small and uncreditworthy for commercial banks; others concentrate on factoring, a line of business many banks consider too risky to enter. Accordingly, the short-term business credit made available by finance companies may be just as relevant as bank credit in macroeconomic analysis. Table 6 also shows the net amount of trade credit outstanding. Trade credit, often extended by large firms supplying parts or materials to smaller firms, substitutes for short-term bank borrowing and could be a nontrivial fraction of the credit extended to small firms. But because trade credit is direct lending from one party to another and the terms are different from a bank loan, it is unclear whether trade credit should be included in a measure of bank credit.

There are at least three ways to proceed in obtaining data in order to conduct econometric research on bank credit. We could use total bank loans or just its commercial and industrial (C&I) component, keeping in mind that these measures include loans that are not special. Alternatively, we could adjust the bank loan figures by adding or subtracting items that should or should not be included. For example, "bank credit" as defined by Bernanke and Blinder is the sum of short- and

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[63]If economic research can show the importance of bank loan availability for the macroeconomy, greater effort can be devoted to collecting the bank loan data.

[64]Some of their lending may be to the parent company. For instance, General Electric Capital Corporation may at times float commercial paper and then lend the proceeds to its parent. General Electric Capital could also lend to some large firms. These loans, too, would not represent special credit.

Table 6

Short-Term Liabilities of Nonfinancial Corporations

Amounts Outstanding at Year-End 1983
(In Billions of Dollars)

Type	Amount	Fraction of Total
Bank loans	401.9	61
Commercial paper	37.7	6
Bankers' acceptances	9.4	1
Finance company loans	100.5	15
Net trade credit	106.1	16
Profit tax payable	8.2	1
Total	663.8	100

Source: Federal Reserve Board, Flow of Funds Outstanding, September 1984.

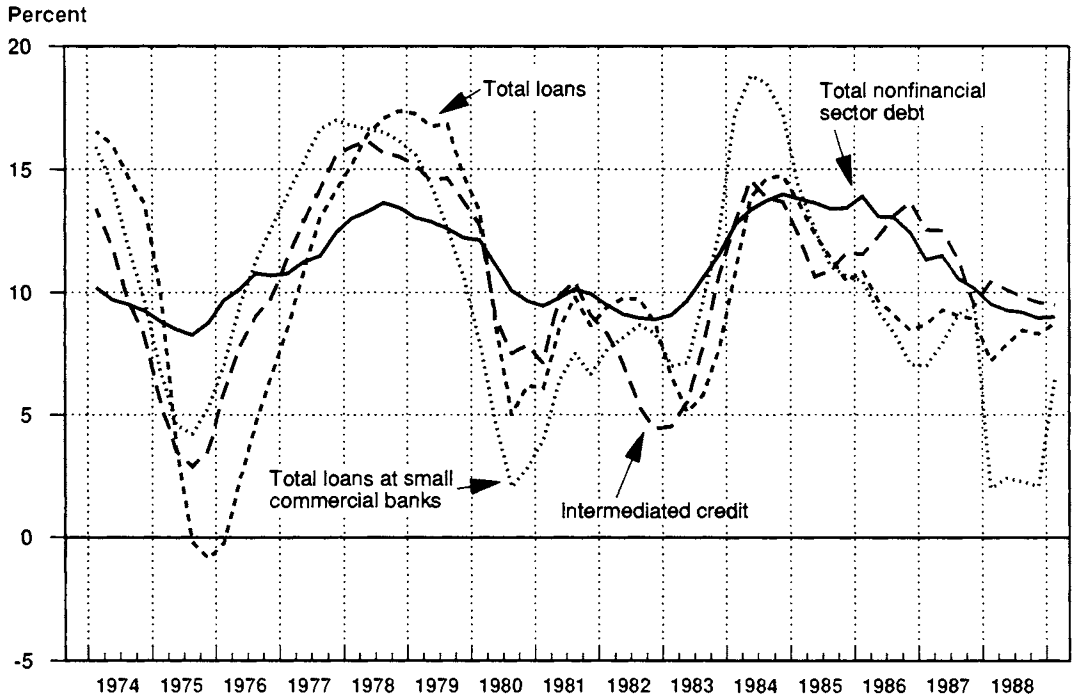
medium-term credit extended to households and nonfinancial businesses by financial intermediaries, as derived from the flow-of-funds data. Apparently, this would be the sum of home mortgages, consumer installment credit, bank loans (not elsewhere classified), and other loans, mortgages, and installment credit extended to the household sector; and mortgages, bank loans (not elsewhere classified), bankers' acceptances, and nonbank finance loans made to nonfinancial businesses. As a second alternative, we could try a proxy for special bank credit--loans extended by smaller banks (possibly with the addition of finance company lending). The reasoning would be that large banks lend primarily to large firms and small banks lend almost exclusively to small firms. Much of the credit extended by large banks is not special and it may be better to exclude their loans; nearly all the credit extended by smaller banks (and finance companies) qualifies as special. Fortunately, the Federal Reserve does report separately loan data from the largest banks (the weekly reporting banks) and the U.S. branches and agencies of foreign banks.[65] The residual, total bank loans less the loans of the weekly reporters and the loans of U.S. branches and agencies of foreign banks, provides an estimate of special bank credit. Of course,

[65] Weekly reporting banks are basically the 169 largest banks in the country, mostly those holding greater than $2 billion of assets as of January 1, 1988.

Chart 2

Bank Loans and Total Nonfinancial Sector Debt

Change from Four Quarters Earlier



Source: Federal Reserve System.

this measure will be distorted if large banks manage to gain a larger share of the lending to medium-size businesses, a change which may well be occurring, or if small banks take more participations in loans to large borrowers.[66]

In Chart 2, the four-quarter growth rates of these measures of "special" credit are plotted: total loans at all banks, total loans at small banks, and intermediated short- and medium-term credit to households and nonfinancial businesses. On the chart, Total Nonfinancial Sector Debt is also drawn for comparison. For each measure of "special" loans, the movements in the four-quarter growth rate appear correlated with the movements in the growth of total credit, but the amplitude of the observed cycles in each of these measures is much greater. It is not clear whether any of these bank loan series

[66] For a report on large banks' attempts to gain small-business customers, see The Wall Street Journal, December 13, 1988, p. B2.

would be useful, but the growth rate of each does show considerably more variation than total debt in the period 1980-84, when the economy went through two sharp recessions and the growth of total debt was relatively smooth.

In Table 7 we report the simple correlation coefficients between the one-quarter growth rates of various monetary, broad credit, and bank loan measures over the period 1973-89. Some correlations are surprisingly weak, especially between measures of bank loans and the narrower monetary aggregates. These weak correlations imply often divergent growth rates and raise the possibility that useful information that is not already contained in the monetary data can be extracted from bank loan data.

Prearranged lines of credit

Another question surrounding measurement of bank credit is whether it is more relevant to measure the actual amount of credit extended by banks or the amount of "potential" credit, that is, the sum of credit extended *and* the unused portions of prearranged credit lines. Normally, the amount of credit outstanding is thought to be more relevant for the measurement of any credit aggregate. Extending credit creates purchasing power, whereas granting a line of credit does not.

What the establishment of a line of credit clearly does is enhance liquidity. And so, prearranged credit lines may create a greater problem for the measurement of a broad monetary aggregate than for the measurement of a credit aggregate.[67] Only if granting a credit line affects the spending of a firm or household in a manner similar to the extension of a loan should unused credit lines be included in a bank credit aggregate.

Prearranged credit lines, however, may affect the timing in the relationship between the growth of a bank credit aggregate and changes in central bank instruments. The aggregate amount of unused credit lines could be a key determinant of the length of the lag between changes in policy instruments and the effect on the volume of bank credit outstanding. A tightening of Federal Reserve policy may initially induce firms and households to make use of their lines of credit as sales revenue or personal income falters, and only sometime later would the amount of credit demanded grow more slowly or contract. Hence, prearranged credit lines may be a determinant of the lag in policy effects on economic activity and of the degree of short-term control that the System has over the quantity of bank credit.

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[67] A monetary aggregate of liquid assets is the topic of Lawrence Radecki and Gabriel de Kock, "Liquid Asset Measures as Intermediate Targets and Indicators for Monetary Policy," in this volume.

Table 7

Correlations among the Monetary and Credit Aggregates

1960-II to 1989-I	M1	M2	M3	L	Total Nonfinancial Sector Debt	Intermediated Credit
M1	1.00					
M2	0.54	1.00				
M3	0.40	0.75	1.00			
L	0.43	0.61	0.83	1.00		
Total Nonfinancial Sector Debt	0.48	0.20	0.35	0.62	1.00	
Intermediated credit	0.31	0.04	0.25	0.43	0.61	1.00

1974-IV to 1989-I	M1	M2	M3	L	Total Nonfinancial Sector Debt	C&I Loans	C&I Loans at Small Banks	Total Loans	Total Loans at Small Banks	Intermediated Credit
M1	1.00									
M2	0.46	1.00								
M3	0.30	0.68	1.00							
L	0.17	0.49	0.88	1.00						
Total Nonfinancial Sector Debt	0.24	-0.06	0.27	0.41	1.00					
C&I loans	0.08	-0.27	0.26	0.39	0.34	1.00				
C&I loans at small banks	0.06	0.16	0.56	0.66	0.34	0.51	1.00			
Total loans	0.15	-0.25	0.30	0.44	0.68	0.83	0.51	1.00		
Total loans at small banks	0.15	0.07	0.37	0.49	0.61	0.33	0.77	0.61	1.00	
Intermediated Credit	0.32	-0.04	0.32	0.37	0.70	0.39	0.30	0.68	0.51	1.00

C. Empirical Research on Bank Credit

There have been several econometric studies of the relationship between bank credit and the level of economic activity. (Brief summaries of the papers cited in this section are presented in Table 8.) The earlier studies, conducted between 1970 and 1975, defined bank credit as total loans and investments at commercial banks,[68] not as total loans or as bank loans to small-to-medium size business firms. Thus, the measure was broader than that recommended by later analysts of the importance of bank credit in the macroeconomy. Nonetheless, most of these earlier studies by Hamburger, Andersen, Hunt, Shadrack, and Levin showed that current and lagged changes in bank credit were capable of explaining as much or more of the changes in nominal GNP than the money supply.[69] Studies conducted a little later, however, were less favorable toward bank credit. For instance, Davis found that bank credit did not do as well as either broad credit measures or money measures in explaining movements in GNP over the period 1961-77.[70] Similarly, Friedman found that bank credit had lower explanatory power than either money or total credit.[71]

While the importance of *bank credit* measured as the sum of all loans and investments was placed in doubt by these studies, the importance of the *bank loan* portion of bank credit was stressed by Bernanke's paper examining the nonmonetary effects of the banking and financial crisis during the Great Depression.[72] Bernanke estimated regressions relating the rate of growth of industrial

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[68] Adjusted to exclude domestic interbank loans and to include net sales of loans to commercial bank affiliates.

[69] Michael J. Hamburger, "Indicators of Monetary Policy: The Arguments and the Evidence," American Economic Review, May 1970, pp. 32-39; L.C. Andersen, "Selection of a Monetary Aggregate for Use in the FOMC Directive," Open Market Policies and Operating Procedures, Board of Governors of the Federal Reserve System, Staff Studies, July 1971; L.H. Hunt, "Bank Credit and the Money Stock: Their Roles in the Determination of Income in the Post Accord Period," Journal of Finance, December 1973, pp. 941-54; Frederick C. Shadrack, "An Empirical Approach to the Definition of Money, Monetary Aggregates and Monetary Policy, Federal Reserve Bank of New York, 1974, pp. 28-34; and Fred J. Levin, "The Selection of a Monetary Indicator: Some Further Empirical Evidence," Monetary Aggregates and Monetary Policy, Federal Reserve Bank of New York, 1974, pp. 35-39.

[70] Davis, "Broad Credit Measures as Targets for Monetary Policy."

[71] Friedman, "The Role of Money and Credit in Macroeconomic Analysis" and "Monetary Policy with a Credit Aggregate Target."

[72] Bernanke, "Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression."

Table 8

Summary of Statistical Findings on Bank Credit Measures

Author	Definitions of Bank Credit Used	Statistical Techniques	Sample Period	Main Results
Hamburger (1970)	Bank credit	Reduced-form	1953-68	Bank credit and total reserves are more closely related to movements of GNP than are the monetary aggregates.
Andersen (1971)	Bank credit	St. Louis approach	1953-69	Bank credit produces a slightly better fit than the other aggregates.
Hunt (1973)	Bank credit	Reduced-form	1953-71	The correlation between bank credit and GNP is generally higher than that between money and GNP.
Shadrack (1974)	Bank credit	Reduced-form	1953-71	The results favor M2 over bank credit.
Levin (1974)	Bank credit	Reduced-form	1960-72	The results favor bank credit slightly over monetary aggregates.
Davis (1979)	Bank credit	Reduced-form	1961-77	Bank credit has less explanatory power than either money or total credit.
Friedman (1983)	Bank credit	Reduced-form, St. Louis approach, VAR	1953-78	Same as Davis.
Bernanke (1983)	Proxy for the banking crisis	Regression	1921-41	The collapse of the financial system had an independent effect on aggregate demand.
King (1984)	Bank loans	VAR	1950-79	The relationship between GNP and demand deposits is stronger than that between GNP and bank loans.
Bernanke (1986)	Bank loans	VAR	1954-84	Money and bank loans have about equal impact on GNP.

Summary of Statistical Findings on Bank Credit Measures (continued)

Author	Definitions of Bank Credit Used	Statistical Techniques	Sample Period	Main Results
Lown (1988)	Bank loans	Reduced-form	1959-87	The results reverse King's findings.
Blinder-Bernanke (1988)	Bank loans	Regression	1974-85	The estimated demand-for-bank-loans equation has coefficients as sensible and significant as those of an estimated demand-for-money equation, and the residuals are smaller in the credit equation.

production to "unanticipated" changes in money and prices in the current quarter and in previous quarters, the rate of growth of industrial production in previous quarters, and proxies for the financial crisis (the deposits of failing banks and the liabilities of failing businesses). The proxies for the banking crisis taken jointly have a high level of statistical significance in the regressions. Bernanke argued that this was confirmation of what was generally believed to be true but until then had not been shown: the collapse of the financial system and the reduced availability of credit had an independent effect on aggregate demand and the economy that was not reflected in conventional monetary data. Nor was the effect seen in the general level of interest rates, although the unusually large spread between the rates on Treasury bonds and low-grade corporate bonds was suggestive.

The findings from postwar data, however, are somewhat ambiguous regarding the importance of bank loans. King used VAR techniques to show that the relationship between demand deposits and future output is far stronger than that between output and C&I loans.[73] But Bernanke subsequently produced a paper that identified a role for bank loans in the postwar economy comparable to what he found during the Great Depression.[74] Looking at the impulse-response functions derived from VARs, Bernanke found that credit shocks have a strong immediate effect on output lasting a year or more, while money shocks have little contemporaneous effect on output (although they do have a lagged effect). Bernanke concluded that "... money and credit are parallel forces of approximately equal importance." Cara Lown updated some of the King and Bernanke work.[75] Over the 1959-87 time period, she found that both total bank loans and demand deposits Granger-cause nominal GNP, but total bank loans have a slightly higher level of significance. Moreover, when the interest rate is paired in a regression equation with bank loans or demand deposits, bank loans are still highly significant in predicting nominal GNP, but not demand deposits.

Recently, Blinder and Bernanke estimated the demand for money and the demand for bank loans using comparable specifications for the regression equations and the same sample period.[76]

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[73] King, "Monetary Transmission: Through Bank Loans or Bank Liabilities?"

[74] Ben S. Bernanke, "Alternative Explanations of the Money-Income Correlation," Real Business Cycles, Real Exchange Rates, and Actual Policies, Carnegie-Rochester Conference Series on Public Policy no. 25, 1986, pp. 49-100.

[75] Cara S. Lown, "The Credit-Output Link vs. the Money-Output Link: New Evidence," Federal Reserve Bank of Dallas Economic Review, November 1988, pp. 1-10.

[76] Bernanke and Blinder, "Credit, Money, and Aggregate Demand."

They found that the coefficients are equally sensible and significant in the credit equation as in the money equation; and the residuals are smaller in the credit equation than in the money equation.[77]

Extending the econometric research on bank credit

In sum, the econometric research on various measures of bank credit has produced mixed results regarding its importance for the behavior of the U.S. economy. The role of the bank loan component is clearest in the case of the Great Depression. The econometric evidence from postwar data, rather limited when compared with the volume of research on broad measures of credit, provides weak confirmation of the usefulness of bank credit measures for policy making in normal times. To supplement what has been done previously, we conduct some analysis of our own.

Regression equations, specified in the same way as those used earlier in the paper to study total credit, were estimated using several measures of bank loans. Table 9 reports the estimates of the regression equations in which the growth of nominal GNP is explained by current and lagged values of various monetary, broad credit, and bank credit aggregates. In an equation which includes both the current and lagged values of the financial aggregate (shown in the upper half of the table), intermediated credit (as defined above) has the most explanatory power over the period 1974-89, followed by M3, L, and total bank loans. (The sample period begins in 1973, the starting date for the loan data.) In equations from which the current value of the financial measure is dropped (lower half of the table), most financial aggregates are no longer statistically significant. Only M3 and intermediated credit show statistically significant explanatory power over the 1974-89 period.

Another set of regressions was estimated, this time using two financial variables simultaneously: intermediated credit and either a monetary aggregate or Total Nonfinancial Sector Debt. The purpose was to see whether a significant contribution to the explanation of GNP movements could be made by intermediated credit, the strongest performer among the measures of bank credit, in a regression equation that already included a conventional aggregate. The results in Table 10 show that intermediated credit is as likely to be statistically significant as the monetary or broad credit aggregate; in a few of the equations, both financial aggregates are significant.

[77] The indicator approach to the analysis of macroeconomic fluctuations has for a long time used bank credit measures extensively. The Bureau of Economic Analysis uses nine credit measures among its 112 principal cyclical indicators. The Credit Flows series are all classified as leading indicators of peaks and troughs in the business cycle. Business Conditions Digest, U.S. Department of Commerce, Bureau of Economic Analysis.

Overall, bank credit measures do as well as the monetary aggregates in these regressions, if not a little better. But because the bank credit data appear to be rather "noisy" on a quarter-to-quarter basis, possibly obscuring the relationship between economic activity and bank credit, an additional set of regressions was run in which the four-quarter growth rates of nominal GNP were explained by four-quarter growth rates of the aggregates. The results are shown in Table 11. In these regressions, M1 and M2 do very poorly; in fact, the correlation between M1 and nominal GNP is negative. M3, L, and Total Debt, however, do make statistically significant contributions to the explanation of nominal GNP at the 1 percent level (the time period is 1974-89).

Three measures of special bank credit--total loans at small banks, commercial and industrial loans at small banks, and intermediated credit--have considerably more explanatory power than the narrow scope of these financial aggregates would have suggested. The growth rates of total loans, total loans at small banks, and intermediated credit are plotted in Chart 3 along with nominal GNP, and the positive relationship between the bank loan measures and GNP can be seen. These regression results would seem to indicate that there may be some validity to the argument that bank credit is special and that bank credit measures could be useful to central bankers in formulating policy.

A study of the relationship in the Canadian economy between monetary and credit aggregates and gross domestic product has recently been completed by an economist at the Bank of Canada.[78] This study, too, found that measures of household credit and business credit contribute to the explanation of movements in the level of economic activity. It was concluded that, despite innovations in the financial markets, monetary and credit aggregates have a place in the formulation of central bank policy.

Perhaps it should be kept in mind that the continued availability of bank credit provides an interesting explanation for the economy's resilience following the 1987 stock market crash. In 1987-IV and 1988-I, when bank credit remained readily available according to the Senior Loan Officer survey, consumption and business fixed-investment spending continued to be strong, and inventories were not liquidated. Apparently, durable goods purchases, business expansion, and inventories could all be readily financed.

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[78] Patrice Muller, "Might Financial Aggregates Still Have a Role in Policy Formulation?" (Paper presented at the Annual Meeting of the Canadian Economics Association, June 1989).

Table 9
Regressions of Nominal GNP on Various Money and Credit Aggregates

Nominal GNP Explained by Current and Four Lagged Values of the Financial Aggregate

Variable	R^2 (1960-II to 1989-I)	R^2 (1960-II to 1974-III)	R^2 (1974-IV to 1989-I)
M1	0.08**	0.30***	-0.01
M2	0.16***	0.21***	0.03
M3	0.14***	0.22***	0.17**
L	0.20***	0.29***	0.17**
Total Nonfinancial Sector Debt	0.19***	0.33***	0.12**
C&I loans	----	----	0.04
C&I loans at small banks	----	----	0.06
Total loans	----	----	0.15**
Total loans at small banks	----	----	0.06
Intermediated credit	0.17***	0.13**	0.21***

Nominal GNP Explained by Four Lagged Values of the Financial Aggregate Only

Variable	R^2 (1960-II to 1989-I)	R^2 (1960-II to 1974-III)	R^2 (1974-IV to 1989-I)
M1	0.08**	0.25***	0.01
M2	0.16***	0.22***	0.05
M3	0.14***	0.23***	0.10**
L	0.12***	0.30***	-0.02
Total Nonfinancial Sector Debt	0.05**	0.19***	-0.04
C&I loans	----	----	0.02
C&I loans at small banks	----	----	0.00
Total loans	----	----	0.02
Total loans at small banks	----	----	-0.04
Intermediated credit	0.06**	0.10**	0.07*

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table 10
Regressions of Nominal GNP on Intermediated Credit and Another Money or Credit Aggregate

Nominal GNP Explained by Current and Four Lagged Values of Intermediated Credit (IC) and Another Financial Aggregate

Financial Variable Included Along with IC	Money and Credit Variables Found to Have Statistical Significance — Sample Period: 1960-II to 1989-I	1960-II to 1974-III	1974-IV to 1989-I
M1	IC***	M1***	IC***
M2	-----	-----	IC*
M3	M3** IC***	M3*	IC*
L	L*** IC**	L***	-----
Total Nonfinancial Sector Debt (TNFSD)	TNFSD** IC*	TNFSD***	TNFSD* IC***

Nominal GNP Explained by Four Lagged Values of the Financial Aggregate Only

Financial Variable Included Along with IC	Money and Credit Variables Found to Have Statistical Significance — Sample Period: 1960-II to 1989-I	1960-II to 1974-III	1974-IV to 1989-I
M1	M1*	M1***	-----
M2	M2***	M2**	-----
M3	M3***	M3**	-----
L	L*** IC*	L***	-----
Total Nonfinancial Sector Debt (TNFSD)	TNFSD*	TNFSD**	IC*

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table 11

Explanatory Power of Various Financial Quantities When Growth Is Measured over Four-Quarter Intervals

(Sample Period: 1974-1989)

	$\bar{R}^2$ of the Regression	
Independent Variable	**Current Value Only**	**Current and One Lagged Value**
M1	0.02[1/]	0.02[1/]
M2	0.04*	0.11**
M3	0.24***	0.30***
L	0.25***	0.39***
Total Nonfinancial Sector Debt	0.05*	0.22***
Commercial and industrial loans	-0.02	0.09**
Commercial and industrial loans of small banks	0.14***	0.21***
Total bank loans	0.03*	0.19***
Total loans of small commercial banks	0.19***	0.22***
Intermediated credit to the household and nonfinancial business sectors	0.15***	0.27***

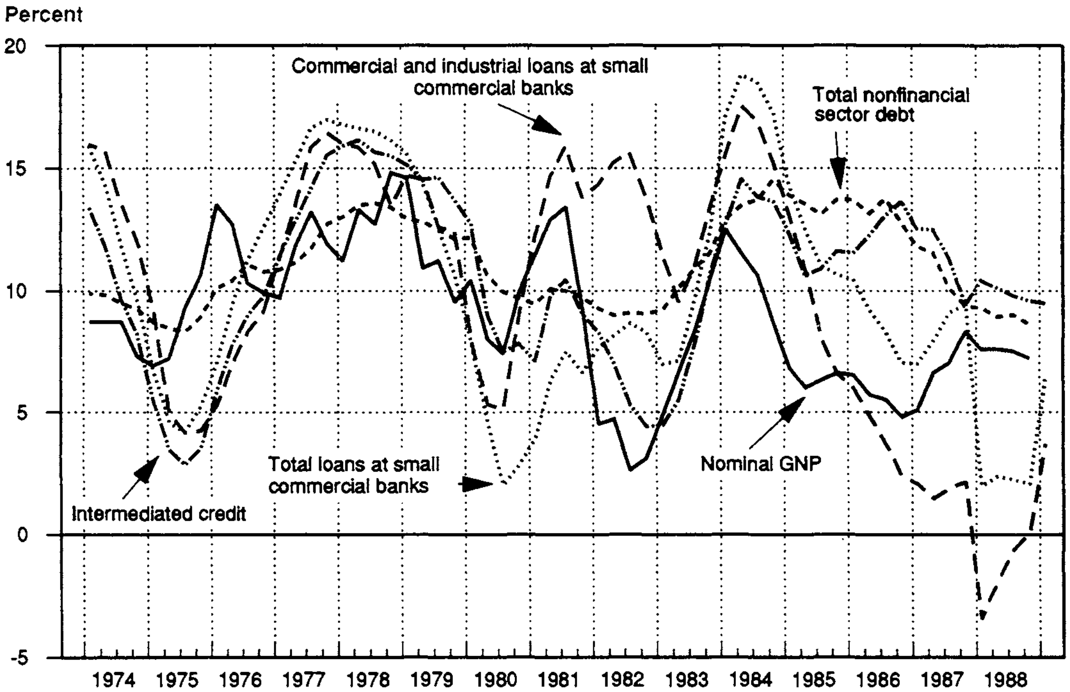
Notes: In the first column, the regression equation is $Y = a + bX + e$, where Y is the percentage change of nominal GNP measured from four quarters earlier, and X is the percentage change of the monetary or credit quantity measured from four quarters earlier. In the second column, the regression equation is: $Y = a + bX + cX(-1) + e$.

[1/] Negative correlation

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Chart 3

Credit Measures and Economic Activity
Change from Four Quarters Earlier



Source: Federal Reserve System.

D. The Potential Usefulness of Bank Credit Measures

Research in macroeconomics has usually focused on the monetary aggregates and, to some extent, on broad credit aggregates. Less consideration has been given to bank credit. During the past ten years, however, the argument that bank credit is "special" in the transmission of central bank policy has been revived and recast in terms of new theories in banking and finance, and some econometric work supports this view. Bernanke's work on the effect of the banking crisis during the Great Depression is thought to show that, at least in that historical episode, the volume of bank lending has an independent effect on the economy, one not accounted for by movements in the money supply and interest rates.

It is maintained that banks are, practically speaking, the main source of credit for many households and for small to medium-size business firms. Cross-sectional data from the manufacturing sector suggest that currently about three-fifths of bank loans outstanding to manufacturing firms are "special" in the sense that the borrower obtains credit mostly from banks rather than the financial markets. These same firms generate one-third or more of the total sales revenue of manufacturing firms. The figures suggest that changes in the availability of bank credit could potentially affect the level of macroeconomic activity, especially if a similar fraction of firms in other sectors also relies on banks for credit. Recent innovations in banking practices, however, may be diluting or reducing the special nature of bank credit.

Two problems arise in obtaining comprehensive time series data on the portion of total credit, provided by banks or other financial intermediaries that is "special." First, data are not collected on the volume of bank loans made to households and business firms that have no good alternative source of financing to bank loans. Second, borrowers use lenders other than commercial banks; firms also borrow from nonbank depository institutions, finance companies, and other nonfinancial firms. Nonetheless, researchers have obtained econometric results from postwar data on the U.S. and Canadian economies that are thought to indicate that bank credit is at least somewhat useful for explaining changes in economic activity and thus may convey information to central bank policy makers.

In this paper, the ability of some measures of bank credit to explain movements in nominal GNP was tested. These measures--including total loans at small banks, C&I loans at small banks, and total credit obtained from financial intermediaries--had some success, showing basically the same power to explain movements in GNP that the money supply or total debt had in the 1974-89 period. The explanatory power demonstrated is rather low, however, in absolute terms. At best about one-quarter of the quarterly movements in nominal GNP can be explained by the various measures of bank credit.

Bank credit thus does not seem to be a suitable intermediate target--its relationship to economic activity is simply too weak. Moreover, the degree of short-term control over bank credit exercised by the central bank may be inadequate. Little research has been undertaken on the issues surrounding the central bank's ability to control the volume of bank credit. One suspects that tight control is not achievable, in part because prearranged lines of credit can be drawn upon when policy is tightened.

Despite the weakness of the overall relationship between bank credit measures and economic activity, bank credit may still play a key role in the transmission mechanism of monetary policy and in the amplification of shocks originating elsewhere in the economy. Hence there may well be some place for a measure of bank credit in the formulation of Federal Reserve policy.

Perhaps the best way to make use of bank credit is to have it supplement the information provided by other important financial market variables. Interest rates appear to be sufficient only for assessing the credit conditions facing large established firms that have ready access to bank and nonbank sources of credit, even during periods of tight money and great economic uncertainty. More indicative of financial conditions experienced outside the corporate sector may be the growth of bank credit, properly measured. Furthermore, data show that the correlation between quarterly growth rates of the money supply and bank credit measures is rather weak, in some cases negative. Information may be contained in the bank credit data that is absent from money supply data. Bank credit may prove to be an unreliable indicator, however, if firms borrow more heavily from banks when their sales begin to lag and their accumulating inventories have to be financed. At the onset of a recession, a bulge in bank credit would give a very misleading signal to policy makers.

TARGETING NOMINAL GNP

Spence Hilton and Vivek Moorthy

By definition, nominal GNP is the product of two important variables of ultimate concern to monetary policymakers: the aggregate price level and total real output.[1] Thus, nominal income cannot be considered a "determinant" of the final policy objectives in the sense that other intermediate target candidates are.[2] Also, because nominal GNP is observed simultaneously with these final objectives, it is not considered a "leading indicator" of the ultimate goals.[3] As the following discussion illustrates, many of the arguments for and against using nominal income as an intermediate target for monetary policy can be tied to this unique relation between nominal GNP and the final policy objectives.

Nominal GNP already receives considerable attention in setting policy. Monetary authorities routinely update forecasts of nominal income and its major components for the forthcoming one to two years, and a "central tendency" of policy makers' expectations is published twice a year. Moreover, when target paths for money aggregates are established, an accompanying trajectory for nominal income is at least implicitly set. While important, these practices do not constitute a formal targeting of nominal GNP. This study only examines regimes where nominal GNP is the principal, if not sole, intermediate target variable (although its use in conjunction with operating targets is considered) and where target levels or growth ranges for nominal income are announced publicly.

The discussion is organized into three main sections. First, the major reasons advanced for targeting nominal GNP are presented. Some of these are theoretical, while others are more practical in nature. As will become apparent, not all advocates of nominal GNP targeting subscribe to the same underlying logic for choosing to target this measure. Second, possible strategies for targeting nominal

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[1]In this paper, the expressions "nominal GNP," "nominal income," and "aggregate income" are used interchangeably.

[2]For example, interest rates, another potential intermediate target, are believed to be an important direct determinant of the level of economic activity.

[3]For instance, some argue that commodity prices are good predictors of inflation.

GNP are considered. For the most part the discussion focuses on existing proposals for nominal income targeting, although other targeting strategies certainly could be devised. Some important unresolved issues raised by these proposals are also addressed, including their potential value for stabilizing economic activity. Third, the difficulties with controlling nominal GNP are examined, along with some proposed operating procedures. A summary and some conclusions are then presented.

I. Rationale for Targeting Nominal GNP

A number of both economic and political reasons have been advanced for using nominal GNP as an intermediate target. On purely economic grounds, nominal income targets are believed by some to offer an effective way to absorb economic shocks or control inflation over time. As a public policy tool, nominal GNP is sometimes seen as a way to limit the policy options available to the monetary authorities and to communicate effectively the final goals of monetary policy. The major arguments provided by advocates for targeting nominal GNP are presented in this section.

A. Absorbing the Impact of Economic Disturbances

Many analysts believe that under a nominal GNP target the impact of a wide variety of economic shocks on prices and output could be effectively absorbed or deflected. The basis for this view is fully developed in Appendix 1, where a textbook IS-LM model and a standard aggregate supply and demand framework are used to examine the effects of economic shocks on price and real output under nominal GNP targeting. For comparison, the impacts of shocks under money stock targeting are also derived. The results of this static analysis are summarized in this section.[4]

When nominal GNP is targeted, demand shocks are neutralized fairly quickly and have no lasting impact on prices and real output. The simple explanation for this result is that monetary policy operates by moving aggregate demand (via changes in the underlying money stock); consequently, any unexpected disturbance to aggregate demand is immediately countered by a policy-induced change in the money stock that restores demand to its initial level. Thus, the price level and real output are unaffected, and nominal GNP is maintained at its original (target) level. Of course, other important economic variables, such as interest rates or the various components of GNP, might be altered in the

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[4]In order to examine the implications of nominal GNP targeting, Bradley and Jansen (1989) adopt an approach similar to that used in Appendix 1 and summarized here.

process.

Unlike demand shocks, supply shocks have a lasting impact on prices and real output, at least in the short to intermediate run when real output might deviate from its full-employment level. A negative supply shock places upward pressure on prices and reduces real output. Under a nominal GNP target, monetary policy is aimed at ensuring that these price and output movements are exactly offsetting (in percentage terms), leaving nominal GNP unchanged. This is accomplished by using monetary policy to move aggregate demand to where the original level of nominal GNP is restored. With the new aggregate supply schedule, each level of real output is now associated with a higher price level; therefore, at the new equilibrium point where nominal income is unchanged, prices will be higher and output lower than they were originally. Advocates of nominal income targeting typically maintain that splitting the impact of supply shocks on prices and output represents a good compromise between the ultimate objectives of price stability and adequate real output. In contrast, attempts to maintain the initial level of output (prices) will lead to excessive swings in prices (output). It can be argued, however, that other combinations of price and output, ones that do not keep nominal GNP fixed, might be preferable. For example, the comparative static results in Appendix 1 show that targeting the money stock could leave output higher, but prices higher as well, than targeting nominal income would, in response to supply shocks.

The results just summarized are derived using a static theoretical framework within which the monetary authorities operate with complete certainty. Policy makers possess enough knowledge about the underlying structure of the economy to be able to control aggregate demand with sufficient precision to keep nominal income on target. In fact, the information required to target nominal GNP successfully undoubtedly exceeds what is needed under other targeting regimes (see Section III). There also are no lags or price dynamics in the simple static analysis. Policy makers can pursue a chosen target without concern about its impact on inflationary dynamics or the formation of inflation expectations. But even some advocates argue that strictly targeting nominal income can lead to considerable instability in levels of real output if there is significant inertia in inflation. In such a case, the monetary authorities might have to develop more flexible strategies for targeting nominal GNP, a subject explored more fully in Section III and in Appendix 2. Nonetheless, this simple analytical framework illustrates the general theoretical arguments for targeting nominal GNP.

B. Control of Inflation

Targeting nominal GNP is often advanced as a way to control if not eliminate inflation over time. This point is most often made by referring to the simple identity relating nominal output to price and quantities:

(1) nominal GNP = $P*Q$,

where P is the general price level and Q measures real output. The neutrality of monetary policy actions on real output in the long run is assumed. Demographic and technological factors, which are outside the control of monetary authorities, determine the "natural" or "potential" rate of real income growth. Potential growth, it is argued, can be reliably estimated from long-run average rates of real growth, and this rate is believed to be reasonably stable because its determinants are slow to change. With potential output largely predictable and predetermined, from a policy perspective, the output variable in the above equation, Q, is seen as fixed. Thus, targeting nominal GNP is equivalent to controlling the general price level, and for this reason it is advanced as an effective strategy for placing a lid on inflation over time.

The time horizon to which this argument for targeting nominal GNP applies is much longer than the horizon implicit in the framework outlined in the preceding section.[5] This difference in time dimension often reflects different perspectives among the advocates of nominal income targeting on the proper conduct of monetary policy. Generally speaking, advocates of nominal GNP targeting who focus on the effectiveness of such a regime in responding to economic disturbances also tend to hold the view that it takes a long time before monetary policy ceases to have an effect on real variables. Within this time frame, policy makers are seen as having the ability to steer the economy to some degree. Thus, a more "activist" approach in general should be taken in conducting monetary policy, but a nominal GNP target would be helpful in guiding policy during these periods.

According to many others, however, the determinants of the price-output split of nominal GNP are poorly understood, unpredictable, and largely outside the control of policy makers. While monetary policy can have an impact on the interaction between nominal and real variables, the effects of monetary policy on real variables are not long-lasting. Moreover, monetary authorities lack the knowledge to exploit any systematic relation between nominal and real variables. Consequently, policy should be aimed solely at longer term objectives like controlling price inflation. Seen from this perspective, the analysis in Section IA and Appendix 1 overstates the ability of policy makers to manage the economy in the short run. Nonetheless, nominal GNP targeting can still be useful as a

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[5]Kahn (1988) analyzes targeting nominal GNP in the "short run" using a model similar to the one developed in Appendix 1 and summarized in the previous section. His description of targeting nominal GNP in the "long run" follows the argument outlined in this section.

means for controlling inflation over longer time horizons for the reason outlined in this section.

The different arguments for targeting nominal GNP mirror a longstanding debate about the proper conduct of monetary policy. As discussed in Section II, the strategies and operating procedures advocated for implementing a nominal GNP target reflect these differing viewpoints.

C. Changes in Velocity

Interest in targeting nominal GNP arose during the early 1980s after unpredictable changes in velocity complicated money stock targeting procedures. In fact, much of the analysis of targeting nominal GNP is made in an explicitly comparative context to highlight its superiority over setting targets for monetary aggregates when velocity is unstable. For advocates of this view, nominal GNP is a substitute for a money aggregate target and shares many of the benefits, but not the drawbacks, of a money target. This point is most often made using the simple money-income identity:

(2) nominal GNP = M*V,

where M is a monetary aggregate and V is its corresponding income-velocity measure.

The "proof" of the superiority of targeting nominal GNP is trivial in this framework. On the assumption that nominal GNP is closely related to the final policy goals, it is better to target nominal GNP directly than to target a monetary aggregate because unexpected velocity shocks can result in an undesirable outcome for nominal GNP, with potentially adverse consequences for real output and prices. That is, by targeting nominal GNP, the impact of changes in the income velocity of money on the economy is, by definition, cushioned. While this argument makes no distinction between the various possible sources of a change in velocity, during the past several years many analysts have claimed that financial innovation and deregulation have led to deviations in the behavior of velocity from longstanding trends. On this basis, they have argued that monetary authorities should target nominal GNP directly rather than a money aggregate.[6]

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[6]Velocity movements induced by an evolving financial structure can be considered a special type of demand shock, one that--in the framework presented in Appendix 1--shifts the LM curve. The appendix shows that nominal GNP targeting is superior to money stock targeting for all types of demand disturbances. Thus, arguments for targeting nominal GNP that focus on the behavior of velocity may be considered derivatives of the arguments outlined in that appendix. However, focusing directly on the money-income identity and velocity presupposes no knowledge about the split between prices and quantities. Moreover, targeting the money supply might be preferred to targeting nominal income if velocity shifts are caused by supply shocks and if there are certain real output objectives. As shown in Appendix 1, targeting the money stock may be more consistent with policy objectives for real output than (continued...)

The preceding demonstration of the relative merits of targeting nominal GNP generally assumes that nominal GNP and a monetary aggregate can be controlled equally well. Alternatively, the variability in velocity may be taken as evidence of the relative uncontrollability of income. Seen from this perspective, the variability in velocity, instead of being an argument for targeting nominal GNP directly, merely underscores the practical difficulties of implementing such a targeting regime, at least through use of a monetary aggregate.

D. Constraints on Policy Objectives

Some advocates of nominal GNP targeting maintain that a nominal income objective would impose a needed constraint on the monetary authorities. According to these analysts, policy makers place undue importance on maintaining a certain level of employment and usually attempt to deflect the effects of negative disturbances away from real output at the cost of accepting price increases. This, it is argued, imparts an inflationary bias to the economy. Targeting nominal GNP, as Kahn (1988) writes, "makes it impossible for policy makers to engineer a short-run increase in real output by allowing inflation to rise." Instead, policy would be forced to maintain a given level of nominal GNP without reference to the behavior of its price and real output components. Thus, the virtue of nominal GNP targeting is that it prevents the kind of myopia sometimes associated with direct targeting of real output.[7]

This argument for targeting nominal income is similar in spirit, but differs in detail, from the argument made using a static model in Section IA when there are price shocks. In the static framework, splitting the impact of disturbances evenly between prices and real output is seen as a satisfactory outcome for these final goal variables. In a dynamic setting, an equal trade-off between inflation and employment may not be a satisfactory outcome at all times, but over time, a nominal income target will constrain policy so as to prevent an eventual or unintended sacrifice of price stability.

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[6](...continued)
targeting nominal income is, in response to supply shocks, depending on the slope of the aggregate demand curve.

[7]Of course, this assumes that policy makers do not adjust their targeted level of nominal income to reflect changing objectives for prices and real output.

E. Communication of the Final Monetary Policy Goals

Most proposals call for initially specifying a target path for nominal GNP that lasts indefinitely, based on a consensus long-run inflation and estimates of potential real growth in the economy (see Section IIA). Such a long-run nominal GNP target requires setting an explicit final objective for price stability. However, the principal concern of many analysts is how (or whether) to set interim targets when economic disturbances move nominal GNP away from its long-run targeted path. This section considers the different views on the likely impact that announced nominal income targets drafted under these circumstances could have on the policy debate.

Analysts disagree about the political consequences of using an intermediate target as closely linked as nominal GNP to the final price and real output objectives of policy. Some believe that the identity between nominal GNP and these final goals would enhance the communication of the objectives of policy. Others are concerned that this same identity raises the likelihood that a nominal GNP target will lead to public pressure to specify targets for prices and output--a development, it is feared, that would ultimately undermine discipline in establishing realistic or appropriate objectives for monetary policy.

One purpose of an announced intermediate target is to convey information about the goals and purposes of monetary policy. Some argue that a nominal GNP intermediate target would be easy to understand and would better communicate the purposes of monetary policy because the variable is so clearly associated with the final policy objectives. Brittan (1983) believes that a target for nominal GNP would be "much easier for people to understand, once they got used to it, than the bewildering variety of money and credit measures" sometimes used to describe policy objectives. And Taylor (1985) writes that "the aims of policy makers would be much easier to interpret if their goals for nominal GNP were clearly stated." Moreover, the definitional relationship between nominal GNP and prices and output could affect the nature of the policy debate surrounding the setting of intermediate target values in a positive way. McNees (1987) argues:

> A nominal GNP objective, reflecting both desired real growth and inflation, focuses attention clearly on the basic policy choice: an "easier" policy will encourage faster nominal GNP growth, which will promote real economic growth, but only at the risk of higher inflation; a "tighter" policy will slow nominal GNP growth as is needed to reduce inflation, but only at the risk of insufficient real growth. . . . Under nominal GNP targeting, the difficult social choice between conflicting objectives receives primary attention.

Not all analysts agree that policy debates would be elevated in this way by using a nominal GNP target. The close association between nominal income and the final objectives of policy might suggest that by targeting income the monetary authorities possess an unrealistic degree of direct control over prices and real output, contributing to equally unrealistic expectations for policy. Furthermore, a number of policy makers have written that as a practical matter it would be difficult to avoid specifying objectives for prices and output when setting a nominal GNP target. Axilrod (1985) argues that "setting a nominal GNP target is unlikely in practice to spare the central bank from taking a view on the mix between real activity and prices," and he expresses concern that strong pressures "would work toward an upward bias in an announced real GNP objective." In a similar vein, Solomon (1984) believes that under a policy of targeting nominal income it would be difficult to resist an evolution "toward setting separate objectives for the price and real output components of GNP," and "the tendency to set GNP goals chronically too high would be very strong." Volcker (1983) further maintains that "the independent status of the Federal Reserve that makes a longer term view possible might well be compromised with GNP targeting, since the Federal Reserve could be under great pressure to conform its target to some immediately attractive number."

F. International Coordination

Nominal income targets figure prominently in several recent proposals for international coordination of economic policy. Frankel (1989) and Williamson and Miller (1987) advocate cooperatively setting nominal GNP targets. These proposals also often call for international cooperation in setting fiscal policy and for establishing targets for external variables.[8] One issue raised by these studies concerns the choice of target variable. Frankel, like Williamson and Miller, argues that it would be inappropriate to pursue an income objective at the expense of trading partners, say, through protectionism. Furthermore, Brittan (1983) writes that the spillover of nominal demand into imports is largely outside the control of monetary authorities. For these reasons, in an international environment, a measure such as domestic demand (GNP less net exports) may be better suited than nominal income as an intermediate target. However, these proposals are not examined further in this study because the basic rationale for using a nominal income target is the same as in a closed economy context, and because most of these proposals also require setting explicit objectives for fiscal policy.

[8]Williamson and Miller assign to fiscal policy the task of hitting the nominal income target, while monetary policy is used to achieve the target set for either the exchange rate or the external balance.

II. Strategies for Targeting Nominal GNP

Proponents of nominal GNP targeting, like advocates for most other target variables, typically write that the "details" for implementing their proposals remain to be worked out. However, even among the advocates of such a policy regime, there is no general consensus about the guiding strategic principles to be applied when targeting nominal income. Perhaps the most important difference centers on how (or whether) target values for nominal GNP should be reset in response to economic disturbances--particularly supply shocks--that move the economy away from its previous target path. This section begins with an overview of some income targeting proposals. Next, the dynamic properties of some of these proposals are evaluated using a simple economic model with unexpected supply disturbances. Finally, some practical and conceptual issues raised by these proposals are discussed.

A. Overview of Proposals

There is little disagreement about the general nature of an intermediate target for nominal GNP. Among virtually all proponents, nominal income is seen as a long-term intermediate target. Recommended target periods usually fall between one and two years and are sometimes much longer. Because of long lags, the potential value of nominal GNP as a leading indicator or an information variable is limited, although some advocates believe that nominal income could play a feedback role, triggering changes in settings for operating instruments.

Upon adoption of nominal GNP as an intermediate target, most proposals call for setting a long-run path for nominal income that is consistent with ultimate inflation goals and with expectations about potential real GNP growth. Hall (1983) recommends that a path be set "once and for all," as does McCallum (1987). Gordon (1985) suggests setting a desired path for nominal GNP ten years ahead. This target path is designed to serve over an extended period, perhaps indefinitely, or at least until new estimates of potential growth or changing inflation objectives require its modification. The significance of this initial step is that it binds the monetary authorities to a permanent objective for nominal GNP, one that is intended to prevent them from arbitrarily casting any immediate price and real output objectives in terms of nominal income and labeling the practice "targeting nominal GNP." In the subsequent discussion, this path is referred to as the "initial" or "long-run" nominal GNP target.

There is some difference of opinion about whether the long-run path should be constructed in terms of levels or growth rates of nominal GNP. A target path specified in level terms has the advantage of ensuring over time the target price level (assuming the path for potential output is unchanged) and, therefore, the value of economic contracts established years earlier. Thus, much of the uncertainty under which agents operate would be eliminated. Others, however, advocate pursuing a long-run growth rate for nominal GNP. The economic costs of returning to a predetermined level of nominal income might be unacceptably high following inflationary shocks. Moreover, following deflationary shocks, the monetary authorities might see no purpose in pursuing temporarily high inflation rates just to return nominal income to its earlier level path. The question whether a long-run path for nominal GNP should be set in terms of levels or growth rates to some degree mirrors the debate over rebasing under money targeting. The preferences of some advocates of nominal GNP targeting are spelled out in the following overview; however, the distinction between setting long-run targets for levels or growth rates does not affect the basic conclusions reached in the later analysis of the dynamic properties of income targeting.

Most proponents of income targeting recognize that economic disturbances or policy mistakes can take nominal GNP far away from its long-run target path. Axilrod (1985) writes that "the focus of a GNP target will inevitably shift away from the intermediate or longer run" to stress the short run, and advocates have proposed various strategies for determining interim targets or objectives for nominal GNP. The importance of this issue is that a rapid return of nominal GNP to any long-run path could induce unacceptable instability in real output--whether this path is defined in terms of levels or growth rates. This overview now turns to the specifics of some of these proposals and their differences.

In perhaps the simplest statement of how a nominal income target might operate, Hall (1983) proposes that

> once and for all, Congress would adopt a target path for nominal GNP. In the future, if nominal GNP were above the path, monetary policy would be judged excessively expansionary and would be required to contract as necessary to bring nominal GNP back to the path. If the economy slipped below the path, monetary expansion would be called for.

Under Hall's proposed target path, which is specified in levels, when nominal income falls below its long-run path, higher *growth* targets of nominal GNP would be set temporarily. In terms of policy strategy, this leaves unanswered how quickly to return to the long-run target path when off course.

McCallum (1987,1988a,1988b) advocates targeting nominal GNP levels in a series of papers. Unlike most other analysts, McCallum is concerned more with the practical problems of achieving such targets, which he argues are best solved by using the monetary base as an operating instrument. His operational rule is detailed fully in Section IIIB, but its implications for setting near-term nominal GNP targets are summarized here. Although McCallum does not actually propose to announce publicly nominal GNP targets on an interim basis when income deviates from its long-run path, a strategy for returning nominal income to its desired long-run level can be inferred from his operating rule.

McCallum sets growth in the operating instrument (the monetary base) each period equal to the desired long-run growth rate of nominal GNP--the estimated potential rate of growth of real output plus desired long-run inflation--with an adjustment for past deviations of nominal GNP from its target *level.* This partial adjustment mechanism will eventually return nominal income to its long-run target path, but at a slow enough pace so as to avoid the kind of dynamic instability that can arise when feedback rules are too strong. McCallum recommends that the most recently observed gap between the level of nominal GNP and its long-run target level be used to adjust growth in the operating instrument, thereby raising base growth whenever nominal income is below its initial path. Because of lags in the adjustment of nominal GNP to changes in the operating instrument, it may take some time before nominal GNP returns to its long-run target level.

McCallum also proposes that monetary base growth be adjusted in response to past changes in the income velocity of the base. In this way his operating rule is akin to regimes that target monetary aggregates but periodically revise the money objectives in response to past or expected changes in velocity. An important theme underlying McCallum's proposal is that policy makers cannot know, much less determine, how changes in nominal income will be divided between inflation and output growth in the short run. Furthermore, he maintains that smoothing movements in nominal income by only slowly adjusting changes in the operating instruments will reduce swings in real output around its potential level.[9]

McCallum's temporary adjustments to the target path for his operating instrument are based solely on past deviations of nominal GNP from its long-run target level. In contrast, some other advocates of income targeting suggest that explicit interim targets for nominal GNP should be constructed to take into account available information on current real economic conditions and knowledge about the trade-off between inflation and real output. For instance, Tobin (1983a,1983b,1985) calls for periodic revisions in targeted income levels to lessen the impact of some disturbances on real output. And in two articles, one by Gordon (1985) and another by Taylor (1985), more detailed strategies of nominal GNP targeting are proposed. An overview of these targeting

[9]In a subsequent paper, McCallum uses simulations from different models of the relationship between nominal and real GNP to support his contention that his rule would help stabilize real GNP as well (see National Bureau of Economic Research, Working Paper no. 3047).

strategies follows, and the dynamic implications of some of the strategies for real output behavior are examined in the next section using a simple dynamic model.

Gordon focuses on the need to modify nominal income targets when faced with economic disturbances.[10] An initial long-run desired path for the level of nominal GNP should be set on the basis of potential growth and desired inflation, and, in general, monetary expansion is called for whenever income is below this path. However, Gordon mostly examines how monetary policy should be conducted when unemployment is away from its natural rate, although much of his discussion is conducted in general terms. According to Gordon, because of aggregate supply constraints, a rapid return to the targeted path of nominal income or strict adherence to a policy of constant nominal GNP growth under these circumstances could induce cycles in real GNP growth. To avoid this kind of oscillating behavior when unemployment is away from its natural rate, monetary authorities should decelerate the growth rate of nominal GNP as real output nears its potential level. Gordon does not specify a procedure for setting interim nominal GNP targets, and it is not clear from his statements how the eventual return of nominal GNP to its long-run target level would be guaranteed.

Taylor also focuses on the implications of targeting nominal GNP for business cycles, and he too finds that after supply shocks, some conditions targeting nominal income can lead to instability in real output because of inflation inertia.[11] To reduce oscillations, Taylor proposes a rule for setting nominal GNP targets:[12]

(3) $q_t - q^*_t = Dp^* - Dp_t$,

where q is the log level of real output, q^* is potential output, and p is the log level of prices. D is the change operator, and Dp^* represents the long-run desired rate of inflation. After some algebraic manipulation, this expression may be rewritten as:

(4) $Dx_t = Dx^* - (q_{t-1} - q^*_{t-1})$.

This states that the current period's target rate of growth in nominal GNP (Dx_t) is equal to the

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[10]Gordon advocates the use of a nominal final sales target (nominal income less changes in inventories) in place of an income target. The series for final sales is less erratic than income because it is not subject to short-term inventory cycles, and for that reason it is perhaps a better measure of underlying demand.

[11]The "elastic price standard" proposed by Hall (1984) is similar to Taylor's rule, except that Hall uses levels of nominal income rather than rates of growth.

[12]If desired inflation is set to zero, then this expression reduces to $(q_t - q^*_t) = -Dp_t$, the formulation used by Taylor.

long-run desired rate of growth (Dx^*) minus the percentage deviation of real output from its potential level in the preceding period. Thus, nominal income growth is raised (lowered) whenever real output is below (above) potential. Unlike other proposals, this rule includes no mechanism that returns nominal income to a predetermined level but only one that returns it to a long-run desired rate of growth.[13]

B. Dynamic Properties of Targeting Strategies

As noted in the preceding section, Gordon and Taylor examine the potential dynamic implications of strictly targeting either the level or growth rate of nominal GNP, and they find that some income targeting policies can induce destabilizing oscillations in real output following supply or price disturbances.[14] They argue that interim nominal GNP targets should be designed to avoid or dampen these cycles. A summary of their analyses is presented in this section. A more detailed presentation of the model and simulation results is in Appendix 2.

A simple aggregate supply relationship or price adjustment mechanism states that current inflation (Dp_t) depends on its past values and the ratio of real output to potential output:

(5) $$Dp_t = Dp_{t-1} + a^*(q_t - q^*_t) + u_t, \ a > 0,$$

where p and q are defined as above, and u_t represents the impact effects of supply shocks on inflation.[15] Inflation tends to rise or fall according to whether output is above or below potential, and the equation incorporates the "natural rate" hypothesis that output above potential cannot be sustained without accelerating inflation. In the simulations reported in Appendix 2, a distributed lag on past inflation replaces Dp_{t-1}. This relation assumes considerable inflation inertia, and therefore it is probably more useful for analyzing the impact of shocks over a somewhat limited time horizon.

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[13]Taylor presents a more general version of equation 3 to allow for a different desired trade-off between inflation and stability in real output:

$$q_t - q^*_t = R^*(Dp^* - Dp_t), \ R>0.$$

With smaller values of R, there is less tolerance for fluctuations in real output, but there is greater tolerance of inflation. This equation may be rearranged:

$$Dx_t = Dx^* - (q_{t-1} - q^*_{t-1}) + (R-1)^*(Dp^* - Dp_t).$$

If, for example, R is below 1 and inflation is above its desired level, then the targeted growth of the nominal GNP target for the period will be above its long-run desired rate of Dx^*.

[14]The effect of demand shocks are also evaluated by Taylor, but these have a much smaller impact on business cycles, and they are not considered in this review.

[15]This model is just a dynamic version of the static aggregate supply relation used in Appendix 1.

To facilitate the presentation of the dynamic implications of the above supply constraint, the definition of aggregate demand is broadened to include the monetary policy reaction function that keeps nominal income on its targeted path.[16] For example, if the level of nominal income is targeted each period to remain on its long-run path, then aggregate demand becomes:

(6) $p_t + q_t = x^*_t$.

Equations 5 and 6 are solved to determine the level of prices and output resulting from this targeting strategy on the assumption that target values of nominal GNP are hit each period except when there are unexpected shocks. Equations representing aggregate demand under other targeting strategies are presented in Appendix 2.

The results reported in the graphs in Appendix 2 show that if the targeted level or growth rate of nominal GNP is not adjusted during transition periods, then an inflation shock will cause considerable variability in real output around its potential level. Intuitively, remaining on the target path after prices jump initially requires a large reduction in real output because of inflation inertia. Output must then remain below potential while inflation slowly decelerates. Gradually, the pace of deceleration in inflation quickens and output growth rises, but then the inertia in the process forces output above potential while inflation continues to drop. A period of slowly dampening cycles ensues. This cyclical behavior remains even when McCallum's rule is used in these simulations.[17] Adjusting nominal income targets on the basis of past deviations of *nominal* income from its long-run target path does not guarantee that instability in real output can be avoided.

Gordon writes that avoiding this type of instability requires a gradual deceleration in the growth rate of nominal GNP as *real* output approaches its potential level. Taylor's proposal provides one way of doing this: following an inflationary price shock, targeted nominal GNP growth is raised and only gradually lowered as the economy nears full output.[18] Oscillations in real output are dampened considerably when this rule is used.

Although these results suggest that nominal income targets should be adjusted to reflect current

[16]In Appendix 1, aggregate demand is derived by collapsing the IS and LM curves, and the target rule guiding monetary policy is a separate function. Here, the definition of aggregate demand incorporates the monetary policy reaction function.

[17]For this exercise it is assumed that the income velocity of money is fixed. The results are not affected by expanding the model to account for velocity changes.

[18]Taylor's rule is not entirely consistent with Gordon's proposals. As the charts in Appendix 2 show, under this rule nominal GNP will not be returned to its initial target *level* as is advocated by Gordon.

conditions of unemployment or real output, a number of criticisms are often leveled against this kind of analysis. Successfully targeting income each period requires first calculating the impact of movements in real output on inflation and then controlling real output so as to hit that period's nominal GNP target. This, critics maintain, assumes an unrealistic degree of knowledge about the structure of the economy and of control over real output. Moreover, doubts are raised about the stability of the price adjustment mechanism and the expectations formation process. A proven long-term commitment to a predetermined target might better ensure that inflation expectations remain consistent with policy goals and are not upset by temporary disturbances. This, it is argued, is better achieved by adhering as closely as possible to a predetermined path of nominal income rather than periodically revising policy objectives in light of current real economic conditions.

C. Strategic Issues in Nominal Income Targeting

The overview of proposals to target nominal GNP demonstrates that the structure of such a regime could take many forms. Some questions and issues raised by these proposals are discussed in this section.

Establishing a long-run path for nominal GNP

Adherence to a permanent or semipermanent path of nominal GNP, whether stated in levels or growth rates, is an important feature of most proposals. Establishing this long-run path requires estimation of the potential rate of real growth and agreement upon a long-run target for prices or inflation.

As for prices, in most academic studies the desired or targeted long-run rate of inflation is assumed to be zero. However, there is a commonly held perception that as the rate of inflation falls, the benefits of lowering inflation further begin to be offset by the economic sacrifices that might be needed to achieve further reductions. Thus, a zero rate of inflation may be resisted by some as an impractical goal. Instead, an "acceptable" rate of inflation may become the standard, but for this it might be difficult to reach a consensus. While this problem always exists in setting policy, the difficulty it presents is enhanced under most proposals for nominal GNP targeting because of the identity linking nominal GNP to the price level and the "once and for all" nature of the long-run target path.

For the most part, these proposals assume that reliable estimates of potential real output growth are available, and that nominal GNP targets will be reset when changes in the natural rate of growth are detected. But there exist different views about potential output growth and the natural unemployment rate, and considerable controversy would undoubtedly accompany any revisions to nominal GNP targets based on perceived changes in this variable. Current estimates of potential growth generally range from less than 2 1/2 percent to a little above 3 percent per annum. When potential growth is overestimated, successively raising a nominal income target in an attempt to reach full employment could lead to accelerating inflation.

Authority for setting targets

Many advocates of nominal income targeting argue that authority for setting targets should not rest just with the Federal Reserve System. Hall, who is quoted above, believes that Congress should have sole responsibility for setting these targets, while Taylor writes that "the Fed in conjunction with the Congress and the administration should state realistic forecasts of nominal GNP growth conditional on their intended plan for monetary and fiscal policy."

Several reasons are given why the Federal Reserve should not be granted sole authority for setting targets under nominal GNP targeting. Because of the close relation between nominal GNP and the final objectives for price and real output, all government branches that help set economic policy have a natural interest in establishing such an important benchmark standard. This would be particularly true if, as some proposals suggest, a target value for nominal GNP were to be set over very long time horizons. As it is, the executive and legislative branches currently present forecasts for nominal GNP growth in shaping fiscal policy for the coming years, along with expected inflation and real growth. It may be inappropriate for the Federal Reserve to have a different nominal income objective.

Ideally, a consensus between the Federal Reserve and the federal government on a nominal income objective would imply improved coordination between monetary and fiscal policy. In practice, difficulties could easily arise in jointly setting nominal GNP targets. At the outset, persistent differences in estimates of potential real output growth between various agencies charged with setting policy might emerge. This, combined with any difficulties in reaching agreement on an acceptable long-run goal for inflation, would complicate setting initial targets for nominal GNP. Furthermore, many proposals for nominal GNP targeting address the need to revise target objectives in response to economic disturbances that move the economy away from its long-run target path. The difficulties in achieving a consensus between the Federal Reserve and the government on the objectives of policy would undoubtedly increase with the frequency of these revisions. Moreover, several policy makers have voiced concern that as a practical matter it would be unrealistic to assume that the Federal Reserve could maintain its independence if it were required to set explicitly objectives for broad economic measures like nominal GNP that are of such direct interest to government officials.

Time horizon for nominal GNP targets

Most proposals call for establishing a long-term target path of nominal GNP, based on estimates of potential real GNP growth and a consensus inflation goal, with modifications made only to reflect changes in potential growth and perhaps slowly evolving long-run objectives for inflation. While many of these proposals also focus on appropriate ways to return nominal GNP gradually to its long-run target after disturbances have moved it away from this path, few advocates are specific about the time frame over which these targets would be set. Most proposals call for short-run targets that begin anywhere from one to four quarters in the future and remain in effect for a period of one to two years. This is done out of recognition of the long lags commonly believed to exist between the operating instruments and nominal GNP. Still, some critics question whether it would be realistic to set nominal income targets for even a year or two ahead because of the uncontrollability of nominal income, an issue examined in further detail in Section III.

Short-term considerations in conducting policy

Advocates of nominal GNP targeting are not in agreement about the use of rules versus discretion in implementing policy or in setting near-term income targets. In particular, they differ on the extent to which short-term considerations should influence the setting of interim nominal GNP targets. Nominal income targeting in some form is compatible with very different views on the proper conduct of monetary policy.

McCallum writes that "a rule exists when the policymaker chooses not to attempt optimizing choices on a period-by-period basis, but chooses rather to implement in each period a formula for setting his instrument that has been designed to apply to periods in general, not just the one currently at hand."

McCallum's rule for setting his operating instrument is in keeping with this view. While some consideration is given to potentially undesirable output dynamics, for the most part the rule is motivated by the view that a trade-off between prices and real output cannot be exploited by policy makers, and that in the long run the credibility of the monetary authorities would be undermined by attempts to do so.[19] Short-term nominal income objectives cannot be constructed under this rule to take advantage of a perceived trade-off.

Many other proposals are premised on the view that there is sufficient knowledge about the structure of the economy to justify setting shorter term nominal GNP targets with explicit underlying objectives for real growth and inflation. Short-run considerations do matter in setting monetary policy, and nominal income targets should be periodically modified to reflect these considerations. From this perspective, an operational rule like McCallum's is not seen as providing sufficient flexibility for achieving near-term objectives.

Advocates such as Gordon and Tobin argue for "discretion" in setting interim nominal income targets. In contrast, Taylor proposes an explicit rule for setting income targets that depends at any time upon the values of real variables. However, it is shown in Appendix 2 that in its modified form, Taylor's rule tends to function as a period-by-period optimizing solution to a standard loss function instead of optimizing over a longer horizon. Thus, Taylor's proposed rule is not a "rule" in the sense used by McCallum, and it may not differ significantly from the kind of short-term optimizing strategies often decried by some analysts.[20]

In sum, intermediate targets are often proposed as a way to prevent authorities from focusing narrowly on near-term objectives, such as a real output or an unemployment goal, to the potential detriment of longer term objectives such as price stability. However, any combination of objectives for inflation and real growth can be framed in terms of a nominal GNP target. Proposals that call for frequent modifications to income targets in order to, say, dampen fluctuations in real output may not prevent longer run goals such as price stability from being ultimately sacrificed in the process. On the other hand, rigid operating rules may preclude the flexibility in setting intermediate targets needed to moderate cyclical movements.

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[19]The paper by A. Steven Englander in this volume deals generally with the time inconsistency problem in setting monetary policy.

[20]Taylor's formula does not conform to McCallum's idea of a "rule" for several other reasons as well. McCallum (1987) writes that a rule should apply to a variable under the direct control of the monetary authorities. Moreover, it should be designed in recognition of the limits of macroeconomic knowledge and not be based on any particular model of the interaction between real and nominal variables in the economy.

III. Controlling Nominal GNP

Proponents often argue that the monetary authorities ultimately can control nominal GNP because it is a nominal magnitude, but many critics question whether this control can be exerted over time horizons relevant to policy makers. This criticism pertains especially to strategies to set income targets covering periods other than just the very long run. To compensate for any lack of control, some suggest using target ranges or working with moving averages of nominal GNP. Even in these circumstances, it is questionable whether nominal income could be controlled accurately enough to serve as an intermediate target. This section explains why controlling nominal GNP is difficult, considers possible operating procedures for targeting nominal income, examines the possible role of forecasts in controlling income, looks at some empirical evidence of controllability, and discusses the possible consequences of targeting a variable that cannot be adequately controlled.

A. Sources of Uncontrollability

Controlling nominal GNP is difficult because the lags between the policy instruments and income are long, imperfectly known, and probably variable. Also, many factors other than monetary policy determine nominal income.

Impact lags measure the length of time that elapses before changes in policy have their effect on targeted variables. By most estimates, between one and two years must elapse before changes in policy instruments have their median impact on nominal GNP. Typically, it is believed that between six and nine months will pass before changes in monetary policy have a substantial effect on real output, and up to another year will pass before inflation is noticeably affected. In addition to being long, these lags are also of uncertain duration. This makes it difficult to measure the impact of past policy changes on the target variable and reduces the value of the targeted variable as a feedback source of information on policy actions. Some analysts maintain, however, that by understanding the ultimate implications of a policy action, market participants can accelerate its impact on the economy and significantly reduce the lags in the policy process, as long as policy actions are seen as "credible." A proven adherence by monetary officials to a nominal GNP target could effectively shorten this impact lag.

Setting target objectives and operating procedures for nominal GNP is complicated by uncertainty about the current level of the target variable. Initial quarterly estimates of nominal GNP, along with a breakdown into real output and price measures, are available about a month following the end of the quarter. Sometimes substantial revisions to this data appear later. Lags in the availability of official GNP statistics contribute to the practical difficulties in targeting nominal GNP, although alternative information sources may help reduce this lag. Much of the underlying data used to construct quarterly GNP statistics is available on a more timely basis, including payroll employment statistics, consumer and producer price data, and measures of industrial output and shipments.

Nominal income is a broad measure of economic activity, and for that reason may be affected by a variety of factors in addition to monetary policy. A host of economic disturbances as well as sustained shifts in the spending behavior of major economic agents such as consumers, businesses, or the government can greatly alter the level of nominal GNP, and the lags in recognizing these changes may be long. For all these reasons, nominal GNP may remain largely outside the control of the monetary authorities for many quarters.

B. Operating Procedures for Targeting Nominal GNP

Proponents of nominal GNP targeting often do not discuss in detail the operational procedures that would be appropriate in this regime. Yet because of the delays and uncertainties involved in measuring the impact of policy changes on nominal GNP, the target variable itself will provide little guidance for policy operations.

Tobin (1985) advocates establishing a hierarchy of targets, each consistent with the other, starting with settings of nominal income for periods of one year or more and extending back to the operating targets of monetary control, such as bank reserves or short-term interest rates. But his proposals do not address which specific lever to use to implement policy.

McCallum offers a specific operating rule for implementing a strategy of nominal GNP targeting. His rule for the quarterly setting of his operating instrument, the monetary base, is:

(7) $$Db_t = Dx^* - (1/16)(V_{t-1} - V_{t-17}) + B^*(x^*_{t-1} - x_{t-1}), \quad 0<B<1,$$

where b is the log of the monetary base, V is the log of the velocity of the base, x is the log of nominal GNP, x^* is its long-run target level, and D is the change operator. The growth rate in the monetary base each quarter equals the long-run desired rate of growth of nominal income, adjusted for past changes in the income velocity of the base and for past deviations in income from its long-run target path. The partial adjustment term, B, is chosen so as to ensure that nominal income will eventually return to its long-run targeted path, but without the dynamic instability that abrupt changes in the operating instrument could induce.

In many ways, McCallum's rule is similar to procedures that modify growth targets of monetary aggregates to offset movements in income velocity, but it differs in its use of the monetary base as the controlling instrument. According to McCallum, the strength of the proposal rests upon the fact that the base is under the direct control of the monetary authorities.[21] Moreover, McCallum cites a close historical correlation between the monetary base and nominal income, although the exact linkages between these variables are not spelled out. Critics argue that the monetary base is a flawed operating tool of policy because its large currency component is subject to erratic changes in demand. B. Friedman (1988) writes that changes in income have been important in driving movements in currency, not vice versa, and he finds that excluding the currency component eliminates any statistical relation between nominal GNP and the monetary base.

C. Use of Forecasts in Targeting Nominal GNP

Intermediate targets are intended in part to alert policy makers to needed changes in their operations. Nominal GNP may not be well suited for this purpose because of the long delays in data availability. To compensate for the lags in data availability, some advocates of nominal GNP targeting propose to use income forecasts in their operations. A path for instrument settings, such as interest rates, would be set on the basis of periodic GNP forecasts made by the Federal Reserve and possibly, as some advocate, using forecasts made by others. Instead of reacting to past (observed) income movements, policy makers would respond to expected movements in future nominal GNP based on forecasted values. Gordon (1985) writes that "there would be nothing novel in the Federal Reserve's using its own forecasts, since it does this already." However, their use in this suggested manner would represent a significant increase in their policy role.

Opinions vary about the reliability of forecasts of nominal GNP. Volcker (1983) comments that "the uncertainty and unreliability of economic forecasts have been amply demonstrated over recent years" and expresses reluctance to grant forecasts any formal role in the execution and formulation of monetary policy. Forecasts might be used not only to provide point estimates of future income, but also to flag turning points in the economy. In summarizing two studies on the forecastability of nominal GNP, Kahn (1988) writes that "forecasts of nominal GNP have been good enough to predict several important cyclical turning points in the economy." However, this conclusion is based on an analysis of composite indexes of forecasts. Any single forecasting model might not consistently anticipate turning points.

[21]The assumption that the total base, as opposed to the nonborrowed reserves portion of the base, is strictly controllable over the relevant period is open to debate. The paper by Meulendyke in this volume examines the money base as an intermediate target.

Many who advocate using forecasts are unclear whether separate forecasts are needed for prices and real output or whether an outlook for nominal income alone is required. Some proposed targeting strategies make use of expectations for real output and inflation. Separate forecasts for these variables might be needed, but these are usually less reliable than forecasts for nominal income alone. In an examination of a few large econometric models, McNees (1985) finds that errors in underpredicting inflation tend to offset errors in overpredicting real growth.

Not all proponents of nominal GNP targeting advocate the use of forecasts. In keeping with a view that the links between policy variables and output are poorly understood, especially as they pertain to the price adjustment mechanism, McCallum's operational rule calls for modifying control instruments solely on the basis of incoming data for nominal GNP. This, he argues, is better than basing policy on fallible forecasts. At the same time, such a "backward-looking" policy, that is, one that responds just to current conditions and past errors, is frequently criticized because it risks accentuating business cycles by, say, stimulating activity only after output is already beginning to expand.

D. Empirical Evidence on Controllability

Empirical evidence provides a mixed picture of how well nominal GNP can be controlled with the instruments available to the monetary authorities. Large macroeconomic models are often used to study the effects of monetary policy on the economy, and these usually indicate that nominal GNP is difficult to control because the links between the instruments of monetary policy and nominal income are indirect and complex, and because nominal GNP is affected by many factors that cannot be predicted or controlled. However, some critics maintain that the imposed structure of these models is often arbitrary and so should not be used to make policy inferences.

Evidence of a statistically significant relation between nominal income and control instruments is often found in smaller scale models where direct links are estimated. However, usually such equations explain just a small fraction of the total variation in nominal GNP. This is true, for example, of the model of GNP reported by McCallum (1987). More formal tests of "causality" also confirm that monetary policy actions are correlated with nominal GNP. Kahn (1988) performs bivariate Granger causality tests between changes in nominal GNP and a control instrument, both lagged four quarters. He finds that the hypothesis that the federal funds rate does not cause nominal GNP can be rejected. The hypothesis that the monetary base does not cause nominal income is also rejected by the same tests. However, Kahn questions whether the relation, while statistically significant, is "economically strong." That is, his results indicate that large movements in policy instruments might be required to make relatively small adjustments in nominal income. Overall, this evidence lends support to the conclusion that nominal GNP may be affected by monetary policy in a somewhat predictable way in the long run, but the degree of control over shorter time horizons is limited.

E. Consequences of Uncontrollability

The available evidence on the controllability of nominal GNP is not conclusive, but even among its advocates the view holds that nominal income is less subject to the control of the monetary authorities than other potential intermediate targets. Whether this undermines the usefulness of nominal GNP as an intermediate target may depend upon the nature or source of this uncontrollability.

Nominal GNP targets might still be useful if the "noise" preventing the monetary authorities from hitting those targets with any precision is caused mostly by random and unexpected changes to the many variables affecting nominal income. This would be like adding an error term to the aggregate supply or demand relationships in the simple analytical framework presented in the appendixes. As long as the impact of monetary policy actions on the economy remains known with sufficient certainty, then the basic conclusions from these sections would carry through in terms of expectations. Targeting nominal GNP may still be justified on the grounds of the expected outcome of this strategy.

Many policy makers are concerned that even in this environment the value of a nominal GNP target as a standard of accountability is undermined because market participants would not know whether to interpret a "miss" as signaling a shift in policy or as reflecting the effect of an unanticipated random shock. A persistent inability to deliver on a nominal GNP target is seen as destroying the usefulness of the target as a tool for evaluating Fed performance. Axilrod (1985) writes that "because it is not attainable with a reasonable degree of certainty, a nominal GNP target would almost inevitably call the central bank's credibility into question." But proponents see in this argument merely an attempt to avoid accountability. Gordon (1985) observes that adopting a relatively uncontrollable nominal income target would not add a new dimension to the public aspects of setting policy because the Fed "has already become expert at giving excuses" for misses in its targets. Ultimately, they maintain, the performance of the economy is the only measure of success of monetary policy that matters, and it remains the only guarantee of credibility for monetary authorities.

Uncertainty about the structure of the economy, including the timing and ultimate impact of policy changes on nominal GNP, also may undermine the value of nominal GNP targets. Inappropriate or "noisy" instrument or target settings may be made when the basic structure of the economy is unknown or misspecified. Under nominal GNP targeting, these errors may be identified only after a substantial period of time has elapsed because long lags prevent a timely monitoring of the impact of policy on income. Improperly set instruments or targets represent a type of "uncontrollability" that injects a persistent bias into monetary policy.

IV. Summary and Conclusions

Several reasons are typically advanced for using nominal GNP as an intermediate target in monetary policy. Advocates frequently maintain that under a nominal income target, economic disturbances affecting aggregate demand will be entirely offset, while the impact of aggregate supply or price shocks will be spread evenly between prices and real output. This view rests on a textbook macroeconomic analysis in which the monetary authorities act to keep nominal income at its targeted level. Some proponents of income targeting claim that had nominal GNP been targeted directly, the complications that unexpected velocity movements caused under money stock targeting could have been avoided. This conclusion follows from the identity that links money and velocity to income. Taking a somewhat longer perspective, some argue that setting targets for nominal GNP would better enable the monetary authorities to control inflation over time. Simply put, because the level of real output is outside the control of the monetary authorities over the long run, the identity between nominal income and the product of prices and real output means that setting target values for nominal income translates into setting targets for prices or inflation. This argument for targeting nominal GNP is more compatible with a view that policy makers should focus solely on the long run and should not attempt to set near-term real output objectives, however acute the apparent need.

Reservations have been expressed about using nominal GNP as an intermediate target because of its relative uncontrollability. Long lags in data availability and policy effects, the sensitivity of nominal income to many economic variables, and the general lack of knowledge about the structure of the macroeconomy combine to place nominal GNP largely outside the direct control of the monetary authorities. Yet in the simple models typically used to demonstrate the value of targeting nominal income, almost complete control is assumed. Even in the most basic models it is clear that the information that would be needed to target nominal income successfully far exceeds what would be required to target, say, the money stock. The volatility displayed in recent years by the income velocity of money, a development often cited as a reason for targeting income directly, can be regarded as evidence that nominal GNP is difficult to control, at least through a monetary aggregate.

The issue of controllability raises a general point about nominal GNP as an intermediate target. Intermediate targets are largely valued because they stand somewhere between the controlling instruments and final objectives of policy and thereby provide needed information and guidance to policy makers. Nominal GNP, by virtue of the identity that links it to prices and real output, is skewed towards the ultimate policy objectives, a condition that leads to offsetting considerations. On the one hand, it may be possible to frame a nominal income target that in theory could be used to achieve desirable outcomes for these final objectives; but on the other hand, the ability to control the intermediate target may be relatively low in the case of nominal GNP because its links to the operating instruments are remote.

Some arguments for targeting nominal income rest more on its symbolic and disciplinary value. Policy makers are frequently criticized for instilling an inflationary bias in their actions by focusing on the short-run real output gains of an expansionary policy at the cost of adding to inflationary pressures. A nominal income target, it is argued, would effectively constrain the monetary authorities from pursuing such policies by forcing them to maintain a given level of nominal income without regard to the split between its price and real output components. Furthermore, nominal income is seen as a relatively comprehensible measure, one that could more readily express the objectives of monetary policy.

At the same time there is some concern that because of the close identification of nominal GNP with prices and real output, a highly visible nominal income target could place counterproductive pressures on policy makers. Several policy makers have expressed the view that, as a practical matter, it would be difficult to avoid setting separate objectives for real output and inflation under nominal GNP targeting. Moreover, the economic benefits that in principle might arise from targeting nominal GNP may be outweighed by the policy makers' loss of credibility in targeting a variable that often remains largely outside their control. These arguments underscore the public policy dimension of targeting nominal income that arises from the close association between the measure and the final policy goals. This dimension needs to be considered when assessing the merits or drawbacks of adopting nominal GNP as an intermediate target.

A major part of this review addresses how, in practice, nominal GNP targets would be set. Most advocates maintain that it would be useful at the outset to establish a long-run target path for nominal income, either in levels or growth rates, based on estimates of potential output growth and long-run inflation goals. One purpose of such a long-run path would be to prevent the authorities from arbitrarily constructing a target value based solely on short-run objectives. There is some disagreement, however, over whether such a path would be set by the monetary authorities alone, or in conjunction with Congress or the Administration.

The monetary authorities would be expected to adhere strictly to the long-run target over time, although analysts disagree about the frequency or manner in which interim targets would be set when nominal GNP has been forced off its long-run target path by economic disturbances. As some simple dynamic models demonstrate, a rapid return to the long-run target path of nominal income, especially following supply shocks, could induce excessive fluctuations in real output. To lessen this kind of instability, some advocates of nominal GNP targeting have designed strategies for setting interim income targets that specifically consider short-run real output or employment objectives. For instance, following an inflationary shock, a more accommodative monetary policy might be tolerated in order to prevent a significant downturn in real output. And if real output is already well below its full employment level, policy makers might aim for faster nominal GNP growth until output returns near its potential level. This kind of strategy is in keeping with the view that the monetary authorities should take a more active role in conducting policy by making use of their knowledge about the structure of the economy in setting and achieving their nominal GNP targets.

An alternative view holds that a closer adherence to a predetermined long-run path of nominal income should be maintained because policy makers' knowledge about the trade-off between prices and output in the short run is limited, and any trade-off may not be invariant over time. Strategies for targeting nominal GNP that use short-term targets to meet real output objectives lose the benefits of a regime based on a precommitment to a rule because they inevitably rely heavily on policy makers' discretion.

Appendix 1: Targeting Nominal GNP and the Money Stock in a Static Theoretical Framework

The impact of economic shocks under a nominal GNP target is developed in this appendix using a textbook IS-LM model and a standard aggregate supply and demand framework. The implications of money stock and interest rate targeting are also assessed.

The Model

The basic model is presented graphically in Figures 1a and 1b. In the charts, the logarithmic values of all variables are plotted so that the slopes of the curves may be interpreted as elasticities. In Figure 1a, the IS and LM curves represent equilibrium combinations of real output and interest rates in the goods and money markets, respectively. In keeping with standard practice, the IS curve slopes down while the LM curve has a positive slope. The monetary aggregate underlying the LM curve is the real supply of money: nominal money deflated by the price level. Thus, changes in either the nominal money supply or in prices will shift the LM curve. The IS and LM curves are assumed to take the following simple functional forms:

(1) IS: $\log(r) = I_0 - I_1*\log(Q)$

(2) LM: $\log(M/P) = L_0 - L_1*\log(r) + L_2*\log(Q)$,

where Q measures the level of real output, r is the interest rate, M is the size of the nominal money stock, and P is the price level. The equations are written so that all variable coefficients are greater than zero.

Aggregate supply and demand relations are represented by the curves AS and AD, respectively, in Figure 1b. Aggregate demand is derived by measuring the effect that changes in the price level have on real output through their impact on the real money supply, holding the nominal money supply constant.[22] The AD schedule will have a negative slope because higher prices reduce the real money supply, causing the LM curve to shift to the left and lowering real output. The exact slope of the aggregate demand curve can be derived algebraically by solving the above equations for prices as a function of real output. The resulting expression is:

(3) slope AD = $-(I_1*L_1+L_2)$,

which, while always negative, may be above or below negative one.

The AS curve describes the response of output to changes in prices.[23] The curve will have a positive slope if contracts or other practices fix costs of supply factors--such as labor--in nominal

[22]The AD curve is derived by tracing the impact that changes in the price level have on the LM curve and thereby on real output in the IS-LM framework in Figure 1a. Shifts in the LM curve brought on by changes in the nominal money supply and shifts in the IS curve lead to shifts in the AD curve. Movements in the LM schedule that are induced by changes in the price level correspond to movements along the AD curve.

[23]If the initial equilibrium point corresponds to potential output, then the AS curve can be interpreted as describing the price changes associated with deviations of real output from its potential level.

Targeting Nominal GNP - Demand Shock

Figure 1a

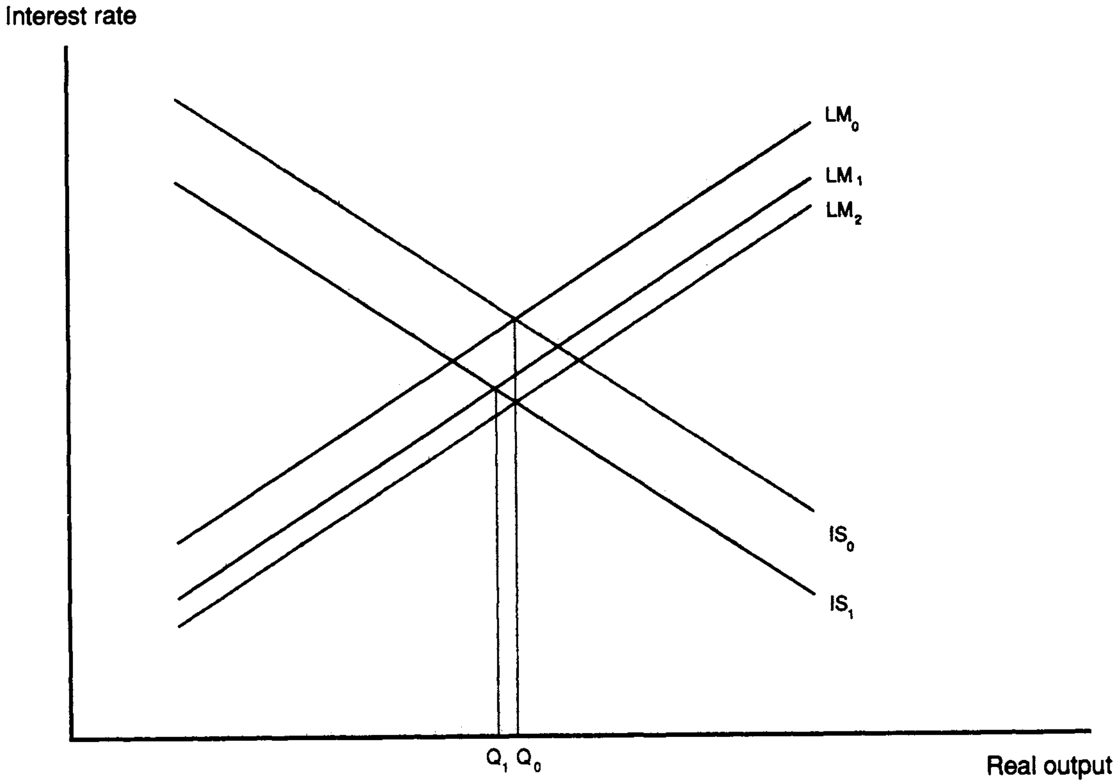
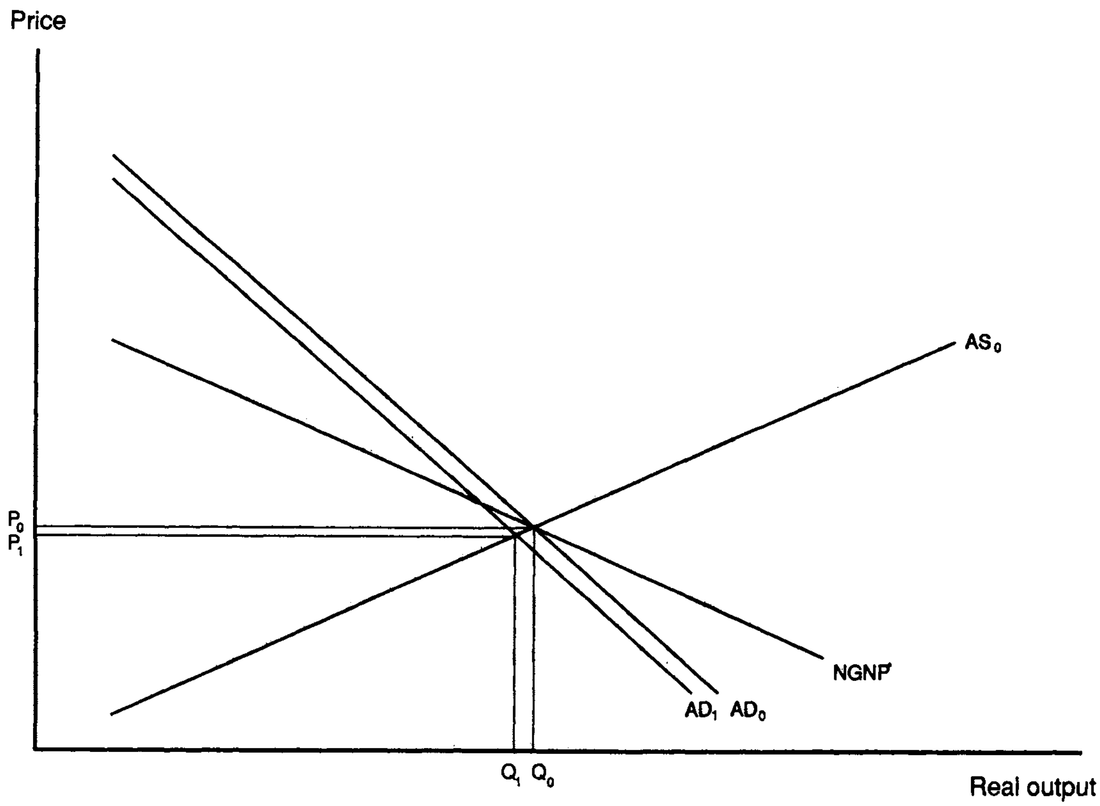


Figure 1b



terms for extended periods. In this case, higher prices will lower real factor costs and more of the productive inputs will be employed, raising real output. It is generally accepted that in the long run the aggregate supply function will be vertical so long as economic agents do not suffer from any form of money illusion. This means that in the long run, actions of the monetary authorities cannot have any impact on the level of real output. However, in the short to intermediate run, monetary policy decisions can either exacerbate or moderate swings in real output caused by economic disturbances. The transition from the short run to the long run is not spelled out in this analysis.

The model is completely deterministic. The monetary authorities fully control their operating instrument, the money supply, and all structural parameters are known with certainty. Thus, nominal GNP, or any single target variable, can always be hit except immediately following unexpected disturbances. The economic relationships in this model are developed largely in real terms, and all prices are specified in levels. Inflation expectations are not incorporated in this framework; thus, among other things, there is no distinction between real and nominal interest rates. The general absence of inflationary dynamics, coupled with the upward sloping supply curve, makes this model more suited for analyzing targeting in the short run. Nonetheless, this static framework highlights some of the principal features that some associate with nominal GNP targeting, and it is a standard tool, at least implicitly, of many discussants.[24]

Targeting Nominal GNP

When nominal GNP is the intermediate target, the monetary authorities change the money stock following economic disturbances (that is, they shift the LM curve) so as to keep the economy at a point where prices and real output yield the target value of nominal income. Let the line labeled $NGNP^*$ in Figure 1b represent all combinations of P and Q that yield this target level of nominal income. By definition this curve has a slope (elasticity) of negative one. In the following examples, the economy is assumed to begin at a point of equilibrium, and the targeted level of nominal GNP remains unchanged following economic disturbances.

Under nominal GNP targeting, demand shocks corresponding to movements in the IS and LM curves have no impact on prices and real output since these are offset by money supply changes. For

[24]Taylor (1985) uses this approach to examine what he labels the "impact" effects of nominal GNP targeting, and Kahn (1988) adopts a similar framework in his analysis of the "short-run" consequences of nominal GNP targeting. Bean (1983) analyzes nominal GNP targeting using a more complex theoretical model.

instance, a decline in business investment shifts the IS curve in Figure 1a from IS_0 to IS_1 and the aggregate demand schedule in Figure 1b from AD_0 to AD_1. The resulting change in prices from P_0 to P_1 will lead to a shift in the LM curve to LM_1 through its impact on real money balances. At P_1 and Q_1, nominal GNP is below the target level. Thus, the money supply expands, simultaneously shifting the LM curve to the right and returning AD to its starting position. In final equilibrium, output and prices are returned to Q_0 and P_0, respectively.[25] Similarly, an increased desire by consumers to hold money balances shifts both the LM and AD curves to the left in Figure 1. This is countered by an increase in the money supply that moves these schedules back to their initial positions, restoring prices and output to their original levels. Under a nominal GNP target, all demand disturbances are completely offset, leaving aggregate prices and real output unchanged.

Unlike demand shocks, supply or price shocks--such as increases in oil prices or declines in labor productivity--have a lasting impact under nominal GNP targeting, but monetary policy distributes their impact evenly between prices and real output.[26] In Figure 2b, a negative price shock shifts the aggregate supply schedule leftward, from AS_0 to AS_1. The higher prices (P_1) caused by this shift reduce real money balances, and the LM curve moves to LM_1. At P_1 and Q_1, nominal GNP is *above* target. Authorities respond by lowering the nominal money supply, a change which shifts the aggregate demand curve to AD_1, where it intersects aggregate supply at a point along the $NGNP^*$ curve. At P_2 and Q_2, nominal GNP is again on target, and the impact of the negative supply disturbance is split evenly between higher prices and lower real output.[27]

Even in this simple framework, the exact policy response needed to keep the economy on the line $NGNP^*$ following a price shock may be unclear. Inflationary supply shocks will always ultimately lead to a decline in the real money supply, but the direction of change in the nominal money supply required to hit the target level of nominal income depends on the slope of the AD curve. The graphical treatment in Figures 2a and 2b presents the situation when the AD curve is steeper than the

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[25]The rise in the nominal money supply needed to move aggregate demand back to AD_0 initially moves the LM curve to the right of LM_2, but the rise in prices from P_1 to P_0 shifts the LM curve back to LM_2 through the real balance effect.

[26]That is, the percentage rise (fall) in prices will exactly offset the percentage fall (rise) in real output, on the assumption that nominal GNP is restored to its initial level.

[27]The shift in the LM curve from LM_1 to LM_2 in Figure 2a reflects both the drop in the nominal money supply needed to shift the AD curve to its new position and the impact of permanently higher prices on the real money supply corresponding to a movement along the aggregate demand curve.

Targeting Nominal GNP - Price Shock

Figure 2a

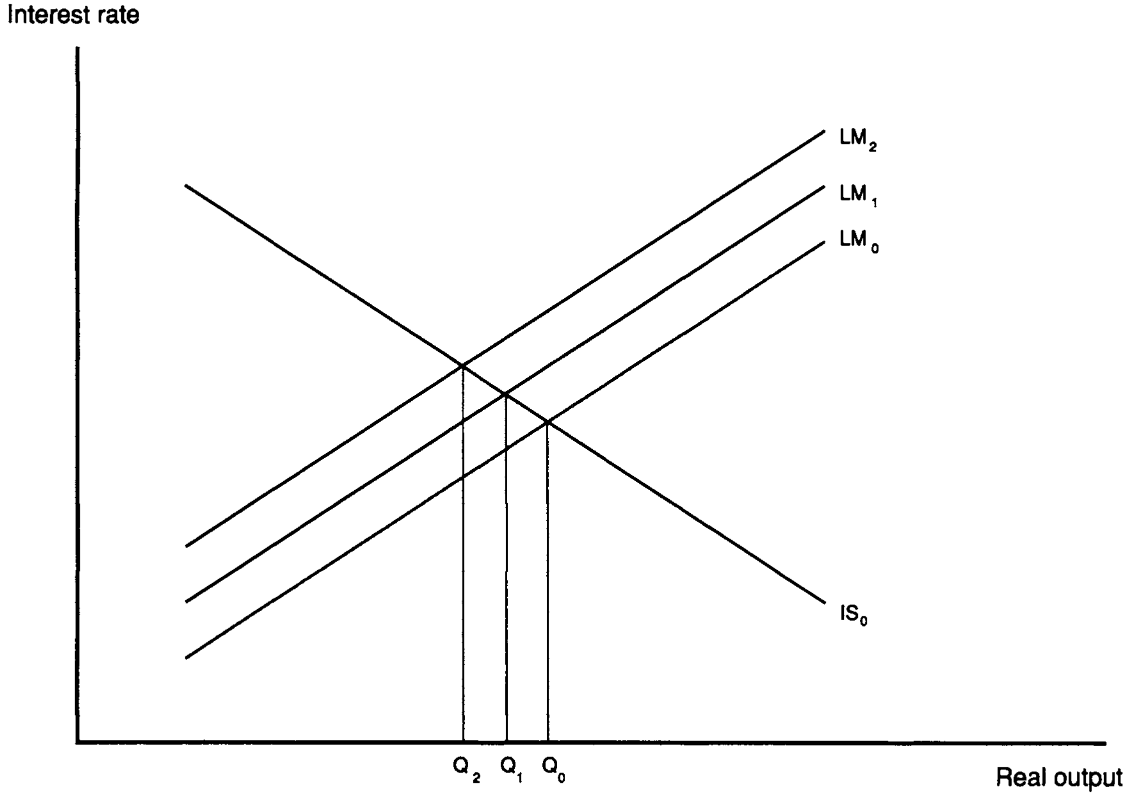
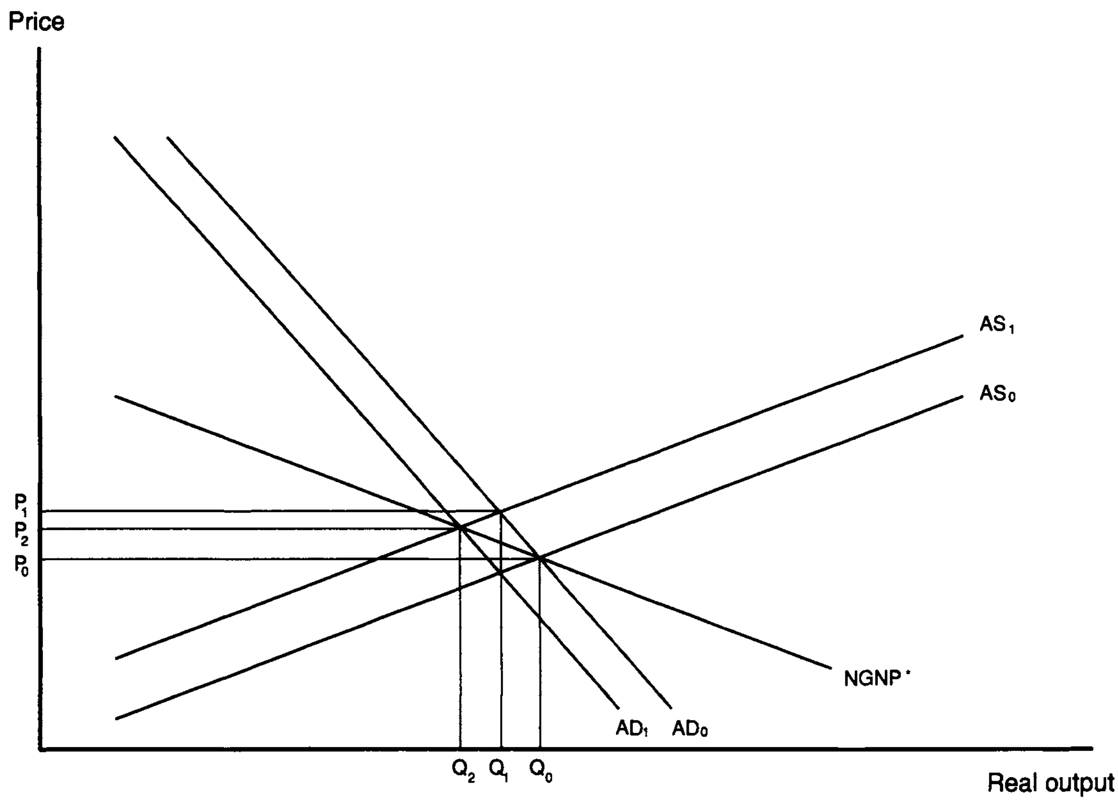


Figure 2b



unit-elastic target line for nominal GNP. The alternative case, where the NGNP* line is steeper than the AD schedule, is presented in Figures 3a and 3b. Here the initial disturbance to aggregate supply shifts that schedule from AS_0 to AS_1. With output at Q_1 and prices at P_1, nominal income is *below* target. (The price rise moves the LM curve to LM_1.) In this example, returning nominal income to its targeted level requires an *increase* in the nominal money supply that shifts aggregate demand to the right, to AD_1, from its initial position and moves the LM curve to LM_2. At P_2 and Q_2, nominal GNP is again on target. Despite the rise in the nominal money supply, real money balances are lower in final equilibrium.[28]

Nominal GNP versus Money Stock Targeting

The impact of supply and demand shocks under money stock targeting is presented in order to provide a basis for comparing these regimes with a policy of targeting nominal GNP. Figures 1 through 3 can be used to illustrate the impact of fixing the money stock in nominal terms. Only the final step in the previous examples of targeting nominal GNP--where the nominal money stock is changed to return to the original level of nominal income--is deleted in the analysis when the money supply is fixed.

Negative demand shocks lower real output and prices when the money supply is targeted. For example, using Figures 1a and 1b, a decline in real investment spending shifts the IS curve to IS_1 and aggregate demand to AD_1. The decline in prices from P_0 to P_1 raises real money balances and the LM curve shifts to LM_1. Unlike targeting nominal GNP, however, money targeting produces no policy reaction and final output remains below its initial equilibrium level at Q_1. A similar result holds in the case of a shock such as an increased desire to hold money balances, which shifts the LM schedule to

[28]This result can be derived by combining the total derivatives of equations 1 and 2 and substituting expressions of (negative) changes in prices for changes in real output, because under nominal income targeting the percent changes in real output and prices are of equal size but opposite sign. In percentage terms, the expression for the change in the nominal money supply required to hit the nominal GNP target reduces to:

Percent change in money = (Percent change in price)*($1-I_1*L_1-L_2$).

The final expression in parentheses must be under one because all coefficients are positive. Thus, the nominal money stock rises less than prices do following a supply disturbance that raises prices, so the real money supply must fall. However, whether the nominal money supply rises or falls depends on the sign of the final expression in parentheses. This expression is simply one plus the slope of the AD curve. Thus, the nominal money supply must fall (rise) following a supply shock that raises prices if the AD curve has a slope greater (lesser) than negative one in absolute value.

Targeting Nominal GNP - Price Shock (alternative case)

Figure 3a

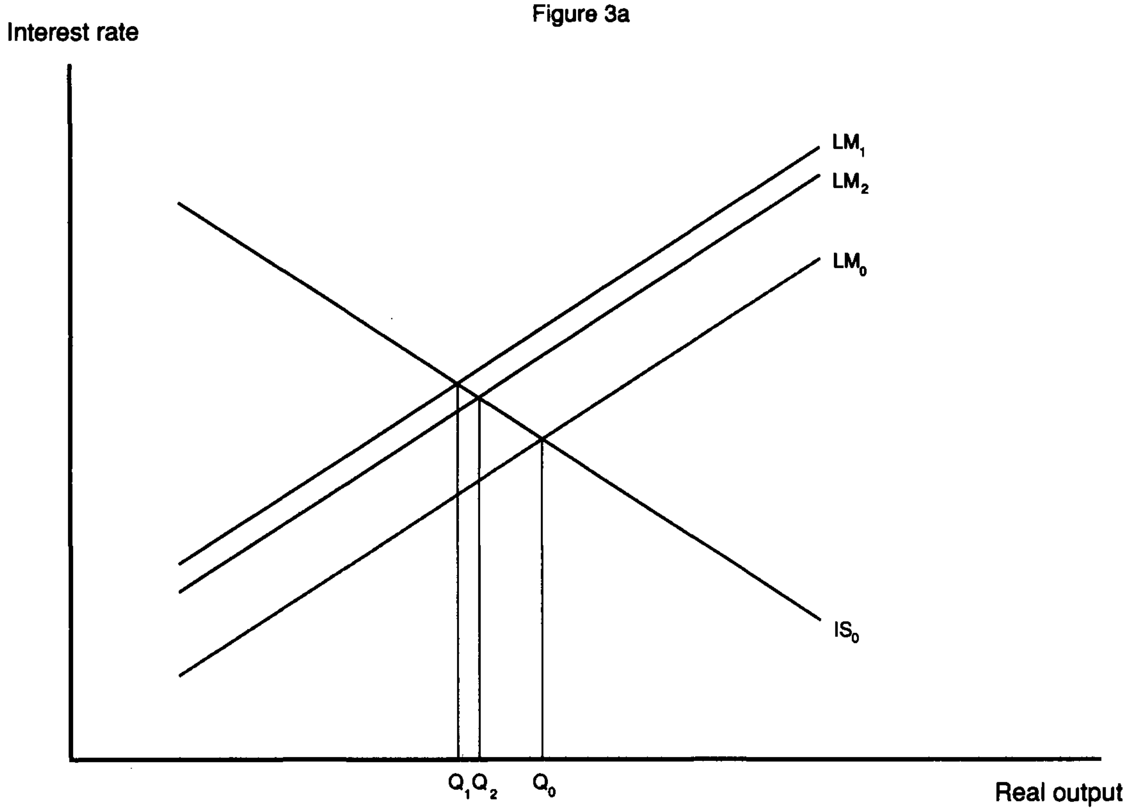
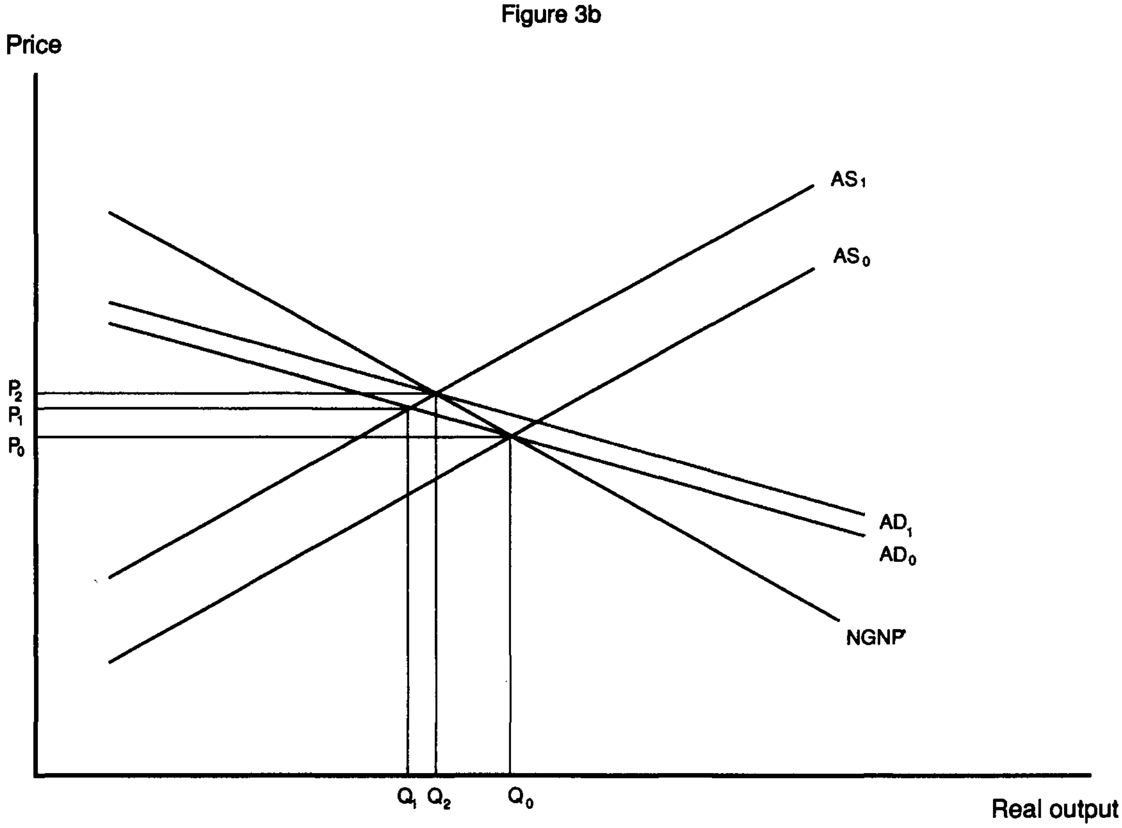


Figure 3b



the left. With money targeting, prices and real output are lower following a negative demand shock than they are under nominal GNP targeting.

The steepness of the AD schedule will determine whether, as compared with nominal income targeting, targeting the money supply will have a greater or lesser impact on real output or prices when there are supply disturbances. In Figure 2b, where the AD curve is steeper than the NGNP* line, a supply shock that shifts the aggregate supply curve from AS_0 to AS_1 leaves output and prices at Q_1 and P_1, respectively, when the nominal money supply is held constant. Compared with final equilibrium under nominal GNP targeting, where policy shifts the AD schedule back to where it intersects aggregate supply on the NGNP* line, real output and prices are higher. The opposite result holds when the aggregate demand schedule has a slope below one in absolute value, as seen in Figures 3a and 3b. In this case, under nominal money targeting, a disturbance that shifts aggregate supply to AS_1 will leave output and prices at Q_1 and P_1, respectively--below the values both variables have at their final equilibrium point under nominal GNP targeting. Taylor (1985) argues that in the short run the responsiveness of real output to interest rate changes is likely to be small; that is, the value of the coefficient I_1 is large. This corresponds to a relatively steep IS curve and, by equation 3, a steep AD curve. In this case, money stock targeting leaves prices and output at higher levels than nominal GNP targeting when there are negative supply disturbances, and so targeting the money supply is described as more "accommodative" than nominal GNP targeting when there are price shocks.

Conclusions of the Static Analysis

The preceding analysis is intended to highlight some of the comparative benefits often associated with targeting nominal GNP. With nominal income targeting, aggregate demand disturbances are entirely offset by policy moves that keep nominal GNP on target while the impact of supply shocks is distributed evenly between offsetting movements in prices and real output. By comparison, with money stock targeting, negative demand shocks reduce both prices and the level of real output. However, the net effect of supply shocks is unclear, and money targeting might be either more or less accommodative to real output than nominal GNP targeting, depending on the underlying parameters of aggregate demand. To proponents of nominal income targeting, these results demonstrate that targeting nominal income not only provides the monetary authorities with enough flexibility to respond to all demand disturbances so as to offset their impact on prices and real output, but also promises to split the impact of supply shocks evenly between prices and output--an outcome believed to represent a satisfactory compromise between the final objectives of sustaining adequate real growth and maintaining price stability.

Appendix 2: Targeting Nominal GNP in a Dynamic Framework

In this Appendix, a quarterly price adjustment model is used to evaluate the dynamic properties of various nominal GNP targeting strategies. Some of these results are summarized in Section IIB. The model is essentially a dynamic version of the aggregate supply framework laid out in Appendix 1, and it is similar to models used by Gordon and Taylor in their analyses of the effects of targeting nominal income on business cycles.

Price adjustment, or aggregate supply, is represented by:

(1) $Dp_t = Dp_{t-1} + a^*(q_t - q^*_t) + u_t, a > 0,$

where p is the log level of prices, and q and q^* are the log levels of real output and potential output, respectively. D is the change operator. The variable Dp_{t-1} is intended to represent the impact of all past inflation rates on the current inflation rate. With the coefficient on this term set to unity, equation 1 incorporates the "natural rate" hypothesis that output above potential cannot be sustained without accelerating inflation. The variable u_t captures the effect of unexpected disturbances on price inflation. In the subsequent exercises, the coefficient of quarterly adjustment of inflation to output, a, is set to .06, which is the adjustment rate estimated by Taylor. Also, the following distributed lag of past inflation rates is substituted for the term Dp_{t-1} in equation 1:

(2) $.4^*Dp_{t-1} + .3^*Dp_{t-2} + .2^*Dp_{t-3} + .1^*Dp_{t-4}.$

As a general rule, the amplitude of the oscillations to real output increase as adjustment lag to past inflation is shortened.

For these exercises, the definition of aggregate demand is broadened to include the monetary policy reaction function that keeps nominal income on its targeted path.[29] Thus, aggregate demand is represented by the rule that is used to set the nominal GNP target each period, and several possibilities are considered here.[30] Most rules make reference to a long-run targeted level or growth rate of nominal GNP, based on estimated potential real growth and ultimate inflation goals, but in most cases

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[29]In Appendix 1, aggregate demand was derived by collapsing the IS and LM curves, and the target rule guiding monetary policy was a separate function. Here, the definition of aggregate demand incorporates the monetary policy reaction function.

[30]Thus, in this framework, as in Taylor's analysis, aggregate demand corresponds to the line labeled $NGNP^*$ in the static framework.

near-term nominal GNP targets may differ from this long-run objective. The log level of the long-run path is labeled x^*_t, and the corresponding growth rate is the constant Dx^*.

If in each period the target level of nominal GNP is set to the long-run targeted *level*, then aggregate demand is:

(3) $p_t + q_t = x^*_t$.

If a constant growth rate for nominal GNP is targeted each period, then aggregate demand is:

(4) $Dp_t + Dq_t = Dx^*$.

The approximation to McCallum's rule used in this analysis ignores changes in velocity (see Section IIA). Thus, targeted changes in the operating instrument equal targeted changes in nominal GNP, and his rule collapses to:[31]

(5) $Dx_t = Dx^* + .25*(x^*_{t-1} - x_{t-1})$,

which states that percentage changes in nominal income are set equal to the desired long-run rate of change plus an adjustment term for lagged deviations in the (log) level of nominal GNP from its long-run target path.

Under Taylor's proposed formula, aggregate demand is:

(6) $Dx_t = Dx^* - (q_{t-1} - q^*_{t-1})$.

Finally, these rules are compared with a policy that minimizes on a period-by-period basis a loss function with the following formulation:

(7) $\text{Loss} = (q_t - q^*_t)^2 + B*(Dp_t - Dp^*)^2$.

The parameter B gives the relative weights attached to deviations of inflation and real output from their long-run targeted levels or rates of change. The strategy that minimizes this function each period is:

(8) $q_t - q^*_t = B*a*(Dp^* - Dp_t)$.

This is functionally equivalent to Taylor's general formula for setting nominal GNP targets, cited in footnote 13 of Section IIA. For this exercise, B is set to one.

The economy begins in initial equilibrium, with real output growing at an assumed 2 1/2 percent potential rate of growth and inflation equal to an assumed long-run desired pace of 3 percent. The effects of a temporary 1 percent (4 percent annualized) shock to inflation are evaluated on the assumption that nominal GNP can be controlled in each subsequent period. The impact under each of

[31]McCallum's rule only states how the operating instrument should be reset each period, and he does not address whether or how formal short-run nominal GNP targets should be set.

the alternative nominal GNP targeting strategies is graphically illustrated for five variables: the level of nominal GNP (Chart 1), the growth rate for nominal income (Chart 2), growth in real output (Chart 3), deviations of the level of real output from potential output (Chart 4), and the inflation rate (Chart 5).

Nominal GNP remains close to its initial target path when either its level or the growth rate is directly targeted (Chart 1). A feedback rule such as McCallum's returns nominal income to its target path after a short while. But nominal GNP steadily moves away from its initial targeted level when Taylor's rule or a period-by-period optimizing strategy is used. In terms of growth rates, McCallum's feedback mechanism quickly returns nominal income growth to its long-run targeted rate (Chart 2). Taylor's rule only gradually restores nominal GNP growth to this rate, and the short-run optimizing strategy puts nominal income growth on an almost permanently higher path.

Both Taylor's rule and the period-by-period optimizing strategy keep real output growing near its potential rate of 2 1/2 percent in all but the very short run (Chart 3). In contrast, strategies that strictly target either the level or the growth rate of nominal income cause considerable instability in

Chart 1
Log Level of Nominal GNP
Under Alternative Targeting Procedures With a Price Shock

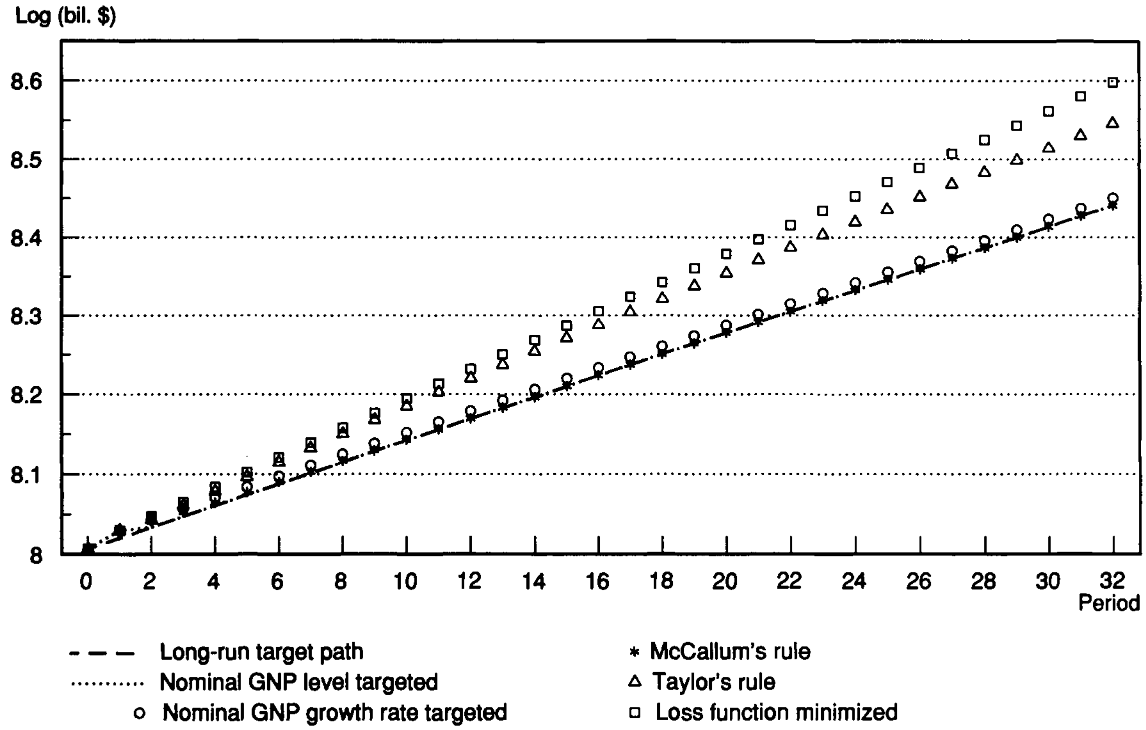


Chart 2
Growth Rate of Nominal GNP
Under Alternative Targeting Procedures With a Price Shock

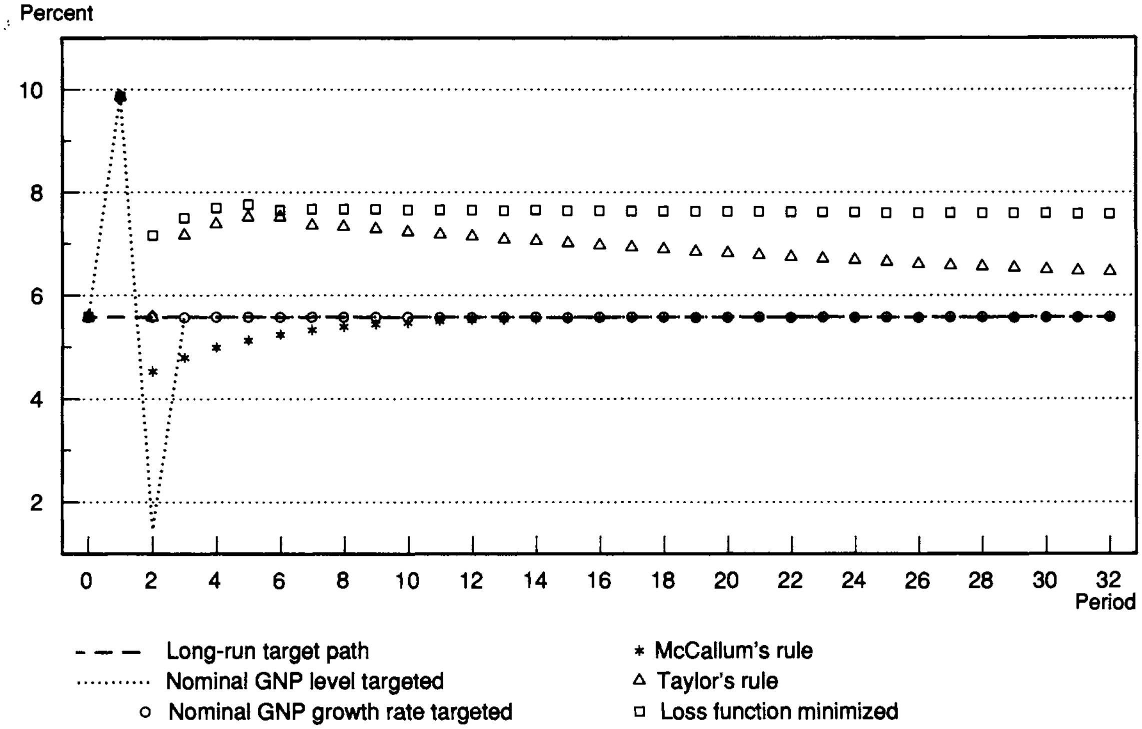


Chart 3
Growth Rate of Real Output
Under Alternative Targeting Procedures With a Price Shock

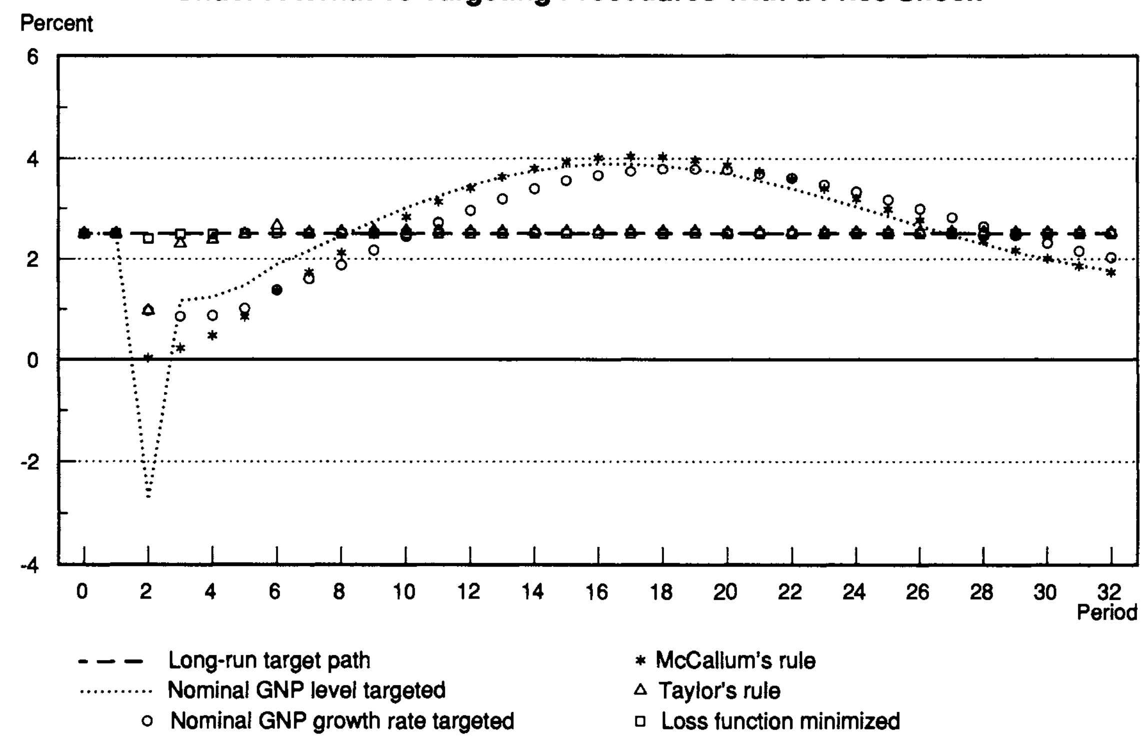


Chart 4

Percent Deviation of Real Output from Potential

Under Alternative Targeting Procedures With a Price Shock

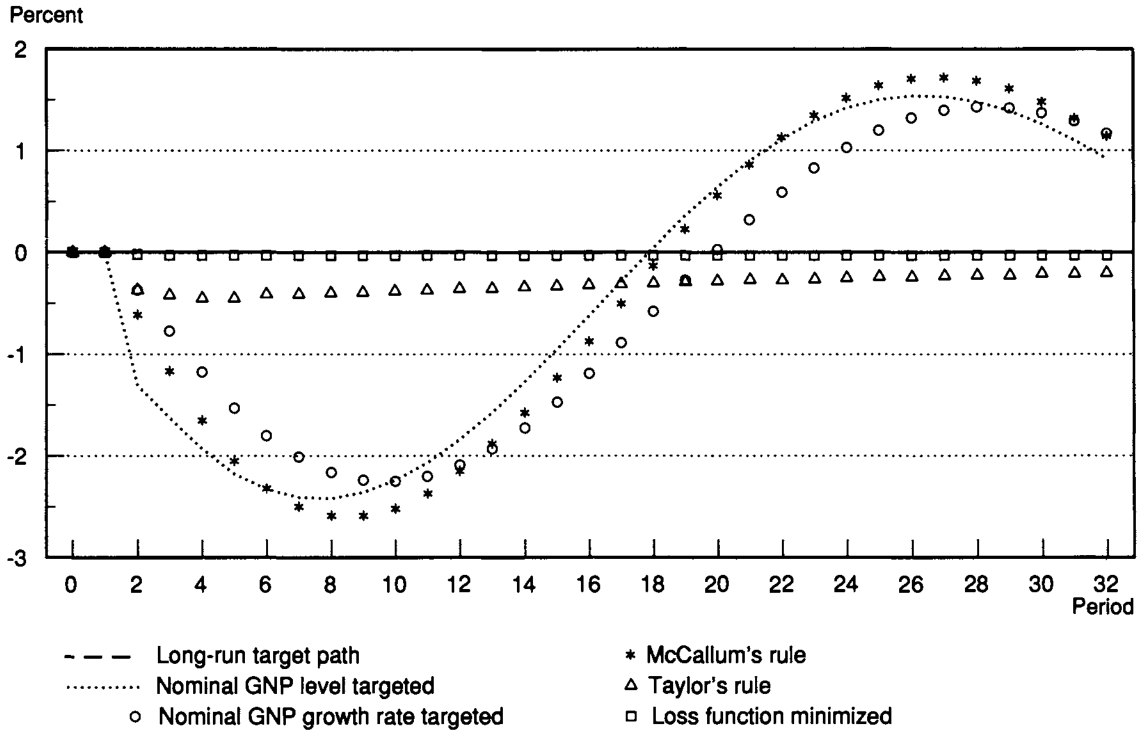
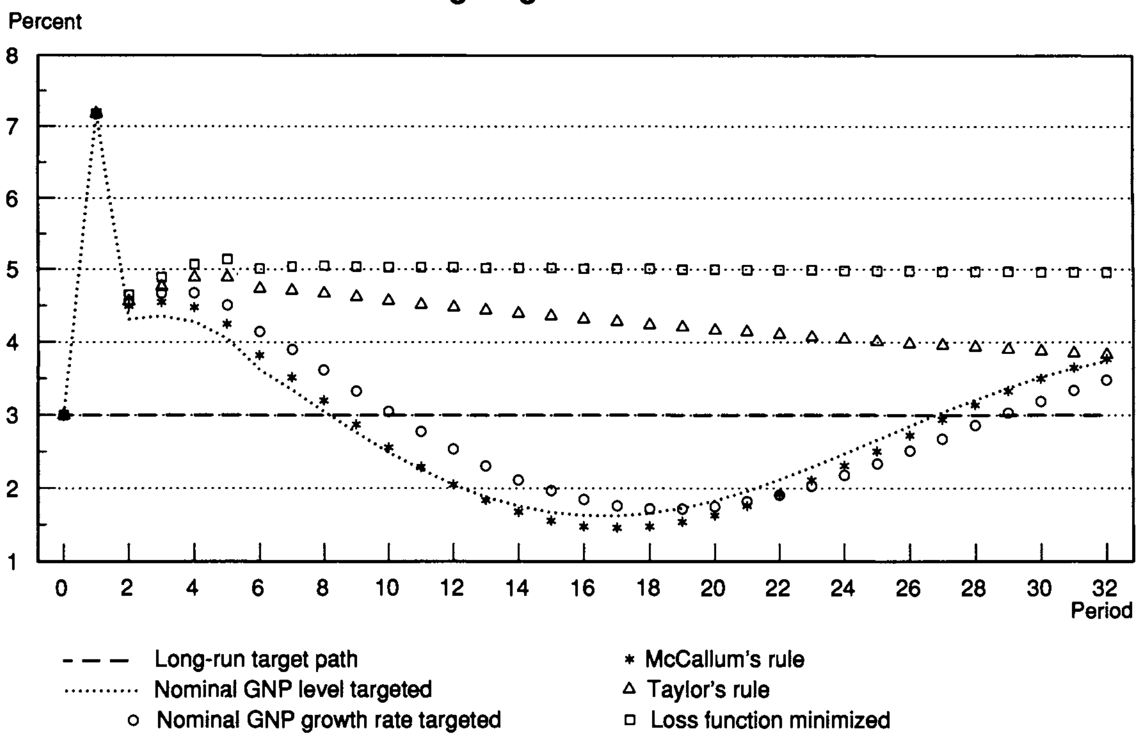


Chart 5

Inflation Rate

Under Alternative Targeting Procedures With a Price Shock



real growth. Real output growth also fluctuates significantly when using McCallum's rule, which has a feedback mechanism from past misses in nominal GNP. A similar set of results holds when examining percentage deviations in the level of real output from its potential level (Chart 4). Under Taylor's rule the level of real output gradually returns to its potential level, and with an optimizing strategy real output never moves far away from potential. But under McCallum's rule, and when levels or growth rates of nominal income are targeted inflexibly, real output oscillates around its potential level.

Finally, the inflation rate moves around its long-run targeted value of 3 percent when the level or growth rate of nominal GNP is targeted and when McCallum's rule is used (Chart 5). Inflation only gradually falls back towards the 3 percent level with Taylor's rule, and under a period-by-period optimizing policy the inflation rate jumps to a permanently higher level.

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INTEREST RATES AS TARGETS AND INDICATORS FOR MONETARY POLICY

Charles Steindel

There has been renewed interest in the use of market indicators in the formulation of monetary policy. Other papers in this study evaluate the pros and cons of using commodity prices, exchange rates, and the yield curve. This paper discusses what may be the most obvious set of price indicators for monetary policy--nominal and real interest rates.

The paper first focuses on the use of interest rates in intermediate targeting. There is almost universal agreement that nominal and real interest rates have serious problems as long-term intermediate targets. Rates can have very weak and unstable, or even perverse, relationships to final goals--especially inflation. Furthermore, the Open Market Desk's ability to control the types of interest rates most relevant to inflation and real growth is limited. For these reasons, rates are not proposed as the sole targets of monetary policy in the same sense as monetary aggregates, with the aim of policy to be the maintenance of nominal rates at certain levels or in certain ranges. However, given the empirical evidence that real interest rates have a significant effect on economic activity, there is some justification for bringing real rates into the intermediate targeting process--at least as information variables helping to evaluate the signals about final goals provided by monetary aggregates. This conclusion is reinforced by recent theoretical arguments that support a role for nominal or real rates in intermediate targeting systems.

Interest rates may also be used as operating instruments to control other intermediate targets, such as monetary aggregates. Short-term nominal interest rates, such as the federal funds rate, have been considered--and used--as operating targets. The literature suggests that given a monetary aggregate as an intermediate target, it will rarely if ever be optimal to ignore money market rates in the formulation of open market operations.

The final section of this paper traces some of the historic uses of interest rates in Federal Reserve policy making. The various shifts in the use of rates in the policy process help to shed light on the issues discussed in other sections.

Before we proceed to the main body of the paper, one further point should be mentioned. At times, interest rate *stability* has been viewed as either a final goal or an intermediate target of policy.

The rationale for smoothing interest rates is that excessive volatility may hamper the efficient operations of the banking and financial system, and an inefficient financial system may hamper the workings of the overall economy. Despite these concerns, the precise relationship between interest rate volatility and the smooth workings of the financial system is by no means obvious. To be sure, large daily swings in securities prices may strain payments and settlements systems and make it difficult for savers and borrowers to evaluate investment opportunities. However, enforced interest rate stability in the face of shocks to the economy may well exacerbate macroeconomic instability, which will in turn create problems for financial markets. The existence of such a trade-off between limiting high frequency interest rate volatility and increasing macroeconomic stability would weaken the case for interest rate stability as a target or final goal.

I. Interest Rates as Intermediate Targets

A. General Considerations

Interest rates have not been proposed as intermediate targets in the same sense as money and credit aggregates. There are no serious proposals that monetary policy be geared toward keeping a single interest rate (nominal or real), or an average of interest rates, at some optimal level or in some predetermined range. The evidence produced in this section implies that there are good reasons for this lack of interest; interest rates (nominal or real) have ambiguous relationships to final goals, such as real growth and inflation, and the ability of the monetary authorities to control the interest rates relevant to final goals through the usual operating instruments is limited.

The analysis of interest rates as intermediate targets is complicated by the potential need to analyze four different types of rates: nominal short-term rates, real short-term rates (that is, the difference between nominal rates and expected inflation), nominal long-term rates, and real long-term rates. In principle, eight sets of linkages may be analyzed--the linkage of Desk operations to each rate type and the linkage of each type to final goals.

The next subsection will discuss the control issue, followed by subsections on the conceptual and empirical linkages of rates to final goals, with a special focus on the incremental information value of rate moves when changes in monetary aggregates are taken into account. A final subsection discusses recent technical literature bearing on the issue of the optimal role of interest rates in an aggregate-based intermediate targeting strategy.

B. Interest Rate Control

Federal Reserve open market operations consist essentially of the purchase and sale (temporary and permanent) of Treasury securities. Purchases involve the creation of bank reserves, while sales remove reserves from the banking system. The large scale of Desk operations relative to the reserves market means that the Desk exerts a great deal of influence on the federal funds rate, the overnight interest rate for reserves. There is little doubt that the Desk can achieve nearly complete control over the funds rate. (For a discussion of control issues in the current financial market environment, see Radecki and Reinhart 1988.) Arbitrage between the funds market and the markets for other short-term securities, such as Treasury bills and bank CDs, implies that the Desk can greatly influence the general level of short-term nominal interest rates. Although there may not be perfect control of an average of short-term rates, the Federal Reserve's ability to control nominal short-term interest rates can be viewed as at least as great as its ability to control any other proposed intermediate target.

By contrast, the control of real short-term rates and long-term rates, nominal and real, raises some significant issues. The problems generally center on in the relationship of inflation expectations and short-term interest rate expectations to monetary operations.

The problems are clearest in the control of nominal and real long-term rates. It is reasonable to assume that nominal long-term interest rates are affected by expectations of the future course of short-term interest rates (the expectations hypothesis of the term structure asserts that such expectations can fully explain long-term rates). A restrictive monetary policy, which has the immediate impact of raising nominal short-term rates, may create expectations that higher short-term rates will persist and thereby increase nominal long-term rates.

Alternatively, however, a restrictive policy may generate expectations that future levels of inflation will be lower, consequently putting downward pressure on future short-term interest rates. Furthermore, a currently restrictive policy may encourage expectations of a future policy change, which could also eventually put downward pressure on short-term rates. Thus, the unpredictability of the relationship between current policy actions and expectations of future interest rates may limit the Desk's ability to control nominal long-term interest rates.[1]

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[1]In a recent study, Timothy Cook and Thomas Hahn (1989) found that changes in the federal funds operating target in the 1970s had a progressively smaller impact on Treasury yields as the time to maturity advanced--smaller in both an economic sense (a given change in the funds rate target had a smaller estimated impact on the longer lived maturities) and in a statistical sense (less of the variation in yields on longer lived instruments was explained by changes in the targeted funds rate).

Real long-term interest rates are defined as nominal long-term rates less expected long-term inflation. One fundamental problem involved with utilizing real long-term interest rates in policy is the lack of any agreed-upon way to measure long-term inflation expectations and thus to *observe* real long-term interest rates. Going beyond this problem is the difficulty of controlling real long-term rates through the usual instruments of monetary policy. Conceivably, as suggested above, a restrictive policy may generate expectations of both lower nominal short-term rates and lower inflation in the future. The effect of the policy on real long-term rates can not be predicted without considerable knowledge of its effect on expectations of future nominal short-term rates and inflation.

One can well doubt that monetary policy can play a predominant role in the movement of real long-term interest rates, even if the effect of policy on expectations at any time were perfectly understood. In the long run, real interest rates will move in tandem with the productivity of the capital stock, which is determined by factors such as the capital-labor ratio and the development of technology. Changes in expectations about these real factors may have more to do with movements in real long-term interest rates than do changes in monetary policy.

Inflation expectations are also not directly observed even over short horizons, meaning that real short-term rates are not observed. In principle, the same interaction between monetary policy moves and inflation expectations that affects long-term interest rate control may be operative at short horizons, complicating real short-term interest rate control. However, there may plausibly be little direct linkage between Desk actions and near-term inflation expectations (say, less than six months), implying that there could be a reasonably stable linkage between Desk actions and real short-term interest rate movements.[2]

Overall, it appears that the monetary authorities can achieve a high degree of control over short-term nominal interest rates and may exert some systematic influence over short-term real interest rates. The effect of monetary policy on long-term interest rates, nominal and real, is problematic.

C. Interest Rates and the Economy

The standard simple IS/LM model of the economy implies a straightforward relationship between interest rates and real output. In the standard models, the aggregate demand for goods and services is negatively related to the one interest rate considered (that is, the IS curve traces the

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[2]Eugene Fama (1975, 1977) argued that the real ninety-day Treasury bill rate is constant. His conclusion was widely contested (Carlson 1977; Joines 1977; and Nelson and Schwert 1977). Robert Shiller (1981) found that the Desk can, indeed, exert some control over real short-term rates.

negative relationship between real demand and the interest rate). Under these assumptions, in the absence of uncertainty, the monetary authorities can achieve a real output goal by targeting the interest rate, increasing the rate target to reduce output and reducing it to increase output.

The simple IS/LM model has fixed prices. It is not directly applicable for analysis of the implications of nominal interest rate moves for real output, or the implications of real or nominal interest rate movements for inflation and nominal output. Furthermore, the model has only one interest rate. It is generally believed that the most interest-sensitive components of demand consist of spending on long-lived products such as capital goods, consumer durables, and structures, so the simple IS/LM model appears most relevant for analyzing the influence of real long-term rates on real output.[3]

The IS/LM model must be extended to analyze the relationship of interest rates to inflation and the influence of real short-term rates and nominal rates (short- and long-term) on real output and inflation. This is often done by appending to the basic model a Phillips Curve relationship between the level of real output (relative to the full employment level) and inflation, fixed term-structure equations relating nominal long-term interest rates to realized short-term interest rates, and an assumption that inflation expectations are related to actual current and past inflation. With these additions, common to the standard large econometric models, there will be at any time a predetermined relationship among all interest rates, real and nominal, short- and long-term, and among movements in rates, real output, and inflation. Any interest rate will in principle have at any time a predetermined relationship to inflation and real output; a given level of the rate will be associated with given levels of output and inflation. The relationship between any rate and final goals will still be subject to statistical uncertainty and some rates will be more closely associated statistically with changes in the real economy and inflation than others.

The structure of many large-scale models implies that it would be possible to set short-term nominal interest rate intermediate targets for monetary policy. The target could be connected to final objectives subject only to the stochastic errors present in the model. In practice, however, such an approach would appear to be seriously flawed. For one thing, the term structure equations used in these models tend to have problems tracking the actual behavior of long-term interest rates (Shiller, Campbell, and Shoenholtz 1983; Blanchard 1984; and Steindel and Palash 1986). This suggests that

[3]This conclusion is not self-evident. If there were perfect secondary markets for capital goods, the profitability of physical investment would be judged by short-run holding period returns, and thus short-term interest rates. For a discussion of this issue, see Robert Hall (1977).

even given predictable, stable relationships between nominal long-term rates and real long-term rates, and between real long-term rates and real output and inflation, the relationship of nominal short-term interest rates to real output and inflation may well be unstable (although under these circumstances nominal long-term rates might have a stable relationship to final goals).

Even in the absence of uncertainty, a policy of nominal interest rate targeting would need to be more sophisticated in practice than simply attempting to peg a short- or long-term rate at a predetermined level and maintaining the target over a period of time. In particular, if inflation, and inflation expectations, happen to be increasing, the maintenance of a fixed nominal rate target may lead to a further acceleration of inflation. If the nominal interest rate target does not change, the upward pressure on the targeted rate stemming from the increase in inflation expectations will be offset by a more expansionary monetary policy, resulting in declines in real interest rates and ultimately upward pressure on real output and inflation. Thus, even in the most favorable case, nominal interest rate targets would have to be continually updated in the light of incoming information on the economy and inflation; a strategy of simply pegging a nominal rate could put the economy on a continuing inflationary (deflationary) spiral if the authorities set the rate too low (high). This problem is sometimes referred to as the lack of a "nominal anchor" for nominal rate targets.

Instability in the relationship among interest rates and between interest rates and the economy causes further problems for a nominal rate target. For example, monetary policy may inappropriately react to random fluctuations in pressure on a targeted rate stemming from shifts in yield curve relationships or changes in risk premiums. Random shifts in real aggregate demand will also influence nominal (and real) interest rates, with an increase in demand putting upward pressure on rates. A policy of literally pegging a nominal (or real) interest rate will add to output instability if such shifts are common (this is, as Poole 1970 showed, analogous to the problems money demand shifts add to targeting monetary aggregates).

Furthermore, a revelation that the central bank is focusing attention on one rate (or a narrow set of rates) could well lead to a concentration of speculative market attention on the rate, leading to the degradation of its relationship to other rates and to final goals. A policy maker would need to have considerable detailed knowledge about markets and the economy to use nominal interest rates (short- or long-term) as intermediate targets.[4]

The general problem of possibly unstable relationships among interest rates and between

[4]Milton Friedman (1968) well describes the hazards of nominal rate targeting.

interest rates and final goals is as true for real as for nominal interest rate targets. The linkage from real rates to inflation is quite indirect and possibly unstable, relying on the links from real rates to real output and from real output to inflation. It is conceivable that a targeted real rate may come under downward pressure as inflation increases, leading to an inappropriate policy response.

There would be fundamental problems with real rate targeting in the areas of both observation and control (particularly severe for real long-term rates), as well as in the possibility of instability in the links among real rates and in the links between real rates and output and inflation. In practice, policy makers (1) may not observe changes in real rates, (2) may not be able to control satisfactorily those real rates most closely linked to final goals, (3) may react to idiosyncratic shifts in the targeted rate, (4) may accommodate rather than offset shifts in aggregate demand, and (5) may accommodate rather than offset inflation. Nominal interest rates are observable, but nominal rate targeting shares all of the other four problems--especially the last.[5]

D. Empirical Evidence on Interest Rates and the Economy

Clearly, intermediate targeting regimes directed solely at controlling nominal or real nominal interest rates are rather unattractive. A secondary, but still important issue, is the empirical importance of interest rate movements: Do movements in nominal and real interest rates systematically lead movements in economic activity? If rate moves lead changes in the economy, then rates are worth monitoring, even if they are not used as intermediate targets.

This issue can be addressed by examining the empirical evidence on the relationship between interest rates and the economy. The first body of evidence comes from the standard large econometric models. Real interest rate effects are pervasive in these models, which are constructed along the lines of the extended IS/LM framework; changes in real long-term interest rates will follow changes in

[5]In contrast, some views of the economy suggest that nominal rate targeting could be used to help control inflation. This approach centers on the "Fisher equation" defining the nominal interest rate as the sum of the real rate and the expected inflation rate. If the real rate is constant, then all fluctuations in nominal rates are due to changes in inflation expectations. Taking the argument to extremes, the monetary authorities might use nominal rate targets to control inflation expectations directly (and ultimately inflation) or, more modestly, use nominal interest rate movements as uniquely qualified information variables about future inflation.

In fact, much research on the issue has failed to detect evidence that nominal rate fluctuations can be used to forecast inflation with any accuracy for periods longer than six months or a year; even at these intervals, there are probably superior forecasting techniques. See Lawrence Summers (1983) and Frederic Mishkin (1990).

operating instruments and precede changes in goal variables, such as real GNP and inflation. In the MIT-Penn-SSRC (MPS) model, increases in long-term real interest rates raise the "cost of capital" and thus reduce investment in consumer durables, housing, nonresidential fixed capital, and inventories.[6] In this model, increases in long-term real interest rates also reduce the value of the stock market, depressing consumer spending on nondurable goods and services. While a "reduced-form" relationship relating monetary aggregates and economic activity may be constructed from the equations of this model, the actual structure of the model is that monetary policy operates by first changing nominal short-term interest rates, then nominal and real long-term rates through fixed term-structure equations (and backward-looking inflation expectations). These changes in real long-term rates ultimately influence economic activity, with changes in the aggregates a byproduct of the general change in interest rates (Modigliani 1971).

The MPS model is largely based on research originally done in the 1960s. More recent work continues to find a leading relationship between real interest rates and economic activity, along much the same lines as outlined in the model (Akhtar and Harris 1987, Bosworth 1989, and Friedman 1989). However, the specific sectoral relationships are unstable statistically and have shifted over time. The looseness of these relationships suggests that it may be inadvisable to give extensive weight to moves in real long-term rates as predictors of future output and inflation.

A second strand of the empirical literature uses vector autoregressions (VARs) to make explicit measurements of the timing relationships between interest rates, monetary aggregates, and economic activity. In 1980, Christopher Sims produced evidence that current and lagged innovations in nominal Treasury bill rates were negatively related to and explained a large fraction of the variation in industrial production during the postwar era, dominating the influence of innovations in M1. Robert Litterman and Laurence Weiss (1984) and James Stock and Mark Watson (1989) have basically reaffirmed Sims' result.

An important impression one draws from the vector autoregression literature is that it is difficult, if not impossible, to accept the hypothesis that the total effect of interest rates on economic activity is captured by movements in money and credit aggregates. It is somewhat surprising, though, that these interest rate effects seem to be captured in nominal, rather than real, interest rate

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[6]Flint Brayton and Eileen Mauskopf 1985.

movements.[7]

A final strand in the empirical literature arises from direct estimates of "reduced forms" relating interest rates to final goals. This approach is analogous to that used in investigations of money and credit aggregate targeting. John Paulus and Steven Roach (1984) calculated that during the 1952-82 period a sustained 1 percentage point increase in short-term real interest rates (measured ex post as the commercial paper rate less the growth in the GNP implicit price deflator) led to roughly a 1 percentage point decline in real GNP after three years.

Raymond Lombra (1984) carried out some further explorations of the Paulus-Roach model. He found that the basic specification was disappointing; the overall fit of the equation was quite low, and the coefficients on the interest rate terms showed some instability.

On the whole, the empirical evidence suggests that movements in interest rates do lead changes in real economic activity (and by inference, inflation, since inflation changes tend to lag changes in real activity). As the earlier discussion of the general issue of interest rate targeting suggested, there is no striking evidence of a strong, stable relationship between any particular rate and the economy.

E. Interest Rates as Information Variables

The direct relationship between interest rates and the economy appears to be unstable. For example, the weakness of Lombra's results suggest that there is little value in simply reestimating the relationship between interest rates and economic activity.[8] However, one may still be interested in a direct, simple test of the hypothesis that interest rates provide information about the economy over and above that provided by a monetary aggregate.[9] If interest rates have some independent explanatory power over and above an aggregate, they might be used to monitor the signals about future activity given by changes in an aggregate target.

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[7]George Kahn (1989) has produced evidence from VAR models that the aggregate effect of short-term nominal interest rates sharply diminished in the 1980s.

[8]More recently, a spate of studies have appeared examining the relationship between the yield curve and the economy. See Robert Laurent (1988, 1989) and Arturo Estrella and Gikas Hardouvelis (1989, 1990).

[9]VARs can be used to provide a formal, rigorous test of this hypothesis. However, the results of VARs are difficult to place in a standard targeting framework--for example, it would be very hard to use the results of a VAR to determine the near-term effect of an interest rate increase on velocity.

The procedure used in the exercise was straightforward. Simple relationships were estimated between nominal and real economic growth and nominal and real M2 growth. Added to these relationships were various combinations of nominal and ex post real federal funds rates. On a formal level, if the rate terms add any information about economic activity, their addition will increase the overall explanatory power of the regressions. More informally, their addition may improve the fit of the regressions at certain critical turning points.

Table 1 presents the results of the regressions. The first regression relates nominal GNP growth to nominal M2 growth. The long-run stability of M2 velocity is upheld--the constant term is effectively zero, and in the long run a sustained 1 percentage point increase in M2 growth will result in a 1 percentage point increase in nominal GNP growth.

The second regression adds a distributed lag on the real federal funds rate to the first equation. The real funds rate is measured on an ex post basis as the nominal rate less the contemporaneous rate of increase in the GNP implicit price deflator. The sum of the coefficients on the real funds rate is less than zero, which suggests that the level of the real rate has a long-run restraining influence on the growth rate of current-dollar spending.[10]

The third regression adopts the idea that fluctuations in the real federal funds rate within "normal" bounds give no particular signal for the course of the economy. In the specification adopted, levels of the real funds rate between 0 percent and 6 percent are constrained to have no effect--the distributed lag is solely on the outlying values of the real funds rate (an alternative range of 0 percent to 4 percent had an inferior fit).

This specification accords with some views of the role of interest rates in intermediate targeting that were advanced in the early 1980s, both within and without the Federal Reserve system (Hester 1982 and Walsh 1982). Two episodes may have sparked this interest. In the late 1970s, real ex post short-term interest rates were generally negative. At the same time, the growth of the monetary aggregates was generally above target, and inflation accelerated. During much of the 1981-82 recession, despite strong growth of the monetary aggregates, real ex post short-term interest rates were extremely high and the economy contracted sharply. The differing response of the economy to rapid money growth in the two episodes could have been the result of many factors, but the very different real interest levels suggest something straightforward for the Federal Open Market

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[10]The regression was also estimated using the level of the nominal funds rate and the changes in both the nominal and real funds rates. The specification using the level of the real rate had the lowest standard error of estimate.

Table 1

GNP Growth Regression
(Estimation Period 1963-I to 1986-IV; Standard Errors in Parentheses)

	Nominal GNP Growth			Real GNP Growth		
	(1)	(2)	(3)	(4)	(5)	(6)
Nominal M2 growth	.985 (.0472)	1.105 (.0556)	1.017 (.0449)			
Real M2 growth				.895 (.0920)	1.009 (.117)	.918 (.0911)
Real federal funds rate		-.566 (.169)			-.276 (.170)	
Extreme real funds rate			-.912 (.274)			-.548 (.267)
Standard error	4.178	3.945	3.909	3.809	3.794	3.708
Durbin-Watson	1.779	1.984	2.070	1.907	1.973	2.070

Notes: M2 coefficients are sums of twelve-quarter second-degree polynomials with a far period constraint. Federal funds coefficients are sums of twelve-quarter second-degree polynomials.

Committee (FOMC) to observe. Thus, these authors suggested that the monitoring of real short-term interest rates might be used as a sort of "firewall" to prevent an egregious outcome: when real short-term rates breach the preset bounds the FOMC should override any constraints placed by aggregate targets and instruct the Desk to bring the real funds rate back into the normal range.

The specification that includes only the extreme real funds rates has the smallest estimated standard error of the three--in other words, all the explanatory power that the real funds rate adds to M2 growth comes from the outliers. Equations 4, 5, and 6 repeat the first three specifications but substitute real GNP and M2 growth for the current-dollar growth rates. The results for the real growth equations are qualitatively similar to those from the current-dollar equations: the real funds rate adds explanatory power to real GNP growth, over and above that given by real M2 growth, with the extreme real funds rate observations providing the explanatory power.

The extra explanatory power given by the real funds rate seems small--a matter of a few tenths of 1 percent on the standard errors of the regression. However, especially in the specifications including only the extreme real funds values, the additional fit makes a major difference in tracking economic growth at certain times. Charts 1 to 4 show the actual and predicted values for real and nominal GNP growth for two important periods: 1977-79 and 1982. They show that there was a tendency for M2 growth to underestimate real and nominal growth in the late 1970s[11] and to overestimate real and nominal growth in 1982. The equations with the real rate added, particularly those with only the extreme values admitted to the specification, do a better job of tracking the economy in these periods.[12]

The upshot of this empirical exercise is that there may well be value in monitoring real interest rates within an aggregate intermediate targeting framework. Periods in which real short-term rates go beyond "reasonable" bounds do appear to be those in which the M2-GNP relationship weakens.[13] Thus, it may be worthwhile to structure the nominal funds rate proviso in the open market directive to the Desk to keep the monitoring range for the nominal funds rate at least within the extreme ranges for the real funds rate. For instance, if the inflation rate can be reasonably forecast at around 5 percent for an intermeeting period, the monitoring range for the funds rate could be set within 5 percent to 11 percent, subject to incoming information on inflation. This strategy should keep the real funds rate within the normal bounds of 0 percent to 6 percent.

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[11]The substantial underestimate of growth in 1978-II reflects abnormal growth in that quarter as the economy sprang back from an unusually severe winter.

[12]Chow tests were performed to test whether any of these regressions show a break in specification between the third and fourth quarters of 1979. In all cases the hypothesis of changed coefficients could be rejected at a 5 percent level. Before the 1980s, the only cases of "extreme" real federal funds rates were those with negative rates. The hypothesis that real or nominal growth reacts differently to negative and positive extremes in the real funds rate could also be rejected at a 5 percent level for the whole sample period.

[13]These results appear roughly consistent with what might be predicted by money demand considerations. In 1977-79, nominal interest rates were rising, a development which would normally suggest an increase in M2's velocity, so it is not a surprise to find that M2 growth, unadjusted for rate effects, underpredicts nominal GNP growth. In 1982 nominal rates fell, suggesting a decline in velocity and an overprediction of nominal GNP growth for an equation relying solely on M2 growth. However, the regressions estimated here are intended to make the point that extreme real rate levels can provide a clear signal to modify growth targets; they are not intended to provide the detailed explanation of velocity that can come from a full-blown money demand function.

Chart 1

Nominal GNP Growth

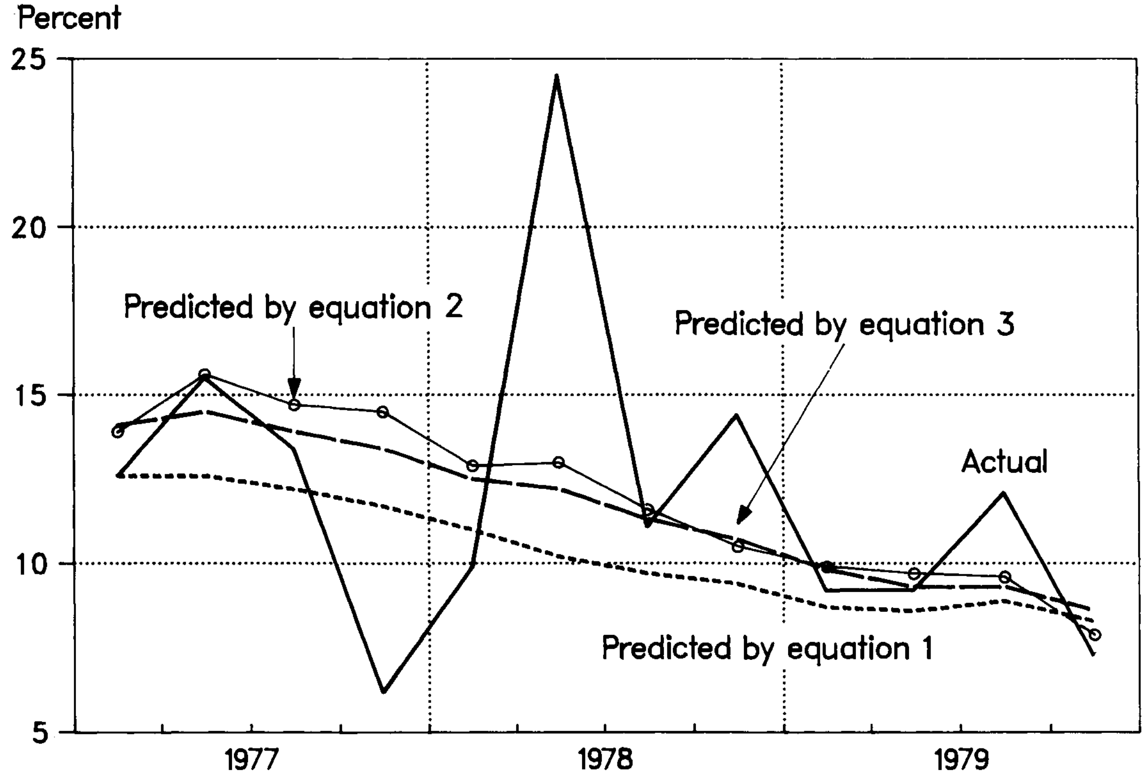


Chart 2

Real GNP Growth

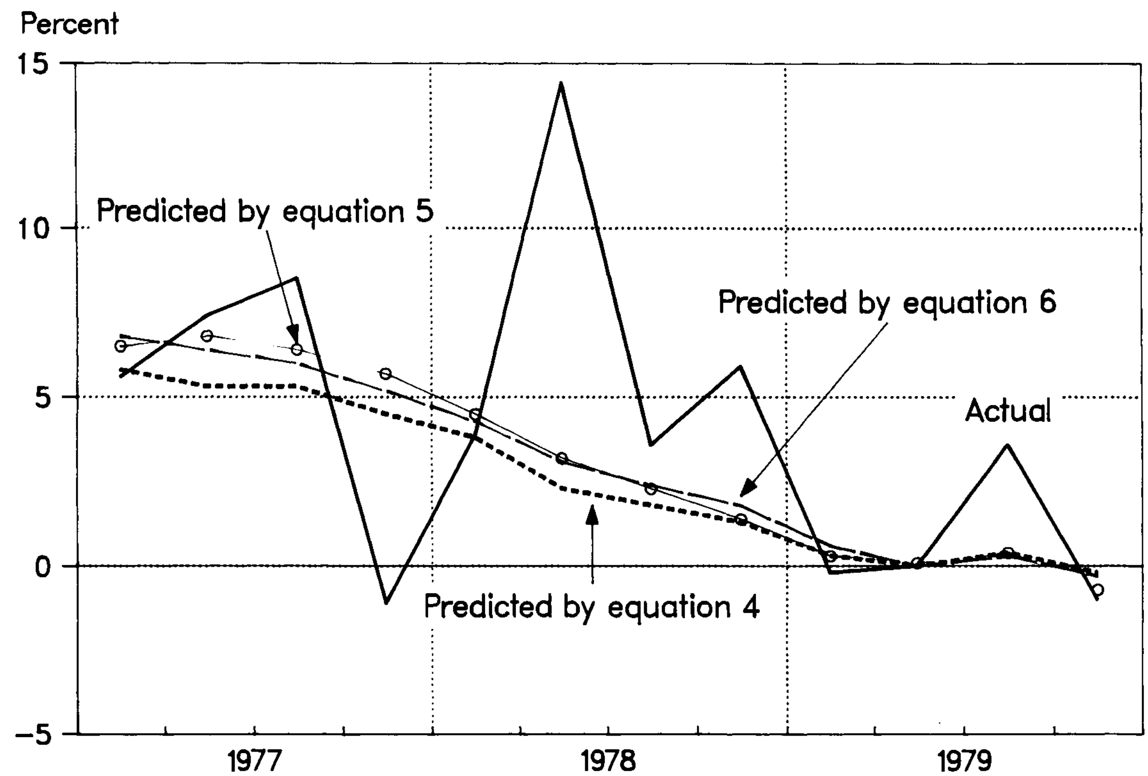


Chart 3

Nominal GNP Growth

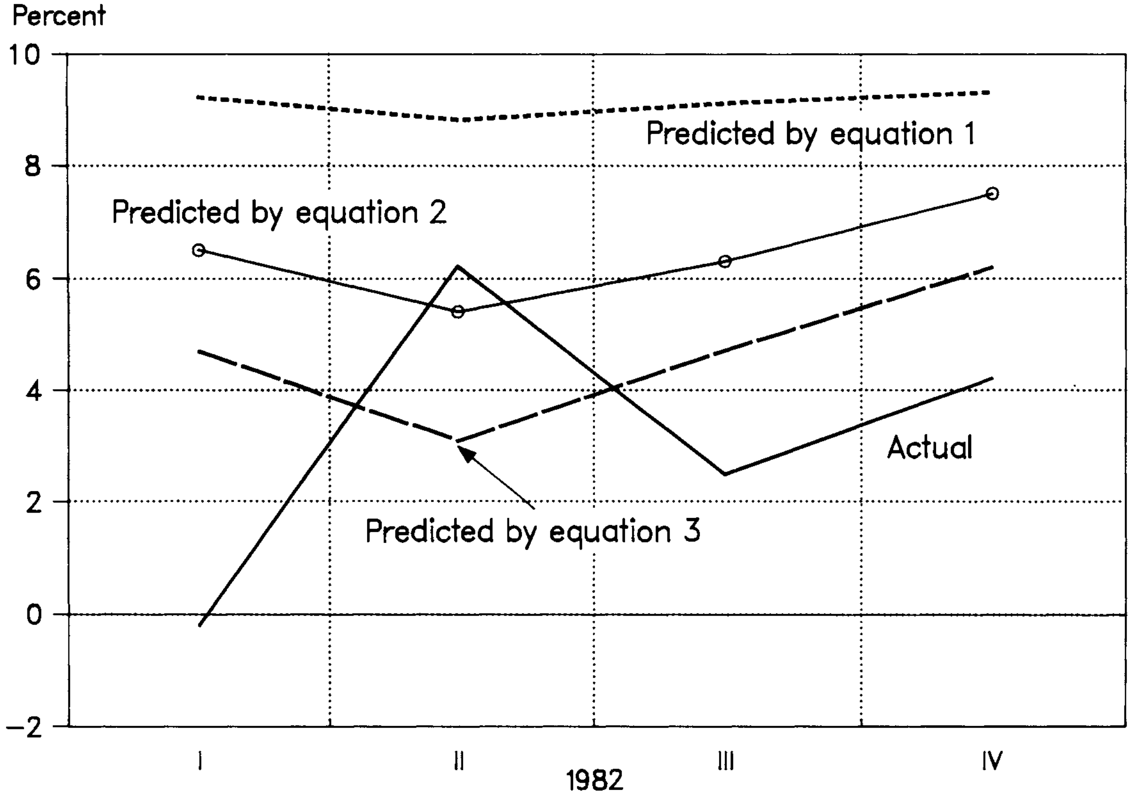
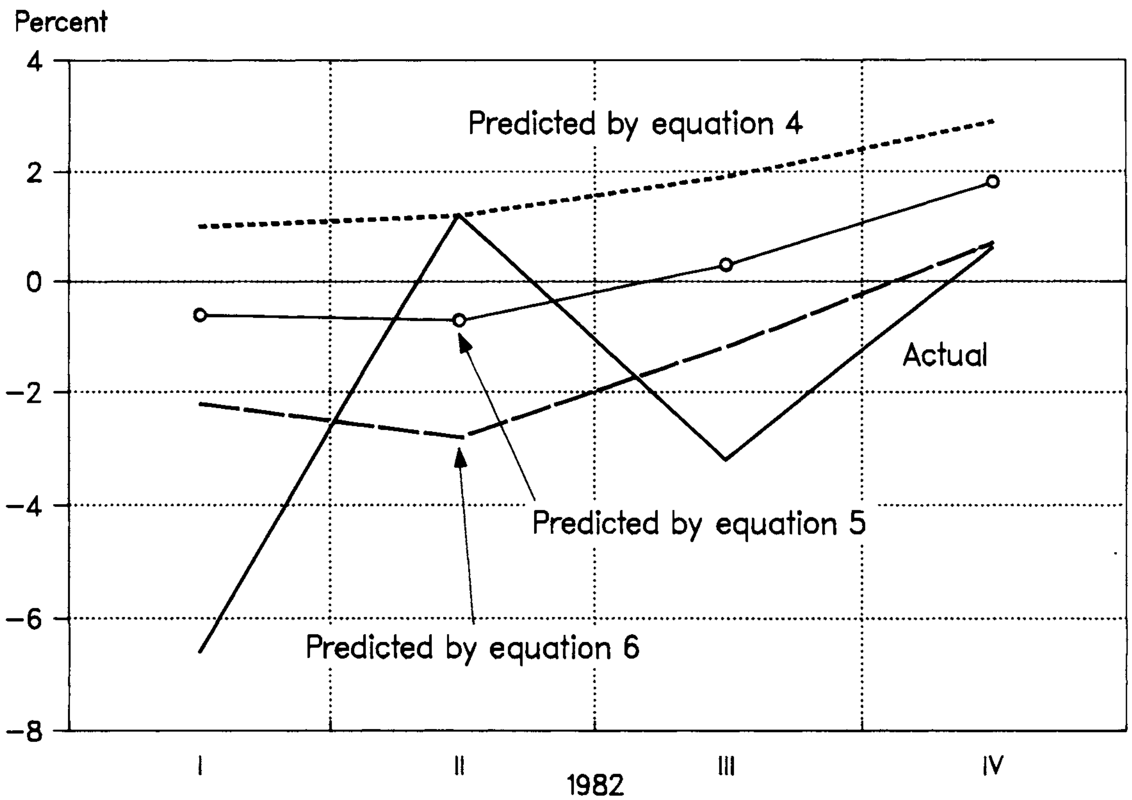


Chart 4

Real GNP Growth



F. Summary of Findings on the Intermediate Targeting of Interest Rates

There is a tension between the ability of the monetary authorities to influence interest rates and the influence of interest rates on economic activity and inflation. Open market operations can be expected to have a well-defined effect on short-term nominal interest rates and probably to have some fairly stable relationship to real short-term interest rates, but they bear a very problematic relationship to nominal and real long-term interest rates. The major channels through which interest rates influence real output appear to run through changes in long-term real rates. Moreover, the relationship of interest rates--real or nominal, short- or long-term--to inflation and nominal output is at best complex and convoluted. The inability to control the rates most critical for real output, the instability of the link between interest rates and output, and the weakness of the link between interest rates and inflation imply that interest rates should not be the primary intermediate targets of monetary policy.

However, empirical evidence suggests that real interest rates (and perhaps nominal rates as well), even at the short end of the maturity spectrum, contain information about the economy that is not captured in the movement of monetary aggregates. This finding suggests that there is value in monitoring interest rates as information variables in a monetary targeting framework. Short-term real interest rates would appear to fit well into such a setup.

Such a dual targeting procedure accords well with some of the recent theoretical literature on the relative merits of aggregate and rate targets. The next section of the paper reviews some of this literature.

G. Modern Theoretical Literature

The modern theoretical literature on the choice between aggregate and rate targets stems, to a large extent, from William Poole's seminal 1970 article.[14] As mentioned above, Poole worked with a standard fixed-price IS and LM model with only one interest rate and one monetary aggregate, variables which the monetary authorities can control perfectly. The structure of the IS curve and the LM curve are known, except for random shocks of zero means and known variances.

In Poole's model the monetary authority's goal is to minimize the variance of real GNP around a predetermined optimal level. The authority can, at any point in time, control either the money supply or the interest rate but can not simultaneously control both. Poole showed that the

[14]Robert Holbrook and Harold Shapiro (1970) and John Karekan (1970) made many of the same points as Poole.

optimal procedure generally involves systematically varying the money supply in response to observations on the interest rate. If the LM curve is stable, the optimal schedule reduces to pegging the money supply at the level that will produce the interest rate expected to yield the GNP objective, given the structure of the IS curve.[15] If the IS curve is stable, the optimal policy is to peg the interest rate at the level consistent with the GNP objective.

The extensive work of James Tobin and his colleagues on the money transmission mechanism and the structure of financial markets (Tobin and Brainard 1963; Brainard 1964; Tobin 1969, 1978) does not directly deal with the issue of intermediate targeting but illuminates some of the issues involved in choosing between aggregates and rates as targets. One thrust of Tobin's work is that given a complex financial structure, where financial instruments (including ownership claims for physical capital) can substitute for one another, it is exceedingly difficult to single out any particular financial aggregate or interest rate as having a well-specified relationship to real economic activity.[16] Although Tobin does not focus on the issue, this result suggests the possibility that a targeting setup combining aggregates and rates may be superior to targeting either alone.

Franco Modigliani and Lucas Papademos (1980) combined the insights of Poole's and Tobin's approaches. In their model, a financial system consisting of a multiplicity of financial assets, somewhat like Tobin's, interacts with a structure of real demands for goods and services (also see Tobin 1982). As in Poole's model, the equations of the Modigliani-Papademos model are subject to stochastic disturbances, and the authors consider the issue of choosing the optimal instrument to target.

The Modigliani-Papademos paper reaches no firm conclusion; the criteria for choosing intermediate targets depend upon a maze of structural parameters and variances about which little can be known or reasonably speculated. Thus they conclude, "The choice among the alternative intermediate targets becomes a substantive problem in the presence of uncertainty" (p. 152).

All of the above models ignore the generation of inflation and inflation expectations. They implicitly assume that the Desk is able to monitor real interest rates and is able to measure the impact of proposed actions on inflation expectations. In contrast, the literature on rational expectations

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[15]Because of the stochastic nature of the IS curve, the actual interest rate realized will differ from the expected interest rate.

[16]"In this complex situation, it is not to be expected that the essential impact of monetary policies and other financial events will be easy to measure. . . .There is no reason to think that the impact will be captured in any single exogenous or intermediate variable, whether it is a monetary stock or market interest rate" (Tobin 1969).

explicitly allows inflation expectations to reflect anticipations of monetary policy.

The classic paper in this tradition was written by Thomas Sargent and Neil Wallace (1975). Sargent and Wallace argued that a policy of nominal interest rate targeting, ignoring monetary aggregates, will result in an "undetermined" price level.

Sargent and Wallace's nominal interest rate targeting policy consists of a feedback mechanism relating the interest rate objective to observations on final goals. Monetary policy in this world consists of varying the monetary base to keep the interest rate at its targeted level. The assumption of rational expectations, however, means that the private sector knows the monetary policy rule and that the difference between actual and expected prices would be due only to stochastic errors. Sargent and Wallace also assume that the real interest rate is given, up to some stochastic error.

These assumptions lead to the conclusion that the economic system can operate at any price level. The combination of knowledge of the central bank's interest rate rule and a fixed real interest rate allows the private sector to make a rational estimate of the expected rate of inflation. Any price level today can be consistent with that expected rate of inflation. The Sargent-Wallace model will pin down a real money supply (the ratio of the nominal money supply to the price level), but this does not pin down the price level, because given the interest rate rule, the nominal money supply can assume any value.

Recent work, however, has shown that a policy of combining nominal interest rate and monetary targeting will not lead to the troubling Sargent-Wallace result, even while maintaining the hypothesis of rational expectations. Several authors have demonstrated that a policy of targeting the nominal rate in the short run combined with a policy of targeting the money supply in the long run can be made consistent with an arbitrary degree of short-term smoothness in interest rates while maintaining a deterministic price level (Parkin 1978; Canzoneri, Henderson, and Rogoff 1983; McCallum 1981 and 1986; Dotsey and King 1986; Goodfriend 1987; VanHoose 1989 and Barro 1989).[17]

The key assumption of these models is that future levels of the money supply are on a predictable path. If the private sector can forecast the future level of the money supply, it can forecast

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[17]James Hoehn (1987) claims that these sorts of policies are simply special cases of money stock targeting. Strictly speaking, he is correct, but this seems to be a rather fine distinction; a money stock rule related to the nominal rate is a rather different animal than one related solely to final goals. The papers in Porter (1990) demonstrate how, theoretically, interest rate targets may be constructed under a variety of assumptions and goals.

the future price level, and if it can forecast the future price level, it can pin down today's price level (from the expected inflation path).

In most of these models, the desirability of smoothing nominal interest rates is assumed, along with inflation control, to be one of the final goals of monetary policy. In the paper by Canzoneri, Henderson, and Rogoff (which may be viewed as an extension of Poole's work to a flexible-price, rational expectations model), the monetary authorities are attempting to control real output and inflation; they show that under a number of alternative assumptions about price-setting behavior by private agents it would be optimal for the monetary authority to use nominal interest rates as information variables to change aggregate targets.

All these rational expectations models are highly stylized, but they show that nominal rates may be successfully combined with aggregates in an intermediate targeting system as long as long-run control of the aggregates is maintained to provide the system with a "nominal anchor."

In conclusion, the theoretical literature surveyed here tends to be skeptical of the notion that targeting monetary aggregates alone, and ignoring interest rate fluctuations, will be an optimal policy.[18] This literature does not yield much in the way of practical suggestions for the implementation of policy. The Poole model would suggest combining aggregate targets with real interest rates, while the rational expectations literature suggests combining aggregates with nominal rates, and neither group pays much attention to the yield curve. Nonetheless, this body of work indicates that it is sensible to pay attention to interest rates in evaluating the movement of aggregates.

II. Interest Rates as Operating Targets

The preceding portion of the paper dealt with the issue of intermediate targeting, in part in terms of rates versus aggregates. A separate, if somewhat similar, set of issues exists in the operating target area: Should the Federal Reserve use interest rates or the elements of the monetary base to

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[18]There are some unconventional arguments that bear on the issue of nominal rate targeting. Public choice considerations suggest that nominal rate targeting is inadvisable, simply because nominal rates are so visible (Kane 1980, 1983). If the authorities acknowledged using nominal rates in intermediate targeting--whether as the sole targets or blended with others--sharp public pressure might be focused on every movement on rates, and pressure would be exerted to keep rates low.

In contrast, the time-consistency literature seems to suggest that nominal rate targets have some desirable properties. As discussed in Steven Englander's paper in this volume, "Optimal Monetary Policy Design," policy objectives stated in terms of easily grasped and monitored targets are desirable in their own right. The credibility policy makers gain by adhering to a fixed nominal (or ex post real) interest rate target may overcome other problems with such a policy.

control an aggregate intermediate target? In this discussion, the rates in question have almost always been short-term nominal money market rates, most notably the federal funds rate.

A simple example where rates are good operating targets is a world where the intermediate target is a monetary aggregate, the demand for which is completely explained by the federal funds rate and lagged nominal GNP. The targeted level of the aggregate for a quarter, in combination with the value of nominal GNP in the previous quarter, yields a level of the funds rate that may be used as an operating target. In this world, Desk operations would consist of adding or subtracting reserves or adjusting the discount rate to peg the funds rate at the optimal level for the quarter.

In reality, of course, the operational use of interest rates would never be so simple. Some problems stem from uncertainties in money demand--uncertainties arising from questions of specification (such as which interest rates belong in a money demand function), stochastic shocks to demand, shifts in the structure of money demand, and imperfect observations of factors affecting money demand. These uncertainties mean that interest rate control alone will not ordinarily be sufficient to achieve satisfactory control of the targeted aggregate. As a general rule, the optimal control procedure would consist of the Desk varying its provision of reserves in response to interest rate signals (Pierce and Thomson 1972; LeRoy 1975, 1979; LeRoy and Waud 1977; Bryant 1983; Axilrod and Lindsey 1981; and Dotsey 1989).[19]

This technical point may be misunderstood. Defending the usefulness of partial or total control of some money market rate in helping to control a monetary aggregate is *not* equivalent to defending the intermediate targeting of interest rates. In the money control problem, interest rate movements can be used to provide information about the near-term growth of the aggregates rather than the economy.[20]

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[19]The optimal schedule depends in part on the relative variances of the public's demand for money and the banking system's demand for reserves. If reserve demand is highly uncertain, then the optimal policy is to peg the interest rate affecting money demand at the level consistent with the optimal money stock, given the structure of the money demand equation--the quantity of reserves would increase with interest rates. If money demand is highly uncertain, the optimal policy is to vary reserve supplies inversely with interest rates, in order to maintain the combination of reserves and interest rates suggested by the structure of reserve demand that will keep the money supply at its optimal level.

[20]Obviously, anything which provides information about the intermediate target also provides some indirect information about final goals. However, in a formal intermediate targeting framework this information might be disregarded. The inefficiencies of ignoring additional information about final (continued...)

Even if the questions about the structures of money and reserve demands are answered, problems arise in the selection and use of an operational rate instrument. The ideal rate to target is one that is closely associated both with the demand for the aggregate and with reserve demand and that is also subject to Desk control. The federal funds rate is not perfect for this use, despite the Desk's ability to exert great control over it, because the association between the funds rate and the demand for any of the usual aggregates is rather indirect. The theoretically correct rate relevant to money demand measures the opportunity cost to households and businesses of holding money, as opposed to other assets. A plausible proxy for this ideal rate might be the spread between the three-month Treasury bill rate and deposit rates (when the money aggregates in question are M1, M2, or M3). Open market operations--which are usually carried out in the bill market, either for outright purchases or sales or in the form of repurchase agreements (RPs)--do affect the bill rate, but the relationship between the funds rate and the bill rate can vary unpredictably.[21] Moreover, in today's world of deregulated interest rates, deposit interest rates may move in hard-to-predict ways with the funds rate. Thus, the funds rate may be a poor control variable for the monetary aggregates, since its relationship to the opportunity cost of holding the aggregates could be unpredictable.

Even if interest rates are not used as formal instruments to control intermediate targets, they can play a role in the operation of monetary policy. Unlike data on financial stocks and flows, interest rate data are available continuously and can be used to gather information about operational targets less frequently observed. The federal funds rate, for instance, has been and can be used to get a sense of the strength of the demand for reserves during a maintenance period.[22]

In general, interest rates may have a useful role in the control of intermediate aggregate targets. Uncertainties in the demand for aggregates and the inability of the Desk to tightly control the opportunity cost of holding aggregates make it inadvisable to use rates as the only operating instruments. At the same time, however, these uncertainties make it inadvisable to ignore the

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[20](...continued)
goals in a rigid intermediate targeting system have been described by John Karekan, Thomas Muench, and Neil Wallace (1970) and Benjamin Friedman (1975, 1977).

[21]An example of such a break in the funds-bill relationship was the exceptionally low rates on bills on a number of occasions in the summer of 1987, as recurrent federal debt ceiling crises resulted in cancellations of a number of weekly bill auctions and technical shortages of bills in the marketplace. See Federal Reserve Bank of New York, Open Market Analysis Division (1988).

[22]This procedure will be discussed in more detail below.

information contained in rates. Interest rates also have a useful supplemental role in providing very high frequency information about other operating instruments.

III. Past Experiences with Rate Targeting[23]

The Federal Reserve System has often made explicit use of interest rates in the policy process. The System's most explicit and prolonged experience with rate "targeting" was, of course, during the rate pegging period of the 1940s. The policy was simplicity itself: the Desk stood ready to buy government securities to prevent nominal rates breaching ceilings. The secondary market yield on three-month bills was maintained at 0.38 percent for the entire period from the spring of 1942 through the middle of 1947, then increased in steps to about 1 3/8 percent by the start of 1951. The yield on U.S. long-term bonds never rose above 2.49 percent during the entire 1942-50 period and dropped as low as 2.08 percent in early 1946.

The initial aim of the pegging policy was to aid in the financing of World War II: since the peg put a floor on government securities prices, it enabled the Treasury to calculate accurately the minimum nominal proceeds and maximum interest expense of debt issues.[24] It is hard to view the peg as either an operating or an intermediate target, because there was no explicit linkage of the peg to the behavior of any financial or economic variable. Nevertheless, the gradual increase in the short-run peg in the postwar period did reflect some concern about inflation, and therefore the peg may best fit into the intermediate target framework.

Perhaps the most interesting developments of the pegging era were the Desk's ability to stabilize both short- and long-term rates and the maintenance of the pegs through the early postwar period. Because inflation rates were high in the late 1940s after price controls ended, ex post real interest rates were negative. During this period, postwar federal surpluses reduced the supply of Treasury issues, and long-run inflation expectations were probably held down by a number of factors, such as fears of a postwar depression, the long-term U.S. history of price-level stability, and the

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[23]For some general overviews of this subject, see Milton Friedman and Anna Schwartz (1963), Ann-Marie Meulendyke (1988, 1990), and Larry Mote (1988).

[24]The modern perspective would argue that the Treasury should have been concerned with the real proceeds and real interest expense of the issues. A nominal peg would not necessarily reduce this uncertainty, since the inflation rate would continue to be uncertain. However, the interaction of the nominal rate peg with effective price controls during World War II meant that the Treasury could implicitly calculate the real proceeds and real cost of debt issues, at least for the short run.

continued connection of the dollar to gold.[25]

The pegged structure of rates came under increasing pressure after the start of the Korean War, as government debt expanded again, inflationary pressures increased, and depression fears faded. The pegging policy was abandoned with the 1951 Federal Reserve-Treasury Accord.

The pegging experience would seem to have few lessons for today--for instance, fears of a severe depression are not likely to emerge as major elements in the financial markets. Nonetheless, the ability of the System to cap rates (both short- and long-term) for nearly a full decade, with the economy showing little sign of exceptional instability, provides some challenge to the more dogmatic rational expectations view discussed in the section on recent theoretical targeting models.

In the generation following the accord, the System tended to avoid policy adjustments in the periods surrounding Treasury refundings--a policy known as "even keeling" (see Axilrod 1971; Kaufman 1973; and Struble and Axilrod 1973). For practical purposes, this meant that the Desk tried to prevent policy from influencing interest rates from the time the refundings were announced until the issues were distributed (interest rates could and did fluctuate for other reasons during these periods).

During the period of even keeling, the Treasury sold coupon issues through subscriptions. A coupon and minimum price were preannounced, and the issues were allocated to the highest bidders. If market interest rates rose following the issue announcement, there was the chance that the issue could fail (the Treasury would not be able to sell the full amount of the issue at the announced coupon), while if rates rose between the time of the auction and the distribution, successful bidders would suffer capital losses. The even keel helped to prevent both of these events; in effect the Federal Reserve was acting as the Treasury's underwriter.

The even keeling policy ended in the early 1970s. The Treasury switched to the current coupon auction procedure, which effectively eliminates the possibility of a failed auction. The increased frequency of coupon issues as the government debt rose may have also increased the likelihood that keeping an even keel would hinder the conduct of basic monetary policy. Furthermore, the increasing liquidity of the government securities market enabled purchasers to sell off exposure in the secondary and derivative markets between the time of auction and distribution.

The even keel approach treated rate stability as a target, with the successful sale of the Treasury issue as the goal. There was some criticism that the procedure may have hindered the Desk's

[25]Karl Brunner and Allan Meltzer (1966, 1989) discuss the pegging experience and its relationship to debt management and monetary policy. Barry Eichengreen and Peter Garber (1990) put the episode in a modern theoretical framework.

ability to control the aggregates, but hard evidence that this was the case is scant (Struble and Axilrod 1973). Given today's very different Treasury auction procedures, this experience offers few direct lessons, but it does illustrate effectively the importance the System has at times placed on limiting interest rate volatility.

In the early 1960s many believed that a flatter yield curve would be desirable. Lower long-term interest rates would supposedly help to increase U.S. capital spending, while higher short-term rates would supposedly attract foreign investment in dollar assets and ease balance of payments problems. To help flatten the yield curve, the System made some efforts to lengthen the maturity of its portfolio ("operation twist").

In practice, the "twist" policy was not strongly pursued. Yield curve considerations were by no means the only factors then governing Desk actions, and analysis suggests that the policy had little effect on the yield curve (Modigliani and Sutch 1966). Conceptually, though, operation twist may be viewed as intermediate targeting. A target (a reduced spread between short- and long-term rates) was chosen as a stand-in for ultimate goals (faster capital formation, increased foreign willingness to hold dollars), and policy was at least partly directed at the target.

The most sustained and systematic use the System has made of interest rates in the last generation has been the role of the federal funds rate as either an outright operating instrument or a guide to Desk operations. During the 1970s, following a period when operations were directed toward affecting credit market conditions (which were in turn believed to be heavily influenced by short-term nominal rates), the Desk tended to peg the funds rate in a narrow range during intermeeting periods. The desired funds range was an operating target supposed to be consistent with the desired growth rates of the monetary aggregates, which were the primary intermediate targets (Axilrod and Lindsey 1981). The usefulness of this type of procedure was discussed above in the section on operating instruments.

This operating policy changed in October 1979. Nonborrowed reserves replaced the funds rate as the primary operating instrument. (The FOMC continued to post ranges for the funds rate in its directive, but these were many times wider than the earlier ranges, applied only to weekly averages, and viewed as signals for consultation, rather than as binding constraints on the Desk.) The view at the time was that high and variable rates of inflation had downgraded the value of interest rates as control variables for the aggregates: the optimal level of the funds rate for monetary control had become excessively volatile and hard to compute.

In 1982, a deep recession, coupled with problems in various parts of the financial system, persuaded the FOMC that the observed strong growth of the monetary aggregates, particularly M1, was not providing a correct signal about the future course of economic activity. The ongoing introduction of variable interest rate accounts had led to large, unpredictable swings of funds into and out of the various aggregates.[26] In these circumstances, the FOMC downgraded the aggregates (especially M1) as intermediate targets, in favor of placing more emphasis on direct observation of economic indicators.

Although interest rates have gained no further role as formal intermediate targets, they have become more important on an operating level (Wallich 1984). With less emphasis placed on control of the aggregates, the Desk has tended to allow short-term shocks to reserve demand to be absorbed by fluctuations in the volume of nonborrowed reserves--the level of borrowings has been viewed as a key operating target. The borrowings target, coupled with the discount rate, suggests a likely range for the federal funds rate during a reserve maintenance period. (The FOMC directive includes a wider monitoring range for the entire intermeeting period.) A tendency for the federal funds rate to breach the top end of such a range, along with high levels of borrowing, implies that reserve demand may be fundamentally stronger than anticipated. If this strength is coupled with unusually strong economic data or rapid growth of the broader aggregates, the FOMC may decide to increase the degree of pressure on reserve markets by raising the borrowings objective or the discount rate.

Thus, under procedures adopted in 1983, the federal funds rate has been used to provide information for setting operating targets. It has not been used as the primary operating instrument, as it had been before 1979, but it has been viewed as a useful indicator of the demand for reserves. In recent years, particularly since the 1987 stock market crash, the relationship between borrowings and the funds rate appears to have shifted or to have become more uncertain than it was previously. In these circumstances, the Desk has often given increased weight to the funds rate in operations and lesser weight to the borrowings target, particularly at times when the markets were sensitive to potential policy shifts.

In sum, the history of interest rates in the formal monetary policy process has been tangled. There has been a gradual evolution away from treating rate levels as either ultimate goals of policy or intermediate targets for final goals. However, the System continues to put weight on interest rates as indicators of reserve market pressure.

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[26]These large shifts of funds ended after the introductory period for the new accounts. However, the changes in the financial system meant that the demand for the aggregates became more sensitive to various interest rate spreads (John Wenninger 1986).

IV. Conclusions

There is little or no reason to believe that using interest rates as the only intermediate targets of monetary policy is desirable. While the Desk can exert great control over nominal short-term interest rates and can probably exert strong influence over short-term real interest rates, its ability to influence nominal and real long-term interest rates in a predictable way is problematic (even assuming that real long-term rates can be observed on an ex ante basis). Since it is generally believed that fluctuations in real long-term interest rates exert more influence on real economic activity than movements in alternative types of rates, interest rate targeting cannot reliably achieve a real output goal. The likely instability in the relationship between interest rates and real output further weakens the case for interest rate targeting.

The relationship between interest rates and inflation is particularly uncertain. In principle, the implications of rate moves for inflation may be derived from their implications for real growth, but making such inferences adds another potentially weak link to an already weak chain.

The empirical literature concludes that real long-term interest rates (and perhaps nominal short-term rates as well) do lead real output movements and ultimately inflation, but the relationship is unstable. It may be possible, however, to use interest rate movements as supplemental information variables in an aggregate targeting system. Some limited empirical evidence suggests that ex post real short-term interest rates would be useful in this context. Such a targeting system seems to be in rough accord with some of the recent theoretical discussion.

The role of interest rates as operating targets is more clearcut than their role as intermediate targets. Under the current operating procedure, the federal funds rate provides information about conditions in the reserve markets.

The System has at times brought interest rates into the forefront of policy making, most notably in the rate pegging period during and after the Second World War, and to a much more limited extent during "operation twist" and in the 1970s, when the federal funds rate acted as the main operational tool. Inflationary pressures led to the end of pegged rates and contributed to the downgrading of the funds rate in 1979 (the funds rate has been more important operationally since 1983). It is likely that unless rate targets are highly flexible, any explicit rate targeting system, on an operational or intermediate level, that ignores the information provided by reserve, money, and credit aggregates would also fall victim to inflation.

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COMMODITY PRICES AS INTERMEDIATE TARGETS AND INFORMATION VARIABLES

Spence Hilton

Commodities have played a central role in many monetary systems through history. Perhaps the most notable commodity-based monetary regime was the international gold standard upon which many countries based their economies until early in the twentieth century. Since that time, commodities have played a greatly reduced role in monetary policy. Recently, however, there has been a revived interest in using commodity prices to help guide monetary policy, but within the general framework of the current monetary structure. This study reviews current arguments and evidence on the use of commodity prices in monetary policy. The principal focus is on the information content, or leading indicator properties, of commodity prices, although some consideration is also given to the usefulness of commodity prices as an intermediate target variable. The discussion is organized into four major parts. First, the various possible uses of commodity prices in monetary policy are examined, beginning with a brief comparison of commodity standards, commodity price targets, and commodity prices as information variables. A simple theoretical examination of the implications of adhering to a price target is included. Second, the behavior of commodity prices is reviewed. The underlying determinants and several key behavioral characteristics of commodity prices are examined, with particular attention given to the reasons that commodity prices might be a leading indicator of economic developments. Empirical evidence on the leading indicator properties of commodity prices, much of which is of recent vintage, is critically reviewed in a third section. A final section discusses the ability of the monetary authorities to control commodity prices.

I. The Role of Commodities in Monetary Policy

This study considers only proposals to utilize commodity prices in the context of the existing financial framework--that is, where monetary policy is implemented using conventional instruments of control, such as open market operations in government securities, within the current regulatory and structural environment. Excluded are proposals that call for a return to a commodity standard. However, a commodity standard is the historical forerunner of proposals to use commodity prices as a target or leading indicator, and despite many institutional differences, there are underlying similarities in the way these different regimes transmit economic disturbances. The essential ingredients of a commodity standard are briefly reviewed, and then recent proposals to use an index of commodity prices as an intermediate target or as an information variable are described. Some implications of using price targets in monetary policy are also examined.

A. Commodity Standards

Under a commodity standard, the currency unit (dollars) is defined as a specific quantity of a commodity or basket of commodities.[1] In principle, any commodity or group of commodities may serve as the underlying resource unit, although historically gold has most often been the basis of a commodity standard.[2] The commodity forming the standard typically has legal tender status, but otherwise any number of institutional arrangements may apply. A practice commonly associated with--but not truly essential to--a commodity standard is for the central bank to intervene directly in commodity markets and to hold commodity stockpiles. In fact, some argue that such intervention can distort important price relations critical to the smooth functioning of a commodity standard, particularly when there are economic disturbances unique to that commodity, by artificially affecting the supply or demand of the commodity.

To its advocates, a commodity standard offers stability in prices and, thereby, stability in real economic activity as well. Aggregate price changes under a commodity standard would be largely the result of shifts in supplies or demand for the commodity relative to total supply and demand. If, say, the commodity constituting the standard becomes more plentiful, then prices for most goods and services will rise in order to maintain the legally defined value of the currency unit. Similarly, if the value of the commodity rises, perhaps because of a supply shortfall, then the general price level will decline.[3]

Proponents of a commodity standard usually argue that the likelihood of price changes arising

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[1]Much of this summary of the workings of a commodity standard is adapted from Hall (1984). See the U.S. Gold Commission (1982) and Bordo and Schwartz (1984) for a retrospective on the gold standard and an evaluation of the possible uses of gold in monetary policy today.

[2]For many years the U.S. dollar was defined as being worth .04838 ounces of gold. Hall (1984) describes how a multicommodity standard might be devised.

[3]Under an international commodity standard, the commodity flows between nations arising from international payments imbalances lead to price level adjustments between countries.

from disturbances affecting relative supplies and demand for the commodity is small when compared with the risk that monetary authorities will pursue inflationary policies under a fiat money regime. Critics respond that the historical record of aggregate price stability under commodity standards is not as good as its advocates suggest. Moreover, as with all monetary regimes, the adjustment of the general price level to changes in the relative value of the commodity can lead to large real economic costs when there exist structural rigidities, such as labor contracts, that fix some nominal prices.[4] Because general price movements under a commodity standard arise largely from the changing relative value of the commodity, a demonstrated stability in this relative price is perhaps the most important characteristic of any commodity chosen to make up the standard.

B. Current Proposals to Use Commodity Prices

Currently, most advocates of an expanded role for commodities in monetary policy suggest using their prices either as an intermediate target or much more commonly as a key information variable, as a way of significantly enhancing the stability of aggregate prices. This section summarizes the main elements of recent proposals to use commodity prices in monetary policy.

Commodity prices as an intermediate target

Under a commodity price target, the central bank attempts to maintain the value of some commodity or basket of commodities within a predetermined range. Unlike a commodity standard, the commodity itself is not legal tender, and the monetary authorities attempt to hit their target by adjusting reserves and interest rates.[5] Most proposals call for targeting an index of "sensitive" commodity prices rather than a single price in order to avoid the complications that can arise when individual commodity markets are disrupted.[6] As an exception, the price of gold is sometimes singled out as a possible target variable. In a variation on direct targeting of a commodity price index, Genetski (1982) proposes to automatically recalibrate the targeted growth range of a money aggregate--the money base--each month, according to a rule based on the rate of growth of an index of

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[4]Hall (1984) argues that when the relative value of a commodity changes, leading to incipient movements in the general price level, the central bank could head off any inflation by adjusting the legal definition of the quantity of the commodity in the currency unit.

[5]Directly intervening in commodity markets is also occasionally proposed as a way to target commodity prices.

[6]Relative price movements and aggregate commodity price indexes are discussed in Section IIC.

sensitive commodity prices.

If the monetary authorities could strictly control the targeted commodity price, then economic disturbances would affect aggregate prices much as they would under a commodity standard. For example, suppose that the central bank hits its targeted level for commodity prices with reasonable accuracy at all times. In this case, general price movements would arise only when the relative value of the targeted commodity changed, as they would under a commodity standard. In the absence of shocks that cause these kinds of relative price changes, a realized commodity price target could contribute to overall price stability.

Most proposals for targeting commodity prices do not detail the time horizon over which these targets should be defined or the circumstances under which they should be changed. Some see commodity price targets as an alternative to intermediate monetary aggregates, suggesting that target ranges covering periods of up to a year would be appropriate. Others emphasize the advantages of targeting a variable whose value is reported daily, indicating that commodity prices might be well suited for a shorter term operational role. This latter possibility, however, seems limited by the volatility of commodity prices even over short intervals (see Section IID). Rarely do these proposals address how target ranges should be revised following relative price movements or changes in real economic conditions during business cycles. Implicit in most proposals is the view that targets should not be modified in order to meet short-term objectives for real variables.

Commodity prices as an information variable

Recognizing some of the practical difficulties in setting formal price targets, many analysts propose to use commodity prices, including gold prices, as an information variable or leading indicator to help guide monetary policy.[7] In this capacity, some index of commodity prices would be carefully monitored because of its historical correlation with aggregate inflation or, sometimes, real output. By anticipating future price movements, commodity prices can provide policy makers the opportunity to combat inflationary pressures at a relatively early stage. Proponents maintain that such a system, properly applied, would ensure overall price stability without being excessively rigid. The current tools of monetary control would be used to implement policy, but there would be no inflexible rule or target value for setting commodity prices or the operating instruments. Instead, the monetary

[7]In this study, the phrase "leading indicator" is used interchangeably with "information variable" to describe a variable that possesses some predictive power for other variables.

authorities would be given considerable leeway in responding to movements in commodity prices, allowing them to react to economic disturbances according to the particular circumstances.

Some proposals would combine the adoption of commodity prices as an information variable with other institutional changes. Angell (1987) proposes a "policy adjustment matrix" for modifying target ranges of a money aggregate on the basis of commodity price behavior but eschews specific feedback rules. Johnson (1988) advocates monitoring commodity prices in conjunction with other sensitive indicators of economic conditions, such as exchange rates and interest rates. Following several sensitive economic measures simultaneously, it is argued, might better enable policy makers to identify the nature of underlying economic disturbances.

Evaluating proposals that recommend monitoring certain variables but do not call for specific policy rules is difficult because it is typically assumed that the judgments needed to correctly apply the proposal will be made. Moreover, to some degree the cental bank's current policy procedure, often characterized as one that "looks at everything," already conforms to these kinds of proposals. In testimony, Chairman Greenspan (1987) indicated that the Federal Reserve already uses information contained in commodity prices in conducting policy, but he stopped short of advocating a more formal role for commodity prices. This review only evaluates proposals that substantially enhance the role of commodity prices in monetary policy.

C. Targeting Aggregate Prices

The maintenance of general price stability is the overriding goal of most proposals to expand the use of commodity prices in monetary policy. Moreover, in most of the proposals it is argued that long-term price goals should not be sacrificed to pursue short-term output or employment objectives. Even the proposed use of commodity prices as an information variable is intended to constrain aggregate price movements. In the extreme, expanding the role of commodity prices in monetary policy may be likened to targeting aggregate prices. This section outlines the implications for real output of economic disturbances when commodity prices are targeted on the assumption that this translates into successfully pegging aggregate prices. The analysis shows that under some circumstances a policy that targets prices could aggravate the impact of economic shocks on real output.

A textbook model of aggregate supply and demand is used in this discussion. The basic model is presented graphically in Figure 1. An upward sloping aggregate supply (AS) curve is used to describe supply relations in the short to intermediate run. A supply function might have a positive

Price Targets with a Demand Shock

Figure 1a

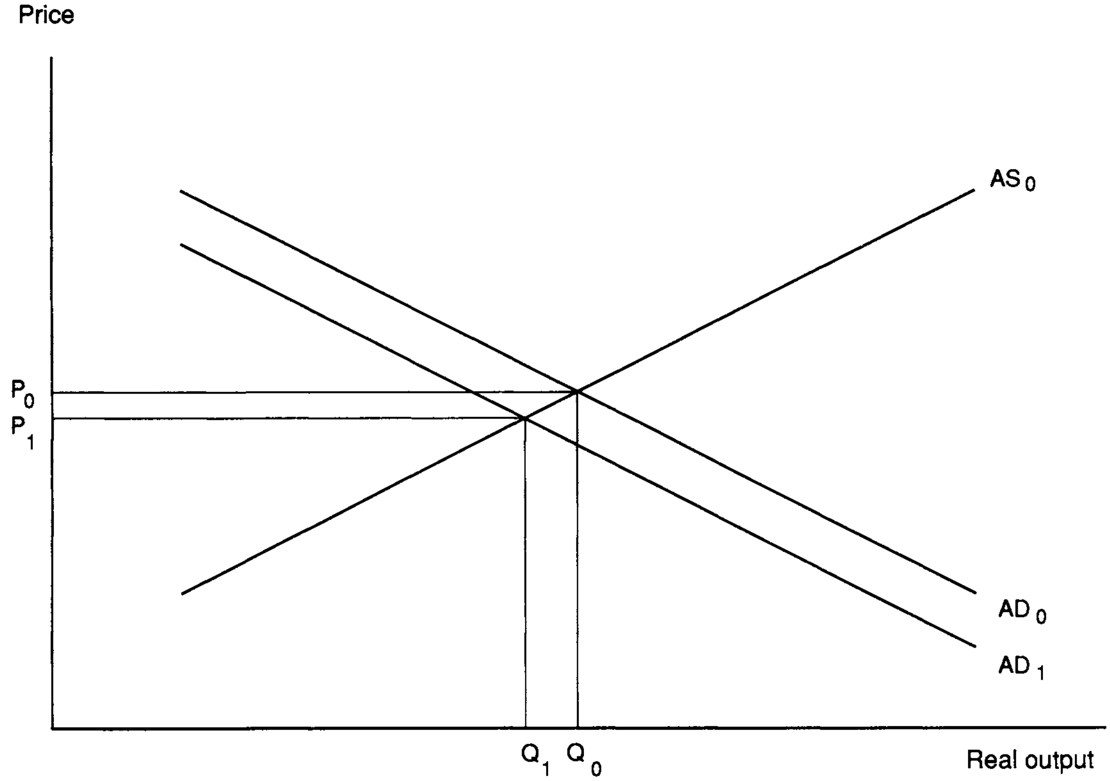
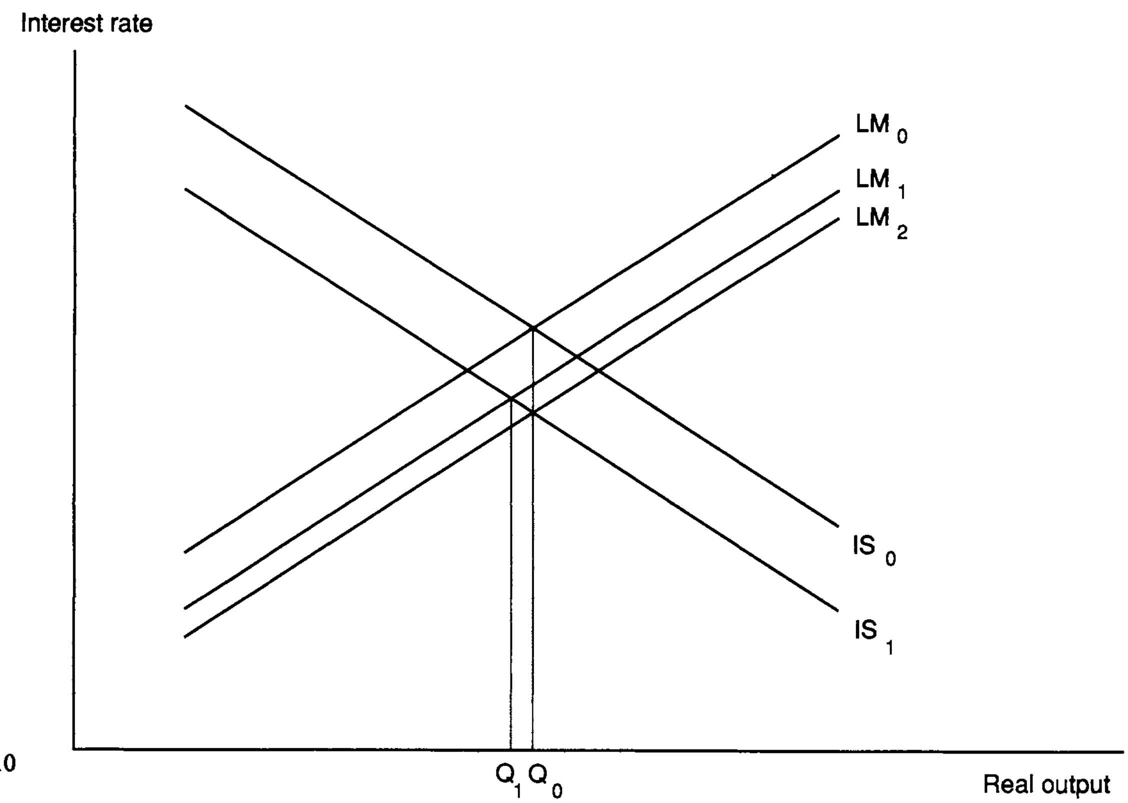


Figure 1b



slope if, say, nominal wages respond with a lag to disturbances that affect the price level. In the long run, the supply curve may be vertical. The downward sloping aggregate demand (AD) schedule is derived from the LM and IS schedules presented in Figure 1b, which describe equilibrium in the goods and the money markets, respectively.[8] In keeping with standard practice, the IS curve slopes downwards while the LM curve has a positive slope. The money stock, which can be used to change the LM curve and thus aggregate demand, is the only instrument of control available to the monetary authorities. When the price level (P) is targeted, the monetary authorities change the money supply following economic disturbances so as to keep prices fixed.

The simplicity of the model obviously limits this analysis. The economic relations are entirely static, and there are no price expectations in the model. In fact, prices themselves play only a very limited role in the underlying behavioral relations represented in the IS-LM framework and in aggregate supply. The mechanism connecting commodity prices to aggregate prices is assumed to be known and stable, allowing the monetary authorities to maintain complete control over commodity price movements. Despite these shortcomings, the framework highlights some of the principal theoretical motivations for targeting commodity prices while also presenting some potential drawbacks.

Under a price rule, aggregate demand shocks corresponding to unexpected movements in the IS and LM curves have no impact on prices and real output. For example, a decline in investment spending will shift the IS curve in Figure 1b from IS_0 to IS_1, lowering real output and interest rates and causing aggregate demand to shift to AD_1. (The resulting change in prices from P_0 to P_1 will lead to a shift in the LM curve to LM_1 through its impact on real money balances.) Under the price rule, the nominal money supply is expanded, shifting the LM curve to the right and returning aggregate demand to AD_0, where prices and real output are restored to their initial levels.[9] Disturbances to the

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[8]The AD curve is derived by tracing the impact that changes in the price level have on the LM curve by changing real money balances and thereby on real output in the IS-LM framework in Figure 1b. Shifts in the LM curve brought on by changes in the nominal money supply and movements in the IS curve lead to shifts in the AD curve. Movements in the LM schedule induced by changes in the price level correspond to movements along the AD curve.

[9]The rise in the nominal money supply needed to move aggregate demand back to AD_0 will initially move the LM curve to the right of LM_2, but the rise in prices from P_1 to P_0 will shift the LM curve back to LM_2 through the real balance effect.

It is assumed that economic disturbances shift the schedules but do not affect their underlying slope parameters. If the slopes of the aggregate demand function were to rotate, maintaining aggregate prices at the level P_0 might cause the level of real output to change.

LM curve are countered in a similar manner. Under a price rule, demand disturbances are completely offset, leaving real output as well as aggregate prices unchanged.

With supply or price shocks, the monetary authorities magnify the total impact of these disturbances on real output by adhering to a price target, at least in the short to intermediate run when aggregate supply is not vertical. Consider a negative supply disturbance, such as an adverse change in factor productivity, that shifts the aggregate supply schedule in Figure 2a leftward, from AS_0 to AS_1. With the nominal money supply initially fixed, the price rise induced by this shift causes the LM curve to move to LM_1 as real money balances decline. To combat higher prices, policy makers reduce the nominal money supply, shifting the LM curve to LM_2 and aggregate demand to AD_2, where prices are restored to their initial level. But this places additional downward pressure on real output when aggregate supply is upward sloping.[10] The cost of returning the price level to P_0 is a further reduction in real output to Q_2.

This simple framework suggests that targeting commodity prices could effectively counter demand disturbances, but unless sufficient flexibility is built into its structure, a commodity price target could aggravate the effects of aggregate supply or price shocks on real output. The analysis assumes that lags in the recognition of disturbances and implementation of policy do not interfere with the policy makers' ability to control aggregate prices. If these lags are significant or if there is some inertia in price movements following an initial disturbance, then attempts to adhere strictly to an aggregate price target could induce some instability in real output as the monetary authorities belatedly attempt to maintain their targeted price level. An important benefit to monitoring or targeting commodity prices, according to its proponents, is that these prices respond relatively quickly to economic disturbances. Consequently, policy makers have sufficient opportunity to respond before these shocks become embedded in the general price structure.

II. Commodity Price Behavior

This section discusses some of the key behavioral characteristics of commodity prices, beginning with an overview of their proximate determinants, and explains why commodity prices, may act as a leading indicator of important economic trends. Also examined are the volatility of commodity prices, which can make it difficult to distinguish between temporary and permanent

[10]In the long run, with a vertical AS curve, restoring prices to their original level induces no further decline in output beyond that caused by the initial supply shock.

Price Targets with a Supply Shock

Figure 2a

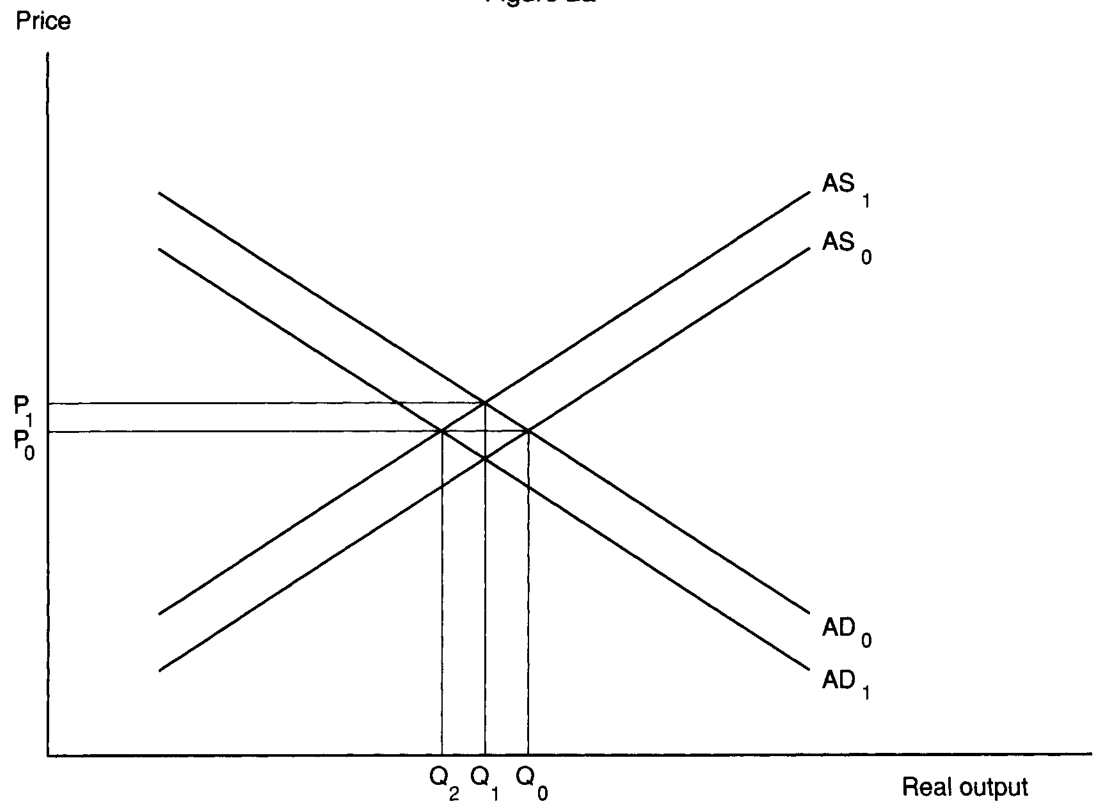
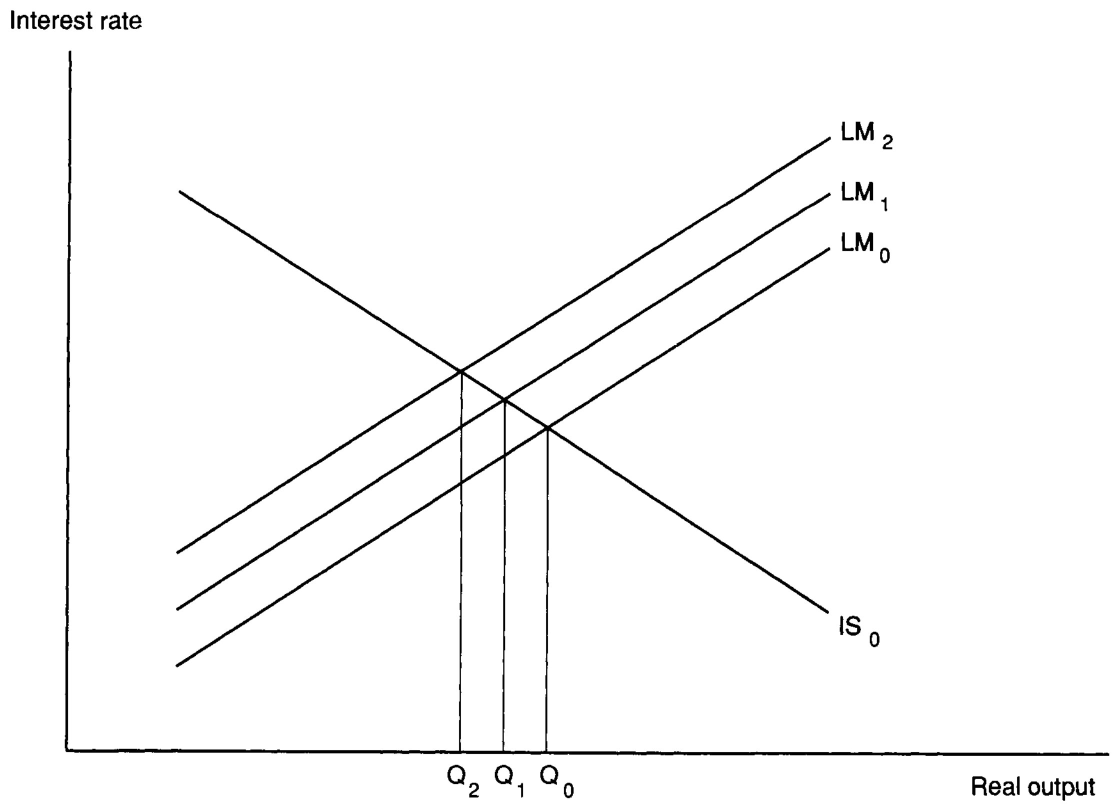


Figure 2b



movements, and the importance of shifts in the equilibrium relation between commodity prices and the aggregate price level.

A. Proximate Determinants of Commodity Prices

The immediate causes of movements in the overall level of commodity prices presented in this section are identified from empirical attempts to model commodity prices. These "proximate" determinants of commodity prices may differ from the "ultimate" determinants, which include monetary and fiscal policies. This overview looks only at determinants of aggregate commodity price measures and does not consider the many factors that can cause movements in individual commodity prices.

Empirical research on the behavior of the general level of commodity prices focuses mostly on the determinants of demand for commodities. In empirical work, real output, interest rates, exchange rates, and aggregate prices are typically found to be the most significant determinants of broad-based commodity price movements.[11] As a measure of real economic activity, industrial production is considered a good proxy for demand arising from the direct production requirements of manufacturing industries, the principal users of primary commodities. Interest rates are seen as capturing both the financing costs to manufacturers and the opportunity costs to speculators of holding commodities. Interest rates may also affect commodity prices indirectly through their impact on the aggregate level of economic activity. Commodity prices often respond to exchange rate movements because of the important role commodities play in international trade. As a general rule, the sensitivity of commodity prices denominated in any one country's currency to exchange rate changes is inversely related to that country's importance (measured in market share) in world supply and demand for the commodity. For example, exchange rate changes should have little impact on the domestic currency price of those commodities that are primarily produced and consumed domestically. Finally, aggregate prices are empirically useful for explaining commodity prices as a proxy for production costs.

Prices of individual commodities, of course, may be greatly affected by the many decisions that affect the exploration, extraction, or cultivation of particular commodities. However, few attempts have been made to capture supply-side factors in estimation because of the difficulties in identifying satisfactory proxy variables.[12] As discussed in Section IID, it is usually assumed that aggregate

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[11]Examples of this research include Chu and Morrison (1984) and Englander (1985).

[12]Chu and Morrison (1986) attempt to estimate supply-price dynamics.

measures of commodity prices are largely unaffected by supply shocks to individual commodities, either because these shocks are offsetting or because their impact falls on just a small number of commodities.

B. Leading Indicator Properties of Commodity Prices

Proposals to monitor commodity prices are based largely on the view that movements of these prices precede broader economic developments, especially general inflation trends. This section outlines the reasons that commodity prices are believed to be a good leading indicator. A survey of empirical evidence on the information content of commodity prices appears in Section III.

Commodity prices are flexible and thus respond quickly to underlying shifts in aggregate demand or supply, as well as to all new information distilled in the marketplace. This flexibility may reflect the competitive market structure in which many commodity prices are set, the relative homogeneity of commodities, and their storability. By contrast, many other important price or cost measures, such as wage rates, are fixed for long periods, perhaps because they are set by long-term contracts.

The importance of commodities as an input in production is sometimes used to explain why they can be used to predict changes in real output and aggregate prices. Primary commodities account for about 10 percent of the value of total U.S. output, and their consumption occurs at a relatively early stage of production. Economic disturbances affecting production translate quickly into changes in demand for primary inputs, and the ability to hold commodities in inventory magnifies this response. Given their flexibility, commodity prices can respond rapidly to these demand pressures. In this way, commodity prices might anticipate future changes in final output. Commodity prices are included in the Commerce Department's index of leading economic indicators for this reason. In addition, commodity prices will signal subsequent changes in prices of final goods induced by sustained movements in real output. It can be argued that aggregate demand pressures may show up first at the retail level and only eventually work their way back towards commodity prices in the early production stages. Even so, if prices for final goods and services are sticky, commodity prices may still respond relatively quickly to these aggregate pressures.

In explaining the predictive power of commodity prices, some analysts focus on the "asset" nature of the claims represented by ownership of commodity stocks and conclude that, like prices of other assets, commodity prices incorporate market expectations about future price developments.[13] Most commodities are nonperishable and can be stored reasonably cheaply, and so their possession represents a kind of real claim on future output and provides a hedge against future inflation. Moreover, because commodity prices are flexible, they can quickly reflect the expected impact of economic developments. Together, these features suggest that commodity prices may respond rapidly to inflationary shocks and be reliable indicators of future general price movements.

The availability of commodity prices on a timely basis is also seen as enhancing their value as a leading indicator. Prices for many commodities are available daily and sometimes are quoted virtually continuously. In addition, several commodity price indexes are compiled regularly and are available at least monthly if not more often. The early availability of commodity price information is seen as enabling policy makers to recognize and respond more quickly to evolving aggregate price pressures.

C. Relative Price Changes and Commodity Price Indexes

The effectiveness of commodity prices as a target or information variable may be undermined by secular changes in the relative price between the target commodity price and aggregate prices. In many ways, the kinds of complications that relative price changes create are analogous to those presented by unexpected income velocity shifts when a money aggregate is targeted. In the case of commodity prices, when the relation between the leading indicator variable and the final policy objectives changes, the ability to infer future price performance from commodity price changes is impaired. The use of broad commodity price indexes to circumvent this problem and the historical importance of relative price shifts are reviewed in this section.

Prices for many individual commodities or commodity groups have been greatly affected by market-specific economic shocks. As a result, basing monetary policy on a narrow set of commodity prices would entail substantial risks that their relative prices could change unexpectedly. To avoid this potential problem, most proposals call for targeting or monitoring the price index of a broad basket of commodities on the assumption that such a price index is unlikely to be unduly disturbed by shocks specific to individual commodity markets.

In choosing a commodity price index to target or monitor, consideration must be given to the commodities included in the index and to the weights used to aggregate the commodities. To reduce

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[13] See Section IID and the work of Frenkel (1986) and Boughton and Branson (1988) for examples.

the likelihood that shocks to a particular commodity category will dominate the entire index, the commodity basket should include goods from most of the major commodity groups, such as agricultural materials, metals, and chemicals. Some prefer to exclude petroleum products from any index, despite its importance in world production, because of the tremendous oil price movements caused by the actions of the suppliers' cartel. Agricultural commodities are also sometimes excluded in proposals because of their sensitivity to weather patterns and their limited use in manufacturing production. Consequently, much of the research on the predictive properties of commodity prices has used price indexes of non-oil raw industrial commodities only.

Most existing commodity price indexes are weighted according to the relative importance of each commodity in world or domestic output, or by its relative importance in trade. Others are simply unweighted averages of the commodities in the index. Ideally, for purposes of forecasting general price changes, commodities are best weighted by their information content about future inflation, which may not be related to their relative importance in output or trade. However, few attempts have been made to estimate optimum weights, and most analysts find it more convenient to rely on existing commodity price indexes.[14]

A number of well known commodity price indexes are plotted in Chart 1. These differ by the commodities included and in the weights used to compile each index.[15] As Chart 1 shows, most commodity price indexes tend to move together over long periods of time, but over shorter periods they can diverge significantly. Currently, no one measure of commodity prices has been identified as being clearly superior for use as a target or leading indicator variable.

There is strong empirical evidence that even broad-based commodity price indexes do not move closely with the general price level for extended periods of time. The series plotted in Chart 2 show that there have been sustained swings in the relative price of commodities and final outputs over the postwar period. At the same time, there has been a secular downward trend in the relative value of commodities. Additional evidence on the historical importance of relative price shifts comes from a series of statistical tests of cointegration between commodity prices and the general price level. Two variables are said to be cointegrated if there exists an underlying equilibrium relationship that prevents

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[14]Boughton and Branson (1988) report limited success in their attempts to estimate optimum weights in constructing a commodity price index. The Journal of Commerce publishes an index that reportedly is weighted by each commodity's value in forecasting inflation.

[15]Rosine (1987) summarizes the purposes and construction techniques behind many aggregate measures of commodity prices and output.

Chart 1
Indexes of Commodity Prices

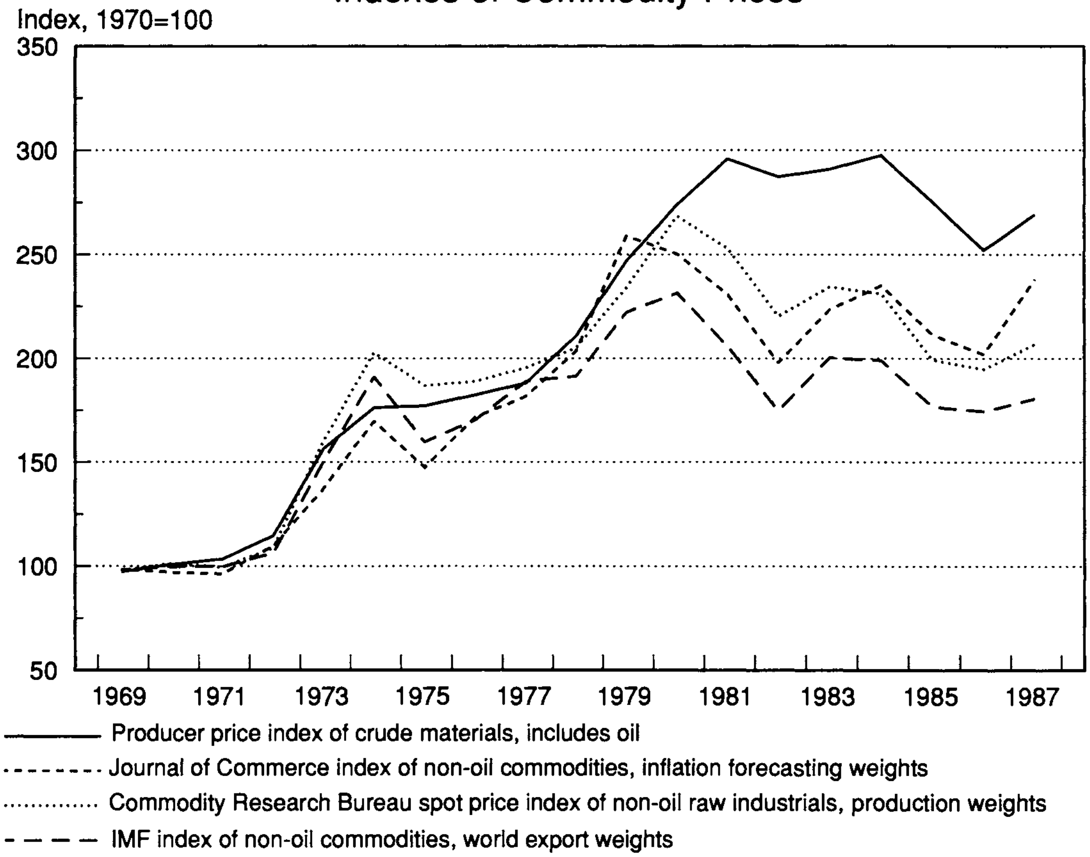
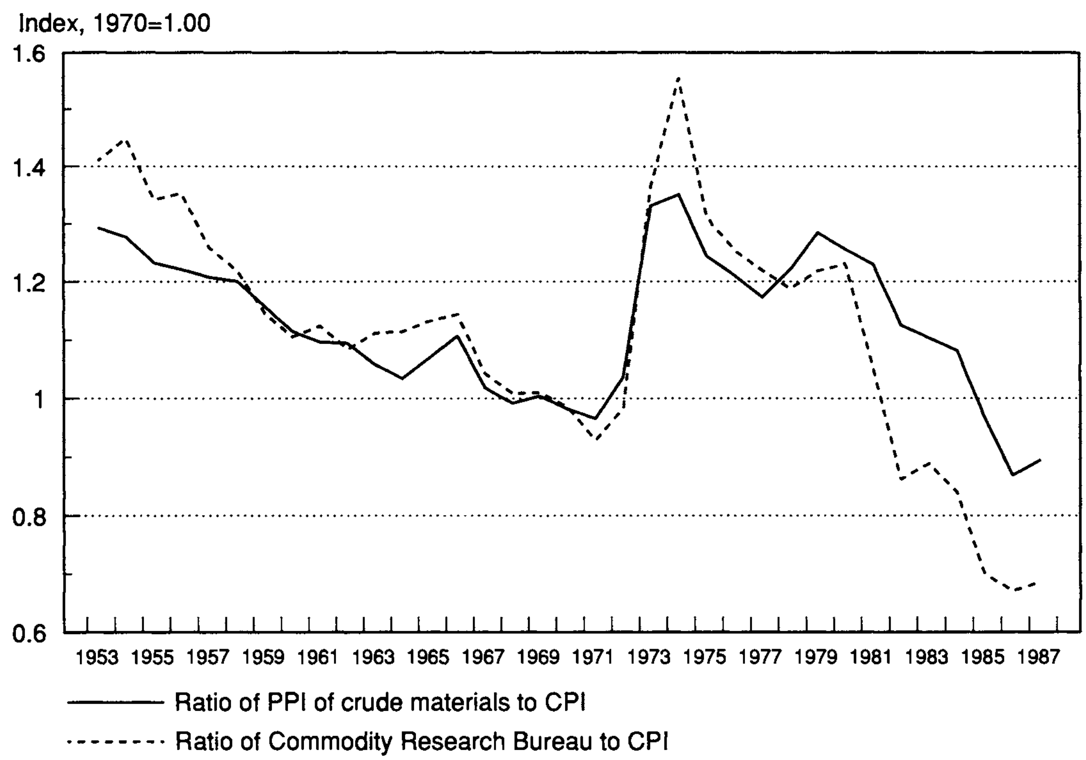


Chart 2
Ratio of Commodity Prices to Consumer Prices



them from drifting apart indefinitely. Using these tests, a number of analysts report that they cannot empirically reject the hypothesis that the *levels* of commodity prices and aggregate prices are not cointegrated.[16]

Even if no long-run equilibrium relation exists between the levels of commodity prices and aggregate prices, commodity prices could still play a useful role in monetary policy. For example, tests for cointegration indicate that *changes* in commodity prices still may be related to general inflation rates, that is, to *changes* in the general price level. Moreover, as long as the change is gradual or predictable, a secular trend in relative prices need not complicate policy procedures any more than, say, smooth velocity shifts complicate targeting a money aggregate. However, Chart 2 suggests that historically these relative price shifts may not always be smooth. On balance, these results raise important questions about the nature of the relation between commodity prices and aggregate prices, and they indicate that inflexible commodity price policy rules may be counterproductive at times.

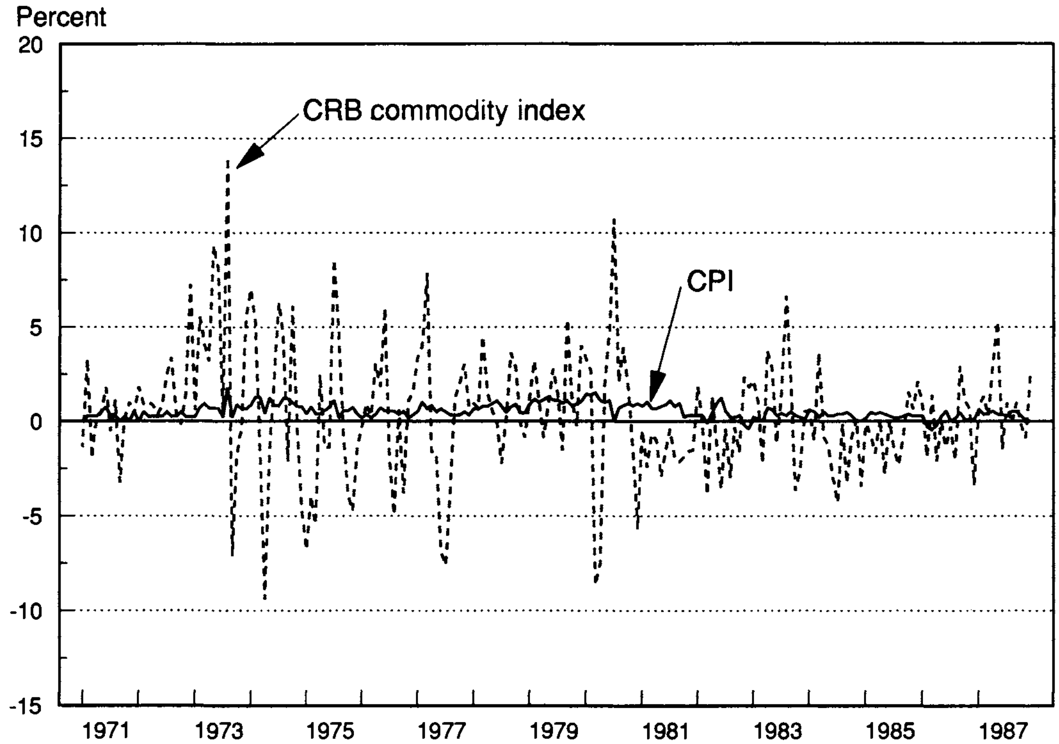
D. Volatility of Commodity Prices

Compared with the economic variables to be predicted, commodity prices are very volatile. Furlong (1989) calculates that during the 1980s changes in many monthly aggregate commodity price indexes were anywhere from three to twenty times more volatile than inflation in consumer prices, depending on the commodity price index used. Chart 3, which plots monthly percent changes of a representative commodity price index and consumer prices, illustrates this point. Changes in general inflation expectations, seasonal factors, or supply shocks cannot account for much of this volatility. This volatility reduces the ability to discriminate between temporary and permanent price movements and makes daily or weekly commodity price data of little value for policy purposes.

Economists have advanced two theories to explain why a price index for even a broad basket of commodities may vary far more than aggregate prices. The first focuses on the inelastic nature of supply and demand for many commodities, at least over short periods of time. Aggregate disturbances that, say, shift demand schedules for all products alike will often initially have a disproportionate impact on commodity prices because their supply elasticities are so low. Over time, as supplies become more plentiful, price pressures ease. Compared with aggregate prices, commodity prices

[16]See the work by Boughton and Branson (1988), Garner (1989), Durand and Blondal (1988), and Cody and Mills (1988) reported in Section IIIA.

Chart 3
Commodity Price Volatility
Monthly Percent Change



undergo much wider swings following economic disturbances. However, this reasoning does little to explain large weekly or even daily commodity price swings.

A model of commodity price behavior that treats commodities as akin to financial assets better explains the sometimes erratic nature of commodity price movements over even short time periods. The basic model is a derivative of the popular exchange rate overshooting models, and examples are found in Frenkel (1986) and Boughton and Branson (1988). This framework is notable for treating commodity markets as though they were like any other asset market. In such asset markets, the following arbitrage condition always holds:

(1) $i = dP_c + b$,

where i is a nominal interest rate, dP_c is the expected rate of change of commodity prices, and b represents the intrinsic real rate of return to holding commodities net of any storage costs, which is typically assumed constant. In long-run equilibrium, dP_c is zero, and i and b are equal to one another.[17]

In the long run, changes in the money stock are neutral. An increase in the money stock, for instance, will eventually cause commodity prices and all other prices to rise proportionately. However, with final goods prices relatively inflexible in the short run, a rise in the money stock leads to a temporary increase in the real money stock and places downward pressure on interest rates. By the arbitrage condition (1), lower interest rates are consistent with an expected decline in commodity prices, which can take place only if commodity prices first jump to a level above their new long-run equilibrium rate. Thus, commodity prices initially overshoot their new long-run equilibrium level.

In sum, commodity prices respond quickly to economic shocks, and this information is readily available. Consequently, commodity price data may be helpful to policy makers in predicting future inflation, so long as these disturbances do not alter the underlying relation between commodity prices and aggregate prices. However, the volatility of commodity prices, which can cause delays in recognizing and reacting to underlying inflation pressures, and the possibility of significant relative price changes militate against an important policy role for commodity prices.

III. Leading Indicator Properties of Commodity Prices: Empirical Evidence

Most empirical work that examines the relation between commodity prices and macroeconomic variables, especially aggregate prices, falls into one of two general categories: econometric evidence using more or less conventional estimation techniques and qualitative work comparing major turning points in the behavior of commodity prices and other economic variables of interest. This section surveys a number of these studies, most of which focus on the usefulness of commodity prices for predicting inflation.

A. Econometric Evidence[18]

Heightened interest in the possibility of targeting or monitoring commodity prices has prompted a number of econometric investigations into the predictive content of commodity prices in the past few

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[17]A theory for a positive return to holding commodity stocks, or inverse carrying charge, is presented in Working (1977). A positive real return to holding commodity stocks may arise from the convenience and cost savings to producers of having commodity inputs on hand. Other possible explanations are found in Frenkel and Hardouvelis (1985).

[18]See the specific authors cited for more detailed presentations of the methods used and results obtained in estimation.

years. From the studies surveyed in this review, five general conclusions about the relation between commodity prices and inflation emerge: (1) there is no apparent long-run equilibrium relation between commodity and aggregate price *levels*; (2) commodity price movements often precede inflation changes; (3) commodity prices apparently are not important direct determinants of aggregate prices; (4) the marginal contribution of commodity prices to inflation forecasts appears small; and (5) the relation between commodity price movements and inflation is not stable. The basis for each of these conclusions is discussed below, following a brief examination of the methodological features common to many of the studies reviewed.

Much of the recent econometric research has been conducted along similar methodological lines. The sample period is usually restricted to the postwar era, and the data used are either monthly or quarterly time series. Most of the studies are restricted to the U.S. case, although some look more generally at countries within the Organization for Economic Cooperation and Development (OECD). A consumer price index (CPI) is the most commonly used measure of aggregate prices, but sometimes a producer price index (PPI) or a general price deflator is substituted.[19] Estimated results do not appear to be particularly dependent on the choice of aggregate price index.

Commodity prices are most often measured using one of the readily available broad-based indexes. These include the Journal of Commerce measure of industrial commodity spot prices (JOC), the producer price index of crude materials (PPICM), the Commodity Research Bureau index of industrial materials spot prices (CRB), and an International Monetary Fund index of commodity prices (IMF). These indexes are slanted toward coverage of raw materials used in manufacturing production, and only the PPICM includes petroleum prices. As an exception, gold prices are sometimes included separately in estimation. Percentage changes of these indexes and broad inflation measures are generally used in estimation, and to reduce seasonality, twelve-month movements are calculated. Moving averages of inflation rates are sometimes used to further reduce the volatility of commodity prices. For the most part, the empirical results reported do not appear to be particularly sensitive to the composition of the commodity price index.

In many of these studies, preliminary statistical work designed to ensure the proper specification of estimated equations reveals that there is no long-run equilibrium relation between the levels of commodity prices and aggregate prices. To guard against the kind of spurious correlation

[19]A CPI is perhaps a better indicator of overall price trends for final output, but a more direct link may exist between commodity prices and a PPI, because the PPI excludes services, which require few commodities for their production.

that can arise when nonstationary variables are included in estimation, logged first differences are typically taken of all price variables used in estimation. This approximates percentage changes, and for most variables this transformation ensures that the series has a stable mean and variance over the sample period, that is, the series is stationary.

To be sure, two nonstationary variables may still be used in estimation if they are cointegrated, that is, if they tend to move together over time. However, tests performed by Boughton and Branson (1988), Garner (1989), Durand and Blondal (1988), and Cody and Mills (1989) on levels of commodity and aggregate prices do not support the hypothesis that these variables are cointegrated.[20] This result suggests that there is no stable equilibrium between the levels of these variables, a finding consistent with the observation that there are often permanent relative price shifts. Most researchers conclude that it is appropriate to use rates of change for the commodity and aggregate price series in regression analysis. One practical implication of this finding is that rules or inferences about aggregate prices based on commodity prices may only be properly framed in terms of inflation rates, not levels. Further clouding this picture, tests performed by Boughton and Branson and by Cody and Mills indicate that an equilibrium relationship may only exist between changes in commodity price *levels* and changes in aggregate inflation rates.[21]

According to standard statistical tests, many estimated relations show that commodity price movements historically have preceded changes in overall inflation. This finding generally supports claims that monitoring commodity price movements may be of some help to policy makers in forecasting aggregate price trends. Again, the estimated equations point to a systematic relation between commodity price inflation and subsequent total inflation. Much of the statistical support for this conclusion is based on a series of Granger causality tests performed by Horrigan (1986), Webb (1988), Garner (1989), Durand and Blondal (1988), and Cody and Mills (1989).[22] In these tests, inflation is specified as a function of its own past values and of lagged values of commodity price inflation. The longest lag on the commodity price variables is typically restricted to no more than one

[20]Many of the empirical studies cited in the bibliography contain a brief description of tests for cointegration and their interpretation. See, for example, Durand and Blondal (1988) and Garner (1989).

[21]These researchers find that commodity prices are integrated of order 1 while consumer prices are integrated of order 2.

[22]Additional econometric support comes from estimates between inflation and commodity price changes reported by Whitt (1988), Boughton and Branson (1988), and Klein and Horvath (1988).

year. Granger causality is determined by measuring the statistical significance of the estimated parameters on the commodity price variable, which in these studies is usually found to support the hypothesis that commodity price changes can be used to foretell changes in overall inflation.[23]

The tests described above actually only reveal whether commodity price changes generally precede movements in inflation. The underlying structural relation between commodity and aggregate prices may merely be one where both series respond independently to the same economic forces, but where commodity prices respond more quickly. If the relation between commodity prices and total prices arises from this kind of mutual correlation with other economic variables, then commodity prices may provide little additional information if those other variables can be monitored directly. To test for this possibility, Horrigan and Garner extend the standard bivariate Granger framework to include measures of real output, interest rates, money aggregates, and exchange rates. Commodity prices remain statistically significant in these estimates, indicating that they retain some explanatory power for overall inflation even after accounting for the information contained in these other variables.

Furlong (1989), Horrigan (1986), and Garner (1989) perform "variance decomposition" tests to examine whether commodity prices are economically important, in addition to being statistically significant, in explaining future inflation. Their results are somewhat mixed but suggest on balance that commodity prices may play a relatively small role in actually causing subsequent inflation. Their methodology attributes forecast errors (innovations) in a vector autoregression model (VAR) to various explanatory variables, including commodity prices, aggregate prices, a money aggregate, and real output.[24] The results are then used to make inferences about the economic relevance or causality of each explanatory variable. In this case, the proportion of the inflation forecast errors generated by the VAR that can be attributed to "shocks" in each variable is believed to correspond to the relative importance of that variable in determining inflation.[25] Horrigan finds that innovations in commodity prices account for only a small portion of the prediction errors of inflation. Furlong finds that the

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[23]Strictly speaking, the hypothesis that commodity price changes do not "Granger cause" aggregate inflation can be reliably rejected. Durand and Blondal also find evidence of Granger causality running from total price inflation to commodity price inflation.

[24]Furlong's measure of real output is the deviation of the unemployment rate from its full employment level, while Horrigan and Garner use industrial output. Also, Furlong and Garner transform price variables into percent changes while Horrigan uses their logged levels in estimation.

[25]Researchers disagree about the conclusions or inferences one may properly draw from these tests. In addition, the results of variance decomposition may be sensitive to the causal ordering that researchers must impose on the variables.

importance of commodity prices in explaining inflation is sensitive to the choice of commodity price index used in estimation, but in any event shocks to the money aggregate always account for a much larger portion of inflation innovations. In contrast, Garner finds that innovations in commodity prices may explain as much as 25 percent of the prediction error variance of inflation.

The interpretation that these findings point to a small economic role for commodity prices in explaining aggregate inflation, if correct, need not undermine the predictive usefulness of commodity prices. Instead, when combined with the findings from Granger causality tests, the results of variance decomposition may shed some light on the channels by which commodity prices signal future inflation. In general, these findings are consistent with the view that prices of commodities have only a small direct impact on prices of final goods through the production process; nonetheless, commodity prices are a leading indicator of inflation, perhaps because the long-run implications of underlying economic disturbances are quickly distilled in commodity markets.

Several of the researchers cited above find that, despite its statistical significance in estimation, the marginal contribution of commodity price information to inflation forecasts is modest. Furlong (1989) and Webb (1988) extend their analyses to measure the impact of commodity prices on the mean squared error of out-of-sample inflation predictions extending out from one to two years. After they have accounted for the information contained in past inflation movements, money aggregates, real economic activity, and various financial measures, the accuracy of their inflation forecasts is little improved by the addition of commodity price data. A similar result is reported by Boughton and Branson (1988) for inflation forecasts generated solely by past inflation movements. To be sure, commodity price data may be available sooner than some other data used in these studies, but this is not true for the monetary and financial indicators. Thus, the incremental improvement to inflation forecasts gained by monitoring commodity price movements may be slight.

The usefulness of commodity prices for predicting aggregate inflation, as distinct from their statistical significance, may also be examined by direct reference to a conventional inflation forecasting equation. In recent work performed at this Bank, a standard expectations augmented Phillips curve, designed to forecast CPI inflation, was estimated using quarterly data over a sample period beginning in 1960 both with and without a variable measuring changes in commodity prices (lagged one year).[26] Year-ahead forecast rates of CPI inflation were compared to actual inflation for

[26]Quarterly CPI changes were specified as a function of the level of the unemployment rate and recent changes in the unemployment rate--to capture aggregate demand pressures--along with past CPI inflation as a proxy for inflation expectations. Quarterly commodity price changes were measured

the 1980s, and the results indicated that including commodity prices in the forecast equation, although statistically significant, made only a small improvement in the forecasts. This same finding held when the energy component of the CPI was excluded from the estimated equations.

Several researchers test for stability in their estimated relations between commodity price changes and general inflation, and their results raise doubts about the reliability of using these estimated relations to forecast inflation.[27] Whitt (1988) estimates inflation as a function of past growth in a monetary aggregate and of commodity price changes. When the sample period is restricted to the 1960s and early 1970s, the monetary aggregate "performs" much better than commodity prices, but in the subsequent period ending in 1987 commodity prices are a much superior precursor of general inflation. This finding, of course, reflects at least in part the deteriorating performance of the monetary aggregates during the later period. Furlong (1989), using his estimated VAR framework over two subperiods, measures the response of inflation to specified commodity price shocks. He finds that the response of inflation to innovations in growth rates of commodity prices is much more pronounced when the model is estimated over a period from the mid-1970s to late 1980s than when the model is estimated over an earlier period. These reported results possibly suggest that the performance of commodity prices as a leading indicator of inflation may have improved over time. Alternatively, the discrepancy in results over the two time periods may have arisen because policy makers in the earlier period responded more effectively to economic disturbances affecting commodity prices before these disturbances became embedded in the general price structure.

Finally, most recent econometric research focuses on the relation between commodity prices and general inflation, but Furlong (1989) and Cody and Mills (1989) use a VAR framework to examine whether commodity prices are a leading indicator of real economic activity.[28] Although the body of evidence is much smaller, statistical results are generally the same as those for commodity prices and inflation. In both studies, commodity price inflation is found to be a statistically significant leading indicator of movements in economic activity. Furthermore, using variance decomposition

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using the average of nine non-oil commodity price indexes.

[27]In addition to the two studies cited, Durand and Blondal (1988) test for stability in their estimated equations over a sample period split in 1973. They also find that these relationships are generally unstable.

[28]The difference between the actual unemployment rate and the "full employment" unemployment rate is Furlong's measure of economic activity, while Cody and Mills use growth in industrial production.

tests, Furlong finds that his commodity price index "explains" real economic activity better than money aggregates do; however, past values of real activity outperform commodity prices.

B. Commodity Prices and Inflation Turning Points

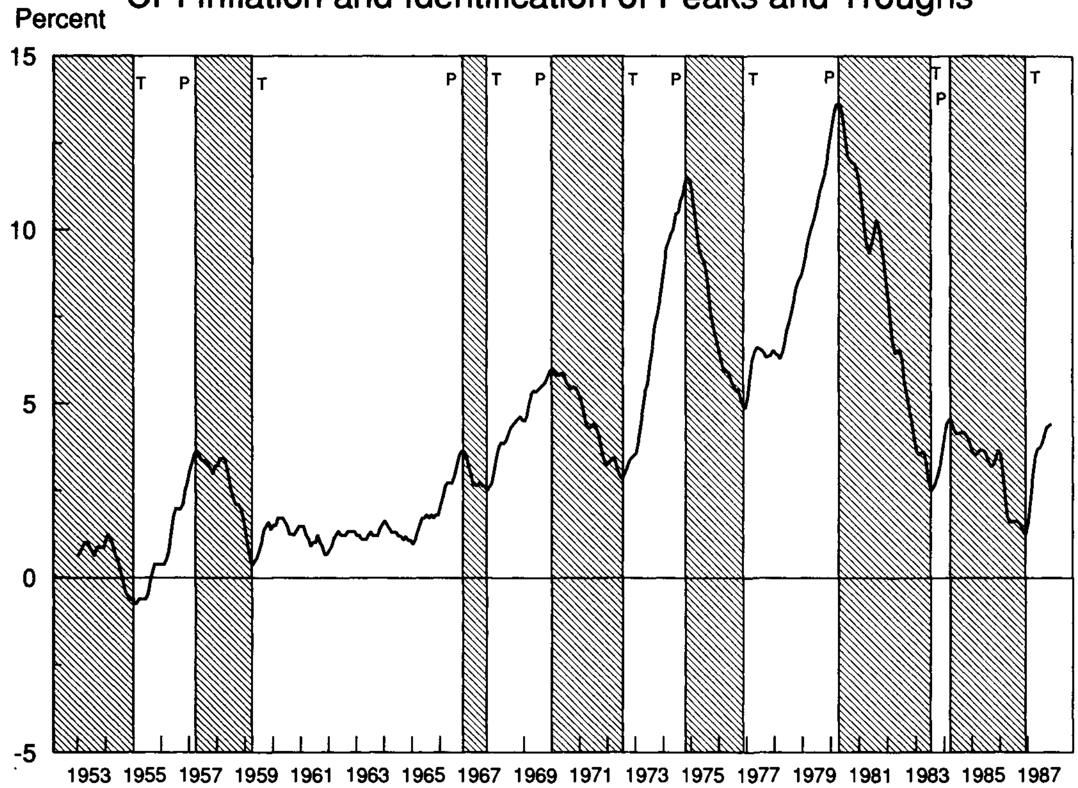
The econometric techniques used in the studies cited above are designed to determine whether a stable quantitative relation exists between the regression variables. A number of analysts argue that even in the absence of such a relation, major turning points in commodity price inflation signal important changes in underlying inflation trends. Empirical evidence reviewed in this section demonstrates that sustained shifts in general inflation usually have been preceded by a significant change in commodity price inflation. However, false signals of impending inflation changes do periodically arise, the lead time of commodity price movements varies, and there is no consistency between the size of these commodity price movements and subsequent changes in inflation. Thus, at best a loose qualitative relation seems to exist between these variables.

Turning points in commodity and aggregate price inflation are correlated simply by visually inspecting the data. Correlating rates of change of commodity and aggregate prices, rather than their levels, seems appropriate in light of the results of the cointegration tests reported in the previous section. Because of their volatility, commodity price movements must be heavily smoothed to aid in the identification of peaks and troughs. The necessity of such procedures underscores that, in practice, turning points in commodity price inflation might be recognized only with considerable hindsight. To preserve the timing between movements in all price series, the measure of aggregate price inflation is smoothed in an identical manner. The specific criteria used to smooth prices and to define turning points are to some degree arbitrary. A major drawback to this kind of analysis is that it does not allow for the impact of other variables on inflation.

Major changes in commodity price inflation have consistently preceded important turning points in aggregate inflation over the past few decades. Based on work performed at the Federal Reserve Board of Governors, Angell (1987) reports that from the late 1960s through 1987 virtually all of eight turning points in CPI inflation were preceded by significant changes in commodity price behavior.[29]

[29]Inflation for all price series is measured as the three-month average of twelve-month growth rates.

Chart 4
CPI Inflation and Identification of Peaks and Troughs

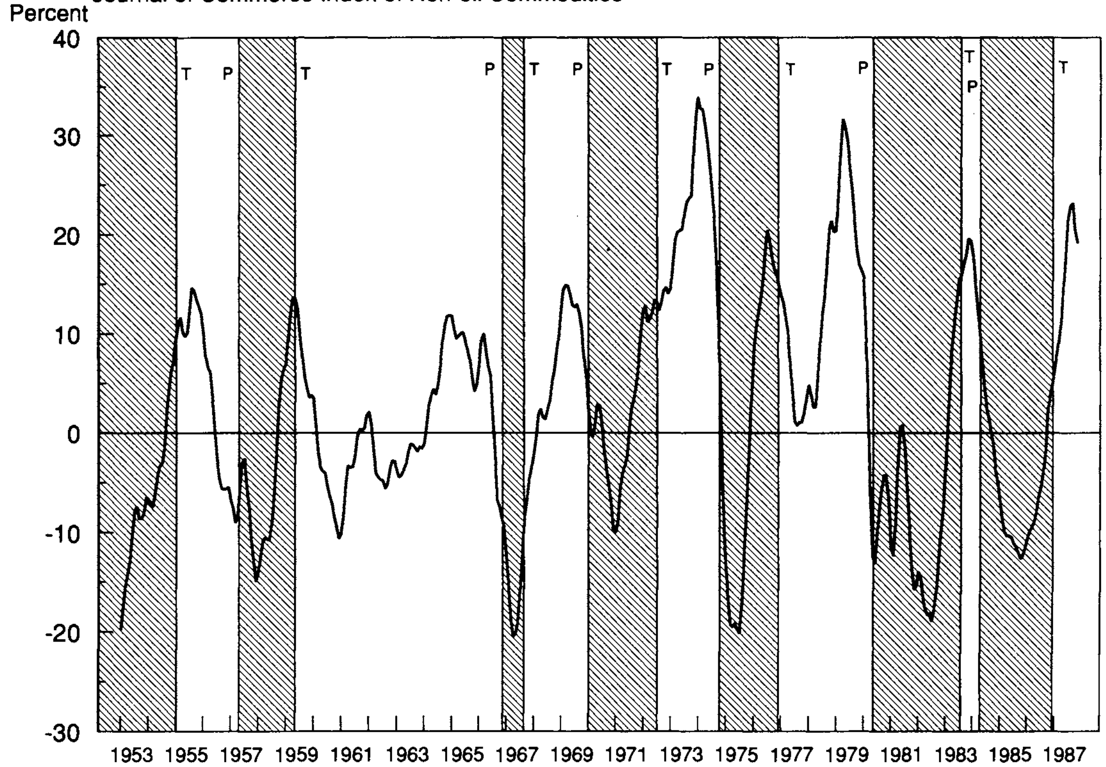


Three-month average of twelve-month percent changes

His measure of commodity prices is the average of nine separate indexes, but the result is reportedly insensitive to the choice of index. The basic findings reported by Angell are upheld when the period is extended back to the 1950s, although the relationship, already loose, becomes less precise. Consumer price inflation and its major peaks and troughs are plotted in Chart 4. These turning points are superimposed over alternative measures of commodity price inflation in Charts 5 through 8. In most cases, turning points in commodity price inflation precede changes in consumer price inflation. In related work, Boughton and Branson (1988) report that since 1970, commodity price turning points led six of nine turning points in an aggregated measure of OECD inflation.[30]

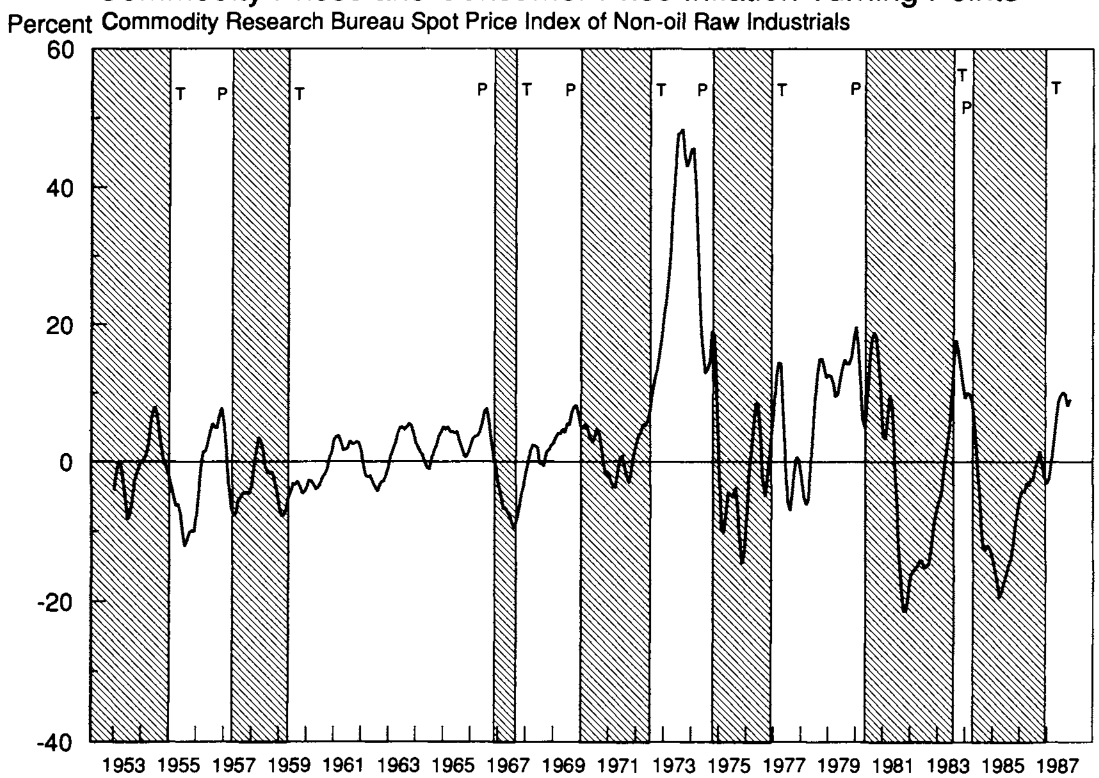
[30]The authors used several measures of commodity prices; this is their best reported result.

Chart 5
Commodity Prices and Consumer Price Inflation Turning Points
Journal of Commerce Index of Non-oil Commodities



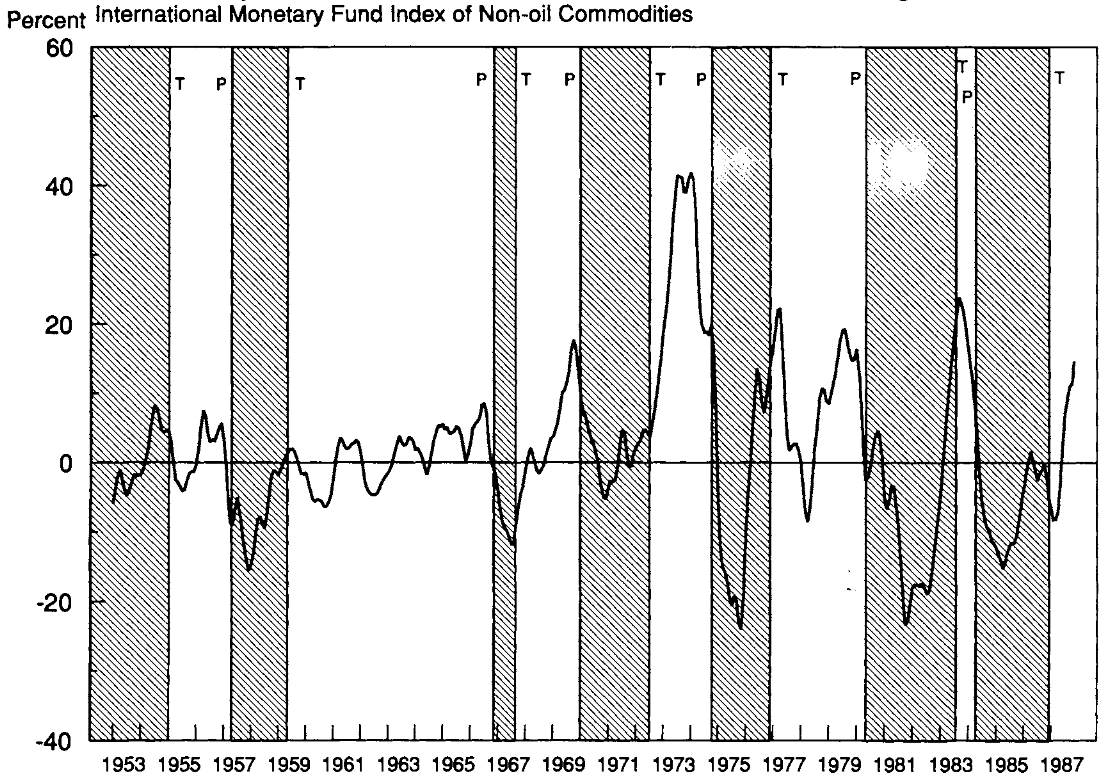
Three-month average of twelve-month changes

Chart 6
Commodity Prices and Consumer Price Inflation Turning Points
Commodity Research Bureau Spot Price Index of Non-oil Raw Industrials



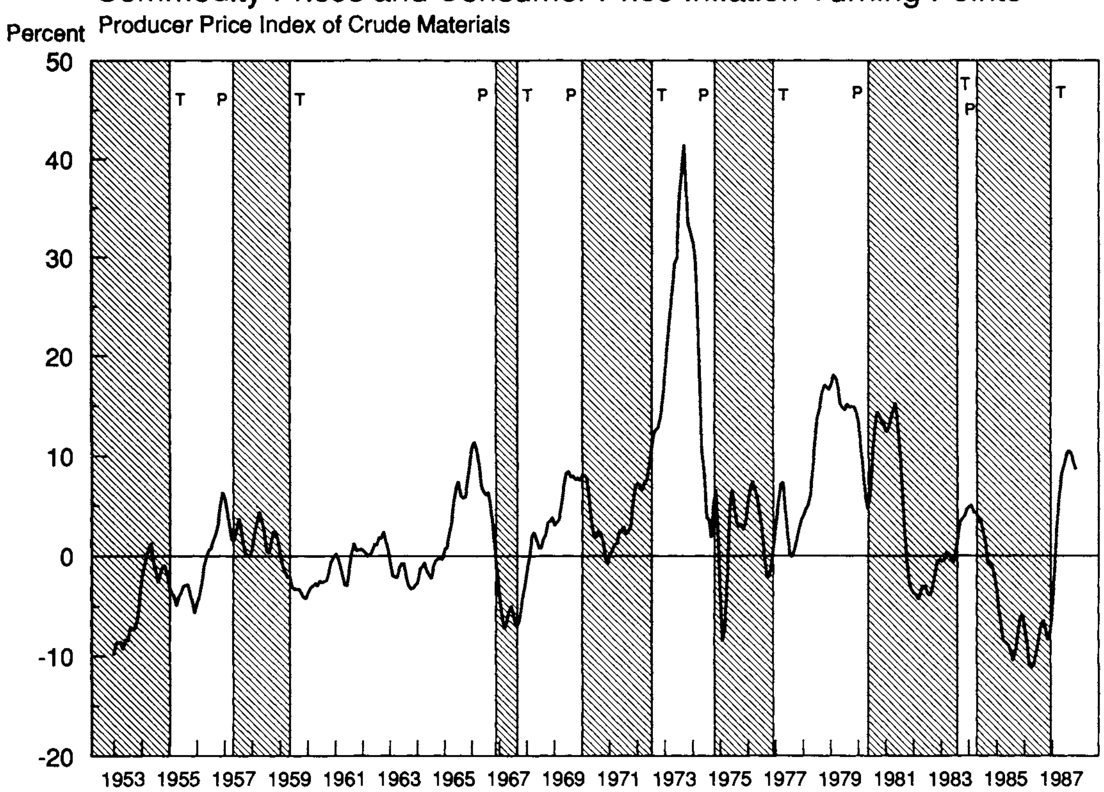
Three-month average of twelve-month changes

Chart 7
Commodity Prices and Consumer Price Inflation Turning Points



Three-month average of twelve-month changes

Chart 8
Commodity Prices and Consumer Price Inflation Turning Points



Three-month average of twelve-month changes

Commodity prices appear more likely to provide false signals of inflation turning points than to miss actual turning points. For example, most of the commodity price indexes presented in the charts incorrectly signaled first an inflation peak and then a trough during 1977, and during the early 1960s several turning points in commodity price inflation were not followed by a change in overall inflation trends. In their study, Boughton and Branson reported two such false signals. In part, this result may arise from the volatility of commodity prices, which remains even after the series is smoothed. Thus, despite a track record of correctly anticipating most major inflation turning points, movements in commodity price inflation would still have to be interpreted cautiously, a condition which dilutes some of their value as a leading indicator.

The lead time between commodity price and CPI inflation turning points varies considerably, but on average appears sufficiently long to be of value to policy makers. The average lead time of the commodity price index in the work reported by Angell is about seven months, much less than his reported average estimated lag between changes in the monetary aggregates and changes in inflation. The lead times of the series plotted in Charts 5 through 8 are on balance somewhat longer than those reported by Angell, averaging about ten months, and they vary considerably from episode to episode as well as across commodity price measures.[31] On balance, these results suggest that commodity prices could in principle provide an opportunity for policy makers to offset inflationary shocks; however, the instability in these lead times, as well as the propensity to send false signals, indicates that forecasts of major inflation turning points must remain highly uncertain.

Finally, there is no clear association between the size of movements in commodity prices and the size of changes in total CPI inflation. In the work reported by Angell, commodity price inflation changes are on average four times as large as CPI inflation changes, but the variation in this ratio is large. This same finding holds for the commodity price indexes presented in the charts. The instability of the ratio between changes in commodity prices and CPI inflation is of more consequence than its absolute magnitude. Thus, an acceleration in commodity price inflation of a given magnitude may provide little guidance about the degree of monetary tightening that is appropriate.

All the empirical work surveyed in this section and in the preceding section may be subject to the "Lucas critique," which holds that the observed relation between, say, commodity prices and inflation may be sensitive to, among other things, the monetary policy procedures followed during the

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[31]Lead times found by Branson and Boughton tend to be significantly shorter than those reported by Angell or presented here.

sample period. Consider a simple example: as market participants came to recognize that the monetary authorities were adjusting policy in order to maintain commodity prices within certain bounds, they might themselves bid commodity prices to within the perceived policy range ahead of any actual policy adjustments. Taken to an extreme, this kind of market reaction could alter the observed relation between commodity prices and general inflation. Furlong (1989) speculates that, to some degree, the differences in his estimates between commodity prices and inflation across different sample periods may reflect this kind of phenomenon.[32]

IV. Controlling Commodity Prices

To successfully target commodity prices, policy makers must be able to keep these prices within certain specified bounds. If policy makers were instead to monitor commodity prices solely for their information content, they might still wish to prevent commodity prices from moving too far outside some broad ranges. This section describes the links between the operating instruments of the monetary authorities and commodity prices and examines the empirical evidence on the controllability of commodity prices.

A. Channels of Control

Interest rates represent the principal channel through which monetary policy can exert some control over commodity prices. Industrial production, a direct determinant of the demand for commodities as an input in manufacturing, is sensitive to interest rate swings. As noted above, interest rate changes may also affect commodity prices by altering the cost of holding commodity inventories. Exchange rates, which affect prices of many commodities traded internationally, are also sensitive to interest rate changes.

Direct intervention in commodity markets is sometimes recommended as a way to control commodity prices.[33] This would represent a significant departure from the current means of monetary control, and a thorough consideration of this possibility is not undertaken here. An important drawback to such proposals is that intervention affects commodity prices by changing the

[32]This issue is also discussed in Richard Davis' introduction to this volume.

[33]Miles (1984) calls for intervention in commodity futures markets to control their price. It can be argued that restricting intervention to futures instead of spot markets makes it unnecessary to maintain commodity stockpiles.

available supply, and thus can distort the relative prices of commodities.

While the means for controlling commodity prices appear to be available, there is considerable skepticism about the precision with which policy makers could control these prices. Long lags exist between changes in monetary policy and changes in manufacturing activity, and the degree of control policy makers have over industrial production or exchange rates--important channels through which policy affects commodity prices--is uncertain.[34] The problems of measuring the impact of monetary policy actions on commodity prices are compounded because economic activity, interest rates, and other direct determinants of commodity prices are influenced by a number of factors outside the control of the monetary authorities. For example, exchange rates are influenced by the stance of monetary policy abroad as well as by domestic actions. The next section surveys some of the available evidence on the ability of the monetary authorities to control commodity prices.

B. Empirical Evidence of Controllability

A few researchers have attempted to examine the ability of policy makers to control commodity prices through conventional means. Overall, their findings point to a weak link of questionable stability between the instruments of monetary policy and commodity prices.

Hafer (1983) finds that the simple correlation between past (lagged one quarter) M1 growth and an index of raw materials commodity price inflation is statistically significant over the period 1960-82. However, the correlation coefficient is not large in absolute magnitude and varies considerably when calculated over different subperiods. A similarly weak result holds when a moving average of M1 growth over the preceding three years is correlated with commodity price inflation. DeFina (1988) extends Hafer's analysis to consider instruments under the more direct control of monetary authorities: the federal funds rate and growth in nonborrowed reserves.[35] Correlations between these variables and commodity price inflation are not statistically significant, even when longer lag lengths on the monetary variables are introduced. These results are supported by simple regression analysis performed on commodity price changes and the monetary variables.

Garner (1989) presents the results of a number of Granger causality tests linking commodity

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[34]To the extent that interest rates affect future expected industrial production, they could have a more immediate impact on current commodity prices.

[35]In addition, both DeFina and Garner (1989) examine the relation between monetary variables and gold prices and find little evidence of a direct link.

price changes to movements in a variety of monetary instruments and other variables. He uses four alternative measures of commodity price inflation, and his control instruments include M1, the monetary base, nonborrowed reserves, and the federal funds rate. Overall, little evidence is found of a statistically significant relation between these variables. Finally, Garner reports the results of some variance decompositions of prediction errors of commodity price inflation derived from his estimated VAR framework (outlined in Section IIIA). These show that the innovations in the monetary variables never explain a large percentage of the prediction error variance of commodity price inflation.

V. Conclusions

Renewed interest has been expressed in the role that commodity prices could play in setting and executing monetary policy. Some analysts have recommended using commodity prices as an intermediate target, but most advocates of an enhanced role for commodity prices envision using them as a key leading indicator or information variable, especially of inflation trends. This study has examined the major behavioral features of commodity prices and surveyed recent empirical examinations of their predictive content. Several important points emerge from the body of evidence reviewed.

Setting formal intermediate targets for commodity prices seems unrealistic for several reasons. Significant shifts have occurred in the relative price of commodities to final goods, commodity prices are highly volatile, and policy makers have only a limited ability to control commodity prices.

These drawbacks would pose much less of a problem to a monetary policy regime that uses commodity prices as an information variable. However, the contribution that commodity prices can make to policy in this role hinges on how valuable and reliable the information contained in commodity prices is and how efficiently this information can be extracted from actual commodity price movements. Only qualified conclusions can be reached on the basis of the evidence surveyed, but skepticism about a *dominant* indicator role for commodity prices in monetary policy is warranted.

A considerable body of evidence points to *some* real predictive content in commodity prices. Standard empirical tests typically show that commodity price indexes have a statistically significant property for explaining overall inflation. This result holds even when the information content of, say, exchange rates and financial variables is accounted for, suggesting that commodity prices might be worth monitoring even in conjunction with other economic variables. Impressionistic comparisons of inflation turning points seem to confirm that commodity prices have some ability to anticipate overall price developments, although false signals have occurred on occasion.

Much of the same evidence, however, suggests that the relation between commodity prices and the general price structure is too loose to justify using commodity prices as a primary basis for making policy decisions. Cointegration tests, tests for stability in estimated relations, and the visual examination of relative price movements all suggest that the link between commodity prices and aggregate prices may not be predictable enough to be exploited by policy makers. At most, only rates of change in commodity prices and in broader inflation measures may be correlated through time. As the simple turning point analysis demonstrates, this uncertainty extends to both the length of the lag and the quantitative correspondence between commodity price movements and subsequent inflation changes. In addition, some researchers find that the marginal contribution of commodity prices to inflation forecasts, although statistically significant, is small. Finally, while most empirical research assumes that important changes in commodity prices are quickly recognized for what they are, policy makers may only become sure about the duration of significant commodity price shifts with a considerable lag because of their volatility. For these reasons, developing reliable operating procedures based largely on the behavior of commodity prices could be very difficult.

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POSSIBLE ROLES OF THE YIELD CURVE IN MONETARY POLICY

Arturo Estrella and Gikas Hardouvelis

In many macroeconomic models, and sometimes in discussions of monetary policy, economists refer to *the* interest rate, as if there were only one fixed income asset in the economy. This simplification is often adequate. However, when the intention is to investigate in detail the mechanisms through which monetary policy operates, it is necessary to examine a wider array of fixed income securities with various terms to maturity.

In the economic literature, most studies of the term structure of interest rates are designed to test whether the "expectations hypothesis" holds. That is, they ask whether long-term rates are weighted averages of expected short-term rates, possibly with an adjustment for various types of risks. By contrast, how monetary policy affects or might make use of the term structure is a question that is rarely addressed directly.

The yield curve has long been known to have important connections with the monetary policy process, although explicit formulations of these connections, either in a policy or a research context, are extremely rare. Recently, however, a member of the Federal Reserve Board of Governors affirmed that the yield curve is one of three major indicators that may be useful in formulating monetary policy.[1]

The purpose of this paper is to examine how and where the yield curve fits in the framework of monetary policy. We ask: Can the yield curve serve as a policy target or indicator? Can the yield curve be used in a routine or even mechanical way in the conduct of policy?

The yield curve could conceivably play various roles--as a final target, an intermediate target, or an economic indicator. A final target of monetary policy, the ultimate object of influence for the monetary authority, is a variable that describes aggregate economic performance. Natural candidates are real GNP, inflation, or perhaps a combination of the two. The slope of the yield curve cannot be a final target, however, because it has no direct link to aggregate economic welfare. Nevertheless, the

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[1]Governor Manuel Johnson (1988) has stated that the Federal Reserve Board looks at the yield curve, as well as commodity prices and foreign exchange rates, in setting monetary policy.

yield curve could potentially serve as an intermediate target. An intermediate target is a variable that is related to the final target in a stable, predictable, and causal way, and that can be readily controlled by policy makers.

For the yield curve to serve as a macroeconomic indicator, and hence to provide monetary authorities with information that will guide their decisions, the requirements are less stringent. It suffices that the yield curve can predict future macroeconomic developments without necessarily causing them.[2]

This paper is organized into two major sections. Section I examines the relationship between a direct instrument of monetary policy, the federal funds rate, and the slope of the yield curve. The empirical evidence suggests that the federal funds rate does have a partially predictable negative effect on the slope of the yield curve. However, the effect varies over time, suggesting that the Federal Reserve can influence--but not control--the slope of the yield curve.

Section II focuses on the relationship between the slope of the yield curve and two important final policy targets: real GNP growth and inflation. The evidence shows that the slope of the yield curve is positively associated with future changes in output and inflation. Furthermore, this positive association is not attributable to the negative effect that restrictive monetary policy can have on both the contemporaneous slope of the yield curve and on future changes in real output and inflation. A safe interpretation of the evidence is that the yield curve is a useful addition to the tool kit of policy makers and others as they try to assess future exogenous macroeconomic developments.

I. The Effect of Monetary Policy on the Yield Curve

Economic theory does not provide a precise and unambiguous link between monetary policy and the slope of the yield curve. The initial effect of a monetary tightening is to raise real short-term interest rates. The effect on long-term rates, however, is more complex, since these rates depend more heavily on expectations about future real output and inflation. A tighter policy implies a period of contraction in real output growth, so that the original increase in short-term rates would be followed by a decrease in future real rates. A tighter policy also implies that the inflation premium component

[2]The term "indicator" has often been used in the monetary policy literature to refer to variables that provide information on the stance of policy. The analysis of Section I, which examines the relationship between the funds rate and the yield curve slope, is a test of the indicator properties of the slope in this sense. A "macroeconomic indicator," on the other hand, provides information on the state of the macroeconomy, a state which is determined partly, but not exclusively, by monetary policy.

of long-term rates would decline. The final effect on long-term rates depends also on whether the monetary tightening is perceived to be permanent or transitory and on whether it comes as a surprise to market participants. Overall, theory suggests that the effect on long-term rates and hence on the slope of the yield curve is ambiguous. How monetary policy relates to the slope of the yield curve thus remains an empirical issue.

This section presents an empirical investigation of the effects of monetary policy on the slope of the yield curve. It examines the relationship between unanticipated changes in the federal funds rate and unanticipated changes in the slope of the Treasury yield curve. Although the funds rate is not a perfect index of monetary policy, unanticipated changes in policy are reflected clearly and promptly in the funds rate.

A. Econometric Framework

We measure the slope of the yield curve as the difference between the ten-year Treasury bond rate and the three-month Treasury bill rate. These rates, as well as the funds rate, are monthly averages of daily rates from January 1955 to May 1989.[3]

In order to construct the unanticipated component of each interest rate, we estimate a vector autoregressive (VAR) model. The model is a system of three ordinary least squares regressions with the funds, bill, and bond rates, respectively, as dependent variables, and the first six lags of each of these three variables as regressors (with a constant term). We model the behavior of the bond and bill rates separately because a system of three equations extracts more precise information from the data than a system of two equations with only the funds rate and the slope. Moreover, it is straightforward to calculate the results for the spread once we know the results for the bond rate and bill rate. The basic vector autoregressive system is of the form:

$$FUNDS_t = \alpha_{10} + \Sigma^6{}_1\ \alpha_{1i}\ FUNDS_{t-i} + \Sigma^6{}_1\ \beta_{1i}\ BILL_{t-i} + \Sigma^6{}_1\ \gamma_{1i}\ BOND_{t-i} + \varepsilon_{1t}$$
$$BILL_t = \alpha_{20} + \Sigma^6{}_1\ \alpha_{2i}\ FUNDS_{t-i} + \Sigma^6{}_1\ \beta_{2i}\ BILL_{t-i} + \Sigma^6{}_1\ \gamma_{2i}\ BOND_{t-i} + \varepsilon_{2t}$$
$$BOND_t = \alpha_{30} + \Sigma^6{}_1\ \alpha_{3i}\ FUNDS_{t-i} + \Sigma^6{}_1\ \beta_{3i}\ BILL_{t-i} + \Sigma^6{}_1\ \gamma_{3i}\ BOND_{t-i} + \varepsilon_{3t},$$

[3] The difference between the ten-year and three-month Treasury rates is proportional to the difference between the nine-year nine-month forward rate and the three-month rate. See Shiller, Campbell, and Schoenholtz (1983) or Estrella and Hardouvelis [1989] 1991).

Table 1

Funds, Bill, and Bond Rates:
Significance Level of Granger Causality Tests*
1955 to 1989

Dependent Variable	Progressors Funds	Bill	Bond
Funds	.000	.000	.011
Bill	.000	.000	.000
Bond	.014	.009	.000

* Significance level of F test of the hypothesis that all six lags of a given regressor have zero coefficients.

where FUNDS is the federal funds rate, BILL is the three-month Treasury bill rate, and BOND is the ten-year Treasury bond rate.

Table 1 presents exclusion tests for all lags of each of the explanatory variables in the above regressions, known as Granger causality tests.[4] Specifically, it shows the probability that a given variable has no explanatory power for a particular dependent variable. As indicated by the low probabilities in the table, there is evidence of causality flowing in every direction in the model. Every test statistic is highly significant, and all but two are significant at the 1 percent level. These results confirm the importance of allowing the three interest rate variables to enter independently.

Our focus in the remainder of this section is on the contemporaneous relations among the unexpected components ε_1, ε_2, and ε_3 of the previous model. Econometric methods cannot determine the contemporaneous cause and effect relationships among these variables. It seems natural to suppose, however, that contemporaneous causation runs from the funds rate to the bill rate to the bond rate. Under this assumption, the previous system of equations can be rewritten as follows:

[4] For a discussion of Granger causality, see Granger and Newbold (1977) or Sims (1972).

(1) $\text{BILL}_t = \delta_1\text{FUNDS}_t + \alpha'_{10} + \Sigma_i\alpha'_{1i}\text{FUNDS}_{t-i} + \Sigma_i\beta'_{1i}\text{BILL}_{t-i} + \Sigma_i\gamma'_{1i}\text{BOND}_{t-i} + \eta_{1t}$

(2) $\text{BOND}_t = \delta_2\text{FUNDS}_t + \alpha'_{20} + \Sigma_i\alpha'_{2i}\text{FUNDS}_{t-i} + \Sigma_i\beta'_{2i}\text{BILL}_{t-i} + \Sigma_i\gamma'_{2i}\text{BOND}_{t-i} + \eta_{2t}$

(3) $\text{SPREAD}_t = \delta_3\text{FUNDS}_t + \alpha'_{30} + \Sigma_i\alpha'_{3i}\text{FUNDS}_{t-i} + \Sigma_i\beta'_{3i}\text{BILL}_{t-i} + \Sigma_i\gamma'_{3i}\text{BOND}_{t-i} + \eta_{3t}.$

In other words, in this new set of equations, current values of the bill rate, bond rate, and spread, respectively, are made functions of that part of their value that is anticipated on the basis of lagged movements in the three interest rates (that is, the content of the first set of equations) and, in addition, the influence of the current movement in the funds rate. The new formulation highlights the contemporaneous effect of the funds rate on the bill and bond rates and on the spread (given by the coefficients δ_i). The estimated coefficient of the funds rate in these equations reflects the effect of an unanticipated change in the funds rate on the unanticipated change in the bill rate, the bond rate, and the spread. The reason is that the remaining regressors control for anticipated movements in these rates.[5]

We begin the empirical analysis by running simple constant-coefficient regressions. Subsequently, we allow the regression coefficients to vary in progressively more complex ways. These procedures are consistent with the presence of specific or unspecified factors (reflecting, for example, the state of the economy, policy credibility, and operating procedures) that affect the sensitivity of the spread to changes in the funds rate.

B. The Basic Evidence

Table 2 examines the sensitivity of the bill and bond rates and of the spread to changes in the federal funds rate under the assumption that the relationship is stable and constant over the period from 1955 to 1989. The table reports the principal results of estimating the reduced form equations (1)-(3). Observe that both Treasury rates move in the same direction as the funds rate. Columns 1 and 2 show that the bill rate is much more responsive than the bond rate to movements in the funds rate. This is evidenced both by the larger regression coefficient and by the higher marginal R^2 of the bill rate. The higher sensitivity of the bill rate implies a flattening of the yield curve in response to a rise in the funds rate.

The third column of Table 2 shows that during the sample period from 1955 to 1989, an

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[5]If the coefficients α, β, and γ are assumed to be constant, the δ coefficients in the reduced form equations can also be obtained from regressions involving only the residuals ε from the basic vector autoregression. See Granger and Newbold (1977, Section 7.3).

Table 2

Bill Rates, Bond Rates, and Spread: Contemporaneous Effects of Funds Rate from Vector Autoregression 1955 to 1989

	Dependent Variable		
	Bill	Bond	Spread
Contemporaneous funds rate	.619	.189	-.431
	(21.17)	(8.24)	(-17.03)
Marginal R^2	.537	.149	.428
R^2	.989	.993	.948
SEE	.319	.250	.276

Notes: t-statistics in parentheses. Marginal R^2 is the proportion of the variance of the dependent variable that is not explained by lags of the funds, bill, and bond rates but is explained by the contemporaneous funds rate. It is the R^2 analogue of the t-statistic for the funds rate.

unanticipated rise of 1 percentage point in the funds rate caused an average drop in the spread of about 43 basis points.[6] The usefulness of this average sensitivity is limited, however, if the sensitivity does not remain constant over time. We now proceed to relax the assumption of constancy in various ways.

C. Tests of Parameter Stability

To test the hypothesis of parameter stability, we partition the sample into two periods with a break point in October 1979. This is a natural break point because the October 1979 change in

[6] As we noted earlier, theory provides little guidance on the magnitude of these effects. In a recent paper, Turnovsky (1989) presents a simple standard macroeconomic model to which he adds a "term structure" equation relating short- and long-term interest rates. He then investigates the effects of monetary and fiscal policy on the variables of the model. The Turnovsky model does not correspond exactly to the empirical model in the text, but like the latter it implies that the long rate reacts less to monetary policy than does the short rate. The ratio of the effect on the long rate to that on the short rate, however, seems to be lower in the Turnovsky model than in the empirical estimates reported in Table 2.

Table 3

Effect of Funds Rate on
Bill and Bond Rates and Spread
1955 to 1989
Sample Split: October 1979

	Dependent Variable		
	Bill	Bond	Spread
Full Period	.619 (21.17)	.189 (8.24)	-.431 (-17.03)
Pre-October 1979	.409 (8.91)	.149 (5.47)	-.260 (-6.51)
Post-October 1979	.761 (14.03)	.242 (4.81)	-.519 (-11.19)
Significance level of F-statistic for change	.0001	.00004	.0001

Note: t-statistics in parentheses.

operating procedure for monetary policy produced significant changes in many empirical relationships in the securities markets. Table 3 shows that the response of Treasury rates to changes in the federal funds rate is no exception. After October 1979, the bill and bond rates, as well as the spread, became more sensitive to unanticipated movements in the funds rate. Although all three coefficients were significant in the earlier period, their absolute values showed a statistically significant increase after October 1979. Observe that an unanticipated 1 percentage point rise in the funds rate causes a decline in the spread of 26 basis points before October 1979 and 52 basis points after October 1979. The instability of the response suggests that both explanatory and predictive accuracy may be improved by allowing the regression coefficients to change over time.

The selection of October 1979 as a break point is, to a certain extent, arbitrary. Although it is an important date for monetary policy, it is by no means the only significant event in recent years. For example, after the summer of 1982, monetary policy operating procedures were modified again.

Developments of this sort suggest that, in addition to October 1979, there may be other important breaks in the sample.[7] To uncover those possible breaks, we continue the empirical analysis by allowing the regression coefficients to vary smoothly over time.

D. Time-varying Regression Coefficients

A relatively simple way of allowing for time variation in the coefficients of a regression is to reestimate the relationship periodically. In this section we consider the results of estimating equations (1)-(3) using the technique of rolling regressions. Specifically, we estimate each equation over five-year intervals, advancing the estimation period one month at a time. Thus, a measure of the sensitivity of the Treasury rates to the funds rate is obtained for each five-year estimation period ending between July 1960 and May 1989. An important feature of this method is its "limited memory." Events that occurred before the beginning of a given five-year period have no statistical influence on the estimated coefficients for that period.[8]

Chart 1 plots the estimated time-varying sensitivity of the slope of the yield curve to unanticipated changes in the funds rate, together with a time-varying 95 percent confidence band for each point estimate. Observe that an unanticipated increase in the funds rate tends to lower the slope of the yield curve, but on certain occasions, notably in 1970, the relationship is reversed. However, none of the sporadic positive estimates is statistically significant, whereas many of the negative estimates are highly significant. The simple average of the coefficient estimates obtained from the rolling regressions is -25 basis points, compared with the estimate of -43 basis points when the coefficient is assumed to be constant.

Chart 2 plots the actual and predicted values of the spread. Clearly, the method of rolling regressions produces reasonably good results in predicting the slope of the yield curve. During the sample period from July 1960 to May 1989, the prediction root mean squared error is only 47 basis

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[7]Another possible break point is 1966. Until 1965, the federal funds rate did not exceed the discount rate and was relatively unresponsive to money market conditions. The Federal Reserve watched the repurchase agreement rate, the three-month Treasury bill rate, and dealer lending rates as gauges of reserve availability and money market conditions. See Meulendyke (1990).

[8] We also experimented with a model in which the sensitivity of the slope with respect to the funds rate is assumed to follow a random walk of the form:

$$\delta_t = \delta_{t-1} + v_t,$$

where δ_t is the sensitivity in month t and v_t is white noise. The results were fairly similar to those obtained from the rolling regressions.

Chart 1

Effect of Funds Rate on Yield Curve Slope

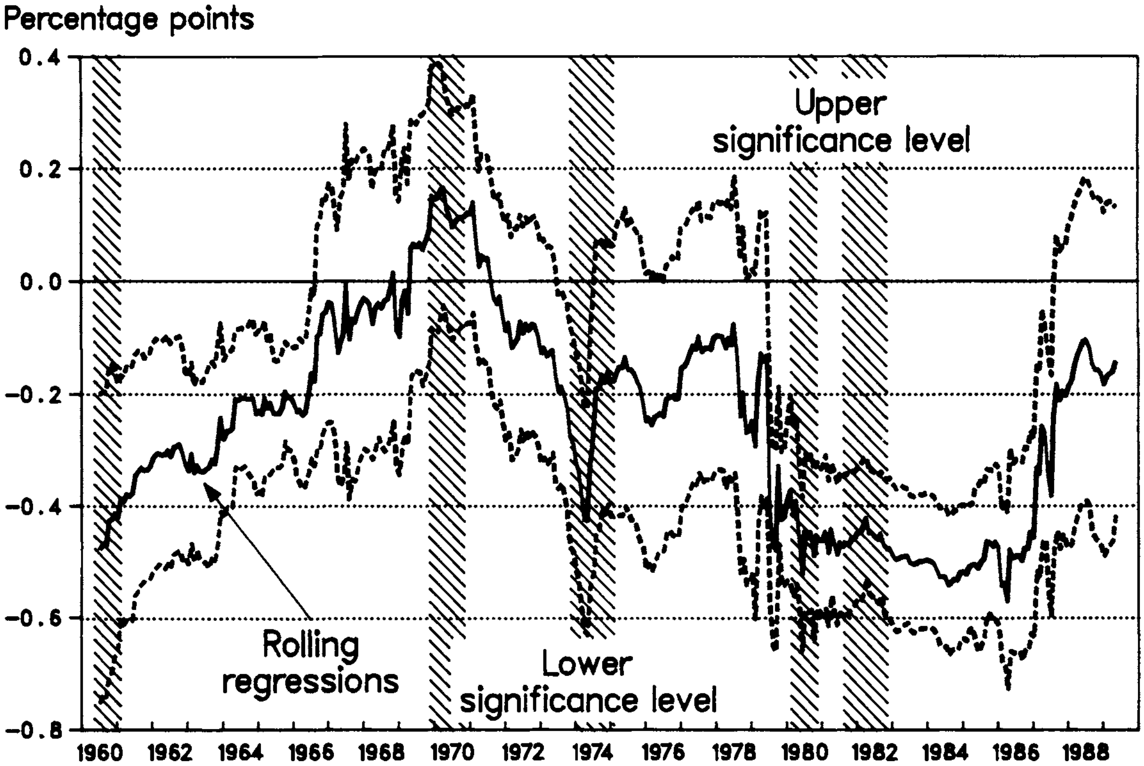


Chart 2

Predicted Yield Curve Slope Using Rolling Regressions

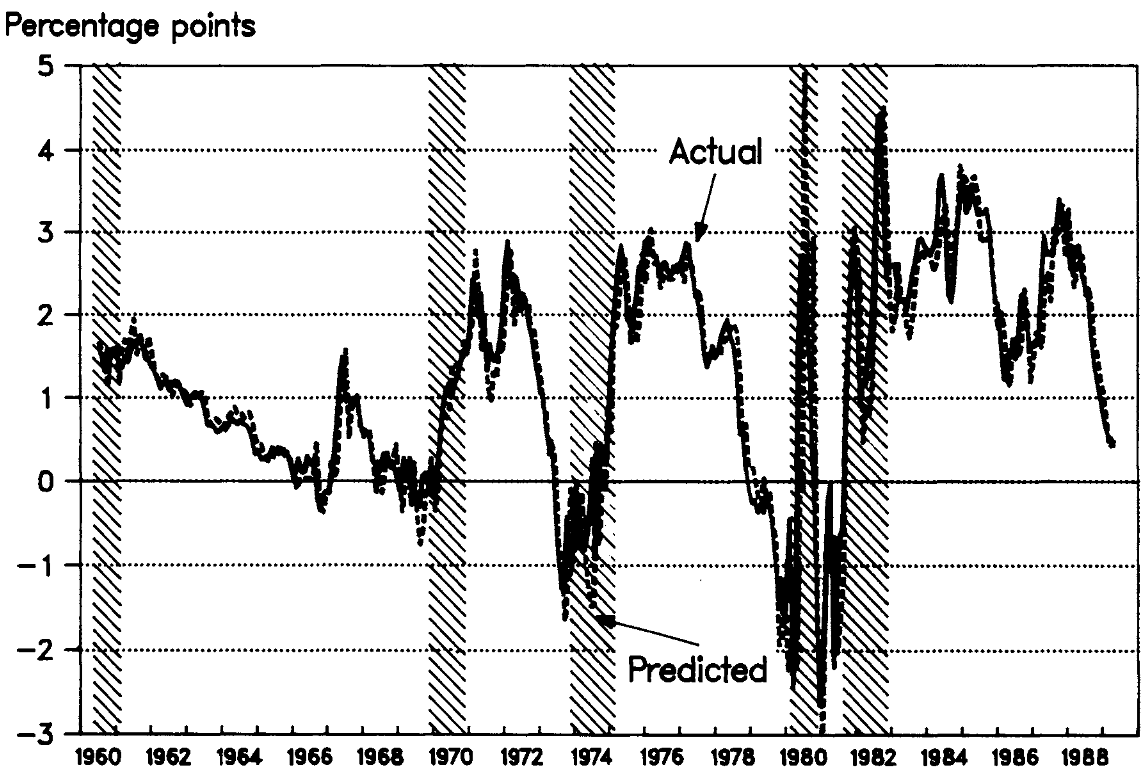
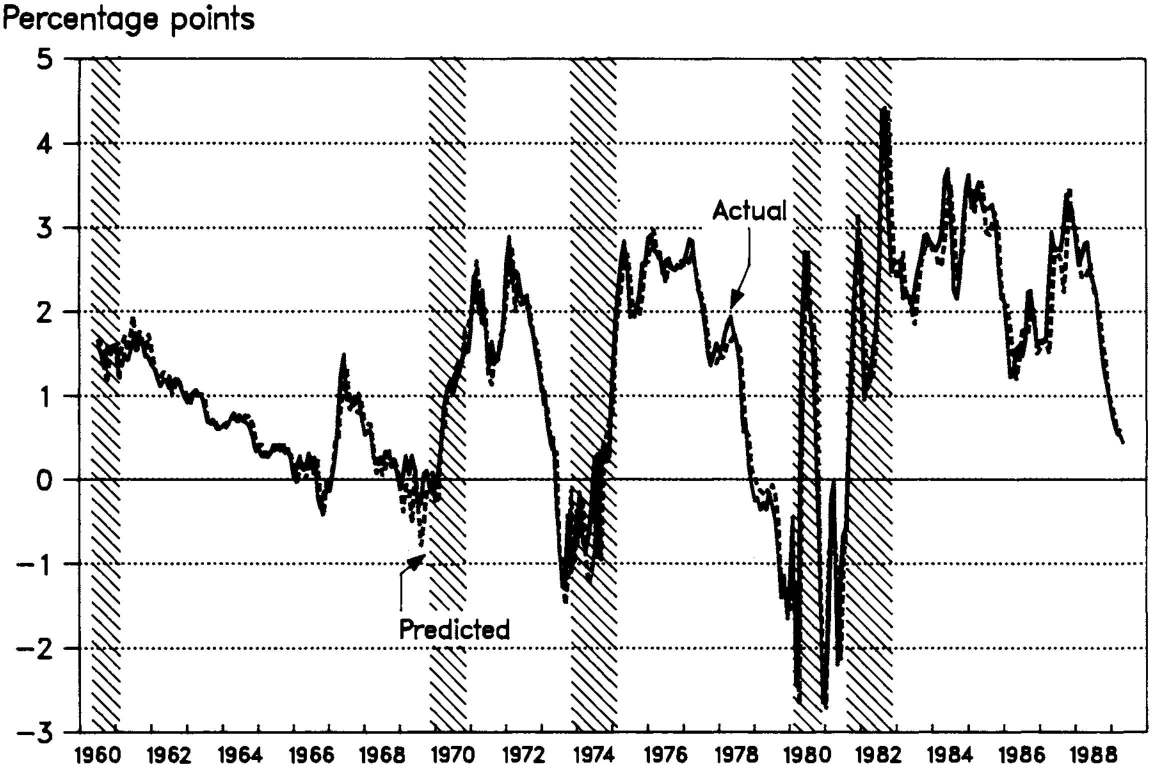


Chart 3

Predicted Yield Curve Slope Using Cumulative Regressions



points, whereas the standard deviation of the spread is 126 basis points.[9]

Although the rolling regressions method produces good forecasting results, it discards the data from earlier time periods. If there is persistence in the structure of the model, this method wastes potentially valuable information. In such a case, a superior method is a cumulative regression, which adds one observation at a time but does not dispose of older observations.

Chart 3 presents the predictions of the cumulative regressions. These predictions are qualitatively similar to the predictions of the rolling regressions. However, the prediction root mean squared error is now only 34 basis points, compared with 47 basis points when the method of rolling regressions is used. The slightly superior performance of cumulative regressions suggests that the

[9]The scale of Figures 2 and 3 may make the estimates appear more accurate than the root mean squared error would indicate. Note, however, that there are some predictive difficulties at turning points.

importance of structural shifts in the VAR model, while statistically significant, should not be exaggerated.

E. Coefficients as Functions of the Macroeconomy

We now explore the possibility that the time-varying sensitivity of the yield curve to monetary policy may be systematically related to the state of the macroeconomy. Many variables influence the effect of monetary policy on interest rates, but of these variables, inflation is the most important.

When the monetary authority assumes a more restrictive policy stance, it is frequently out of concern that the economy is overheating and that inflation rates may exceed acceptable levels. In these circumstances, the policy action would have a noticeable effect on future inflation and hence on inflation expectations. Thus, when an unanticipated increase in the funds rate occurs during a period of relatively high inflation, the tightening would probably be perceived as intentional and sustained and would therefore have a stronger negative effect on longer term inflationary expectations. Hence, the negative reaction of the yield curve to unanticipated increases in the funds rate would probably be more pronounced at times when inflation is high.

To test the importance of the level of inflation in the relationship between the federal funds rate and the slope of the yield curve, we may pose the following question: Is the effect of an unanticipated rise in the funds rate on the unanticipated change in the yield curve slope greater in magnitude when inflation is high? To measure the unanticipated component of the interest rates, we estimate an enhanced VAR of the sort described earlier using the funds, bill, and bond rates and the rate of inflation. Six lags of each variable are included as regressors. The difference between this VAR and the one reported earlier is the introduction of the inflation rate. Inflation is included mainly for consistency, since the contemporaneous rate will be introduced in a second stage of the estimation, but this addition does not affect the results in any appreciable way.

The main regression equation then has the following form:

$$\text{SPREAD}^u_t = \beta_0 + (\beta_1 + \beta_2\text{INFLATION}_t) * \text{FUNDS}^u_t,$$

where the superscript u identifies the unanticipated component of the variable, which is the residual from the appropriate VAR equation. Observe that the coefficient of the unanticipated component of the funds rate is a function of the inflation rate. The parameter estimates for the sample period from August 1955 to May 1989 are as follows:

β_1 = -.303 (-6.17)

β_2 = -.181 (-2.81),

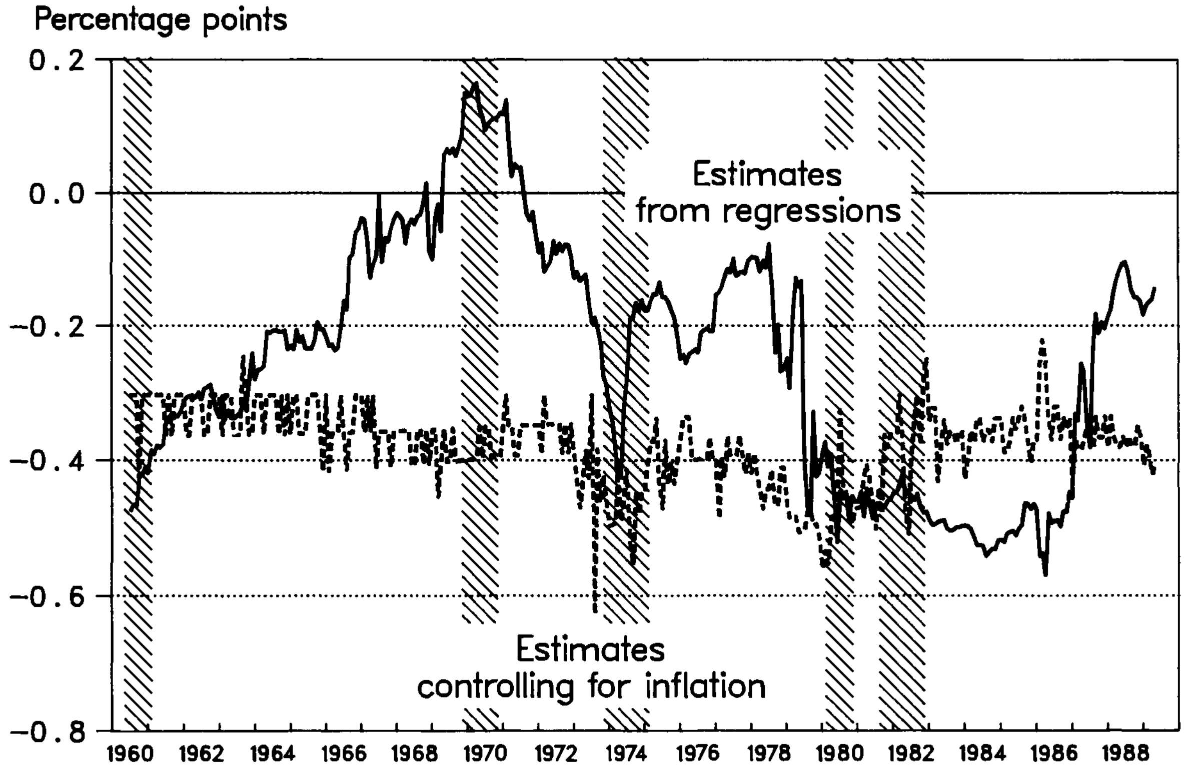
where t-statistics appear in parentheses. The negative and significant β_2 implies that the inflation rate has an important effect on the sensitivity of the slope to the funds rate. For every additional percentage point of inflation, the decline of the spread in response to a percentage point rise in the funds rate increases by 18 basis points. Thus, the evidence is consistent with the hypothesis that higher inflation makes contractionary policy more "credible."

Furthermore, there is evidence that the inflation rate explains a large portion of the overall variability in the sensitivity of the spread to the funds rate. When the coefficient of the funds rate is allowed to vary with inflation, there are no further strong signs of instability in the model. For example, a structural break in October 1979 is rejected at the 5 percent level of significance.

Chart 4 plots the predicted sensitivity of the slope of the yield curve from the previous regression with the time-varying sensitivity from the earlier rolling regressions. It is clear from the chart that the contemporaneous effect of inflation identified in this section does not fully explain the statistical variability of the sensitivity of the yield curve slope to the funds rate. Nevertheless, the significance of the β_2 coefficient shows that inflation does explain a large portion of that variability.

Chart 4

Effect of Funds Rate on Yield Curve Slope



F. Summary

The results of this part of the paper suggest that monetary policy has significant and predictable effects on the slope of the yield curve. The magnitude of these effects has varied over time, however, and has been highest in periods of high inflation. Over the entire sample period from 1955 to 1989, an unanticipated increase in the federal funds rate of 1 percentage point decreases the spread between the ten-year Treasury bond rate and the three-month Treasury bill rate by about 40 basis points. Currently, the effect is weaker, however, and is in the neighborhood of 15 to 20 basis points.

II. The Yield Curve, Future Output, and Future Inflation

The yield curve could be an intermediate target of monetary policy if it were to exhibit a stable and causal relationship with the ultimate targets of policy, namely, real output and inflation. The more causal and direct the relationship, the better the variable as an intermediate target. In the case of the yield curve, it is difficult to conceive of a strong causal relationship with the final targets, but there is evidence of a predictive relationship between these variables.

Estrella and Hardouvelis ([1989], 1991) and Laurent (1988, 1989) present evidence that the yield curve predicts future real output. Mishkin (1987) and Fama and Bliss (1988) show that the yield curve predicts future inflation. Overall, the yield curve is a predictor of real activity in the short run (within two years) and of inflation in the long run (beyond two years). The remainder of this section summarizes and evaluates the evidence on the predictive power of the slope of the yield curve.

A. The Yield Curve as a Predictor of Real Activity

Economic theory--the expectations hypothesis--provides a clear connection between present interest rates of different maturities and future expected spot rates. It does not, however, establish a precise connection between current spot interest rates and the future level of real economic activity.

Theoretically, for example, an inverted yield curve may predict either a decrease or an increase in real GNP. The spot short-term rate may be expected to fall in the future because of a decline in real economic activity (an inward shift of the textbook IS curve). Alternatively, the interest rate may be expected to fall because an expansionary monetary policy is anticipated (an expected future outward shift in the textbook LM curve, so long as the policy is not perceived to be inflationary). In the latter case, the implicit prediction in the term structure is that output would expand. Another possibility is that an inverted yield curve may reflect an expected decrease in the rate of inflation attributable to an expected expansion in aggregate supply. Here too an increase in output is anticipated.

Because theory offers no clear resolution of this issue, the contention that the slope of the yield curve predicts future changes in real economic activity in a specific direction can only be judged on empirical grounds. We find that the empirical relationship between the slope of the yield curve and future GNP growth is positive. Chart 5 plots the growth rate of GNP from four quarters earlier and the spread between the ten-year Treasury bond and the three-month Treasury bill four quarters earlier (that is, at the beginning of the period over which growth is measured). The slope of the yield curve tracks the future realization of output growth impressively well, especially in the 1970s and 1980s.

To present more precise empirical evidence, we run regressions of the form:

$$Y_{t,t+k} = \alpha + \beta \text{ SPREAD}_t + \varepsilon_t,$$

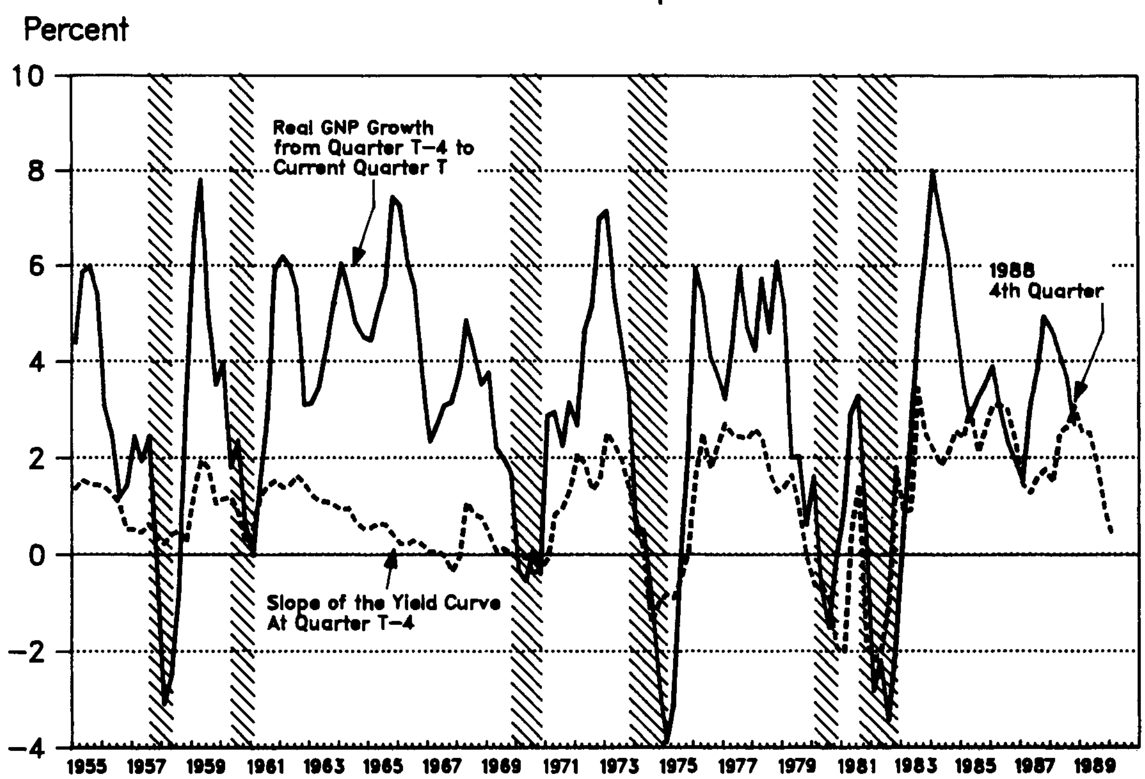
where y_t = real GNP in quarter t,

$Y_{t,t+k} = (400/k)[\log(y_{t+k}/y_t)]$ = cumulative real GNP growth over the next k quarters at an annual rate,

SPREAD_t = ten-year Treasury bond rate minus three-month Treasury bill rate on a quarterly average basis in quarter t.

Chart 5

Growth of Real GNP and the Slope of the Yield Curve



The value of k, the prediction horizon, is allowed to run from one quarter to five years. We estimate the model using quarterly data from 1955 to 1988 and using overlapping observations for k-quarter GNP growth when k is 2 or more.

For forecast horizons beyond one quarter, the overlapping horizons produce econometric problems that have been discussed by Hansen and Hodrick (1980). The data overlap creates a moving average error term of order k-1, where k is the forecast horizon. This does not affect the consistency of the ordinary least square (OLS) coefficient estimates but does affect the consistency of the OLS standard errors. To perform hypothesis tests, we adjust the standard errors using the Newey-West (1987) method.

Table 4 presents the basic regression results. Empirically, the yield curve slope and future real growth are positively correlated. A steeper yield curve slope implies faster future growth in real output. The R^2 provides a measure of in-sample forecasting accuracy, while the statistical significance of the SPREAD coefficient provides information on the reliability of the equation in predicting the direction of a future change in output. Observe that accuracy in predicting cumulative changes is highest five to seven quarters ahead. For these horizons, the spread explains more than one-third of the variation in future output changes. This result is especially impressive because, as shown below, the lagged value of real GNP growth has very little predictive power.

The yield curve seems to make particularly good predictions when large changes in output take place. To illustrate this, we use the SPREAD variable, as defined above, to predict whether or not the economy will be in a recession four quarters ahead. (We employ the National Bureau of Economic Research dating of recessions.) Chart 6 shows the periods when a recession occurred, together with the probability of a recession based on a model that uses the spread of four quarters earlier as the only explanatory variable. The dependent variable in the equation assumes a value of one in quarters within a recession and zero otherwise. The resulting equation, estimated using quarterly data from 1956 to 1988, is:

$$\text{Probability(recession)} = N[\underset{(.16)}{-.56} - \underset{(.16)}{.78}\ \text{SPREAD}_{t-4}],$$

where N denotes the standard normal cumulative distribution function and standard errors appear in parentheses.[10] As Chart 6 shows, the only time the yield curve gave a wrong signal was in 1966-67,

[10]The model was estimated using the probit method, a maximum likelihood technique that assumes that the errors in the equation are normally distributed.

Table 4
Predicting Future Change in Real Output Using the Slope of the Yield Curve
Sample: Quarterly, 1955 to 1988

$$(400/k)(\log y_{t+k} - \log y_t) = \alpha_0 + \alpha_1 \text{SPREAD}_t + \varepsilon_t$$

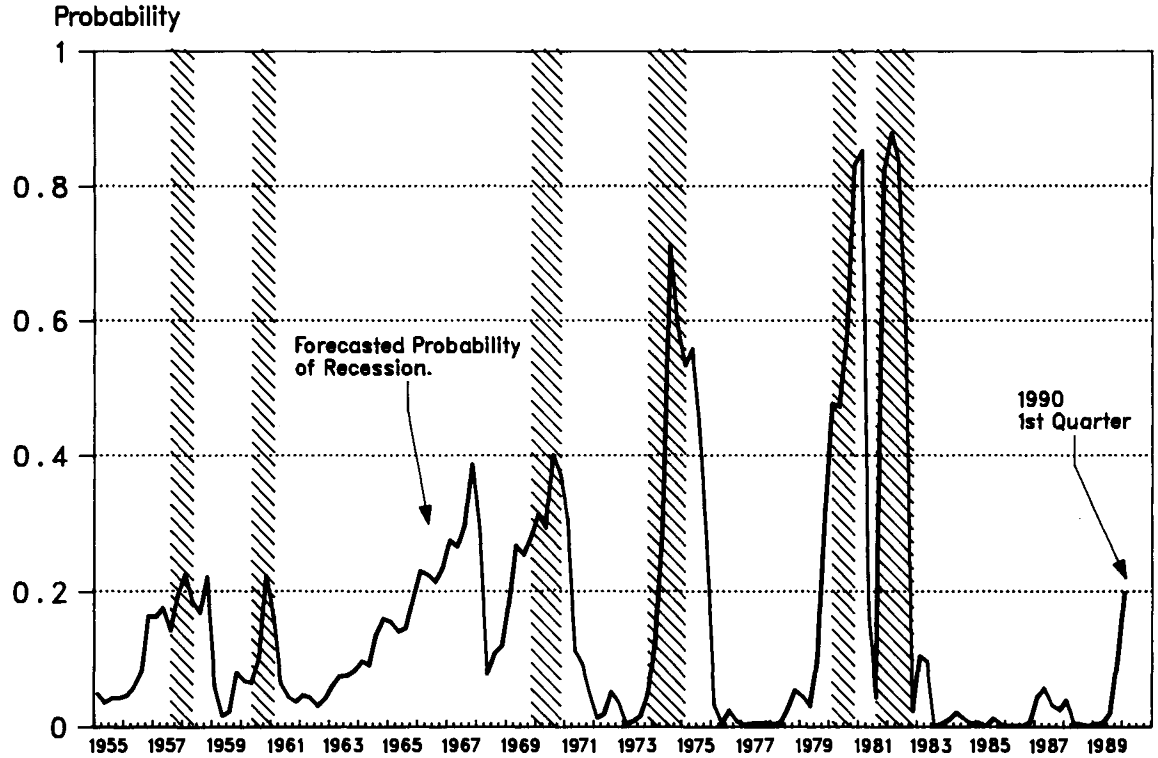
k (Quarters Ahead)	Nobs	α_0	α_1	R^2	SEE
1	135	1.74* (0.64)	1.23* (.29)	.13	3.75
2	134	1.63* (0.56)	1.35* (.28)	.24	2.82
3	133	1.64* (0.54)	1.35* (.28)	.31	2.39
4	132	1.70* (0.52)	1.30* (.27)	.35	2.08
5	131	1.79* (0.50)	1.24* (.24)	.38	1.86
6	130	1.89* (0.48)	1.15* (.22)	.38	1.70
7	129	1.99* (0.46)	1.05* (.19)	.37	1.59
8	128	2.11* (0.44)	0.93* (.16)	.33	1.54
12	124	2.50* (0.37)	0.53* (.14)	.18	1.34
16	120	2.75* (0.30)	0.33* (.11)	.09	1.16
20	116	2.86* (0.24)	0.23 (.14)	.05	1.00

Notes: y_t is the level of real GNP of quarter t. SPREAD_t is the difference between the ten-year Treasury bond and three-month Treasury bill rates. The interest rates are annualized quarterly-average bond-equivalent yields. In parentheses are Newey-West (1987) corrected standard errors that take into account the moving average created by the overlapping of forecasting horizons as well as conditional heteroskedasticity. Nobs denotes the number of quarterly observations, R^2 the coefficient of determination adjusted for degrees of freedom, and SEE the regression standard error.

*Significant at 5 percent level.

Chart 6

Probability of Recession (within Sample) Based on Yield Curve Slope for Quarter T−4



when a slowdown occurred instead of a recession.

B. The Yield Curve, Other Information Variables, and Real Activity

In this section, we add to the basic regression equation a number of information variables that are widely thought to predict future real economic activity. Our aim is to determine whether the slope of the yield curve continues to have predictive power in the presence of these other variables. We also examine how the yield curve slope performs relative to survey forecasts of real GNP growth.

The information variables we choose are: the real federal funds rate, the recent growth in the Commerce Department's index of leading indicators, lagged growth in real output, and the lagged rate of inflation. The real federal funds rate is included as a proxy for the tightness of monetary policy. The nominal funds rate is adjusted for inflation expectations obtained from a twelfth-order autoregressive model for the inflation rate. Lagged inflation and lagged output growth are included in the regression primarily because they describe the state of the economy.

Our reasons for including the index of leading indicators, which consists of eleven macroeconomic variables, are obvious. The variables, both real and financial, are termed leading indicators precisely because they have been found to have predictive power. The index provides a convenient way of summarizing their aggregate information without entering each variable separately in the regression equation. Some of the components do not become known until a month or more after the statement month. Since we want to use only regressors that are known to market participants at the time the slope of the yield curve is determined, we define the rate of growth in the index from the first month of the previous quarter to the first month of the current quarter.

The regression results, presented in Table 5, point to several interesting conclusions. First, the spread continues to have explanatory power over the entire range of forecasting horizons. Its regression coefficients are statistically significant up to three years into the future. Second, an increase in the real federal funds rate predicts a drop in real GNP, ceteris paribus, for about six quarters into the future. Third, an increase in the index of leading indicators predicts a future increase in real GNP; however, the predictive power lasts for only three quarters. This performance is very weak when compared to that of the yield curve. Fourth, the lagged growth in output has a negative coefficient, showing a slight degree of reversion towards the mean. Fifth, the lagged rate of inflation also shows a negative coefficient; this coefficient is statistically significant at horizons beyond two quarters.

C. Comparison with Survey Forecasts

Another way to test the quality of the information in the yield curve slope is to compare its forecasting performance with that of survey forecasts. We use data from a midquarter survey of real GNP forecasts conducted by the American Statistical Association and the National Bureau of Economic Research since the beginning of 1970. The data are the survey medians and refer to the current and the following two quarters. Starting with 1981, we also have forecasts for three quarters ahead.

Table 6 presents the results of regressing the realized percentage change in GNP on the spread and on the survey prediction. It is clear that the spread is a better predictor than the survey median. The survey has predictive power for only one and two quarters ahead, but not for three quarters ahead. This is evidenced by the level of the R^2s and by the significance of the coefficient β_1, which corresponds to the survey forecast. Observe that the R^2s for the yield curve alone are consistently higher than those for the survey alone. In addition, the coefficient of the survey forecast is not significant beyond one quarter if the spread is present in the regression.

Table 5

Predicting Future Change in Real Output Using the Slope of the Yield Curve and Other Information
Sample: 1955 to 1988

$$(400/k)(\log y_{t+k} - \log y_t) = \alpha_0 + \alpha_1 \text{ SPREAD}_t + \alpha_2 \text{ RFF}_t + \alpha_3 \text{ GLI}_t + \alpha_4 \text{ LDEP}_{t-k} + \alpha_5 \pi_{t-k,t} + \varepsilon_t$$

k (Quarters Ahead)	α_1	α_2	α_3	α_4	α_5	$\bar{R}^2$	SEE
1	.55*	-.24*	.16*	-.03	-.14	.28	3.40
	(.26)	(.11)	(.04)	(.10)	(.11)		
2	.73*	-.31*	.10*	-.04	-.17	.40	2.51
	(.24)	(.07)	(.03)	(.07)	(.12)		
3	.78*	-.27*	.07*	-.15*	-.26*	.46	2.12
	(.26)	(.07)	(.03)	(.07)	(.12)		
4	.81*	-.24*	.04	-.18*	-.29*	.49	1.84
	(.26)	(.07)	(.024)	(.05)	(.12)		
5	.82*	-.20*	.02	-.21*	-.31*	.52	1.63
	(.24)	(.06)	(.02)	(.08)	(.12)		
6	.82*	-.17*	.00	-.21	-.29*	.50	1.52
	(.22)	(.07)	(.01)	(.11)	(.12)		
7	.79*	-.12	-.00	-.22	-.27*	.48	1.45
	(.20)	(.07)	(.01)	(.13)	(.11)		
8	.71*	-.10	-.01	-.26	-.27*	.44	1.41
	(.17)	(.07)	(.01)	(.13)	(.11)		
12	.38*	-.00	-.01	-.33	-.26	.29	1.25
	(.15)	(.07)	(.02)	(.21)	(.15)		
16	.27	.05	-.01	-.36	-.29*	.29	1.02
	(.19)	(.04)	(.01)	(.27)	(.08)		
20	.16	.09	.01	-.54*	-.32*	.44	0.77
	(.09)	(.05)	(.01)	(.09)	(.05)		

Notes: y_t is real output of quarter t. SPREAD_t equals the ten-year Treasury bond rate minus the three-month Treasury bill rate. RFF_t is the real federal funds rate (nominal minus expected inflation). All interest rates are annualized quarterly averages. GLI_t is the annualized growth in the index of leading indicators from the first month of quarter t-1 to the first month of quarter t. $\text{LDEP}_{t-k} = (400/k)(\log y_t - \log y_{t-k})$ is a lagged dependent variable. $\pi_{t-k,t}$ is the annualized rate of inflation of the GNP deflator from quarter t-k through quarter t. Newey-West (1987) corrected standard errors are in parentheses.

*Significant at the 5 percent level.

Table 6
Survey Forecasts versus Term Structure Forecasts

$$Y_{t+k} = (400/k)(\log y_{t+k} - \log y_t) = \alpha_0 + \alpha_1 \text{ SPREAD}_t + \beta_1 \text{ SURVEYF}_{t,k} + e_t$$

k (Quarters Ahead)	Sample Period	α_0	α_1	β_1	$\bar{R}^2$	SEE	Chi-Squared(2) (α_0=0,β_1=1)
1	February 1970	.56		.67*	.08	4.08	16.5*
	to		(.59)		(.10)		[.000]
	April 1988						
		1.08*	1.30*		.19	3.83	
		(.45)	(.27)				
		.46	1.13*	.26*	.19	3.84	
		(.54)	(.28)	(.09)			
2	March 1970	-.32		.88*	.15	3.11	5.83
	to		(.74)		(.17)		[.054]
	April 1988						
		.96*	1.42*		.37	2.68	
		(.36)	(.22)				
		.21	1.28*	.27	.38	2.67	
		(.93)	(.24)	(.26)			
3	January 1982	2.28		.22	-.04	3.01	0.51
	to		(3.44)		(1.25)		[.777]
	April 1988						
		-.13	1.59*		.39	2.33	
		(.82)	(.28)				
		-3.88	1.72*	1.04	.41	2.26	
		(2.58)	.26	(.82)			

Notes: Y_{t+k} is the annualized cumulative growth rate of real GNP from quarter t to quarter t+k. SPREAD_t is the difference between the ten-year Treasury bond and three-month Treasury bill yield. $\text{SURVEYF}_{t,k}$ is the ASA/NBER forecast of Y_{t+k}. Numbers in parentheses are Newey-West (1987) corrected standard errors. The last column presents a test for unbiasedness of the predictions $\text{SURVEYF}_{t,k}$. Numbers in brackets are significance levels.

*Significant at the 5 percent level.

D. The Yield Curve as a Predictor of Inflation

We now examine the ability of the slope of the yield curve to predict changes in the rate of inflation. We regress the change in the inflation rate over a forecast horizon of k quarters ahead on the level of the spread and on the first lag of the dependent variable. The basic equation is:

$$\Pi_{t,t+k} = \alpha + \beta \text{ SPREAD}_t + \gamma \Pi_{t-k,t},$$

where $\Pi_{t,t+k}$ is $\pi^k_t - \pi^1_{t-1}$, π^k_t is the k quarter inflation rate starting in quarter t, and SPREAD is defined as before.

Table 7 presents the results. The spread has predictive power, but only for forecast horizons of two years or longer. Like the relationship between real activity and the spread, the association between inflation and the spread is positive, but the significance appears at longer forecast horizons and the statistical fit is not as close.

III. Conclusion

We studied the relationship of the yield curve to one policy instrument, the federal funds rate, and two policy targets, real GNP and inflation. In all cases, we found historical relationships that may be useful additions to the armamentarium of policy makers as they try to assess the economic outlook.

First, although the historical relationship between the federal funds rate and the slope of the yield curve has varied over time, our evidence indicated that the slope has been sensitive to policy actions and that the monetary authority has had a significant influence over the slope. Second, we found that the yield curve has provided information about future real activity and inflation that may have been useful to both private observers and policy makers. Clearly, since the level of the short-term rate[11] has been significant in explaining the slope, part of the information in the slope is related to the stance of monetary policy. But there is also a component of predictability that is not related to current monetary policy and may reflect expectations of future developments in the real sector of the economy (shifts in the IS curve). This last component may be of interest to policy makers.

While the intertemporal relationships between the slope of the yield curve and real GNP or inflation are clear and statistically significant, they cannot be easily interpreted in a causal manner. This limitation suggests that the yield curve does not have a role as a formal intermediate target of monetary policy. The relationships simply indicate that the yield curve slope has historically been one of a series of variables that both the public and the private sector could have utilized in the

[11]The funds rate, whether real or nominal, and the Treasury bill rate.

Table 7

Predicting Future Change in the Rate of Inflation with the Slope of the Yield Curve

Sample: 1955-1988

$$\Pi_{t,t+k} = \alpha_0 + \alpha_1\ SPREAD_t + \alpha_2\ \Pi_{t-k,t} + \varepsilon_t$$

K (Quarters Ahead)	Independent Variable			
	SPREAD	LDEP	$\bar{R}^2$	SEE
1	-.05 (.08)	-.44* (.07)	.18	1.74
2	.03 (.09)	-.29* (.06)	.07	1.68
3	.00 (.08)	-.21* (.07)	.03	1.69
4	.03 (.08)	-.07 (.06)	-.01	1.70
5	.05 (.06)	-.05 (.04)	-.01	1.71
6	.05 (.08)	-.11 (.07)	.00	1.75
7	.08 (.09)	-.14 (.08)	.02	1.79
8	.22* (.08)	-.02 (.09)	.01	1.83
12	.36* (.12)	-.12 (.09)	.07	1.93
16	.60* (.11)	-.00 (.08)	.10	2.01
20	.70* (.14)	.02 (.05)	.11	2.12

Notes: The dependent variable is defined as the annualized rate of inflation of the GNP price deflator from current quarter t to future quarter t+k minus the annualized rate of inflation from quarter t-1 to current quarter t. LDEP is a lagged dependent variable. SPREAD is defined as the current forward rate implicit in the term structure minus the three-month Treasury bill rate. All interest rates are annualized quarterly averages.

* Significant at the 5 percent level.

formulation of their plans and policies. The statistical relations of the past, however, may well deteriorate in the future, especially if policy makers attempt to make use of the slope of the yield curve as a predictor of future macroeconomic developments.[12]

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THE USE OF DOLLAR EXCHANGE RATES AS TARGETS OR INDICATORS FOR U.S. MONETARY POLICY

Charles Pigott and Christopher Rude

In the last decade, financial deregulation, innovation, and other economic changes have significantly reduced the usefulness of the targets and indicators traditionally used to guide U.S. monetary policy. As documented in other contributions to this volume, the medium-term relation between the money and credit aggregates and nominal GNP, real GNP, and inflation has become more variable and less predictable, while the economic impacts as well as information content of interest rates have continued to be uncertain. The apparent deterioration of conventional monetary policy guides has spurred renewed discussion of the utility of alternatives. This paper examines one of the more novel of these alternatives, namely, dollar exchange rates.

In keeping with the other papers in this volume, we review the available evidence to determine how exchange rates might be used in U.S. monetary policy as traditionally defined, where price stability and other *domestic* goals are the primary concerns. While extensive, most of the literature on exchange rates and monetary policy presupposes a somewhat different context, one in which external objectives such as current account balance or maintenance of a fixed exchange rate are explicit goals of policy. Accordingly, our task in this paper is to examine what the literature suggests about how and to what extent exchange rates might aid U.S. monetary policy as it is presently defined.

We begin in the next section with a discussion of several characteristics of exchange rate behavior that differ importantly from those of more traditional monetary policy targets and that are likely to condition its use in monetary policy. This discussion draws on the short sketch of current views of exchange rate determinants and their effects given in Appendix 1. The remaining sections evaluate specific ways in which exchange rates might be employed to assist U.S. monetary policy. Section I considers the use of the dollar as a primary intermediate target (largely) in place of domestic interest rates or money/credit aggregates. Section II categorizes and analyzes ad hoc uses of exchange rate considerations as "side constraints" or "modifiers" on the path of more traditional operating instruments or intermediate targets. Section III examines evidence on the utility of exchange rates as indicators of the stance of monetary policy and the course of the economy.

Given the complexity of exchange rate behavior, it should hardly be surprising that the evidence does not provide much in the way of specific prescriptions for the use of exchange rates as guides for U.S. monetary policy. Our review does lead, however, to three more general conclusions that say much about both the limits and the potential of exchange rates in monetary policy formulation. The first is that the use of exchange rates in monetary policy raises broader issues than those associated with the use of more traditional domestic target variables such as the money aggregates and interest rates. The influences on exchange rates are significantly more varied than those affecting domestic interest rates and other traditional monetary policy variables, and the present understanding of these influences is considerably less. Equally important, the systematic use of exchange rates in U.S. monetary policy formulation would almost inevitably involve considerations of international economic policy interdependence to a much greater degree than does the use of interest rates or other more obviously domestic variables.

The second conclusion is that use of exchange rates as primary intermediate targets of U.S. monetary policy, even if those targets are fairly flexible, would not improve the performance of policy in maintaining macroeconomic stability and could easily add to instability under the circumstances that prevailed through much of the last decade. Use of exchange rate targets would be most appropriate if shifts in the demand for money balances were the *primary* macroeconomic disturbances to currency values and the economy at large, a proposition very strongly rejected by the evidence of both the literature and historical experience.

Nonetheless, despite this negative verdict, the literature does suggest (our third conclusion) that exchange rates may have certain more limited policy uses. The two most important are the ad hoc use of exchange rate considerations as policy guides when policy objectives or the efficacy of policy instruments are impaired by foreign exchange market conditions, and the use of exchange rates as indicators of the state of the economy and the policy stance. The difficulty is that present knowledge is inadequate to define how such exchange rate considerations might be more reliably and systematically used by policy makers than is presently possible.

Accordingly, our review suggests neither that U.S. monetary policy procedures should be significantly modified to take a more systematic account of exchange rates, nor that exchange rates should in any sense be ignored by policy. Future research seems unlikely to alter either of these conclusions--unless the basic priorities of U.S. monetary policy are substantially altered. Nevertheless, future research may--and, with luck, will--make the eclectic weighing of exchange rate considerations in policy formulation a somewhat more systematic and informed task.

I. Basic Issues Concerning the Use of Exchange Rates in Monetary Policy

The literature has traditionally characterized the tools of monetary policy in terms of policy *instruments* and *operational targets* (the variables controlled most directly and closely by authorities), *intermediate targets*, and *indicators*.[1] Collectively, these tools are used to achieve the fundamental objectives of monetary policy, which in the United States are the essentially internal goals of price stability (or an acceptably low rate of inflation) in the long run and stabilization of real growth near potential in the medium term.[2] Within this context, exchange rates plainly cannot be viewed as objectives. Nor, for reasons that will become obvious shortly, is it likely that exchange rates can be controlled sufficiently closely to be used as instruments or operational targets, at least without a radical reorientation of U.S. monetary policy operations.

Accordingly, our discussion in the remainder of this paper is confined to the various ways in which exchange rates might be employed as intermediate targets or as systematic monetary policy indicators. As we will see, the issues that must be considered include not only those discussed in the standard literature on domestic targets and indicators, such as the "stability" of a variable's relation to the operating targets and goal variables and the information content of potential indicators, but also questions arising from the special characteristics of exchange rates as macroeconomic variables.

We emphasize that our discussion concerns uses of exchange rates in addition to, or beyond, the normal assessment of the likely economic effects of the dollar along with interest rates and other key domestic variables that authorities now, of necessity, regularly undertake in formulating policy. As is increasingly obvious, the United States is an open economy and monetary authorities here, like their counterparts abroad, simply cannot ignore exchange rates in evaluating the condition of the economy and the effects of their policy actions. The question considered in this paper is whether exchange rate considerations should be elevated beyond this very important role to a more central and formal place in monetary policy formulation.

Although the role of exchange rate considerations in monetary policy has been a major theme

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[1] See the Introduction to this volume by Richard Davis for a more precise and extensive discussion of these tools and their functional role in monetary policy.

[2] As defined in the Federal Reserve System Purpose and Functions (Board of Governors of the Federal Reserve, October 1984 edition), "The basic goal of monetary policy . . . is to ensure that, over time, expansion in money and credit will be adequate for the long-run needs of a growing economy at reasonably stable prices. Over the shorter run, monetary policy is also conducted so as to combat cyclical inflationary or deflationary pressures" (p. 13).

of the international economics literature for many years, most of that literature has been concerned with the use of policy to achieve (at least in part) external objectives, such as a balanced current account or the maintenance of a fixed exchange rate or some other exchange rate *regime*. Little, in contrast, has been written about the use of exchange rates as targets or indicators in a domestically oriented monetary policy of the sort used in the United States. This does not mean that the literature is in any sense uninformative about the issues to be considered here, but it does mean that conclusions must largely be based on inferences from the broader literature on exchange rates and their macroeconomic effects.

Partly for this reason, we begin our discussion with a summary of several key features of exchange rate behavior that are particularly relevant to the use of exchange rates in U.S. monetary policy. Our review includes considerations likely to condition or limit the ways in which exchange rates could feasibly be used in U.S. monetary policy and characteristics that make exchange rates "different" in an important sense from more traditional monetary targets and indicators. The discussion here draws in part on a summary of current views of exchange rate behavior and determinants given in Appendix 1.

A. Considerations Shaping the Use of Exchange Rates in Monetary Policy

Exchange rate behavior has proved a notoriously complex and controversial subject and it might seem therefore that one could make few definite claims about the use of exchange rates in monetary policy. Such a conclusion would be premature, however. As explained in Appendix 1, there is considerable agreement about the general framework to apply to the analysis of exchange rates: the rates are regarded essentially as asset prices determined by a wide range of monetary, financial, and real factors. Moreover, the major controversies about exchange rate behavior largely concern the relative empirical importance of various potential influences rather than the fundamental channels through which these influences operate. In this sense, significantly more is actually known about exchange rate behavior than is often appreciated, and enough, at the least, to suggest several general considerations about the way in which exchange rates might be used in U.S. monetary policy.

The foremost, and certainly most obvious, feature distinguishing exchange rates from more traditional monetary policy tools is their international character. Admittedly, domestic interest rates and other conditions are increasingly influenced by conditions abroad, but dollar exchange rates are inherently international variables in that they are determined by foreign as much as domestic conditions. Plainly, dollar exchange rates cannot be independently targeted by the U.S. monetary authorities or their foreign counterparts; the dollar value of the yen, for example, is jointly influenced by U.S. and Japanese monetary policy. Furthermore, movements in the dollar have important impacts on the incomes, price levels, and trade balances of our partners as well as ourselves. Consequently, a path of exchange rates that is desirable for the U.S. economy can easily be less desirable, or even undesirable, for foreigners.

One obvious consequence of these interdependencies is that any policy use of exchange rates involves consideration of both foreign and domestic economic conditions. More important, such use almost inevitably raises issues of international policy coordination and potential policy conflicts. The reason is that any systematic attempt by the United States (or foreigners) to use exchange rates as policy targets is likely to affect the policy trade-offs faced by foreigners and could restrict their policy options. Thus, although U.S. authorities might in theory be able to use exchange rates as intermediate targets while maintaining their traditional monetary autonomy and priorities, in practical terms, as we will see in the next section, this arrangement is unlikely to be viable without some significant degree of coordination with our partners. More generally, the use of exchange rates in monetary policy normally cannot be separated from broader issues of international macroeconomic policy coordination nearly as easily as the use of money aggregates or interest rates.

A second key feature of exchange rates is the exceptionally wide range of their determinants.[3] Admittedly, the difference in this respect between exchange rates and other domestic financial prices, which are also subject to many influences, is one of degree, but the difference nonetheless has important policy implications. As explained in Appendix 1, exchange rates are influenced by determinants of domestic and foreign interest rates, home and foreign price levels, and the relative prices of traded and nontraded products--a list which includes virtually all macroeconomic "fundamentals."[4] Moreover, as asset prices, exchange rates are potentially influenced by expectations

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[3] Exchange rates, in fact, differ from other asset prices in that they are in an important sense determined by home and foreign asset markets *collectively* rather than in a market for any particular asset. The dollar value of the German mark does not represent the price of a particular dollar or mark asset but rather a rate at which dollar and mark assets generally trade for one another. Thus the effective "market" influencing exchange rates is very large and broad. Partly for this reason, the management of exchange rates if used as intermediate targets is likely to involve considerably looser control than the management of short-term interest rates or even the money aggregates under more traditional operating procedures.

[4] Exchange rates in effect represent the collective outcome of economic developments at home and abroad and therefore cannot, except under very special circumstances, be viewed in terms of the (continued...)

about all these variables (even those that are only "long-run" determinants of exchange rate equilibrium) as well as their actual outcomes.[5] Furthermore, and of particular importance here, the evidence and historical experience amply demonstrate that all the major theoretical determinants of exchange rates--inflation, interest rates, and real factors--have played important roles empirically in exchange rate determination, and that the relative importance of each has varied considerably over time and across countries.

The implication is that observed currency movements and their interactions with other economic variables are likely to be exceptionally complex and variable. Indeed, theoretical models have shown that any particular disturbance is likely to induce complex "dynamics" in exchange rates in conjunction with interest rates, prices, and incomes. The pattern of these interactions depends upon the formation of expectations (for example, "rational," adaptive, or other types of expectation) and short- and long-term adjustment lags in various markets. Moreover, the currency movements that are actually observed will normally be a reflection of the current and lagged effects of not one but many such disturbances.

These observations have three important consequences for the use of exchange rates in monetary policy formulation. First, the interpretation of exchange rate movements, taken alone or in conjunction with other variables, is inherently at least as difficult, and generally more difficult, than

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[4](...continued)
simple supply and demand frameworks often used to analyze the demand for money or short-term interest rates. The simple monetary models introduced in the mid-1970s (for example, Frenkel 1976, Mussa 1976, and Bilson 1978a), which were based on Harry Johnson's monetary approach to the balance of payments (1978a, 1978b), did depict exchange rates as determined by relative demands and supplies for home and foreign money. However, the simple monetary model requires the virtually continuous maintenance of purchasing power parity, that is, essentially fixed *real* exchange rates, a proposition likely to hold only when economic disturbances are nearly exclusively monetary in nature. In practice, real exchange rates are observed to vary virtually as much as nominal rates, so the empirical practicality of simple monetary models for all but fairly long-run horizons (or hyperinflations) has proved quite limited.

[5] Indeed, the fact that exchange rate changes statistically are nearly random suggests that their fluctuations are virtually dominated by revisions in market expectations, or "news" (see Appendix 1 for further discussion). There is also ample evidence that expectations about long-run trends have substantial influences on current exchange rates. The notion that anticipations of future inflation influence current exchange rates is part of the consensus lore in this area. Work by Campbell and Clarida (1986) implies that fluctuations in real exchange rates are dominated by revisions in the rates' anticipated long-run values. Hutchinson and Throop (1985) provide evidence that market projections of future budget deficits have played an important role in the evolution of the dollar during the 1980s.

the interpretation of other domestic financial variables. Extracting the "information" about the state of the economy theoretically provided by exchange rate movements requires in practice considerable knowledge about the economy's structure and the disturbances affecting it. Likewise, relations between exchange rates and other monetary policy tools and objectives almost inevitably will be more complex and less stable than those typically found for more traditional variables. Second, such relations are likely to vary over time as the economic forces affecting the economy change. As a result, any rules for using exchange rates as indicators or targets, beyond the most general, will probably need to be altered periodically if they are to remain effective. In this sense, exchange rates as guides for monetary policy are apt to be even more prone to the obsolescence that increasingly seems to afflict more traditional monetary policy regimes. Third, exchange rates, even if used as intermediate targets, are unlikely to be controlled as closely as more traditional target variables. Stringent control of the dollar exchange rate would be difficult to achieve and, more importantly, most likely undesirable.

B. Two Additional Observations

Beyond these general conclusions, two more specific considerations also condition the way in which exchange rates might be used in U.S. monetary policy operations. The first concerns the extent to which official purchases of dollar-denominated securities for securities denominated in foreign currencies--sterilized foreign exchange market intervention--can have a lasting effect on exchange rates independent of standard open market operations; this issue is largely, although not entirely, a matter of the substitutability of dollar for foreign currency assets in investor portfolios. If sterilized intervention has such effects, policy might, in principle, be able to influence the path of exchange rates in addition to pursuing a more conventional intermediate target for an interest rate or money aggregate.

Overall, however, the evidence does not provide any adequate basis for regarding sterilized intervention as a viable independent tool of basic domestic monetary policy operations. Admittedly, the evidence on the substitutability of assets denominated in different currencies is inconclusive: the literature does suggest that assets denominated in different currencies are imperfect substitutes to at least some degree, and recent studies indicate that sterilized intervention may at times affect exchange rates by influencing ("signaling") market perceptions and expectations.[6] At the same time, however,

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[6] For a review of evidence on the effectiveness of sterilized intervention, see Edison (1990). Dominguez (1988, 1989) and Dominguez and Frankel (1989) offer evidence that intervention can (continued...)

despite years of research, attempts to systematically relate exchange rate movements to changes in the currency composition of market portfolios have been unsuccessful. For this reason, the pursuit of exchange rates as intermediate targets is likely to involve essentially the same tools--the discount rate, open market operations, and so on--as those now used under more conventional regimes.

Finally, the size of the U.S. economy is an important consideration in evaluating how exchange rates may appropriately be used as monetary policy guides. In smaller and more open economies, exchange rate movements tend to have fairly direct and comparatively large impacts on domestic prices, incomes, and interest rates; these impacts can significantly affect the trade-offs and relations on which monetary policy is based. Large and unexpected exchange rate movements may then require authorities to respond by altering the settings of their normal instruments simply to meet previously defined objectives. In this sense, exchange rates almost inevitably become important guides for monetary policy for smaller and more open economies. In the United States, however, exchange rate movements normally have considerably smaller (although at times significant) impacts on the basic trade-offs facing monetary authorities. Hence the case for making exchange rate considerations a key formal element in policy formulation (beyond the normal assessment mentioned earlier) is almost inevitably weaker. This point will arise in more concrete terms at several points in our discussion in the following sections.

Our preliminary considerations can be summarized as follows. Exchange rates, viewed as monetary policy targets or indicators, differ significantly from more traditional variables used for these purposes, and their use in monetary policy formulation is apt to raise broader and more complex issues. Exchange rates, if used as intermediate targets, would not be controlled as tightly as more traditional variables, although any such control is apt to rely primarily on the same set of policy instruments that is used now. Equally important, whether exchange rates are appropriately used in U.S. monetary policy formulation, as well as how they are to be used, is apt to be especially sensitive to the particular pattern of disturbances and other basic conditions of the economy. Consequently, the efficacy of using exchange rates as targets or indicators turns more on their robustness in varying circumstances than on their utility in hypothetical situations.

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[6](...continued)
affect exchange rates through both signaling and portfolio channels. Even so, the duration and reliability of their impacts are highly uncertain.

II. The Dollar as Intermediate Target

We now consider the most extensive use of the dollar in U.S. monetary policy that has been seriously proposed, namely, as an intermediate target. If the dollar exchange rate were used in this way, the U.S. monetary authorities would follow an explicit exchange rate target to maintain their primary policy objective of domestic output and price stability. Under such a policy regime, targeting the dollar would be the primary monetary policy rule.[7]

Detailed proposals for the use of dollar exchange rates in monetary policy formulation have been advanced by Ronald McKinnon, John Williamson, and others.[8] But, as explained in Appendix 2, their recommendations are largely based on objectives that lie outside our concerns in this paper. McKinnon and Williamson are concerned in the first instance with increasing the degree of international policy coordination, and thus they see the increased use of the exchange rate in monetary policy as but one element in the general reform of the international economy. Here we are asking whether it would be beneficial for the United States alone to use the dollar as an intermediate target to achieve its traditional domestic objectives, assuming (even if unrealistically) that this could be done without any formal and systematic coordination with our partners.

The operational use of the dollar as an intermediate target could take a variety of forms. The target variable would almost certainly be a fairly broad index of the dollar's value against many currencies rather than any one exchange rate, and most likely a moving average of those values over one or more quarters. As with other targeting regimes, moreover, the authorities would vary their instruments to counter deviations from a preassigned path or "zone" in pursuing an intermediate target for the dollar. Given the doubts about the effectiveness of sterilized intervention to influence more than short-term exchange rate movements, the authorities would normally be required to use their standard instruments--open market operations or the discount rate--in targeting the dollar. Thus if the U.S. authorities chose to use their instruments to target the dollar, they almost certainly could not

[7] It probably would be necessary to announce or explain publicly the main dimensions of the target and the rule. Beyond these general considerations, however, authorities most likely would not publicly commit to any particular path, or even specific zones, for the dollar.

[8] See McKinnon (1984, 1988), Williamson (1985, 1987, 1988, 1989), Williamson and Miller (1987), and Edison, Miller, and Williamson (1987).

independently control interest rates or a money aggregate at the same time.[9]

Given the wide range of domestic and international influences on exchange rates, it is equally clear that targeting the dollar would involve considerably looser control than has typically been the case under interest rate or money aggregate targeting regimes.[10] The target would have to be defined in terms of a fairly wide zone around some path allowing for variation over time. The authorities would not attempt to control the dollar closely or suppress the wide range of factors that now affect it, but rather would try to influence its course by moderating pressures contrary to the target's direction. Thus the use of the dollar as an intermediate target would not imply a commitment to a fixed exchange rate. Instead, any exchange rate targeting rule adopted by the U.S. authorities would have to be a loose one: the exchange rate would at most function as a medium-term "feedback rule" telling the authorities if their stance is too tight or too loose relative to longer term goals.

To be consistent with policy objectives, a dollar target would clearly have to be based on projections of foreign economic conditions--inflation at the least--in addition to the more standard considerations now used in formulating interest rate and money intermediate targets. Partly as a consequence, any targets for the dollar would probably be quite provisional and particularly subject to revision. Finally, as emphasized earlier, the use of the dollar as an intermediate target would almost certainly entail consultation with monetary authorities abroad, even if more explicit coordination were not necessary.

A. Stabilizing Properties of Dollar Targeting

The key issue about the appropriateness of the dollar, or any other variable, as intermediate target concerns the extent to which its use would be stabilizing in the sense that the exchange rate "feedback rule" would offset rather than reinforce the shocks disturbing the economy.[11] The question is one of relative merits, not only whether dollar targeting is stabilizing on balance, but more importantly, whether it is likely to be superior in this respect to alternative target variables. To resolve this issue, two key questions, one conceptual and the other empirical, must be answered: First, under

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[9] The authorities could pursue a hybrid target that was some combination of individual variables, but this approach would still normally require the use of the traditional policy instruments.

[10] Lesser control would also be necessary if foreign "acquiescence" were to be at all realistic.

[11] Thus the appropriateness of using the dollar as a monetary policy target must be evaluated in the same way that Poole (1970) evaluated interest rates and the money aggregates in his classic contribution to the stabilization policy literature.

what theoretical conditions would targeting the dollar be stabilizing or destabilizing? And second, what conditions does the U.S. economy actually face?

To help answer these questions, the table on the following page shows the most probable near-term responses of the U.S. economy to various fundamental disturbances (normalized so that the dollar appreciates in each instance), assuming *no* change in monetary policy operating instruments. In each case, exchange rate targeting can be said to be stabilizing if monetary expansion to counter the dollar's rise would partially offset the original disturbance's effect on real output and inflation. We emphasize that the responses in the table are those that the literature *suggests* for a large, comparatively closed economy subject to a fairly high degree of international capital mobility. As indicated below, these responses are quite ambiguous in some cases, depending upon the exact behavioral parameters assumed. Accordingly, the table is intended as a heuristic guide to the discussion rather than an exact or definitive summary.[12]

When exchange rate targeting is stabilizing

As the table indicates, there are situations in which the use of the dollar as an intermediate target is probably beneficial, situations in which dollar targeting is probably destabilizing, and situations in which the effectiveness of dollar is simply not clear. At one extreme, the table shows that exchange rate targeting is most clearly stabilizing if the U.S. economy is subject to an unexpected change in home money demand (an "LM shock"). An increase in home money demand lowers real output and the pressure on prices by raising real interest rates and the value of the dollar. Limiting the dollar's rise by increasing the domestic money supply would accommodate the increase in money demand, suppressing its transmission to the general economy.

The fact that money demand in the United States has become unstable in recent years[13] might appear to suggest that the use of the dollar as an intermediate target would be beneficial--if, indeed, this were the primary disturbance affecting the U.S. economy. But this is in general the only situation in which exchange rate targeting is clearly beneficial. Moreover, as is well known, this is precisely

[12] Disturbances that have straightforward impacts on closed economies are not infrequently found to have ambiguous effects on open economies once the effects of exchange rate variations and the transmission of the shocks to and from foreign economies are taken into account. See Boyer (1978), Cooper (1976), Henderson (1979a), and Mundell (1962, 1963, 1968). Dornbusch (1980a) gives an updated version of the "standard" model for an open economy.

[13] See "Monetary Aggregates as Intermediate Targets" by John Wenninger in this volume.

When Exchange Rate Targeting is Stabilizing:
Probable Near-Term Response of U.S. Domestic Variables to Disturbance
When Exchange Rate Is Not Controlled
(U.S. Monetary Policy Instruments Held Constant)

Disturbance (Normalized So That Dollar Rises)	Output	Inflation	Nominal Interest Rates	Real Interest Rates
Exchange rate targeting probably stabilizing				
Increase in U.S. money demand (domestic LM shock)			+	+
Decrease in foreign domestic demand (foreign IS shock)	- or <>	- or <>	- or <>	- or <>
Exchange rate targeting probably destabilizing				
Increase in foreign inflation	<>	<>	<> or +	<>
Increase in foreign money supply	?	?	- or <>	- or <>
Oil or other terms-of-trade improvement	+		<> or -	+
Increase in U.S. domestic demand (domestic IS shock)	+	+	+	+
Effects of exchange rate targeting unclear				
Increase in demand for U.S. bonds (away from foreign bonds)	?	?		

Notes: <> indicates effect is negligible. The response to the terms-of-trade case assumes that the economy is a net importer.

the situation in which interest rate targeting is appropriate.[14] If the United States were subject to uncertainty only in the domestic money market, therefore, it is unlikely that targeting the dollar would have an obvious advantage over another, more traditional target variable--short-term interest rates.

Admittedly, countering exchange rate fluctuations caused by fluctuations in foreign expenditure demand (a foreign "IS" shock) may also be stabilizing, but any benefits are likely to be significantly smaller and less certain than in the prior case. A fall in foreign demand arising from, say, a contraction in fiscal policy directly reduces the demand for U.S. exports and thus U.S. output more generally, but as shown in case two in the table, it may also lead to downward pressure on U.S. interest rates, a development which would tend to stimulate the U.S. economy. Unless the interest rate decline is fairly substantial, the net effect on U.S. output and prices most likely would be contractionary, although in most instances fairly small given the relatively large size and comparatively closed nature of this country's economy.[15] Thus, countering the dollar's movement would be stabilizing in this case, but the effects are likely to be too small and uncertain to justify exchange rate targeting on this ground alone. (Note that interest rate targeting would again be stabilizing under the same circumstances.)

When exchange rate targeting is destabilizing

At the other extreme, the table shows that exchange rate targeting is likely to be destabilizing to the U.S. economy if the authorities respond to unanticipated shifts in foreign inflation or foreign monetary policy, if the United States' terms of trade change unexpectedly, or if the U.S. economy experiences real demand disturbances.

Limiting the dollar's movements in the face of an unexpected change in foreign inflation would tend to transmit the foreign price pressures to the United States.[16] For example, if the U.S.

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[14] The argument that interest rate targeting in a closed economy context is stabilizing in the face of monetary disturbances (and destabilizing in the face of real disturbances) was, of course, made famous much earlier by Poole (1970).

[15] This conclusion is consistent with the results reported by Bryant, Henderson, Holtham, Hooper, and Symansky (1988) in simulations of eleven large macroeconomic models. The direct effect on U.S. interest rates is likely to be substantial only if the foreign demand fluctuation is large enough to have an appreciable effect on longer term world interest rates.

[16] If allowed to move freely, the dollar would tend to appreciate in proportion to any increase in foreign prices, thus effectively insulating the U.S. economy from any increase in foreign inflation.
(continued...)

authorities countered a dollar appreciation arising from increasing (but unperceived) foreign inflationary pressures, they would only succeed in importing the foreign inflation: the dollar prices of imported goods would rise with the foreign price increases, and monetary expansion would contribute to an increase in domestic prices more generally.[17]

Targeting the dollar can be destabilizing if the U.S. authorities are uncertain about the course of foreign monetary policy, because the required U.S. policy response to an unexpected change in foreign monetary policy would mirror the foreign policy change: at the least, the U.S. authorities would have to adjust their own stance in the same direction as the change in the foreign authorities' stance to limit the dollar's movements. Expansionary foreign monetary policy, for example, simultaneously increases foreign demand and the demand for U.S. exports and, by lowering foreign interest rates, may also reduce dollar interest rates. But since an increase in the foreign money supply also increases the value of the dollar, the net effect on U.S. output and prices is uncertain.[18] On the other hand, domestic monetary expansion to limit the dollar's appreciation would lower dollar interest rates still further, stimulate domestic income, and thus prove destabilizing.

Using monetary policy to limit the dollar's movements in the face of an unexpected change in the United States' terms of trade, such as a change in oil prices, can also be destabilizing. Such a disturbance involves a change in the relative price of the good in question; preventing the exchange rate from moving means, in effect, that domestic prices must vary to effect the relative price change--with problematic consequences for output. For example, a rise in world oil prices tends to lower U.S. output while raising domestic prices; in the event of a rise, the dollar would probably fall on average

[16](...continued)
Long-term nominal dollar interest rates might rise somewhat, but the effects on output and inflation would tend to be small or negligible.

[17] Obvious shifts in the trend in foreign inflation could be offset by adjusting the target zone or path for the dollar. In practice, however, whether the exchange rate is responding to such pressures or to other factors is likely to be unclear. Moreover, too frequent shifts in the exchange rate targets, however loose, could undermine the credibility of the authorities' policy--or at least make it confusing to the public.

[18] Mundell (1963) finds that monetary policy is transmitted negatively internationally, that is, that foreign monetary expansion would have contractionary effects on the U.S. economy. Under his assumption of perfect capital mobility, the exchange rate effect is dominant. In most larger macroeconomic models (see Bryant, Henderson, et al. 1988), foreign monetary expansion tends to increase U.S. output but to decrease U.S. consumer prices.

since the United States is a net importer of oil.[19] Though monetary contraction to limit the dollar's fall would reduce the upward pressure on prices, it would add to the downward pressure on output. Thus decreasing the money supply following an unexpected rise in world oil prices would not offset but only transform the effects of the disturbance.

Exchange rate targeting is apt to be destabilizing in the case of a shift in the demand for U.S. products (an "IS shock") because the change in the policy instrument required to maintain the exchange rate target would aggravate the effects of the original underlying disturbance on real output and/or prices. For example, an unexpected (and unperceived) increase in private spending increases domestic output and, by raising domestic nominal and real interest rates, pushes the dollar up. Monetary expansion to limit the dollar's rise would reinforce the original disturbance by stimulating output further and ultimately adding to inflationary pressures.[20]

The U.S. historical experience of the early to mid-1980s illustrates the risks of exchange rate targeting under these circumstances. During this period, economic growth in Europe was slow, and by comparison the United States was growing rapidly. As both nominal and real interest rates in the United States increased and then held steady, dollar-denominated assets became an attractive investment, and between January 1980 and February 1985, the dollar rose 94 percent on a trade-weighted basis. U.S. monetary policy thus would have been more accommodating during this period if it had been directed toward limiting the dollar's rise. But this would have stimulated domestic demand still further and would have required that the U.S. monetary authorities reverse their efforts to contain the inflationary pressures that were the legacy from the late 1970s.[21]

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[19] Admittedly, the mark and the yen--currencies of countries even more dependent on oil imports than the United States--would probably fall against the dollar, while the pound and the Canadian dollar would rise. Nominal dollar interest rates might increase somewhat in this case in keeping with a rise in expected inflation rates; real interest rates probably would move lower following a rise in world oil prices as U.S. output moved lower.

[20] The destabilizing effects of exchange rate targeting in the face of real disturbances are well documented. See Mundell (1962, 1963, 1968), Fleming (1962), Dornbusch (1988), Henderson (1979a), Feldstein (1989), and Obstfeld (1985). Clearly, exchange rate targeting is also equivalent to interest rate targeting in this case--and both are destabilizing.

[21] See Sachs (1985). The combination of fiscal stimulus and monetary contraction helped the United States both to combat inflation and to avoid the recessionary consequences of doing so. In fact, the dollar's rise during the period in itself contributed to the reduction in the domestic inflation rate by putting downward pressure on all U.S. tradable goods and reducing the costs of imported raw materials and intermediate products. Admittedly, this policy mix led to large external deficits.

(continued...)

When the effectiveness of exchange rate targeting is uncertain

The effectiveness of targeting the dollar when a variety of international financial market disturbances alter market preferences among bonds of different currencies is not clear because the impact of these shocks on the underlying economy is ambiguous. Because a decrease in the demand for dollar bonds relative to nondollar bonds would raise long-term dollar interest rates and depreciate the dollar, for example, the consequences for the economy depend on how the disturbance is split between interest rates and exchange rates and on the exact response of the domestic economy to changes in interest rates and the dollar exchange rates.

If the interest rate effect is dominant, and output and the pressure on prices move lower, then monetary contraction to limit the dollar's decline would aggravate the consequences for real output and/or prices. Even when the opposite is the case and the feedback relationship between the behavior of the exchange rate and output and prices is in the right direction, exchange rate targeting would not necessarily be stabilizing. Only when it is fairly certain that the initial impact of the disturbance will be felt on the exchange rate alone can one have confidence that using monetary policy to limit the dollar's rise is warranted.

Thus there is no reason in general to believe that targeting the dollar would help to guarantee the stability of the United States' income and price performance in the face of the increased integration of the world's financial markets in the 1980s. On the other hand, exchange rate targeting is apt to increase the international transmission of the purely financial market disturbances themselves.[22]

B. U.S. Exchange Rate Targeting and International Economic Cooperation

As emphasized earlier, any target range for the dollar would have to be based on projections of foreign as well as domestic economic conditions, and for this reason alone would require consultation

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[21](...continued)
However, the evidence suggests that expansionary monetary policy could not have prevented the deficits because its effect on the trade balance is at best transitory and small.

[22] For example, a shift in demand away from dollar bonds to nondollar bonds wound tend to raise dollar interest rates, lower nondollar interest rates, and depreciate the dollar; the measures that the U.S. authorities would take to limit the dollar's decline would raise dollar interest rates still further and thus reinforce the rise in dollar interest rates relative to nondollar interest rates. The exaggerated dollar interest rate movements might be instantaneous if the U.S. policy makers' likely responses were incorporated into market expectations.

with monetary authorities abroad. Other considerations, however, strongly suggest that the implementation of a policy of targeting the dollar would probably have to go beyond consultation to more active coordination.

In particular, unexpected foreign policy changes are quite likely to complicate the pursuit of chosen target ranges for the dollar. Obvious shifts in foreign monetary and fiscal policy could be offset by adjusting the target zone or path for the exchange rate. In practice, however, whether the exchange rate is responding to such pressures is likely to be far from clear. Moreover, the U.S. authorities would have to be concerned as well about the effects that frequent adjustments in their targets might have on the credibility of their commitment to exchange rate targeting as well as their long-term objectives. Thus U.S. authorities could easily find themselves adjusting their stance to counter movements in the exchange rate stemming from unexpected changes in foreign policy. As we have seen, such adjustments could well be destabilizing.

Using the dollar as an intermediate target, therefore, at a minimum requires close consultation with the monetary authorities abroad simply to reduce the need for frequent adjustments to the U.S. dollar targets and thus to protect the credibility of U.S. monetary policy. Increased international cooperation, even if unnecessary, probably would ease and enhance U.S. exchange rate targeting. But increased cooperation would require the U.S. authorities to give up some degree of their autonomy.

Given the size of the U.S. economy in the world economy, moreover, foreign policy makers are unlikely to be indifferent to any effort by U.S. monetary authorities to influence the dollar's medium-term course. If, for example, foreign authorities were attempting to counter an internal (IS) disturbance stimulating domestic demand, efforts by the United States to limit the downward pressure on the dollar could complicate the foreign authorities' task. More generally, foreign authorities would probably raise questions about dollar targets that they viewed as inconsistent with their own policy objectives. Even when the dollar target was for the moment consistent with their own policy goals, there would always be the possibility that the targets chosen by the United States in the future might limit their maneuvering room.

Thus it is unrealistic to assume that foreign authorities would be willing to accept without question a move on the part of the United States toward exchange rate targeting. Instead, foreign monetary authorities, especially in the other major industrial nations, would very likely accept U.S. exchange rate targeting only if they had some say in the exchange rate policies pursued. The more stringent the dollar target, moreover, the more likely it is that they would expect their views to be considered.

Foreign authorities would have additional concerns. They could question how a move toward exchange rate targeting would affect the way in which U.S. economic disturbances are transmitted to the rest of the world. U.S. exchange rate targeting, for example, would tend to increase the effects on foreign output and prices of U.S. fiscal expansion: since U.S. efforts to limit the dollar's rise under these circumstances would add monetary expansion to fiscal expansion, whatever price pressures U.S. fiscal expansion placed on the U.S. economy would be transmitted more quickly and forcibly to the rest of the world. Thus, with exchange rate targeting, foreigners would be concerned not only with U.S. monetary policy but also with U.S. fiscal policy.

More generally, attempts by the United States to use the dollar as an intermediate monetary policy variable inevitably confront the fact that in a world of "N" nations, there can be only "N-1" independent exchange rate paths and hence only "N-1" exchange rate policies. Since an increase in one country's exchange rate is a decline in that of its partners, exchange rate policies are inherently interdependent. This observation would not be particularly consequential if the United States were a small economy and dollar assets were not so widely traded internationally. Given the position of the United States in the world economy, however, the use of the dollar as a monetary policy target could easily affect the currencies of our partners and have significant consequences for their economic conditions and policy choices. Under these circumstances, international policy cooperation and coordination are likely to be necessary to avoid serious conflict with economic partners.[23]

We must conclude that the dollar exchange rate is not a particularly robust monetary target variable, even if used in a fairly flexible way, and that the use of the dollar as a primary intermediate target of U.S. monetary policy could easily have added to instability under the circumstances that prevailed through much of the last decade. Using the dollar as a monetary policy "feedback rule" is very unlikely to improve the stability of U.S. output and prices in the face of unexpected changes in foreign inflation, foreign monetary policy, real domestic demand, and commodity prices or the United States' terms of trade. Furthermore, dollar targeting may or may not stabilize the domestic economy in the face of international financial market disturbances. Using the dollar as a monetary policy target is potentially stabilizing in the face of unexpected changes in foreign demand, but the benefits of

[23] Since a rise in one currency is simultaneously a decline in another currency, one can argue that a policy of targeting the exchange rates will inevitably lead to policy conflicts. Dollar depreciation, for example, stimulates the U.S. economy but dampens economic growth abroad. International economic cooperation is needed both to ease the resolution of inevitable conflicts and to prevent "beggar-thy-neighbor" policies from being adopted.

doing so may not be very large. The dollar is most clearly an appropriate monetary policy target in the face of one variety of major economic disturbance--instability in the domestic money market--but in this case, short-term domestic interest rates would more than likely be the preferred target.

Any move toward unilateral U.S. exchange rate targeting, moreover, is unlikely to be feasible. From the U.S. point of view, increased international economic cooperation would ease the targeting process but would entail some loss of independence. From the point of view of foreign authorities, increased international cooperation might be seen as a prerequisite to exchange rate targeting. At the least, foreigners would expect their views to be taken into consideration in the exchange rate targets chosen by the United States.

III. The Dollar as Side Constraint

Although the dollar exchange rate should probably not be used as a primary intermediate target of U.S. monetary policy, it might play a significant role in an ad hoc and temporary way as a *side constraint* on the normal functioning of U.S. monetary policy when the monetary authorities are using another variable as their primary intermediate target.[24] The dollar might usefully function as a side constraint on those occasions when there appear to be quite serious financial risks associated with exchange market conditions or when exchange market developments appear to alter temporarily the response of the financial markets or the underlying economy to the Federal Reserve's policy instruments and targets to a substantial degree. The exchange rate could also function as a side constraint when exchange rate movements appear to alter fundamentally the output-inflation trade-offs that the policy makers originally assumed in calculating the time-paths for their instruments and targets.

Admittedly, the relationship between the exchange rate and any primary target chosen by the U.S. monetary authorities, both in the formulation and the execution of policy, will nearly always be a close one. When the U.S. monetary authorities set and then implement their policy targets, they must take account of the exchange rate responses and their economic impacts, and in this sense the exchange rate normally acts as a factor conditioning or constraining monetary policy. But the active

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[24] The evidence suggests not only that the dollar has a role to play as a side constraint, but also that the dollar may in fact have played this role in U.S. monetary policy in recent years. Indeed, the argument presented in this section is based, in part, on both the "Record of Policy Actions of the Federal Open Market Committee" that appears in the Federal Reserve Bulletin (see Federal Open Market Committee) and the Federal Reserve Bank of New York's quarterly reports on "Treasury and Federal Reserve Foreign Exchange Operations" (see Federal Reserve Bank of New York).

use of the dollar as a side constraint involves something more. The dollar would cease to be simply one among a number of factors that must be taken into account and would become for the moment a primary focus of attention; it would no longer be used simply as one of several indicator variables but would become, for a short time, an object of major policy concern and possibly a temporary target. Thus, as stated earlier, the question considered here is whether exchange rate considerations should be elevated to a more central and formal place in monetary policy formulation beyond the normal assessment of the likely economic effects of the dollar.

Since the United States is a large and, at this point, still a comparatively closed economy, exchange market developments are likely to impinge upon the normal operation of U.S. monetary policy only enough to justify the use of the dollar as a side constraint relatively infrequently; even on such occasions, the dollar would supplement, but not replace, the primary intermediate target. That is, use of the dollar as a side constraint is likely to be most appropriate when exchange market developments alter quite substantially the balance of near-term risks faced by the authorities or the trade-offs determining the speed at which operational instruments or intermediate targets are moved to their desired paths. More frequent use of the dollar as a side constraint could risk undermining the clarity and even the credibility of the authorities' normal objectives, to the extent that such use could convey to the public the impression that the dollar was a secondary target or one part of a dual target.[25]

In principle, the dollar can modify the application of the basic monetary policy rule in three situations. First, when there appear to be significant financial market risks associated with exchange rate developments, the exchange rate can temporarily alter the near-term weights given to alternative ultimate policy objectives. Second, when exchange market developments modify the linkages between the operational and intermediate targets and between intermediate targets and the underlying economy, the exchange rate can temporarily affect how monetary policy is transmitted to the economy. Third, when exchange rate movements significantly change the output-inflation trade-off that can be achieved in a particular situation, those movements may temporarily affect the time-path used to achieve a given output-inflation objective.

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[25] Furthermore, on those occasions when exchange market developments do become an important policy consideration, authorities may need to explain their actions carefully and to emphasize that their ultimate targets and goals remain valid.

A. Modifying the Trade-offs between Policy Objectives

Exchange market developments can modify the trade-offs between fundamental policy objectives--and not simply the path taken to achieve a given policy objective--on those occasions when financial market stability becomes a pressing concern temporarily outweighing goals for domestic output and price stability. Thus, for example, the monetary authorities may be reluctant to ease monetary policy during a period in which the dollar is especially vulnerable to sharp downward pressures lest easing precipitate instability in the foreign exchange market that could spill over into the other financial markets.

The dollar seems to have functioned as a side constraint on U.S. monetary policy in this way on a number of occasions. In the spring of 1987, for example, the dollar came under strong selling pressures, especially against the yen, and concern about the stability of the dollar spread to other financial markets. As investors sought alternatives to dollar-denominated assets, the dollar's depreciation precipitated sharp declines in prices of U.S. bonds and equities and contributed to price increases in precious metals and bonds denominated in other currencies. In view of the fragility of the dollar in the foreign exchange market, the U.S. authorities were very cautious in their provision of reserves during this period.[26] At the same time, the exchange rate was moved to the first position in the order of the variables in the policy directive in the March 1987 Federal Open Market Committee (FOMC) meeting and to second position in the directive in the May 1987 FOMC meeting.[27]

B. Altering the Response to the Authorities' Policy Instruments and Targets

Exchange market developments can temporarily alter the response of the financial markets or the underlying economy to the Federal Reserve's policy instruments and intermediate targets in a number of ways. In an open economy, for example, monetary policy affects domestic interest rates both directly through the domestic financial markets and indirectly through its effects on the exchange rate and exchange rate expectations. The direct domestic linkages are fairly straightforward: a credible move toward monetary restraint will raise short-term nominal interest rates and probably both short-term and long-term real interest rates. The indirect foreign exchange market linkages, however,

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[26] Federal Reserve Bank of New York, Open Market Analysis Division (1988, p. 56).

[27] Furlong (1989). Heller (1988) argues that the order in which the various economic variables are mentioned in the FOMC's policy directives is generally consistent with the relative importance placed on these variables in monetary policy considerations. Furlong provides an updated listing of the order of the variables in the policy directives.

are more subtle: a credible move toward monetary restraint may lead to expectations of dollar appreciation and possibly reduce the risk premium on dollar assets as well, thus lowering medium- and long-term dollar interest rates. The magnitude of any reduction is contingent on exactly how the policy move affects exchange rate expectations and the perceptions of risk. Extensive international capital mobility can complicate the effect of a change in monetary policy on domestic interest rates because the indirect exchange market channel can alter the response of domestic interest rates in ways that cannot always be easily predicted.

Of course, monetary authorities will normally give the exchange market channel linking monetary policy and the domestic financial system careful consideration in the formulation of their monetary policy rules. Indeed, any estimate of the effects of a change in monetary policy on short-term and long-term interest rates is implicit in the policy makers' estimates of the time-paths linking a change in their intermediate target and the financial system.[28] Nonetheless, the exchange rate may need to function as a side constraint on some occasions because the strength of the exchange rate channel varies with market conditions and is contingent on the effects of monetary policy on market expectations.

If the authorities are using a medium-term interest rate target, for example, they may choose to modify their standard operating procedures when certain conditions prevail in the foreign exchange market. During periods when the dollar is susceptible to heavy selling pressure, monetary expansion may have smaller effects on interest rates by increasing the expected rate of dollar depreciation. More importantly, the effect of a given change in monetary expansion on interest rates is likely to be less predictable since it would depend upon the effect of the expansion on market expectations, which under the circumstances are volatile. There could be serious unintended effects, therefore, if the authorities were to continue to follow their standard operating procedures in those presumably infrequent situations in which the normal linkages between instruments and targets and the economy have been seriously distorted by the volatility of market expectations.

The spring 1987 episode can be interpreted from this point of view as well. During this period, the dollar was under considerable selling pressure, and dollar interest rates were rising as

[28] The studies collected in Research Papers on International Integration of Financial Markets and U.S. Monetary Policy (Federal Reserve Bank of New York, 1987) investigate how increased international capital mobility has changed the way in which monetary policy is transmitted to the U.S. economy. The essays by Radecki and Reinhart (1987) and Kasman and Pigott (1987a, 1987b) focus in particular on the changing relationship between monetary policy and the financial sector.

investors, motivated in part by their concern for the dollar's future stability, were selling dollar for nondollar assets. Monetary expansion under these circumstances could well have precipitated a sharp fall in the value of the dollar, thus increasing the market's anxieties about the dollar and dollar-denominated assets; there was a risk that, instead of lowering dollar interest rates, expansion might have precipitated a further rise. The more cautious policy stance actually taken, on the other hand, helped to increase the market's confidence in the dollar and dollar assets and thus helped lead to a reduction in dollar interest rates. Once the episode was over and market confidence was restored, the more normal, less counterintuitive relationship between monetary policy and interest rates reemerged.

C. Modifying the Output-Inflation Trade-off

The exchange rate can influence the output-inflation trade-off in a given economic situation in part because of the effect which the exchange rate itself has on these two variables: a particular time-path for short-term interest rates will yield lower inflation more rapidly for a given level of economic activity when the dollar is rising and reduce inflation less rapidly for the same level of activity during a period when the dollar is falling. Depending on the duration and the strength of the upward or downward pressure on the dollar, therefore, monetary authorities might at times choose to alter the speed at which monetary policy is changed to achieve a given output-inflation objective--for example, postponing contraction if the dollar is under sustained upward pressure and speeding up monetary contraction if the opposite is the case.[29]

The exchange rate, however, is likely to be an appropriate constraint only when exchange rate movements so substantially alter the output-inflation trade-offs originally assumed by policy makers in calculating the time-paths for their instruments and targets that these paths need to be changed or when the trade-offs that the policy makers normally assume to exist are no longer viable. On those occasions when the dollar functions as a side constraint in this way, moreover, the dollar would probably be used more as an informational variable than as a temporary intermediate target. Thus the authorities might postpone contraction if the dollar were under sustained upward pressure, because contraction might accelerate the dollar's upward movement. A rapidly rising dollar might bring about a lower domestic inflation rate more quickly and at a lower level of real activity than was desired. In

[29] Again, the authorities will normally consider how the exchange rate is likely to affect the output-inflation trade-off in their regular deliberations about setting their instruments and targets. But the use of the dollar in this way is largely informational; that is, the dollar serves as an indicator of higher or lower inflation and not as a side constraint.

certain circumstances, the authorities might also want to alter the behavior of the dollar so that the output-inflation trade-offs normally assumed would return. For example, they might be reluctant to tighten or might be inclined to ease somewhat until the dollar came down to a more acceptable level.

In the September 1985 Plaza Agreement among the Group of Five (G-5) industrial nations, concern focused on what appeared to be an overvalued dollar and a major loss of U.S. competitiveness, reflected in a decline in activity in U.S. manufacturing due to a shift to overseas producers, as well as a large payments deficit financed by a massive buildup in foreign debt. The G-5 authorities agreed to intensify individual and cooperative efforts to achieve sustained noninflationary growth and resolved that "some further orderly appreciation of the main non-dollar currencies against the dollar [was] desirable."[30] Consistent with these policy objectives, the U.S. discount rate underwent a series of reductions and the federal funds rate declined more or less steadily in 1986.[31] During this period as well, the position of the exchange rate in the order of economic variables in the FOMC's policy directives suggests that greater importance was given to the dollar in monetary policy considerations: the exchange rate was raised to the third position in the meetings of August 1985 through April 1986 from last place in the meetings of March through July 1985.[32]

One must emphasize again that the use of the dollar as a side constraint in this way is somewhat exceptional. The U.S. economy is such a large and relatively closed economy that issues of international competitiveness only infrequently alter the inflation-output trade-offs enough to call for a significant alteration in the thrust of policy. One can also argue that U.S. monetary authorities used the dollar's level in 1985 less as a side constraint than as an indicator variable. Moreover, even on this occasion, when the use of the dollar as a side constraint might have been warranted, there was no fundamental change in the basic paths for the authorities' actual operational targets, intermediate targets, and final goals.

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[30] Group of Five Communiqué, September 1985.

[31] Furlong (1989), noting that unemployment was above 7 percent and inflation below 3 percent in 1986, suggests that because this policy stance was consistent with a goal of stimulating the domestic economy, one cannot definitely conclude that a desire to lower the dollar was the reason for these policy initiatives. But this is the point: the dollar became an object of policy concern precisely because of its effect on the domestic policy trade-offs.

[32] Furlong (1989, p. 12).

IV. Exchange Rates as Monetary Policy Indicators

Our final topic concerns the use of dollar exchange rates as formal indicators for U.S. monetary policy. We mean in this context the systematic use of exchange rates as indicator variables (rather than targets) providing information about fairly specific economic conditions. This use goes beyond the general assessment of exchange rates that authorities regularly undertake in the course of formulating and adjusting policy.[33] As we have emphasized, the behavior of exchange rates, their likely reactions to policy actions, and their effects on the economy must always be taken into account in determining the settings of monetary policy operating instruments and intermediate targets--regardless of whether they are used as formal indicators.

Interest in the explicit, regular use of exchange rates as indicators has grown in recent years as the behavior of the more traditional information variables--interest rates and the money and credit aggregates--has seemingly become more difficult to interpret. Since the mid-1980s, for example, U.K. authorities have used the value of the pound (particularly relative to the German mark) as one indicator of the tightness of monetary policy, as well as a supplementary target on certain occasions.[34] In the United States, a number of government officials as well as academics have expressed interest in developing exchange rate measures in conjunction with more standard indicators to improve the formulation of monetary policy.[35]

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[33] Admittedly, the distinction between simply "taking account" of exchange rate behavior and the more formal use of exchange rates as specific indicators is far from precise. Furthermore, exchange rates could in principle serve as both indicators and intermediate targets. Indeed, as Richard Davis notes in the introduction to this volume, there are strong conceptual similarities between targets and indicators.

[34] See Copeley and Ryding (1988) as well as the Financial Statement and Budget Report of the Chancellor of the Exchequer (1982). The report states that

> the behavior of the exchange rate can help in the interpretation of monetary conditions, particularly when the different aggregates are known to be distorted. . . . External or domestic developments that change the relationship between the domestic money supply and the exchange rate may therefore disturb the link between money and prices, at least for a time. Such changes cannot readily be taken into account in setting monetary targets. But they are a reason why the Government considers it appropriate to look at the exchange rate in monitoring domestic monetary conditions and in taking decisions about policy. (p. 14)

[35] See, for example, Federal Reserve Vice Chairman Johnson's argument (Johnson 1988) for using exchange rates in conjunction with the interest-rate term structure and commodity price measures. He suggests that a combination of a steepening of the term structure, accelerating commodity prices, and a (continued...)

In principle, an economic indicator could be any variable that provides some useful information about the economy, including its current state or future course, its underlying structure or the nature of the disturbances affecting it. In practice, formal monetary policy indicators have typically been applied somewhat more narrowly as indicators of underlying inflation, real growth trends, and actual or potential strains in financial markets, or as measures of the tightness or ease (stance) of monetary policy.[36] Exchange rates, in particular, are most often viewed either as "leading indicators" of inflation pressures or as indicators of the policy stance.

A. Some General Considerations

In assessing the literature on exchange rate indicators, much of which is theoretical in nature, it is useful to bear in mind several important considerations that, while applying to policy indicators generally, are especially relevant in the case of exchange rates. The first and perhaps most obvious is that exchange rates, because of the relative complexity of their behavior and determinants, are likely to be useful as indicators only when employed in conjunction with other variables. The possible circumstances that can lead to any given exchange rate movement are so numerous that exchange rate fluctuations by themselves are apt to be hopelessly ambiguous indicators of underlying economic conditions. Most obviously, since the dollar's value effectively reflects U.S. conditions relative to those abroad, any sensible judgment of what a given exchange rate movement implies about the U.S. economy requires an assessment of foreign economic data. In addition to such data, interpretation of exchange rate movements will nearly always require examination of domestic interest rates, inflation trends, and other closely related developments. Because exchange rates must be considered in connection with these other factors, they appear most likely to be useful as supplementary indicators for monetary policy rather than primary indicators. Thus a key question is how much information exchange rates add to that available from other measures.

A related second consideration is that an indicator, to be practically informative, must be interpretable on the basis of the knowledge that policy makers can reasonably be expected to possess. The theoretical literature excels in identifying circumstances under which the exchange rate or some

[35](...continued)
falling dollar (presumably relative to trend) could be taken as a sign of increasing inflation pressures and the need to tighten monetary policy.

[36] See the introduction by Richard Davis, especially page 6.

other variable supplies critical information--provided policy makers have fairly detailed knowledge of the economy's behavioral parameters and are confronted by a limited array of disturbances whose general statistical distribution is also known.[37] In practice, however, policy makers almost always have to interpret available indicators with highly incomplete and imprecise information about the economy's structure, which in any case tends to vary unpredictably over time. An indicator whose interpretation depends critically on knowledge of parameters only barely known, or on circumstances that tend to change and are difficult to predict or identify, is unlikely to be very informative in practical terms, whatever its theoretical information content. This consideration again applies especially to exchange rate indicators, in large part because exchange rate behavior is so heavily dependent on the structure of disturbances and on the policy reactions of authorities, both of which are subject to fairly frequent changes.

Third, any given indicator or set of indicators is almost inevitably less informative (and the information required for interpretation is greater) when there are many disturbances to the economy than when there are only a few shocks, as is most often the case in theoretical models. For example, the work on exchange rates as indicators of the policy stance (see Subsection C) is in large part based on the observation that exchange rates in principle can help distinguish an increase in nominal interest rates due to higher expected inflation from, say, an increase in excess money demand: in the first case, the dollar is likely to fall (ceteris paribus), whereas in the second, the resulting increase in real interest rates is likely to result in dollar appreciation. On this basis, exchange rates could be quite helpful in interpreting interest rate movements when the economy is responding to only one shock at a time (or when one disturbance dominates).

In practice, however, many disturbances affecting exchange rates, interest rates, and the economy generally occur simultaneously. In most circumstances, a rise in the dollar coinciding with an increase in domestic interest rates can reflect a wide combination of shifts in expected inflation, foreign inflation, domestic money demand, and many other changes. Compared with hypothetical situations in which disturbances occur one at a time, the observable information in this case changes

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[37] This literature is very extensive. For discussions motivated by practical monetary policy considerations see, for example, Truman et al. (1981), Glick and Hutchison (1989), and Bergstrand (1985a, 1985b).

little but the possible explanations increase greatly.[38] Further complications are presented by the lag in economic responses, which means that the observed behavior of a given set of indicators at any time reflects the delayed influence of past disturbances in addition to any present shocks, as well as the reactions of authorities to those disturbances and the market perceptions of all these factors. As a result, analysts inevitably must confront questions of the following nature: is the current dollar appreciation reflective of a new increase in U.S. relative to foreign real interest rates or simply a response to past overly expansionary monetary policy whose earlier effects in lowering interest rates are now receding?

A recent paper by Fuhrer and Moore (1989) graphically illustrates the problems of using asset indicators when the economy is responding to a variety of current and past circumstances. Their analysis shows that the covariation of asset prices, real GNP, inflation, and other fundamentals depends quite importantly upon parameters such as the response of output and factor prices to aggregate demand and the feedback rule followed by authorities. Indeed, their simulations indicate that a rise in the dollar may signal a tightening of monetary policy under one targeting rule but a loosening of policy under another rule.[39]

Neither this example nor the larger complications it illustrates mean that exchange rates lack all value as monetary policy indicators. They do mean, however, that the use of such indicators will be an inherently rough and inexact business most suitable to fairly modest objectives. This lesson is

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[38] This is an illustration of a more general problem. Like other asset prices, exchange rates can be viewed as composed of a collection of unobservable "latent" variables, such as real interest rates, expected inflation, the projected long-term real exchange rate, and so on. The problem is that typically the latent variables greatly exceed the observable indicators so that the parameters of the statistical distribution of the former (which are needed to infer their values) are much greater in number than those (observable) parameters of the observables' distribution. Unfortunately, economic theory and evidence provide little if any insight into the majority of the parameters in question, namely, the correlations among the unobservable variables. For one illustration of the problems involved, see Pigott (1983).

[39] The statistical answer to these complications (which amounts essentially to running regressions) is simple in theory but hardly so in practice. In principle, given a particular fixed statistical distribution of the underlying disturbances and the economy's structural linkages, there is a "best" predictor (the conditional expectation or ideal "regression") of the variables the authorities are trying to infer based on the indicators available. The problem is that the predictor depends on all the current and lagged relations among the key economic variables and on the variances and correlations among the underlying disturbances. These would be difficult enough to determine even if they remained constant indefinitely--which is certainly not the case.

confirmed by the following review of the empirical evidence.

B. Empirical Evidence on Exchange Rates as Inflation Indicators

The widespread view that exchange rate movements are fairly good "leading indicators" of fluctuations in inflation is not based on theory alone.[40] Several historical experiences, such as the period in the late 1970s when sharp depreciation of the dollar preceded the peak in U.S. inflation, appear to support this view as do numerous empirical studies linking exchange rates, import prices, and the general price level for many countries. In the U.S. case, empirical analyses have fairly consistently found that a 10 percent decline in the dollar leads ultimately to an average increase of about 7 percent in import prices and a rise of about 1 to 2 percent in the consumer price index (CPI), with the effects spread over eighteen months to two years. (Of course, the specific estimates in the studies fall into a significant range centered about these means.[41])

However, the interpretation of these apparently close relations between exchange rate movements and subsequent U.S. inflation is less clear than might seem apparent for at least two reasons. First, exchange rates, through their effect on import prices, are a direct input into domestic costs and prices. Hence exchange rate movements directly affect inflation developments in the near and medium term, in much the same manner as other cost components such as food or gasoline prices. The usual equations relating the CPI or GNP deflator to exchange rate movements and other costs must be interpreted as largely reflecting these direct effects. These relations do not generally tell us whether exchange rate movements are good indicators of more persistent *underlying* inflation pressures that are of particular concern to policy makers and also relatively more difficult to measure. A second potential problem with these relations is that in many cases they represent reduced forms or partial reduced forms of a larger set of structural relations relating the underlying determinants of inflation to actual price movements. As with all reduced forms, the parameters relating exchange rate movements to future inflation are apt therefore to vary as the structure of underlying disturbances and the responses of policy change over time.[42]

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[40] See, for example, the comments in Willett (1985).

[41] For surveys of such studies and their methodology, see Hooper and Lowrey (1979) and Goldstein and Khan (1985).

[42] For a discussion of these and other problems of interpreting standard exchange rate and inflation relations, see Pigott, Rutledge, and Willett (1985).

The results of the relatively few (and recent) studies assessing the value of exchange rates as indicators of medium-term to longer term inflation pressures have been mixed. These studies provide evidence that movements in the dollar have "led" fluctuations in inflation in some cases and that, in certain circumstances, the dollar has added significantly to the information about future inflation provided by the term structure and commodity prices.[43] However, as Lown (1989) shows, the accuracy of dollar movements in predicting inflation has varied considerably; in particular, the sharp dollar depreciation from 1985 through early 1986 was followed by a (further) decline in U.S. inflation rather than an increase.

More generally, the use of exchange rates as inflation indicators is subject to a number of conceptual pitfalls in addition to the ones mentioned above. First and most obviously, exchange rates reflect *relative* conditions in the broad array of domestic compared with foreign product and asset markets. Thus signals given by dollar movements about U.S. inflation necessarily involve an assessment of foreign inflationary prospects.[44] For the same reason, exchange rate movements are unlikely to be the best indicators of developing worldwide inflationary pressures. Second, in periods when real disturbances are important (as they have been for much of this decade), exchange rate movements are liable to give misleading signals about underlying inflation trends. For example, the dollar's fall beginning in 1985 is widely attributed to real factors (specifically, a shift in actual and expected relations between national saving and investment) and perhaps for this reason proved not to be a good indicator of future domestic inflation.

None of these caveats should be taken to mean that exchange rates cannot be helpful in assessing inflation pressures in some circumstances. On balance, however, the utility of exchange rates as indicators of underlying inflation pressures, as distinct from those pressures directly but temporarily generated by their own movements, has probably been exaggerated and indeed seems, on present evidence, to be fairly limited. Given their nature, exchange rates seem unlikely to be superior to interest rates, commodity prices, or other equally available data as indicators of worldwide inflationary pressures. Moreover, the more obvious historical cases in which exchange rate movements have proved to be good leading indicators of inflationary pressures are ones in which the signals

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[43] Many of these studies have appeared in Federal Reserve publications. See Bergstrand (1985a, 1985b), Whitt et al. (1986), and Lown (1989).

[44] Most studies relating dollar movements to future U.S. inflation in fact have not accounted explicitly for foreign inflation, although Lown (1989) is an exception.

provided by interest rates and other domestic indicators appear in retrospect to be equally clear and timely. What exchange rates can add to assessments of underlying inflationary pressures on a regular basis, therefore, remains to be documented.

C. Exchange Rates as Indicators of the Policy Stance

A second set of empirical studies involves the use of exchange rate indicators to distinguish movements in real interest rates from changes in the inflation premia--a step in assessing the stance of macroeconomic policies. The handful of analyses in this area are most useful for what they reveal about the potential information gains from using exchange rates in conjunction with the level and term structure of interest rates--as well as the severe problems that will have be addressed before these gains can be realized in practice.

Policy makers have often used real interest rate measures to assess the stance of monetary policy and its likely effects on real activity and inflation. Short-term real interest rates can be gauged relatively easily, though roughly, because anticipated near-term inflation is likely to be closely related to recent past inflation developments (that is, because inflation tends to exhibit considerable short-term inertia). Medium-term and longer term real interest rates are, however, generally of much greater value in assessing the stance of policy and the future course of the economy, yet their measurement (that is, of medium-term and longer term expected inflation) is much more difficult.[45]

As indicated earlier, exchange rates react quite differently to changes in real interest rates than to changes in expected inflation; for this reason, exchange rates in principle can be informative about movements in these two components of nominal interest rates. This observation is the basis, in fact, for presumptions that increases in the dollar together with U.S. interest rates signal "tight" domestic macro policies, that is, a sustained rise in real interest rates. Of particular importance in the present context is that exchange rates, by their nature, are potentially informative about longer term real interest rates and, for this reason, may also help in interpreting the term structures of nominal and real interest rates.[46]

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[45] Admittedly, surveys of medium-term U.S. inflation expectations are available (in particular the Hoey survey) but their accuracy as measures of general market anticipations is uncertain.

[46] Recall that current exchange rates can be viewed as equal to their expected long-term levels discounted by the home-foreign long-term interest differential adjusted for risk (associated with the currency denomination). Accordingly, the "information content" of exchange rates concerning longer (continued...)

Several studies of the U.S. experience with money aggregate targeting in the early 1980s demonstrated that exchange rates could provide useful information about real interest rate movements and the stance of policy, at least under some circumstances.[47] During this period, reported increases in M1 above announced FOMC targets tended to lead to virtually immediate increases in both short-term and longer term interest rates. The studies used the reaction of dollar exchange rates to discriminate between the two possible explanations of this pattern: that the monetary overshoot was interpreted by the market as an indication of an acceleration in future money growth and hence as an increase in inflation premia; or that the market expected the overshoot to be corrected in subsequent months through an increase in real interest rates. The second hypothesis appeared confirmed by the fact that dollar appreciation typically accompanied the rise in U.S. interest rates following announcements of unexpectedly high money increases (dollar depreciation, or at least no change, would have been expected if the first hypothesis were correct). The apparent success of this use of exchange rate indicators must, however, be tempered by its relatively narrow application to short-term movements in interest rates under a very specific monetary policy regime. Whether analogous approaches can provide equally useful information, particularly about broader movements under interest rate targeting rules, remains to be seen.

A subsequent study by Pigott (1984) attempted to apply the general principles underlying the above studies to estimate movements in long-term real interest rates using observable data on nominal interest rates and real exchange rates. The approach was to use certain identifying assumptions to develop a prediction equation relating the observable interest rates and exchange rates to their underlying components, in particular long-term real interest rates. The broad movements in the estimated U.S. real interest rate obtained in this fashion seemed broadly plausible. Whether the approach could be practically useful and extended to other periods is uncertain for at least two reasons. First, the estimates almost inevitably depend on a number of fairly arbitrary identifying restrictions, which are supported by very little independent evidence. Second, the parameters of the prediction equation depend critically on the structure of the underlying disturbances to interest rates and exchange rates and thus would need to be periodically (if not continuously) updated.

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[46](...continued)
term interest rates will generally decline as the volatility of expected long-run currency levels and the risk factor increase.

[47] See Hardouvelis (1984) and Cornell (1982).

In recent years, virtually no additional formal empirical analyses of the information content of covariations in interest rates and exchange rates have appeared in the literature. There has been much more work, of increasing sophistication, attempting to extract information about real interest rates and expected inflation from the term structure of domestic interest rates.[48] Given the possibilities raised by the earlier studies cited above, renewed research examining the indicator properties of exchange rates in conjunction with the level and term structure of interest rates might hold significant promise. As yet, however, these possibilities remain largely unexamined.

V. Conclusions

This paper has reviewed evidence from the literature on the use of exchange rates in the conduct of U.S. monetary policy. As we have emphasized, U.S. authorities in formulating policy routinely consider the likely behavior of dollar exchange rates and its effects on the economy. In this sense, because the U.S. is an increasingly open economy, authorities can hardly afford to ignore exchange rate considerations in their policy deliberations. Our task here, however, has been to consider whether the dollar should be used in a more active and systematic fashion in monetary policy formulation, either as an intermediate target or as a formal indicator. In keeping with the other studies in this volume, we have deliberately confined our analysis to the traditional context of U.S. monetary policy, in which domestic goals of an acceptable inflation rate and real economic stability have been pursued without any explicit coordination with policies abroad. The literature on exchange rates and monetary policy, while quite extensive, has been primarily concerned with issues beyond this narrower context, in particular the pursuit of external objectives and the maintenance of international monetary regimes; thus our analysis of necessity has been based largely on inferences from the larger literature.

The increased attention over the last decade to the possibility of using exchange rates in the formulation of monetary policy owes much to the breakdown of relations between the traditional targets and indicators, the money and credit aggregates and interest rates, and nominal and real activity. This breakdown, which has occurred in many other countries as well, has greatly increased interest in alternative variables that might be used to guide policy. In the United States particularly, interest in using dollar exchange rates in this context has also been spurred by growing awareness of the degree to which the economy is influenced by conditions abroad, whose effects, at least at first, tend most often to be transmitted through exchange markets.

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[48] See, for example, Mishkin (1989).

As we have argued throughout, however, the literature clearly shows that very important differences, some fundamental, separate exchange rates from the other variables that have been considered for use in monetary policy formulation. We have emphasized two of these differences in particular. First, exchange rates are determined by a significantly wider range of real and financial variables than are other asset prices, with the possible exception of stock prices; the list of exchange rate influences includes virtually the entire spectrum of real and financial macroeconomic fundamentals in the domestic economy and abroad. Exchange rates, no less than other asset prices, are critically dependent upon market expectations, but these expectations generally concern a greater variety of factors than are normally the focus in short-term money markets, bond markets, or commodity markets. Second, exchange rates are inherently international variables that are directly affected by and have direct effects on macroeconomic developments in both foreign and domestic economies; thus their use in policy by any one country almost inevitably involves questions of international macroeconomic interdependence and policy coordination.

At the least, these differences mean that use of exchange rates in monetary policy is likely to be an inherently more complex process, involving broader issues, than the use of more traditional variables--a conclusion underscored perhaps most clearly by our analysis of proposals to use the dollar as an intermediate target. Loosening or tightening U.S. monetary policy as the dollar rises or falls about some predetermined trend is likely to be beneficial for the U.S. economy only if disturbances are dominated by shifts in money demand, and will generally be destabilizing under a wide range of alternative, both nominal and real, shocks. The evidence of the last two decades suggests overwhelmingly, however, that exchange rates have typically been subject to a very wide range of nominal and real influences whose relative importance varies over time. If anything, the shocks under which exchange rate targeting rules would be destabilizing have tended to predominate, especially during the 1980s. Thus, countering the rise in the dollar in the first half of the 1980s through monetary policy almost certainly would have seriously impeded the effort to reduce U.S. inflation. In sum, the evidence in this area is fairly clear: the performance of U.S. monetary policy, judged simply in terms of its success in achieving traditional domestic goals, would not be improved, and most likely would be harmed, by use of the dollar as an intermediate target. Accordingly, the case for using the dollar as an intermediate target and related proposals must be made on other grounds, in particular in the context of international macroeconomic policy reforms in which external objectives and the possibility of coordination of domestic and foreign policies become central. (Indeed, given the key importance of dollar exchange rates to foreign economies, these considerations could hardly be avoided if the United States, for whatever reasons, were to seriously pursue exchange rate targeting over any sustained period.)

While it is reasonably clear that exchange rate targeting by U.S. monetary policy would be inadvisable, the literature suggests that other, less ambitious and narrowly defined uses of exchange rates may hold more promise. Indeed, the cumulative experience with floating exchange rates shows that U.S. policy makers must take account of exchange rate movements, if only in gauging the effects of their actions on the economy. Beyond this, the historical record includes a number of episodes in which exceptional conditions in foreign exchange markets, alone or in conjunction with other financial markets, appear either to have posed serious risks to key medium-term or longer term monetary policy objectives or to have significantly if temporarily altered the responses to the operating instruments. Under these circumstances, the use of exchange rates as temporary side constraints on near-term policy actions may well be necessary simply to achieve domestic objectives or to restore the efficacy of the authorities' instruments. The use of the dollar as a temporary side constraint seems, in fact, the primary context in which exchange rate considerations (beyond their use as indicators) actually have been given weight in U.S. monetary policy decisions during the 1980s. The literature, however, has virtually nothing to say about the potential benefits or risks from such uses, a fact which is perhaps not surprising given the unavoidably irregular and ad hoc nature of these uses. However, the challenge for analysts is to define more clearly the circumstances under which exchange rate considerations should override normal monetary policy procedures and to determine how exchange rates should be used in such circumstances.

Historical experience and the formal literature, while mildly encouraging about the potential utility of exchange rates as formal monetary policy indicators, provide only very general suggestive guidelines as to how they might be so used. Most clear is that, given the complexity of their determinants, any information provided by exchange rate movements themselves is hopelessly ambiguous unless gauged in conjunction with interest rates and other indicators. If anything, the literature, which has concentrated on identifying hypothetical circumstances in which the authorities are faced with a very limited array of disturbances to gauge, understates the practical difficulties of using exchange rate indicators. Given the complexity of exchange rates' interactions with other economic variables, analysts must know a great deal about the disturbances hitting the economy and other features of its structure if they are to extract significant additional information from currency movements. Needless to say, this task is very difficult because these economic features tend to change unpredictably over time. Thus it remains to be seen that exchange rates can in practice provide useful regular information to guide policy in other than fairly extreme and infrequent circumstances. At the same time, the literature has not thoroughly explored the possible ways in which exchange rate indicators might prove useful (indeed, the task has barely begun). In particular, the extension of recent work on the information content of the term structure of interest rates to include exchange rates may hold some promise, although its value has yet to be tested.

Overall, therefore, the evidence does not provide any thoroughly compelling case for substituting exchange rates, either as targets or indicators, for more traditional monetary policy guides. In the future as in the past, policy makers will need to examine exchange rate movements in assessing the course of the economy and the effects of their policy actions. Beyond this, the evidence does not provide any firm basis for the use of exchange rates as targets except in fairly extreme and irregularly occurring circumstances. Nor is there any compelling case as yet for the systematic use of exchange rates as more than general indicators, or as supplements to more traditional indicator variables whose properties are better understood. Thus the use of exchange rates in U.S. monetary policy is likely to, and probably should, remain an "art" for the foreseeable future. The challenge to analysts is to determine through further research whether that art can be refined and made more systematic and reliable than it presently is.

Appendix 1: Exchange Rate Determinants and Effects: A Short Primer

Exchange rates, their determinants and their effects, are the subject of an enormous literature and much ongoing controversy. Nonetheless, there is considerable continuity in the way economists have viewed exchange rates over the years and more agreement presently than is often appreciated about the general framework that needs to be applied to their analysis. Below we sketch the general features and major controversies concerning the "modern" theory of exchange rates relevant to our topic; this discussion is primarily for the benefit of those readers not familiar with these issues and is not intended as a definitive survey.[49]

[49] There are many excellent surveys of exchange rate models and evidence; good examples are Dornbusch (1980a, 1980b, 1987a), Isard (1987), Obstfeld (1985), and Shafer and Loopesko (1983). Arndt and Pigott (1985) trace the postwar development of exchange rate models and their evolving representation of key policy questions.

The Economics of Exchange Rates

The common theme of exchange rate analyses for (at least) the last forty years is that currency values must be consistent with *balance of payments equilibrium*.[50] This equilibrium condition simply says that the balance of a nation's current account transactions (CA) must equal, or be financed by, its net inflows of capital (NCI):

(1) CA = NCI

Note that net capital inflows include all private as well as official inflows into the country.

During the 1950s and 1960s, the current account side of this equilibrium relation was given primacy in explaining exchange rates. This emphasis largely reflects the fact that international capital flows were sharply constrained by official and institutional barriers (capital mobility was quite low) and economists' limited understanding of how exchange rate movements could affect financial market demands and supplies. Exchange rates were typically viewed as varying either to maintain the relative prices of traded goods needed for current account balance or, alternatively, to offset movements in relative national price levels in accordance with the much older doctrine of purchasing power parity (PPP).[51] In either case, real factors determining equilibrium relative prices in goods markets were viewed as critical to exchange rate determination.

The dramatic increase in the size and mobility of international capital beginning in the mid-1960s and improvements in the analytical technology for analyzing financial market equilibrium led to increasing emphasis on the capital account's role in exchange rate determination. In the highly influential Mundell-Fleming model introduced in the 1960s, exchange rates were jointly determined by the current and capital accounts, with the latter's importance an increasing function of the degree of capital mobility.[52] The present framework used by virtually all economists to analyze exchange rates, known as the "asset market approach," is essentially the limiting case of the Mundell-Fleming model

[50] This view was well established even before the advent of more formal treatments. For an early example applying this view systematically, see Meade (1951).

[51] Purchasing power parity dates back to the nineteenth-century writings of Casel (and earlier in the view of some historians). Models based on current account equilibrium were essentially Keynesian in nature, emphasizing the effects of exchange rate changes on relative prices on traded goods and their repercussions for domestic incomes; good examples are Meade (1951) and Alexander (1959). Subsequent extensions, notably Machlup (1956) and Laurson and Metzler (1956), emphasized broader macroeconomic effects on wealth and asset markets.

[52] Mundell 1962, 1963, 1968; Fleming 1962.

when capital mobility is highly, if not perfectly, mobile.[53]

The asset market approach views exchange rates as proximately determined in financial markets.[54] This framework is based on three assumptions: first, that exchange rates are free to vary essentially instantaneously in response to market conditions; second, that asset markets themselves are nearly continuously in stock equilibrium; and third, that potential, ex ante international capital flows are much larger than fluctuations in trade flows. The first and second assumptions are in contrast to what is commonly assumed about product markets, where prices are often constrained by contracts or other institutional "rigidities" and where (partly as a result) full market clearing can take considerable time; the third assumption indicates that the asset approach is most appropriate in an environment of relatively high international financial integration and capital mobility.

The asset approach can be summarized by saying that the current value of the exchange rate (S(t)) is the discounted value of its expected future level "n" periods in the future ($S^e(t;n)$), where the "discount" factor is the risk-adjusted interest differential between the home and foreign country (expressed as the return over the n period horizon):

$$(2)\ S(t) = S^e(t;n)/[(1+i(t,n))r(t,n)/(1+i^*(t,n))],$$

where i and i* are the home and foreign interest rates and r is the differential risk premium.[55] The risk premium effectively represents the extra risk (to the market as a whole) of investing in home assets as against assets denominated in foreign currencies. The relation simply says, equivalently, that the return on foreign assets is equal, on a risk-adjusted basis, to the return on (comparable) foreign assets after accounting for the expected depreciation of the home currency over the holding period.

As this relation suggests, the asset approach effectively describes exchange rate movements in

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[53] The asset approach developed as an outgrowth of the Mundell-Fleming framework beginning in the early 1970s. Its development was spurred in part by work of Branson (1972), Officer and Willett (1979), and others on stock-flow distinctions in the determination of international capital flows. Work by Tobin (1969), Foley and Sidrauski (1970), and others on domestic portfolio balance models also contributed. Johnson's seminal monetary approach to the balance of payments (1978a, 1978b) was at least a precursor of the asset approach. Other relatively early examples are Kouri (1976), Kouri and Porter (1974), and Branson (1979).

[54] Informative discussions of the underpinnings of the asset approach can be found in Horne (1980) as well as in Allen and Kenen's treatise (1980).

[55] This standard formulation is exploited by Isard (1980) to develop a very useful accounting framework for classifying factors affecting exchange rates. Note that this relation assumes that legal or other barriers to international capital flows are essentially negligible. Where such barriers are important, the term r() includes their effects in addition to the effects of risk.

terms of changes in their expected long-run equilibria and fluctuations about those equilibria due to variations in risk-adjusted domestic relative to foreign interest rates. Indeed, as is often pointed out, the asset approach itself describes only the relation between current exchange rates and their future values, and is incomplete without a theory of the long-run determinants of currency values.[56] Economists' views about these long-run determinants remain quite similar to those incorporated in traditional approaches. That is, long-run equilibrium nominal exchange rates (S) can be viewed as the product of the long-term equilibrium levels of a) the real exchange rate (X), which summarizes equilibrium relative prices of home versus foreign goods, and b) relative national price levels (P/P*):

(3) $S' = X'(P/P^*)'$,

where ' denotes long-run values.

The implication of the asset approach as summarized by relations 2 and 3 is that market expectations are likely to be a major, even dominant, influence on currency values.[57] Furthermore, the "dynamics" of exchange rate adjustments to their long-run values are likely to be closely related to the dynamics of domestic and foreign interest rate movements. Note also that, although exchange rates are proximately determined in financial markets, real factors nonetheless can affect currency values in the short run as well as the long run through their influence on expected future equilibrium exchange rates.[58] Indeed, any factor influencing exchange interest rates, inflation rates, or relative prices--which is to say virtually any macroeconomic variable--is a potential exchange rate determinant.

Controversies about particular models of exchange rates amount in large part to questions about the relative importance of various subsets of the broad range of factors that, in theory, can

[56] The notion that exchange rates are heavily influenced by new information, normally referred to as "news," has led to an extensive literature, some of which is relevant to our discussion of exchange rate indicators in Section IV, and is now one of the generally accepted "stylized facts" about exchange rate behavior. See, for example, the surveys by Mussa (1977) and Dornbusch (1980a).

[57] See, for example, Isard (1978, 1980) and Dooley and Isard (1982, 1983).

[58] This view is highly traditional, as indicated by the discussion in Yeager (1976). It is also completely consistent with the modern approach, as the treatises of Allen and Kenen (1980), Dornbusch (1980b), and Niehans (1977) make abundantly clear. The primary difference between older and more recent models in this respect is that older approaches tend to view the current account as the major direct channel transmitting real influences to exchange rates, whereas modern asset models focus on expectations (about future currency values and their determinants) as the dominant channel.

influence currency values.[59] The available models can be divided into three basic classes: monetary models emphasizing variations in money demands and supplies; portfolio balance models emphasizing the currency composition of assets (money and bonds) available to the public; and current account models incorporating considerations of (long-run) current account equilibrium. These models are consistent with a variety of complex exchange rate behaviors but do not, even collectively, consider the full range of potential exchange rate determinants; real factors particularly tend to be ignored or (as in the last group) treated only in a very limited and generally ad hoc fashion.

Monetary models are based (naturally) on the presumption that nominal disturbances are dominant and are closely linked (because of money neutrality) to purchasing power parity (PPP). The simplest models assume that output prices are perfectly flexible so that PPP holds continuously (that is, real exchange rates remain absolutely constant). The model has proved to be most useful in understanding broad exchange rate movements over long periods or during hyperinflations, situations in which the relative importance of monetary disturbances are likely to be greatest.[60] However, the monetary models' utility over more normal medium-term intervals has been at best very limited, since real exchange rates are observed to vary considerably--indeed as much as nominal rates.[61] Dornbusch's extension of the simple monetary model, based on "sticky" price adjustment to excess demand, does allow for (transient) real exchange rate movements in parallel with changes in real interest rates in response to money shocks, but predicts (if monetary disturbances are dominant) considerably stronger empirical interest-rate and exchange rate relations than are actually observed.[62]

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[59] The realization that this is the main issue, rather than timeless "structural" propositions about exchange rate behavior, has emerged only gradually. Even a decade ago, empirical surveys and evaluations of various exchange rate models tended to be couched in terms of key "hypotheses" about exchange rate behavior in general; examples (and excellent and informative surveys) are Horne (1980), Frenkel (1980), Isard (1978), and Schadler (1977). These are usefully compared with more recent surveys conditioned by sobering empirical experiences with various models: Dornbusch (1980a, 1987a), Frenkel (1980, 1981), and Obstfeld (1985). Arndt and Pigott (1985) also emphasize the relative importance of disturbances as the key distinction among the various models.

[60] See Johnson (1978a, 1978b), Bilson (1978a, 1978b), and Frenkel (1976) for seminal examples.

[61] Another stylized fact cited in Mussa's (1977) survey.

[62] Dornbusch's (1976) overshooting model of exchange rate determination spawned numerous theoretical extensions and applications. The price/interest rate dynamics of the model represented nothing beyond those of standard domestic macroeconomic texts and empirical models, but the implications for exchange rate behavior were not well understood until its advent. Although initial (continued...)

While very helpful in clarifying monetary policy transmission to exchange markets (and in helping to explain why, for example, U.S. interest rates and the dollar both rose sharply during the early 1980s), the Dornbusch model has not proved empirically robust across periods or countries.[63]

Portfolio balance models, essentially international versions of the domestic models of Tobin (1969) and others, seek in large part to examine the influence on exchange rates and interest rates of the currency composition of (outside) assets; the degree of substitutability of assets in different currencies and the closely related question of the determination and empirical importance of the currency "risk" premium (r) are the primary issues in these models.[64] The most modern versions are the international capital asset pricing (ICAPM) frameworks based on finance principles of risk diversification.[65] Unfortunately, given the importance of the issues addressed, portfolio balance models have met with little success empirically, whether in reliably measuring asset substitutability and the effects of changes in asset composition, in identifying or explaining the behavior of the risk premium (if any), or even in verifying basic assumptions underlying the framework.[66]

Exchange rate models incorporating current account or related considerations can be viewed as attempts to account for shifts in long-run equilibrium relative prices or for permanent departures from a given PPP equilibrium.[67] While there is growing evidence that such shifts may be important

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[62](...continued)
empirical applications appeared promising (in particular, Frankel 1979a, 1979b), subsequent analyses raised considerable doubts about its utility as a general explanation. See (among very many examples) Brittain (1977), Willett and Forte (1969), and Pigott and Sweeney (1985).

[63] See Dornbusch (1980a, 1987a) and Obstfeld (1987).

[64] The models developed out of work by Branson (1977), Henderson (1979a), and Allen and Kenan (1980). Early empirical analyses include Branson, Haltunnen, and Mason (1977) and Artus (1976).

[65] For example, Lewis (1988) and Engle, Frankel, and Rodrigues (1989).

[66] In particular, studies have so far failed to detect a statistically significant or reliable effect of currency composition or more general portfolio balance effects on exchange risk premia. See Frankel (1982) as well as Engle, Frankel, and Rodrigues (1989). Portfolio balance models often do outperform the monetary models, however (Horne, 1980).

[67] In attempting to explain dollar movements in the 1970s and early 1980s, Hooper and Morton (1980) add a proxy for movements in current account equilibrium to a standard portfolio balance model. In similar spirit, Hutchinson and Throop (1985) use the expected U.S. budget deficit in their exchange rate model, while Keran and Zeldes (1980) examine the effect of oil prices on the dollar-yen rate.

sources of currency fluctuations, their empirical modeling is still at a very early stage. Existing models have generally relied on rough proxies and/or have been tailored to very specific conditions, such as the effects of oil price increases; these models, like their competitors, have not been successful empirically beyond limited episodes.

Overall, the various exchange rate models, while seemingly useful in explaining certain episodes or aspects of exchange behavior, have proved to be empirically unstable and unable to explain or predict currency values to any economically significant degree. Indeed, the one established empirical proposition in this area is that exchange rate changes are nearly random.[68] Studies by Meese and Rogoff (1983a, 1983b, 1988) showed that a random walk predictor outperforms the formal exchange rate models, even when realized values of the explanatory variables are used in place of expectations variables. These "failures," while amply justifying pessimism about economists' ability to predict exchange rates or estimate their "equilibrium" values with any precision, are nonetheless informative in that they strongly suggest that exchange rates in any given period are affected by a very wide range of disturbances, rather than dominated by any particular set incorporated in a given model.

Exchange Rate Effects on the Economy

The economic effects of exchange rates and exchange rate linkages to other macroeconomic variables have also been the subject of a copious and longstanding literature, one which has reached somewhat more definite conclusions than the literature on exchange rate determinants. The real sector impacts of exchange rates are the most familiar and probably least controversial of the linkages. For example, a fall in the dollar itself tends to raise the absolute and relative prices of foreign as against U.S. traded goods, leading after a lag to a fall in U.S. imports and a rise in U.S. exports, developments which in turn stimulate domestic production and income. The rise in import prices also tends to raise the domestic price level, both directly and by influencing prices of domestically produced substitutes and wages. Foreign countries, of course, experience qualitatively opposite effects on their own prices,

[68] Simple statistical tests nearly always fail to reject the hypothesis that exchange rate changes are nearly random. See, for example, Logue, Sweeney, and Willett (1978). Studies have also shown, however, that future exchange rate changes can be predicted to some degree by certain (generally nonlinear) rules based on past exchange rate behavior; see Dooley and Shafer (1983) and Logue, Sweeney, and Willett (1978). The apparent paradox is probably explainable by the growing evidence that the variance of exchange rate changes (volatility) evolves over time in the manner suggested by the ARCH model of Engle (1987). That is, a relatively "large" change in the exchange rate at a given time raises the probability of further changes that are "large" in magnitude; however, the probabilities of a change in either direction are not affected.

trade balances, and output.

Empirical knowledge about these impacts and their timing, while far from exact or definitive, is nonetheless sufficient to gauge, at least roughly, the effects of given exchange rate movements on the real economy. It is also considerably superior to empirical knowledge about other aspects of exchange rates. Goldstein and Khan (1985) provide a good summary of the effects of exchange rate changes on U.S. foreign trade and prices. Their work suggests that a 10 percent depreciation of the dollar should lead to a 7 to 10 percent decrease (increase) in the relative price of U.S. exports (imports) over two years and that the estimated long-run price elasticities of U.S. exports and imports are on average 1.19 and 1.23 percent, respectively. Thus the consensus view seems to be that a 10 percent decrease in the dollar should over time raise real U.S. exports and lower real U.S. imports by roughly 8 to 12 percent. Moreover, since a 10 percent increase in import prices would raise U.S. consumer prices by roughly 1.5 percent, the Goldstein and Khan survey suggests that a 10 percent decline in the value of the dollar should raise U.S. consumer prices by 1 to 1.5 percent over time.

Bryant, Henderson, et al. (1988), using eleven large macroeconomic models to simulate the behavior of the U.S. economy and the rest of the world's economy over six years, provide some useful estimates of the likely effects of an exogenous change in the exchange rate and a change in the exchange rate induced by monetary policy. On average, the eleven models predict that a gradual *exogenous* (that is, not due to any policy shift) decline in the value of the dollar by 25 percent over five years will raise real U.S. GNP by as much as 0.7 percent (by the third year), increase U.S. consumer prices by as much as 5 percent ultimately, and improve the U.S. current account balance by $20 billion (after four years)--all relative to baseline. The estimated effects of using U.S. monetary policy to lower the value of the dollar by the same amount are, not unexpectedly, generally much larger.[69] On average, the models suggest that the increase in the monetary aggregates required to lower the dollar by 25 percent over five years would raise U.S. GNP to a peak of nearly 5 percent above baseline by the third year, after which the effect would diminish to about 2 percent above baseline by the sixth year. Consumer prices would increase by 8 percent (more or less permanently) as a result of the money-induced dollar depreciation. Owing to a J-curve effect, the models predict on average that the U.S. current account balance would at first decline by more than $11 billion in the second year and then gradually increase by nearly $4 billion relative to baseline by the sixth year.

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[69] The models suggest that the U.S. monetary aggregates would have to be increased by a little more that 4 percent on average to bring about a 25 percent decline in the value of the dollar by the fifth year.

Note, however, that these estimates reflect the average results of the eleven different simulation exercises and are somewhat misleading because the individual models often differ considerably.[70]

Much less is known about the equally important interactions of exchange rates with asset markets generally. Numerous experiences in recent years strongly suggest that developments in the foreign exchange markets can spill over to domestic financial markets and that concerns about exchange rate volatility or prospective movements in currency values can affect domestic interest rates and even the stock markets. Indeed, the possibility that dollar fluctuations might undermine international investors' confidence in dollar investments has at times been of significant concern to authorities here and abroad. However, the literature has yet to provide a basis for systematically assessing the effects of currency fluctuations on interest rates and other asset prices in particular instances.

Appendix 2: McKinnon's and Williamson's International Monetary Reform Proposals

Ronald McKinnon's proposal for an "international standard for monetary stabilization" and John Williamson's "target zone" proposal have serious implications for how the dollar might be used in U.S. monetary policy.[71] But their approach to the use of the dollar differs from the approach

[70] Although some of the models predict that an exogenous depreciation of the dollar will have stimulative effects on U.S. GNP, significantly larger than the average, others suggest that U.S. output might be actually reduced instead. All the models predict that U.S. consumer prices will increase, but the estimates range between 1 and 13 percentage points. Most of the models predict that the U.S. current account balance will improve following an exogenous decline in the dollar, but a few predict just the opposite. All of the models predict that U.S. monetary expansion to lower the dollar will initially raise U.S. GNP relative to baseline, but the stimulative effects tend to weaken after a few years and even become negative in a few cases. Most of the models predict that U.S. consumer prices will increase following the required money supply increase, but the range of the estimates is from minus 2 to plus 18 percentage points. Finally, although most of the models predict that the U.S. current account balance will decline in the first few years following monetary expansion, the results for the longer run are quite diverse. One model predicts that monetary expansion designed to lower the dollar by 25 percent will reduce the U.S. current account balance as much as $80 billion after five years; at the other extreme, another model predicts that the current account balance will increase by the same amount.

[71] See McKinnon (1984, 1988), Williamson (1985, 1987, 1988, 1989), Williamson and Miller (1987), and Edison, Miller and Williamson (1987).

taken in the this paper in at least two fundamental ways: both McKinnon and Williamson assume a high degree of international economic cooperation and both see a move toward exchange rate targeting as a key element in a reform of the international economy.

At times, McKinnon's arguments about the usefulness of the dollar as a target variable seem to be motivated by a similar concern, namely, the declining usefulness of the traditional intermediate target variables--the money aggregates and interest rates. This generally seems to be the case with McKinnon, for McKinnon's proposal seems to be motivated in part by a concern for the deterioration of the traditional monetary policy targets, and its validity rests to a large degree on the argument that the observed instability of money demand in the United States is due to the variability of exchange rates.

But McKinnon's plan quickly goes beyond anything envisioned here. Arguing that the observed instability of money demand not only in the United States but in the other major industrial nations would be resolved at the global level, McKinnon proposes that the monetary authorities of the three major industrial nations--the United States, West Germany, and Japan--cooperate to control inflation under a system of stabilized exchange rates maintained by symmetrical unsterilized intervention. For McKinnon, therefore, exchange rate targeting becomes a way to ensure the symmetrical operation of monetary policy at the global level: in response to a rise in the dollar against the yen, for example, the U.S. monetary authorities would ease their stance and the Japanese authorities would tighten their stance in an equal and offsetting manner so that the stance of money policy at the global level would be unaffected.

McKinnon's earlier proposals have a very monetarist flavor. Contending that the observed instability of money demand at the national level was due to currency substitution, McKinnon (1984) proposed that monetary authorities of the three major industrial nations cooperate to realize a growth target for their combined money supplies under a system of fixed exchange rates by using national targets for domestic credit expansion and symmetrical unsterilized intervention. Prompted by persistent criticism of currency substitution and by subsequent experience (see Dornbusch 1983 for a good critique of currency substitution), in 1988 McKinnon shifted to the view that monetary policy at the global level should be directed toward maintaining global price stability, rather than monetary growth, but continued to argue that exchange rate targeting was a way to deal with the observed instability of domestic money demand. He also retained the view that stabilizing exchange rates through unsterilized intervention would ensure symmetrical monetary policy but permitted nominal exchange rate fluctuations within 10 percent of par to give each monetary authority greater flexibility.

John Williamson's "target zone" proposal is another monetary reform plan that has also been associated with exchange rate targeting. But Williamson's proposal has very little to do with the uses of the dollar examined in this paper, for his proposal stems primarily from dissatisfaction with the regime of floating exchange rates. Arguing that floating exchange rates have failed to insulate the U.S. economy from foreign economic disturbances because changes in nominal exchange rates have led to significant changes in real exchange rates, Williamson has proposed that the Group of Seven (G-7) industrial nations use monetary policy to prevent their real effective exchange rates from departing significantly from equilibrium levels implied by current account objectives.

Under Williamson's earliest plans for international monetary reform, the Group of Seven (G-7) industrial nations would use monetary policy to prevent their real effective exchange rates from deviating by more than 10 percent from equilibrium levels implied by the mutually agreed-upon current account objectives. When economists countered that this proposal would inevitably lead to inflation,[72] Williamson recommended that the G-7 nations a) use their individual fiscal policies to realize national nominal income targets, b) adjust the average level of their real short-term interest rates to stabilize the aggregate level of nominal income, and c) adjust their real short-term interest rate differentials with supplemental intervention operations to keep their real exchange rates within the target zones to maintain external balance. Since expected and actual domestic inflation rates would both presumably be determined by the national fiscal and global monetary policies, the targeting of real exchange rates through real interest rate adjustments would presumably imply adjusting nominal interest to keep nominal exchange rates within certain variable ranges in practice.

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[72] See Adams and Gros (1986).

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OPTIMAL MONETARY POLICY DESIGN: RULES VS. DISCRETION AGAIN

A. Steven Englander

This paper reviews some recent academic literature on "optimal" monetary policy design. Over the last fifteen years, the entire direction of the debate on optimal monetary policy has been reversed. Earlier literature assumed that an optimal monetary policy could be devised by solving a "dynamic optimization" problem. It assumed that given a set of policy objectives and a model of the economy, the optimal path of inflation and GNP could be obtained.[1] The current literature argues that it is precisely the public's recognition that policy makers engage in such optimization that leads the public to expect positive inflation in equilibrium, even when both the public and government view any inflation as undesirable. According to this argument, the public will perceive that the authorities are willing to exploit a trade-off between inflation and output, and it will adjust its expectations accordingly.

The main thrust of this literature is to explain how a positive inflation rate can emerge on average, even when all parties view this as an inferior outcome that produces no extra output. The phenomenon that the authors are trying to explain is readily apparent: inflation has averaged above zero in all OECD countries in the postwar period, but few policy makers or economists believe that these inflation rates have contributed to economic well-being. The persistence of inflation at above desired levels in most OECD countries has led analysts to propose economic models yielding inflation as an equilibrium phenomenon explained by optimizing behavior on the part of the public and policy makers rather than happenstance.

The proposed explanation is that the public views policy making as opportunistic: policy makers are willing to exploit a short-run inflation/output trade-off even if a long run trade-off neither exists nor is thought to exist. This explanation also yields a strong policy conclusion. If the public expects positive inflation because it believes that policy makers are trying to exploit this trade-off, the key to lowering actual and expected inflation is to guarantee that no such exploitation will occur. The mechanism by which this can be accomplished is to propose a readily visible rule that eliminates

[1] For example, Kalchbrenner and Tinsley (1976).

policy makers' discretion to inflate opportunistically. In large part this literature argues that the mere ability of policy makers to use discretion, even if the discretion is not actually exercised, will lead the public to expect positive inflation. Hence, the new monetary policy literature examines the old question of "rules versus discretion" from a new perspective.

The argument that the *structure* of the monetary policy making process (that is the presence of discretion) rather than the *conduct* of monetary policy is the source of inflationary bias also points, as the authors see it, to the solution. Changing the structure of policy making to one guided by formal rules, they contend, might yield lower inflation on average with a relatively small loss of output. Implicit in such a recommendation is the assumption that only small losses will arise because the rule prevents policy makers from responding to shocks or disturbances. Advocates of such rules generally argue that feedback mechanisms can be incorporated into the rules to offset shocks and that the magnitude of such shocks might be lower if a consistent noninflationary policy rule were installed.[2]

The alternative explanation of the prevalence of inflation in recent decades is that it was caused by a combination of mistaken policies and adverse shocks, and subsequently compounded by the unwillingness of policy makers to accept the output costs of disinflation through much of the 1970s. Changing the structure of policy making, in this view, would not accomplish much if the public and policy makers were unwilling to accept the costs of policies aimed at lowering inflation.

Such considerations have a direct connection with the issues surrounding the use of "intermediate targets" for monetary policy. It can be argued that if policy makers do not have a reputation for maintaining low inflation, they may find it necessary to pursue an intermediate target rule that can be monitored easily and on a timely basis by the public. This course may involve some loss of output or inflation control if the intermediate target is imperfectly linked to the final objectives. Nevertheless, the visible pursuit of a nominal intermediate target may provide sufficient offsetting benefits in the form of improved credibility and lowered inflation expectations to offset the imperfect linkage. In one sense, the rules-versus-discretion question involves comparing the losses from the imperfect linkages of intermediate targets to final objectives under a rules mechanism with the losses due to the inflation bias alleged to arise from discretion.

The focus of this paper, however, is the interaction between the policy makers' goals and the public's expectations and behavior in response to these goals. Thus, intermediate targets will be

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[2] Most of the literature is theoretical and does not make any effort to calculate the benefits or losses from adhering to a rule. In a series of articles, McCallum proposes a specific feedback rule and attempts to estimate the loss from it. See, for example, McCallum 1987.

discussed again only as a potential means for improving credibility. Much of the discussion below will assume that policy can successfully hit not only intermediate targets but also ultimate goal variables, such as inflation or nominal income growth. More specifically, the discussion will assume that policy makers can achieve their long-run inflation target *and* hit an output target temporarily by exploiting a short-term inflation/output trade-off. Over the long term it is assumed that output growth is at trend and is independent of policy.[3]

Recent literature has also examined the question of optimal monetary policy under conditions of considerable uncertainty about the structure of the economy and the policy makers' ability to hit targets on a period-by-period basis. In the face of such uncertainty, some results are weakened because the public, as might be expected, finds it more difficult to distinguish policy moves from random shocks--and to distinguish policy makers who are inflation prone from those who are not. Uncertainty about the structure of the economy also generally makes strict adherence to rules undesirable because it is difficult to design rules suitable under a broad range of conditions; in forming inflation expectations during periods of uncertainty, the public will usually place more weight on the policy makers' past inflation record.

In recent years several other reviews of the literature on optimal monetary policy design have appeared.[4] This paper seeks to emphasize the intuition underlying the models (Sections I, IIA, and III) and to evaluate some of the suggested mechanisms for achieving credible policies (Section IIC). After examining the lessons that can be drawn for policy, the paper argues that the policy relevance of this literature has been overstated. The theoretical insights emerging from this literature differ little from those of the earlier literature, and are achieved only at the cost of analytical assumptions that are difficult to sustain empirically (Section IIB). Moreover, outside of a few extraordinary episodes, it is very difficult to find any concrete illustrations of the recent literature's key policy prediction that a credible disinflation can be relatively costless (Section IV).

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[3] This assumption can be identified with the Lucas supply curve, which is common in the literature. See Lucas (1972), and Barro and Gordon (1983b).

[4] Other nontechnical discussions can be found in Barro (1985), Blinder (1987), and Fischer (1989). Somewhat more technical but largely readable are the surveys in Blackburn and Christensen (1989), Persson (1988), McCallum (1984), and Rogoff (1987). Of these discussions, Barro's and McCallum's are most sympathetic to the policy thrust of the literature, and Blinder's the least.

I. Some Terminology

The recent literature on optimal monetary policy is difficult for nonspecialists to read, in part because the terminology is difficult. This section reviews the terminology and puts it in the context of the issues to be discussed in greater detail subsequently.[5]

In common language, a "consistent" policy is one that follows a well-defined set of rules over time. It would normally be viewed as superior to an "inconsistent" policy. Because the new literature on monetary policy emerged out of the earlier optimal control literature, the common usage has been altered. A *time consistent* policy is one that results from solving a long-term dynamic optimization problem *without* incorporating the effect of current policy actions on the public's expectations of the future.[6] The "consistency" which emerges in solving such problems is that the optimal policy in all future periods is the same as was determined in the initial period, provided that there are no unexpected occurrences or shocks to the economy. Put yet another way, in the absence of shocks, the optimal policy path laid out in time period 0 continues to appear optimal in period 1, period 2, and so on.[7] In no future period do policy makers have any reason to alter the policy path that they devised in period 0, again assuming that no shocks have occurred. If such shocks do occur, the time consistent policy path has the property that no currently *anticipated* developments would lead policy makers to anticipate changing their program in the future.

This type of consistency does not necessarily mean that the resultant policy path is desirable, only that policy makers see themselves as unable to do better. Whether the outcome is desirable in fact depends on how the public formulates its expectations. The assumption made by policy makers following a time consistent policy is that the public's behavior in each period depends on past policy decisions only. If the public's expectations are rational, however, so that on average the public correctly anticipates and reacts to future policy actions, the policy makers' decisions and the public's

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[5] The terminology and literature began with Kydland and Prescott (1977) and Calvo (1978). Buiter (1981) discusses the relationship between the new literature on monetary policy design and the older optimal control literature.

[6] Such models are often referred to as "causal" models since current behavior can be traced directly to past events. By contrast, "noncausal" models allow expectations of future events to affect current behavior.

[7] Buiter (1981), citing Kydland and Prescott (1977) and Bellman (1957), states that "a sequence of policy actions is time consistent if, for each time period, the policy action in that period maximizes the objective function, taking as given all previous policy actions and private agents' decisions and as given that all future policy actions will be similarly determined."

actions could be based on different views of the impact of the policy decisions. The public could correctly (on average) anticipate future policy moves because it recognizes the incentives faced by policy makers and incorporates these expectations into its current behavior, while policy makers assume that the public's decisions are *independent* of their future actions. In this situation, policy makers are aware of the public's current expectations, but ignorant of how those expectations respond to policy actions. In this respect, the assumption of rational expectations on the part of the public provides it with an informational advantage over the policy makers.

The equilibrium that emerges is the outcome consistent with *both* views of the public's inflation expectations; it maximizes the policy makers' objective function, contingent on the public's current expectations. It is not necessarily the best outcome by any means. The public may base its expectations on worst case assumptions, and policy makers may find that the "optimal" policy in this case has the effect of validating these assumptions.

An example may illustrate this point. Assume that the public correctly believes that policy makers wish to lower the unemployment rate as much as possible provided that inflation does not exceed some critical threshold. For policy makers, the time consistent policy is to remain expansionary as long as inflation is below this critical value. The public, knowing that this is the policy makers' rule, will quickly adjust its inflation expectations to the critical level, since it knows that government policy will quickly bring inflation there. Hence, the time consistent outcome is that inflation expectations and actual inflation adjust upward to the critical level, leaving the authorities little room in fact to implement the expansionary policy--that is, to lower the unemployment rate below some "natural rate."

In this example, the time consistent outcome has the following properties:

a) Policy makers always follow their perceived optimal rule of expanding output until inflation hits a critical level.

b) The public is not fooled in that it correctly predicts policy makers' action.

c) The outcome, characterized by a rapid jump in inflation expectations to the equilibrium level (the policy makers' threshold level), is unlikely to produce the output gains sought by policy makers.

d) At the equilibrium inflation rate, policy makers have no incentive to alter their policy.

By contrast, a *time inconsistent* policy path, which may in fact represent the optimal long-term

Payoff Matrix from the Policy Makers' Viewpoint

	Policy Decision	
Public's Expectation	**High Inflation**	**No Inflation**
High inflation	2 (A)	1 (B)
No inflation	4 (C)	3 (D)

Higher numbers represent preferred outcomes.

policy path, does not necessarily appear optimal to policy authorities on a period-by-period basis.[8] As a result, each period policy makers would be tempted to renounce the initial time inconsistent policy path and substitute a new one. In the example above, the time inconsistent policy is to resist the temptation to lower the unemployment rate below the natural rate, even when the public's expectation is for zero inflation and expansionary policy would appear desirable from the policy makers' viewpoint.

The distinction between time consistent and time inconsistent policies can be illustrated further in the context of game theory. Consider the policy makers' payoff matrix, which specifies the value of a given outcome under a variety of circumstances and which is assumed to be known by the public (see the table).[9] From the policy makers' viewpoint, the best option is to inflate when the public expects no inflation, thereby gaining the benefits of faster growth (outcome C).[10] The worst option is to disinflate when inflation expectations are high, thereby entailing a loss of output (outcome B).

In between are equilibrium outcomes. When the policy and the public's expectations are noninflationary (outcome D), the outcome is slightly worse than when the inflation takes the public by surprise, but better than when both public expectations and policy are inflationary (outcome A).

The key point is that the public recognizes that the government has an incentive to generate

[8] To quote Blanchard and Fischer's (1989) definition, "A policy is dynamically inconsistent when a future policy decision that forms part of an optimal plan formulated at an initial date is no longer optimal from the viewpoint of a later date, even though no relevant new information has appeared in the meantime."

[9] Blackburn (1987) provides a comprehensive review of the game theory elements of this literature.

[10] The policy makers' objective function will be discussed below in greater detail.

inflation whether the public expects high or low inflation. Outcome A is preferred to outcome B and outcome C is preferred to outcome D--that is, the high inflation strategy dominates.

The time consistent outcome is A: policy and expectations match, creating an equilibrium, and the authorities can do no better given the public's expectations. Outcome D, however, is the time inconsistent equilibrium and is clearly superior to A, but this outcome may be unsustainable. Once the public's expectations are decided, policy makers can do better by inflating. The public will also recognize that if inflation expectations are low, the authorities will choose C. Hence, the public will never expect the low inflation equilibrium because policy makers' optimizing behavior consistent with that expectation yields high inflation.

Thus, in some instances adhering to a time inconsistent policy path is superior to following a time consistent path, provided that the public can be made to believe that policy makers are sincere in their pursuit of a policy that forgoes short-run optimization. In the game theory example, the superior time inconsistent outcome D could be achieved if policy makers could guarantee that they would not try to achieve C, their true optimum. Much of the policy makers' problem consists of convincing the public of their resolve to follow the time inconsistent path, when the public realizes the temptation to reoptimize. The problem resembles that of the Prisoner's Dilemma in that the outcome without cooperation between the players (in this case, the policy makers and the public) is likely to be inferior to that with cooperation. What prevents the superior outcome is the absence of a mechanism to guarantee the cooperative solution, when cheating promises a better result for policy makers acting on their own.

A key element of the coordination problem is that the public is assumed to arrive at its expectation of current period policy before policy makers make their decision. If the authorities moved first, the coordination problem would be mitigated because there would be no opportunity to fool the public. Paradoxically, the time consistency problem would be resolved because there would be no incentive to deviate from preannounced plans. Many of the proposed solutions to the time consistency problem amount to removing "surprise" as a policy tool. In the context of the table, they amount to forcing policy makers to choose between the no inflation equilibrium (D) and high inflation equilibrium (A).

To resolve the coordination problems that arise if the time inconsistent policy path is superior, policy makers may wish to commit or precommit themselves to the time inconsistent policy, which they know to be superior in the long term, and renounce the possibility of reoptimization. By committing themselves to the time inconsistent policy, they may hope to convince the public that they will not inflate, even when it would be advantageous to do so. A further difficulty may arise, however. If policy makers face no sanctions for violating their commitment or if the public cannot monitor on a timely basis policy makers' commitment, any commitment may lack *credibility*. Both the public and the policy makers may agree that the committed policy is best, but the public will not believe that the policy makers will follow through because of the period-by-period temptation to renege.

In practice, it may often be difficult to determine whether policy makers are adhering to the precommitted policy. Targets can be missed either because of random shocks to the economy or because policy makers are reneging on their commitments. Because of this ambiguity, advocates of precommitted policies often argue that following fixed rules makes it easier for the public to observe adherence to announced policies.[11] The rules can be very simple (for example, constant money growth rules) or more complicated, but they have to be understandable, and compliance has to be readily visible.

The requirement of ready visibility may make rules with *no feedback (open loop rules)* at times superior to rules in which policy actions are contingent on actual events. The public may lose confidence in its ability to monitor adherence to a rule if the rule permits action in response to events not readily observable. For example, assume that a particular monetary aggregate deviates from its precommitted path. The central bank may claim that it is merely accommodating a money demand shock. But the public, having no way to ascertain that such a shock has occurred, may assume that the deviation represents a policy easing and may therefore adjust inflation expectations upward.

To sum up, the long-run optimal policy may be time inconsistent if the public can understand and predict future policy responses (that is, the public has rational expectations). It may be preferable for policy makers *not* to optimize on the basis of expectations which they view as fixed, but rather to anticipate the negative effect that such optimization will have on expectations of future policy actions. More concretely, in the monetary policy case, policy makers who are expected to take advantage of low inflation expectations in order to pursue expansionary (and inflationary) policies may find that expectations are extremely sticky at undesirable levels in subsequent periods. Recognizing this, the policy makers may wish to commit themselves to a series of policy actions that may not be optimal on a period-by-period basis, but that is consistent with low inflation expectations in the long run. To

[11] The other papers in this volume provide extensive references to the literature on monetary policy rules.

succeed in the long run, such a commitment must be credible, and credibility in turn may depend on adherence to readily visible fixed rules. Fixed rules with no feedback make it easiest for the public to observe that policy is following its precommitted path.

II. Is There an Inflationary Bias to Monetary Policy?

This section considers the conditions under which positive inflation may emerge as an equilibrium, even when both the public and the policy makers view the outcome as inferior to one of zero inflation.[12] It examines the circumstances under which dynamic optimization by policy makers will produce an inferior result to a policy following relatively fixed rules. Following the presentation of the basic model, a critical discussion of the assumptions needed to yield the equilibrium inflation result is presented. The section concludes with possible approaches to mitigating the alleged inflationary bias of policy.

A. How Do Inflationary Biases Emerge?

The basic structure of the models under discussion is very simple.[13] Policy makers try to achieve inflation and output goals that are inconsistent. The desired output level is greater than could be achieved at stable inflation.[14] Policy makers face the choice between maintaining stable inflation at an output level lower than they would otherwise try to achieve or achieving desired output levels at the cost of ever-increasing inflation. Higher inflation emerges in the second case because the only mechanism available to policy makers by which output can be increased to desired levels is a positive inflation surprise. In a multiperiod context, inflation surprises would be needed each period to

[12] For convenience of exposition and in accord with the rest of the literature, this paper will treat zero as the inflation target. In practice, measurement problems or nominal wage and price stickiness may make a positive but low level of inflation preferable. What is essential for the analysis is that the public view policy makers as willing to inflate above the target, whether it is zero or a positive value.

[13] Barro and Gordon (1983a), Barro (1983), and Blanchard and Fischer (1989) provide clear descriptions of the analytical model underlying this section.

[14] Economists usually attribute this to some distortion that lowers output below its potential. The most common example is the distortionary tax that lowers supplies of labor and capital. Alternatively, political considerations may lead to a greater emphasis on short-term output gains near elections. See Alesina (1988), Alesina and Sachs (1988), and Nordhaus (1989). In theory, the government's objective function could be strictly rising with output, but this would imply a willingness to trade leisure for output that would not be consistent with utility maximization by the public.

maintain desired output; hence, spiraling inflation would emerge.

It is assumed that policy makers are less willing to tolerate additional inflation when inflation rates are already high. For example, going from 0 to 2 percent inflation will cause policy makers some discomfort, which may be offset by the temporary output gain. Each successive increment of inflation causes additional discomfiture, ultimately reaching a point where policy makers are unwilling to accept the higher inflation levels, even if output can thereby be maintained above the level corresponding to the natural rate. Thus, under these assumptions, there is a strict upper limit to the inflation rate policy makers would engineer, even if the public's inflation expectations were set naively. In many cases this upper limit will also be the public's equilibrium inflation expectation since the public knows that policy makers would not intentionally raise inflation any further.

It is also assumed that the public cannot be systematically fooled or surprised by inflation. The public knows policy makers' preferences and the structure of the economy, and knows that policy makers have an incentive to try to produce surprise inflation. The public also knows the increasing discomfiture of policy makers at high inflation rates. (The public's preference function is often assumed to be the same as the policy makers'--that is, to eliminate conflicting preferences as an underlying cause of equilibrium inflation.)

The public tries to predict the inflation rate by evaluating how policy makers are likely to act. The public recognizes that if policy makers observe low inflation expectations, they will have an incentive to create surprise inflation in order to reap output gains from the surprise. But the public also knows that at sufficiently high expected inflation levels, policy makers, by their own choice, would never inflate further, even by surprise, and might even choose to disinflate because of the perceived costs of a high level of inflation.

Using this knowledge, the public forms its expectations. It will never expect inflation to be so low that policy makers will have an incentive to create surprise inflation. Nor will the public expect the government to produce an inflation rate that is so high that the government would subsequently be tempted to engineer a recession (that is, create surprise disinflation) to reduce inflation to more acceptable levels. The rational expectation is thus for an inflation rate just high enough to eliminate the incentives for policy makers to surprise inflate and low enough to remove the incentive to surprise deflate. From the viewpoint of policy makers, losses from additional surprise inflation at this inflation rate just balance the perceived benefit of the additional output. The government, facing this expectation, has no incentive to produce any surprise. This outcome is characterized by inflation that is positive in equilibrium and output that is at the natural rate (but below the government's desired level). Nothing is gained on the output side from the additional inflation, but a welfare loss is incurred because of inflation. Thus, the outcome that emerges is inferior to the one that could be attained at zero inflation.

Although the extent of the knowledge attributed to the public by these models strains credulity, many of the specific assumptions are analytically convenient without being essential. What is essential is the public's assumption that policy makers are willing to use surprise inflation as a tool to generate higher employment. It is not necessary that the public know the exact form of the policy makers' preferences or the exact structure of the economy.

B. Underlying Assumptions

The basic ingredients creating a conflict between short- and long-term policy making are (i) irreconcilable output and inflation goals, (ii) forward-looking or rational expectations on the part of the public (but not the policy makers), and (iii) a perceived ability on the part of policy makers to "surprise" the public with unexpected inflation.

Although these assumptions seem technical in nature, assessing their realism will clarify the realism of the entire analysis. In particular, the sensitivity of the analysis and the results to changes in the assumptions will help us to evaluate the claim that the structure of policy making is the source of persistent inflation in recent times. Indeed, one of the major contentions of this paper is that the implications of the time consistency literature are virtually indistinguishable from those of a standard backward-looking adaptive expectations framework. The additional theoretical elegance of the time consistency models is achieved only at the cost of assumptions whose empirical robustness is dubious.

Incompatible targets

The assumption of incompatible goals is essential.[15] In particular, policy makers are assumed to strive for an unemployment rate that is inconsistent with the natural rate. By assumption, the natural rate is the only unemployment rate at which inflation is stabilized; hence, policy makers must balance approaching their targeted unemployment rate against the extra inflation generated in getting there. There is no conflict between time consistent and time inconsistent policies if policy makers have only a single goal or multiple goals that are mutually supportive. If policy makers aim only at

[15] This assumption dates back to Kydland and Prescott (1977). It is used in Barro and Gordon (1983a, 1983b), Cukierman and Meltzer (1986), and virtually every other paper on the subject.

stabilizing inflation (at zero or any other value) or at stabilizing the unemployment rate at the natural rate (that is, the rate consistent with stable inflation), the time consistent policy path produced by dynamic optimization is fully consistent with the time inconsistent policy path toward the equilibrium of zero inflation (or any desired rate). Hence, the structure of policy making is irrelevant if policy makers are perceived as pursuing only a zero inflation target or a sustainable output target. It is only when the public views policy makers as regarding favorably the prospect of trading additional inflation for additional output that the inflationary bias emerges.

The reason that time consistency problems do not emerge when the output target is the natural rate is that the public has no reason to question the willingness or ability of policy makers to achieve their inflation and output goals. Because there is no conflict among goals, there is no question of commitment or credibility and no policy trade-off to exploit.[16]

As to the policy makers' objective function, the theoretical elegance of time consistency models appears greatly oversold. Undesirably high inflation as an equilibrium is derived at the cost of assuming that policy makers pursue targets that they know to be inconsistent. Often the pursuit is justified as a necessary consequence of the political process or as a way of offsetting other output-reducing distortions in the economy. In general, however, scant attention is paid to motivating the policy makers' assumed objective function empirically or theoretically.

Rational expectations

The other requirement for time consistency problems to emerge is rational expectations by the public. That is, the public knows enough about the preferences of policy makers and the structure of the economy to forecast policy accurately on average.[17] Under rational expectations, policy makers cannot systematically fool the public and so cannot gain the extra output that is sought, even temporarily. There is an asymmetry here in that while both the public and the policy makers know the structure of the economy and the policy makers' preference, only the public optimizes on the basis of future events. Indeed, in the earliest models that developed the time consistency problem, it was

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[16]Malcomson and Hillier (1984) argue that the essence of the time consistency problem is that the policy makers have two targets, inflation and output, but only one instrument. Surprise inflation becomes a second instrument that the policy makers are attempting to utilize.

[17]Rational expectations are not strictly required. As long as the public's behavior responds somewhat to its expectation of future policy, a time consistency problem can emerge. However, virtually all of the literature assumes rational expectations.

explicit that the public reacted to both past and future policies, while policy makers optimized only on the basis of past events.[18] Such myopia on the part of policy makers is often attributed to their susceptibility to short-term political influences. Policy makers do not recognize that the public discerns and reacts to their incentives. If policy makers recognized that the public cannot be fooled, they would not make the effort to do so. Furthermore, in many cases, even if policy makers assumed (incorrectly) that the public had backward-looking expectations, they would nevertheless be deterred from inflating opportunistically as long as their discount rate was not too high and they viewed the public's expectations as responding reasonably promptly to actual inflation.[19] By implication, in those models where high inflation equilibria emerge, policy makers believe that they can fool most of the people for a long time.

The assumption that the public holds rational expectations can also be challenged on empirical grounds. Most empirical tests of the rational expectations hypothesis reject it. In particular, inflation expectations appear to be more backward- than forward-looking and inflation "surprises" can last for a long time.[20] If such is the case, the premise that adherence to a credible policy rule will produce costless disinflation may prove to be far off the mark. In practice, policy makers may find it risky to adopt a policy path whose success depends crucially on the assumption that the public will both anticipate correctly and react immediately to the effects of future policies.

In considering the robustness of policy conclusions to be drawn from the models under review, it is important to recognize that backward-looking (for example, adaptive) expectations on the part of the public can yield many of the same results produced by rational expectations in these models. Adaptive or backward-looking expectations in a multiperiod context would not be strictly "rational," but in regimes of moderate or low inflation the results would not diverge greatly from rational expectations. As long as expectations eventually catch up to actual inflation, any systematic inflation surprise can only be transitory. During this transition, policy makers could temporarily generate

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[18] For example, see Kydland and Prescott (1977). In equilibrium, expectations are fulfilled, so both the policy makers' and the public's expectations are rational ex post.

[19] For example, the low inflation reputational equilibria discussed in Barro and Gordon (1983a) can be interpreted as emerging because policy makers recognize that inflation expectations respond quickly to actual policies. Also see Chari and Kehoe (1988) and Grossman (1990). Backus and Driffill (1986) find that the response of expectations even with Fischer-Taylor-type overlapping wage contracts is sufficiently quick to avoid the bulk of the costs associated with time inconsistent policies.

[20] See Englander and Stone (1989) and the references therein.

higher output (a course not open to policy makers if strictly rational expectations are assumed), but long-run output growth would be unaffected as long as policy makers were unwilling to accept ever-increasing inflation. Equilibrium inflation would be higher and output temporarily higher.

With such backward-looking expectations, however, it makes no difference if policy makers are credible, and there is no conflict between the time consistent and time inconsistent solutions. From the policy makers' point of view, they are obtaining the best solution given their preferences and the structure of the economy. That is, they may feel that if inflation is running at very low levels, the short-run increase in output can justify a small, but long-run, increase in inflation. In practice, however, if inflation expectations react quickly to increases in inflation, the willingness to inflate is likely to be extremely curtailed.

The key point is that in the absence of rational expectations, policy makers, perhaps reflecting the tastes of the public, have preferences that lead them to exploit the inflation/output trade-off and that make them unwilling to accept the output losses required for a return to zero inflation. In this case, it is probably better to choose better policies or better policy makers than to impose a structure of rules that may respond inflexibly, and thus suboptimally, to economic shocks or changes in priorities.

Surprise inflation as a policy tool

The final critical assumption of these models is that policy makers can generate surprise inflation to exploit an inflation/output trade-off temporarily. While this assumption is commonplace in the literature, the process by which the inflation/output trade-off is exploited in practice is not clearly described. Indeed, it seems to rest on two assumptions: 1) that anticipated policy moves (such as an expected easing in monetary policy) should have little or no effect on output, and 2) that policy makers can manipulate the surprise component of inflation to alter the path of output temporarily.

Surprise inflation is not a tool directly at the disposal of policy makers. Some other instrument--interest rates, money growth, reserve requirements--must be used to implement policy. By common consensus, however, long and variable lags separate movements in these potential instruments from changes in inflation or output. It is doubtful whether the degree of surprise experienced by the public when inflation rates change is any greater than that experienced by policy makers or whether economic behavior is greatly affected because of ignorance of the price level.[21] Hence, it is unlikely that mistaken beliefs as to the level of real wages or relative prices can generate significant output fluctuations.

The question of the mechanism by which surprise inflation affects aggregate output, while apparently arcane, is important for determining whether the structure of policy making is the key factor inducing persistently high inflation expectations. If policies that have been previously announced, or for some other reason are already expected, nevertheless can have an effect on real output, the structure of the problem assumed in the time consistency literature is altered fundamentally.[22] The reason is that policy makers can achieve output gains, at least in the short run, without resorting to policy moves that fool the public. Policy makers would optimize subject to their knowledge that unsustainable expansionary policies lead to inflation. Depending on the policy makers' objective function, they might tend to choose inflationary or noninflationary policies, but the source of the inflation would be the policy makers' actions rather than the structure of policy making or expectations conditioned on future policies.

The public might revise its inflation expectation upward when it observed expansionary policy being implemented, but it would not do so in the absence of such policy. Again, the conduct of policy making, rather than its structure, appears to be the underlying determinant of inflation.

Recognizing that ignorance of the level of prices or real wages is unlikely to produce major output effects, some analysts have argued that the effects of inflationary policy moves are seen immediately in asset values and capital accumulation decisions (but before the inflationary effects show up in actual prices). Hence, the policy surprise operates through wealth rather than inflation. The empirical consequences of such redistributions of wealth, however, are difficult to pin down. Some authors contend that inflation leads to higher output because the lower real value of government debt allows the government to engage in further spending. In contrast, others argue that price inflation

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[21] As discussed below, Barro and Gordon (1983) and Kydland (1989) argue that the effects of surprise inflation on nominal asset values and capital accumulation are of greater empirical significance than the effects of wage or relative price surprises on output.

[22] See Mishkin (1983), for example. Both his original work and his reworking of Barro and Rush (1980) suggest that, if anything, anticipated policy moves have more impact on output than unanticipated policy.

may actually lead to a reduction in output by lowering the incentives to accumulate capital.[23]

While the issue appears abstract, the considerable uncertainty attending the effects of surprise asset inflation makes it unlikely that such surprises are the mechanism by which an inflation/output trade-off is consciously exploited by policy makers. Yet the structure of such models and the policy conclusions that they yield presuppose that surprise inflation is the only means by which policy can affect outcomes. If this assumption is false, it is hard to make the argument that the mere presence of discretionary policy making yields an inflationary bias. Again the time consistency problem seems less important than systematic policy errors or preferences in generating inflation.

Credibility

If the zero inflation outcome is preferable to the equilibrium outcome in the eyes of both parties, why do they not agree to maintain the preferred alternative? The time consistency literature argues that the answer to this question involves the credibility issue. The public recognizes that policy makers have every incentive to assert that they will maintain low inflation, but it also recognizes that policy makers have a greater incentive to renege if the public accepts the assertion at face value. According to this view, the public in general will not believe that low inflation will be maintained unless policy makers are viewed as strong adherents of low inflation or policy makers can provide evidence that they are following a policy rule that will yield low inflation. It is in this latter context that adhering to an intermediate target path believed consistent with low inflation, for example, may reduce inflation expectations.

This is where credibility issues become important. A commitment can be credible either because policy makers have a reputation for backing their commitments or because a way of enforcing the commitment exists. Among the suggested strategies for achieving commitment are

i) requiring commitment through legislation

ii) ensuring that any breaches are obvious

iii) choosing policy makers whose sole objective is low inflation.

The mechanisms by which these proposals provide credibility are discussed below. This analysis concludes that the stategies, while possessing some attractive features, are extremely difficult to implement and may carry concomitant disadvantages that could greatly outweigh their potential

[23] Barro and Gordon (1983a) emphasize the revenue-generating function of inflation, Kydland (1989) the effect of inflation on capital accumulation decisions.

benefits. Moreover, if inflation expectations are essentially backward-looking, such policies may be redundant and potentially damaging if they tie policy makers' hands unnecessarily. The discussion concludes with an analysis of a fourth consideration that may encourage commitment:

iv) the adverse consequences of a reputation for opportunism may encourage policy makers to adopt low inflation policies even in the absence of a specific policy rule.

Legislation

By mandating a specific inflation goal, or intermediate target, legislation has the appearance of eliminating discretion by policy makers and substituting prescribed behavior.[24] In this way, the authorities' conduct of policy may gain credibility in the eyes of the public.

One problem with legislated solutions, however, is the difficulty of ensuring an adequate degree of flexibility. Legislation can permit deviations from the rule under certain specified circumstances, such as war or deep depression, but there may be other circumstances, more difficult to identify or foresee, that would also justify a deviation, even at the risk of higher inflation. If the set of exceptions is made too general, however, the entire legislation may lose its credibility. Moreover, if the legislation is predicated on the assumption that disinflation can be achieved costlessly, a conflict between the explicit inflation goals and implicit output targets may well emerge. The public may discount legislation that does not state explicitly whether output losses are an acceptable cost of disinflation. In much of the time consistency literature this problem is "eliminated" by the assumption that a sufficiently "credible" disinflation will be costless, but the literature offers no set of criteria by which to predict *in advance* whether the costs of disinflation have in fact been lowered.

A second role for legislation might be to reduce or eliminate the conflict among final goals. A definite statement that price stability is the primary goal for monetary policy and that any output target ought to be consistent with this goal on average might mitigate the time consistency problem because it might reduce any temptation to exploit the inflation/output trade-off.

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[24] Legislation can be viewed as imposing a severe penalty on policy makers for pursuing inflationary policies. Persson et al. (1987a, 1987b) suggest an alternative, but not very practical, way of penalizing inflationary behavior. They argue that if the government is a net creditor (and bound by some restrictions on the term structure of its holdings), the reduction in the real value of its assets from inflation would provide a disincentive to inflate opportunistically.

Making dissonant behavior obvious--intermediate targets

A second possible way of ensuring adherence to the announced path is to remove the possibility of surprise inflation from the hands of policy makers. In practice this could be achieved by tying policy to a particular nominal aggregate. Deviations from target would, at least in theory, be readily visible and viewed as reneging on the commitment. Policy makers would be able to comply with the rule and benefit from the low inflation equilibrium. Once they deviated from the rule, the public would recognize their lack of commitment and expectations would revert to the inflationary, discretionary solution. Faced with these two possible outcomes, policy makers would adhere to the rule.

Obviously this strategy requires that the aggregate in question be controllable and predictably related to the final objectives. If the first condition does not hold, it is impossible to determine whether deviations from target represent a willful effort by policy makers to create inflation, that is, to renege.[25] If the second condition does not hold, the credibility will be achieved at the cost of being unable to respond to shifts in the velocity of the aggregate in question. Unless an intermediate target satisfying both these criteria can be found, it will be impossible to have both credibility and control over final objectives. These trade-offs are crucial to determining the desirability of an intermediate target rule. The controllability criterion points to a narrow aggregate--if control is limited, then the observation that an intermediate target is conforming to, or deviating from, a desired path brings little information. With a narrow aggregate, however, the link to final targets may be long and uncertain, and adherence to the intermediate target may lead to shocks to the final target.[26]

By and large, there appears to be scant evidence that strict observance of an intermediate target

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[25] In fact, Anderson (1986) argues that if policy makers have better information than the public about the source of money demand shocks, they would have an incentive to dissemble even under a constant growth rate rule.

[26] See, for example, McCallum (1990) and Friedman (1990), who come to opposite conclusions about the suitability of the monetary base as an intermediate target. Currie (1985) provides a discussion of the ill effects of what he perceives to be a poorly chosen intermediate targeting strategy in the United Kingdom in the early 1980s. Some analysts argue that strict control of monetary aggregate growth over long periods would reduce the drift in velocity of the monetary aggregates; they claim that many of the velocity changes seen in the last generation were themselves induced by the high inflation rates of the 1970s and early 1980s. See Barro (1985) and Judd and Scadding (1982). The alternative view is that much of the shift in velocity was exogenous to inflation and caused by improved technology, which allowed much greater control by firms and individuals of assets, and by financial deregulation.

would yield better control over final targets. This raises an important practical question about the use of such intermediate targets. Would a poorly selected intermediate target itself lack credibility because the public would recognize that adherence requires compromising the final targets for long periods of time? Knowing that the relationships between intermediate and final targets are by no means tight and unchanging, the public may well discount adherence to such targets as being unsustainable, just as legislation predicated on a costless disinflation is likely to be discounted.

To get around the problem of achieving credibility under shifting relationships between intermediate and final targets, it has been proposed that there be some feedback from final targets to policy instrument settings or that final objectives themselves (inflation or nominal income growth) be targeted.[27] Various contingent rules have been proposed to increase the stability of real output. As more contingencies are built into the rules, the performance in historical simulations appears to improve, but the public may view adherence to a complicated rule as being too difficult to monitor and hence little better than discretion.

A second mechanism that has been proposed to make reneging obvious is to release the record of policy deliberations and decisions immediately after they are made. The argument is that the public would thereby immediately be able to recognize the inflationary consequences of policy changes, rendering surprise inflation unfeasible. However, such proposals depend critically on the assumption that the lags between policy deliberations and their public release are used by policy makers to generate surprise inflation or disinflation. In fact, lags between monetary policy decisions and their public release are currently so short--about six weeks--that it is hard to believe that such lags could be a source of inflation surprises. Moreover, a plausible argument could be made that immediate release would be counterproductive. If immediate release of deliberations made them more subject to political pressures, inflation expectations might rise rather than fall.[28]

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[27] Implicit in some of these rules is the assumption that price expectations and actual inflation rates will be more responsive to policy under a rule than under discretion. If factors other than the structure of policy lead to sluggish adjustment of actual and expected inflation, this presumption would not be justified. The inflation and real output growth engendered by such rules might not be desired by either the public or the policy makers. Hilton and Moorthy review a variety of such rules in "Targeting Nominal GNP" in this volume.

[28] See Poole (1990). The political business cycle literature, which treats political influences on economic policy making, is beyond the scope of this survey. For recent discussions and further references, see Nordhaus (1989) and Alesina (1988).

Choosing conservative policy makers

By choosing policy makers of impeccably noninflationary tastes, the public is relieved of the need to monitor policy makers' decisions. The literature conventionally describes these policy makers as "conservative." Put differently, the public can choose policy makers who attach far greater weight to low inflation than high output, and hence are more likely to err on the low inflation side.[29] Indeed, the assumption is that they are more averse to inflation than is the public.

This approach is likely to be inferior to a policy combining discretion with output targets that are consistent with low inflation in an economy subject to random shocks. For example, if there is a supply shock, policy makers who pursue both output and price targets will wish to distribute the shock between the two, while policy makers who focus only on inflation will allow output to take the complete shock in order to attain inflation targets. Choosing conservative policy makers is equivalent to selecting the latter. In doing so, society forgoes the flexibility embodied in the former. It is not possible to determine in advance whether the gain in credibility from choosing conservative policy makers offsets the resulting loss in flexibility. In general, the gain from flexibility is higher when policy makers use their discretion to smooth output and inflation in an economy subject to large shocks. By contrast, the gains from discretion could be small in a relatively placid economy, and strongly noninflationary policy makers might be preferable to more flexible ones in that setting.

If society prefers stability in both inflation and real output, it is preferable to allow policy makers discretion in spreading shocks between prices and output. An inflation bias would not emerge if policy makers were aiming on average at consistent inflation and output targets. Again, a trade-off between discretion and rules emerges only if the public knows that the ultimate output target is not feasible without inflation.

Reputation

Although formal rules seem most direct in constraining inflationary proclivities, the need to maintain a noninflationary reputation can be almost as effective in constraining opportunistic policy makers. If policy makers have a long time horizon and do not discount the future too heavily, they may be reluctant to exploit an inflation/output trade-off opportunistically because this will raise inflation expectations in subsequent periods. A long time horizon is necessary because it increases the

[29] Rogoff (1985, 1987a, 1987b) discusses the implications of selecting policy makers with an unusually strong aversion to inflation.

period during which policy makers would be "punished" by higher inflation expectations. The moderate time discount rate is necessary because the policy makers would otherwise put much more emphasis on short-run optimization, an approach which might lead to opportunistic behavior. Analysts have pointed to the long and overlapping terms of central bankers as a way of promoting an institutional long horizon.

The precise degree of restraint that reputational factors impose on policy makers depends in large part on how the public forms its expectations, how fast expectations respond to a change in policy, and whether, once policy has been opportunistic, expectations revert back to low inflation without a loss of output. However, the following general conclusion is robust: unless policy makers are extremely short-sighted, valuing short-term output gains very heavily, their own willingness to inflate may be greatly constrained by the prospect of a long period of high inflation and inflation expectations. Knowing that the penalties from a loss of reputation are severe, policy makers may even choose zero inflation. Indeed, in the context of these models the public may lower its inflation expectations because it knows that policy makers view these penalties as a deterrent. Hence, even where there is a willingness to behave opportunistically, discretionary time consistent optimization may not produce significantly higher inflation than time inconsistent policies aimed at zero inflation.

Reputation may be important in a different way even when policy makers do not have full credibility. Much of the literature compares results when policy makers have full credibility at zero inflation with results when there is no credibility at all--that is, when policy makers are expected to inflate to their maximum tolerable inflation level. Under such circumstances, zero inflation is not a credible result because policy makers have too much incentive to renege. However, there may be an inflation level that is above zero but below that of the no credibility level to which policy makers could make a credible commitment.[30] While the policy makers may wish to behave opportunistically, they may be deterred by the possibility that the public's inflation expectations would revert as a result to the fully noncredible level. Hence, policy makers may find it preferable to adopt policies consistent with this intermediate level of expectations rather than try to achieve additional output gains.

Such considerations may help explain why announcements of near-term zero inflation targets often carry little credibility. The public may feel that policy makers will too readily jettison the zero inflation target if there is the opportunity to obtain extra output. While this logic would appear to argue in favor of announcing more credible gradualist disinflation policies, there does not appear to be

[30] Barro and Gordon 1983. See also Taylor's (1983) comments on Barro and Gordon.

much evidence that such announcements themselves produce more credible and less painful disinflation. The reason may be that the short-run policy moves are often too small to be convincing. The public may also doubt the medium-term political sustainability of the gradualist policy if it could imply persistent restraint.

III. Uncertainty

Much of the previous discussion has been deterministic. The public knows with precision the aims of policy makers and the structure of the economy (including the linkages of intermediate targets to final outcomes). Loosening these assumptions of precise knowledge affects the results as intuition would suggest: in the short run the public is less categorical in its interpretation of apparent policy moves; in the long run it will interpret a string of positive inflation results as an indication that policy makers are willing to exploit an inflation/output trade-off.

Two types of uncertainty are discussed below. The emphasis is less on modeling than on exploring intuitively how uncertainty affects the results discussed earlier.

A. Uncertainty about the Structure of the Economy

When there are structural changes in the economy, rigid adherence to a policy rule may be less desirable even than the time consistent (discretionary) outcome. Simply stated, the benefits from allowing policy makers to offset shocks may well outweigh the losses from higher inflation expectations due to time consistency problems.[31]

In some cases the optimal strategy may be mixed: follow a rule during normal times when shocks are relatively small, but switch to discretion in the presence of large shocks.[32] The reasoning is that it is expensive for policy makers to specify behavior under important but relatively rare events, just as it is difficult for the public to specify behavior under all possible contingencies in its private contracts. In the event of a crisis, such as a war or major downturn, both the public and the policy makers are likely to view a rule as inferior to discretion. Rather than adhere to imperfect rules or attempt to determine rules for all contingencies it may be preferable to allow discretion, but require

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[31] In general, it has to be assumed that only policy makers are able to recognize the shock. Otherwise the public would be able to incorporate the shock into its expectations. Buiter (1981) has a comprehensive discussion of the how informational advantages may tip the scale in favor of discretion.

[32] See Flood and Isard (1989).

some ex post justification for invoking it.[33] According to this reasoning, however, the benefits from adhering to a rule may outweigh the benefits of discretion during normal periods, provided that an adequate rule can be formulated.

When the economy is subject to shocks, however, the public may be more inclined to expect higher inflation because it knows that in the short run policy makers could disguise policy moves by claiming that they are actually random shocks to the economy. As a consequence, policy makers may find it more difficult to acquire a reputation for noninflationary policies if they are not adhering to a verifiable rule. Over the medium term, however, discretion may remain compatible with noninflationary behavior by policy makers. For example, while uncertainty may mean that a given positive inflation shock can not be interpreted as opportunistic behavior, on average negative and positive shocks should offset each other over the medium term. By considering whether an observed sequence of inflation rates is more consistent with stable inflation than with opportunistic behavior, the public may be able to establish with fair precision the true objectives of the policy makers. In one such model, policy makers maintain credibility as long as inflation remains within a certain range but lose credibility if inflation rates stray outside.[34] Again, the proof of the pudding emerges in the eating--in the presence of uncertainty, the past record of inflation performance is more useful than an imperfect proxy for policy as an indicator of policy makers' targets.

It has also been suggested that an explicit trade-off can be made between the loss of flexibility due to strict intermediate targeting and the risk that policy makers may turn out to be more opportunistic than expected. One such model argues that in an economy with weak ties between intermediate and final targets, the inflation record of policy makers with a strong noninflationary record ought to be judged over a longer period than in an economy where intermediate targets are closely tied to final goals and the policy makers' reputations are not as well established.[35] That is, policy makers of good reputation should be given more medium-term discretion when intermediate

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[33] Flood and Isard point to the requirement in many countries that central bankers testify periodically before elected officials as an example of a mechanism that will limit abuse of discretion. As part of this testimony, the bankers are closely questioned about their policies.

[34] See Canzonerri(1985). The decision rule is analogous to the rule used in quality sampling. If an unusual number of defectives emerges in a small sample of a larger lot, the entire lot is rejected. There is a finite chance that a few atypical defectives will lead to rejection of a basically good lot; similarly, there exists the chance that random shocks beyond the policy makers' control will lead to their acquiring a reputation as inflation-prone.

[35]See Garfinkel and Oh (1990).

targets are unreliable indicators of the stance of policy.

B. Uncertainty about Policy Makers' Preferences

A large literature analyzing how the public forms its expectations when it is uncertain of policy makers' preferences has emerged in recent years. Time consistency problems are replaced in this literature by the problem of identifying policy makers who are more (or less) willing to inflate opportunistically.[36] Once policy makers are found to be weak on inflation, they lose credibility and inflation expectations move up to the time consistent level.

This literature focuses on the incentives prompting opportunistic policy makers to look like inflation fighters. Revealing themselves to be opportunistic carries a permanent cost of higher expected inflation, so they have an incentive to look tough on inflation for some period of time. (If their time horizon is infinite, the effect may be absolute). By and large, an incentive for opportunistic policy makers to adopt noninflationary policies emerges under a wide variety of conditions.

If there is uncertainty about the state and structure of the economy, as well as about policy makers' preferences, the advantages accruing to a noninflationary reputation diminish, however. The reason is that when the public sees an apparently inflationary outcome, it may be uncertain whether the outcome results from a policy action or from a random shock.[37] Policy makers can do little in the short term to convince the public of their noninflationary intent. Because of this ambiguity, opportunistic policy makers may inflate early because it may take some time for the public to catch on. While the formation of the public's inflation expectations would obviously be influenced by such ambiguities, the use of a policy rule has the same problem as in the earlier discussion--that is, where economic shocks are large, discretion plus noninflationary policy makers dominates rules.

IV. Empirical Evidence and Conclusions

There is little firm empirical evidence on many of the issues discussed in this paper. The optimal structure of monetary policy clearly depends on many factors whose importance is difficult to measure. These factors include a) the public's ability to predict policy makers' actions, b) the policy makers' goals, c) the predictability of linkages between policy tools and final goals, d) the extent of

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[36]The seminal papers are Backus and Driffill (1985a, 1985b). See also Barro (1986) and Driffill (1989).

[37] See Driffill (1989) and Mino and Tsutsui (1989).

shocks to the economy, and e) the perceived credibility of policy makers. Although much of the literature has been written by authors who hold strong views on the qualitative importance of these factors, actual measurement is so difficult that theoretical analysis has been far more common than empirical work.

As a result, most of the empirical work has focused on measuring whether the output costs of disinflation respond to the perceived credibility of policy.[38] Credible disinflationary policies, supported by verifiable rules, should carry a lower output cost than less credible discretionary disinflationary policies. Yet efforts to distinguish credible from noncredible disinflations have not met with great success. Most empirical work has not found any significant decline in the output costs of disinflation either in the United States or in the rest of the OECD through the early 1980s, and, indeed, these relations appear to have been stable in most OECD countries since the 1960s.[39] This apparent stability has persisted depite the view of many that anti-inflationary policies became more "credible" in the early 1980s.

It is difficult to state with any confidence that a particular set of policies will generate a credible disinflation with low output costs. The countries that disinflated in conjunction with a "rule"--which took the form of tying their currencies to stronger currencies in the European Monetary System--generally experienced high unemployment in the process. One interpretation of these 1980s disinflations, in line with the time consistency literature, is that the policies put in place were not in fact credible. The public may have questioned the commitments of the policy makers to low inflation and thus did not alter behavior and expectations in response to the announced policies.

A problem with this interpretation is that it is difficult, if not impossible, to find alternative independent tests of the presence or absence of credibility. There are few examples of countries adhering to monetary targeting rules that might provide a baseline test of whether such rules produce credibility and lower the cost of disinflation. In the view of many authors, the low-inflation OECD countries do not appear to follow an explicit rule.[40] To the extent that low inflation is built into expectations in these countries, it is because of the countries' recent success in maintaining low inflation, rather than their adherence to an explicit rule.

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[38] Fellner (1979) first suggested this approach.

[39] For the United States, see Englander and Los (1983), Blanchard (1984), and Gordon and King (1982). For other OECD countries, see Chan-Lee, Coe, and Prywes (1987).

[40] See, for example, Hutchinson (1986) and Trehan (1988).

A second interpretation of the 1980s experience is that disinflation is expensive because expectations are largely backward-looking and do not readily incorporate the effects of policy changes. At least in labor markets, most studies have found this characterization to be broadly accurate as long as inflation is low or moderate.[41] If this is so, policy makers and society have to accept the output costs if they wish to disinflate to very low inflation rates. With this backward-looking, rather than rational, view of expectations formation, the kind of time consistency problem described in the literature under discussion does not exist in reality.

Although most analyses have not found any empirically significant credibility effects, there are a few exceptions, primarily in cases of disinflating from hyperinflation. Disinflations in Central Europe in the 1920s and in Chile and Denmark more recently appear more successful, although considerable controversy remains as to whether these disinflations were indeed painless.[42] What characterizes these credible disinflations is that monetary, fiscal, and, in some cases, exchange rate policies were all subordinated to the disinflationary goal. In particular, it has been argued that fiscal tightening, which would make future monetization of government debt unnecessary, was a key factor in convincing the public that the low-inflation path was sustainable.

Two other characteristics of these disinflations are noteworthy, however, and cast doubt on whether examples of disinflating from the hyperinflation prevalent in some of these cases are relevant for disinflating from moderate inflation. First, it may be easier to move from high to moderate inflation rates because both the policy makers and the public clearly desire to lower inflation. There is a high real output cost of hyperinflation in terms of time and energy spent exchanging "money" whose value drops daily into assets with more stable value. Hence, the ambiguity whether the policy objectives are in fact consistent is not as profound as at lower inflation rates. Also, hyperinflation in many cases greatly reduced the real value of government debt. As a result, fiscal policy could start de novo with little or no debt service burden. Whether disinflation from moderate to low levels of inflation can occur with as little cost is not clear. Other instances of disinflation from more moderate inflation levels have generally resulted in substantial output costs.[43] Indeed, even the cases of successful disinflation from hyperinflation involved some apparent output cost. What makes them

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[41] See Englander and Stone (1989) and the references therein.

[42] See Sargent (1982), Christensen (1987a, 1987b), and Baxter (1985). Blackburn and Christensen (1989) provide a concise survey of this literature.

[43] Gordon (1982) reviews several such instances of disinflation in the United States and abroad.

seem painless is the low output cost per percentage point of disinflation reduction.

Second, the key reform in each of these cases was generally not an explicit attachment to a monetary policy rule but rather the creation of a set of mutually consistent monetary and fiscal policies. The consistency of policies may also have served to convince the public that lower inflation was the preeminent goal. Moreover, in several cases of disinflation with relatively small output costs, a coordinated structure of wage bargaining may have been important in unwinding a wage/price spiral.[44] Although credibility may have been important, these considerations suggest that it is not rules per se that create credibility but policies that will lead to disinflation irrespective of the underlying economic model.

A final consideration is that, in practice, policy may be more credible in one market than another. In the case of Ireland's disinflation in the 1980s, it has been argued that a reduction in long-term interest rates reflected a policy credibility in financial markets that did not exist in labor markets, as reflected in the sharp rise in unemployment rates.[45] As long as labor market expectations are slow to adjust, it is unlikely that the output cost of disinflation can be eliminated.

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[44] Gordon (1982) argues strongly for this interpretation in several OECD country disinflations in the 1960s and 1970s.

[45] See Kremers (1990) and Dornbush (1989). Christensen (1987a) also provides evidence on the sluggishness of price expectations in labor markets.

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A REVIEW OF FEDERAL RESERVE POLICY TARGETS AND OPERATING GUIDES IN RECENT DECADES[1]

Ann-Marie Meulendyke

In March 1951, the Federal Reserve regained the power to conduct an active monetary policy that it had relinquished during the Second World War. The occasion was the signing of the Treasury-Federal Reserve Accord permitting a move away from the pegged interest rates that had helped to hold down the cost of Treasury financing. The Accord made it possible for the Federal Reserve to make adjustments to its monetary policy stance in pursuit of its ultimate goals of economic expansion and price stability. While those goals have not changed in the ensuing three and a half decades, the intermediate and operational targets of policy have been subject to several significant shifts. This article traces the development of Federal Reserve monetary policy and operating targets since the Accord and discusses the modifications that were made to them.

The Federal Reserve uses intermediate targets and indicators of policy because it does not have the means to achieve the ultimate goals directly. The Federal Open Market Committee (FOMC), which directs monetary policy for the Federal Reserve, developed intermediate targets that were linked, at least indirectly, to the ultimate goals and subject to indirect Federal Reserve control. Because the FOMC lacked the tools to realize even the intermediate objectives over short periods of time, it also developed reserve operating targets that it could achieve promptly, using the policy tools available to it. The Board of Governors of the Federal Reserve System had the authority to affect the banks'

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[1]This paper is reprinted, in a slightly revised form, from the Federal Reserve Bank of New York Quarterly Review, vol. 13, no. 3 (Autumn 1988), pp. 6-17. The paper draws heavily on the annual reports prepared by the Manager of the System Open Market Account for the FOMC and on policy records and directives. Beginning with the 1962 report, large portions of the Manager's reports have been published. The annual report for 1962 appeared in the Federal Reserve Bulletin (as did some reports for the 1970s.) The reports for 1963 through 1969 appeared in the Annual Report of the Board of Governors of the Federal Reserve System. Subsequently, the reports appeared in the New York Reserve Bank's Monthly Review or Quarterly Review.

Additional information was obtained through conversations with John Larkin, Fred Levin, Paul Meek, Robert Roosa, Irwin Sandberg, Peter Sternlight, and Robert Stone, who were at the Desk during many of the years covered. Stephen Axilrod and Donald Kohn of the Board of Governors also provided insights. Other source material is listed in footnotes and in the bibliography.

demand for reserves through the policies it established with respect to reserve requirements, the discount rate, and the rules of access to the discount window. The FOMC had the means to affect the supply of bank reserves by instructing the Trading Desk at the Federal Reserve Bank of New York to carry out open market purchases or sales of securities. These policy tools could be manipulated to bring about some desired behavior of the operating targets.

I. Overview

In the 1950s and 1960s, the behavior of bank credit generally served as the primary intermediate objective. It was joined by money beginning in the latter part of the 1960s. Various monetary aggregates became the primary intermediate targets in the 1970s. Money received its greatest emphasis in the late 1970s and early 1980s. During the 1980s, as the demand for money seemed to change in a fundamental way, the Committee treated its monetary targets more flexibly and sought to supplement them with other indicators. The immediate operating targets have, in a sense, come full circle since the 1950s: the FOMC initially targeted free reserves and then shifted to federal funds rates, to nonborrowed reserves, and more recently to borrowed reserves, a measure similar in many ways to free reserves.[2] As the demand for borrowed reserves shifted in the late 1980s, the FOMC has once more taken increased guidance from the behavior of the federal funds rate.

All of the target variables and indicators that have been used over the years are interrelated. Whenever reserve measures have been the primary operating target, interest rates have played a role in modifying the policy response, and vice versa. But the existence of such relationships does nothing to diminish the importance of the principal target; the selection of this target influences how the Federal Reserve will respond to price behavior and to new developments in the economy.

A. 1953-65: Bank Credit and Free Reserves

The Federal Reserve gradually resumed its pursuit of monetary policy goals after the Treasury-Federal Reserve Accord freed it from the obligation to support a pattern of pegged rates on Treasury debt issues. Before the Accord, the Treasury had insisted that the Federal Reserve continue the practice, begun during World War II, of standing ready to buy or sell Treasury securities at posted rates. By 1950, the FOMC was convinced that rates were being held too low, particularly in view of

[2]Mechanically, the behavior of free reserves only differs from that of borrowed reserves when excess reserves change. The various reserve measures are defined in the appendix.

the stimulus to economic growth and to speculative buying associated with the Korean War. The low rates were contributing to excessive provision of reserves and significant inflation. The FOMC believed that a return to an independent monetary policy was essential if inflation were to be contained. It negotiated with the Treasury for a number of months to reach the Accord.[3]

After the Accord, the Federal Reserve gradually withdrew its support of rates.[4] The FOMC created a subcommittee to investigate how the Federal Reserve could best carry out an active monetary policy and encourage the return of an efficiently functioning government securities market with "depth, breadth, and resiliency." The subcommittee made its recommendations at the end of 1952.[5] It emphasized that the securities markets would function better if policy operations were conducted in ways that showed the public that the Federal Reserve was no longer setting interest rates and that gave a large number of dealers the opportunity to make markets with minimal interference from the Fed. To achieve these goals, the subcommittee recommended that open market operations be confined to the short-term Treasury bill market, where the price impact of an operation ought to be the smallest. That would give the securities dealers the opportunity to make active markets in a range of securities and allow the forces of supply and demand to determine the structure of rates. Only if the market for coupon securities were clearly disorderly, and not just adjusting to new information, would the Fed step in to buy or sell coupon securities.

The report also expressed dissatisfaction with the Desk's operating technique. During the interest rate pegging period, the Trading Desk had often used one of a group of ten dealers as a broker or agent to arrange orders in the market. The dealers that were not part of that group complained that

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[3]Allan Sproul, who participated in the negotiations as President of the Federal Reserve Bank of New York, offered an interesting commentary on the process in "The 'Accord'--A Landmark in the First Fifty Years of the Federal Reserve System," Federal Reserve Bank of New York Monthly Review, November 1964; reprinted in Lawrence S. Ritter, ed., Selected Papers of Allan Sproul, Federal Reserve Bank of New York, December 1980.

[4]The Federal Reserve followed a so-called even keel policy during Treasury financing periods through the early 1970s. Until that time, most Treasury coupon securities were sold as fixed-price offerings. Around the financing periods, the Fed avoided changes in policy stance and tried to prevent changes in money market conditions. Major financing operations occurred four times a year, around the middle of each quarter. However, extra unscheduled financing operations occurred when the Treasury found itself short of money. Debt issuance was put on a regular cycle in the 1970s.

[5]"Federal Open Market Committee Report of Ad Hoc Subcommittee on the Government Securities Market," reprinted in The Federal Reserve System after Fifty Years, Hearings before the Subcommittee on Domestic Finance of the House Committee on Banking and Currency, 88th Cong., 2d sess. (Washington, D.C.: GPO, 1964), vol. 3, pp. 2005-55.

they were unfairly excluded from dealings with the Federal Reserve. The dealers that did act as agents were also dissatisfied because they could not transact business with the Fed for their own portfolios when they were acting as agent. Both groups of dealers felt it was difficult to make two-way markets as long as the Federal Reserve was willing to buy or sell securities at known rates in response to public demand.

The FOMC adopted most key recommendations of the subcommittee. It actively pursued a countercyclical policy using an array of measures to evaluate economic activity and inflationary forces. Between 1953 and 1960, it pursued what came to be known as a "bills only" policy, confining its open market operations to the bill sector except when the coupon market was "disorderly." Throughout the 1950s, there was considerable debate within the System about whether coupon operations should be reintroduced to promote orderly markets or whether coupon markets should be left to function as much as possible without interference from the Fed. On only two occasions during this period--when the coupon market was clearly perceived to be disorderly--were Treasury coupon issues purchased.

To create a climate where the dealers could make markets on an equal footing, the Trading Desk developed the competitive "go around" technique, still in use today, in which all of the dealers were contacted simultaneously and given the opportunity to make bids or offers. It also increased the number of dealers with which it would trade and specified criteria that dealers had to meet to qualify for a trading relationship.

During the 1950s, the Federal Reserve developed open market operations into the primary tool for carrying out monetary policy, with discount rate and reserve requirement changes used as occasional supplements. Margin requirements on stock purchases were adjusted occasionally to encourage or discourage credit use. In establishing open market policy, the FOMC took into account that the level of the discount rate would influence interest rates and the banks' perception of reserve availability. It did not (and does not), however, have the authority to change the discount rate, and it considered the rate to be given within the context of short-term policy making. The Board of Governors approved periodic adjustments to the discount rate when the rate got out of line with market rates. On other occasions, changes were made in conjunction with adjustments in other tools when the Board wished to emphasize a shift in policy stance. The window was administered to reinforce the banks' reluctance to borrow from the Federal Reserve. The Board changed reserve requirements occasionally to signal a policy shift. The changes were far smaller in magnitude than those of the 1930s, and the impact on reserves was generally cushioned with open market operations that partially offset the reserve impact.

While FOMC members believed that interest rates played an important role in the economy, they felt it would be unwise to establish interest rate targets. The use of such targets, they reasoned, would increase the difficulty of making a break with the strict rate pegging of the 1940s. In developing policy guidelines at its meetings, the FOMC considered a number of indicators. It gave special emphasis to the behavior of bank credit (commercial bank loans and investments) as an intermediate policy guide. It sought to speed up bank credit growth in periods when economic activity showed weakness and to slow it down in periods of rapid growth. It did not have direct control over bank credit, however, or even timely information on recent performance, so bank credit was not suitable for day-to-day operating guidance.

The instructions for the Desk's day-to-day operations focused on free reserves--referred to as net borrowed reserves when borrowed reserves are greater than excess reserves--and money market conditions. By money market conditions, the FOMC meant not only short-term interest rates but also indications of the ready availability of funding to the securities dealers. The written directive provided by the FOMC to the Desk was deliberately nonspecific, avoiding even a hint of targeting interest rates. For example, in November 1957, the FOMC directed the Desk to conduct operations "with a view to fostering sustainable growth in the economy without inflation, by moderating pressures on bank reserves." The Manager of the System Open Market Account surmised from the discussion at the FOMC meeting what the Committee wanted.[6]

Free reserves were targeted in order to provide some anchor to the policy guidelines. A relatively high level of free reserves represented an easy policy, with the excess reserves available to the banks expected to facilitate more loans and investments. Net borrowed reserves left the banks

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[6]At that time, the Trading Desk was not authorized to modify its policy stance between meetings without receiving additional instructions from the Committee. The executive committee of the FOMC met frequently--generally every two weeks through the middle of 1955. Subsequently, the full Committee met every three weeks. The Committee sometimes had telephone meetings between regular meetings.

The Committee members were kept informed of what was happening through written reports describing the reserve forecasts, money market conditions, Trading Desk operations, weekly lending patterns of large banks, and background information on other securities markets. Reports were prepared in the open market operations area at the end of each statement period and before each FOMC meeting. An FOMC member also had the opportunity to participate in a daily conference call at which Desk personnel described recent developments affecting reserve demands and supplies and the behavior of the money markets. A wire summarizing the daily conference call was sent to the FOMC members. The written and oral reports have continued through the years, although the topics emphasized have changed as the priorities of policy have changed.

without unpledged funds with which to expand lending; they were viewed as fostering a restrictive policy stance. It was assumed that banks would adjust loans and investments when reserve availability changed.

The linkages between free reserves and bank credit were viewed at the time as somewhat complex.[7] High rather than rising free reserve levels were believed to foster rising bank credit since banks would perpetually have more excess reserves than they wanted and would continually expand lending. High net borrowed reserve levels would, in a parallel manner, encourage persistent loan contraction. However, defining the point where free or net borrowed reserves were neutral--that is, fostering neither rising nor falling bank credit levels--was believed to be possible conceptually but not empirically. Other factors complicating the linkage were the distribution of reserves, loan-deposit ratios, the maturities of bank portfolios, the strength of loan demand, and the stage of the business cycle. Still, the Federal Reserve did not consider any of these difficulties to be fatal to the procedure so long as bank credit growth was monitored over time.

Operationally, the Trading Desk worked with a free reserve target that had been implied by the discussion at the most recent FOMC meeting. Research staff members developed and refined techniques during the 1950s and 1960s for forecasting each day what free reserves would be over the reserve maintenance period by forecasting both nonborrowed and required reserves. Maintenance periods were one week long for reserve city banks (member banks with offices located in cities with Federal Reserve banks or branches) and two weeks long for country banks (all other member banks). Computation and maintenance periods were essentially contemporaneous. The reserve factor estimates, which affected nonborrowed reserves, were subject to sizable errors, even though considerable resources were devoted to obtaining timely information about past and likely future behavior of the more volatile factors. Forecasts of required reserves were a problem initially but were improved in the 1960s as data flows were accelerated. Furthermore, reserves were not always well distributed across classes of banks, a condition that sometimes contributed to disparate behavior of free reserves and interest rates. These forecasts guided the Desk in making the appropriate reserve adjustments. It could buy or sell Treasury bills when forecasts suggested that free reserves were below or above the

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[7]See (Peter D. Sternlight), "The Significance and Limitations of Free Reserves," Federal Reserve Bank of New York Monthly Review, November 1958, pp. 162-67; and "Free Reserves and Bank Reserve Management," Federal Reserve Bank of Kansas City Monthly Review, November 1961, pp. 10-16. A critique of free reserves and a survey of the literature are provided by A. James Meigs in Free Reserves and the Money Supply (Chicago: University of Chicago Press, 1962).

objective. Temporary reserve injections could be made with repurchase agreements (RPs), although the agreements were not used nearly as much as they were later.

Because of the uncertainties in the forecasts of free reserves, and because the FOMC was also interested in money market conditions, the Desk watched "the tone and feel of the markets" each day in deciding whether to respond to the signals being given by the reserve forecasts. Reading the tone of the markets was considered something of an art. Desk officials watched Treasury bill rates and dealer financing costs. They factored in comments from securities dealers about difficulties in financing positions. Desk officials were primarily concerned with the direction in which interest rates were moving, rather than their level, and with the availability of funding. The tone of the markets might suggest whether the free reserve estimates were accurate. If the banks were short of free reserves, they would sell Treasury bills, a secondary reserve, and put upward pressure on bill rates. The banks would also cut back on loans to dealers, thus making dealer financing more difficult.

The federal funds rate played a limited role as an indicator of reserve availability in this period, but it began to receive increased attention during the 1960s. The interbank market was not very broad as the 1960s began, but activity was expanding. During the 1960s, the reports of the Manager of the System Open Market Account increasingly cited the funds rate in the list of factors characterizing money market ease or tightness. Until the mid-1960s, the funds rate never traded above the discount rate. During "tight money periods," when the Desk was fostering significant net borrowed reserve positions, funds generally traded at the discount rate, and the rate was not considered a useful indicator of money market conditions. When free reserves were high, funds often traded below the discount rate and showed noticeable day-to-day variation. At such times, they received greater attention as an indicator of reserve availability.

There was considerable surprise when funds first traded above the discount rate, briefly in October 1964 and more persistently in 1965. Why, it was asked, would any bank pay more for overnight funding than the Federal Reserve charged? In fact, large banks were becoming more active managers of the liability side of their balance sheets. Borrowing from other banks, away from the Federal Reserve, played a role in this management. Though it was not noted at the time, the changes in liability management techniques were making free reserves an increasingly uncertain predictor of bank credit growth. The relationship between bank credit and free reserves depended upon banks responding passively to reserve availability. In 1961, banks developed negotiable certificates of deposit (CDs), which they could use to accommodate increased loan demand without having unused free reserves. Interest rate ceilings on CDs under Regulation Q occasionally brought a sudden halt to this kind of expansion. The next logical step was to finance loan demand by purchasing overnight federal funds and renewing the contract each day. Takings in the funds market were not subject to reserve requirements or Regulation Q interest ceilings. (Such ceilings were dropped for most large CDs in 1970.) The discount window could not be used on such a steady basis. The Federal Reserve actively discouraged frequent or prolonged borrowing, thus reinforcing banks' longstanding reluctance to borrow.

In 1961, several developments led the FOMC to abandon its "bills only" restrictions. The new Kennedy Administration was concerned about gold outflows and balance of payments deficits and at the same time wanted to encourage a rapid recovery from the recent recession. Higher rates seemed desirable to limit the gold outflows and help the balance of payments, while lower rates were wanted to speed economic growth.

To deal with these problems simultaneously, the Treasury and the FOMC attempted to encourage lower long-term rates without pushing short-term rates down. The policy was referred to in internal Federal Reserve documents as "operation nudge" and elsewhere as "operation twist." The Treasury engaged in advance refundings and maturity exchanges with Trust accounts and concentrated its new offerings in shorter maturities. The Federal Reserve attempted to flatten the yield curve by purchasing coupon securities while simultaneously selling Treasury bills. The procedure continued for another year and then ceased to be discussed after short-term rates rose in 1963. The Manager's reports focused mostly on operational difficulties in purchasing coupon issues after a long period of absence from that sector and reached no judgment on the effectiveness of the policy. Academic economists' studies have suggested that the effect on the yield curve was minimal, while practitioners have had mixed views of its success.

B. Second Half of the 1960s: Transition to New Targets and Indicators

The formal policy procedures were changed only modestly over the latter half of the 1960s, but the period was marked by questioning and a search for alternative intermediate targets and techniques for achieving them. Inflation, which had been low over the previous decade, was a growing problem, and the annual reports expressed considerable concern about the lack of tax increases (until late 1968) to finance the Vietnam War involvement and the "Great Society" programs. Interest rates rose and became more variable.

Economists, both within and outside the Federal Reserve, questioned the assumed linkages underlying the policy process, including the connections of free reserves and bank credit to the ultimate policy goals of economic expansion and price stability. Quantitative methods were increasingly applied to test the hypothesized relationships among operational, intermediate, and ultimate policy objectives. Some studies suggested that more attention should be paid to money growth and to the behavior of total reserves or the monetary base.

In response to these developments, the FOMC expanded the list of intermediate guides to policy. The directives continued to focus on bank credit but added money growth, business conditions, and the reserve base. Free reserves continued to be the primary gauge for operations. When excess reserve behavior proved difficult to predict, borrowed reserves received increasing weight.

As the federal funds market became more active, the funds rate gained more prominence as an indicator of money market conditions. The annual report for 1967 explicitly cited the funds rate as a goal in itself rather than merely an indicator of the accuracy of free reserve estimates. It said that daily open market operations "focused on preserving particular ranges of rates in the federal funds market and of member bank borrowings from the Reserve Banks."[8] The report expressed concern that reserve forecast errors might lead to unintended money market firmness that market participants could misinterpret.

Although the FOMC met every three to four weeks, it was concerned that developments between meetings might alter appropriate reserve provision. Consequently, in 1966 it introduced a "proviso clause" that set forth conditions under which the Desk might modify the approach adopted at the preceding meeting. The FOMC would have preferred to use bank credit as the trigger to change money market conditions, but data still were available only with a lag. Hence, it used a proxy for bank credit in the proviso clause. After some experimentation, it adopted what it called the bank credit proxy, which consisted of daily average member bank deposits subject to reserve requirements.

Logically, the bank credit proxy, which represented most of the liability side of the banks' balance sheets, should have moved in a similar fashion to bank credit, which was most of the asset side of the banks' balance sheets (other than reserves), but they often differed. One source of distortion was the growing use of nonreservable liabilities to finance credit extension. Banks encountered rising interest rates as inflation heated up, and the rate ceilings mandated by Regulation Q often limited the

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[8]"Open Market Operations during 1967," a report prepared for the Federal Open Market Committee by the Open Market Operations and Treasury Issues Function of the Federal Reserve Bank of New York, February 1968, p. 4. The published version of this report, "Review of Open Market Operations in Domestic Securities in 1967," in Board of Governors of the Federal Reserve System, 54th Annual Report, 1967 (1968), pp. 208-75, had a somewhat different introduction. It omitted the discussion of operational complications that had contained the reference to the funds rate.

banks' ability to raise rates enough to attract deposits. Furthermore, higher interest rates made reserve requirements more burdensome. Consequently, banks raised money in the Eurodollar market to finance lending. In 1969, the bank credit proxy was expanded to include liabilities to foreign branches, the largest nondeposit liability. Nonetheless, the proxy continued to deviate from bank credit as reserve ratios changed.

If the bank credit proxy moved outside the growth rate range discussed at the FOMC meeting, the Desk would generally adjust the target level of free or net borrowed reserves modestly, on the order of $50 million or so according to rough recollections of officials participating at the time. Sometimes the proviso clause permitted either increases or decreases in the objective for free reserves. Frequently it allowed adjustments in only one direction.

To decide each day on its operations, the Desk looked at the reserve forecasts, short-term interest rates, and availability of financing to the dealers. If the need for reserves was confirmed by a sense of tightness in the markets, the Desk generally responded soon after the 11:00 a.m. conference call. During this period it used a larger share of outright transactions than it currently does, partly because it engaged in less day-to-day fine tuning, but it did make active use of RPs and, after their introduction in 1966, of matched sale-purchase transactions. In 1968, the Board of Governors adopted a system of lagged reserve accounting under which reserve requirements were based on average deposit levels from two weeks earlier, with all member banks settling weekly. The change made it easier to hit free reserve targets--ironically, shortly before free reserve targeting ended.

C. 1970 to 1979: Targeting Money Growth and the Federal Funds Rate

The inflationary pressures that began in the late 1960s led to a number of policy initiatives in the early part of the 1970s. In 1970, the Federal Reserve formally adopted monetary targets with the intention of using them to reduce inflation gradually over time. In August 1971, the Nixon Administration froze prices and wages and suspended gold payments.[9] The techniques for setting and pursuing money targets developed gradually, with frequent experimentation and modification of procedures taking place in the first few years of the 1970s. Nonetheless, until October 1979 the framework generally included setting a monetary objective and encouraging the federal funds rate to

[9]During the next few years, the government imposed a variety of wage-price controls, which had the effect of creating shortages and distorting various price indexes. It also created a Committee on Interest and Dividends that restricted interest rate increases and thus distorted financial market activities.

move gradually up or down if money was exceeding or falling short of the objective. The federal funds rate, as an indicator of money market conditions, became the primary guide to day-to-day open market operations, and free reserves took on a secondary role. An increasingly active market for federal funds made the funds rate a feasible target, and the passage of time reduced the association of interest rate targeting with the rate pegging episode of the 1940s.

Bank credit and its proxy continued for a while in the list of subsidiary intermediate targets, but they received decreasing attention. The Desk also continued to watch the behavior of both free and borrowed reserves, mostly as indicators of how many reserves were needed to keep the federal funds rate at its desired level. The procedures exploited the positive relationship between borrowing and the spread between the funds rate and the discount rate. The relationship was imprecise, but it gave the Desk an idea of how many free or net borrowed reserves were likely to be consistent with the intended funds rate. The Desk used the forecasts of reserve factors to gauge the appropriate direction and magnitude for open market operations.

Initially in 1970, the FOMC selected weekly tracking paths for M1, which were generally the staff projections of likely behavior. It simultaneously continued to specify desired growth of the bank credit proxy and indicated preferred behavior for M2, but those measures received less weight than M1.[10] It instructed the Desk to raise the federal funds rate within a limited band if the monetary aggregates were well above the tracking path or to lower the funds rate within that band if the aggregates were below the tracking path.

In 1972, a number of significant modifications were made. The weekly tracking path for M1 was supplemented (and later replaced) by two-month growth rate ranges that used the month before the FOMC meeting as a base. The change was designed to reduce the weight given to the rather volatile weekly money numbers and to quantify significant deviations. At the end of that year, the Committee also sharpened the distinction between targeting desired money growth and targeting expected money growth. Initially, the M1 tracking path had been based on Board staff expectations. Setting the desired growth path equal to the projection ran the risk of aiming for money growth that was too high or too low to be consistent with noninflationary growth. By late 1972, the Committee took note of that problem. It developed independent estimates of monetary aggregate growth that were

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[10]At the time, M1 consisted of currency and privately held demand deposits. Other checkable deposits were added to the definition in 1980. M2 consisted of M1 plus time and savings deposits other than large CDs at commercial banks. Thrift institution deposits, overnight RPs, Eurodollars, and money market funds were not included until 1980.

expected to be consistent with moving gradually toward lower inflation. It introduced six-month growth targets designed to achieve these goals. Econometric models, supplemented by the judgments of the staff, were used to develop the six-month and one-year estimates. The models allowed money growth to respond to economic activity and interest rate behavior. The weekly and two-month estimates were derived judgmentally, allowing for a range of technical factors.

The FOMC also introduced a reserve operating mechanism in 1972 that was designed to influence the supply of money. It was to be used simultaneously with the interest rate guideline, which worked through the demand for money. The FOMC made the addition to address a weakness in the existing procedure, namely, the need to rely on staff estimates of the funds rate required to achieve desired money growth. The funds rate worked by affecting the interest rates banks both paid and charged customers and hence the demand for money. But the demand for money was also a function of nominal income and anticipated inflation (which was only partially captured by the behavior of nominal interest rates). The Board staff built models of money demand, as did other Federal Reserve research departments. There was much debate throughout the decade about these models and their accuracy. Some observers felt that the models would have done well enough over periods judged to be of meaningful length (six months to a year) if the FOMC had really allowed interest rates to move as much as the models required. Others felt that it was not feasible to control money adequately by working through the demand side, either because the models were not reliable enough or because the interest rate consequences could be too disruptive to markets.

The development of a reserve guideline to aid in achieving monetary targets was based on the reserve-money multiplier model of money control. The model implied that controlling total or required reserves would constrain money growth through the operation of the reserve requirement ratio. The FOMC was concerned, however, that a pure reserve provision strategy would cause undesirable short-run volatility of interest rates. The FOMC briefly tried reserve targeting in 1972 but, to limit money market volatility, it put a constraint on the funds rate.

A technical problem complicated the use of a reserve guideline. Controlling total or required reserves was considered the best means of affecting deposits, yet these measures were subject to change for reasons unrelated to the behavior of money. In particular, interbank and federal government deposits were excluded from all the money definitions but were subject to reserve requirements. Government deposits at the time varied far more than they have in recent years. All tax and loan account monies were kept in commercial bank demand deposits subject to reserve requirements until 1977, when a legal change permitted note option accounts that pay interest and are not subject to reserve requirements. To take account of the reserve requirements on deposits not in the money definitions, the Federal Reserve developed a measure that excluded reserves against government and interbank deposits. It was called reserves on private deposits, or RPD. While RPD behavior was closer to that of M1 than was total reserve behavior, the linkage was not very close because reserve requirements differed widely according to the size and membership status of the bank. Movements of deposits between large and small banks or member and nonmember banks changed the ratio of RPD to M1. Changes in the ratio of currency to deposits also affected the relationship between RPD and M1.

Using staff estimates of the various ratios, the FOMC set two-month growth target ranges for RPD designed to be consistent with the desired growth in M1, and instructed the Desk to alter its reserve provision in a way that was intended to achieve them. The actions were also supposed to be consistent with achieving a specified federal funds rate each week, which could be moved within a band between meetings. Usually the specified band was 1 to 1 1/4 percentage points wide over the intermeeting period and somewhat narrower each week. Intermeeting intervals were four to five weeks long. As it turned out, the relatively narrow funds rate constraints often dominated, and the Desk frequently missed the RPD target. RPD targets were declared unachievable, although the funds rate constraint precluded a true test. In 1973, the Committee changed RPD's status from operational target to intermediate target, placing it in the same category as M1 and M2. Since information on the behavior of M1 was about as good as information on RPD, RPD gradually fell into disuse. It was dropped as an indicator in 1976.

Subsequent modifications to techniques mostly related to the nature of the monetary targets. In 1975, in response to the requirement of a congressional resolution, the Federal Reserve adopted annual monetary target ranges and announced them publicly. A growth cone was drawn from the base period, which was the calendar quarter most recently concluded. Every three months, the target range was moved forward one quarter. The procedure meant that by the time the annual target period was completed, the target had long since been superseded. Frequently, the targets were overshot, and complaints about upward base drift were legion. The Full Employment and Balanced Growth Act of 1978, known as the Humphrey-Hawkins Act, established the current procedure requiring the Federal Reserve to set targets for calendar years and to explain any misses.

In addition to setting the annual targets in February and reviewing them in July as required by the Humphrey-Hawkins Act, the Committee continued to set two-month ranges. In theory, the two-month money growth targets were supposed to be consistent with returning to the annual target range if the money measures were outside the range, and with holding the aggregates within the ranges if they were already there. However, the Committee was often skeptical of staff forecasts. Furthermore, the Committee sometimes felt that the estimated changes in the funds rate needed to get money back on target were unacceptably large. It sometimes approved growth rates that stretched out the period for bringing money back on track, and on occasion it acknowledged that target growth probably would not be achieved within the year.

During most of the 1970s, the FOMC was particularly reluctant to change the funds rate by large amounts at any one time, even when staff estimates suggested that sizable modification was necessary to achieve the monetary goals. Part of that reluctance reflected a wish to avoid short-term reversals of the rate. Keeping each rate adjustment small limited the risk of overdoing the rate changes and then having to reverse course. Those priorities restricted the options available to search for the appropriate rate at times when the FOMC was uncertain about the correct rate. The adjustments in the funds rate often lagged behind market forces, allowing trends in money, the economy, and prices to get ahead of policy.

At the FOMC meetings, the Committee voted for a federal funds range that surrounded the most recent rate target. The Committee also put relatively narrow limits on the range of potential adjustments that could be made between meetings if money growth went off course. In the early 1970s, the intermeeting funds rate range was generally 5/8 to 1 1/2 percentage points wide. By the latter part of the decade, its width was usually about 1/2 to 3/4 percentage point, and on a couple of occasions only 1/4 percentage point. In addition, the specifications for the aggregates were often set in a way that made it likely that the funds rate would be adjusted in one direction only, effectively cutting the range in half.

In implementing the funds rate targeting procedure, the Desk became increasingly sensitive to preventing even minor short-term deviations of the funds rate from target. It generally added reserves by purchasing securities or arranging RPs in the market in a visible way when the funds rate exceeded the objective even slightly, and it absorbed reserves through sales or matched sale-purchase agreements when the funds rate fell short of the objective. It felt some constraint not to make reserve adjustments in an overt way when the funds rate was on target. At times when reserve estimates suggested that a large adjustment was needed but the funds rate did not confirm it early in a statement week, the Desk would worry about delaying the reserve adjustment and having to make an unmanageably large open market transaction late in the week. When the funds rate failed to confirm an estimated reserve excess or shortage, the Desk often made the reserve adjustments by arranging internal purchases or sales with foreign accounts that could not be observed by market participants. The introduction in 1974 of customer-related RPs--agreements on behalf of official foreign accounts--gave the Desk a tool for adding reserves when the funds rate was on target but a reserve need was projected. (Market participants routinely assumed that outright transactions in the market for customers did not signal dissatisfaction with the funds rate, and they initially regarded customer-related RPs the same way.)

If the estimated need to add or drain reserves was too large for these techniques, the Desk often pounced on very small funds rate moves off target to justify an operation. For instance, when estimates suggested that additional reserves were needed, the Desk would often enter the market to arrange an RP when the funds rate rose 1/16 percentage point above the preferred level. But if the funds rate fell despite the estimated need to add reserves, the Desk typically would allow a 1/8 percentage point deviation to develop before it would arrange a small market operation to drain reserves. If the funds rate continued to trade off target after the Desk's first entry of the day, the Desk often arranged a second open market operation. There was an operational limit to how late in the day transactions could be done for same day reserve effect. The cutoff was supposed to be 1:30 p.m., but if the desired funds rate move occurred just after the time, the Desk often responded if it was anxious to do an operation. The end of its operating time was close to 2:00 p.m. by 1979.

The Desk's prompt responses to even small wiggles in the federal funds rate led banks to trade funds in a way that tended to keep the rate on target. Except near day's end on the weekly settlement day, a bank short of funds would not feel the need to pay significantly more than the perceived target rate for funds. Likewise, a bank with excess funds would not accept a lower rate. Rate moves during the week were so limited that they provided little or no information about reserve availability or market forces. Probably few, if any, in the Federal Reserve really believed that brief small moves in the funds rate were harmful to the economy. The tightened control developed bit by bit without an active decision to impose it.

D. 1979 to 1982: Targeting Monetary Aggregates and Nonborrowed Reserves

In October 1979, the FOMC radically changed the operating techniques it used for targeting the monetary aggregates. It explicitly targeted reserve measures computed to be consistent with desired three-month growth rates of M1. The constraint on the federal funds rate applied only to weekly averages, not to brief periods during the week. Its width was 4 to 5 percentage points, wide enough to allow the adjustments needed to achieve the monetary target. Persistent overshoots of money targets and severe inflation had changed priorities. Interest rate volatility, so feared when the RPD targets were developed in 1972, seemed more tolerable.

Operationally, the FOMC chose desired growth rates for M1 (and M2) covering a calendar quarter and instructed the staff to estimate consistent levels of total reserves. The process resembled that used to estimate RPDs. The staff estimated deposit and currency mixes to derive average reserve ratios and currency-deposit ratios. The estimation technique employed a mix of judgment and analysis of historical patterns. It was complicated by the wide range of reserve ratios applied to Federal Reserve member bank deposits and by the absence of reserves, or even timely deposit data, from nonmember banks. From the total reserve target, the Desk derived the nonborrowed reserve target by subtracting the initial level of borrowed reserves that had been indicated by the FOMC.[11] The initial borrowing level was intended to be consistent with the desired money growth. If it were inconsistent, money and total reserves would exceed or fall short of path. If the Desk only provided enough reserves to meet the nonborrowed reserve path, borrowing would automatically rise if money growth (and total reserve demands) were excessive, or fall if such growth were deficient. The borrowing move would affect reserve availability and the funds rate and would encourage the banks to take actions that would accomplish the desired slowing or speeding up of money growth. If the pace of adjustment implied by the mechanism did not seem appropriate, instructions were occasionally given to accelerate or delay the borrowing adjustment. The FOMC could make alterations to the basic mechanism at a meeting or direct the Desk to make them under specified conditions between meetings.

To reduce overweighting of weekly movements in money, the total and nonborrowed reserve paths were computed for intermeeting average periods, or two subperiods if the intermeeting period were longer than five weeks. (In 1979 and 1980, the FOMC met nine and eleven times, respectively; in 1981 it moved to the schedule of eight meetings a year in use today.) A consequence of this averaging technique was that errors in the early part of the period had to be offset by large swings in borrowing in the final week. Informal adjustments were sometimes made to smooth out those temporary spikes or drops in borrowing that were deemed inconsistent with the longer term pattern. While the adjustments were considered necessary to avoid severe swings in reserve availability and interest rates, they gave the appearance of "fiddling" and have led to considerable confusion in the literature. Each week the total reserve path and actual levels were reestimated, using new information on deposit-reserve and deposit-currency ratios.

In implementing the policy, the Desk emphasized that it was targeting reserves and not the

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[11]The Board staff made estimates of consistent combinations of borrowed reserves and money growth for the given discount rate. The estimates were derived from modified versions of money demand models and borrowed reserve equations.

funds rate by entering the market at about the same time each day--usually between 11:30 and 11:45 a.m.--to perform its temporary operations. It confined outright operations to estimated reserve needs or excesses extending several weeks into the future. It arranged outright operations early in the afternoon for delivery next day or two days forward. The federal funds rate was not ignored; it was used as an indicator of the accuracy of reserve estimates, although it was not always that reliable. On the margin, it could accelerate or delay by a day or so the Desk's entry to accomplish a needed reserve adjustment, but its role was much diminished.

Wide swings in the federal funds rate had been anticipated, although there was some surprise at the degree of volatility. Swings in the short-term growth rates of the monetary aggregates also were wider than generally had been expected, although the risk of some overadjustment of money had been recognized from the beginning. Some observers saw it as a necessary antidote to the earlier procedure, which often moved the funds rate too little too late. In part, the sharp movements in both interest rates and money probably reflected the underlying conditions. The effort to end the inflation that had built up over one and a half decades and had come to permeate economic relationships forced major adjustments. Expectations about inflation and economic activity were very fluid during those years; they fluctuated sharply as people evaluated new information and judged whether the anti-inflation policies were likely to succeed.

The control mechanism itself almost assured that money growth would cycle around a trend unless the FOMC intervened in the process. If money rose above its desired level, required reserves would rise by a fraction of the overshoot determined by the reserve ratio. Following the procedures would cause borrowed reserves to rise as well. They would not decline until money growth, and hence total reserve growth, slowed. The higher borrowing would slow money growth, but with a lag. By the time the procedures called for lower borrowing, it would have been high too long, ensuring that money growth would fall below the desired level in what appeared to be a "damped cycling process." Borrowing would then fall short too long, setting up the next round of acceleration of money growth.

E. 1983 to the Present: Monetary and Economic Objectives with Borrowed Reserve Targets

A breakdown in the relatively close linkage between M1 and economic activity, rather than dissatisfaction with the procedures, led to the next set of changes, although there was also some sentiment that short-term rate volatility had been excessive. By the latter part of 1982, it was becoming apparent that the demand for money, particularly M1, was strong relative to income, so that growth within the target range would have been more restrictive than seemed desirable under the circumstances. Some of the increase in the demand for money was attributed to the ongoing deregulation of interest rates on various classes of deposits. In particular, NOW accounts were making it more attractive to hold savings in M1. In addition, the maturing of a large volume of special tax-favored "all savers" deposits in October of that year was expected to add substantially to M1 holdings. The FOMC had hoped that M2 would continue to be a reliable indicator, and for a few months at the end of 1982 it attempted to use it as a guide to building total and nonborrowed reserve targets. However, money market deposit accounts (MMDAs), authorized beginning in December 1982, proved very attractive, and the demand for M2 rose sharply.

In the absence of a stable relationship between money and economic activity, the FOMC followed ad hoc procedures for guiding reserves provision, hoping that the distortions to the relationship would prove to be short-lived. The FOMC focused on measures of inflation and economic activity to supplement the aggregates. Instead of computing total and nonborrowed reserve levels linked to some aggregate and deriving a level of borrowing that moved with the deviations of the aggregate from target, it chose the borrowed reserve level directly. It intended to adjust it up or down whenever money seemed to be deviating from the desired growth path in a meaningful way (after making allowance for distorting factors and taking account of the supplemental indicators).

The monetary aggregates did not quickly resume their prior relationship with economic activity. Declining inflation made holding money more attractive, and interest rate sensitivity increased, since rates on some components of M1 were close to market rates but slow to change. Policy decisions continued to be guided by information on economic activity, inflation, foreign exchange developments, and financial market conditions. In time, money growth was moved from a predominant position in the directive to join the list of factors shaping adjustments to the borrowing level. What apparently started out as a temporary procedure persisted, with modifications, for most of the 1980s.

Under procedures developed in 1983, forecasts of reserve availability are compared to a maintenance period average objective for nonborrowed reserves that is believed to be consistent with achieving the desired amount of borrowing. The decision each day whether to provide or drain reserves is guided to a considerable extent by the estimated difference between the forecast volume of nonborrowed reserves and the objective for the two-week maintenance period. The Desk uses money market conditions, this time specifically the funds rate, to supplement the reserve forecasts, particularly in choosing the days on which operations are conducted and the instruments used to make the reserve adjustments. For instance, if the funds rate is significantly above the range that is expected to correspond to the intended borrowing level (based on the discount rate that is in place), the Desk is more prompt in meeting an estimated reserve need to indicate that the funds rate probably is out of line. But it generally continues to intervene at a standard time and accepts more variation in the funds rate than in the 1970s. By the latter part of the 1980s, relationships between borrowing and money market rates seemed to go through a series of shifts. In the face of these hard-to-predict shifts, policy tended to become somewhat more sensitive to deviations in the federal funds rate than it had been earlier in the decade.

II. Summary

Over the post-World War II period, the FOMC made several significant changes in both the intermediate and operating targets of policy. Concerns about inflation were often a driving force for change. The inflation that accompanied the Korean War led the Federal Reserve to negotiate with the Treasury a means to resume an active monetary policy. The techniques developed after the 1951 Accord reflected the predominant Committee view that bank credit cost and availability played a major role in determining economic activity and that inflation resulted when the economy overheated. Free reserves and money market conditions were adjusted to influence bank credit. Some FOMC members believed that a strong link existed between interest rates and economic activity, but most members, recalling their experience with forced rate pegging in the 1940s, were disinclined to target interest rates directly. The procedure adopted in the early 1950s appeared to work in a generally satisfactory way for a time, and its use persisted for more than one and a half decades.

The change from bank credit to a monetary aggregate as an intermediate target began to evolve in the late 1960s. It was made because observers came to see the relationships between Federal Reserve actions and ultimate outcomes as more complex than previously thought, and because of distress about rising inflation. Some academic research suggested that the behavior of money was a better leading indicator of economic activity and prices than was bank credit or interest rates. Reliance on the federal funds rate rather than on free reserves developed as the federal funds market became more active and as the passage of time made associations between funds rate targeting and the rate pegging episode of the 1940s less likely. The changes were formally implemented at the start of the 1970s.

In 1979, the FOMC shifted operating targets dramatically. It did so because the monetary objectives had been overshot repeatedly and inflation had accelerated to unacceptable rates. Use of the funds rate as the operational target was thought to be partly to blame because, as the adjustment tool, rates were changed too cautiously. The monetary aggregates remained the intermediate target, but additional efforts were made to avoid persistent overshooting. Nonborrowed reserves, which were more directly linked to M1, became the operating target.

By contrast, the 1982 adjustments primarily stemmed from problems with M1, and to some extent with the broader money measures, as intermediate targets. By that time, considerable progress had been made in slowing inflation. The modifications were motivated by an apparent breakdown in the traditional relationship between the monetary aggregates, especially M1, and economic activity. Although operating targets had to be modified when the monetary aggregates were de-emphasized, the primary operating target, borrowed reserves, was a variant of the previous nonborrowed reserve target.

Since 1982, the Committee has watched what might be called intermediate indicators rather than targets. It has continued to monitor the aggregates and to set targets for M2 and M3. The target setting has been guided by insights that have been gained about how interest rate deregulation and changing expectations of inflation have altered the relationship between the monetary aggregates and the economy and prices. Nonetheless, the relationships are not sufficiently precise to support close short-run targeting of the aggregates at this stage. In the absence of a reliable intermediate target, the Committee has followed developments of the economy and prices directly and has observed a variety of economic statistics, in addition to the monetary aggregates, that point to future moves in the goal variables.

Appendix: Reserve Measures

Free reserves are defined as excess reserves less borrowed reserves, or alternatively, as nonborrowed reserves less required reserves. Free reserves are derived from two reserve identities. Total reserves of the banking system equal required reserves plus excess reserves. Total reserves also equal borrowed reserves plus nonborrowed reserves. Total reserves are reserve balances held by depository institutions (DIs) at the Federal Reserve and vault cash that is applied toward meeting requirements. (Before the Depository Institutions Deregulation and Monetary Control Act of 1980, only banks that were members of the Federal Reserve held reserves. Now any DI that accepts transactions accounts can be subject to reserve requirements.) Required reserves are total reserves that DIs must hold to comply with Federal Reserve regulations. They are specified in Federal Reserve Regulation D and are fractions of various maintenance period average deposit levels. Excess reserves are reserve balances that DIs hold that are not needed to meet requirements. Since DIs do not earn interest on excess reserves, they attempt to limit their holdings. However, DIs cannot hit reserve targets precisely, and they can be penalized for failing to meet their requirements on average or for ending the day with their reserve account overdrawn. Hence it is hard to avoid holding some excess reserves. Excess reserves moved in a relatively narrow range for long periods of time, then became more variable in the 1980s, and consequently became harder to estimate. Borrowed reserves are reserve balances acquired from the Federal Reserve's discount window facility. (Extended credit borrowing by banks in difficulty is often treated as being akin to nonborrowed reserves.) Nonborrowed reserves are all reserves arising in other ways, primarily through open market operations and through changes in other factors on the Federal Reserve balance sheet.

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