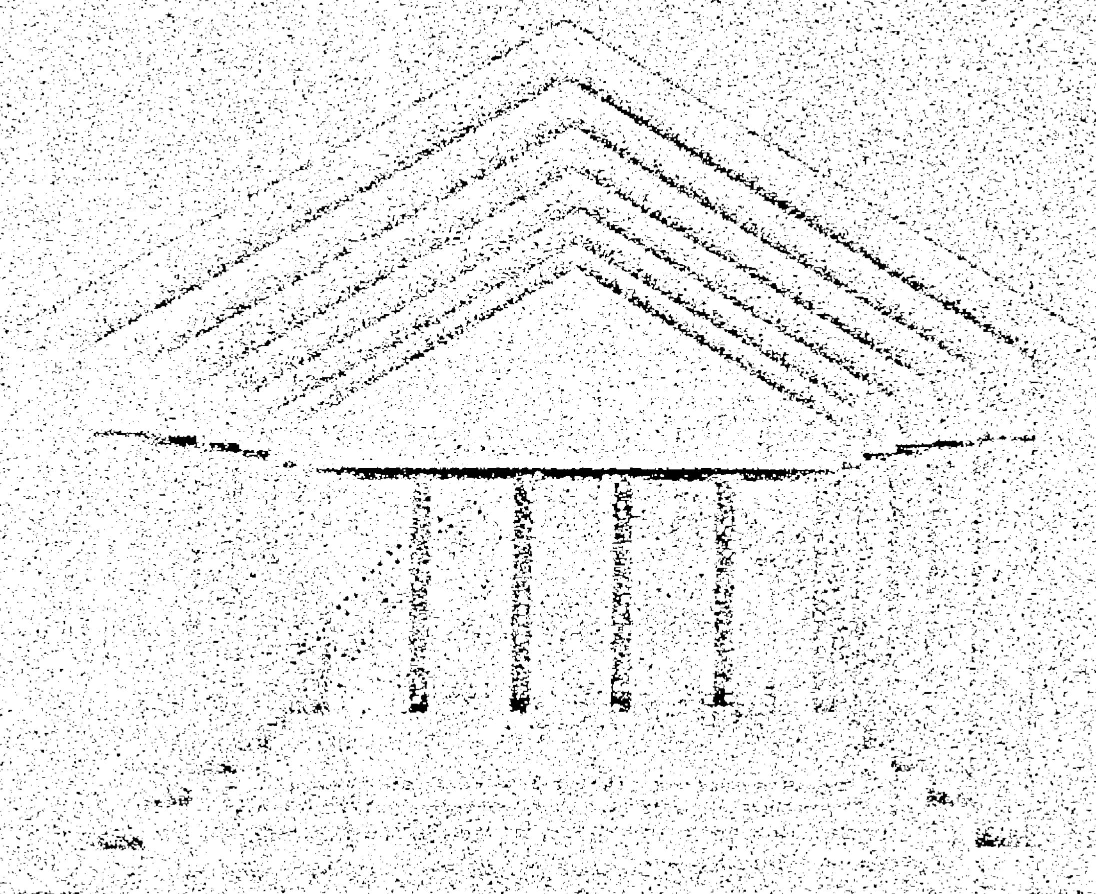
Open Market Policies and Operating Procedures–Staff Studies



BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

Open Market Policies and Operating Procedures-Staff Studies

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PREFACE

The staff studies included in this book were prepared as part of a study of the policies and operating procedures implicit in the policy directives of the Federal Open Market Committee. These studies represent the views of the individual authors and should not be attributed to either the Federal Open Market Committee or individual members of that Committee.

The role of monetary aggregates and of money market conditions in the decision-making process of the FOMC and in the day-to-day conduct of open market operations is described in an article, "Monetary Aggregates and Money Market Conditions in Open Market Policy," which appeared in the Federal Reserve *Bulletin* for February 1971. This article is reprinted here as an appendix.

OVER-ALL CONTENTS

by Stephen H. Axilrod

THE FOMC DIRECTIVE AS STRUCTURED IN THE LATE 1960's: THEORY AND APPRAISAL

CONTENTS

INTRODUCTION

This paper attempts to lay out and appraise the workings of, and a possible theory for, the structure in the latter part of the 1960's of the Federal Open Market Committee's directive to the Manager of the Open Market Account. An effort is made to indicate and evaluate the practice of open market policy as it flowed from the structure of the directive. The paper also attempts to outline one theoretical rationale for the directive's structure and to indicate the nature of the flow of economic information, including projections, that appears to be required to satisfy such a theoretical underpinning for the directive.

STRUCTURE OF THE DIRECTIVE

For many years the FOMC directive has contained two paragraphs. The first paragraph is a statement about the economy and the general goals of monetary policy, while the second contains operating guides for the Account Manager covering the interval between Open Market Committee meetings. In the recent past this interval has generally been 3 or 4 weeks. The nature of the information and instructions in these two paragraphs has changed over the years. In this section, the paragraphs as they were formulated in the late 1960's will be described and evaluated.[1]

NATURE OF FIRST PARAGRAPH. The first paragraph of the directive typically contained statements about over-all economic activity, prices, various financial flows—particularly bank credit and money—and interest rates. Generally, only the statement about over-all economic activity had a future cast to it. But the time horizon for this future was often rather indefinite. Sometimes the wording has been such that the reader would think it referred to no more than a quarter ahead, or to the quarter in process. An example of such wording would be "economic activity appears to be slowing." On the other hand, at times statements simply noted that economic activity is projected to slow. In such cases the time horizon appears more indefinite.

To understand the magnitude and timing of the future projections of economic activity that provide a basis for FOMC decisions and for the instructions given to the Account Manager, it is necessary to look outside the directive itself. For the public, the policy record that is published at the same time as the directive (both with about a 3-month lag) contains a general indication as to the direction and magnitude of the gross national product, but the references are qualitative and not necessarily consistent as to time periods mentioned. The

NOTE.—The author is Associate Director, Division of Research and Statistics, Board of Governors of the Federal Reserve System.

[1] The wording of the directive issued on Aug. 12, 1969, is as follows:

> The information reviewed at this meeting indicates that expansion in real economic activity slowed somewhat in the first half of 1969 and some further moderation is projected. Substantial upward pressures on prices and costs are persisting. Most market interest rates recently have receded slightly from their earlier highs. In July the money supply expanded as U.S. Government deposits decreased further; bank credit declined on average, after adjusting for an increase in assets sold to affiliates and to customers with bank guarantees. The run-off of large-denomination CD's which began in mid-December continued without abatement in July, and there apparently were net outflows from consumer-type time and savings accounts at banks and nonbank thrift institutions combined. The over-all balance of payments deficit on the liquidity basis remained very large in July; the balance on the official settlements basis was still in surplus in the first half of the month but subsequently shifted toward deficit as U.S. banks' borrowings of Euro-dollars leveled off. Foreign exchange markets appear initially to be adjusting in an orderly fashion to the announced devaluation of the French franc. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to the reduction of inflationary pressures, with a view to encouraging sustainable economic growth and attaining reasonable equilibrium in the country's balance of payments.
>
> To implement this policy, System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining the prevailing firm conditions in money and short-term credit markets; provided, however, that operations shall be modified if bank credit appears to be deviating significantly from current projections or if pressures arise in connection with foreign exchange developments or with bank regulatory changes.

FOMC itself has available to it specific, dated projections presented by the staff at each meeting. The staff projections are in considerable detail with specific numbers and generally with a time horizon of about a year.

Thus, the economic analysis behind FOMC instructions to the Account Manager in the directive cannot be understood by reference only to the first paragraph of the directive; it requires other documentation. Some might argue that there is no reason for the first paragraph to express the full scope of the economic and financial analysis that lies behind the specific operating instruction of the second paragraph. However that may be, the main point here is that the structure and meaning of the directive that is issued cannot be understood in itself but must be considered in relation to the information gathering, economic analysis, and policy discussion that are integral to the FOMC meeting. In that respect, it should, of course, be pointed out that the staff material and projections may not give a correct impression of the views of the members of the FOMC. Their outlook for the future has often been different from the staff's, and a thorough understanding of their views and the relation of these views to the directive requires access to the minutes of the meeting, although a brief summary of the policy discussion is contained in the policy record that is published along with the directive.

The final sentence of the first paragraph of the directive states the goals of monetary policy as they relate to the balance of payments, economic growth, and inflation. From time to time the structure of this sentence is rearranged so as to give particular emphasis to the balance of payments, or to price stability, or to the need to encourage economic growth, as may be appropriate. This rearrangement can then be taken to represent a general statement of the Committee's over-all priorities with respect to the ultimate goals of policy.

There is no explicit mention of potential trade-offs among various competing goals, however, in the final sentence of the first paragraph. The order in which the goals are presented may give some indication of priorities attached to particular goals by the Committee, but there is nothing to indicate that the Committee is considering the sacrifice of a degree of attainment of one goal in order to obtain a greater degree of attainment for another goal. In fact, it may be an overstatement to suggest that rearrangements of the wording of this sentence indicate explicit consideration by the Committee of the trade-off problem. It is more likely that rearrangement should be interpreted as indicating that the Committee is moving, for example, toward an emphasis on combating inflation rather than encouraging growth. But whether the Committee believes it can have both some desired level of economic growth and a desired degree of price stability over some given time period is certainly not made clear in the general statement of goals.

The indefinite nature of the time horizon of the first paragraph and its very general statement of goals make its connection with the operation elements of the second paragraph rather tenuous. The second paragraph refers explicitly to how the Account Manager should operate in the market over the interval between Committee meetings. Presumably, these operations would be consistent with the desires of the Committee with respect to the economy and the balance of payments as expressed in the last sentence of the first paragraph. But how these two paragraphs relate to each other is not made clear in the directive itself, or in the policy record accompanying the directive. In order to relate them it would seem necessary to analyze the relationship of: (1) the operating variables that the Manager works with, (2) the financial flows and over-all interest rates that result from these operations, and (3) related effects over time on economic activity, prices, and the balance of payments. Thus, while clear for the first paragraph of the directive, it is even clearer for the whole structure of the directive as constructed in the late 1960's—not to mention other periods—that the directive cannot be analyzed independently of the total flow of material and projections given to the FOMC, and of the nature of the discussion undertaken by the FOMC in relation to this material. In brief, the procedures of the FOMC and the directive are inseparable.[2]

Before discussing the relationships among the day-to-day operational variables in the second paragraph of the directive, aggregate monetary flows, over-all interest rates, and longer-run projections of the economy, it is desirable to describe the constituent elements of the second paragraph that affect the Manager's operations. These are by no means clear, of course, as expressed in the second paragraph of the directive, but they are fairly clear to those present at FOMC meetings and with access to the full FOMC documentation.

OPERATIONAL ELEMENTS IN THE SECOND PARAGRAPH. The second paragraph of the FOMC directive generally has asked the Manager to maintain—or ease, or seek tauter, as the case may be—money market conditions. Sometimes the term "money market conditions" has been expanded to "money and short-term credit market conditions." In addition, in the last 4 years of the 1960's the second paragraph included a proviso clause, which noted that the money market conditions should be attained provided bank credit was not deviating significantly from projections. Moreover, the second paragraph contains, when appropriate, references to "even keel" around periods of Treasury financings. And finally, this paragraph has made references to possible modifications of operations in cases of liquidity crises or similar emergencies, such as exceptionally large outflows of funds from banks or thrift institutions at interest-crediting periods or potential domestic market reactions to foreign exchange market developments. The Manager also appears to have a continuing authority to avert disorderly market conditions; just how such conditions are defined is unclear, but they are generally taken to mean a drying-up of trading in securities and large and cumulative downward price movements for which no end seems in sight.

Money and other short-term market conditions. The money and other short-term market conditions referred to in the second paragraph include principally the Federal funds rate, borrowings by member banks, and net free or net borrowed reserves. At times, the rate on 3-month Treasury bills has been included in this constellation. The words "other short-term market conditions" have generally been taken to indicate inclusion of the 3-month bill rate, although that rate has also at times been something of a factor in operations even without such specific wording. The emphasis placed on the bill rate has varied considerably with monetary and economic conditions. For instance, in the early 1960's when it was thought that international flows of funds were responsive to relations between short-term market rates here and abroad, much attention was paid to the 3-month bill rate in operations. Also, the 3-month bill rate was a particularly important operating variable when it and the whole bill rate structure were hovering around Regulation Q ceilings, and the Committee did not wish to encourage either a large expansion in bank credit that might be associated with a decline in the bill rate or a large contraction that might be associated with a rise in the bill rate.

A constellation of money market conditions, rather than a single indicator, has been relied on for operating purposes because changes in reserve distribution and other temporary market factors may result in divergent tendencies in any one of the money market conditions, and such a divergent tendency might be offset through manipulation of other conditions in order to maintain an over-all degree of ease or tightness in the money market. For example, when reserves are distributed in favor of lead-

[2] This paper will not, however, discuss the content of FOMC discussions and the nature of the go-around among FOMC members, but will rather concentrate on the economic issues germane to the theoretical basis of the directive—thereby implicitly discussing the types of decisions that would appear to require FOMC discussion.

ing money center banks the Federal funds rate will often decline, and this would appear to be an indication of easing in the market unless member bank borrowings are permitted to rise and net borrowed reserves deepen. On the other hand, when reserves and funds move away from money center banks, the Federal funds rate will tend to rise because these major money center banks appear to be more willing than other banks to borrow and to pay higher rates for day-to-day money in the market. In such a case, if member bank borrowings are not permitted to decline somewhat, the over-all money market will appear to tighten. There are limits within which these trade-offs can take place, and the range of trade-offs represents the over-all constellation of money market conditions that have been the day-to-day operating guide for the Account Manager.

The operating emphasis on money market conditions has meant that the directive was essentially accommodative, in the sense that market demands for credit and money would be accommodated at a given Federal funds rate or level of net borrowed or net free reserves. Some constraint on the degree of accommodation was instituted by the proviso clause, but in practice this represented a rather minor element of constraint, in part because the Committee was willing to tolerate wide swings in bank credit and in part because the proviso clause was not in application taken as a strong target of policy.

Bank credit proviso. The proviso clause in the directive during the latter part of the 1960's was for the most part related to bank credit, although in its early days required reserves were used (and on one or two occasions money supply was noted along with bank credit). The bank credit referred to was originally a proxy for daily-average bank credit as measured by total member bank deposits, a series for which daily figures are available.[3] As time went on, and nondeposit funds became relatively important sources of bank credit, the bank credit referred to became the total of member bank deposits plus the average for the month of weekly data on liabilities to branches abroad, and then finally plus the average of borrowings through commercial paper issued by bank-related affiliates. A theory behind the proviso clause will be discussed in an ensuing section of the paper, including some discussion of what particular aggregates might best be included in such a clause.

The proviso was generally a two-way proviso. That is, the Manager was directed to ease money market conditions a little if bank credit were falling short of expectations and was directed to tighten them a little if bank credit were rising above expectations. Sometimes, however, the proviso was expressed so that its effect was only one way. For example, if the Committee were particularly anxious to avoid a sharp rise in bank credit, it might have directed the Manager to alter money market conditions only if bank credit were rising above projections.

For the most part, projections of bank credit provided by the staff were for only 1 month ahead, although on occasion figures for a slightly longer time period were presented. The monthly projections were based on recent trends in deposit data, knowledge as to likely Treasury financing activity, expectations as to the effects of market interest rates on time deposits given Regulation Q ceilings at banks, and a view as to the intensity of loan demands in light of the outlook for GNP. Either the projections have assumed no change in money market conditions, or if a change in the second paragraph was to be considered by the FOMC, then they have been based on somewhat tighter or easier money market conditions, as the case might be. The Committee generally, but not always, accepted the staff projections as the appropriate quantities for the proviso clause.

There was nothing in the directive to indicate when the proviso would be put into effect —whether it would be after 1 week of devia-

[3] Loans and investments of the large weekly reporting banks are available weekly in fairly detailed categories, while estimates for loans and investments at all commercial banks are available only for the last Wednesday of the month.

tion from projections or 2 or 3. Nor was there anything in the directive to indicate how much of a change in money market conditions the Manager should seek in light of a deviation of bank credit from projections. Much of the time the word "significantly" appeared in the proviso in relation to deviations from projections, and this would appear to indicate that the deviation would have to be relatively large, with the dimension having to be gleaned by the Account Manager from Committee discussion.

No large change in money market conditions was ever undertaken by using the proviso clause. Only small shadings were undertaken, no matter how large the deviation of bank credit from projections, with the FOMC reconsidering its whole stance at the next Committee meeting. When it was used, the proviso clause was generally not taken as a target, or at least not as a strong target, because the Account Manager was not directed to alter marginal reserves and money market conditions as need be to attain the specified bank credit range.

Even keel. The words "even keel" have referred to the operations of the Federal Reserve Open Market Account around periods of Treasury financings. As the appendix notes, "in practical terms 'even keel' has meant that, for a period encompassing the announcement and settlement dates of a large new security offering or refunding by the Treasury, the Federal Reserve has not made new monetary policy decisions that would impede the orderly marketing of Treasury securities and significantly increase risks of market disruption from sharp changes in market attitudes in the course of a financing."

The past timing of even keel and its effect on interest rates and monetary aggregates are discussed in some detail in the appendix and will not be repeated here. However, two points should be highlighted. One is that there have been rather marked fluctuations in both day-to-day interest rates and longer-term interest rates during even-keel periods, as well as fluctuations in member bank borrowings and net reserves; but in spite of such fluctuations, the trend of the narrow money market measures has not generally changed during even-keel periods. As a second point, it should be noted that during even-keel periods the money supply and bank credit have often risen relative to their trend and that they have not always completely dropped back after even keel. If any general conclusion about even keel can be drawn, it may be that in such periods the Federal Reserve has permitted somewhat more expansion in monetary aggregates than it might otherwise have done in order to keep interest rate fluctuations more damped than they otherwise would be.

But whether such a conclusion should be attributed to even keel, as such, is a question. Since the FOMC directive has been essentially an accommodative directive, and regardless of whether the System maintained even keel, very lumpy credit demands, such as the Treasury's, would have been associated with an enlarged expansion in bank credit and money. The major impact of even keel has been that the System refrained from changing its constellation of money market conditions in a period of Treasury financings, whereas it would not refrain from doing so in periods of particular corporate or State and local government financings. The reasons for refraining with respect to Treasury financings are the very large size of such financings and the extreme sensitivity of the markets as a whole to the receptions given these financings. Moreover, should such financings fail, the System would be under extreme pressure to take up the slack since the Treasury generally requires the money either to roll over maturing debt or to finance committed expenditures.

Liquidity, emergency, and other provisions. As noted above, one use of liquidity and emergency provisions in the second paragraph of the directive has been to guard against market disruption in case of very large and unexpected net outflows of funds from banks and savings or other types of financial institutions. While these net outflows would often make funds available to the securities markets, they could raise the threat that the institutions would not be able to meet commitments and, therefore, that confidence in the institutions, and perhaps in financial markets generally, might be dissipated—with undesirable repercussions on the economy itself. Certain kinds of liquidity and emergency provisions have also been used at times when foreign exchange markets have been in flux, and large outflows of funds from the dollar were in prospect that would have exerted strong and undesired upward pressure on the interest rate structure in this country.

Finally, it might be noted that the second paragraph of the directive has at times given the Manager authority with respect to adjusting operations to take account of changes in the discount rate or reserve requirements when it seemed relatively certain that such changes were about to take place. Exactly how he should adjust operations is, of course, not spelled out in the directive. But some guidance has been given through Committee discussion or through staff analysis. Nevertheless, in this respect as in others, there is a role, although circumscribed, for the Manager's judgment.

ROLE FOR MANAGER'S JUDGMENT. The Manager's judgment as to what money market conditions to seek has been circumscribed in recent years through greater statistical specification by the Committee. The staff has presented projections of bank credit, as noted earlier, and also detailed projections of member bank deposits, the money supply, time deposits, nondeposit sources of funds, and interest rates generally, on the assumption of unchanged money market conditions or, as an alternative, either tightened or eased conditions. Ranges have been given both for money market conditions and for the projected monetary aggregates. Needless to say, not all members of the FOMC would accept staff specifications as their own. Thus some members might prescribe a slightly different range for the Federal funds rate, even for a directive for unchanged money market conditions. And some members might be more willing than others to see bank credit expand above, or move below, projections.

Given the multiplicity of variables and the sometimes conflicting desires of various Committee members, the Manager has had considerable scope to play off one variable against another as consistent with his sense of the desires of the majority of the FOMC so long as at least some key variables remain within specified ranges. The problem of compromising among objectives is made more difficult because not all Committee members necessarily discuss the same variables, so the Manager cannot be sure of the wishes of those members who have not expressed themselves with respect to, say, the Federal funds rate or the 3-month bill rate. Finally, it might be noted that the Manager seems to have had some capacity marginally to alter money market conditions if credit markets more generally were being buffeted by unusual conditions or if the public's view of System monetary policy seemed to be changing undesirably—with market expectations developing that policy was either tighter or easier than the FOMC desired—as a result of a published series of money market statistics or operations deviating significantly from previous trends or actions.

While a good deal of specification is presented by the staff and while the various Committee members themselves often specify numerically what they hope to see happen, developments often turn out differently from projections. This, of course, has been less likely to happen with the narrow money market conditions—such as the Federal funds rate and net borrowed reserves—since these have been the principal operating variables the Manager sought to attain; and it has been much more likely to happen with bill rates, longer-term interest rates, bank credit, and money supply. In large part, of course, unexpected developments are the result of errors in specifying the relationship between money market conditions and monetary aggregates, or it may be that the levels of economic activity and credit demands are stronger or weaker than assumed for purposes of making the projection.

But whatever the reason for the difference between the projected and the actual outcome with respect to interest rates and monetary aggregates, or even with respect to narrow money market conditions, some outcomes are acceptable to the FOMC even though unspecified as a possibility. For example, a greater than expected rise in interest rates, as compared with projections, may turn out to be acceptable to the FOMC if this occurs at a time when demands in the economy are turning out to be larger than anticipated. In fact, the FOMC may often have told the Manager not to offset a market-generated tendency for interest rates to rise, or to fall.

Whether the multiplicity of short-run targets means that the Manager has had more scope for judgment than if he had only a single target is an open question. If the single target were net borrowed reserves, it would be clear that the Manager would have almost no scope for judgment, because net borrowed reserves are one of the more certainly attainable objectives within the constellation of short-run targets. However, if the single target were a rate of increase in the money supply, the Manager might have to exercise a very considerable degree of judgment because he would likely be faced with sharp day-to-day variations in deposits and hence would have to make almost continuous judgments as to whether he should tighten money market conditions or ease them in the particular statement week in order to make sure that over the month, the quarter, or whatever the relevant period, he would attain the desired money supply target.

While the degree of judgment required of the Manager need not be a principal factor in determining FOMC operating targets, the attainability of targets with a reasonable degree of accuracy should probably be a criterion. What types of targets are so attainable, and over what time periods, are not within the purview of this paper. The only point that might be added here is that emphasis on money market conditions in the second paragraph of the directive has reflected in part a sense by the FOMC that such conditions represented an attainable target, one to which the Manager could be held accountable, and one that might minimize his scope for judgment in day-to-day operations. Other targets too might be feasible —and perhaps more desirable for economic reasons—but they would require more day-to-day judgmental decisions by the Manager since the target (for example, money supply or bank credit) might be one or two steps removed in terms of availability of statistics from the day-to-day flow of bank reserve adjustment data and money market information. Such targets might be attainable, but they would require that the FOMC provide the Manager with more day-to-day—or more importantly more week-to-week—freedom in operations and might also require greater tolerance for errors, given existing institutional arrangements (such as the structure of reserve requirements).

FUNCTION OF MONEY MARKET CONDITIONS AS AN OPERATING GUIDE

As an operating guide, money market conditions have given the Manager a rather specific means by which he could determine whether or not to inject or absorb reserves. The net borrowed reserve position of member banks is relatively easy to meet within a week, particularly since required reserves are given as a result of lagged reserve accounting, and the Federal funds rate is available every day. In addition to providing the Manager with a target that he can achieve and thus one to which he can be held accountable, the money market conditions target permits market demands to influence money, bank credit, and reserves, as has been earlier noted. In that sense it permits, among other things, the market to make its own seasonal adjustment of the money supply and related items.

At the same time, of course, nonseasonal changes in demand would also be accommodated. Whether such accommodation is desirable has been one of the critical issues over the years in the FOMC's method of operation, since it raises the danger of providing or absorbing bank reserves, credit, and money in a procyclical fashion.

DAY-TO-DAY ROLE OF FREE RESERVES AND THE FEDERAL FUNDS RATE. This section will analyze in detail the day-to-day operating function of free reserves and other money market conditions, principally the Federal funds rate. The net reserve position and the Federal funds rate are basic elements of money market conditions influencing the Manager's day-to-day decisions as to whether to buy or sell securities. In the framework of the directive of the late 1960's, it is his task to supply or absorb reserves in response to market demands under given money market conditions. The Federal funds rate—the rate banks charge for selling excess reserves to other banks, usually on an overnight basis—is one of the most sensitive measures of the demand for or the supply of reserves. While shifts in the distribution of reserves among major banks, or between major money market and country banks, affect this rate, a persisting tendency for the rate to rise from previous levels indicates a greater desire for reserves relative to supply than in earlier periods, and vice versa.

The Federal funds rate generally bears a consistent, and relatively stable, relationship to the net free or net borrowed reserves position of member banks, although there can be week-to-week fluctuations between the two measures as a result of reserve distribution problems or unusual Treasury and other short-term financing demands in the market. There can also be a longer-run shift in the relationship—for example, the Federal funds rate may rise relative to net borrowed reserves if bank deposit drains cumulate and bank liquidity becomes increasingly strained, thereby increasing banks' demands for Federal funds borrowings (and assuming their effective demand for borrowing at the discount window is restricted by Federal Reserve rationing). In day-to-day operations the Federal funds rate and net reserves have been considered jointly, while recognizing the necessity of some give-and-take in maintaining an over-all unchanged state of ease or tightness for the money market (assuming the FOMC voted for an unchanged state of money market conditions).

The net reserve position of member banks is measured by the difference between their excess reserves and their borrowings. For purposes of understanding the relation of free reserves to System operations, however, it is better to look at such reserves as the difference between nonborrowed reserves (the reserves that can be supplied through open market operations) and required reserves (the result of joint decisions by banks and the public affecting the level and distribution of deposits, at given interest rates).

If the FOMC voted to keep money market conditions unchanged, the Account Manager would assume that the net reserve position of banks should remain about where it was in previous weeks. In his operations the amount of reserves he supplied or absorbed through the market would depend on other sources of nonborrowed reserves and on required reserves during the statement week. Thus, the Desk has to have at hand projections of float, the Treasury balance at the Federal Reserve, currency in circulation outside the banking system, gold flows, and foreign drawings or repayments on Federal Reserve swap lines, all of which are factors other than his own operations that affect nonborrowed reserves and that are for the most part outside his control.

In addition, the Desk would need to have for the current statement week estimates of the amount and distribution of deposits by type of deposit and class of bank in order to obtain a measure of required reserves. Under the lagged reserve scheme put into effect in September 1968, required reserves in a current statement week are based on deposits 2 weeks earlier, and thus the Desk knows with certainty what required reserves will be in the current week. But the System had operated with a money market conditions target (with or without a proviso) for a great many years before adopting the lagged reserve provision, and the theory of using money market conditions as an operating guide is little different with or without lags—although the timing of the effects of operations on key financial variables might be affected by the presence of lags.

MONEY MARKET CONDITIONS IN RELATION TO BANK DEPOSITS. Over the very short-run period of a bank reserve statement week, bank deposits are probably determined mainly by credit demands on banks and by bank investment policies, given money market conditions and, more generally, the level and structure of interest rates. As individual banks enter a new statement week, they are confronted with particular supply and demand conditions. On the supply side, they are faced with a set of fund availabilities given to them and about which they can do little (U.S. Government and private demand deposits, which in large part are beyond their influence in the short run) [4] and costs (reserve requirements; rates on Federal funds on Euro-dollars, and on CD's and other time deposits if available under Regulation Q; and so forth) that influence their willingness to obtain additional funds and affect their loan terms and portfolio policies. On the demand side, banks have formulated portfolio policies and they are faced with demands for loans, reflecting the underlying demand for goods and services and given the costs to borrowers of various alternative methods of financing, including banks' own loan rates and terms. Through interaction of these supply and demand forces, a certain volume of credit will be extended by banks and a volume of deposits will be generated.

A similar short-run process takes place regardless of whether reserves are lagged. A bank's willingness to extend loans or to compete for time deposits, even under a lagged scheme, will be limited by its seasonal pattern of demand deposit flows and by the cost to it of obtaining reserves in the Federal funds market, including particularly expected deposit flows and costs of Federal funds 2 weeks hence when reserve requirements on the current week's deposits have to be met. It must be assumed under existing procedures that the discount window is not a permanent source of reserve supply and that it can provide funds to individual banks only for short and infrequent periods when their reserve calculations go astray.

While the general theory of operating with a money market conditions guide is the same when reserves are lagged as when they are not, there may be some difference in timing of bank response to System operations. For example, if the System is tightening under an unlagged scheme, it is possible for the banking system to adjust to a smaller increase in nonborrowed reserves by selling assets to the public and reducing required reserves in the current week. Under a lagged scheme, the banking system cannot reduce required reserves in the current week, but that does not mean that banks need necessarily avoid preparing for the tightening of conditions in the current week. Clearly, they may still sell assets to the public in the current week—thereby reducing deposits currently and required reserves 2 weeks from now. However that may be—and the charac-

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[4] There are obvious exceptions to the statement that pertain to both private and Government demand deposits, but some of these in reality apply to banks' lending or borrowing policy rather than demand deposit flows as such. For example, banks can obtain U.S. Government deposits at times by bidding for Treasury bills offered with payment through credit to tax and loan accounts. But to an individual bank this is a temporary source of funds, which it considers on the same basis as Federal funds. The Federal funds rate represents the opportunity cost to the bank that influences the price at which it bids for the tax and loan balance. Such U.S. Government deposits are probably more appropriately considered as Federal funds in contrast to, say, normal seasonal deposit flows. Similarly, policy with respect to compensating balances may be changed by banks in the short run, but this is probably better considered as a factor in loan terms and conditions.

teristic of bank reactions to changes in reserve availability within short-run periods is an area where further empirical research is much needed—in this paper it is assumed that bank deposits in the very short run, such as a statement week, are not much affected in practice by System operations within that period, and that the operating option for the System is whether to supply the necessary required reserves through the discount window or by providing nonborrowed reserves.

If money market conditions are kept unchanged, the System through open market operations will supply or absorb enough nonborrowed reserves—given the other factors affecting nonborrowed reserves—to keep the net reserve position of banks and member bank borrowings (the most volatile element in the net reserve position under current circumstances, with excess reserves generally at minimal levels) at around their previous levels. And apart from reserve distribution problems, the Federal funds rate would generally also show little net change.

Because projections of non-System factors affecting nonborrowed reserves are uncertain (and in the days before the lag, projections of required reserves too were uncertain), the behavior of the Federal funds rate in the course of a statement week helps provide a clue as to whether the staff projections of net borrowed reserves and factors affecting such reserves are correct. For instance, if staff projections show that net borrowed reserves early in the statement week are deeper than those prevailing in earlier weeks (and thus would require System reserve-supplying operations under an unchanged policy), while at the same time the Federal funds rate is opening lower than in previous weeks, the Manager might consider holding off on any reserve-supplying operations in the expectation that there were in fact more reserves available than the projection for net borrowed reserves indicated. This might then turn out to be the case when the next day's figures became available because, say, float was running higher than was allowed for or than was normal for that particular time of the year. The interplay between statistical projections and the Federal funds rate is a valuable source of information to the Account Manager.

If the FOMC voted to tighten money market conditions, the Account Manager would conduct his operations so as to force banks to borrow more at the discount window than they had in earlier weeks, assuming excess reserves are at minimal levels. As banks find that they are forced more into the discount window, they also find fewer reserves available relative to demand in the Federal funds market (both being aspects of a reduced supply of nonborrowed reserves by the System) and the Federal funds rate tends to rise. Banks will also begin to undertake portfolio adjustments, such as selling Treasury bills, particularly if they think the tighter conditions are likely to persist; they will begin to alter offering rates on CD's and Euro-dollars; and they will begin to change loan terms and conditions. These changes soon begin to show up in the rate of growth of bank deposits and credit. For example, slower growth than otherwise in deposits may develop over a period of weeks as individual banks begin selling securities to the nonbank public as part of the adaptation to tighter money market conditions.

MONEY MARKET CONDITIONS IN RELATION TO OVER-ALL INTEREST RATES. While following a money market conditions target essentially has meant that the System would accommodate whatever market demands for money and deposits developed at a given Federal funds rate and bank net reserve position, this did not necessarily mean that the System could be construed as stabilizing interest rates other than the overnight money rate. Interest rates broadly conceived will probably tend to fluctuate less in the short run under an accommodative monetary policy than they might otherwise. But still there are likely to be rather wide swings, and also trend movements, in interest rates on obligations maturing in 2 or 3 months and longer as a result of shifts in credit demand or market expectations, if money market conditions remain unchanged. Experience in the latter half of 1969 is evidence in this respect, although the markedly slower rate of growth in the money supply that developed simultaneously would also be consistent with the hypothesis that an unwillingness on the part of the System to accommodate completely demands for money—however that unwillingness came about—was an important causative factor in the increase in interest rates.

A number of factors can account for the over-all variability in interest rates under an unchanged money market conditions target. One, of course, is expectations. An increase in inflationary anticipations, for example, will increase the interest rate premium demanded by investors and will make borrowers more willing to pay it. Similarly, an abatement of inflationary expectations will have the reverse effect.

Expectational effects on interest rates can also develop out of shifting attitudes with respect to fiscal and monetary policies. Anticipations of a fiscal surplus, and of course the actual development of one, may lead to declines in interest rates on both short- and long-term Treasury securities as dealers become more willing to position securities currently in anticipation of a relative scarcity of securities later or in recognition of a shortage in the process of developing.

Similarly, a pervasive attitude that the monetary authority may at some time in the future begin to ease money market conditions is likely to bring interest rates down currently as investors attempt to acquire large amounts of high-yielding securities. In the bill market, such a phenomenon may be associated with declines in both 3- and 6-month bill rates, but often a relatively greater decline develops in the 6-month bill rate—reflecting the greater likelihood that short-term rates will be lower in the longer-term future than over the very near term. Expectations of a tightening in money market conditions will have the reverse effect. But if expectations of a shift in money market conditions prove unfounded, interest rates are likely to revert to previous levels.

A more permanent effect on interest rates, however, can develop as money market conditions remain unchanged over a sustained period because of a cumulating tightness that develops on banks. For instance, if member bank borrowings from the Federal Reserve remain at, say, around $1 billion for a number of months, many banks will have sought funds at the discount window a number of times. Given the attitude of the Federal Reserve that such borrowing should be only occasional and primarily for unforeseen reserve adjustment contingencies, the reluctance of banks to borrow will tend to increase with the number of times they have previously borrowed. Thus, as a given degree of pressure on bank reserve positions is sustained, banks will increasingly sell Treasury bills, reduce purchases of municipal securities, and make other adjustments that reduce the likelihood of their having to come to the discount window. These adjustments will add to upward pressures on interest rates.

Such a process tends to be intensified in periods when Regulation Q ceilings are at unrealistically low levels and banks are forced to adjust portfolio policies and loan terms because of large losses of time deposits. Interest rates tend to rise under such circumstances partly because the banks appear to be more efficient investors than are the large number of individuals and corporations. But in addition, it is likely that the structure of interest rates may be affected—with long-term interest rates rising relative to short-term rates—as those withdrawing funds from banks, such as corporations, invest largely in short-term market instruments, while banks react not only by selling Treasury bills but also by reducing acquisitions of long-term State and local government securities and by stiffening lending terms, which may force some business borrowers into the open market, including the capital market, for funds.

Finally, over-all interest rates may vary, given money market conditions, along with changes in basic credit demands, which may reflect changes in the trend of GNP. A weakening of demands for bank credit will reduce the need for banks to undertake liquidity and portfolio adjustments and will contribute to a lowering of market interest rates in general. Changes in demands on bond markets—predicted in part on, say, changing needs to finance business capital outlays—will also affect long-term interest rates while money market conditions remain unchanged. However, in these, as in other instances of changing credit demands, the extent of the change in interest rates will be influenced by expectations and will also be limited by the accommodative posture of the Federal Reserve—that is, by the extent to which the Federal Reserves does or does not permit money market conditions to change.

In general, as credit demands weaken, the accommodative monetary policy at given money market conditions will be consistent with interest rate declines, but the extent of decline in the short run will be limited by System actions leading to unchanged, rather than to easing, day-to-day financing rates and member bank indebtedness at the Federal Reserve. Similarly, as credit demands strengthen, interest rates generally will rise, but the degree of rise in the short run will be limited by System actions maintaining day-to-day financing costs at previous levels rather than letting them rise and making it more expensive for dealers to underwrite the securities that are issued and more expensive for individual banks to accommodate loan demands through marginal borrowing in the Federal funds market.

EVALUATION OF THE NEED FOR A MONEY MARKET CONDITIONS GUIDE. One of the chief advantages of operating with money market conditions as a guide would appear to be the automatic seasonal adjustment that is provided for bank reserves and money. For instance, the drain on bank reserves from outflows of currency to the public around the Thanksgiving and Christmas holiday periods and the greater transactions need for demand deposits are not permitted to tighten the money markets, since the System provides offsetting reserves to the banks through open market operations. The resulting increase in the money supply, as it recurs regularly, would be represented as no more than seasonal in the money supply statistics. In addition, other temporary demands are provided for, even though they may not recur year after year and thereby qualify as seasonal demands. An example would be a one-time speed-up in corporate tax payments.

The desirability of stabilizing money market conditions in order to provide an automatic short-run accommodation to banks' changing demands for reserves may, of course, be open to question. One reason for operating in that way is that banks have not had automatic access to the discount window. If there were such access, and assuming that the discount rate were continuously in touch with market rates, member bank borrowings—rather than nonborrowed reserves—might be permitted to fluctuate for seasonal reasons. But apart from that possibility, the theory behind the directive has appeared to imply the desirability of providing seasonal and other temporary accommodation to the market on the grounds that the market cannot be completely relied on to arbitrage out, through the interest rate mechanism, the shifting seasonal demands for credit and money. It seems unlikely, for instance, that the market would fully anticipate tax-period needs for credit at times of seasonal slack and thereby avoid severe crunches in credit markets at tax dates. Of course, one might argue that the market's learning process is rapid and that it would not take more than one or two tax dates before the market did learn to borrow in advance, when short-term interest rates would be tending to be lower.

While there is something to be said for accommodating seasonal and temporary market demands in the System's day-to-day operations, there are also dangers. The chief danger is that if economic activity is advancing faster than expected, there is likely to develop over the short run a larger expansion of bank credit and money than is desired for seasonal, temporary, or longer-run growth reasons. On the other hand, if the economy is weakening, the System is likely to find itself in a position of absorbing more reserves over the short run than it may wish to when taking into account the sustainable growth needs of the economy.

This condition might be corrected, of course, either by strict adherence to the proviso (that is, by making it more of a target) or by adjusting the money market conditions target when the FOMC again meets. But in very weak or very strong economic situations, small adjustments in money market conditions—and experience shows that in the past the FOMC has moved in small steps with respect to money market conditions—may not be sufficient to achieve over-all financial conditions consistent with desired economic activity. A focus on money market conditions, therefore, and a concern with stability of money market conditions tend to limit the System's ability to control monetary aggregates and to effect the desired associated changes in over-all credit conditions and interest rates.

While money market conditions have generally been considered to be an operating and merely instrumental target, they have been moved infrequently enough and slowly enough that, for all practical purposes, they assumed the aspects of a goal of policy. The stability of the money market has clearly been a short-run goal, but often the desire not to have sharp shifts in money market conditions has appeared to be a longer-run goal, in that the System in the past has appeared reluctant to change money market conditions by more than small, gradual amounts. Such short-run and longer-run goals for the money market can often interfere with the attainment of the longer-run interest rate, bank credit, and money objectives of policy—all of which appear to be more closely related to economic activity than are money market conditions themselves.

It is not without reason that the System pays such close attention to the money market and its operations. Many of the reasons have been discussed earlier in this paper. In particular, the use of such a target for enabling the System to provide for the seasonal and temporary reserve needs of the economy has been noted. In addition, at least the theoretical consistency between money market conditions and longer-run policy goals will be sketched out in a subsequent discussion of how the System might attain credit conditions and monetary flows consistent with a desired GNP, while operating day to day on money market conditions, through an interlocking set of short- and long-run projections of financial and real flows.

But perhaps the chief reason why the FOMC has focused on the money market in its operations has been the feeling that such a focus would lead to less interest rate fluctuation and less danger of liquidity crises than would a focus on a monetary aggregate. The history of central banking, and particularly the genesis of the Federal Reserve System, has had as one of its main themes the need to have an institution that will be able to avert old-fashioned financial panics by providing a source of ultimate liquidity to the economy. Thus, the state of the central money market—where liquidity pressures focus—has historically been a main concern of the Federal Reserve. Perhaps partly explainable as an outgrowth of such a tradition, it would appear that the structure of the directive in the late 1960's, not to mention earlier years, was consistent with a belief by the FOMC that wide fluctuations in interest rates over the short run are more likely than short-run swings in the money supply or bank credit to cause destabilizing disturbances in the behavior of borrowers and lenders, who rely to a great extent on the interest rate structure as a source of information about current and prospective credit and possibly economic conditions.

The sharp rise in both short- and long-term interest rates over the latter half of 1969 certainly raised questions, however, as to how much stability in interest rates is produced by a focus on narrow money market conditions. Setting aside the question of whether one should stabilize interest rates at all in the short run, it might be pointed out that more stability could be introduced into the interest rate structure, if that were desirable, by encouraging offsetting fluctuations in the Federal funds rate. That is, a tendency for bill or other interest rates to rise could be offset by forcing the Federal funds rate down, and vice versa. This might be desirable, depending on economic prospects, but there is the danger that such a policy would simply increase the likelihood of providing reserves procyclically. For example, if people expected interest rates to rise, an effort by the System to lower the Federal funds rate and to provide more nonborrowed reserves in order to prevent such a rise would result in an even larger short-run rise in the money supply than would otherwise be the case. And this might over the longer run forestall a rise in market interest rates if the greater expansion in money should lead to inflationary expectations.

While changes in money market conditions to offset fluctuations in over-all interest rates are not desirable in a period when the economy is either strengthening undesirably or weakening undesirably, it may be desirable to permit money market conditions to move in such a way as to reinforce over-all interest rate movements. That is, the money market itself might be permitted to tighten as other interest rates rise, or to ease off as other interest rates decline. But if the money market is permitted to tighten sharply, there is a danger that the tightening might affect the solvency of dealers in securities who may have exposed positions and may rely on the money market for financing. Thus, an excessive tightening of the money market over the short run could lead to some failures of underwriters and to an associated weakening of confidence generally.

While there is reason for the System to assure a degree of stability in the money market, more fluctuation in money market conditions than has been permitted seems to have desirable aspects. An emphasis on money market conditions apparently leads many market participants to view a change in money market conditions as signaling a change in policy. If the money market were permitted to fluctuate more, this view might be eroded. To the extent that that happened, the System's flexibility in attaining targets for interest rates more generally, reserves, or other monetary aggregates would be enhanced.

A greater fluctuation in money market variables, once the market had become accustomed to such fluctuation, would not appear in and of itself to affect credit conditions that affect spending. As the Federal funds rate fluctuates up and down, banks are unlikely to change loan and investment policies, and dealers in securities are unlikely to become significantly more or less aggressive in bidding for a position in securities. But a clear trend in money market conditions toward either the tight or easy side would, as it has in the past, have an effect on over-all credit conditions.

If the money market were permitted to fluctuate more, this might make it possible for the System to carry out an open market policy with less short-run variability in the money supply, bank reserves, bank deposits, and possibly even interest rates generally. But whether it is better policy to minimize short-run variability in the money supply or short-run variability in money market conditions is a much debated question.

If the System were to move to a monetary aggregate target for the short run, the effect on money markets would depend on how the value of the aggregate was chosen. The System could choose, for example, to expand bank credit in accommodation of Treasury financing demands in a current month just as it would under a fixed money market conditions target. If the staff projected that bank credit would expand at a 15 per cent annual rate in a month with fixed money market conditions, given the Treasury financing and past seasonals, and the Committee accepted the 15 per cent as a suitable target for the month, then it is likely that money market conditions, assuming the staff is correct, would remain relatively stable within the month and would show little change from the previous month.

In practice, however, if an aggregate were taken as a primary target, the money market would be likely to fluctuate more than in the past because the Manager would have to move rapidly to attain the aggregate target if the projections appeared to be wrong. But an aggregate target over a 1-month period is not likely to be considered except as a part of a desired longer-term trend. And as it became clear to the market what the longer-term trend appeared to be, some of the short-run variation in money market conditions might tend to moderate as borrowers and lenders became more efficient in discounting the future.

POSSIBLE RELATIONSHIP BETWEEN THE STRUCTURE OF THE DIRECTIVE AND A THEORY OF MONETARY POLICY FORMULATION

The second paragraph of the directive is essentially an instruction to the Manager on how to operate in the open market during the interval between Committee meetings. In that sense the second paragraph need not be interpreted as representing monetary policy, if monetary policy as it influences financial markets is to be judged by such key variables as over-all credit conditions, interest rates, the availability of funds to the mortgage market, the money supply, and the liquidity positions of banks, other financial institutions, corporations, and individuals. All of these key financial variables can change while the operating phrases in the second paragraph of the directive remain unchanged, at least as the directive was structured in the latter part of the 1960's. It takes only a cursory reading of history to point out such periods, but the one that comes to mind most quickly is the period from the spring to the end of 1969, when there was a sharp tightening in what almost anyone would call monetary policy—whether judged by interest rates, money supply, or liquidity—without any accompanying change in the second paragraph of the directive.

Since money market conditions themselves are not a key variable affecting spending, the theory of using money market conditions, with a proviso clause, as day-to-day operating variables in the directive can be explained by noting one possibility of how the second paragraph of the directive of the late 1960's might relate to projections for key financial variables that affect the economy and to projections of economic activity itself. It should first be pointed out that the view of these interrelationships to be presented here represents a theory that it is not clear that all, or even most, members of the FOMC held, particularly as the theory pertains to the role of the proviso. Nevertheless, it is a theory that is generally consistent with the type of information presented by the staff to the FOMC, although as will be brought out in the concluding section of the paper, there are gaps between theory and practice. Some of these gaps may reflect the fact that the FOMC itself did not accept or did not follow the theory, and some may be because the detailed information and interrelationships required by the theory simply were not ascertainable with a reasonably small margin of uncertainty, given the state of economic knowledge.

FORMULATION OF LONGER-RUN PROJECTIONS. The staff ordinarily presents to the FOMC longer-term projections of developments in the economy, with certain assumptions as to monetary policy. These assumptions have been expressed in various ways at various times; for example, at times they have been expressed in terms of a particular bill rate, at other times in terms of a growth in bank credit, and at times in terms of growth in total reserves. Most frequently, perhaps, the policy assumptions are stated as a collection of financial flow and interest rate variables that are believed to be mutually consistent.[5]

Basic to the formulation and operations of monetary policy is a long-run forecast of how the economy is likely to develop over a period of, say, 1 year. For the purposes of this analysis, the techniques of such forecasts—the alternatives and problems of which have been under intensive debate among economists for some time now—will not be discussed. Within the structure of a long-run forecast of economic activity—meaning GNP in both real and nominal terms—there would be contained a time path of economic activity. The units of time could be as small as one would like, but the state of economic data and the art of forecasting suggest one quarter as a reasonably short division of time for projections of real economic activity and associated financial flows. While the quarterly pattern of projections within the context of a longer-run projection may be satisfactory for policy formulation by the FOMC, it seems clear that even shorter-run projections, at least of certain key financial variables, are needed for the operations of policy in the open market in order to verify that policy is on the track of the longer-run projection, assuming that attainment of the latter projection represents a goal of policy.

But before discussing the projections needed for day-to-day open market operations, it is necessary, first, to consider in a little detail the assumptions behind the longer-run forecast of real activity and financial flows, since this forecast is presumed to provide the ultimate guideline for operations. One basis for a longer-run forecast would be an assumption of no change in over-all credit conditions as currently prevailing, or changes in credit conditions could be posited if required to lead to a desired GNP. One reason for using an assumption about credit conditions is that most of the links thus far found between financial conditions and categories of spending appear to be from the credit side—interest rates and credit availability—rather than from the asset side—money supply and so forth. A forecast could also be constructed on the assumption of no change in the rate of money supply growth from, say, a growth of the previous several months on average. And, of course, assumptions about credit conditions imply a particular money supply growth, and vice versa. But for purposes of presenting a theory consistent with the directive of the late 1960's, it will be assumed that projections of GNP are based on credit market assumptions.

An assumption of unchanged credit conditions from those prevailing in the recent past might not be inconsistent with some fluctuation or movement of nominal interest rates, but it would not be consistent with such large variations as to change the willingness of borrowers to undertake credit-financed spending from what had been anticipated at the time of the forecast. Real economic activity also depends, of course, on past financial market conditions as they have come to influence spending in the quarters ahead. Finally, fiscal policy, wage and price pressures, and exogenous shocks to the system—such as technological changes, unforeseen defense emergencies, and sudden surges of consumer optimism or pessimism—all influence the forecast of economic activity.

For the forecast level of GNP to be realized, a certain pattern of financial flows would be required, given current and past credit conditions. This pattern would reflect the credit demands of businesses, individuals, the U.S. Treasury, and State and local governments. The financing of these demands, given a level and structure of interest rates, would imply a distribution of financial assets held by consumers and others that would in effect serve as a source of funds for the borrowers. Thus, the

[5] The following few paragraphs on the formulation of longer-run projections and their relation to operating guides are based for the most part on a paper, "Notes on Monetary Policy Formulation and Operations," written by the author for another occasion.

money supply, time deposits, savings and loan shares, and so forth fall out of the projection; and so does the need for aggregate bank reserves.

If the pattern of real economic activity in the projection is satisfactory to the monetary authority, then in view of how the projections were made, there will be no need for monetary policy to be changed—in the sense that there is no need for open market operations to be directed toward achieving firmer or easier over-all credit conditions. But that does not mean that there would be no short-run variations in rates of growth in bank reserves and the money supply, given the lumpiness of various types of demands from both the U.S. Government and businesses, as required to be consistent with the longer-run financial and credit flows necessary to achieve the desired level of growth of economic activity.

If some other pattern of change in real economic activity were desired by the FOMC, a consistent projection of real economic activity and financial flows could, of course, also be worked out, with the effects of past monetary policies imposing a restraint on how soon a more desired economic goal might be achieved or on how large a wrench might be required in the financial system to attain it.

ROLE OF MONEY MARKET CONDITIONS AND PROVISO IN RELATION TO LONGER-RUN PROJECTIONS. A structure of interest rates and pattern of financial flows consistent with the credit and money demands generated by the desired level of economic activity can be attained by using money market conditions as a day-to-day guide for open market operations as described in the earlier section of the paper, provided the relationship among money market conditions, financial and monetary flows, over-all credit conditions, and desired GNP can be reasonably well predicted. In this context, day-to-day open market operations conducted in terms of money market conditions can be said to be free of the sin of money market myopia. But they can only be said to be so if there is no hesitancy in resetting the money market conditions guide when it appears that over-all credit conditions are becoming tighter, or easier, than desired. What all this amounts to is that money market conditions have little meaning for policy in and of themselves and that they acquire meaning only as they lead to changes in financial variables that affect spending.

Needless to say, however, there can be many slippages between the specification of the set of money market conditions and the ensuing financial developments that more directly affect GNP (as well as reflect GNP), just as there can be large miscalculations as to the basic state of aggregate demands in the economy or of the degree of fiscal stimulus and restraint. Because of these slippages and because money market conditions in themselves do not include variables that directly affect spending, it would appear that such conditions would have to be varied frequently as errors in specification between money market conditions and variables that affect spending become apparent or as errors in projections of aggregate demand become apparent. In practice, therefore, one would on theoretical grounds expect rather frequent changes in both the directive and in projections.

One way of hedging against the possibility that given money market conditions are leading to a policy that condones undesirable economic developments is to make short-run forecasts for time units of less than one quarter—such as for the months within the quarter—for certain key banking and monetary variables, such as total reserves, nonborrowed reserves, money supply, and time deposits, that are immediately responsive to open market operations. In other words, money market condition targets can be set in the expectation that they will lead to a certain growth of bank credit, money, and reserves over a particular 1-month period, which represents an interval roughly reflective of the time between FOMC meetings. And the growth rate in such variables over that month—as well as the successive monthly projections

—would be consistent with the quarterly growth rates that are implicit in the credit conditions leading to the GNP forecast—provided all the elements were put together consistently, that is, with correct analysis of the relationships between real economic activity and credit conditions (taking due account of the distinction between nominal and real interest rates in judging the appropriateness of credit conditions), between credit conditions and the public's preferences for assets, and between financial flows this month and next month. That such relationships can be predicted with accuracy represents, of course, a very heroic assumption, but this paper is discussing theory as much as reality.

The proviso clause in the directives of the late 1960's can be interpreted as using total member bank deposits subject to reserves—called the bank credit proxy—as a variable for testing the consistency between money market conditions and projected developments in the real economy. If the successive weekly and monthly observations of this variable were rising faster than projected, the assumption would be that GNP was stronger than expected. If this variable were weaker than projected, the assumption would be that GNP was weaker.

On this theory that the proviso clause is the link between the day-to-day money market conditions target and the ultimate GNP goal, two principal criteria for the variable to be included in the proviso clause could be reasonably posited: one would be its responsiveness to GNP, and the other would be the ready availability of data on a daily basis so that they could be taken into account in the course of operations. Still another criterion might be the controllability of the variable through open market operations; but this criterion becomes more important to the degree that the proviso is considered more as a target to be attained rather than as an indicator of GNP trends. And the proviso may have certain target aspects because under particular conditions—such as inflation—the FOMC might wish to put more stress on attaining the specified aggregates if it felt relatively more uncertain about appropriate credit conditions because of inability to evaluate the impact of inflationary expectations on interest rates. The ambiguities in the concept of the proviso—whether it is a target or an indicator of whether GNP and associated credit demands are behaving as expected—are discussed in somewhat more detail later in this section.

Whether total member bank deposits meet the first criterion of being related to aggregate economic demands in a consistent manner is a testable proposition. On a priori grounds, one might think that the money supply would be a better variable in this respect, since the income elasticity of money probably dominates the interest rate elasticity of money. Total member bank deposits, on the other hand, include a time deposit component that is highly elastic with respect to interest rates and probably less elastic with respect to income.

In its short-run forecasts of total member bank deposits, the staff does attempt to estimate the extent to which time and savings deposits, as well as demand deposits, will be affected by the level of market interest rates expected to accompany a given level of money market conditions. Thus, an expected amount of so-called intermediation or disintermediation is included in the forecast. For purposes of the proviso clause, the assumption could then be made that if the projection of total member bank deposits is wrong, it is wrong not because of errors in forecasting intermediation or disintermediation, but because the assumption about aggregate demands is wrong. It is obvious, however, that the staff may also miscalculate the income elasticity of total member bank deposits, even if its forecast of GNP is correct.

The monthly projections of monetary aggregates provided to the FOMC may be thought of as the link between day-to-day money market conditions and real economic activity. This link depends on a degree of detailed knowledge about the functioning of the economy and about interrelationships between real and financial variables and among financial variables that is barely attainable by the human mind, and is certainly not at hand at the moment. Thus, at best, the directive may be said to have been working with a very imperfect mechanism, but a mechanism—that is, a proviso clause—which was probably better than no such mechanism at all, for it may give correct signals in periods when there are large deviations in GNP as compared with projections.

Before the problems of errors and uncertainties implicit in such a theory and practice of the directive are discussed in somewhat more detail, the ambiguities in the role of the proviso clause in practice need to be brought out. Many apparently have considered that the proviso clause represented a target for policy, not an indicator of whether money conditions were set in such a way as to achieve a desired GNP. Those who have considered the proviso as a target, therefore, have been concerned about whether it measures bank credit properly, if that is taken as a goal of policy. It may have been concern with the target aspect of the proviso that led the FOMC to add to total member bank deposits the funds obtained abroad through Euro-dollars and obtained domestically through nondeposit sources when specifying the ranges for the proviso. But if the proviso is taken purely in its indicator role—that is, its role as reflecting transactions or credit demands in the economy—it is not clear that it needs to be a comprehensive measure of bank credit. In this sense, the use of the term "bank credit proxy" may have led to considerably more conceptual confusion than is necessary.

The theoretical bases for considering the proviso clause as a target as compared with considering it as an indicator of whether the relationship between money market conditions and evolving GNP is about as expected would appear to be quite different. Taking it as a target, one would have to argue that the proviso clause should contain a flow variable readily controllable by the Federal Reserve and most likely to lead to desired GNP in the future, given the lags in monetary policy. Moreover, one would probably also have to argue that the proviso clause should be the principal operating instruction. However, taking the proviso clause as an indicator of GNP (not as an indicator of monetary policy in this context, it should be stressed), one might argue that it need only contain a flow variable that is highly income-sensitive and that is readily available. It is not immediately apparent that, insofar as monetary aggregates are concerned, a target variable and indicator-of-current-GNP variable need be one and the same, though this is an empirical question basically. But there does seem to be some uncertainty in the FOMC directive as to which type of variable has been sought.

ERRORS AND UNCERTAINTIES CONSIDERED. As the previous section has attempted to make clear, there is considerable scope for error in the relationship between the operating targets in the second paragraph of the directive and the ultimate goal of policy—a satisfactory performance of the economy in terms of activity, prices, and the balance of payments. Errors in projections of GNP and in prices, since they are given in framing monthly and quarterly financial projections, can obviously lead to errors in the directive variables given to the Manager. In addition, GNP might be correctly projected, but the staff might err in its evaluation of the relationship between current financial flows and the given GNP. Finally, there may simply be random variations, or noise, affecting monthly estimates of monetary flows. One result of random events or noise as a source of misestimation would be that, if money market conditions were given in the directive, bank credit might turn out to be stronger or weaker than projected, but still not be inconsistent with the desired GNP. Nevertheless, the deviation of bank credit from projections might trigger the proviso clause and set up a chain of events that would lead to an undesired GNP. The possibility of this sort of error is one of the reasons why the proviso clause was generally not triggered except in cases of large deviations from projections, and that when triggered, it led to only very minor changes in money market conditions.

There are potential sources of error that would affect operations, of course, regardless of whether the directive was couched in terms of some monetary aggregate rather than money market conditions, or whether the clauses in the directive were reversed—that is, with an aggregate in the principal clause and money market conditions in the proviso. But the sources of error might differ somewhat. With some sort of monetary aggregate target—such as the money supply—there would be some built-in protection against underevaluating the effect of inflationary expectations on nominal interest rates and thereby choosing a wrong interest rate target when using a market conditions guide. On the other hand, a money supply target might very well be set wrongly—say, too low—in relation to liquidity demands, with the result that credit conditions become too tight to achieve desired GNP.

In general, linkages between financial variables and economic activity, as well as among financial variables, including money market conditions, are—despite two decades of empirical research—still subject to considerable uncertainty. As a result, any form of directive by the FOMC is likely to involve the risk of error and thus of poor policy after the fact, though presumably economic research will lead us to a point where it will be possible to specify operating variables that at least minimize the potential deleterious effect on the economy of mistakes in projecting relationships among economic and financial variables. Whether such operating variables would encompass monetary aggregates, interest rates, or some combination of the two is not within the purview of this paper.

The potential sources of errors are the result of uncertainties as to linkages between and among financial and economic variables, as well as the unpredictability of exogenous shocks to the economy, such as wars, technological breakthroughs, and erratic changes in consumer buying sentiment. There is uncertainty as to which financial variables affect economic activity—for example, it is not clear whether or what type of rationing occurs in the economy when there is a shortage of credit relative to demand, or whether the balancing of demand and supply is accomplished completely through interest rates. It is not clear what the lags are between changes in financial variables and changes in economic activity. And it is not clear how strong a change in financial variables is required to obtain a given effect on economic activity—that is, whether the money supply should rise or fall 2 or 4 per cent, or whether interest rates should fall or rise 2 or 4 percentage points.

In addition to these uncertainties as to linkages, there are uncertainties as to how much variability should be permitted in key financial variables over the short run. One of the premises underlying the form of the FOMC directive in the latter part of the 1960's was that it is better to keep money market conditions stable over the short run, while permitting more short-run variability in such items as the money supply, longer-term interest rates, and even Treasury bill rates.

A decision to stabilize money market conditions would appear to assume that this will lead to fewer mistakes with respect to other financial variables that more directly affect the desired volume of economic activity than would a decision to stabilize a longer-run interest rate or a money supply variable itself. In other words, the directive of the late 1960's seemed to assume that the greater variability in member bank borrowings and the Federal funds rate that might result from specification of a money supply or total reserve target would be more harmful to the economy—given the prevailing state of uncertainty as to what should be the level, rate of change, and value of key financial variables—than would stability of money market conditions. The reason would have to be that a money market conditions target gives maximum scope for permitting market demands to determine financial flows and for permitting expectations to determine movements in interest rates away from the basic relationship to the Federal funds rate. These may be determinations that the FOMC felt it could not make directly, at least in the short run, because in the current state of knowledge it could not know the linkages; or because it believed that the demand for money is inherently unstable; or because, out of concern with the potential for liquidity crises, it placed higher value on money market stability in the short run than on predetermined levels or rates of change in other variables.

Perhaps at the risk of reading more into the framing of the directive than was in the minds of the framers, it would appear that uncertainties as to linkages between financial variables and economic activity, and uncertainties as to the ability to determine the short-run demand for money and bank reserves, were important factors behind the choice of money market conditions as the principal operating target. In addition, it is likely that money market conditions can be thought of as bearing a closer and more predictable relationship to over-all credit conditions and liquidity positions of banks and other key lending institutions. This may be a reason why those who adhere to a view that credit conditions—rather than changes in the public's holdings of financial assets, particularly money—determine spending may feel more comfortable with the money market conditions target. But for those who hold such a theory, it is difficult to understand why it would not be better to specify some particular interest rate, constellation of interest rates, or desired reduction or enhancement of liquidity for banks, as a target instead.

However that may be, the uncertainties faced by the policy-makers, together with the need to provide the Manager with an attainable target, provided them with a reason for adhering to money market conditions as a short-run operating guide for the System Account Manager, while at the same time keeping an eye on other financial variables that bear more direct relations to spending and to GNP in the formulation of policy.

MONEY MARKET CONDITIONS: POLICY TARGET ASPECTS. While the staff's presentations and projections of GNP and financial variables in both the short run and the long run do give members of the FOMC an idea of what is likely to happen to key variables under given money market conditions, there is still the danger that a directive couched primarily in terms of money market conditions will lead to unexpected and undesired changes in variables that are more directly reflective of the impact of monetary policy on GNP. This can happen not only because of errors in staff projections but also because money market conditions themselves can come to be taken as an objective of policy. Money market conditions can become an objective of policy partly because the need for a stable money market in the short run is overstressed. But it can happen in part because a continued stable money market comes to be viewed by the market as an objective of policy. When this occurs, the System often tends to get locked in, because it feels that any change in money market conditions will be interpreted as a change in policy and, therefore, lead to overreactions by market participants and others. This is particularly true in periods, such as 1969, when abatement of inflationary psychology appeared to be the ultimate aim of monetary policy. With that aim, there seemed to be the fear that any change in money market conditions would be interpreted itself as signaling a change in policy and thus would fuel inflationary psychology.

Whatever the relation in particular periods among money market conditions, over-all credit conditions, and the money supply, it does seem clear that concentration on money market conditions in the operating paragraph of the directive has led both the Committee and the market at times to interpret these conditions as policy itself. If an operating directive were phrased in terms of some monetary aggregate, or even in terms of over-all credit conditions, the Manager might have more difficulty in operating but there would tend to be less confusion between operating variables and the financial conditions that are the goals of policy. Such a directive might also lead to more fluctuation in money market conditions —but that would come to be considered normal. However, it is difficult to predict how money market conditions would react over the longer run to such a recasting of the directive, since the market itself might find ways of stabilizing itself as borrowers and lenders come to discount the future more accurately.

In sum, the second paragraph of the directive would appear to have had only a tenuous relationship to monetary policy as most economists perceive such policy. That relationship has depended on staff projections of the relationship between money market conditions and other financial variables. These projections are generally made known in summary form to the public when the policy records are released after a 3-month lag. Unless money market conditions themselves change, many in the market do not consider that monetary policy has changed, and it is not completely clear that this view has not also been held by many members of the FOMC.

The focus on money market conditions has in practice tended to prevent the Committee from adjusting these conditions rapidly. Changes in money market conditions, when they have been undertaken, have been undertaken gradually. Another reason for gradual changes, apart from concern with the money market as such, has been the uncertainty of the System as to effects of its actions or as to their desirability. This resulted in a directive that specified attainment of slight, modest, or moderate changes in money market conditions. But because of this unwillingness to move money market conditions rapidly at times, the System may also have been put in the posture of not being able to encourage so rapid an acceleration (or decelaration) in money supply growth or so large an easing (or tightening) of credit conditions as might be necessary to achieve its economic goals. Thus, there may have been a conflict between the attitude toward money market conditions and what is necessary to achieve changes in financial variables that more directly affect changes in the public's spending propensities.

RECAPITULATION AND CONCLUDING REMARKS

This paper has attempted to indicate how the construction of the second paragraph of the FOMC directive, as it was in the late 1960's, related to the flow of money and deposits and of interest rates broadly conceived in the practice of open market operations. It also attempted to present one theory—though admittedly one that might not be generally held or acted upon by the FOMC—as to how the money market conditions operating guide in the second paragraph, in conjunction with the proviso clause, could be fitted into a nexus of financial and nonfinancial projections of the economy and related to financial variables that more directly affect spending decisions. It was not the task of the paper to determine if another theory—for example, one that put more stress on monetary aggregates both in operations and in their role in economic forecasting —would improve the functioning and posture of monetary policy. But the paper has pointed out the great uncertainties present in the economic and financial relationships that would have to be projected both over short and over longer periods of time to satisfy the theoretical basis presented here for the FOMC directive of the late 1960's. Uncertainties, though perhaps of not exactly the same sort, would also plague other conceivable forms of a directive.

While the general problem would appear to be one of finding a form for the directive that would minimize the potential for errors in policy, it does not appear that the directive of the late 1960's, even on its own terms, quite lived up to the theory that has been constructed for it here. There were, in other words, gaps between theory and practice. Some of these gaps may have occurred because the theory required more knowledge or explanation than was, or conceivably could have been, produced; some, because the FOMC simply operated on another theory or theories; and some because money market conditions in practice took on aspects of a target role instead of playing only an instrumental role in policy.

The following points recapitulate the highlights of the paper and offer some conclusions:

1. Neither the first nor the second paragraph of the FOMC's directive to the Account Manager, nor the relation between the two paragraphs, has been completely understandable when the directive is considered by itself, or perhaps even when it is taken in conjunction with the simultaneously published policy record. It can be best understood as an aspect of the whole procedure at FOMC meetings, including the economic information and projections presented and the discussion of policy by the members of the FOMC as ultimately revealed in the minutes published for the meeting. Within this context a theory for the directive might be constructed, particularly a theory that relates the operating instructions of the second paragraph to the economic forecast and objectives that are noted, however vaguely, in the first paragraph.

2. One theory for using money market conditions—essentially the net free or net borrowed reserve position of member banks and the Federal funds rate—as a day-to-day operating guide for the Account Manager would be that such conditions bear a predictable relation to over-all credit conditions, that over-all credit conditions (including interest rate structure, bank liquidity, and so forth) can be set so as to influence economic activity in a desired direction or toward a desired level, and that the flow of bank reserves, bank credit, and money expected to result from the money market conditions and desired credit conditions will, perforce, be appropriate. Such a theory does not imply that monetary policy would stabilize either interest rates broadly conceived or a rate of change in some monetary aggregate. It does imply, however, that over the short run money demands would be accommodated at any given Federal funds rate, and to that extent policy operations would tend to moderate fluctuations in other interest rates, although such rates would still be affected by changes in expectations and shifts in credit demand.

3. Under such a theory, economic and associated financial projections are required for several quarters ahead, as are short-run projections—for, say, a month—of key monetary flows, such as bank credit and the money supply. The short-run projections can be used to indicate whether the money market conditions fixed for the interval between FOMC meetings are leading to the flows of bank credit and money that were projected over the longer run to be consistent with desired GNP, given credit conditions, and interest rates. To the degree that the short-run flows are showing changes greater or less than projected, the presumption is that GNP, or aggregate demand, is stronger or weaker than projected. In this view, the proviso clause in the second paragraph serves as an indicator of aggregate demand, which would suggest that the variable included in the clause should be one that is dominated more by income elasticity than by interest rate elasticity. This may be an argument for using money supply rather than bank credit, although the staff projection of bank credit would have already allowed for the interest elasticity of bank deposits, particularly time deposits.

4. There are many gaps between theory and practice. The most obvious is that even if such a theory provided a proper basis for policy, the requisite economic knowledge of interrelationships among financial variables and between financial variables and real economic activity might not exist to permit the attachment of a high degree of probability to the nec-

essary projections. It is probably recognition of the uncertainties about the state of economic knowledge—not to mention the sharp and unexplained swings noticeable in daily and week-to-week deposit and reserve data—that led the FOMC to require implementation of the proviso clause for the most part only when deviations from projections were "significant" and that led to only very minor variations in money market conditions when the proviso clause was implemented.

5. Another gap between theory, at least as presented here, and practice is that the proviso may have been considered to serve partially as a target for monetary policy rather than as an indicator of the relationship between money market conditions and GNP. Viewing the proviso clause as a target may help to explain why it focused on bank credit (which those who start from credit conditions may believe to be a reasonable short-run target related to spending)—without here discussing whether the change in bank credit was really a desirable flow target (as compared with other possibilities such as the change in aggregate reserves or money supply). But if the proviso were taken as a target, it does not appear to have been a very high-priority one, since experience shows that money market conditions were not varied rapidly enough or to the extent necessary to keep bank credit within proviso limitations when it tended to move significantly outside those limitations.

6. The desire of the FOMC to minimize short-term variability in money market conditions, as well as the relatively small changes in such conditions that were undertaken when the money market target was shifted, suggests that in themselves money market conditions were to some degree a target of policy, rather than being merely instrumental variables through which the interest rate and financial flow, and ultimately economic, objectives of policy are attained. While the relation between free reserves and over-all credit conditions might be predictable—at least judgmentally if not econometrically—experience, especially in 1969, appears to indicate that the relation is not consistent—that is, with fixed free reserves, credit conditions can and will change. Thus, minimizing fluctuations in money market conditions and changing such conditions only gradually over the longer run would represent yet another gap between theory as presented here and practice—unless, of course, the FOMC willingly accepts the changes in over-all credit conditions (not to mention inflows of monetary aggregates) that accompany an unchanged, or only gradually changing, level of free reserves.

7. As a short-run target, money market conditions have the advantage of permitting the market to make decisions about the appropriate short-run flows of bank credit and money. But as is well known, so accommodative a monetary policy might lead the System also to provide larger or smaller amounts of reserves, credit, and money than are consistent with desired economic objectives if credit demands turn out to be stronger or weaker than projected, or, expressed in another way, if bank's demand for free reserves turn out to be weaker or stronger than expected. The proviso, of course, has represented something of a hedge against such undesired short-run developments.

But if the economy weakens or strengthens considerably more than expected, the proviso is a weak hedge unless the FOMC is willing, either when it meets or in the interval between meetings, to move money market conditions, or permit them to be moved, rapidly enough to offset the changing impact on reserves of demand forces. For example, both the money supply and interest rates may be declining because demand is weakening; to turn the economy around under such circumstances may require a sharp easing of money market conditions (for example, a sharp short-run decline in member bank borrowings, assuming they are already high) if the Federal Reserve is to do more than merely permit a built-in flexibility of over-all interest rates to brake the decline in economic activity and is to encourage an expansion of economic activity, credit, and money.

8. The target aspect of money market conditions inhibits the flexibility of monetary policy when these aspects become so ingrained in market thinking that the System is reluctant to move for fear that any move will be overinterpreted. When combatting inflationary psychology is taken as a primary goal of policy, for instance, it becomes difficult to permit an easing in money market conditions because this might be taken as signaling an unwillingness of the System to persist in its efforts to reduce inflationary expectations.

9. The short-run stability of money market conditions and the gradualness of any longer-run change in money market conditions tempt one to the conclusion—be theory what it may—that a basic reason for couching the second paragraph in such terms was pragmatic. Given uncertainties as to the proper levels or changes in money supply, bank credit, or interest rates, money market conditions represented objectives that were readily attainable, that kept the scope for the Account Manager's judgment within reasonable bounds, and to which the Account Manager could be readily held accountable.

10. Within the context of the theory presented in this paper, or almost any other theory of how monetary policy works, it would appear desirable to permit more short-run variability in money market conditions and to move such conditions more rapidly or frequently over the longer run in carrying out open market operations. This would, at a minimum, reduce the market's focus on these conditions and thus increase the flexibility of the FOMC in attaining targets for reserve or monetary aggregates, if it so wished, or even in attaining credit condition objectives in relation to shifting demands and GNP by reinforcing, or offsetting, a tightening or an easing of trends in credit terms and conditions when it appeared desirable to do so.

11. There are probably some limits to the flexibility that could be permitted in money market conditions, although the degree of limitation is both a conjectural proposition and an empirical question on which precious little evidence is available. Such limitations would appear to apply more to the tightening side than to the easing side. When interest rates are rising, a considerable tightening of the money market might have undesirable repercussions on such sensitive market participants as securities dealers, who might be faced with the prospect of failures if carrying costs rose sharply relative to the return on their pre-existing security holdings, and might thereby lead to financial crises that would affect confidence generally. Even on the easing side, a sharp easing of money market conditions could lead to an overly large build-up in speculative positions in securities, which might force the System to provide more reserves and money than it would otherwise want to, or be faced with considerable market confusion and churning if the market were forced to liquidate these positions over the short run.

But in the absence of much recent experience with a monetary system in which relatively wide fluctuations in money market conditions were permitted,[6] it is obviously hard to tell how the market would react in such a different environment. If human nature is any guide, there will be periods of market problems, including undue speculation, no matter what the system by which monetary policy works. Some concern with money market conditions might reduce this problem, but the contribution of money market stability might not be commensurate with the key role of such conditions in the directives of the late 1960's and of earlier years, and with the System's apparent unwillingness to change such conditions except by small degrees.

12. Perhaps the chief general conclusion to be drawn from the rather lengthy analysis

[6] Very wide fluctuations may not develop if the market discounts the future properly.

of this paper is that a workable theory for the directive of the late 1960's might be constructed, but that in practice there are gaps—some of which may have been unavoidable given the state of economic knowledge—between theory and practice. Among the requirements for bridging theory and practice are a more certain knowledge of relations among financial variables and between these and economic activity, a sophisticated and consistent meshing of short- and long-run projections, and a willingness to reduce the target aspects of money market conditions and regard them solely as instrumental variables capable of short-run fluctuation and more rapid trend movement.

APPENDIX:
An Empirical View of "Even Keel"

The words "even keel" refer to the policy pursued by the Federal Reserve in relation to Treasury financings. In practical terms even keel has meant that, for a period encompassing the announcement and settlement dates of a large new security offering or refunding by the Treasury, the Federal Reserve has not made new monetary policy decisions (as contained in announcements from the Board of Governors or as specified in the second paragraph of the policy directives of the Federal Open Market Committee) that would impede the orderly marketing of Treasury securities and significantly increase risks of market disruption from sharp changes in market attitudes in the course of a financing.[1] Financial markets as a whole are highly sensitive to the reception of Treasury financings because of the sheer size of offerings, the involvement of the U.S. Government's credit, and the key role of the Government securities market in liquidity and portfolio adjustments of investors.

Even keel should be sharply distinguished from the old pre-1951 policy of pegging interest rates on U.S. Government securities. The even-keel policy does not provide any assurance that particular interest rates on new or outstanding Treasury issues will be maintained. Rather, the even-keel approach only helps to smooth the process of marketing several billion dollars of Treasury issues (even more in the case of advance or prerefundings). It provides those who help underwrite Treasury issues (such as banks and nonbank U.S. Government securities dealers) with a short period of time in which market forces rather than new monetary policy decisions are the main factors affecting interest rates. Those who make markets in U.S. Government securities are by no means assured of stable interest rates on the new issues, but they do have some time to contact customers with no more than a normal market risk on their temporary holdings of securities.

NOTE—The views expressed in this appendix do not necessarily represent those of the Federal Reserve System. Parts of this paper are drawn from a previously unpublished paper on the subject prepared by the author and Joseph E. Burns.

[1] Discussion of the even-keel policy has usually been focused on its relation to tightening actions. But in practice the policy also influences the timing of easing actions. For instance, a discount rate reduction in the middle of a Treasury financing period may be avoided because it might encourage undue speculative activity.

Because of the relatively limited nature of the Federal Reserve's even-keel commitment, the definition of the commitment in terms of financial variables is to a degree equivocal. The timing of even keel, the behavior of interest rates and other monetary variables, and the extent of Federal Reserve open market operations depend in large part on the type of market and market psychology that develops in anticipation or in the wake of the Treasury financing involved. The purpose of this paper is to review the behavior of key financial variables during the 3 years 1966–68 in an effort to determine how much variation or stability they show during even-keel periods in comparison with other periods.

This empirical approach is designed to shed some light on the variations in financial variables that have been tolerated under the constraint of even keel. But the results are necessarily limited by inability to quantify market attitudes, changes in which will influence the tolerance with which the market views differing degrees of variations in interest rates, reserves, and related measures. The results are also limited in part by the "crude" nature of the empirical analysis of the paper, which consists of charting time series for the relevant variables and of scanning these series for differences in behavior. While such an approach has obvious limitations, its advantage is that even-keel periods can be easily viewed in relation to longer-term trends and turning points in such trends. Moreover, fluctuations of a variable within an even-keel period are also discernible. And questions as to the exact dating of even-keel periods can be minimized since the charts would indicate the direction of change if 1 or 2 weeks were added to, or subtracted from, the beginning or end of even-keel periods.

THE TIMING OF EVEN KEEL AND TYPE OF TREASURY ISSUE. The policy directives of the Federal Open Market Committee provide a basis for dating even-keel periods and for relating them to the type of Treasury security offering. Such directives during even-keel periods would refer to Treasury financings as a factor to be taken into account in the conduct of open market operations. Generally the directive would also stipulate that operations should be directed to maintenance of prevailing money market conditions. But it is also possible that the operations could be directed toward tightening or easing. This could occur, for example, if the directive were written for a policy period that begins fairly well in advance of the anticipated Treasury financing announcement, thereby permitting some adjustment in policy prior to the financing period. Or this could occur to permit some shading toward restraint or ease depending on the developing market attitude toward the financing, including the speed with which the financing is distributed in the secondary market and the extent to which the market is tending to discount potential Federal Reserve action in advance.

The time span of, and money market stability during, even keel has varied in the past with the nature of the Treasury financing, with the market environment, and with the urgency behind the need for a monetary policy change. For purposes of this study, the interval from a week before the announcement of terms to a week after settlement date has been taken as the basic unit of time for an even-keel period, but shortened when necessary to be consistent with the dating of FOMC directives referring to Treasury financings. The various relevant dates that bear on even keel are shown in Table 1.

In practice, even keel might extend somewhat beyond 1 week after settlement date if an especially large volume of new securities were left overhanging the market, whereas if the new offering were small or well distributed even keel might end at settlement date. And the period might not begin until 2 or 3 days before announcement date, depending on market conditions as they affect the Treasury's ability to appraise pricing of the new issues. On balance, the basic unit of time for even keel in this study probably tends to err on the generous side.

Even keel has been applied quite consistently to coupon issue financings, which are generally large in size. A period of 2 to 3 weeks normally elapses between announcement of the offering and payment. The Treasury sets the price and coupon rate when the offering is announced; a few days later books are open and the public places its orders; and a week and a half or more passes before payment or settlement date on the new issue.

In contrast to offerings of coupon issues, the even-keel constraint has not been regularly a feature of FOMC directives around Treasury bill financing periods. When it has been, the period has generally been shorter than for coupon issues, although it has also overlapped a coupon issue period and thereby lengthened the time when even keel has been applied in consecutive weeks. Even keel has been noted in directives at times when bill issues for cash have been large and/or when short-term markets have been likely to be under particular strain. During the 3 years 1966–68, there were three instances in which the even-keel constraint was noted in the directive in relation to Treasury bill financings raising net new cash, out of 12 such financings in the period (other than simply additions to the regular weekly or monthly bill actions). The three financings varied between $3½ billion and $4½ billion in size.

There are a number of reasons for keeping the even-keel period short in relation to bill financings and for applying it less rigorously, if at all. First, the bill is auctioned, so there is less need to hold markets stable between announcement date and auction date; in a coupon financing, on the other hand, the new issue is priced by the Treasury at announcement in the expectation that market attitudes will not shift significantly in the interval (typically 5 days in recent financings) until the books are open. Second, the risk of price fluctuation to holders of bills, which ma-

TABLE 1: Treasury Financings During Even-Keel Periods

Dates related to even keel				Description of offering			
Directive date	Announcement date	Books opened	Settlement date	Type	Amount[1] (billions of dollars)	Maturity	Attrition or allotment ratio
				1966			
12/14/65 1/11	1/5	1/10	1/19	Cash	1.5	10 mo	.14(AL)
1/11 2/8	1/26	1/31–2/2	2/15	Rights (incl. pre-refunding)	13.7	18 mo 4 yr 9 mo	[2] 7.4/.17(AT)
4/12 5/10	4/27	5/2–5/4	5/15	Rights	2.5	18 mo	.46(AT)
7/26	7/27	8/1–8/3	8/15	Rights (incl. pre-refunding)	8.1	1 yr 4 yr 9 mo	[2] 4.3/.20(AT)
10/4 11/1	10/5	10/11	10/18	TA	3.5	185 day 247 day	—
11/1	10/27	11/1	11/15	Cash	3.2	1 yr 3 mo 5 yr	.30(AL) .10(AL)
				1967			
1/10 2/7	1/25	1/30	2/15	Cash	3.9	1 yr 3 mo 5 yr	.10(AL) .07(AL)
5/2	4/26	5/1–5/3	5/15	Rights (incl. pre-refunding)	9.1	1 yr 3 mo 5 yr	.19(AT)
6/20	6/28	7/5	7/11	TA	4.0	255 day 286 day	—
7/18	7/26	7/31	8/15	Cash	3.8	1 yr 3 mo	.35(AL)
8/15	8/17	8/22	8/30	Cash	2.6	3 yr 5½ mo	.38(AL)
10/3	9/22	10/3	10/9	TA	4.4	196 day 259 day	—
10/24	10/25	10/30	11/15	Cash	4.8	1 yr 3 mo 7 yr	.36(AL)
				1968			
2/6	1/31	2/5	2/15	Rights	12.0	7 yr	.28(AT)
	2/8	2/13	2/21	Cash	4.1	15 mo	.39(AL)
4/30	5/1	5/6	5/15	Rights	3.9	7 yr	.30(AT)
	5/1	5/8	5/15	Cash	3.2	15 mo	.28(AL)
7/16	7/31	8/5	8/15	Cash	5.1	6 yr	.18(AL)
10/8 10/29	10/23	10/28	11/15	Rights	5.5	18 mo 6 yr	.33(AT)

[1] Offered to the public.
[2] Amount exchanged in pre-refundings in billions of dollars.
AL allotment ratio; AT attrition ratio; TA tax anticipation bill.

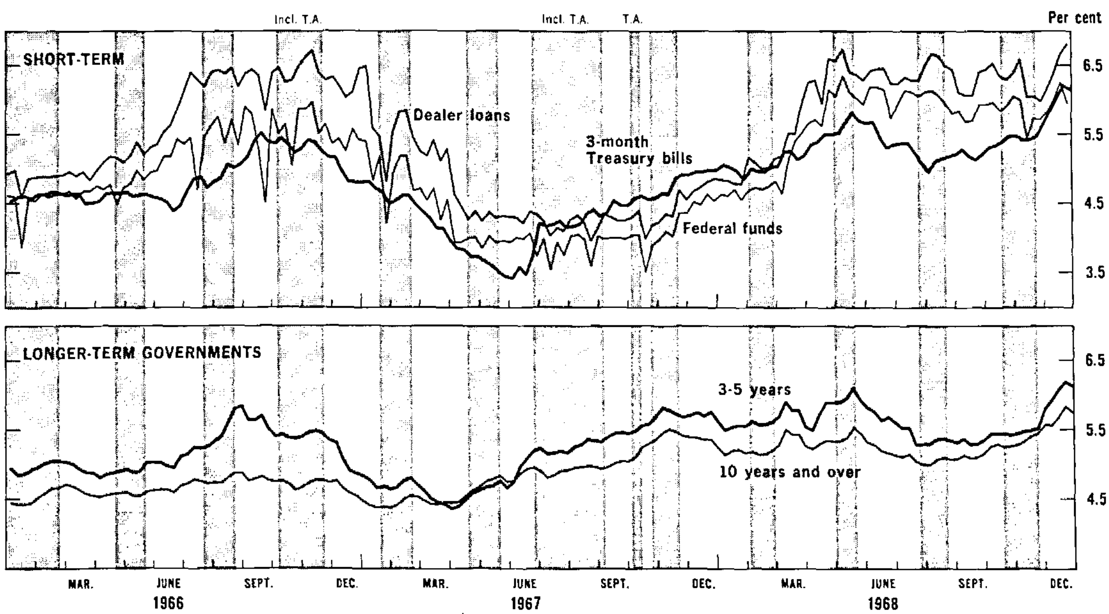
ture in a year or less, is smaller than to holders of intermediate-term or long-term coupon issues. And third, the time span between auction and payment for bills is generally about 1 week, while for coupon issues 10 to 14 days usually elapse between subscription and payment dates; this is a technical matter, but presumably it reflects the shorter period normally required to distribute a new bill issue as compared with a longer-term obligation.

EVEN KEEL AND INTEREST RATES. Interest rates have shown a relatively large amount of movement during even-keel periods. Movements of interest rates are shown in Chart 1, with even-keel time spans represented by the shaded areas. It is not without interest that the even-keel periods defined as noted above take up roughly 40 per cent of the 36 months shown. Normal quarterly refundings themselves would lead to even keel for about one-quarter of the year, with the actual result being a little more or a little less depending on market conditions and also the requirements of monetary policy. When the Treasury raises cash, or undertakes advance refundings outside the regular quarterly refunding period, monetary policy is affected at rather more frequent intervals.

Day-to-day money rates. Short- and long-term interest rates show different patterns of movement during even-keel periods and also differ in relation to their behavior outside such periods. Day-to-day rates, such as the Federal funds and dealer loan rates, sometimes fluctuate rather sharply within an even-keel period, just as they do in other periods. For instance, the Federal funds rate fluctuates in response to week-to-week shifts in the distribution of reserves between country and city banks. However, these rates generally do not show either an upward or downward trend in even-keel periods. Trend movements in such rates—that is, a clear upward or downward tendency persisting for some weeks—generally occur in the periods between even keel.

While an absence of trend movements in day-to-day money rates is a characteristic of even-keel periods, there have been a few exceptions during the period under review. In even-keel periods during the winter and spring of 1966, directives sought some reduction in reserve availability, while taking into account forthcoming or current Treasury financings. These directives covered the mid-February and mid-May refundings. Federal funds and dealer loan rates did not in any event show a rising trend in the first of these

FIGURE 1
INTEREST RATES



Shaded areas indicate periods of even keel. T.A. tax anticipation bill.

periods, but in the even-keel period covering from about the third week in April to the third week in May, an upward trend in Federal funds and dealer loan rates was in practice permitted to develop.

Because the April–May period illustrates a modest tightening of policy during even keel, it is worthwhile to note the results of the financing and market factors bearing on it. The financing involved was a $2.5 billion rights exchange (in terms of public holdings) involving an offering of a single 18-month note. The attrition rate for this offering was very large—46 per cent—the highest attrition rate by far in the period covered. Of course, April–May 1966 was a period of sharply rising loan demands in credit markets, so the unfavorable reception might be partly attributed to cash needs of commercial banks and other holders of the maturing issue. In addition, the market was disappointed at that time by a fading of hopes for a program for fiscal restraint. Finally, the offering was priced to have a yield advantage of 10 to 12 basis points over the outstanding market, which represents only a normal yield spread between new offerings and outstanding issues of a comparable maturity. All in all, there appear to be a variety of market factors accounting for the poor reception of the issue, but tightening of monetary policy, as expressed by money market conditions, and expectations of further tightening certainly contributed.

Bill rates. Treasury bill rates, as indicated by the yield on the 3-month bill, tend to display roughly the same kind of behavior—both in terms of fluctuation and trend—during an even-keel period as is characteristic of the span of surrounding weeks and months. In 1965, a year not shown on the chart, bill rates—not to mention other rates—showed little movement in or outside even-keel periods. In the 1966–68 period, however, bill rates moved relatively widely both in and outside even-keel periods.

As examples of cyclical-trend movements in bill rates in even-keel periods during the 1966–68 period, there were upward movements in the rate during the late July–late August 1966 period and in the May 1968 period; there were downward movements in the late January–late February 1967 period and in the late April–May 1967 period. It is likely that the more evident trend movement in the 3-month bill rate, as compared with day-to-day money rates, in even-keel periods reflects the role of expectations in determining interest rates. With a 3-month horizon, investors in 3-month bills are more likely to be influenced by what monetary policy—and also other factors such as debt management and business credit demands—may be expected to do in the period ahead. Consequently, even-keel policies would become correspondingly less important in influencing these interest rates during the weeks in which even keel is in effect.

Longer-term rates. Longer-term rates, as typified by the yields on 3- to 5-year Government securities and on such securities maturing in over 10 years, would also tend to be less influenced than day-to-day money rates by current monetary policy, and longer-term rates do show trend movements both in and outside even-keel periods. They have both risen and fallen in even-keel periods, the direction being generally consistent with the over-all tendency of surrounding periods. Rate movements appear to have generally been larger in magnitude outside even-keel periods, but this is by no means always the case.

For instance, there was a very sharp rise in the yield on intermediate-term Governments in the mid-July–late August period of 1966. This was a relatively large refunding, including a pre-refunding, that zeroed in on the intermediate-term coupon area. Moreover, the financing took place in a period when financial market pressures were building to a peak; and certain tightening monetary policy measures, including increases in reserve requirements announced in late June and mid-August, were put into effect quite close to the refunding period. With respect to open market operations, the FOMC directive on July 26 indicated an even-keel stance and no change in money market conditions.

While even keel was technically in effect in this financing, the sharp rise of interest rates in the maturity area containing one of the new issues offered in the refunding reflects the general expectation of the time that financial markets were facing a credit crunch. This expectation, in turn, was partly a reflection of the monetary policy actions that appeared to be in train before the even-keel period, and in prospect afterwards. Thus, a technical even-keel condition did not forestall a tightening of financial markets; nor was it accompanied, at that time, by any expansion in the monetary base (member bank reserve balances plus currency held by banks and the public), bank credit, or the money supply.

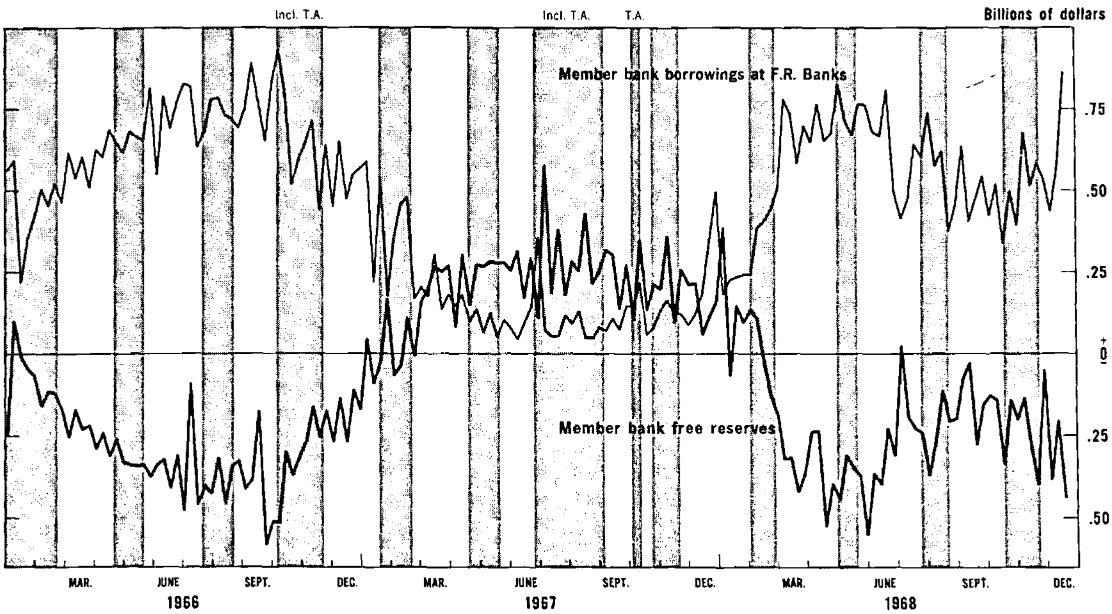
Sharp downward movements in longer-term interest rates began in the middle of the May 1968 even-keel period and continued until the August period. Brightening prospects for fiscal restraint legislation contributed to the turnaround. And the decline was sustained by an accommodative open market policy, as indicated by the mid-June and mid-July directives. These directives stipulated that open market operations should accommodate tendencies for short-term rates to decline (in mid-June) and for less firm money market conditions to develop (in mid-July). The mid-July directive took cognizance of the forthcoming August refunding in the operating paragraph. But the mid-June directive did not take note of an early July $4 billion tax bill financing, as the market atmosphere of the time clearly posed no marketing problem for even a very large bill financing for cash.

MARGINAL RESERVE MEASURES. Free reserves and member bank borrowings, shown in Chart 2, behave somewhat the same in even-keel periods as does the cost of 1-day money—that is, Federal funds and dealer loan rates. They tend to show less cyclical or trend movement than the 3-month bill rate and longer-term market rates in even-keel periods, but they do fluctuate widely and occasionally do move persistently in one direction.

Free reserves showed downward movements in the February and May 1966 periods, for example, when the FOMC was tightening in terms of reserve availability, while taking account of Treasury financing. On the other hand, free reserves rose, and member bank borrowings declined, in the even-keel period of October–November 1966, beginning the trend movement in those variables that lasted until the spring of 1967.

In 1968, net borrowed reserves deepened, and member bank borrowings rose, during the even-keel period in February. The FOMC directive of February 6, 1968, sought to maintain firm conditions in the money market, but permitted operations to be modified to the extent permitted by the Treasury financing if bank credit appeared to be expanding as rapidly as projected. The expansion of bank credit in that period apparently was sufficiently large to lead to some diminution in the extent to which reserves were supplied by open market operations (that is, through nonborrowed reserves) relative to demand.

FIGURE 2
MARGINAL RESERVE MEASURES



Shaded areas indicate periods of even keel. T.A. tax anticipation bill.

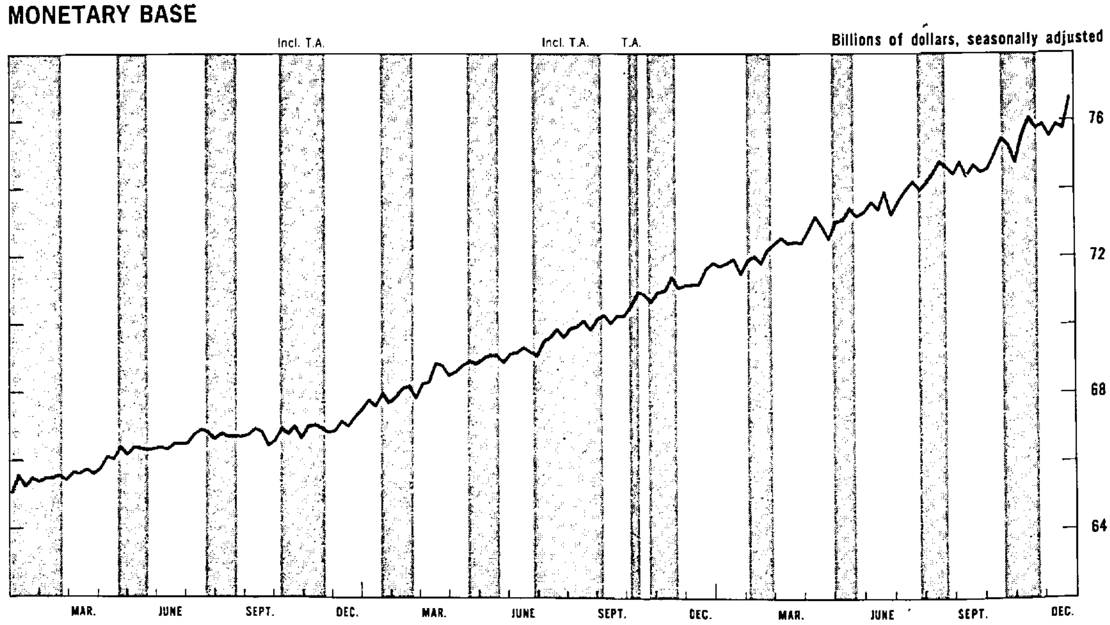
MONETARY AGGREGATES. The relation between even keel and monetary aggregates (monetary base, bank credit proxy, and money supply) is both highly complex and erratic. As shown in Chart 3, it is difficult to perceive significant differences in behavior of the monetary base in even-keel periods as compared with surrounding periods. In the summer and fall of 1966, the monetary base showed virtually no growth in or outside even-keel periods. Beginning in late 1966, the monetary base began to expand, and a more or less steady expansion persisted for the ensuing 2 years, with the rise in even-keel periods seemingly little different from the rise outside such periods.

It is true that in October of 1967 there was a relatively sharp increase in the monetary base during an even-keel period, as was also the case in November 1968. The October 1967 period comprises a $4½ billion tax offering. The relationship to even keel was less direct than with an ordinary even-keel constraint. The second paragraph of the directive of October 3, 1967, noted that operations should be directed to maintaining prevailing conditions in the money market with a proviso that operations should be modified to the extent permitted by Treasury financing to moderate any apparent tendency for bank credit to expand significantly more than currently expected. Apparently bank credit (as measured on a proxy basis weekly by total member bank deposits) did not rise significantly more than expected, although the increase in the period was quite sharp as shown in Chart 4. Growth of bank credit did slow in subsequent weeks.

While the monetary base appears to show relatively little difference in behavior in even-keel as compared with other periods, there are somewhat more frequent occurrences of differential behavior for bank credit and money supply measures (weekly figures on a daily-average basis).[2] The February 1968 coupon financing was an instance of accelerated bank credit growth in an even-keel period. This financing was a combination "rights" exchange and cash financing, with the cash part settled a week later than the exchange. About $4

[2] Technically, differences in behavior among bank credit, money supply, and the monetary base may be explained by changes in deposit mix or in deposit distribution between country and city banks. But the monetary base series comes from a source different from that for the credit and money supply series, and the seasonal factors could also be inconsistent.

FIGURE 3
MONETARY BASE



Monetary base: member bank deposits at Reserve Banks and currency held by banks and the nonbank public.
Shaded areas indicate periods of even keel. T.A. tax anticipation bill.

billion of new money was raised in the financing. The large net new cash demand made the financing similar in effect on bank credit to the tax bill financing noted above. There was, however, a contraction in outstanding bank credit for some weeks subsequent to the Treasury financing.

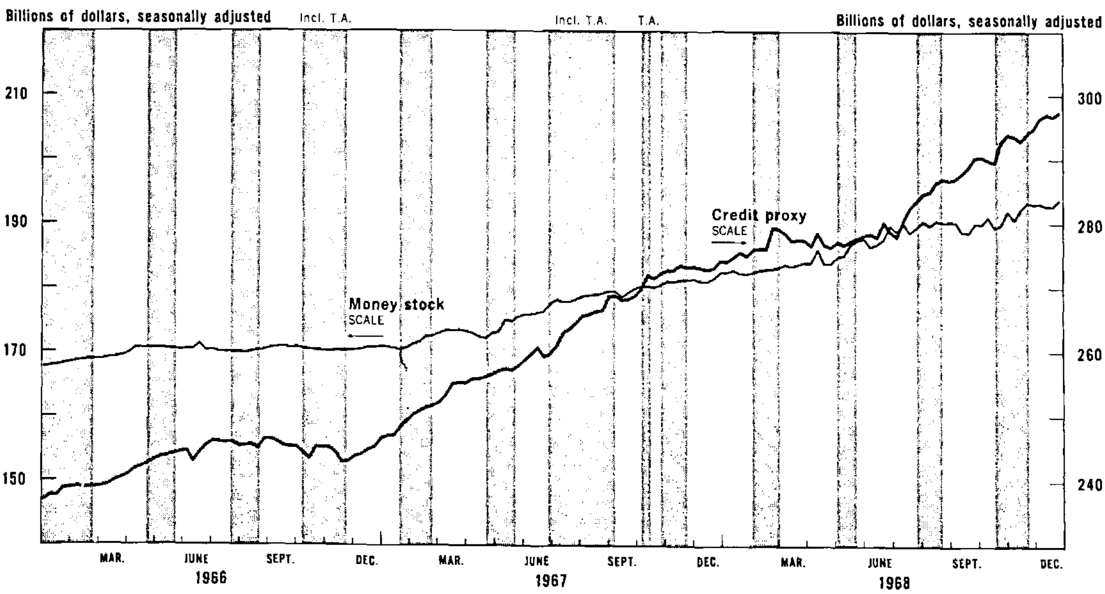
Bank credit also appeared to show an accelerated expansion in the October–November 1968 even-keel period. The mid-November financing did raise about $2 billion of new money. The accelerated rate of credit expansion continued into December, sustained by issuance of a $2 billion tax bill by the Treasury for payment in early December—a financing that was not even keeled in the sense of recognition in FOMC directives.

It would appear that even keel is often associated with accelerated bank credit expansion in periods when even keel is applied to financings that raise large amounts of net new cash and when at the same time market interest rates are low enough relative to Regulation Q ceilings that individual banks do not feel constrained in their ability to obtain time deposits and thus in their capacity to invest in U.S. Government securities as well as to make loans. In the long even-keel period in the summer of 1967, there was an accelerated bank credit expansion, which helped finance about $6½ billion of new cash raised by the Treasury ($4 billion in tax bills and the remainder in coupon issues). On the other hand, through the summer and early fall of 1966, bank credit showed no tendency to expand—even keel or not—despite about $8 billion of net new cash raised by the Treasury, practically all through new bill issues. In this period, banks were unable to compete effectively for time deposits.

The money supply, too, showed more rapid growth at times in even-keel periods than in surrounding periods. A number of periods where this seems the case may be cited—February 1967; May 1967; May 1968; and October–November 1968. It is not simple to develop an explanation for this phenomenon. One might hypothesize that the process of exchanging securities, or issuing new securities, at times leads to enlarged holdings of cash balances as investors prepare for and consummate payments—either cash payments directly to the Treasury, or payments to other investors and underwriters for buying "rights" or in secondary market distribution of the new issues. Some confirmation of that explanation might come from noting that money supply growth slowed or contracted following each of the even-keel periods noted above.

CONCLUSIONS. 1. Even keel has been applied consistently to coupon issue financings.

FIGURE 4
BANK CREDIT AND MONEY STOCK



Shaded areas indicate periods of even keel. T.A. tax anticipation bill.

With respect to bill financings, even keel has been applied in large financings, but only in certain market situations, and has been generally ignored in small financings.

2. There is nothing in the material analyzed to suggest that even keel is necessarily a fixed period or that it excludes some shading of policy toward restraint or ease.

3. Even keel has been consistent with varying movements of bank credit, money supply, and interest rates. If any variable were to be taken as an objective indicator of even keel, at least as it has unfolded in recent experience, one would select the cost of 1-day money, and assign marginal reserves to a secondary, but important, role. These are the variables most in the minds of market participants and also the ones that show the least trend movement during even-keel periods (after allowing for normal day-to-day or week-to-week fluctuations)—although even here market participants would tend to recognize that financing demands related to the distribution of newly offered Treasury securities would themselves tend to exert upward pressure on day-to-day money rates.

4. There have been fairly wide day-to-day fluctuations in money market variables during even-keel periods, and there have also even been some trend movements reflecting efforts by the FOMC to tighten or ease while taking account of Treasury financings. At times, this has been accomplished while not changing the attitudes of market participants because trend movements have been disguised for a few weeks by the large fluctuations that market participants are used to or because they have encompassed only a small portion of an even-keel period as defined for purposes of this analysis.

5. While the wide variations in behavior of the variables examined suggests that the even-keel commitment is flexible not only in terms of timing but also in terms of credit conditions, any sharp movements permitted in day-to-day money market conditions, or even under some circumstances in interest rates, are likely over the short run to risk an unsuccessful Treasury refunding in the sense of an unexpectedly large attrition or high allotment ratio.

6. Bill rates and intermediate- and long-term rates are influenced by changes in the supply of securities and by expectations as well as by monetary policy. Thus, it is not surprising that bill rates and other yields show movements independent of even keel. However, it may be that their movements during financings would be more exaggerated without the even-keel constraint. But whether the trend of interest rates over a relatively long period would be any different without even keel is quite another, and an unresolved, issue.

7. The behavior of monetary aggregates in even-keel periods has not been consistent. But when they have diverged from their behavior outside even-keel periods, it has been in the direction of relatively greater expansion, though often offset by slower growth or contraction in subsequent weeks. The relatively greater expansion, when it occurs, may not be a function of even keel, however. It may more basically be a function of the way monetary policy is conducted—with or without even keel. In general, monetary policy attempts to encourage credit conditions in the economy consistent with sustainable economic growth. The credit conditions sought by the Federal Reserve influence the interest rates the Treasury has to offer on its securities and the type of buyer—for example, bank or nonbank—attracted to these securities. Treasury credit demands, like such demands from businesses or consumers, tend to fall in part on banks, who may either buy Treasury securities or help finance those who do. And money supply may also expand as an aspect of the financing and distribution process. Thus, credit demands or refinancings by the U.S. Government at times have led to an accelerated expansion in bank credit or money. But the extent to which this occurs will be affected by the existing tautness or ease of credit markets as influenced by monetary policy; in 1966, for instance, net cash borrowing by the Treasury did not lead to expansion in bank credit or money. In any event, the significance of any accelerated expansion of monetary variables in even-keel periods—as in other periods—cannot be assessed without evaluating the credit conditions with which they are associated and the appropriateness of these conditions to the economic goals being sought.

by Richard G. Davis

SHORT-RUN TARGETS FOR OPEN MARKET OPERATIONS

CONTENTS

INTRODUCTION

This paper examines several types of targets that could be used by the Federal Open Market Committee to guide the actions of the Manager during the interval between meetings. The paper considers a number of different monetary, banking, and money market measures that might be used as target variables, as well as strategies that could be used to aim the variable chosen at the target value selected by the Committee.

The paper starts from the premise that whatever may be the ultimate goals of the FOMC and whatever criteria (or indicators) it may use to judge the impact of its decisions, the Committee must give instructions to the Manager to determine his actions between meetings. For various reasons, these instructions will not be couched in terms of goal variables such as the gross national product or the rate of change of the price deflator. These instructions may or may not be couched in terms of the same variables the Committee uses to measure the impact of its actions. For example, the Manager may be instructed to hold free reserves within a given range, making free reserves the target variable, and at the same time the Committee may use levels of free reserves to define degrees of policy tightness and ease. Thus the same variable, free reserves in this case, may serve both as "target" and as "indicator"—to use the Brunner-Meltzer terminology.[1] Alternatively, the instructions to the Manager might be couched in terms of free reserves, but the Committee might judge tightness and ease in terms of some other variable such as the monetary growth rate—that is, target and indicator may be distinct.

NOTE.—The author, who is Adviser to the Federal Reserve Bank of New York, is indebted to Paul Meek for many useful conversations on the subjects discussed in this paper. He would also like to thank Susan K. Skinner for excellent research assistance. The author assumes sole responsibility for the views expressed.

[1] See, for example, Karl Brunner and Allan Meltzer, "The Meaning of Monetary Indicators," in G. Horwich, ed., *Monetary Process and Policy* (Homewood, Ill.: R. D. Irwin, 1967), pp. 187–217.

In any case, the target variable or variables will almost certainly come out of a familiar, if rather long, list of banking and money market measures—free reserves, nonborrowed reserves, the money supply, and so forth. A target may take many forms. Thus, for example, it might be stated in terms of a single value, or in terms of a range of values. The target might be a single variable or it might be several variables—provided, of course, that the values or ranges chosen for these variables were compatible during the period in question. The primary target variable might be made subject to a side condition stated in terms of some other variable—as in the case of the so-called proviso clause.[2] The target might be stated in terms of an explicit or implicit weighted average of several variables. For example, the famous notion of money market "tone" as a target may be thought of as a weighted average of several measures of marginal reserves and money market rates—with the weights left unquantified, though hopefully reasonably well understood in any given historical situation.

Much of the attention of this paper is devoted to ways in which the so-called "aggregative" or "quantity" variables (such as money supply and bank credit) could be used as targets, the accuracy with which such targets could be hit, the cost of aiming at such targets in terms of money market stability, and the ways in which the use of such targets could be reconciled with an acceptable minimum of market stability. These subjects have been chosen for the major share of attention because they seem to be the ones of greatest interest at the moment.

On the other hand, relatively little is said about money market targets as such. Experience has already taught us much about such targets and there seems little new to be added in a general way. Another subject that is treated only tangentially is the relative merits as between different quantity (or aggrega-

[2] For a discussion of the proviso clause see pp. 64–65.

tive) targets: Is M_1 a better target than M_2? Is M_2 a better target than bank credit? Most of the interesting problems that arise in trying to answer such questions turn out really to be questions as to which variable is the more economically meaningful, which variable is the better measure of the impact of the System on the economy, and which variable better characterizes the tightness or ease of policy. Since the paper is concerned only with the "target" properties of these variables as such, questions of this kind are considered off limits.

While the paper makes no attempt to come up with a specific recommendation from among the various possible targets, the writer should perhaps admit to a feeling that for various reasons, the System is likely in the future to judge its performance more on the behavior of quantities—monetary and bank credit growth rates—than it has in the past and less on the basis of money market conditions. By the same token, the degree of control provided over some of these quantitative growth rates seems likely to become a more weighty consideration in the choice of FOMC procedures in the future than it has been in the past—even if this means some reduction in the ability to stabilize money market conditions.

The format of the paper is as follows: The first section looks at the various possible targets from the point of view of the noncontrolled variables that must be offset to hit these targets. Out of this analysis it picks the variables that appear to be operationally feasible as week-to-week objectives. The second section considers the main elements of multiweek strategies, strategies through which targets not feasible as week-to-week objectives may nevertheless be hit over the longer period between FOMC meetings. The third section considers ways in which targeted values of such multiweek targets (for example, the monetary growth rate) might be translated into appropriate average weekly values of the variables used as week-by-week targets (such as nonborrowed or free reserves). In addition, this section attempts to provide some assessment of the accuracy with which variables such as the monetary or bank credit growth rates could be manipulated over periods as short as a month or a quarter if such manipulation became the deliberate and sole objective of open market operations.

The fourth section tries to determine how much buffeting the money market might suffer if the use of money market targets were replaced by procedures that aimed directly at the monetary aggregates without special regard for their market consequences. The fifth section offers some "mixed" strategies through which control over monetary aggregates might be blended with concern for a reasonable degree of money market stability. The final section offers some brief general comments on the results of the paper.

For convenience, a list of the variables considered singly or in combination as possible targets, and the symbols used to represent them, follows:

R_u	Member bank nonborrowed reserves
R_t	Member bank total reserves
R_e	Member bank excess reserves
R_b	Member bank borrowed reserves
R_f	Member bank free reserves
R_r	Member bank required reserves
B_u	Nonborrowed monetary base
B_t	Total monetary base
C	Currency in hands of nonbank public
D_p	Private demand deposits adjusted
D_t	Treasury deposits
M_1	Private demand deposits adjusted plus currency
M_2	Private deposits adjusted plus currency
BC	Total bank credit
FR	Bank credit proxy (variously defined)
r_{ff}	Federal funds rate
r_d	Discount rate
r_b	Treasury bill rate

OFFSETTING ACTIONS NEEDED TO HIT TARGET VARIABLES AT THE DESIRED LEVELS

The only variable under the complete and direct control of the Open Market Account Manager is the size and composition of the Account's portfolio. Nevertheless, for obvious reasons, the portfolio has in recent times seldom if ever been suggested as a target variable. Thus every variable that *has* been suggested is determined in part by actions not under the direct control of the Manager. Some of these actions are taken by the Treasury, some by the banks, some by the public, and some, even, are Acts of God! Thus the first question in determining the feasibility of hitting any particular target variable is: "What noncontrolled items are involved?" Since hitting the target means adjusting the portfolio to offset the effects of these noncontrolled items on the target variable, the next consideration may well prove to be: "How well can the movements in the noncontrolled items be predicted?" or alternatively, "Can the movements of the noncontrolled items be known soon enough so that the appropriate offsetting actions can be carried out during the time period —day, week, or month—during which the target variable is to be hit?"

A CLASSIFICATION SCHEME FOR TARGETS IN TERMS OF NEEDED OFFSETTING ACTIONS. Table 1 summarizes the noncontrolled items that must be offset to fix the target variable listed in the left-hand column at whatever level or range has been specified by the Committee. The targets listed have been divided into four groups, A, B, C, and D, according to the different sorts of problems involved in hitting specific values of each target within a given reserve-averaging period—that is, one week.

TARGETS IN GROUP "A." The first group of items, the A group, is the easiest to hit. The noncontrolled factors that must be offset to hit targets in this group are entirely exogenous with respect to open market operations. Hence there will be no feedbacks, no "simultaneity problem" involved. The first two items, nonborrowed reserves and the nonborrowed monetary base, can be hit on a weekly basis with as much (but no more) accuracy as the noncontrolled operating transactions, such as float, can be forecast. The second two targets, nonborrowed reserves less reserves required behind Treasury deposits and the nonborrowed base less such required reserves, obviously require, in addition to the operating transactions, correct forecasting of the behavior of Treasury deposits at commercial banks.

TABLE 1: Target Variables and Noncontrolled Items to be Offset

Target	Operating transactions	Excess reserves	Borrowed reserves	Total required reserves	Member bank reserves required against— Time	Treasury	Private demand	Net interbank	Demand deposits at nonmember banks	Time deposits at nonmember banks	Market demands for various instruments
A R_u	X										
A B_u	X										
A R_u-R^r Treas.	X					X					
A B_u-R^r Treas.	X					X					
A R^f	X			X							
B R_b	X	X		X							
B R^t	X		X								
B B^t	X		X								
B R^t-R^r Treas.	X		X			X					
B B^t-R^r Treas.	X		X			X					
C M_1	X	X	X		X	X		X	X		
C M_2	X	X	X		X	X	X	X	X	X	
C Proxy	X	X	X		X	X	X	X			
D r^{ff}											X
D r_b											X

Free reserves, the final item in the A group, require the offsetting of both operating transactions and changes in required reserves. Since the advent of lagged reserve accounting, however, required reserves are known at the beginning of each week and hence present no additional forecasting problem.

Prior to lagged reserve accounting, of course, required reserves were not strictly predetermined. However, the working assumption of the System seems to have been that required reserves were, in fact, largely independent of the level of nonborrowed reserves in the same week. Put differently, the banking system's purchase of assets was assumed to be rather unresponsive to the state of money market conditions within the same week. Under the circumstances, required reserves would have been determined largely by conditions in previous weeks and therefore would have been essentially exogenous insofar as the current week was concerned. Hence, to the extent that this is true, the introduction of lagged reserve accounting has not changed the situation in any fundamental way, although it has reduced the number of exogenous variables that the System must *forecast* in any given week.

TARGETS IN GROUP "B." Success in hitting targeted values of variables in the B group involves offsetting items whose movements are themselves functionally related to the volume of open market operations undertaken within any given week. As a result, attempts to aim directly at variables in the B group require not only projections of exogenous movements in operating transactions but also some attempt to estimate the feedback effects of open market transactions on other variables entering into the target. For the variables included in the B group, the crux of the feedback problem lies in the long-observed interdependence between the volume of nonborrowed reserves supplied through open market operations and the volume of borrowed reserves supplied through the discount window.

To analyze the problem and the possibilities for hitting targets in the B group, it is useful to analyze the market for reserves as that market exists within a given reserve-averaging period. In the general case, it can be assumed that bank demands for both borrowed and excess reserves are interest rate sensitive—perhaps the Federal funds rate is especially relevant. Required reserves are predetermined by lagged reserve accounting as noted. Nonborrowed reserves are an exogenous variable, being determined by market factors and System operations. In the linear case, the system of equations describing the reserve market is therefore simply as follows (ignoring constant terms):

$$(1) \qquad R_b = a(r_{ff}) + e_b$$

$$(2) \qquad R_e = b(r_{ff}) + e_e$$

$$(3) \qquad R_t \equiv R_b + R_u$$

$$(4) \qquad R_t \equiv R_e + R_r$$

where e_b and e_e are random variables representing the random components of the demands for borrowed and excess reserves, respectively.

If the System supplies reserves, its actions will tend to raise nonborrowed reserves and lower interest rates. Excess reserves will tend to rise and borrowed reserves will tend to fall. The Trading Desk can predict the effects of its actions on these magnitudes and on total reserves only if it has some notions about the elasticities of demand for borrowed and excess reserves—in addition, of course, to predictions about the behavior of operating factors.

Some features of the situation are brought out more clearly by solving equations 1 to 4 for the reduced form equation for total reserves.

$$(5) \qquad R_t = \frac{b}{b-a}(R_u) - \frac{a}{b-a}(R_r) + \frac{b}{b-a}e_b - \frac{a}{b-a}(e_e).$$

As the equation indicates, errors in predicting operating factors and stochastic elements in the demands for excess and borrowed reserves would remain as sources of error even if the

Desk knew the elasticities of demand for excess and borrowed reserves. Since a, the interest rate coefficient of the demand for borrowed reserves, is equal to or greater than zero, and since b, the interest rate coefficient of the demand for excess reserves, is equal to or less than zero, $b/(b - a)$, the response of total reserves to an increase in nonborrowed reserves, will be nonnegative.

However, the response of total reserves in a given statement week to an injection of nonborrowed reserves in the same statement week may approach zero under two circumstances. First, it will approach zero for very large values of a—that is, when demands for borrowed reserves are very sensitive to the interest rate effects induced by increases or decreases in nonborrowed reserves. In the limit, an increase in nonborrowed reserves will be exactly offset by the repayment of borrowings without any perceptible fall in interest rates. Thus in this case, an increase in nonborrowed reserves has no effect on total reserves until the point is reached where borrowings are reduced to zero. Further increases in nonborrowed reserves beyond this point, however, increase total reserves by the same amount, with the interest rate falling enough to absorb the entire increase into excess reserves.

Second, $b/(b - a)$ will approach zero as b approaches zero—that is, when demands for excess reserves are very *in*sensitive to interest rates. In the limit, the demand for excess reserves reduces to a random variable (presumably with positive mean), and the reduced form equation 5 for total reserves becomes

$$R_t = R_r + e_e \tag{5a}$$

In this case, as in the first case, an increase in nonborrowed reserves will, in general, have no effect on total reserves within the same statement week. An increase in nonborrowed reserves tends to push down interest rates. But since, by assumption, this fall in rates produces no rise in the demand for excess reserves, the fall in rates must proceed far enough to induce banks to repay borrowed reserves by the full amount of the increase in nonborrowed reserves. (As in the first case, this process is obviously limited by the fact that borrowings cannot fall below zero.)

How likely is it that one or the other of these two extreme cases will prevail and that, as a result, the Desk will have little or no influence on total reserves within a given statement week by its actions within that week? The first possibility, in which the elasticity of demand for borrowed reserves approaches infinity, can be ruled out. Indeed, all of the argument has been over whether borrowings show *any* substantial responsiveness to interest rates. The second case, however, in which the interest elasticity of the demand for excess reserves approaches zero, seems to have some real significance. Market experts apparently believe, for example, that when excess reserves are down to virtually frictional levels, as at present (fall 1969), demands for excess reserves may be quite insensitive to rate fluctuations within the normal range, so that week-to-week fluctuations in excess reserves have to be treated as essentially random.

The following example (summarized in Table 2) was suggested by one market observer. Suppose, as at the present writing, that net borrowed reserves are around \$1.0 billion in a given week. Suppose that in the following week required reserves rise by \$200 million. If the System supplies \$200 million in nonborrowed reserves, free reserves will obviously remain unchanged. Abstracting from random shifts in the demand for excess and borrowed reserves, the Federal funds rate would also be unchanged, as would both excess and borrowed reserves. Total reserves would rise by the \$200 million increase in nonborrowed

TABLE 2: Example of Change in Reserves—Tabular Summary (where $b/(b - a) = 0.2$)

Example number	Assumed change: Required reserves	Assumed change: Nonborrowed reserves	Resulting change: Excess reserves	Resulting change: Borrowed reserves	Resulting change: Free reserves	Resulting change: Total reserves
1......	+200	+200	0	0	0	+200
2......	+200	+100	−20	+80	−100	+180

(and required) reserves. Now if, on the other hand, the System were to supply only \$100 million in nonborrowed reserves, this market observer felt that borrowed reserves might rise by about \$80 million instead of remaining unchanged, and that excess reserves might fall by about \$20 million instead of remaining unchanged. In effect, this observer is estimating that $b/(b-a)$ is only about 0.2, owing to a very low elasticity of demand for excess reserves. If this estimate is correct, a \$100 million reduction in the rate at which the System supplies nonborrowed reserves produces only a \$20 million reduction in the rate at which total reserves grow.

Certainly a value of 0.2 for $b/(b-a)$ is by no means the same as a zero value, and it by no means implies a complete inability to influence total reserves within the statement week. It may be low enough, however, to reduce greatly the practical ability of the Desk to control total reserves on a week-by-week basis. Thus a \$100 million cutback in the rate at which nonborrowed reserves are supplied might have a significant influence on the Federal funds rate while reducing excess (and total) reserves by only \$20 million, a very small effect relative to the random component of week-to-week fluctuations in excess reserves. The implication of these estimates, if correct, is that the Desk might be able to exert a clear and substantial influence over total reserves within the statement week only, if at all, by inducing rather violent fluctuations in borrowings and in the Federal funds rate. Moreover, attempts to hold the growth of total reserves *below* the predetermined rate of growth in required reserves very quickly run into the absolute limitation that excess reserves cannot be negative.

TARGETS IN GROUPS "C" AND "D." The variables in group C present problems similar to those in B. In principle, however, the problems are more severe because a larger number of functional interdependencies are involved. For example, direct aim at the narrow money supply on a week-by-week basis would require not only predictions of operating factors and knowledge of the demand schedules of excess and borrowed reserves, but also knowledge of the demand schedules for all the major deposit liabilities as well—obviously an impractical requirement. From this point of view M_1, M_2, the proxy, and bank credit are on a par since they all require knowledge of the same relationships—though arranged in different ways.

Finally, the group D variables—the money market rates—present a different kind of problem considered as week-by-week target variables. In principle, their successful use as targets would require a complete model of the money market. In practice, however, a tolerable accuracy can be achieved by taking advantage of the reasonably close relationship between money market rates and free reserves and borrowings. Thus the general strategy for a given week could be laid out by the level of free reserves thought to be compatible with the targeted level of, say, the Federal funds rate. Specific daily adjustments in this general strategy could then be made in response to the emergence of rates in the market that deviates from targeted values.

SUMMARY. The results of this survey of targets can be summarized as follows: The variables in the A group—nonborrowed reserves, the nonborrowed base, these two variables less reserves required behind Treasury deposits, and free reserves—can all be used as weekly targets subject only to errors in predicting operating transactions and, where relevant, required reserves behind Treasury deposits. Variables in the B group—borrowings, total reserves, the total base, and these last two items less required reserves behind Treasury deposits—can theoretically be used as weekly targets provided the Desk has at least some crude knowledge of the interest rate elasticities of demand for excess and borrowed reserves (that is, $b/(b-a)$). As with the A group, errors in hitting targets in the B group will be subject to errors in hitting operating transactions and also to errors in estimating the demand elasticities of excess and borrowed reserves and/or stochastic shifts in the demand schedules for these quantities. Since it is difficult to imagine why errors in hitting operating factors should be systematically offset by errors in judging the demands for excess and borrowed reserves, variables in the B group will be significantly harder to hit on a week-by-week basis than variables in the A group. Moreover, under certain assumptions about the demand elasticities of excess and borrowed reserves, targets in the B group, such as total reserves, may not be feasible *at all* as weekly targets. Thus it is often argued that the interest elasticity of demand for excess reserves is so low under present conditions that the Desk's operations within a week have only a marginal influence on total reserves within that week—at least within tolerable limits of interest rate fluctuations—and that actual control would not be possible. Variables in the C group, such as the money supply and bank credit, could be aimed at directly on a week-by-week basis only with presently unavailable knowledge of numerous demand and supply schedules. The D group variables, including money market rate targets, present much greater problems in theory, as noted, than they do in practice when considered as weekly targets.

The difficulty, and perhaps the impossibility, under present conditions of aiming directly at total reserves, the total base, and the various money and credit variables on a weekly basis does not mean that these variables cannot be used as targets to be approached indirectly over somewhat longer periods. It does, however, mean that week-by-week targets must be chosen from among those variables that can be used for this purpose, with the weekly setting of these targets picked according to some strategy designed to hit the basic target variable on the average over some longer period. Since, as indicated in the introduction, the "target problem" is the problem of the instructions to be given to the Manager by the Committee, the logical period in this context appears to be the period between FOMC meetings, presumably about a month. The next section considers the rough outlines of a multiweek control strategy for hitting target variables not suitable for use on a week-by-week basis.

MULTIWEEK STRATEGIES FOR HITTING PARTLY ENDOGENOUS TARGETS

If System actions to fix nonborrowed or free reserves within a given week have only a small influence on the behavior of variables such as the money supply or bank credit within that week relative to random or otherwise hard-to-predict influences, these variables cannot be used as operationally meaningful targets governing Desk decisions on a week-by-week basis. To put it more concretely, the decision to increase nonborrowed reserves by $50 million in a particular week, given a forecast of operating factors, implies a concrete decision about open market operations. The injunction to increase the money supply by $50 million in a particular week, by contrast, is probably almost empty of concrete implications for open market operations given the state of our knowledge at present and for the foreseeable future. Nevertheless, while variables in the C group such as the money supply (and probably variables in the B group such as total reserves) are not controllable on a week-by-week basis and are therefore not suitable as week-by-week targets, it is clear that the weekly settings of targets in the A group, such as nonborrowed and free reserves, do influence the behavior of the broader variables over the somewhat longer run.

The question arises as to what kinds of strategies are available for using this influence to hit targets that are not under the direct control of the Desk over the longer period of about a month between FOMC meetings by setting week-by-week targets for variables that can be directly hit—subject only to errors in offsetting operating transactions and other purely stochastic matters. Any strategy would appear to consist of three basic elements: (1) the choice of a weekly target; (2) a procedure for translating the value of the monthly target into week-by-week values of the weekly target; and (3) a set of rules for responding to "misses" within the period between FOMC meetings. (Presumably responses in subsequent periods to misses over the entire period are a matter for the FOMC to decide at its meeting and therefore beyond the scope of this paper.) Assume that the FOMC issues its instructions in terms of a desired seasonally adjusted growth rate over the month for one of the broader magnitudes such as the money supply. This of course can immediately be translated into a seasonally *un*adjusted level of the monthly target for the month in question.

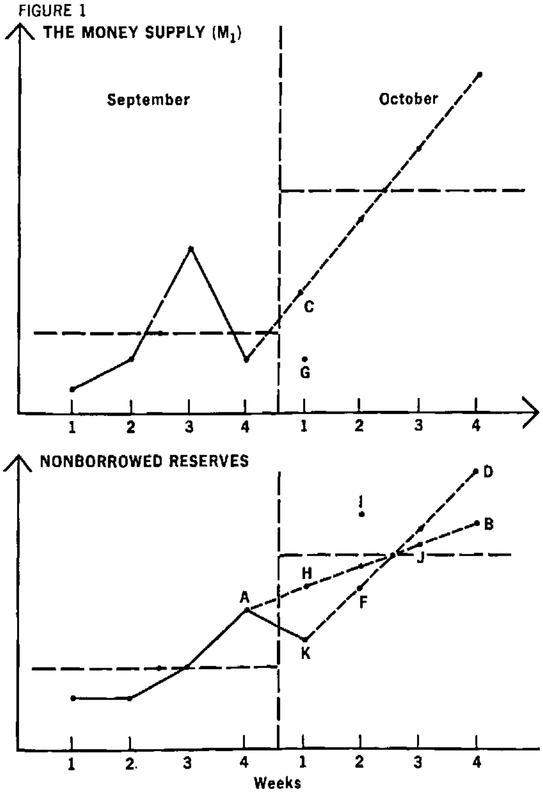
CHOICE OF VARIABLES TO BE USED AS A WEEKLY TARGET. As suggested earlier, the first question in carrying out the Committee's instructions is the choice of variables to be used as a weekly target. The previous analysis has argued that in practice, the choices probably narrow down to nonborrowed reserves, free reserves, borrowings, and money market rates. It should be noted, however, that in any given week, the choice between free reserves and nonborrowed reserves is not really a choice at all. Given required reserves, a decision about a target level of nonborrowed reserves is simultaneously a decision about free reserves—and vice versa. There may be a tactical difference, though. For example, it might prove better to make decisions based on known past relationships between rates of growth of nonborrowed reserves and the monthly target variable rather than on known past relationships between levels of free reserves and the rate of growth of the monthly target variable.

TRANSLATING THE MONTHLY TARGET INTO APPROPRIATE VALUES OF THE WEEKLY TARGET. Once a decision has been made as to which of the possible weekly target variables will be used, the next step is to translate the monthly target determined by the FOMC into appropriate values of the weekly target. For example, the preliminary judgment might be reached that a 4 per cent targeted annual rate of growth in M_1 for the month of October could be achieved by about a 5 per cent annual rate of growth in nonborrowed reserves. Such a judgment might be reached by means of a regression equation or a "hand" method based on the projectionist's "feel" for the probable behavior of the money supply under various assumed rates of growth in nonborrowed reserves. (The next section of this paper presents the results of a number of regression equations relating monthly values of directly controllable variables such as nonborrowed reserves to monthly values of targets from groups B and C—such as total reserves, the money supply, and bank credit.) Whatever method is used, the resulting monthly rate of growth in nonborrowed reserves could be translated into preliminary weekly targets for nonborrowed reserves simply by making the appropriate extrapolation from the level of such reserves in the last week of the previous month. The situation is illustrated in Figure 1. The top panel shows a weekly pattern of M_1 consistent with the targeted growth rate for the month designated "October." The line AB in the bottom panel of the diagram shows the preliminary weekly targets for nonborrowed reserves given the targeted behavior of M_1.

ERROR-RESPONSE MECHANISMS. The third and final broad element in a strategy consists of error-response mechanisms. Errors, or "misses," are of course inevitable. They are of two basic types. First, weekly targets may be missed—in the case of free and nonborrowed reserves because of misses in predicting operating factors; and in the case of borrowed reserves and money market rate targets, for other reasons as well. Second, even if the actual values of the week-by-week control variables are right on target, the expected path of the broader monthly target may not result.

The Manager might decide to respond only to the first type of error, errors in hitting the weekly target. In that case, successful hitting of the targeted path for nonborrowed reserves would imply that he would continue to move along the given path (AB in the diagram) even though M_1 was not responding as expected. This would be a plausible approach if slippages between the money supply and nonborrowed reserves could be assumed to be random

FIGURE 1



over time so that they could be expected to cancel out when averaged over a period of weeks. Even if the Manager does respond only to errors of the first kind—in this case errors in hitting the weekly targets for nonborrowed reserves—there are still a number of possible types of error-response open to him. Some of the possibilities are illustrated in Figure 1, where point H is assumed to be the targeted level of nonborrowed reserves in the first week of October. Suppose the actual level falls short of this, say to point K. This might call for a new and steeper path of targeted values for the remaining 3 weeks such as KFD. Alternatively, the Manager might try to offset *all* the effect on the monthly average of the first week's miss in the second week. In that case he would aim for point I in the second week. If it were successfully hit, he would revert to his original path in the final 2 weeks—that is, points J and B. Presumably there are many other possibilities.

Instead of responding only to errors in the weekly target, the Manager could also respond to errors in the monthly target. Thus, for example, if all were going well, the level of M_1 reached in the first week would be point C in the upper panel of the diagram. Whether because of errors in hitting the weekly target or slippages between the weekly target and the value of the monthly target expected to be associated with it, M_1 might fall short of this level in the first week of October, say to point G. Such an error might then call for resetting the target path of growth for nonborrowed reserves for the remaining 3 weeks of the month in an attempt to compensate for this "miss" of total reserves in the first week.

In summary, if the FOMC wishes to aim for some target that cannot be aimed for directly on a week-to-week basis, a target that must instead be approached indirectly over a period of weeks, decisions concerning the following must be made: (1) A week-by-week target variable must be chosen. (2) Some rule must be found for translating the FOMC's monthly target into weekly values for the week-by-week target. (3) Rules for responding to inevitable misses, whether in the weekly targets themselves or in the expected relationship between weekly target values and the monthly target, must be devised. These three elements must be faced whether the monthly target be M_1, as assumed here, bank credit, total reserves, or what have you.

TRANSLATING MONTHLY TARGETS INTO AVERAGE MONTHLY VALUES OF WEEKLY TARGETS

As noted in the previous section, a complete strategy for hitting monthly deposit and bank credit targets involves translating monthly target values into appropriate values for one of the operational weekly targets. The translation procedure might itself be part of the instructions given by the FOMC to the Manager. However, it is more likely that the determination of such a procedure would be regarded as a technical problem—one that required week-by-week or even day-by-day flexibility and one that would best be solved by the operating personnel on the spot.

REGRESSION TECHNIQUES. One way in which monthly deposit or credit targets could be translated into average monthly values of a weekly target such as nonborrowed reserves is by use of a regression equation relating the FOMC's monthly target to monthly-average values of the weekly target together with whatever lagged variables and seasonal dummies seem useful. Given such an equation, the average monthly value of the weekly target variable needed to achieve the FOMC's deposit or credit objective could be calculated from its coefficient in the equation. Moreover, the pattern of forecast errors observed from applying the equation to data both within and without the equation's sample period could be used as an indication of the accuracy with which monthly deposit and credit variables could be controlled by manipulating the average monthly value of the week-by-week target.

There are, to be sure, a number of dangers involved in interpreting such equations. First, the historical tendency of the System to accommodate demands for reserves in the process of stabilizing money market conditions may introduce a simultaneous equations bias into the estimation of such equations. They may not be true reduced forms, and the coefficient of nonborrowed reserves may not give an unbiased estimate of the impact on deposits and credit of a given deliberate change in nonborrowed reserves. Second, use of the error terms from such equations to evaluate the accuracy with which the dependent variable could be controlled assumes perfect control of the independent variable. The current exogenous variables included in the various equations presented below are, alternatively, nonborrowed reserves, total reserves, and these two measures less required reserves behind Treasury deposits. For reasons already discussed in detail, none of these variables can be set by the actions of the Desk without error, and it may be virtually impossible to set total reserves on a week-by-week basis under a wide range of circumstances. A third problem with these equations is that they make no allowance for the time distribution within a period of changes in reserve measures. Thus, for example, they tacitly assume that the expected effect of raising the daily-average level of nonborrowed reserves in a month by $100 million is the same whether the change is spread out evenly over the period or concentrated entirely in the final day.

Despite these difficulties, as well as some other limitations to be mentioned later, such regression equations still seem to have a clear relevance to the problem at hand, and a large number of such equations are presented in the accompanying tables. In Tables 3 and 4, Parts A and B, it is assumed that nonborrowed reserves are to be the week-by-week target variable. Consequently the tables show a number of equations in which *percentage changes* in various potential monthly targets from groups B and C are regressed on current monthly percentage changes in nonborrowed reserves and in some lagged nonborrowed and total reserve changes. Part A of Table 3 shows equations for nonseasonally adjusted data, both with and without seasonal dummies. Table 4, Part A, repeats Table 3, Part A, with required reserves behind Treasury deposits subtracted from the various reserve measures. Again the results are reported with and without seasonal dummies. Part B of Tables 3 and 4 repeats Part A, this time with seasonally adjusted data. All equations were estimated over the 1965–68 period. The standard errors are reported as percentage changes arithmetically blown up to annual rates. (The justification for annualization is simply that annual rates of change are the common measure in terms of which these growth rates are usually expressed.)

In a large number of cases, the R^2's of the equations are impressively high, but the standard errors are discouragingly large. For example, by using seasonal dummies, the R^2's of percentage changes in the deposit components of M_1 and M_2 are 0.95 and 0.88, respectively, but the standard errors amount to annual rates of 6.4 and 4.4 per cent (Table 3, Part A). If current movements in Treasury deposits are correctly allowed for, these standard errors drop somewhat, to 5.9 and 3.9 per cent, respectively (Table 4, Part A). As Part B of these tables shows, somewhat better results in terms of standard errors are obtained when seasonally adjusted data are used. However, it is clear that none of these standard errors are small in terms of the ranges of growth rates normally thought of as spanning the gap between "tight" and "easy" monetary policy. For example, the smallest standard error in the demand deposit component of the money supply, 4.5 per cent, may be compared with the 2 to 6

TABLE 3: Current-Period "Exogenous" Variable: ***Nonborrowed Reserves***

Regressions of Monetary Aggregates on Reserve Aggregates

Dependent variable	Constant	% Δ NBR	% Δ NBR-1	% Δ NBR-2	% Δ TR-1	% Δ TR-2	R^2 $\bar{R}^2$	D.W.	SEE	Simple R^2 of % ΔNBR
A. Based on monthly data without seasonal adjustment, 1965–68										
Without seasonal dummies:										
% Δ*TR*	.3582	.553 (5.9)	.490 (3.8)	.091 (0.6)	−.635 (−4.0)	−.249 (−1.6)	.6819 .6440	1.82	9.35	.535
% Δ*DD*	.2448	.977 (6.1)	−.081 (−0.4)	−.062 (−0.3)	−.234 (−0.9)	−.104 (−0.4)	.5882 .5391	2.18	15.95	.547
% Δ*TD & DD*	.5998	.429 (5.8)	.108 (1.1)	−.016 (−0.1)	−.168 (−1.3)	−.022 (−0.2)	.5613 .5091	2.10	7.35	.535
% ΔProxy	.4320	.525 (10.2)	.042 (0.6)	−.035 (−0.4)	.000 (0.0)	.043 (0.5)	.7553 .7262	1.34	5.14	.750
With seasonal dummies:										
% Δ*TR*	.7774	.208 (1.2)	.543 (2.7)	.275 (1.2)	−.597 (−3.4)	−.247 (−1.4)	.7562 .6303	1.78	9.53	
% Δ*DD*	2.5527	.128 (1.1)	−.093 (−0.7)	.279 (1.9)	−.183 (−1.5)	−.081 (−0.7)	.9517 .9268	1.50	6.36	
% Δ*TD & DD*	1.1532	.155 (1.9)	.126 (1.4)	.164 (1.6)	−.099 (−1.2)	.013 (0.2)	.8835 .8234	1.18	4.41	
% ΔProxy	1.0870	.316 (3.8)	.202 (2.2)	.053 (0.5)	.026 (0.3)	.064 (0.8)	.8645 .7945	1.27	4.45	
B. Based on monthly data seasonally adjusted, 1965–68										
% Δ*TR*	.0664	.758 (10.2)	−.127 (−1.0)	−.167 (−1.2)	.227 (1.5)	.226 (1.5)	.7721 .7450	1.87	3.18	
% Δ*DD*	.2386	.297 (2.4)	−.198 (−0.9)	−.028 (−0.1)	.134 (0.6)	.136 (0.5)	.1463 .0447	1.74	5.20	
% Δ*TD & DD*	.5468	.235 (2.9)	.119 (0.8)	.137 (0.9)	−.076 (−0.5)	−.013 (−0.1)	.3826 .3910	1.40	3.50	
% ΔProxy	.3284	.465 (5.8)	.091 (0.6)	.030 (0.2)	.108 (0.7)	.040 (0.2)	.6408 .5980	1.58	3.43	
C. Based on quarterly data seasonally adjusted, 1960–67										
% Δ*TR*	−.4823	.899 (10.7)	−.242 (−1.9)	−.105 (−1.1)	.516 (3.1)	.392 (3.2)	.8928 .8722	1.63	1.22	
% Δ*DD*	−.4412	.432 (2.7)	.036 (0.1)	−.039 (−0.2)	.270 (0.9)	.413 (1.8)	.5623 .4781	1.45	2.30	
% Δ*TD & DD*	.4528	.546 (3.6)	−.117 (−0.5)	−.245 (−1.5)	.606 (2.0)	.617 (2.8)	.6574 .5915	1.25	2.21	
% ΔProxy	.1825	.770 (5.6)	−.281 (−1.3)	−.238 (−1.6)	.696 (2.6)	.585 (2.9)	.7246 .6716	1.16	2.01	

NOTE.—Standard errors of estimates (SEE) are at annual rates. "t" values are in parentheses.

per cent range of growth rates for M_1 sometimes cited as the prudent limits of tight and easy money. A more graphic impression of the size of the errors can be obtained from Figures 2–5 showing the time series of residuals from certain of the equations presented in Tables 3 and 4, Parts A and B. The equations have been used to "predict" developments in the first half of 1969. As the figures indicate, the results were quite poor in most cases. Perhaps part of the difficulty could stem from structural changes produced by the inauguration of lagged reserve accounting in the fall of 1968.

For the sake of completeness, a second set of tables, Tables 5 and 6, paralleling Tables 3 and 4, Parts A and B, has been prepared that assume, in effect, that total reserves rather than nonborrowed reserves are the variable to be used as the week-by-week target. Again, the control problem with regard to total reserves should be kept clearly in mind in evaluating these equations. In any event, the lesson of Tables 5 and 6 is essentially the same as the lesson of Tables 3 and 4. The standard errors of estimate (expressed, as before, in terms of annual rates) are still quite large relative to

TABLE 4: Current-Period "Exogenous" Variable: *Nonborrowed Reserves Adjusted for Reserves Required Against U.S. Government Deposits*

Regressions of Monetary Aggregates on Reserve Aggregates Adjusted for Reserves Required Against U.S. Government Deposits

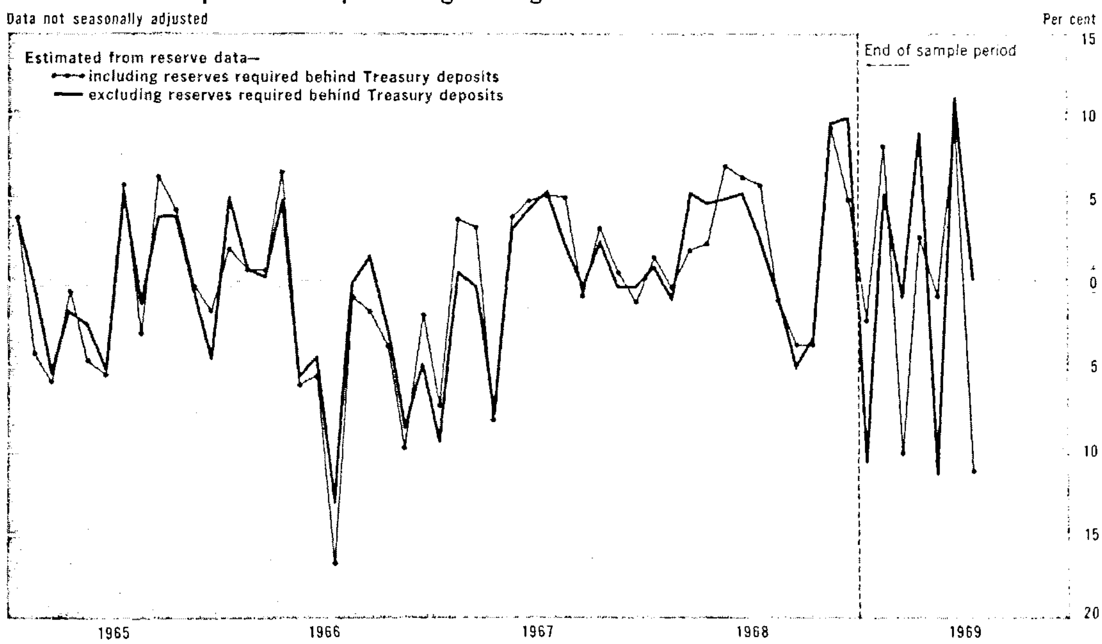
Dependent variable	Constant	% Δ NBR*	% Δ NBR-1*	% Δ NBR-2*	% Δ TR-1*	% Δ TR-2*	R^2 $\bar{R}^2$	D.W.	SEE	Simple R^2 of % ΔNBR
A. Based on monthly data without seasonal adjustment, 1965–68										
Without seasonal dummies:										
% Δ*TR**	.3850	.601 (6.8)	.495 (3.8)	.099 (0.7)	−.680 (−4.2)	−.282 (−1.8)	.7449 .7145	1.85	9.71	.621
% Δ*DD*	.0146	1.145 (12.7)	−.177 (−1.3)	−.037 (−0.3)	.048 (0.3)	.004 (0.0)	.8416 .8228	1.46	9.89	.828
% Δ*TD* & *DD*	.5192	.495 (11.0)	.060 (0.9)	.000 (0.0)	−.065 (−0.8)	.002 (0.0)	.8015 .7779	1.42	4.94	.797
% ΔProxy	.4594	.411 (7.1)	.065 (0.8)	−.066 (−0.7)	.023 (0.2)	.046 (0.4)	.6241 .5793	1.73	6.37	.597
With seasonal dummies:										
% Δ*TR**	.9441	.224 (1.2)	.510 (2.4)	.125 (0.5)	−.624 (−3.5)	−.285 (−1.6)	.8063 .7063	1.80	9.85	
% Δ*DD*	2.2414	.348 (3.0)	−.081 (−0.6)	.138 (1.0)	−.060 (−0.6)	−.044 (−0.4)	.9579 .9362	1.29	5.93	
% Δ*TD* & *DD*	.8956	.270 (3.6)	.163 (1.9)	.088 (1.0)	−.030 (−0.4)	.034 (0.5)	.9093 .8624	1.10	3.89	
% ΔProxy	1.0993	.223 (2.5)	.313 (3.1)	.064 (0.6)	.038 (0.5)	.072 (0.9)	.8490 .7710	1.40	4.70	
B. Based on monthly data seasonally adjusted, 1965–68										
% Δ*TR**	.1123	.696 (9.1)	−.100 (−0.8)	−.184 (−1.4)	.228 (1.5)	.189 (1.2)	.7178 .6842	1.79	3.11	
% Δ*DD*	.0771	.486 (4.4)	−.286 (−1.6)	−.152 (−0.8)	.351 (1.6)	.256 (1.2)	.3629 .2870	1.87	4.50	
% Δ*TD* & *DD*	.4592	.329 (4.3)	.071 (0.6)	.082 (0.6)	.047 (0.3)	.036 (0.2)	.5169 .4594	1.36	3.09	
% ΔProxy	.3088	.288 (3.0)	.220 (1.4)	.108 (0.7)	.148 (0.8)	−.023 (−0.1)	.5196 .4624	1.56	3.97	
C. Based on quarterly data seasonally adjusted, 1960–67										
% Δ*TR**	−.4067	.816 (9.9)	−.157 (−1.4)	−.073 (−0.9)	.424 (2.8)	.363 (3.1)	.9103 .8930	1.57	1.05	
% Δ*DD*	−.7124	.655 (4.4)	−.156 (−0.8)	−.094 (−0.7)	.396 (1.4)	.530 (2.5)	.6978 .6397	1.74	1.91	
% Δ*TD* & *DD*	.2781	.739 (4.9)	−.329 (−1.6)	−.282 (−2.0)	.789 (2.8)	.598 (2.8)	.7364 .6857	1.09	1.93	
% ΔProxy	.2319	.734 (4.2)	−.212 (−0.9)	−.259 (−1.6)	.565 (1.7)	.612 (2.5)	.6637 .5990	1.61	2.22	

NOTE.—* shows where reserve requirements against U.S. Govt. demand deposits have been subtracted from the reserve measures. Standard errors of estimates (SEE) are at annual rates. "t" values are in parentheses.

FIGURE 2

Residuals from equations for percentage changes in DEMAND DEPOSITS

Data not seasonally adjusted

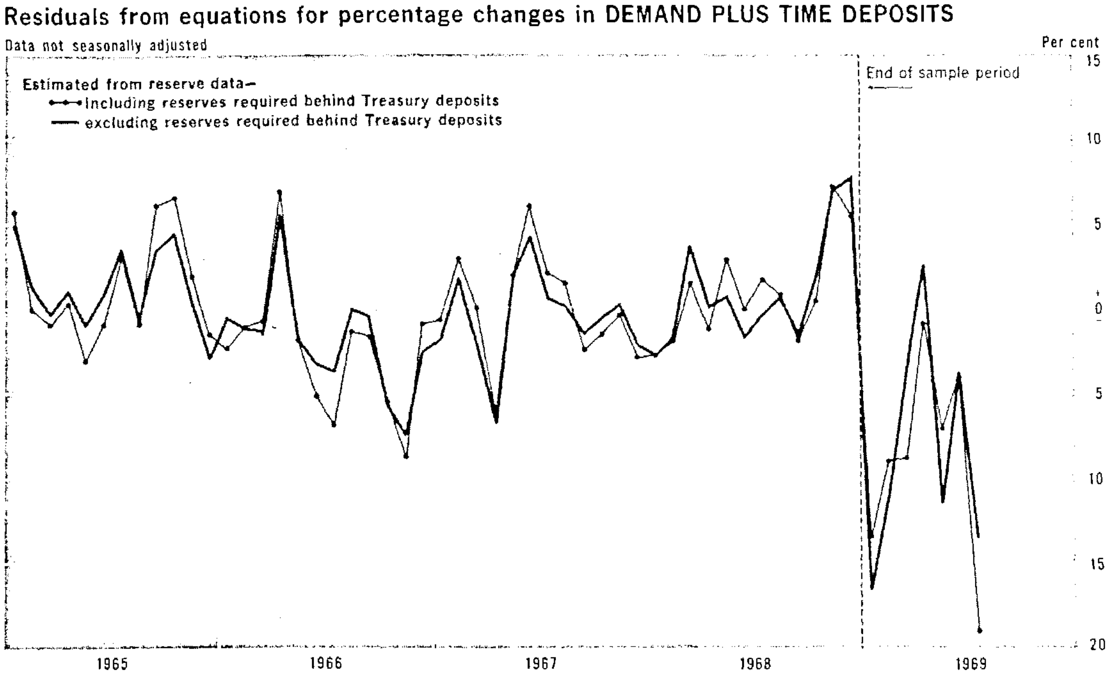


Monthly data shown at annual rates. Equations employ seasonal dummies.

FIGURE 3

Residuals from equations for percentage changes in DEMAND PLUS TIME DEPOSITS

Data not seasonally adjusted

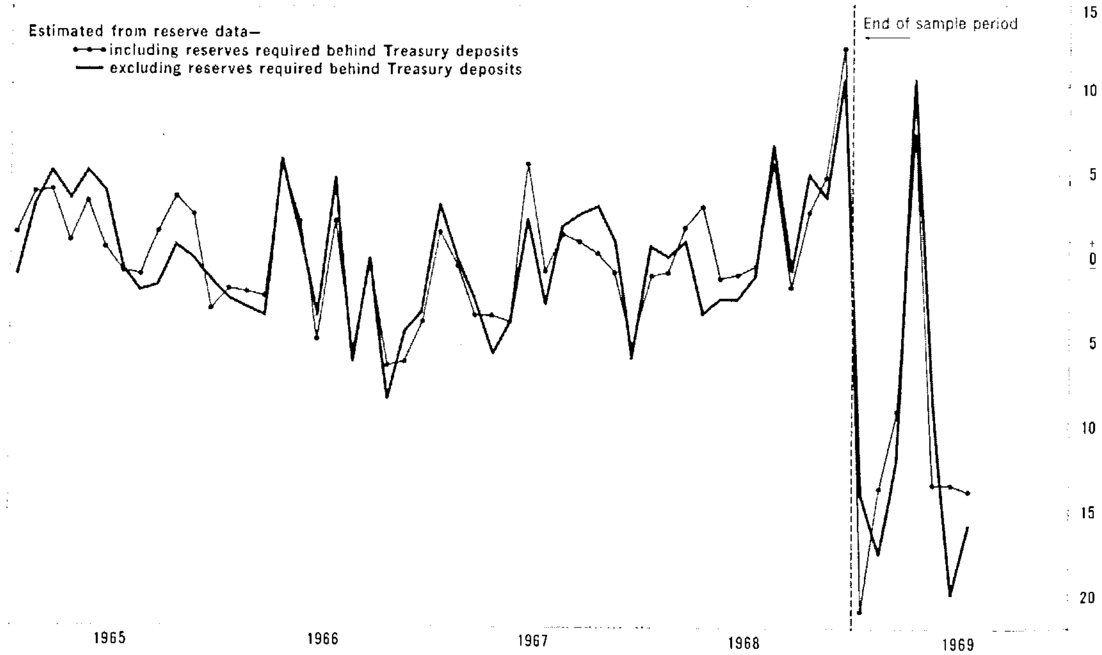


Monthly data shown at annual rates. Equations employ seasonal dummies.

FIGURE 4

Residuals from equations for percentage changes in the PROXY

Data not seasonally adjusted

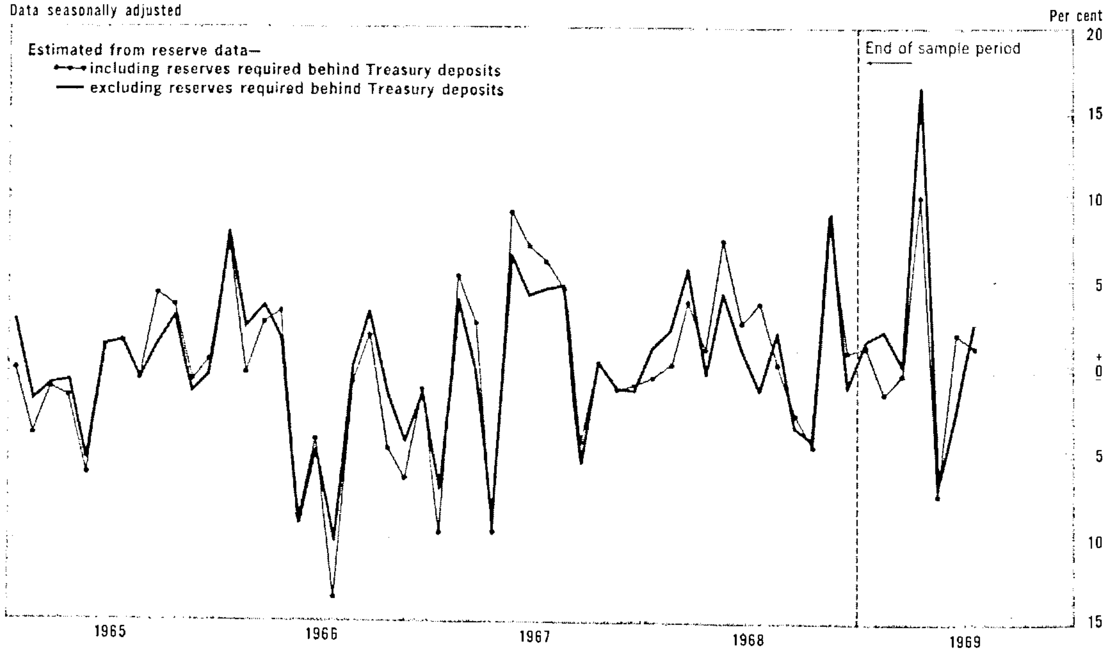


Monthly data shown at annual rates. Equations employ seasonal dummies.

FIGURE 5

Residuals from equations for percentage changes in DEMAND DEPOSITS

Data seasonally adjusted



Monthly data shown at annual rates. Equations employ seasonal dummies.

TABLE 5: Current-Period "Exogenous" Variable: *Total Reserves*

Regressions of Monetary Aggregates on Total Reserves

Dependent variable	Constant	% Δ TR	% Δ TR-1	% Δ TR-2	R^2 $\bar{R}^2$	D.W.	SEE	Simple R^2 of % ΔTR
				A. Based on monthly data without seasonal adjustment, 1965–68				
Without seasonal dummies:								
% Δ*DD*	.2919	.811 (4.3)	−.323 (−1.7)	−.178 (−1.0)	.4395 .4013	2.33	18.18	.402
% Δ*TD & DD*	.5895	.412 (4.9)	−.068 (−0.8)	−.027 (−0.3)	.4381 .3998	2.26	8.13	.430
% ΔProxy	.4321	.479 (6.8)	.036 (0.5)	.016 (0.2)	.5518 .5212	2.26	6.80	.549
With seasonal dummies:								
%Δ*DD*	2.8102	.133 (1.3)	−.070 (−0.7)	.036 (0.4)	.9452 .9220	1.80	6.56	
% Δ*TD & DD*	1.3705	.158 (2.1)	.054 (0.7)	.112 (1.5)	.8549 .7933	1.19	4.77	
% ΔProxy	1.4128	.281 (3.5)	.205 (2.5)	.142 (1.8)	.8089 .7278	1.36	5.12	
				B. Based on monthly data seasonally adjusted, 1965–68				
%Δ*DD*	.2339	.325 (2.6)	−.075 (−0.6)	.083 (0.7)	.1494 .0914	1.78	5.07	1.37
% Δ*TD & DD*	.4834	.375 (4.5)	.044 (0.5)	.095 (1.2)	.3910 .3495	1.50	3.39	.362
% ΔProxy	.2548	.664 (9.4)	.158 (2.2)	.026 (0.4)	.7311 .7128	1.85	2.90	.697

NOTE.—Standard errors of estimate (SEE) are at annual rates. "t" values in parentheses.

TABLE 6: Current-Period "Exogenous" Variable: *Total Reserves Adjusted for Reserves Required Against U.S. Government Deposits*

Regressions of Monetary Aggregates on Total Reserves Adjusted for Reserves Required Against U.S. Government Deposits

Dependent variable	Constant	% Δ TR*	% Δ TR-1*	% Δ TR-2*	R^2 $\bar{R}^2$	D.W.	SEE	Simple R^2 of % ΔTR
				A. Based on monthly data without seasonal adjustment, 1965–68				
Without seasonal dummies:								
% Δ*DD*	.0243	.998 (7.4)	−.093 (−0.7)	−.043 (−0.3)	.6513 .6276	2.39	14.34	.648
% Δ*TD & DD*	.4889	.480 (8.2)	.016 (0.3)	.020 (0.3)	.6640 .6411	2.27	6.29	.663
% ΔProxy	.4665	.373 (5.3)	.070 (1.0)	−.012 (−0.2)	.4407 .4026	2.19	7.60	.423
With seasonal dummies:								
% Δ*DD*	2.5245	.295 (3.1)	.068 (0.7)	.079 (0.8)	.9542 .9348	2.04	6.00	
% Δ*TD & DD*	1.1824	.244 (3.5)	.135 (1.8)	.137 (2.0)	.8780 .8263	1.38	4.37	
% ΔProxy	1.3592	.233 (2.7)	.237 (2.6)	.170 (2.0)	.7841 .6925	1.38	5.45	
				B. Based on monthly data seasonally adjusted, 1965–68				
% Δ*DD*	.0428	.597 (5.2)	−.018 (−0.1)	.113 (1.0)	.4207 .3812	1.96	4.19	.408
% Δ*TD & DD*	.3564	.536 (7.3)	.096 (1.3)	.110 (1.5)	.6287 .6034	1.58	2.65	.588
% ΔProxy	.1912	.521 (5.0)	.354 (3.3)	.072 (0.7)	.5476 .5168	1.64	3.77	.414

* Where reserve requirements against U.S. Government demand deposits have been subtracted from the reserve measures.

NOTE.—Standard errors of estimates (SEE) are at annual rates. "t" values in parentheses.

what is often considered the range between prudent extremes of "tight" and "easy" monetary policy.

IMPLICATIONS OF THE REGRESSION RESULTS. First of all, the results provide no support whatever for the view expressed, for example, by Allan Meltzer that "month-to-month changes in money . . . can be kept within a very narrow range".[3] His conclusion is apparently based on an examination of equations relating monthly dollar changes in M_1 and M_2 to current and one-period lagged changes in the monetary base and Treasury deposits at commercial banks. The R^2's of Meltzer's equations range from 0.70 to 0.86, thereby leading to his optimistic view of the prospects for control. As the results for similar equations presented above show, however, R^2's may indeed be high, especially when unadjusted data are used and seasonal dummies are included. Nevertheless, the standard errors remain quite large. Even if the standard errors had been substantially smaller, moreover, Meltzer's conclusion would still remain subject to the reservations regarding this type of regression equation noted on page 48.

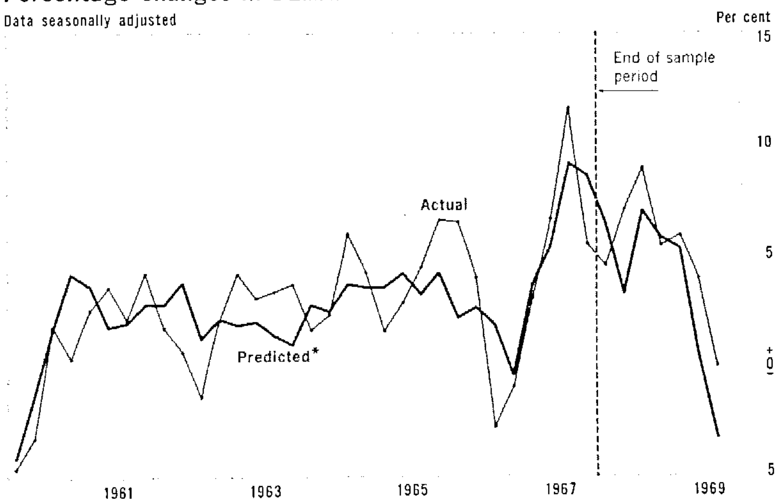
While the equations do suggest that the Desk would be likely to miss rather badly any given deposit or credit target in any given month if it simply used one of these equations to guide its actions, the results do not necessarily mean that there is *no* way of hitting such targets with tolerable accuracy on a monthly basis. First, better equations could probably be devised with further experimentation. More variables exogenous to the banking sector could be included. More complex lag structures could be investigated. Systematic allowance for autocorrelation could be made, and so forth. Second, informed judgment by the Desk might yield better ways of determining appropriate growth rates for nonborrowed reserves than any equation could provide. Third, even if such equations were relied on fairly mechanically, there can be little doubt that results would be improved by making midmonth adjustments in the targeted behavior of nonborrowed reserves for the balance of the month in light of any misses in the deposit or credit target occurring earlier in the month.

Finally, even if there proved to be *no* way of hitting such targets as the monetary growth rate with tolerable accuracy on a monthly basis, this does not mean that such targets could not be hit with acceptable accuracy on the average over a span of months. The operation of a strategy with a multimonth horizon might well require the FOMC to review deviations of actual results over the preceding period from targeted values presented to the Account Manager at the previous meeting. While the operation of a multimonth strategy is beyond the scope of this paper, some equations using quarterly data but otherwise similar to the ones discussed above are presented in Part C of Tables 3 and 4 (pp. 49 and 50). Here the equations were estimated on percentage changes in seasonally adjusted quarterly-average values of the variables for the period 1960–67. The standard errors in the deposit and credit proxy equations are all about 2 per cent (annual rate), much lower than for the monthly equations, as expected.[4] For the seven quarters beyond the sample period (that is, all of 1968 and the first three quarters of 1969), the average absolute prediction error for demand deposits was a 2.1 per cent annual rate if no allowance were made for Treasury deposits. Adjusting for behavior of reserves required behind Treasury deposits actually wors-

[3] "Controlling Money," Federal Reserve Bank of St. Louis *Review* (May 1969), pp. 18 and 19.

[4] If quarterly percentage changes in *total* reserves are used, there is only a negligible reduction in the standard error for the two deposit measures. If total reserves are used with adjustments for reserves required behind Treasury deposits, the standard errors for the two deposit totals drop moderately to about a 1.6 per cent annual rate. Again warning is made of the implicit assumption that total reserves less reserves required behind Treasury deposits can be perfectly controlled. Indeed, as Part C of Table 3 shows, nonborrowed reserves can only be used to control total reserves on a quarterly basis up to a standard error of 1.2 per cent (annual rate).

FIGURE 6
Percentage changes in DEMAND DEPOSITS
Data seasonally adjusted



* Based on data in Table 3, Part C. Quarterly data shown at annual rates.

ened the results slightly, giving an average prediction error of 2.3 per cent (annual rate) in the seven-quarter period.

Results beyond the sample period for equations for time and private demand deposits combined were less satisfactory, with the equation consistently and substantially overstating the growth rate of the deposit total. The average absolute prediction error for these equations amounted to a 4.5 per cent annual rate. Predicted and actual figures for the sample period and for the seven-quarter extrapolation period for demand deposits and for demand deposits plus time deposits are shown in Figures 6 and 7.[5]

It is possible to take either an optimistic or a pessimistic view of the results using quarterly data. One could say that the standard errors of around 2 per cent per annum for the sample period and of about that size in the case of demand deposits in the seven-quarter extrapolation period are not large and could be substantially reduced in practice by means of midcourse corrections. The poor results for demand plus time deposits in the 1968–69 period could be dismissed as simply failing to allow for the profound effects of Regulation Q. Such a deficiency, it might be argued, could easily have been overcome in practice. The pessimistic view, however, would be that all the equations show a number of quarters both within and without the sample period where errors amount to a 2 per cent annual rate or more and that, for percentage changes in quarterly average levels, this is simply not a very good performance in a world where an annual rate of 2 to 6 per cent is accepted by many as defining the limits of prudent policy.

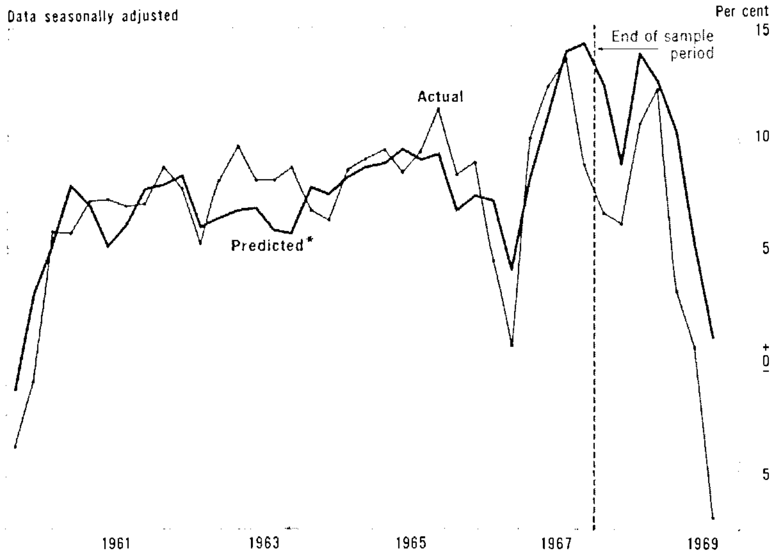
Probably a sensible conclusion would be somewhat as follows: (1) There is no existing evidence to demonstrate the possibility of tight control over monetary and credit growth rates —even over quarterly-average periods and even if such control is sought relentlessly to the exclusion of other possible considerations. (2) Nevertheless, existing evidence does give reasonable grounds for hope that such control would in fact be possible over quarterly periods if midquarter corrections and the use of

[5] Prediction errors beyond the sample period for equations using current changes in total reserves were about the same as for the equations using current changes in nonborrowed reserves.

FIGURE 7

Percentage changes in TIME plus DEMAND DEPOSITS

Data seasonally adjusted



* Based on data in Table 3, Part C. Quarterly data shown at annual rates.

judgment can be brought in to substantial advantage.

The proposition that the Federal Reserve could control monetary growth rates or the credit proxy with tolerable accuracy on a quarterly-average basis if it sought to do so without regard to any other possible constraints on its behavior should perhaps not seem terribly controversial. The problem of just what sacrifices might in fact have to be made as regards the money market effects of such a pursuit is discussed in the next section.

THE EFFECTS OF QUANTITY TARGETS ON MONEY MARKET STABILITY

THE NATURE OF THE PROBLEM. Every sort of evidence suggests that the FOMC has relied largely on money market targets in the period from the Treasury–Federal Reserve accord through the late 1960's. These targets included free reserves, borrowed reserves, the Federal funds rate, the rate on 3-month Treasury bills, and other rates. The emphasis on these various measures has no doubt fluctuated over time. In most cases, the actual target has probably represented essentially a weighted average of these variables, with the weights never quantified or spelled out—though defined to some extent in the discussion at the Committee's meetings. These variables tend to be reasonably collinear in any given period. Thus it is possible, for example, to spell out levels of free reserves that would be compatible with certain levels of borrowed reserves, the Federal funds rate, and the bill rate. Stabilizing one or more of these measures in effect fixes the "tone" of the money market—since that elusive concept appears to be essentially coterminous with a weighted average of these variables. The single major exception to the complete dominance of money market targets has apparently been the use of the proviso clause.[6] In obedience to this clause, money market targets have been altered between FOMC meetings on several occasions when the bank credit proxy has

[6] See pages 64 and 65.

deviated substantially from its projected growth rate.

A basic feature of money market targets is that their use requires accommodation of fluctuations in levels of required reserves during the period within which the target variable is to be stabilized at a given value. Since fluctuations in required reserves ultimately reflect fluctuations in the demand for bank credit and deposits at the level of money market rates associated with the given money market target, a money market target basically means accommodating fluctuations in the demand for credit and deposits. This is true whether the fluctuations are seasonal or trivial random movements or whether they are related to changes in business conditions or to shifts in the underlying structural demand equations for bank credit and deposits.

To argue that the use of money market targets necessarily involves accommodation of demand shifts is not to argue that the System is *wholly* passive with respect to quantities whenever it employs money market targets. The *level* at which the target is set, *ceteris paribus,* does influence the rate of growth of the aggregates for reasons developed by many writers both before, but especially after, James Meigs' well-known treatment of the problem.[7] Despite this influence, however, the essential points are (1) that once a money market target has been set, the System reacts essentially passively to shifts in demands as long as the target is unchanged, and (2) that the *ex-post* statistical relationship between levels of money market targets and rates of growth of reserves, money, bank credit, and so forth have tended to be extremely weak. This point has also been rather well established by many writers from Meigs on. As a result of these considerations, many have argued that the use of money market targets has in practice deprived the System of any effective means of controlling aggregates. Defenders of money market targets have argued that the System *should* accommodate, at least in the short run, most shifts in the demand for bank credit and deposits since such shifts are predominantly seasonal and temporary in nature. Failure to accommodate them, according to this view, would simply produce economically undesirable fluctuations in money market conditions.

Whatever the merits of these arguments, it remains true that just as stabilizing money market conditions involves the accommodation of fluctuations in demand, so would the use of quantity targets involve fluctuations in money market conditions. If you wish to stabilize the price of any good, the amount you supply will reflect fluctuations in the demand schedule for the good; conversely, if you wish to stabilize the amount you supply, you must allow fluctuations in demand to be reflected in price fluctuations. A major question therefore is how much money market instability would be produced by attempting to follow quantity targets and how serious a problem would such instability turn out to be.

Unfortunately, there appears to be no way of providing confident answers to these questions in advance. Experience would have to tell the story. In principle, a correctly specified money market model could be used to simulate the interest rate effects of any given rate of growth of nonborrowed reserves. Unfortunately, no suitable model exists and the construction of such a model would undoubtedly be a major task. Even if a suitable model did exist, moreover, the answers it would grind out might have relevance only for a short time. It seems reasonably likely that money market institutions themselves would evolve under the pressure of changed conditions, and that the ultimate impact on money market rates of ceasing to accommodate demand shifts would be different from the initial impact.

Suppose, for example, that the System replaced money market targets with a target stated in terms of week-by-week stability in

[7] See references to the literature cited in Thomas Mayer, *"Monetary Policy in the United States"* (New York: Random House, 1968) Chapter 3, pp. 79–109.

the rate of growth of nonborrowed reserves, not seasonally adjusted. All our experience suggests that sharp week-to-week fluctuations in demand for bank credit and deposits as well as marked seasonal patterns in these demands would lead to erratic and large movements in the Federal funds rate and related rates and would substantially magnify any seasonal patterns that may exist in money market rates. How far out on the maturity spectrum the rate fluctuations introduced by such a change in the System's *modus operandi* would extend is a question. At the very short end of the market, there is every reason to believe that conditions would be substantially different from what they are today. After banks and other financial institutions began to acquire some experience with the new environment, however, they might well discover ways of adapting to it that would themselves tend to dampen rate instability in the market. For example, by borrowing ahead, borrowers could avoid having to pay very high rates at periods of seasonal tension. This would tend to diffuse rate pressures over time. Similarly, lenders could take advantage of seasonal rate pressures by building up adequate loanable funds in advance, and this too would tend to diffuse rate pressures.

In general, institutions could be expected to learn to respond more flexibly to take advantage of rate fluctuations—thus increasing the supply elasticity of funds and thereby dampening the fluctuations themselves. Banks would probably want to keep stronger average basic reserve positions, with an increased willingness to buy or sell Federal funds depending upon rate conditions. While the precise nature of these institutional adaptations cannot be foreseen, it seems clear that some developments along these general lines would occur, tending to dampen random and seasonal fluctuations in money market rates.

AN EXPERIMENT. While, as noted above, only the simulation of a complete money market model could, even in principle, give an accurate indication of the kind of money market instability that would be created in the short run by quantity targets, the following cruder procedure may give some rough insight into the dimensions of the problem. In general, the method used here consists of computing the weekly levels of free reserves as they would have been in a particular historical period if the System had provided a constant week-by-week growth in nonborrowed reserves in that period, given the historical pattern of actual changes in required reserves. An equation relating the Federal funds rate to free reserves and the discount rate is then used to estimate what the funds rate would have been had the System followed the quantity target. The computed rate is then compared with the actual pattern of the rate for the period.

The period for the initial test covered July, August, and September 1967, a period in which policy was unchanged and in which the summary money market measures remained quite stable. For example, the average Federal funds rate in those 3 months was 3.79, 3.90, and 4.00 per cent, respectively; borrowings averaged \$87 million, \$89 million, and \$90 million, respectively; and free reserves averaged \$272 million, \$298 million, and \$268 million, respectively. Between the week of June 28 and the week of September 27, nonborrowed reserves rose by a total of \$732 million, *not* seasonally adjusted. This increase occurred in an irregular fashion, however, since week-to-week fluctuations in such reserves roughly matched week-to-week fluctuations in required reserves as the Desk went about the business of stabilizing money market conditions.

Let us suppose, contrary to fact, that the System had produced the \$732 million increase in nonborrowed reserves that occurred in this period through steady, equal weekly increments of about \$56 million. Let us also suppose, however, that week-to-week changes in required reserves under this hypothetical situation would have been the same as they in fact were during the period. In Table 7 the resulting hypothetical weekly levels of free reserves are compared with the levels that ac-

TABLE 7: Actual and Hypothetical Reserve Measures

Week	Nonborrowed reserves		Required reserves (actual)	Free reserves	
	Actual	Hypothetical [1]		Hypothetical (2−3)	Actual
	(1)	(2)	(3)	(4)	(5)
1967—June 28.....	23,406	23,406	23,116	290	290
July 5.....	23,531	23,462	23,422	40	109
12.....	23,997	23,519	23,423	96	574
19.....	23,838	23,575	23,653	−78	185
26.....	23,967	23,631	23,589	42	378
Aug. 2.....	23,858	23,687	23,679	8	179
9.....	23,869	23,743	23,589	154	280
16.....	23,634	23,800	23,381	418	253
23.....	23,726	23,855	23,300	555	426
30.....	23,429	23,912	23,215	697	214
Sept. 6.....	23,846	23,969	23,593	376	253
13.....	23,969	24,025	23,653	372	316
20.....	24,210	24,081	23,908	173	302
27.....	24,138	24,138	24,001	137	137

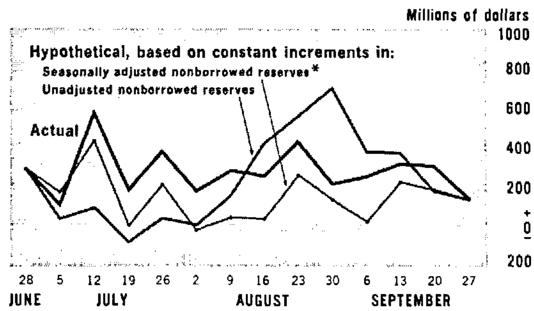
[1] Computed by dividing actual change in nonborrowed reserves between weeks of June 28 and Sept. 27 into 13 equal weekly increments.

tually prevailed. The actual level of free reserves fluctuated, for the most part, reasonably narrowly around the average for the period. Actual week-to-week fluctuations presumably reflected not only misses by the Desk due to misallowance for operating factors, but also deliberate changes reflecting allowances by the Desk for shifts in the distribution of reserves within the banking system and other familiar considerations.

Compared with the actual course of free reserves, the hypothetical level shows a distinct time path (Figure 8). Thus the hypothetical level (based on constant increments in unadjusted nonborrowed reserves) rises strongly during August, reflecting the seasonal weakness in required reserves, and thereafter declines as the September tax date puts upward pressure on required reserves, and, in this hypothetical world where such seasonal pressures are not accommodated, on money market conditions as well.

It can be validly argued, of course, that the assumption on which this exercise rests—namely, that weekly movements in required reserves would be the same in the hypothetical situation as in the actual situation—is false, at least to some degree. Presumably the growing money market ease through late August pictured in the hypothetical situation would bring forth greater credit and deposit demands and hence larger required reserves than actually occurred, with the reverse process occurring as stringencies developed in September. Since such developments *would* no doubt have occurred to some extent, the seasonal movement in free reserves generated by the hypothetical example has to be regarded as defining the outer limits of the possible effects on the money market of a policy of rigid weekly increments in nonborrowed reserves during the period. The true pattern of free reserves under such a policy would no doubt show a somewhat milder seasonal pattern. Furthermore, the experiment was conducted assuming constant weekly increments in nonborrowed reserves

FIGURE 8
FREE RESERVES, JUNE 28-SEPT. 27, 1967



* Computations are the same as those described in the text, *except* that the Desk is assumed to supply a constant increment in *seasonally adjusted* nonborrowed reserves over the period (as determined from weekly seasonal factors).
Data are weekly averages of daily figures.

without seasonal adjustment. Simple translation to a rule of constant increments in seasonally adjusted nonborrowed reserves would tend to smooth the fluctuations in free reserves generated by the use of a strict quantity target.[8]

In any case, the effects on money market rates of the hypothetical policy of nonaccommodation can be estimated with the aid of an equation relating the Federal funds rate to the level of free reserves and the discount rate. One such equation, estimated on biweekly re-

[8] Some experiments along these lines suggest that the smoothing effects would be quite substantial. See Figures 8–11.

serve averaging periods from mid-1966 to mid-1968 is shown below ("t" values in parentheses).

$$r_{ff} = 2.30 - \underset{(12.0)}{.002R_f} + \underset{(5.2)}{.549r_d}$$

$$R^2 = .915, \bar{R}^2 = .912, \quad \text{SEE} = .22 \text{ percentage point}$$

This equation can be regarded as a reduced form, derivable from the simple model presented on page 42 if the discount rate is included, as it should be, in the demand equations for excess and borrowed reserves. The free reserves variable is of course nonborrowed reserves minus the predetermined level of required reserves and may itself be determined as an exogenous policy variable, deliberately fixed (subject to random errors) by the Desk.

If this equation were used directly to compute the hypothetical Federal funds rate, the results would differ from the actual rate not only because of differences between hypothetical and actual levels of free reserves, but also because of the error term in the equation. To avoid this muddying of the waters, the hypothetical funds rate was computed, instead, by obtaining the difference between hypothetical and actual free reserves in each week from Table 7, multiplying this difference by the free reserves coefficient in the equation (− .002), and adding the result to the actual level of the funds rate. The resulting hypothetical time path of the Federal funds rate is shown in Table 8. Both the actual and hypothetical funds rates are shown in Figure 10.

The range of the funds rate under the hypothetical program of steady increments in nonborrowed reserves is, of course, much larger than the range under a regime of accommodating fluctuations in required reserves. Thus in the hypothetical case, the funds rate ranges from a high of 4.94 per cent in the week of July 12 to a low of 2.62 per cent in the week of August 30. In fact, the rate ranged from a high of only 4.07 per cent in the week of June 28 to a low of only 3.54 per cent in the week

TABLE 8: Derivation of Hypothetical Federal Funds Rate

Week	Hypothetical free reserves *less* actual free reserves times (−.002)	Actual Federal funds rate	Hypothetical computed Federal funds rate
1967—June 28....	0	4.07	4.07
July 5....	+.138	3.73	3.87
12....	+.956	3.98	4.94
19....	+.526	3.54	4.07
26....	+.672	3.93	4.60
Aug. 2....	+.342	3.75	4.09
9....	+.252	4.02	4.27
16....	−.330	4.05	3.72
23....	−.258	3.98	3.72
30....	−.966	3.59	2.62
Sept. 6....	−.242	4.02	3.78
13....	−.112	3.98	3.87
20....	+.258	4.00	4.26
27....	0	4.00	4.00

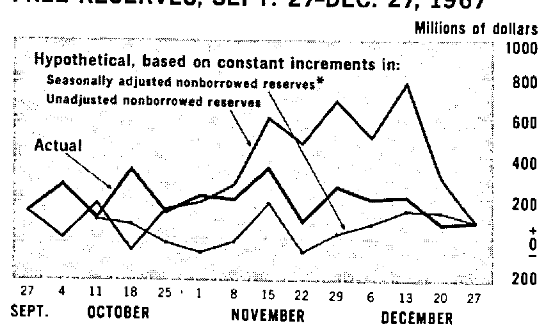
of July 19. Thus the hypothetical spread was 232 basis points, as compared with an actual spread of only 53 basis points.

Computed week-to-week fluctuations in the funds rate were also substantially larger under a policy of constant weekly increments in nonborrowed reserves than they were in fact during the period. Thus the average absolute weekly change in the level of the funds rate was 0.22 percentage point. The computed average weekly change was almost 2½ times as large, or 0.53 percentage point.

Roughly similar results, as to effects on both the range of the funds rate and the average size of its week-to-week fluctuations were obtained for each of the three subsequent 3-

FIGURE 9

FREE RESERVES, SEPT. 27-DEC. 27, 1967



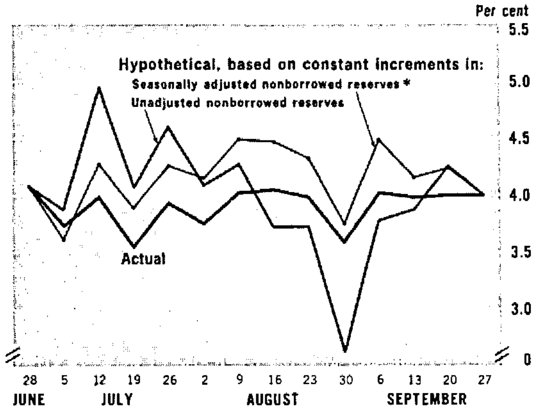
* Computations are the same as those described in the text, *except* that the Desk is assumed to supply a constant increment in *seasonally adjusted* nonborrowed reserves over the period (as determined from weekly seasonal factors).
Data are weekly averages of daily figures.

month periods. The technique for computing the funds rate was exactly the same as was used for the period June–September just described. In each period, the assumed week-to-week increase in nonborrowed reserves was the average actual weekly increase from the first week of the period to the last week of the period. The results are summarized below in Table 9.

EVALUATION. The experiment reported above is hardly a sufficient basis for judging the amount of money market instability that might be associated with rigid adherence to a quantity target. In two respects at least, it seems to overstate the likely degree of instability. First, as noted earlier, it assumes that required reserves would not respond at all to the effects on free reserves and the funds rate of pumping in a constant increment of nonborrowed reserves week by week. Actually, there would certainly be at least some response, and it would be in a stabilizing direction. Required reserves would tend to weaken under the pressure of tight money market conditions and to strengthen under the encouragement of easy money market conditions, thereby themselves tending to modify the extremes of tightness and ease in the money market.

Secondly, and also as noted earlier, the provision of a constant increment of seasonally adjusted nonborrowed reserves would certainly produce substantially milder seasonal movements in money market conditions than would the provision of constant increments of *un*seasonally adjusted reserves. A comparison of hypothetical paths for free reserves and for the Federal funds rate using equal seasonally adjusted increments with hypothetical paths using equal unadjusted increments for two

FIGURE 10
FEDERAL FUNDS RATE, JUNE 28-SEPT. 27, 1967



* Computations are the same as those described in the text, *except* that the Desk is assumed to supply a constant increment in *seasonally adjusted* nonborrowed reserves over the period (as determined from weekly seasonal factors).
Data are weekly averages of daily figures.

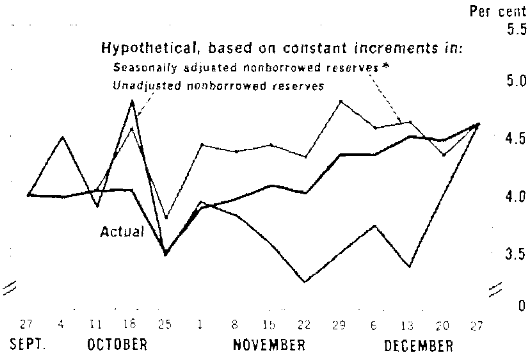
different 3-month periods is shown in Figures 8–11. Of course, the implementation of a seasonally adjusted nonborrowed reserve target would raise the thorny technical problem of developing satisfactory weekly seasonal adjustment factors.

Having said that certain features of the experiment tend to overstate the degree of potential money market instability, however, the writer is inclined to the view that the degree of instability indicated is nevertheless rather surprisingly mild. As Table 9 shows, the computed average absolute weekly change in the Federal funds rate tends to be only around 50 basis points, certainly substantially larger than the average changes that actually occurred (around 17 basis points), but not more than the market would seem able to handle without undue stress. Similarly, the computed ranges of

TABLE 9: Federal Funds Rate, Selected Periods

Period	Actual values				Computed values			
	High	Low	Range	Average absolute weekly change	High	Low	Range	Average absolute weekly change
June 28 to Sept. 27	4.07	3.54	.53	0.22	4.94	2.62	2.32	0.53
Sept. 27 to Dec. 27	4.63	3.50	1.13	0.15	4.83	3.25	1.58	0.51
Dec. 27 to Mar. 27	5.40	4.55	.85	0.13	5.92	4.49	1.43	0.69
Mar. 27 to June 26	6.34	5.40	.94	0.16	6.57	4.56	2.01	0.43

FIGURE 11
FEDERAL FUNDS RATE, SEPT. 27-DEC. 27, 1967



* Computations are the same as those described in the text, *except* that the Desk is assumed to supply a constant increment in *seasonally adjusted* nonborrowed reserves over the period (as determined from weekly seasonal factors).
Data are weekly averages of daily figures.

the funds rate over the periods tested, about 150 to 225 basis points, were substantially larger than the ranges that actually occurred, about 50 to 115 basis points, but again, seemingly not beyond the limits of manageability considering that the funds rate is a 1-day rate. Moreover, as Figures 8–11 suggest, these ranges could well be narrowed considerably by even a crude allowance for seasonal fluctuations in reserve demands associated with seasonal fluctuations in required reserves.

Perhaps the apparent mildness of the money market's reaction to a quantity target as indicated in this experiment ought to be regarded with some degree of skepticism. One factor upon which the reasonableness of the calculations depends is, of course, the estimate of the coefficient of free reserves in the equation for the funds rate, −.002 in this case. How stable is this coefficient? How indicative is the −.002 estimate of what might be expected in the future? A similar equation covering a period 18 months earlier, the beginning of 1965 to the end of 1966, gives a very similar result (the coefficient of free reserves is − .0018). For pre-1965 periods, the computed coefficient tends to be much smaller, but the relevance of results before 1965 is questionable because of the market convention that the funds rate would never go above the discount rate and, as one goes further back in time, because of the lesser importance of the funds market.

SOME MIXED STRATEGIES—BLENDING MONEY MARKET AND QUANTITY CONSIDERATIONS IN FRAMING TARGETS

Having examined some features of monetary aggregates as FOMC targets, it now seems useful to sketch some procedures through which improved control over these aggregates might be reconciled with the desire to moderate fluctuations in the tone of the money market. These procedures involve "mixed strategies" in which both the monetary aggregates and measures of money market conditions have a specific role to play. Before looking at these mixed strategies, however, some salient features of pure money market and pure quantity strategies are reviewed.

PURE MONEY MARKET STRATEGIES. In a pure money market strategy, the Manager can be instructed to maintain marginal reserve measures at a certain level or within a certain range, or he can be instructed to hold money market rates, in recent years especially the Federal funds rate, at a certain level or range. The normal practice, as noted earlier, has been to use a somewhat vaguely defined blend of these two approaches. If the banking system's aggregate demand schedules for excess and borrowed reserves remain stable,[9] rates such as the funds rate and the marginal reserve measures will move fairly closely in step with each other. Hence it will make little difference whether the Committee's instructions emphasize the marginal reserve measures or short-term interest rates. Stabilizing free or borrowed reserves at some target level will effectively stabilize the funds rate, and vice versa.

In fact, the aggregate demand schedules of the banking system for excess and borrowed

[9] That is, the demand schedule defined with respect to the level of money market interest rates.

reserves evidently show a fair degree of shiftability. This is due in large measure to shifts in the distribution of reserves between groups of banks with very different individual demand schedules. The country–city bank shift is the one most often cited. However, not all causes of shifts in the banking system's aggregate demand schedules need be as shortlived as those related to shifts in the distribution of reserves generally are. For example, shifts in bankers' expectations about future reserve needs may shift their demand schedules for excess and borrowed reserves at crucial junctures. Thus it has been argued that the demand for free reserves shifted to the right in the summer of 1966 as the risk of a huge September run-off in CD's began to seem more real to bankers. According to this argument, banks sought both to build up excess reserves and to reduce borrowings so as to strengthen their claim to future discount-window accommodation when the period of peak strain actually arrived. Whatever the causes of shifts in the demand schedules for excess and borrowed reserves, such shifts drive a wedge between short-term rates, such as the funds rate, and aggregate levels of free and borrowed reserves. As a result, it does make some difference whether a pure money market strategy focuses primarily on stabilizing marginal reserve measures or primarily on the Federal funds and related rates.

If attention is focused on interest rates, the Desk will find itself accommodating not only shifts in the demand for deposits and bank credit, a feature of all pure money market strategies, but also shifts in the banking system's aggregate demand for free reserves. If the Desk is instructed to hold the Federal funds rate at around x per cent, it must respond equally to both types of shifts. A surge in the demand for deposits (bank credit) at current interest rates will expand the amount of required reserves, and in order to keep the funds rate from rising the Desk will have to supply nonborrowed reserves. Similarly, an attempt on the part of banks to build up excess reserves or to repay borrowings and thus clear the books for subsequent borrowings will also tend to push up the funds rate. Again the Desk will have to supply enough nonborrowed reserves to keep the funds rate from rising.

On the other hand, if the money market strategy is framed exclusively in terms of the marginal reserve measures, only shifts in the public's demand for deposits and credit will be accommodated. A rise in the level of free reserves desired by the banking system at given interest rates will *not* be met by the Desk with a corresponding increase in nonborrowed reserves. As a result, actual free reserves remain unchanged, consistent with their targeted behavior, while interest rates rise, and, *ceteris paribus,* rates of growth of the deposit and bank credit aggregates tend to decline. Since it is difficult to see what policy purpose is served by the interest rate and deposit/credit effects of unexpected shifts in the aggregate demand schedule for free reserves, the interest rate variant of the money market strategy seems to have advantages over versions relying on marginal reserve measures. Clearly, the use of such reserve measures can produce wholly unintended tightening or easing both of money market rates and of the aggregates when demand schedules for these reserves shift.[10]

PURE QUANTITY STRATEGIES. At the opposite extreme of the pure money market strategy, whether in its free reserves or Federal

[10] A formal elaboration of the implications of interest rate targets for the behavior of marginal reserve measures and the growth of aggregates and of the implications of marginal reserve targets for the behavior of interest rates and the growth of aggregates is given in Richard G. Davis, "Open Market Operations, Interest Rates, and Deposit Growth," *Quarterly Journal of Economics,* (Aug. 1965), pp. 433–42. Occasions in which shifts out in the demand schedule for free reserves may have resulted in inadvertent tightening are examined in two articles by Jack M. Guttentag. "The Strategy of Open Market Operations," *Quarterly Journal of Economics,* (Feb. 1966), pp. 1–30, discusses such shifts the first half of 1960, while "Defensive and Dynamic Open Market Operations, Discounting, and the Federal Reserve System's Crisis-Prevention Responsibilities," *Journal of Finance,* (May 1969), pp. 249–63, discusses the summer of 1966.

funds rate variant, is the pure quantity strategy. This strategy involves exclusive use of rates of growth in some monetary aggregates as targets to be pursued without any regard for the resulting effects on money market conditions. The main features of this approach have been discussed in earlier sections and need only be recapitulated very briefly here. A desired growth rate in bank credit, M_1, M_2, or some other aggregate would be picked by the FOMC for the month ahead. Conceivably the Committee itself, or more likely the staff, would translate this target into a monthly rate of growth in nonborrowed reserves and, ultimately, into week-by-week targets for such reserves. The pure quantity target need not, of course, involve anything so crude as a constant week-by-week increment in nonseasonally adjusted nonborrowed reserves during the period between FOMC meetings. Indeed it almost certainly would not. Seasonally adjusted data might be used, for example, and, given the inevitable "misses" and the existence of some kind of "error response" mechanism as described in an earlier section, the pure quantity target would in fact probably involve week-to-week changes in the nonborrowed reserve increments sought by the Manager. By definition, however, these changes would never be chosen in light of their impact on money market conditions, but solely in terms of their appropriateness for hitting a monthly target for M_1, bank credit, or whatever variable the Committee has in mind. Clearly the result would be larger fluctuations of a short-term and perhaps medium-term nature than presently exist in free reserves, the Federal funds rate, and other measures of money market conditions.

While something very akin to the pure money market target was used over a period of many years, it came under increasingly heavy criticism. The pure quantity target, on the other hand, has never been tried. In view of the possible risks posed by the pure quantity target to the money and capital markets—most of them risks of essentially unknown and perhaps unknowable magnitude—many would no doubt argue that a pure quantity target *should not* be tried. In these circumstances, the middle ground between pure money market and pure quantity targets is of considerable interest. Such a middle ground would hopefully contain approaches that would retain some solicitude for money market conditions while providing a real measure of control over the monetary aggregates.

THE CREDIT PROXY PROVISO CLAUSE. The first operational result, insofar as open market strategies are concerned, of the increased concern within the System over the behavior of monetary aggregates was apparently the "proviso" clause. The inclusion of such a clause in the Committee's regular directive to the Account Manager represents, however, only the most cautious of steps outside the familiar world of the pure money market target. As it has been used, the proviso clause requires the Manager to shift the money market targets in the appropriate offsetting direction if growth in the bank credit proxy is deviating significantly from the figures projected at the time of the FOMC meeting.

There have, of course, been many doubts and criticisms raised in connection with the proviso clause. Some would prefer to substitute other variables for the credit proxy as being more economically meaningful. Others feel that the proviso clause has in practice proved too vague to give the Manager sufficient guidance. Thus there are always uncertainties as to just when deviations in the proxy from projections become substantial enough to require modification of the money market targets and uncertainties as to how large any such modifications should be. From the point of view of the present discussion, however, the chief problem with the proviso is that it does relatively little to augment the System's control over quantities. Indeed, in the minds of some within the System, it has not even been intended or expected to have such an effect.

In the first place, the wording of the proviso in terms of deviations from "currently projected" growth rates stops far short of indicating a *desired* growth rate, that is, a genuine target growth rate. Secondly, the proviso clause falls far short of providing a program for hitting such a target. The proviso clause does provide for a shift in the money market target in a somewhat easier or tighter direction if the proxy falls substantially short of, or rises substantially higher than, its projected growth rate. All the existing literature, as noted earlier, indicates that, *ceteris paribus,* the effects of these changes in the money market target should, in fact, tend to move the proxy in the desired direction. But there is no way of knowing how great the influence will be or what rate of change in the proxy will, in fact, be associated with the revised money market target. Moreover, the proxy and other quantity targets will continue to fluctuate in response to shifting demands under the new money market target, just as they did under the old one—although presumably the fluctuations will be around a higher (or lower) average than would have obtained under the old target.

Without denying the very real usefulness of the proviso clause in protecting the System against large, unforeseen, and undesired movements in the rate of growth of the proxy, it is evident that the proviso clause moved the System only a little closer to real control over quantities than it had been in the days of the *pure* money market target. In view of this situation, it seems worthwhile to consider some other ways of trying to blend quantity targets with a reasonable degree of money market orderliness.

USING MONEY MARKET TARGETS AS A TACTICAL DEVICE IN A QUANTITIES-ORIENTED STRATEGY. One way of using money market targets as a tactical device in a quantities-oriented strategy really involves no departure at all from the pure money market target. It does, however, require a more flexible use of such targets. Over much of the period since the accord, and even at present, the FOMC has apparently tended to identify its money market targets with the "tightness" or "ease" of policy. In the Brunner-Meltzer terminology, it has tended to treat its "target" as, simultaneously, its "indicator." A change in the money market targets that the Manager is instructed to maintain is identified as a change in "policy." In one sense, the identification of changes in the money market target with changes in "policy" is a merely semantic matter. Nevertheless, the consequences of this identification have been far from trivial. Thus it becomes a major act for the Committee to change its money market target since, by definition, this is a change in "policy." As a result, the target may go essentially unchanged or may be modified only slightly and gradually over fairly long periods. Often, events may have to become rather radically out of joint with the Committee's intentions before enough momentum is generated to produce a clear and decisive change in the money market target. This sort of "inertia" can lead to long periods in which fluctuations in the rates of change of monetary aggregates remain almost wholly at the mercy of fluctuations in demand conditions. Periods in which there have been only minor, if any, modifications in the money market objectives but in which rather major, and often unwanted, accelerations or decelerations in the monetary aggregates have nevertheless developed have not been rare.

If the Committee were to drop its tendency to identify changes in money market targets with changes in policy, a very different sort of situation could well develop. In the first place, a change in the money market target instructions given the Manager would very likely come to be thought of as involving only a routine technical adjustment—a change in tactics, rather than a fairly weighty decision to be made only after substantial evidence of unacceptable developments has accumulated. Consider, for example, a situation in which the Committee identifies "policy" with the rate of growth of the bank credit proxy. In that case the first paragraph of the directive might describe current economic conditions and the current objectives of policy, as it does now.

The second paragraph might then go on to say that in these circumstances, a growth rate in the proxy of approximately x per cent per annum seems appropriate. In a final sentence, it might then state that for the period ahead, such a growth rate could best be fostered by such and such money market conditions. These conditions could be stated either as ranges for specific money market measures or simply described by some qualitative phrase, with numerical values understood from the discussion at the Committee meeting.

The actual content of this final sentence with its reference to the money market target would have to be determined on the basis of staff projections. As long as policy were to remain "unchanged," the rate of monetary growth referred to in the second paragraph as appropriate in view of the objectives stated in the first paragraph would remain unchanged. The money market conditions target, however, might be expected to change routinely at every meeting, even with "unchanged policy." This being the case, monthly-average levels of free reserves and the Federal funds rate might be expected to fluctuate more frequently and more widely than they do at present. The general procedure of sticking to money market targets, but modifying them more or less routinely in the service of some more basic quantity objective has the advantage of requiring only a fairly modest departure, operationally, from a pure money market target. While money market targets would be changed substantially more often and perhaps by substantially larger amounts than under a pure money market target, the state of the money market would still be the Desk's primary week-by-week concern. The money market would not be left to its own devices; there would be no more risk of the daily-average rate for Federal funds jumping from 2 per cent one week to 12 per cent the next than there is at present. It is very difficult to see how the health of the financial markets could in any way be risked by following such a procedure.

The main objection to the proposal is that while it certainly promises closer control over aggregates than exists under the regime of relatively inflexible money market targets, it may not go far enough. One reason is that, as long as the money market targets remain rigid in the period *between* meetings, the System's response to shifts in bank credit and deposit demands *within that period* remains essentially accommodative and passive. Second, there is still the problem of the very loose relationship between money market variables and monetary and credit growth rates. It may be very hard to find the right money market targets given the desired monetary growth rate. Once the money market target is fixed, moreover, the resulting behavior of the growth rate may show unacceptably wide deviations from its expected response.

QUANTITY TARGETS WITH MONEY MARKET MODIFIERS. The next step along the road that leads from pure money market targets to pure quantity targets would be a procedure in which the FOMC instructs the Desk to hit a quantity target over the month, but to hit this target in a way that takes account of the impact on money market conditions. Presumably the general format of the operational part of the directive under such a regime would be something like this: "Open market operations shall be conducted in such a way as to encourage the bank credit proxy to grow at an annual rate of about x per cent, while smoothing fluctuations in money market conditions to the extent possible consistent with this objective."

There are any number of ways by which such a directive might be carried out in practice. It may be useful to give one rather concrete but also rather mechanical procedure as an illustrative example. Suppose the Committee wants to see the proxy grow at an 8 per cent annual rate over the month ahead. As discussed in earlier sections, this desired 8 per cent rate of growth must then, by one technique or another, be converted into an appropriate monthly percentage change in nonborrowed reserves. Given the average level of such reserves in the previous month, this change can, in turn, be translated into an average level for the month ahead. Now there are any number of possible weekly patterns of changes (or levels) of nonborrowed reserves compatible with the desired monthly average level. Thus there is considerable leeway in making decisions about individual weekly changes (levels) in nonborrowed reserves for the 4 or 5 weeks covered by the period in question. The aim of the Desk in carrying out the Committee's directive should then be to choose levels (or changes in) nonborrowed reserves week by week that (1) average out to the desired level over the month, and at the same time (2) minimize week-to-week fluctuations in the tone of the money market.

One very reasonable way of interpreting (2), the money market "modifier," would be to pick weekly levels of nonborrowed reserves (consistent with the desired monthly average) that seem likely to minimize week-to-week fluctuations in free reserves. If it is assumed that the bulk of week-to-week fluctuations in required reserves are seasonal, and if weekly seasonal factors are computed, a rough pattern for week-to-week fluctuations in required reserves for the month can be projected. Given these projected week-to-week fluctuations in required reserves, the familiar reserve identity associates with every possible weekly change in nonborrowed reserves a corresponding weekly change in free reserves. Thus, given the required reserve projections and the reserve identity, we can solve for that set of week-to-week changes in nonborrowed reserves consistent with the targeted monthly-average level that (a) minimizes the average absolute weekly change in free reserves, or (b) minimizes the sum of the squares of the weekly changes, or (c) equalizes weekly changes, or (d) satisfies some other criterion that seems to capture the idea of smoothing out changes in the tone of the money market.

The possibilities outlined above may seem to suggest that the problem could be solved with mathematical rigor. While this is true in principle for any well-defined notion of "smoothing" free reserves, there would obviously have to be much fudging in practice. First, not all weekly changes in required reserves would be precisely seasonal. Indeed, if they were, there would hardly be any point to the exercise. Second, weekly seasonal factors always involve heavy doses of judgment. Third, there would be misses in hitting nonborrowed reserves. Fourth, midmonth corrections would probably have to be made on the monthly nonborrowed reserves objective whenever it became apparent that the primary objective, the monthly growth rate in the bank credit proxy, was not turning out as targeted. Yet despite these problems, and others that could be mentioned, it still seems reasonable to hope that any given desired monthly change in nonborrowed reserves could be distributed over the month in a way that takes advantage of prior knowledge about seasonal changes in reserve needs and thereby minimizes money market instability. This is really all the proposal amounts to.

A MONEY MARKET PROVISO. A final possible version of the "mixed strategy" idea would be to use a quantity target with a money market conditions proviso, exactly the reverse of the procedure currently in use. In spirit, this suggestion is very similar to the one just discussed. That proposal involves aiming directly for some monthly-average value of a quantity variable, but adjusting the week-by-week path of developments in a way most likely to minimize money market instability. In the present proposal, a monthly value of some quantity variable would again be the objective, but there would be no specific attempt to make week-by-week changes in nonborrowed reserves such as to minimize fluctuations in free reserves. Instead, the concern for reasonable money market stability would be implemented by absolute constraints on the permitted range in the level (or weekly change) in some money market variable such as free reserves or the funds rate. Thus the operational part of the directive might read something like this: "Open market operations shall be conducted in such a way as to encourage the bank credit proxy to grow at an annual rate of about x per cent, except that operations shall be modified when needed to prevent undue stringency or ease in the money market." Again, the last clause could be quantified in the directive itself, or the acceptable limits of fluctuations in free reserves or the funds rate could be more informally communicated. As in previous examples of quantity targets, moreover, the targeted x per cent growth in the credit proxy would of course have to be translated into an appropriate rate of growth for the month in nonborrowed reserves.

In one sense, the money market proviso approach is somewhat more conservative than the approach presented in the previous section since it puts absolute limits on the amount of money market instability that would be permitted in pursuit of the basic quantity target. Thus, for example, if the permissible limits of fluctuations in net borrowed reserves were placed at $800 million to $1,200 million, this pursuit would simply have to be abandoned in any week when the quantity objective appeared to call for a change in nonborrowed reserves that would, in turn, imply a level of free reserves outside the permitted range. Obviously the significance of the money market proviso would depend, in practice, on how wide a range in free reserves (or the funds rate) were to be allowed.

SOME GENERAL CONCLUSIONS

In the last analysis, a decision about targets for open market operations has to be made on the basis of considerations that go beyond the relatively narrow focus of this paper. Consequently any attempt to make recommendations here would be misplaced. A basic question, for example, is whether it is better for the Federal Reserve to attempt to exercise reasonably close control over monetary and bank credit growth rates, or alternatively whether its basic aims can be better served by seeking direct control over the tone of the money market, and thereby exerting an important conscious influence on related financial markets. It would be grossly simple-minded to interpret this issue as a question of "Keynesianism" versus "monetarism." Nevertheless, it is true that some major questions currently agitating monetary economics are involved.

While the relative values to be attached to control over aggregates versus control over the money market are beyond the scope of this paper, considerable attention has been given to the trade-offs between these two objectives. Experience seems to indicate that the System can exert a very high degree of control over money market conditions if it chooses to disregard quantity considerations. By contrast, there is no experience to show what degree of control over monetary aggregates might be possible if such control were to be pursued exclusively and without regard to the effects on the money market. Similarly, there is no experience to show what the cost in terms of money market instability might be. The evidence adduced in this paper has not been able to provide firm answers to these questions. In the nature of the case, a high degree of uncertainty is bound to remain, unless and until the FOMC actually experiments with procedures that depart from current and past practices.

Despite the lack of adequate evidence on the controllability of quantities and on the costs of such control in terms of money market instability, some tentative judgments on these matters can be made. Thus, the prospects for close control of aggregates over monthly periods do not look terribly bright. The slippage between current monthly changes in nonborrowed, or even total, reserves and current changes in the major monetary aggregates appears to be rather large. An advance allowance—even one that is perfectly correct—for the reserves that will be needed to back movements in Treasury deposits helps, but apparently not enough. Further allowance for other types of deposit movements that are similarly insensitive to System operations within a given month and that can therefore be projected more or less independently of the assumed supply of reserves would provide additional help. Time deposits other than large certificates of deposit appear relevant in this connection. Midmonth adjustments in the planned supply of reserves to compensate for unsatisfactory performance in the first part of the month would probably also help significantly in improving control over the month-by-month movements in the aggregates. Nevertheless, despite the improvements obtainable from these various devices, it is still likely to turn out that the systematic response of the banking system to given changes in the rate at which reserves are supplied within a given month would be only moderate relative to other, largely unpredictable determinants of deposit and bank credit behavior within that same month.

On balance, it appears likely that even a policy designed to zero in on the growth rate of some aggregate would still leave the month-to-month behavior of that aggregate importantly conditioned by these random, hard-to-predict developments. Hence the short-term behavior of the aggregates would continue to display a substantial amount of statistical "noise." It does not at all follow from this, however, that the influence of the System might not be dominant in the longer run. A policy of aiming at the growth rate of, say, the money supply might be able to fix the actual growth rate of that target averaged over a multimonth period with a satisfactory degree of precision. The results obtained for quarterly-average figures can be interpreted as reasonably encouraging—again assuming the regression results can be materially improved upon by midcourse corrections, the use of judgment, and so forth. No doubt the results could be improved further if still longer periods were used. Unfortunately, of course, the need to average the behavior of a quantity target over relatively long periods to obtain an acceptable degree of control means that a change in the setting of the target might have a reliable and clearly visible effect on the actual behavior of the target variable only after a similarly long period of time.

The results of this study suggest that the Committee could adopt the use of explicit quantity targets without producing an unacceptable degree of short-term instability in the money market. In part, this conclusion rests on the evidence presented in the section beginning on page 56. That section suggests that movements in the Federal funds rate induced by supplying nonborrowed reserves (not seasonally adjusted) at a constant rate would not be intolerably large. Everyone will recognize the insufficiency of this evidence taken by itself, however. More fundamentally, therefore, the conclusion rests on the belief that allowance for seasonal changes in required reserves—or, better yet, adoption of one of the "mixed strategies" presented in the previous section—would permit fluctuations in money market conditions to be held within tolerable bounds.

Probably the worst that could result from the adoption of one of these mixed strategies would be that neither the aggregate nor the money market would turn out to be regulated with much precision. It could be that given the difficulty of precise control of the aggregates in the short run under even the best of circumstances, and given the compromises that might be needed to hold money market fluctuations within acceptable limits, the behavior of the aggregate target might continue to be dominated by random, or at least uncontrolled, factors. At the same time, both the marginal reserve measures and the Federal funds rate would surely show a less steady, "rational" pattern than is presently the case. As long as laboratory experiments on these matters are impossible, however, such risks are inevitable. Whether they should be taken depends heavily on how much importance is attached to achieving meaningful control over monetary aggregates—as opposed merely to exerting a rather loose "influence" over these magnitudes.

by Leonall C. Andersen

SELECTION OF A MONETARY AGGREGATE FOR USE IN THE FOMC DIRECTIVE

CONTENTS

INTRODUCTION

One suggestion for change in the Federal Open Market Committee directive is to place main emphasis on a stipulated movement in a monetary aggregate. Presumably this would be the best aggregate available for assisting the FOMC in achieving its ultimate economic goals.

There are two general ways in which a monetary aggregate could be incorporated into the directive. First, the desired rate of change in the aggregate could be specified directly in the second paragraph of the directive. This paragraph contains the specific instructions of the FOMC to the New York Federal Reserve Bank for the conduct of open market operations between Committee meetings. The Manager of the open market desk at the New York Federal Reserve Bank is assigned the responsibility for carrying out the directive. Second, a desired rate of change in the chosen aggregate could be specified in the first paragraph of the directive, with instructions given to the Manager in the second paragraph in terms of changes in some other variable that could be more readily observable by the Manager and might be subject to his more direct control. Achievement of the specified movement in this latter variable by the Manager would be expected to produce the FOMC's desired rate of change in the monetary aggregate. In either case, the explicit goal of the FOMC is desired movements in one monetary aggregate. The two procedures just outlined differ only in the short-term operating instruction given to the Manager.

In this paper six monetary aggregates are considered for inclusion in the directive—nonborrowed reserves (Nb), total member bank reserves (TR), the monetary base (B), the narrowly defined money stock (M_1), the money stock plus time deposits at commercial banks (M_2), and bank credit (BC). This paper is concerned primarily with properties of each aggregate as they relate to the ability of the Federal Reserve System to achieve its ultimate goals of desired real product growth and price level stability. Although other papers discuss in detail the ability of the Manager to control various aggregates, this paper merely takes a brief look at this problem.

A GENERAL FRAMEWORK OF THE INFLUENCE OF MONETARY ACTIONS ON THE ECONOMY

The general framework used in this paper for relating the influence of monetary actions to movements in real output and the price level differs greatly from that incorporated in most large-scale econometric models. Monetary actions, summarized by changes in some monetary aggregates, and changes in Federal Government expenditures are viewed as the main determinants of total spending measured in current-dollar gross national product (nominal GNP). A given change in nominal GNP is then divided between a change in real output and a change in the GNP deflator. An important factor in explaining this division is the difference between potential real output in the quarter and actual real output in the preceding quarter. Another factor is past price movements. The specific model relating a particular summary measure of monetary influence (M_1) to output and the price level is presented elsewhere.[1]

In contrast, most econometric models use a building-block approach, which considers that the major influence of monetary actions on both output and the price level is primarily indirect—for example that it operates through interest rates. One building block consists of the major components of GNP and their determinants, which include fiscal actions and other exogenous variables. A second building block, the financial sector, determines a market rate of interest. Finally, the price level is deter-

NOTE.—The author is Vice President, Federal Reserve Bank of St. Louis.

[1] Leonall C. Andersen and Keith M. Carlson, "A Monetarist Model for Economic Stabilization." *Review*, Federal Reserve Bank of St. Louis (Apr. 1970).

mined by a Phillips curve equation or a wage/price mark-up equation. Joint simulations of the three blocks are used to allow interactions among the three blocks. Frequently, the components of GNP in real terms are summed, and this sum is multiplied by the price level to produce an estimate of nominal GNP.

MONETARY AGGREGATES AND MOVEMENTS IN GNP

This section presents empirical evidence that is used to select the best monetary aggregate from those under consideration for inclusion in the FOMC directive. First, the relation between changes in GNP and changes in each aggregate is measured by regression analysis. Second, three criteria are presented for the selection of the "best" aggregate, and relevant data are developed for application of the criteria to each aggregate.

RESPONSE OF GNP TO EACH MONETARY AGGREGATE. As mentioned earlier, monetary actions and changes in Government expenditures are viewed as the major determinants of movements in GNP. Six individual regression equations are run in which quarterly changes in GNP are regressed on current and lagged changes in each of the six monetary aggregates along with, in each regression, current and lagged changes in Government expenditures on goods and services plus transfer payments (ΔE). Ordinary least-squares estimates of parameters are made, by using Almon lags with a fourth degree polynomial and coefficients for $t + 1$ and $t - n - 1$ constrained to zero. The length of the lag period (n) is determined by the minimum standard error of estimate.

The regression results are presented in Table 1. The fits of the equations seem to be very good, considering that first differences are used. The smallest R^2 is 0.52 for nonborrowed reserves, and the largest is 0.67 for bank credit. The Durbin-Watson statistic indicates small likelihood of serial correlation in any of the residuals. Most of the regression coefficients are statistically significant from zero at the 5 per cent level.

Some may be surprised by the positive coefficients for Government expenditures for a few quarters followed by negative coefficients. In every regression, the sum of the coefficients for ΔE is not statistically significant from zero at the 5 per cent level. Each regression may be viewed as measuring the response of GNP to changes in a monetary aggregate with Government expenditures held constant and its response to changes in Government spending with the monetary aggregate held constant. In the latter case, Government expenditures are financed by taxing or borrowing from the public. In such an instance, Government expenditures may, over time, crowd out an equivalent amount of private expenditures, thereby accounting for the observed pattern of regression coefficients.

In most econometric work, the question of simultaneous-equation bias is always present. The appendix discusses this question in some detail and highlights the unsettled nature of this problem. In summary, formal discussions of bias are based on the asymptotic properties of large-size samples, and little is known about bias in the limited, finite samples available in economic research, and even these discussions do not apply to the case in which lagged endogenous variables appear. Moreover, one of the papers cited in the appendix shows that, in small samples with no lagged endogenous variables in a regression, if ordinary least squares (*OLS*) are biased, then two-stage least squares (*TSLS*) estimates are also biased, although under certain circumstances the degree of bias is smaller. *TSLS* estimates are commonly used to handle the bias problem.

Bias, however, is not the only undesirable property of an estimation procedure; a large variance of parameter estimates is also undesirable. It is well known in statistics that parameters estimated by *OLS* have smaller variances than those estimated by *TSLS*. Thus, in selecting estimation procedures, one may have to trade off bias against larger variance of parameter estimates. The appendix cites both a demonstration and experimental results to show that the mean-squared error statistic—which combines bias and variance of parameter estimates into one number—can, in certain circumstances, be considerably greater for *TSLS* than for *OLS*. In view of the unsettled nature of these issues in economic research, there is no clear-cut case for asserting that there is obviously a large bias in the *OLS* parameter estimates presented in Table 1, or that the bias is of such a magnitude as to more than offset the gain from a smaller variance of parameter estimates.

BASIS FOR SELECTING A MONETARY AGGREGATE. Three criteria are used in this study for selection of a monetary aggregate for monetary management. First, it should perform best in terms of goodness of fit relative to the five other aggregates in the sample period used to relate changes in GNP to changes in each monetary aggregate. Second, and more importantly, the aggregate selected should produce the smallest forecasting errors in *ex ante* forecasts of changes in GNP made beyond the sample period. Third, the aggregate should perform best with regard to the ability of the Federal Reserve to control its movements.

In the sample period 1953-I to 1969-III, there is virtually no difference in the fit of the regressions for the equations involving M_1, M_2, B, and BC (Table 1). The R^2's range from 0.65 for the monetary base to 0.67 for bank credit and, similarly, the standard errors of estimates (SEE) range from 3.79 to 3.93. The fit of the regressions involving TR and Nb are not so close—with R^2's of 0.52 and 0.59 and SEE's of 4.26 and 4.63. For these last two regressions the Durbin-Watson statistics are also lower. On the basis of sample-period statistics, M_1, M_2, B, and BC all seem to perform equally well, and they all perform better than Nb and TR.

The *ex ante* forecasting ability of each equation was tested for successive eight-quarter periods beginning with 1965-I. For example, each regression equation was estimated for 1953-I to 1964-IV; then quarterly forecasts of changes in GNP for 1965 and 1966 were made by using the parameters estimated for the sample period. This procedure assumes

TABLE 1: Minimum Standard Error Regressions (1953-I–1969-III)

Item	(1) ΔM_1	ΔE	(2) ΔM_2	ΔE	(3) ΔB	ΔE	(4) ΔTR	ΔE	(5) ΔNb	ΔE	(6) ΔBC	ΔE
Quarters												
t	1.231*	.589*	−.074	.277	3.310*	.415*	2.192	.386	2.315*	.192*	.072	.255
t-1	1.787*	.442*	.548*	.370*	6.248*	.164	7.349*	.342*	3.842*	.265*	.631*	.335*
t-2	1.600*	−.021	.935*	.084	7.058*	−.235*	11.021*	.081	4.741*	.254*	.893*	.074
t-3	.875*	−.440*	.732*	−.444*	5.159*	−.459*	10.850*	−.192	5.153*	.190	.606*	−.399*
t-4	.091	−.513*	.156	−.740*	1.145	−.382*	6.568*	−.281	5.205*	.098	.042	−.662*
t-5					−3.213*	−.071			5.004*	.002		
t-6					−4.969*	.210			4.643*	−.083		
t-7									4.198*	−.143*		
t-8									3.729*	−.172*		
t-9									3.277*	−.166*		
t-10									2.871*	−.126		
t-11									2.518*	−.058		
t-12									2.213	.026		
t-13									1.931	.112		
t-14									1.634	.179		
t-15									1.264	.203		
t-16									.750	.154		
Sum	5.583*	.057	2.297*	−.453	14.738*	−.358	37.979*	.336	55.287*	.927	2.243*	−.396
Constant	2.669*		1.532		2.506*		.846		−2.664		.972	
R^2	.66		.66		.65		.59		.52		.67	
D.W.	1.75		1.70		1.73		1.50		1.30		1.73	
SEE	3.88		3.86		3.93		4.26		4.63		3.79	

* Values are significant at the 5 per cent level.

that the values of the independent variables for the forecast period were known in 1964-IV. Next, the regressions were rerun to include an additional year, and quarterly forecasts were made for the next 2 years. This procedure was repeated until the sample period ending with 1968-IV was reached.

Two statistics are developed for each successive 2-year forecast period to compare the forecasting abilities of the six equations. The average-squared residual between the actual and the forecasted quarterly changes in GNP are calculated for each year of a forecast period and for each whole 2-year period. The second statistic is the standard error of forecast for each quarter of a 2-year forecast period. The standard error of forecast takes into consideration the stochastic element in each equation, the variance of the parameters estimated for the sample period, and the variability of the independent variables in the forecast period.

Table 2 presents the average squared residuals for each equation. For every 2-year forecast period as a whole, the equation for M_1 has the lowest average squared residual. Although in a few cases some of the other five equations for an individual year have smaller average squared residuals than the M_1 equation, their average squared residuals vary considerably more from year to year than in the case of the M_1 equation. For example, forecasts of changes in GNP based on a 1953–65 regression for BC have average squared residuals of 2.7 for 1966 followed by 60.1 for 1967. The comparable averages for M_1 are 10.7 and 12.1.

The average standard error of forecast and its variance over each 2-year forecast period are presented in Table 3. In most forecast periods there is little difference between the average standard error of forecasts for each regression, except for Nb, which consistently has the largest average standard error of forecast. However, there is considerable difference in the variability of the standard errors of forecast. In almost every case, its variance for forecasts of changes in GNP based on M_1 regressions is relatively small and for three forecast periods is the smallest.

This paper covers only two aspects of the System's ability to control monetary aggregates. These are the magnitude of the control problem and the present flow of information on which control would be based. The prob-

TABLE 2: Average Squared Residuals of GNP Forecasts Based on Monetary Aggregates

Sample period	Forecast period	ΔM_1	ΔM_2	ΔB	ΔTR	ΔNB	ΔBC
1953-I–1964-IV							
	1965	20.9	22.4	35.2	31.2	38.5	25.7
	1966	7.1	13.9	63.5	19.2	10.3	6.1
	Average	14.0	18.2	49.4	25.2	24.4	15.9
1953-I–1965-IV							
	1966	10.7	9.3	28.3	16.2	17.1	2.7
	1967	12.1	47.5	69.7	53.1	105.0	60.1
	Average	11.4	28.4	49.0	34.7	61.1	31.4
1953-I–1966-IV							
	1967	16.1	44.8	52.0	45.8	65.5	62.0
	1968	11.8	13.4	1.3	1.1	16.6	3.8
	Average	14.0	29.1	26.7	23.5	40.6	32.9
1953-I–1967-IV							
	1968	11.2	8.9	2.2	1.1	36.7	0.8
	1969*	7.0	38.2	19.4	28.7	34.2	24.6
	Average	9.1	23.6	10.8	14.9	35.5	12.7
1953-I–1968-IV							
	1969*	9.1	28.0	20.6	30.3	20.2	26.5
	Average	9.1	28.0	20.6	30.3	20.2	26.5

* Forecast period consists of only three quarters.

TABLE 3: Comparison of Standard Error of Forecast

Sample period	Forecast period [1]					
	ΔM_1	ΔM_2	ΔB	ΔTR	ΔNB	ΔBC
1953-I–1964-IV						
Mean	5.26	5.25	5.16	5.05	7.09	4.67
Variance	.25	.62	.27	.10	.86	.10
1953-I–1965-IV						
Mean	5.67	6.26	5.71	5.61	8.39	5.28
Variance	.17	.48	.15	.15	1.58	.23
1953-I–1966-IV						
Mean	5.41	5.71	5.42	5.24	8.75	5.16
Variance	.06	.49	.19	.12	.53	.12
1953-I–1967-IV						
Mean	4.90	5.01	5.01	4.99	8.69	5.13
Variance	.03	.32	.17	.04	.11	.12
1953-I–1968-V						
Mean	5.70	5.25	4.65	4.75	7.74	5.06
Variance	[2]	.17	.07	.03	.06	.02

[1] The forecast period for each of the sample periods ending 1964, 1965, and 1966 is eight quarters; for the sample ending 1967, seven quarters; and for the sample ending 1968, three quarters.
[2] Less than .005.

lem of control is investigated by partitioning the six monetary aggregates into two classes. The first class consists of those considered to be more closely related to GNP—M_1, M_2, and BC; the second set consists of those considered to be subject to closer Federal Reserve control —B, TR, and Nb.

The Brunner-Meltzer framework provides an approach for investigating the ability of the Federal Reserve to control M_1, M_2, and BC. This approach views each of these aggregates as the product of the appropriate multiplier (m_i) and the monetary base. The values of the m_i's reflect actions of the public, commercial banks, and the Government as they influence movements in each of the three aggregates. The monetary base reflects actions of the Federal Reserve. To reach a desired level of one of these aggregates, the monetary base would be changed to compensate for movements in the appropriate multiplier.

Within the multiplier-base framework, there is a smaller problem of controlling M_1 due to actions of the public, commercial banks, and the Government (variations in the M_1 multiplier) than for M_2 and BC. Multipliers were developed for M_1, M_2, and BC (monthly averages of unadjusted data [2] for January 1960 to November 1969), and the standard deviations and ranges of monthly changes in each multiplier were calculated. The standard deviations are: 0.008 for ΔM_1, 0.017 for ΔM_2, and 0.018 for ΔBC. Given the monetary base and the level of each aggregate for November 1969, these standard deviations in annual rate of change in each aggregate are: 3.6 per cent for M_1, 4.0 per cent for M_2, and 4.3 per cent for BC. Similar rates of change for the range of variation in these multipliers are: 23 per cent for M_1, 26 per cent for M_2, and 46 per cent for BC. Thus, there is smaller variability in M_1 due to variations in its multiplier, thereby creating a lesser control problem than in the cases of M_2 and BC.

The question remains of the ability of the Federal Reserve to control the monetary base relative to its ability to control member bank reserves and nonborrowed reserves. Table 4 lists the factors determining each of these aggregates. If the Federal Reserve were to meet a desired level of one of these aggregates, its holdings of U.S. Government securities would be adjusted so as to offset movements in the sum of all other factors. Changes in monthly-average levels (unadjusted data, January 1960

[2] Monthly averages for BC were approximated by averaging end-of-month data for the current and previous month. This procedure may tend to overstate the variability in BC.

to November 1969) of factors other than System holdings of U.S. Government securities were calculated for *B*, *TR*, and *Nb*. The standard deviations of these changes are little different for each aggregate—0.412 for total reserves, 0.437 for nonborrowed reserves, and 0.443 for the monetary base. These standard deviations in terms of annual rates of change from November 1969 levels are substantially different—7 per cent for the monetary base, 18 per cent for total reserves, and 20 per cent for nonborrowed reserves. It appears that the control problem, as measured above, is less for the monetary base than for the two reserve aggregates.

The preceding analyses of controlling each of the six monetary aggregates considered only the comparative magnitudes of variations in each aggregate from sources not under direct System control. The ability to forecast such variations was not examined on a comparative basis.

Finally, let us consider the data requirements for controlling *B*, *TR*, and *Nb*. Table 4 demonstrates the difference among these three aggregates regarding the data required to control each. All of the data required to control the monetary base are required to control the other two. In addition, both *TR* and *Nb* require information on currency in circulation and its distribution beween member banks, nonmember banks, and the nonbank public. Currency movements can cause wide seasonal movements in *TR* and *Nb*, thereby adding to the control problems for these two aggregates beyond those caused by similar movements in factors common to all three of these aggregates. From a data standpoint, the monetary base appears easier to control than total reserves or nonborrowed reserves.

TABLE 4: Factors Affecting Monetary Base, Total Reserves, and Nonborrowed Reserves of the Banking System, July 1969 [1]

Monthly averages of daily figures in millions of dollars

Item	Sources of base		Total reserves and nonborrowed reserves of banking system	
Federal Reserve credit		[2] 60,888		[2] 60,888
Holdings of securities	54,298		54,298	
Member bank borrowings from F.R.	1,190		1,190	
Other borrowings				
F.R. float	2,684		2,684	
Other F.R. assets	2,670		2,670	
Gold stock		10,367		10,367
Treasury currency outstanding		6,737		6,737
Treasury cash holdings		− 657		− 657
Deposits at the F.R. (other than member bank deposits)		− 1,732		− 1,732
Treasury	− 1,117		− 1,117	
Foreign	− 142		− 142	
Other	− 473		− 473	
Other F.R. liabilities and capital		− 2,038		− 2,038
Currency in circulation				−51,256
Source base		73,565		
Reserve adjustments [3]		3,876		
Monetary base		77,441		
Member bank reserves with the F.R.				22,309
Currency held by member banks (allowed as required reserves)				4,671
Total reserves of member banks				26,980
Currency held by nonmember banks				[e]1,432
Reserve adjustments [3]				3,876
Aggregate reserves of the banking system				32,288
Member bank borrowings from the F.R.				− 1,190
Nonborrowed reserves				31,098

[1] Not adjusted for seasonal variation.

[2] Includes $46 million acceptances not shown separately.

[3] Adjustments for changes in reserve requirements, shifts in deposits between time deposits and demand deposits, and shifts among classes of banks.

[e] Estimated.

Source.—Federal Reserve *Bulletin*.

RECOMMENDATION

The results of this study, in my opinion, suggest that among the six monetary aggregates investigated, M_1 would be the best to include in the FOMC directive. The regressions for the sample period of changes in GNP on the six aggregates indicate that total reserves and nonborrowed reserves would be inferior to the other four. The *ex ante* forecasting experiment indicates that M_1 performs the best. With regard to our ability to control movements in M_1, M_2, and (Bank Credit), evidence was presented that M_1 would be subject to closer control.

These results lead me to recommend that M_1 be incorporated in the Committee's directive, preferably in the instructions to the Manager. If it is believed that there exists a major problem of controlling M_1 and that it would be desirable to give operating instructions in terms of some other aggregate, I recommend the monetary base. Among the aggregates influenced more closely by the Federal Reserve (Nb, TR, and B), control of the monetary base appears to have fewer problems. In such a case, however, I also recommend that desired movements in M_1 be specified in the first paragraph of the directive. Implicit in this study is the assumption that the Manager's instructions be in terms of annual rates of change in quarterly averages of M_1 and/or B.

APPENDIX:

Estimation Aspects of the "Simultaneous Equations Bias" Issue

by H. Albert Margolis

This appendix surveys the general state of knowledge regarding the problem of "simultaneous equations bias." Such bias is said to arise when one applies ordinary least squares (OLS) estimation procedures to an equation in which a critic feels at least one of the independent variables is not predetermined, that is, all of the independent variable's current and past values are not independent of the current random disturbance term ([2], p. 353).

In statistical terms, if all but one of the variables in an estimated equation are exogenous, then OLS yields estimators with desirable properties. In particular, the bias is zero, that is, the difference between the expected value of the estimator and the true parameter is zero.[1] If there is more than one endogenous variable in the estimated equation, "classical least-squares applied to the individual structural equations yield biased estimates of their parameters" ([6], p. 385). This is the standard textbook assessment of the situation. Oi's ([11], p. 36) statement is that when "two or more variables in an equation are simultaneously determined by some larger system of equations," then OLS "will produce asymptotically biased parameter estimates." [2]

For purposes of specific discussion, let us take an equation that has been estimated by ordinary least squares in which changes in GNP are considered to be a function of present and lagged values of changes in indicators of monetary influence—for example, the money supply—and present and lagged values of changes in Government expenditures. The question is raised as to how much reliance can be placed on the estimated coefficient of the money supply in the current time period. The critics who raise this question assert that the money supply is an endogenous variable. In such a case, a statistically complete system would require at least one additional equation accounting for the behavioral mode by which GNP reacts back on the money supply.

Most textbooks point out that, "In recursive models [3] of the type advocated by Wold . . . single-equations least-squares estimators are consistent ([5], p. 14)." But this is simply begging the question in the equation under discussion. Critics of the equation are asserting that the system is not causal—that is, that there is indeed reverse causation from GNP to money. It seems natural to ask these critics to indicate the form of the reverse causation.

The question might be stated informally, "When should one of the explanatory variables be considered endogenous and an additional structure equation added to the model?" Christ ([2], p. 157) elaborates on this point as follows:

NOTE.—The author is an Economist at the Federal Reserve Bank of St. Louis.

[1] The definitions of technical terms used in this appendix can be found in most econometric texts (for example 2, 6, 7). For the convenience of the reader, a few basic definitions are given here in a relatively informal phrasing. An estimator is *consistent* if its probability distribution tends to become stacked completely above the true parameter as the sample size increases beyond a certain value. An estimator is *asymptotically unbiased* if the mean of the estimator approaches the true parameter as the sample size increases. The former is a stronger property than the latter. They are both "large sample" properties.

[2] Sawa ([13], p. 932) shows that under very special circumstances the small sample bias of both OLS and TSLS (two stage least squares) disappears.

[3] A system is recursive if the equations in it can be ordered so that in the first equation only one endogenous variable appears and in each succeeding equation only one new endogenous variable appears in addition to previously included endogenous variables. In addition, the covariance matrix of the disturbance terms is diagonal.

> For there is no point in the enlargement of most models at which a convincing stand can be made against such arguments for the addition of another equation—unless it is the point where all possible variables have already been included, and of course the model would then be utterly unmanageable. What the economist should do in practice, therefore, in my opinion, is to stop adding equations and variables when he believes that the variables he chooses to call exogenous meet the definition *closely enough* so that the errors incurred through the discrepancy are small in comparison with the degree of accuracy that he thinks is desirable for his purpose (or is attainable). This is necessarily a somewhat arbitrary decision, for, unlike the other variables, the random disturbances by their nature can never be observed either. These decisions, like other decisions about what the form of each equation is to be and what variables are to be excluded from each, must be made on the basis of whatever presumptions seem plausible in the light of economic theory and experience. The model itself can be definitively tested only after it is confronted with new data. If it proves reasonably accurate all may be well, and if not, it is likely that at least one wrong assumption was made somewhere.

This seems to say that there is no statistical way to test whether an assumption that a variable is exogenous is correct.[4]

A survey of basic econometric texts shows two discussions in which techniques are mentioned by which the single-equation format is retained.[5] Christ ([2], pp. 457–63) follows Bronfenbrenner [1] and suggests that attempts be made to determine the range of possible error in the estimate by making assumptions about the unobservable error term in the equation. This seems extremely arbitrary. Kane ([8], pp. 313–18) gives an example in which Ferber avoids an overestimate of the marginal propensity to consume by estimating the marginal propensity to save. In other words, bias in favor of a particular hypothesis is reversed (but not eliminated). This strategem is more easily adopted because in the example—as in most discussions of simultaneous equation bias—the second equation is an identity. On the whole, these suggestions do not seem useful in the present circumstances.

We proceed now to the question as to what the situation involves if we feel there should be a second endogenous variable in the estimated equation. In other words, let us examine the situation as envisioned by the critics. As soon as the money supply is considered to be endogenous, conceptually we have a larger system in which one equation is the GNP equation; now lagged values of an endogenous variable—money supply—occur in the GNP equation. We are then faced with a choice among various estimation procedures—OLS, TSLS, other forms of limited information methods, and full information methods. The latter two procedures have not been widely used in practice. The choice seems to narrow to one between OLS and TSLS.

Fisher ([4], p. 602) points out that TSLS estimators share with other limited information methods certain practical difficulties when used in economy-wide econometric models with lagged endogenous variables. The first stage of estimation (the reduced form) may be difficult. The inclusion of lagged endogenous variables "raises considerable difficulties in the likely presence of serial correlation of the disturbances."

According to Walters ([9], p. 189), a choice between OLS and TSLS can be made on the basis of the purpose of the estimation. If our purpose is to predict an endogenous variable, OLS will yield unbiased and best estimators while those of TSLS are biased and inefficient. On the other hand, if our purpose is to estimate structural parameters, then OLS gives biased and inconsistent estimators while those of TSLS are consistent "although biased in small samples."[6]

This reference to the small sample properties of TSLS estimators seems very relevant, and we pursue it by quoting first from several textbooks and finally by referring to a recent paper that addresses itself directly to this question.

Fisk ([5], p. 6) comments:

[4] To emphasize this, we should point out that a necessary condition for zero bias under OLS estimation is that the independent variables not be correlated with the error term ([4], p. 591). But the error term is unobservable. We have the residual as only an approximation, and the estimates are constructed so that the expected value of the product of the residual and the independent variable is zero.

[5] Reference should be made to T. Haavelmo, who is usually credited with the discovery of the bias (cf.[10]).

[6] The results indicated in this paragraph apply only if there are no lagged endogenous variables included; otherwise there are no known finite sample results.

> It is not obvious that this lack of consistency (of single-equation least-squares) should always cause concern, particularly when dealing with small samples for which the alternative consistent estimator may have grossly inflated variances compared with the biased estimator given by (least-squares). We must always balance the desirability of consistent estimators against the other criteria by which we judge estimators—principally: degree of precision of the estimator and ease of calculation.

Goldberger ([6], p. 360) points out:

> . . . for small samples the second moments of the classical least-squares estimators (about the true parameter values) may be less than those of the TSLS estimators—their variances may be sufficiently small to compensate for their bias. It should be emphasized, however, that as the sample size increases, the variance of both classical least-squares and TSLS tend to zero, but the bias of classical least-squares persists.

Christ ([2], p. 466) gives a table of properties of various types of estimators in a model that admits lagged endogenous variables. It shows that OLS yields inconsistent estimators in general, although with a small variance. The various other estimation procedures are shown to yield consistent estimators. It should be remembered, however, that consistency is an asymptotic property and is frequently used as a criterion only because there are very few results dealing with small sample properties.

Among the first steps toward the latter goal—that is, working with the exact distribution functions of OLS and TSLS estimators—is an important paper by Richardson and Wu [12]. This paper shows that in a case similar to the GNP equation, with the important and vital differences that the Richardson and Wu case does not admit lagged endogenous variables, TSLS estimators are unbiased if, and only if, OLS estimators are unbiased. It is not possible to derive the size of the bias from these results, but the relative bias of TSLS and OLS as a function of various parameters is tabulated. The values vary from almost one to almost zero as the sample size ranges from approximately 10 to approximately 100.

In another paper Sawa [13] derives the exact sampling distributions of OLS and TSLS estimators of a structural parameter in a structural equation with two endogenous variables. The exact distributions are "essentially similar," and in a numerical example he finds that the plotted distributions are "surprisingly similar," with the bias of each always in the same direction.

These results do not apply in a rigorous sense to the case discussed in this study, because, thus far, they have not been extended to include lagged endogenous variables. On the other hand, in a very similar sense, the criterion of consistency is not relevant to models with a finite sample size but it is used for lack of a better criterion.

The Richardson and Wu and the Sawa papers are among the few dealing with the exact distribution of the various estimators. Most works dealing with small sample properties have used Monte Carlo experiments. Fisher ([4], pp. 604–05) points out that even these results do not apply to the case in which lagged endogenous variables appear.

The quotes from Fisk and Goldberger suggest that the small variance of OLS may compensate for any bias. The mean-square-error criterion discussed in Johnston ([7], pp. 276–77) combines the effects of these two pathologies, variance and bias. The author (p. 294) rejects OLS on the basis of the bias even though he cites some studies that show OLS performing well on the mean-square-error criterion. Goldberger ([6], pp. 362–63) also opts for TSLS even though in the principal study he indicates that "the variance of OLS was sufficiently small to give it generally the smallest second moment . . ."

Sawa ([13], p. 933) suggests that TSLS is preferable but with some qualifications:

> Indeed the TSLS estimator seems to dominate the OLS estimator in every case, but, in certain cases, this dominance is not readily observable. Furthermore, the bias of the TSLS estimator is not negligible. Consequently, it may be said that the TSLS estimator is not such a good estimator as expected in finite samples.

The Richardson and Wu paper ([12], pp. 11–13) gives more perspective on this issue by presenting a table that derives the exact ratio of expected mean-square errors of TSLS and OLS estimators as a function of several parameters. The values in the table range from 9.5 to 0.04 as the sample size ranges from approximately 10 to approximately 100. This means that it is possible for either TSLS or OLS to enjoy a considerable advantage over the other according to the mean-square-error criterion. The caveat is repeated that the formulas used in this study do not include the lagged endogenous case. But then, as we have seen, neither the theoretical large sample properties nor the Monte Carlo small sample results apply in a firm fashion to the present case.

For a last note of nihilism in the simultaneous-equation bias controversy we quote Fisher ([4], p. 590), who points out that "very few results are available on the relevant robustness—the relative degree to which they (various estimators) stand up to such things as multicollinearity, specification error, and serial correlation in the disturbance of the model." Evans ([3], p. 5) refers to results obtained by Klein, which suggest that, when multicollinearity is present, it is the more complex methods of estimation other than OLS that are more susceptible to bias.

Christ ([2], pp. 480–81) summarizes by saying "it is not yet clear that the least-squares method for structural estimation is dead and should be discarded. . . . For structural parameters, least-squares sometimes are preferable to simultaneous-equations methods (probably especially where samples are small and specification error is present). . . ."

Oi ([11], p. 45) quotes Theil approvingly:

> Therefore, after reviewing all arguments we should conclude that although the method of least-squares can no longer claim to have the brilliant properties which earlier econometricians thought it had, it can be regarded as one of the few one-eyed men who are eligible for king in the country of the blind—at least as far as experimental small-sample estimation unaided by significant *a priori* information is concerned.

Estimates of regression coefficients and the determination of lag structures cannot be accomplished with certainty. The fact that we have lagged variables and that we have only small samples, while our statistical techniques refer chiefly to large sample properties with current values, only highlights the unsettled nature of measuring economic relationships. The controversy over the choice of estimation procedures is far from being settled when skeptics have a larger arsenal of weapons to use in critizicing research results than constructive researchers have for their purposes. "These problems must be faced, however, if an attempt is to be made to estimate the structure of the economy by empirical methods. Rejecting all empirical results out of hand because of visible disagreement among different studies will not help bring about a solution to these problems." ([3], p. 2)

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by John Kareken, Thomas Muench, Thomas Supel, and Neil Wallace

DETERMINING THE OPTIMUM MONETARY INSTRUMENT VARIABLE

CONTENTS

INTRODUCTION

For some time monetary economists and officials have been debating how central banks ought to operate. Should the Federal Reserve, for example, seek to control one or another of the monetary aggregates? And if so, which one? Or should it control some interest rate or rates?

We do not know how the Federal Reserve, or for that matter any other central bank, ought to operate. We do, though, know what seems to us a not unreasonable way of deciding; a way, that is, of determining the optimum monetary instrument variable. And in this paper we explain or, better, illustrate our way.

The central bank that is certain about the economic structure constraining it or does not care about the variance of policy outcomes can, with complete indifference, use any possible instrument variable. It is difficult, however, to imagine any central bank being certain or not caring about the variance of policy outcomes. The presumption must therefore be that most if not all central banks have a true choice to make: namely, which of all possible instrument variables to use.[1] And what we would have central banks do is decide by maximizing their respective expected utilities; or in other words, by comparing the maximum expected utilities associated with all the various possible instrument variables. What in effect we would have the Federal Reserve do is calculate alternative opportunity loci, there being one such for each possible instrument variable, and then, having specified values for its target variables, determine which of these loci or constraints allows it to achieve the greatest expected utility. We would have the Federal Reserve do this not once but, since the cost is not much, at the beginning of every policy period.

Nor is it impractical to suggest this. However complex the underlying economic structure, opportunity loci can be calculated. In Section I, we use a very simple economic structure. But we do so only because our purpose there is to explain our way of determining the optimum monetary instrument variable; and it is convenient in explaining to use a simple structure. In Sections II and III, wherein we derive actual Treasury bill rate and demand deposit loci, we use the Federal Reserve–MIT–University of Pennsylvania economic structure, which is very complex.[2]

We do then provide some numbers or experimental findings. We would caution, however, against paying much attention to them. They are not, we think, even suggestive of how the Federal Reserve ought to operate. We decided to include them in the paper only because they show that our way of determining the optimum monetary instrument variable is practical.

But our way is practical or feasible only for myopic central banks, for those concerned only about current-period developments or, by way of approximation, willing to pretend that they are. It is no accident that in Sections I and II we take utility as depending simply on current-period nominal gross national product and in Section III as depending on current-period real GNP and the current-period change in the price level. Had we taken utility as depending on future-period values as well, we would not have been able to go further; we would not have been able to show the practicability or feasibility of calculating and comparing the maximum expected utilities associated with the various possible instrument variables.

NOTE.—Messrs. Kareken, Muench, and Wallace, all of the Economics Department, University of Minnesota, are Consultants to the Federal Reserve Bank of Minneapolis; Mr. Supel is Senior Economist at that Bank. They would like to thank Arthur Rolnick for his very considerable help, and the Minneapolis Bank for its financial support.

[1] See W. Poole, "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model," *Quarterly Journal of Economics*, (May 1970), and J. Kareken, "The Optimal Monetary Instrument Variable," *Journal of Money, Credit, and Banking*, (Aug. 1970).

[2] Hereinafter, we shall refer to the FR structure. There is, we understand, a new version. If so, we used an old version, the one described in part by F. de Leeuw and E. Gramlich in "The Federal Reserve-MIT Econometric Model," Federal Reserve *Bulletin*, (Jan. 1968).

It is not known what policies are optimal for a central bank that is uncertain about the true values of structural parameters and whose concern extends into the future.

We might have proposed comparing the expected utilities of arbitrary rather than optimal policies. But which ones? Or we might have proposed that variances of structural parameters be ignored. It seemed to us, however, that uncertainty about parameters is an important fact of life and that we ought therefore to take utility as depending only on current-period values of target variables.

Some readers might want to object that the Treasury bill rate and the stock of demand deposits are not possible Federal Reserve instrument variables. We believe, though, that the Federal Reserve if it wanted to could determine the bill rate exactly. It would only have to announce a price for bills. And is coming quite close to some preassigned value for, say, the 3-month average of demand deposits impossible? We think not. But it does not really matter if we have been inept in selecting possible Federal Reserve instrument variables. Our way might be used for choosing between (or among) other possible instrument variables.

I. QUADRATIC UTILITY AND A SIMPLE ECONOMIC STRUCTURE

Let the monetary authority's utility function be

$$U = -(Y - \bar{Y})^2$$

where Y is nominal current-quarter GNP and $\bar{Y}$ is the desired or target value of Y. Then

$$EU = -VY - (EY - \bar{Y})^2$$

where E stands for expected value and V for variance. Iso-expected utility contours are parabolas, symmetric about $EY = \bar{Y}$, in the positive quadrant of the (EY, VY) plane. The relevant opportunity loci, or constraints subject to which EU is maximized, are therefore all attainable combinations of EY and VY.

Let the economic structure be

$$(1) \qquad Y = s_0 + s_1 r + e_1$$

and

$$(2) \qquad m = s_2 + s_3 Y + s_4 r + e_2$$

Equation 1 describes nominal aggregate demand as a function of the interest rate, r, and equation 2 the condition for equality between the actual stock of demand deposits, m, and the desired stock. The monetary authority is uncertain about the values of the parameters, $s_0, s_1, \ldots, s_4$ and about the values of the disturbances e_1 and e_2.

If r is used as the instrument variable, the reduced-form equation for Y is equation 1. If m is used as the instrument variable, it is

$$(3) \qquad Y = s_5 + s_6 m + e_3$$

where

$$s_5 = \frac{s_4 s_0 - s_2 s_1}{s_4 + s_1 s_3}$$

$$s_6 = \frac{s_1}{s_4 + s_1 s_3}$$

and

$$e_3 = \frac{s_4 e_1 - s_1 e_2}{s_4 + s_1 s_3}$$

From these reduced forms, the two loci can be obtained. To illustrate, from equation 1,

$$(4) \qquad EY(r) = Es_0 + rEs_1 + Ee_1$$

and

$$(5) \qquad VY(r) = V(s_0 + e_1) + r^2 Vs_1 + 2rC(s_0 + e_1, s_1)$$

where C stands for covariance. Solving equation 4 for r and substituting the result into equation 5 gives the r-locus

$$(6) \qquad VY(r) = c_0 + c_1 EY(r) + c_2[EY(r)]^2$$

where

$$c_0 = V(s_0 + e_1) + \frac{Vs_1[E(s_0 + e_1)]^2}{(Es_1)^2} - \frac{2E(s_0 + e_1)C(s_0 + e_1, s_1)}{Es_1}$$

$$c_1 = \frac{2C(s_0 + e_1, s_1)}{Es_1} - \frac{2Vs_1E(s_0 + e_1)}{(Es_1)^2}$$

$$c_2 = Vs_1/(Es_1)^2$$

Equation 6 gives all combinations of EY and VY attainable when r is used as the instrument variable.

The opportunity locus for m, the m-locus, is obtained in the same way as the r-locus was, but from equation 3.

As we show in Section II, traditional or classical estimation of equations 1 and 2 provides the basic information needed to determine numerical values for the coefficients of the r-locus (that is, for c_0, c_1, and c_2) and for the coefficients of the m-locus. And with numerical opportunity loci, the monetary authority can determine its optimum instrument variable. All it has to do is specify a target value for Y.

It is worth pausing briefly here to consider what it means to determine numerical opportunity loci by traditional estimation of the economic structure. Each variance of possible outcomes of Y, for example $VY(r)$, combines true randomness in the economy and uncertainty about the values of structural parameters. Indeed, $VY(r)$, like $VY(m)$, is a forecast variance; that is to say, a variance of forecast Y around "true" or actual Y. To be sure, the randomness of "true" Y is entirely attributable to e_1 and e_2. But the monetary authority, in making its instrument variable choice, must also be influenced by how certain it is about parameter values. Suppose that when m is used as the instrument variable, Y is partly determined by some parameter the value of which is extremely uncertain; and when r is used as the instrument value, Y is not determined even in part by this parameter. If at all averse to risk, the monetary authority should then, *ceteris paribus*, use r as its instrument variable.

II. QUADRATIC UTILITY AND A COMPLEX ECONOMIC STRUCTURE

The FR economic structure is, as we have said, very complex. There are many behavioral equations, some of which are nonlinear. It can be written

$$F_i(x, z, r, \alpha_i, e_i) = 0 \qquad (i = 1, 2, \ldots, K)$$

where x is a vector of the current values of endogenous variables, K in number; z is a vector of contemporaneous, nonpolicy exogenous variables; r is the rate on 3-month Treasury bills; α_i is a vector of parameters; and e_i is a disturbance. If all nonlinear terms in x and r are approximated by first-order Taylor expansions, then the structure can be written

$$Ax = Br + C \tag{7}$$

where A is a KxK matrix with elements a_{ij}; B is a $Kx1$ matrix with elements b_{ij}; and C is a $Kx1$ matrix with elements c_i. Also,

$$a_{ij} = f_{ij}(x^0, z, r^0, \alpha_i, e_i)$$

$$b_{ij} = g_{ij}(x^0, z, r^0, \alpha_i, e_i)$$

and

$$c_i = h_i(x^0, z, r^0, \alpha_i, e_i)$$

where x^0 and r^0 are the values of x and r used in making the model linear. It follows that

$$x_1 = Y = d_{11}r + d_{10} \tag{8}$$

and

$$x_2 = m = d_{21}r + d_{20} \tag{9}$$

where $d_{j1} = A_j^{-1} B$, A_j^{-1} being the jth row of A^{-1}, and $d_{j0} = A_j^{-1} C$. Then

$$Y(r) = d_{11}r + d_{10}$$

and

$$Y(m) = \left[\frac{d_{11}}{d_{21}}\right] m - \left[\frac{d_{20}d_{11} - d_{10}d_{21}}{d_{21}}\right] = D_{11}m + D_{10}$$

So what is required are estimates of the first two moments of the vectors (d_{11}, d_{10}) and (D_{11}, D_{10}). But since the d's and D's are complicated functions of the underlying random variables—the parameters α_i, the disturbances e_i, and the contemporaneous values of noninstrument exogenous variables z_i—their distributions cannot be derived analytically from the distributions of the underlying random variables.[3] It is possible, though, to sample from the distributions of the underlying random variables, insert the sampled values into equation 7, and solve for values of the reduced-form coefficients, the d's and the D's. By repeated sampling, a set of values of the d's and the D's is built up, from which moments can be estimated and numerical opportunity loci derived.[4]

It is also possible to proceed differently. Relevant opportunity loci can be determined point by point from a nonlinear structure. For each of a set of values of r and each of a set of values of m, a sample of values of Y is generated and estimates of the first two moments are calculated. We decided against proceeding this way in part because of the cost. A great many simulations would have been required: $2(nxp)$ simulations, in fact, in order get p points on each locus, using n observations on Y for each point.

DISTRIBUTIONS OF PARAMETERS, DISTURBANCES, AND EXOGENOUS VARIABLES. We assumed that the mean of each parameter in F_i is equal to the corresponding estimate, that the variance-covariance matrix of a set of parameters is equal to a constant times the variance-covariance matrix of the corresponding estimators, and that the variance of the disturbance in F_i is equal to a constant times the corresponding residual variance.[5]

Sample values of α_i, the vector of parameters in the ith equation, not the original structure, were generated jointly according to the matrix equation

$$\alpha_i = \bar{\alpha}_i + R_i v$$

where $\bar{\alpha}_i$ is the vector of point estimates of α_i, R_i is a matrix such that $R_i R'_i$ equals the estimated variance-covariance matrix of $\bar{\alpha}_i$, and v is a vector of random variables chosen independently of one another from a normal distribution with mean zero and variance one truncated at plus and minus two. The disturbance for the ith equation was generated according to

$$e_i = \hat{\sigma}_i v$$

where $\hat{\sigma}_i$ is the estimated residual standard error for the ith equation and v is a single independent drawing from the same truncated normal. It follows that the expected value of α_i is $\bar{\alpha}_i$, that the variance-covariance matrix of α_i is 0.77 times the variance-covariance matrix for $\bar{\alpha}_i$, that the mean of e_i is zero, and that its variance is 0.77 $\hat{\sigma}_i^2$. (The constant is 0.77 because we inadvertently failed to recognize that the variance of the truncated normal is 0.77 and not unity.)

We chose a truncated distribution for v because many of the equations of the FR structure are in a form inconsistent with an un-

[3] Even for very simple economic structures, such as that of Section II, it is difficult if not impossible to derive the distributions of the reduced-form coefficients as functions of the moments of the structural parameters. To determine the numerical loci implied by the structure of Section II, it would therefore also be necessary to sample from the joint distributions of the structural parameters that are consistent with statistical estimation.

[4] Why derive numerical opportunity loci rather than calculate expected utilities? It is just that to calculate expected utilities, $\bar{Y}$, the desired or target value of Y, must be known or assumed. But having derived numerical loci, one may find dominance in a neighborhood of some reasonable value for $\bar{Y}$—that one variance is smaller than the other at every value of EY in the neighborhood. Clearly, deriving numerical loci is for outsiders.

[5] Thus, the data requirements for each estimated equation are the point estimates of the coefficients, the point estimates of the residual variance, and the inverse of the relevant cross-product matrix of the independent variables. The coefficient and residual variance estimates were available, but the cross-product matrices had to be re-estimated.

limited range for the disturbance. For example, several of the estimated equations for interest rates are linear, so that disturbances from a distribution with unlimited range could produce negative interest rates. Also, we did a certain amount of linearization and thereby changed some estimated equations which originally had forms that constrained the dependent variables to proper ranges.

There are quite a few noninstrument exogenous variables in the FR structure that can be treated as random. These include population, Federal Government expenditures, and exports. We assumed that these variables are generated by second-order autoregressive schemes,

$$z_{t,i} = \beta_{0i} + \beta_{1i}z_{t-1,i} + \beta_{1i}z_{t-2,i} + u_{t,i}$$

The β's were taken as fixed and equal to the estimated coefficients from an ordinary least squares regression of z_i on two lagged values of itself over the period 1952-Q1 to 1968-Q4. (It was an oversight that we did not also take the β's as random.) The disturbance, $u_{t,i}$, was treated as random with mean zero and variance equal to 0.77 times the estimated residual variance from that regression.

The distributions of the exogenous variables can play an important role in determining the better instrument variable. In a simple model, the less variance in the aggregate demand schedule the more likely is it that the interest rate is the better instrument variable. Inability to forecast exogenous variables like government expenditures and exports contributes directly to variance of aggregate demand. Thus, if there are schemes that forecast those variables with smaller error variance than do our autoregressive schemes, our failure to use them would seem, on the whole, to favor demand deposits as the optimum monetary instrument variable.

RESULTS. We derived opportunity loci for the first quarter of 1969 using 100 random drawings.[6] With r as the instrument variable

$$E(Y) = 884.9 - .819r$$

and

$$V(Y) = 361.0 - 2(.671)r + .088r^2$$

where r is measured as a per cent per annum and Y is measured in billions of dollars at an annual rate. Therefore, the r-locus is

$$V(Y) = 102{,}012 - 231.4\,E(Y) + .13166\,[E(Y)]^2$$

The highest value of $E(Y)$ for which the locus has any meaning is $E(Y) = 884.9$, since there $r = 0$. At $r = 10$, $E(Y) = 876.7$. The locus is drawn in Figure 1 for approximately that range of values. We would expect our estimated locus to most closely approximate the locus obtained from the original nonlinear model in the vicinity of $r = r^0$, the value around which we linearized, or in the vicinity of $E(Y) = 880.3$.

With m as instrument,

$$E(Y) = 805.8 + .495m$$

and

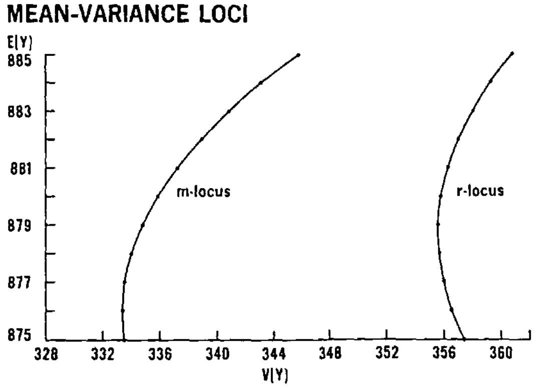
$$V(Y) = 1067.0 - 2(5.178)m + .0365m^2$$

where m is in billions of dollars. Therefore, the m-locus (also shown in Figure 1) is

$$V(Y) = 114{,}713.7 - 261.2E(Y) + .14909[E(Y)]^2$$

Note that in Figure 1 m dominates r as an instrument variable. For any expected value of Y, the variance of Y is smaller with m as the instrument variable than with r as the instrument variable. But the difference between the

FIGURE 1
MEAN-VARIANCE LOCI



[6] Deriving loci for 1969-Q1, we linearized the FR structure around values for 1968-Q4.

variances at, say, $E(Y) = 880$ is 20, and 20 is not a significant difference. For a sample of 100 drawings, a 90 per cent confidence interval around the variance of the m-locus at $E(Y) = 880$ ranges from 269 to 432, whereas the corresponding interval for the r-locus ranges from 285 to 457. There is, therefore, considerable overlap of the confidence intervals.

III. THE REAL INCOME-VARIANCE OF PRICE UTILITY FUNCTION

We also derived the first-quarter 1969 opportunity loci relevant for maximization of expected utility, where

$$U = \log X - b[100(P - P^0)/P^0]^2$$

X is real GNP in 1958 prices, P is the GNP deflator, and P^0 is the deflator for the fourth quarter of 1968. Iso-expected utility contours for this function are straight lines with slope b in the $[E \log X, 10^4E(P - P^0/P^0)^2]$ plane. The log function implies risk aversion; at a given value of the variance of the deflator, fair gambles on X are always rejected. The relevant opportunity loci consist of all attainable combinations of $E \log X$ and $10^4E[(P - P^0)/P^0]^2$. These were obtained for r and for m as follows.

Whether r or m is used as the instrument variable, there are reduced-form equations for both real income and the deflator. Let

$$X = b_1r + b_2$$

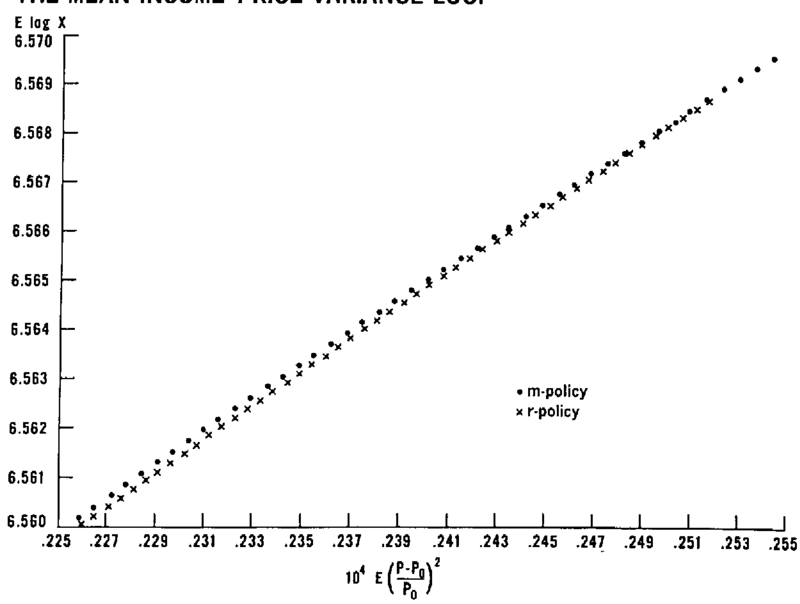
$$P = b_3r + b_4$$

be those for r. Thus,

$$E(\log X) = E \log (b_1r + b_2)$$

so $E \log X$ cannot be written as a function of r and of the moments of b_1 and b_2. It is possible, however, to compute $E \log X$ for each value of r in a reasonable range. We let r range from 1 per cent to 10 per cent. For each value of r, we computed and averaged $\log (b_1r + b_2)$ over the sample of values of b_1 and b_2 and took the resulting average as our estimate of $E \log X$. From the reduced form for P, we have

FIGURE 2
THE MEAN INCOME-PRICE VARIANCE LOCI



$$E\left[\frac{P-P^0}{P^0}\right]^2 = 1/(P^0)^2[r^2E(b_3{}^2) + E(b_4{}^2) + (P^0)^2 - 2P^0(rEb_3 + Eb_4) + 2rE(b_3b_4)]$$

Selected values of $E \log X$ and $10^4E\left[\frac{P-P^0}{P}\right]^2$ are given in Table 1. Some values for the m-locus, which were obtained in the same way using the reduced-form equations for m, are also given in Table 1. Both loci are shown in Figure 2.

TABLE 1: Selected Values For Real Income—Price Variance Loci

r-locus			m-locus		
r	$E \log X$	$10^4E\left(\frac{P-P_0}{P_0}\right)^2$	m	$E \log X$	$10^4E\left(\frac{P-P_0}{P_0}\right)^2$
1	6.569	.252	140.1	6.559	.222
2	6.568	.250	142.1	6.560	.226
3	6.567	.247	144.1	6.561	.229
4	6.566	.244	146.1	6.562	.232
5	6.565	.241	148.1	6.563	.235
6	6.564	.239	150.1	6.564	.239
7	6.563	.236	152.1	6.566	.242
8	6.563	.233	154.1	6.567	.245
9	6.562	.231	156.1	6.568	.249
10	6.561	.228	158.1	6.569	.252

Once again m dominates r; at each value of $E \log X$ the variance of the deflator is smaller for the m-locus than it is for the r-locus. The difference, however, is miniscule. At $E \log X = 6.5647$, which corresponds to $r = r^0$ for the r-locus, the percentage variance of the deflator for the m-locus is 0.2393, while that for the r-locus is 0.2397. For a sample of 100 drawings, 90 per cent confidence intervals around those estimates are almost coincident.

IV. CONCLUSION

As indicated in the introduction, we think that little attention should be paid to our experimental findings. It is not only because our samples were too small, but also because, to calculate numerical loci, it is necessary to assume a utility function and, what is more, an economic structure. And to accept calculated loci, or a comparison thereof, is to accept the assumed utility function and the assumed structure. Even if our samples had been larger, we would not then have cared to press our findings. Before doing that, we would want to average over time [7] and several economic structures.

But more fundamentally, we feel that no monetary authority should decide once and for all, by statistical inference, which of its possible instrument variables to use. Unless faced with prohibitive costs, it should decide which variable to use at the beginning of every policy period or possibly every quarter. This ultimately is why we could in good conscience content ourselves only with offering a way of determining the optimum instrument variable (and with a sample of only 100 drawings).

[7] See the appendix, wherein we appraise the attempt of Holbrook and Shapiro to determine empirically the optimum monetary instrument variable.

APPENDIX:

Holbrook and Shapiro on the Optimum Monetary Instrument Variable

There has been one attempt that we know of, by Holbrook and Shapiro (H&S), to determine empirically the Federal Reserve's optimum instrument variable.[1] What H&S did was to calculate and then to compare certain variances of real GNP, variances associated with three possible monetary instrument variables: the narrowly defined stock of money, the monetary base, and, what would seem a rather surprising choice, the average rate on long-term Treasury bonds.[2] What they found was, for every calendar quarter in a long stretch of years, a smaller variance for the narrowly defined money stock than for both the monetary base and, by a much wider margin apparently, the average Treasury bond rate. Thus, their tentative conclusion was that, in setting its policy, the Federal Reserve ought to use the narrowly defined money stock.

But H&S calculated and so compared the wrong variances. They went astray, we suspect, because they forgot that there must be disturbance terms in their structural equations. Whatever the explanation, though, they cannot be regarded as having made a case, even a highly provisional case, for the narrowly defined money stock as the Federal Reserve's optimum monetary instrument variable.

H&S distinguished between actual GNP, denoted here by Y, and predicted GNP, denoted here by y_p. Suppose that

$$(1)\qquad C = a_1Y + U_1$$

$$(2)\qquad I = a_2 + a_3r + U_2$$

$$(3)\qquad r = a_4 + a_5Y + a_6m + U_3$$

$$(4)\qquad Y = C + I$$

where C and I are, respectively, consumption and investment, r and m are the two possible monetary instrument variables, respectively, the rate of interest and the stock of money and U_1, U_2, and U_3 are random disturbances.[3] Then

$$(5)\quad Y(r) = \frac{1}{1 - a_1}(a_2 + a_3r + U_1 + U_2)$$

and

$$(6)\quad Y(m) = \frac{1}{1 - a_1 - a_3a_5}(a_2 + a_3a_4 + a_3a_6m + U_1 + U_2 + a_3U_3)$$

where $Y(r)$ is actual GNP with r as the instrument variable and $Y(m)$ is actual GNP with m as the instrument variable. Also

$$(5a)\qquad y_p(r) = \frac{1}{1 - \hat{a}_1}(\hat{a}_2 + a_3r)$$

and

$$(6a)\quad y_p(m) = \frac{1}{1 - \hat{a}_1 - \hat{a}_3\hat{a}_5}(\hat{a}_2 + \hat{a}_3\hat{a}_4 + \hat{a}_3\hat{a}_6m)$$

where $y_p(r)$ is predicted GNP with r as the instrument variable, $y_p(m)$ is predicted GNP with m as the instrument variable, and $\hat{a}_i$ is the estimator of a_i.

[1] See Robert Holbrook and Harold Shapiro, "The Choice of Optimal Intermediate Economic Targets," *American Economic Review*, May 1970, pp. 40–46.

[2] Holbrook and Shapiro referred to the narrowly defined stock of money, the money base, and the average rate on Treasury bonds as possible intermediate target variables. But they assumed that the Federal Reserve is able to determine exactly any one of these three variables, so it is quite proper for us to refer to them here as possible instrument variables.

[3] This economic structure is far simpler than the one specified by H&S. But since we want only to illustrate wherein they went wrong, we do not need even a faintly realistic structure or more than two possible monetary instrument variables. H&S failed to include disturbances in describing their model, but they must surely belong there, for otherwise the model must be rejected unless the data fit it exactly.

The loss function explicitly assumed by H&S is

$$(7)\quad L(x) = [Y_p(x) - Y(x)]^2 \qquad (x = r, m)$$

where $Y_p(r)$ and $Y_p(m)$ are the first-order Taylor expansions of, respectively, $y_p(r)$ and $y_p(m)$ around the point $a = (a_1, a_2, \ldots, a_6)$.

Since

$$(8)\quad Y_p(r) = \frac{1}{1 - a_1}[\hat{a}_2 + \hat{a}_3 r + (\hat{a}_1 - a_1)Y]$$

and

$$(9)\quad Y_p(m) = \frac{1}{1 - a_1 - a_3a_5}[\hat{a}_2 + a_3\hat{a}_4 + a_3 m\hat{a}_6 + (\hat{a}_1 - a_1)Y + (\hat{a}_3 - a_3)r + a_3(\hat{a}_5 - a_5)Y]$$

it follows that[4]

$$(10)\quad EL(r) = E[Y_p(r) - Y(r)]^2 = VY_p(r) + V\left(\frac{U_1 + U_2}{1 - a_1}\right)$$

and

$$(11)\quad EL(m) = E[Y_p(m) - Y(m)]^2 = VY_p(m) + V\left(\frac{U_1 + U_2 + a_3U_3}{1 - a_1 - a_3a_5}\right)$$

$EL(r)$ is the expected loss with r as the instrument variable and $EL(m)$ is the expected loss with m as the instrument variable.

The straightforward procedure would seem to be to minimize $EL(r)$ by the choice of r and to minimize $EL(m)$ by the choice of m and then to compare the respective minima. But doing so would amount to assuming that the monetary authority does not care about the expected value of Y. H&S therefore assumed that "the policy maker . . . select(s) the value of each intermediate target variable such that the expected value of income is equal to desired income, and then . . . choose(s) among (instrument) variables that one which minimizes the expected squared deviation of actual from desired income." So H&S would have the monetary authority minimize $EL(x)$, but subject to the constraint

$$(12)\quad EY_p(x) = \bar{Y}$$

where $\bar{Y}$ is the target value of Y. But they themselves did not compute their constrained minima of $EL(x)$, that is, $EL(\bar{x})$.

They forgot to calculate the second terms on the right-hand sides of equations 10 and 11.[5] This is hardly a minor oversight. Those terms would remain even if the sample size were indefinitely large. And we suspect that for their estimated model the omitted terms are relatively large. A ranking of instruments by $VY_p(x)$ in no way implies a ranking by $EL(x)$.

Even if H&S had not forgotten the second terms on the right-hand sides in equations 10 and 11, they would have ended up calculating the wrong variances. For in calculating variances, they used actual values of both r and m (that is, r_a and m_a). And as is easily shown, $EY_p(m_a)$ is not in general equal to $EY_p(r_a)$. The expectation of Y_p at $r = r_a$ is, by equation 8,

$$(13)\quad EY_p(r_a) = \frac{1}{1 - a_1}[a_2 + a_3 r_a]$$

assuming unbiased estimators of the a_i's. From equation 3, it follows that

$$(14)\quad m_a = \frac{1}{a_6}[r_a - a_4 - a_5Y(r_a) - U_3]$$

and from (5) that

$$(15)\quad m_a = \frac{1}{a_6(1 - a_1)}[(1 - a_1 - a_3a_5)r_a - a_4 + a_1a_4 - (a_5U_1 + a_5U_2) + U_3 - a_1U_3]$$

But the expectation of $Y_p(m)$ at $m = m_a$ is, by equations 9 and 15,

$$(16)\quad EY_p(m_a) = \frac{1}{(1 - a_1)}[a_2 + a_3r_a] - \frac{a_3(a_5U_1 + a_5U_2 + U_3 - a_1U_3)}{(1 - a_1 - a_3a_5)(1 - a_1)}$$

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[4] This formula for forecast error holds exactly only in the post-sample period, for in the sample period there is also a covariance term.

[5] In footnote 7, p. 45, they recognize but do not deal with this omission.

So at any point in time $EY_p(m_a) \neq EY_p(r_a)$ unless, by some chance, all U_i's happen to be zero.

Thus, if actual or observed values of both (all) possible instrument variables are used in calculating variances, the resulting variances will correspond to different mean values of Y_p, and a comparison of variances corresponding to the same value of EY_p, which is what H&S proposed, is not achieved.

by James L. Pierce

THE TRADE-OFF BETWEEN SHORT- AND LONG-TERM POLICY GOALS

CONTENTS

INTRODUCTION

The existence of long lags in the response of the real sectors of the economy to changes in monetary policy is well documented. These lags may require an horizon for monetary policy strategies that spans many calendar quarters. Even if long planning horizons are desirable, specific operating strategies still must be adopted for the actual short-run conduct of monetary policy. These, however, should be consistent with the long-term goals. If short-run considerations—such as stabilization of money market interest rate movements—cause modification of the operating strategy, the long-run goals in terms of income, employment, and the price level may suffer. This paper discusses some of the areas in which short- and long-term goals may conflict and attempts to evaluate the costs to the long-term targets of imposing short-run side conditions on policy actions.

SHORT-RUN VS. LONG-RUN GOALS

Available econometric evidence indicates that variations in monetary policy instruments can exert little influence on the nonfinancial sectors of the economy in the short run. Experiments with a recent version of the Federal Reserve–MIT model indicate that, other things equal, a $1 billion increase in the money stock in a given quarter will produce only a $0.3 billion increase in nominal gross national product in that quarter. Further, inspection of the coefficients for the relevant equations in the model suggests that even this small response is probably overstated. It is interesting to note that the long-run multiplier relation between money and nominal GNP is substantial. Other things equal, a $1 billion permanent rise in the money stock leads to a permanent increase in nominal GNP of approximately $3.2 billion.

NOTE.—The author, who is Associate Adviser, Division of Research and Statistics, would like to thank William Poole for his constructive comments on an earlier version of this paper.

Given the short-run multiplier, attempts to establish short-run (quarter by quarter) control over the economy may require variations in policy instruments that are unacceptably large. An example may clarify the issue. Assume that during a generally inflationary period, the decision is made to attempt to stop the inflation within a single quarter. To accomplish this end, a sharp rise in interest rates, and probably a substantial reduction in the levels of the monetary aggregates, would be required during the quarter. Even if this strategy were successful, a new problem would immediately develop. With the passage of time beyond the quarter, the economy would continue its deflationary adjustment—probably at an increased rate—in response to the monetary restriction. If an overresponse of the economy to the original policy restriction is to be avoided, policy must reverse itself immediately by sharply reducing interest rates and expanding the monetary aggregates. This easing of policy would require in turn a restrictive policy the next quarter. Thus, by never looking more than one quarter ahead, large short-term reversals of policy would be required to stabilize the economy.

Whether this myopic strategy of trying to hit targets in the real sector on a quarter-by-quarter basis can be successful over the long run depends, among other things, upon the existing parameters of the system.[1] It is quite possible that pursuit of such a strategy would have no long-run future because ever larger changes in monetary policy instruments would be required to achieve stability in the real sector. Even if the strategy produced permanent economic stability, it could create extreme fluctuations in financial markets.

It is quite possible, however, that large fluctuations in financial variables would alter in-

[1] For a simple treatment of this problem see E. Gramlich, "The Usefulness of Monetary and Fiscal Policy as Discretionary Stabilization Tools," presented at the Conference of University Professors sponsored by the American Bankers Association, Sept. 1969.

terest rate expectations enough to weaken greatly the efficacy of the myopic policy strategy. Rapid reversals of monetary policy may encourage investors to expect wide fluctuations in short-term interest rates. In this situation, efforts to reduce long-term rates would be thwarted by investor expectations of a rise in rates in the near future. Thus, the pursuit of the myopic policy strategy could be self-defeating.

There are two obvious ways to approach the problem posed by the small amount of short-term control over the economy. First, monetary policy could pursue the myopic rule of attempting to hit a target quarter by quarter but could subject the strategy to constraints imposed by financial conditions. Thus, a specific target value for employment or for the price level would be pursued provided the act of attempting to hit the target did not cause excessive fluctuations in interest rates. If interest rates moved more than was deemed desirable, policy instruments would be changed sufficiently to bring interest rates within the allowable range. The imposition of such constraints could greatly reduce the ability of monetary policy to achieve short-term goals.

The second approach would involve a lengthening of the policy-planning horizon. In this situation, policy would take a view longer than one quarter into the future. The aim would be to achieve the best path of, say, employment over some interval of time consistent with acceptable performance of financial markets. Extension of the horizon would allow problems of the real sector and of the financial sector to coexist on a more equal basis. No immutable constraints would be placed on the system by money market conditions if the planning horizon could be extended. However, by giving up some short-term control over variables in the real sector, it should be possible to reduce fluctuations in financial variables to more manageable proportions.

Conceptually, it should be possible to determine the trade-off between (1) short-term control over employment and prices and (2) stability of the financial sector. In general, a lengthening of the policy-planning horizon to promote short-run stability in financial markets will come at the cost of reduced control over nonfinancial variables. Alternatively, a shortening of the planning horizon will come at the cost of increased short-run fluctuations in financial variables.

Lengthening the horizon for major policy goals raises some obvious problems. Because the long-term goals of employment and prices are relatively far in the future, it is easy to give them a back seat to the short-run stabilization problems often encountered in financial markets. The problem with this approach is that overattention to short-run problems may have important implications for the paths required to hit desired long-run targets. Further, if short-run constraints are continually imposed, it may be impossible to hit the long-run goals in the time specified. Under those circumstances it may be necessary to lengthen the horizon and to accept the ensuing costs of less desirable performance of the real sector.

The previous paragraph suggests that over the longer run the goals of price and output stability may not conflict with the goal of money market stability. Overzealous attempts to stabilize the money market in the short run may distort output and prices to the point that large changes in interest rates are required in the longer run to bring the economy under control. By allowing wider short-run fluctuations in money market conditions, it might be possible to avoid large swings in interest rates over the longer run.

The discussion suggests that, given a set of initial conditions in the economy, there is an optimal policy strategy available. The strategy determines simultaneously the length of the planning horizon, the paths of target variables such as employment and prices over the period, and the expected stability of financial markets. The determination of specific strategies is a problem in optimal control theory and is beyond the scope of this paper. Instead, the paper attempts to assess the trade-offs involved and illustrates problems that may arise from pursuing particular policy strategies.

SOME SIMULATION EXPERIMENTS

This section describes some simulation experiments that were conducted to illustrate the problems encountered when short-term and long-term goals conflict. The structure of a recent version of the FR–MIT model was used for the simulation exercises.[2]

The first experiment assumes a monetary policy that focuses on the rate of growth of the money stock provided the change in the Treasury bill rate over any quarter does not exceed some arbitrary value. An unconstrained growth in money is assumed to promote desired long-run behavior of the real sector. However, if the policy-determined money stock for a quarter led to a projected change in the bill rate over that quarter that exceeded the constraint value, then the money supply was changed sufficiently to bring the change in the bill rate back to its allowable range. In those situations in which monetary policy is attempting to offset either boom or recession, this constrained policy would lead to a performance of the economy that is inferior to one which is unconstrained.

If shifts in the demand for money are the source of wide interest rate fluctuations when policy is attempting to hit a money stock target, the situation is changed. Here, it would be appropriate to introduce interest rate constraints. Such constraints would automatically satisfy the demand for money after some point. Limiting interest rate movements in this case would promote long-run stability.[3] The results of the simulation experiments suggest, however, that one should have strong reasons for believing that shifts in money demand are causing wide quarter-to-quarter fluctuations in interest rates. If unexpected shifts in aggregate demand are the cause, long-run goals may suffer greatly.

To illustrate the problems that arise during periods of excess aggregate demand, various simulations of the FR–MIT model were run for the 1963–68 period. First, a control simulation was run that took all exogenous variables at their historical values but assumed that the money stock grew at a constant annual rate of 4.25 per cent. This was the constant rate at which the initial money stock in 1962-IV had to grow to achieve its actual value in 1968-IV. Then additional simulation experiments were conducted by applying the same exogenous variables and the same 4.25 per cent money growth rate to the model provided that the Treasury bill rate did not change during the quarter by more than a specified absolute amount. If the bill rate fell outside the allowable range, bank reserves and the money supply were changed sufficiently to bring the bill rate back to the nearest boundary of the range. All other exogenous variables were assumed to remain unchanged. Several absolute change values were attempted; results for absolute changes of 30 basis points and 10 basis points are reported.

The results indicate that the placement of sufficiently narrow bounds on the change in the bill rate can have a large impact on the simulated value of GNP. Figure 1 shows the differences between the simulated values of GNP for the steady rate of growth of money and those subject to maximum absolute changes in the bill rate of 30 and 10 basis points, respectively. In both cases, because interest rates could not rise in the later periods, there was a tendency to add to the existing excess demand conditions.

As indicated earlier, if interest rate fluctuations are caused by erratic shifts in the demand for money, then stabilization of interest rates may be a reasonable course of action. The simulation results suggest, however, that interest rate stabilization can be costly during periods of strong excess demand.

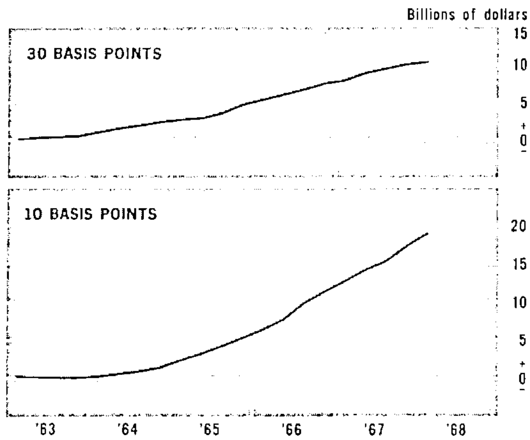
[2] Some of the simulation results reported here are drawn from an earlier paper on a related topic. See J. Pierce, "Some Rules for the Conduct of Monetary Policy," in *Controlling Monetary Aggregates* (Federal Reserve Bank of Boston, 1969).

[3] For a theoretical discussion of the desirability of interest rate versus money stock stabilization in a stochastic world, see W. Poole, "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model," *Quarterly Journal of Economics,* Vol. 84 (May 1970), pp. 197–216.

FIGURE 1

Effect on GNP of 4.25% GROWTH IN MONEY SUBJECT TO MAXIMUM ABSOLUTE CHANGE IN BILL RATE

Deviations from STRAIGHT 4.25% MONEY-GROWTH SIMULATION



It is interesting to note that if stabilization of financial markets takes the form of constraining the rate of growth of the money stock, the problems encountered during periods of shifting aggregate demand are diminished. Assume that monetary policy attempts to hit an employment target by setting market interest rates at appropriate levels. Introducing a constraint on the allowable range of growth rates of the money stock in this situation can under some circumstances lead to improved performance of the economy. If it happens that the interest rate selected is not the correct one because aggregate demand is either stronger or weaker than expected, variations in the rate of growth of the money stock can provide important evidence of this condition. For example, if aggregate demand is stronger than expected, given the interest rate and the demand for money, the growth in the money stock will be greater than expected. If the acceleration in the growth rate of money is taken as a signal to raise the interest rate, the growth rate of money will fall and the excessive growth in aggregate demand will be reduced.

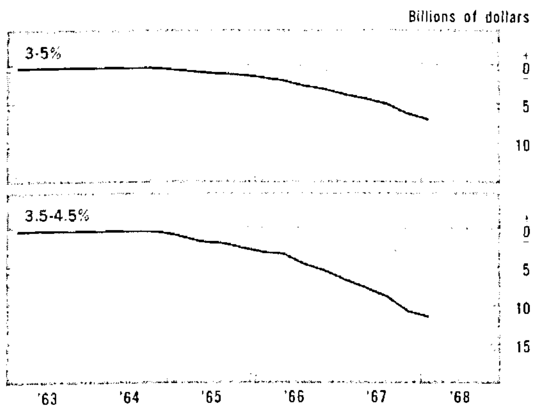
If the unexpected growth in the money stock is the result of a shift in the demand for money, then the monetary expansion should be accommodated. In this situation, interest rates should not rise. There is really no way to avoid making judgments concerning the causes of fluctuations in the money stock and in interest rates. If the source is unexpected strength or weakness in aggregate demand, one course of action is called for. If the source is erratic shifts in the demand for money, quite a different policy reaction is required. The purpose of the simulation experiments was not to "prove" that aggregate demand is always the cause of money market fluctuations. Rather, the purpose of the exercises was to illustrate the potential costs of pursuing a policy strategy that implicitly assumes that money market fluctuations are caused primarily by an erratic, unpredictable demand for money.

Simulation experiments with the model were conducted to measure the impact of constraints on the growth rate of money. The control simulation was one in which the interest rate was made to rise at a constant annual rate from a base period of 1963-I to achieve its actual value in 1968-I. In this simulation, the money stock is endogenous. Additional policy simulations were then conducted in which constraints on the growth rate of money were imposed on this interest rate policy. If the rate of growth of the endogenous money stock fell outside the allowable range, the interest rate was changed sufficiently to bring the growth in money back to the nearest boundary of its allowable range.

Figure 2 shows the difference between the values of GNP from the control simulations and those for maximum ranges of 3 to 5 per cent and of 3.5 to 4.5 per cent in the annual growth rate of money. The results indicate that this combination of interest rate and money supply policies would have been beneficial over the period of simulation.

Further simulation experiments were conducted taking the conditions of the 1960–61 recession as the starting point for the policy exercises. The results were similar to those described above for periods of excess demand. Control simulations were conducted for the period 1960-III to 1968-I under the assumption of a constant rate of growth of the money stock. Given the actual history of the exogenous variables in the system and given the initial conditions, the time required to get initially to full employment was a decreasing function of the money growth rate. Particularly rapid growth rates, however, lead to substantial overshooting and can create chronic excess demand. Quite predictably, imposition of a constraint on policy in the form of maximum allowable quarterly changes in the Treasury bill rate made it more difficult to hit the full employment target. The interest rate constraint produced a slowing of the rate of expansion of output and employment from the recession base and lengthened the time necessary to hit a full employment target. The results also indicate that the degree of the slowdown of economic expansion resulting from the constraint depends upon how quickly the target level of employment is to be reached and how narrow is the allowable range of the quarterly change in interest rates.

FIGURE 2
Effect on GNP of CONSTANT BILL-RATE GROWTH SUBJECT TO MAXIMUM MONEY-GROWTH RATES
Deviations from STRAIGHT BILL-RATE-GROWTH SIMULATION



It should be emphasized that a restriction on changes in interest rates is potentially less disruptive to the economy than is a restriction on the level of rates. Constraints on the maximum short-term change in interest rates can retard but not arrest desired adjustments of the economy. The existence of ceilings or floors on the level of interest rates may prevent the adjustments from ever occurring. Pegging the level of interest rates can lead to a total loss of control by policy over output, employment, and prices.

The recession results for a money supply constraint are also similar to those obtained for the excess demand case. A monetary policy that attempts to achieve its objectives through influencing money market conditions—interest rates—can be enhanced in the recession case by imposing a constraint on the rate of growth of money. If the course of aggregate demand proves to be other than expected, variations in the interest rate promoted by the constraint imposed by an allowable range of growth in money rates will serve to push the rate of expansion in the desired direction.

CONCLUSIONS

The brief discussion in the preceding section suggests that high priority should be placed on coordinating short-run operating procedures with the longer-run goals of monetary policy. Failure to achieve such coordination can lead to a serious reduction in the ultimate effectiveness of monetary policy. Stabilizing short-term interest rate fluctuations can lead to destabilizing shocks to the real sectors of the economy.

Better information on the stability of the demand functions in the economy is sorely needed. The focus of policy on money market conditions may be badly misplaced if the money demand function is relatively stable and predictable through time. Certainly the hypothesis that the demand for money is erratic and unpredictable is not well documented. It is curious, therefore, that policy decisions should depend so strongly on money market conditions.

It might be argued that the central bank is obligated to stabilize the markets for debt instruments. An unfortunate paradox can result here. An overly zealous attempt to stabilize interest rates can so disturb the real sectors of the economy as to lead ultimately to extreme variations in market interest rates. The experience of the last few years appears to bear out this contention. It would appear that a monetary policy based almost exclusively on stabilizing short-run money market conditions is a luxury we can ill afford.

On a conceptual basis the appropriate course of action for policymaking appears to be clear. Given staff projections of the course of the economy over the coming year or so, the instruments of monetary policy should be set to promote the desired time paths of variables such as employment and prices over the period. In order to make such decisions meaningful, several policy alternatives should be presented showing alternative time paths for the target values in the real sector.

The policy alternatives should be compared both in terms of the expected values of such variables as output, employment, and prices, and in terms of the dispersion of these projections around their expected values. In assessing the variability of the projections, it is necessary to provide evidence as to the possible impacts on the projections of various shocks to the system. How sensitive are the projections to shifts in the demand for money or in the demand for investment goods? An analysis of the impact on the projections of alternative assumptions concerning the values of certain key exogenous variables such as Government spending is also crucial. Furthermore, it is quite likely that the sensitivity of the projections to shocks and alternative values of exogenous variables is not independent of the existing state of the economy. At times projections are quite insensitive to fairly large changes in the underlying specifications of the system, but at other times they are extremely sensitive to these specifications. It is essential, therefore, that evidence be provided concerning the likely dispersion of relevant variables around their projected values.

The fluctuations in interest rates and monetary aggregates implied by the various policy alternatives should also be projected. On the basis of all of this information, trade-offs between expected money market stability and the behavior of variables in the real sector can be assessed. The need for reliable econometric models and for seasoned judgment in these exercises is obvious. At this point, our ability to generate the required set of projections is quite limited. These limitations suggest that policy strategies should be fairly simple and straightforward. Elaborate policy strategies do not seem consistent with our ability to assess and trace through time the impact of policy acts on the economy.

Given a policy strategy over the coming year or so, how can the strategy be reduced to day-by-day operating procedures? Here, there is need for a document that presents projections of financial conditions to be expected over the near term. A blending of projections obtained from quarterly and monthly econometric models is sorely needed. Conceptually, such blends are difficult but possible. On the basis of these short-term projections and the basic policy strategy mentioned above, specific operating instructions can be formulated. Here, limitations on the ability to make short-term projections suggest that the operating procedures adopted should be fairly simple.

We now come to the central problem. How can we continue to link the basic policy strategy with operating procedures as the economic forecasts are modified and as monetary policy strays off course? As policy is currently conducted, there is no effective means of varying the basic strategy as new information comes in, and there is no way to relate changing conditions to actual operating procedures.

Ideally, we would like to generate new long-term forecasts each quarter and to map out new alternative policy strategies each quarter. Often, however, the new information that comes in leads to conflicting conclusions about changes in the future course of the economy. Further, econometric models and other procedures often do not predict with sufficient accuracy to allow useful quarter-by-quarter changes in implied operating strategy. The discussion of the original projections also suggests that the initial strategies may at times be very much in doubt.

A possible strategy under these conditions is to set quarterly operating instructions in terms of some combination of interest rates and money stock. A policy that sets an interest rate subject to constraints on the rate of growth of money is a very appealing candidate. By setting a range to the allowable growth of money, shifts in the money demand function are automatically accommodated up to the extreme points of the range. The width of the range should depend in part on estimates of likely quarterly fluctuations in the demand for money. In setting the range, however, it must be recalled that the wider the allowable range, the greater the potential loss in output and employment when variations in aggregate demand are the cause of money growth fluctuations. For this reason, a relatively narrow band, for example, 4 to 6 per cent, seems desirable as a working principle.

Certainly, if there are persuasive arguments explaining why an unusual shift in money demand occurred in a particular quarter, then a growth rate of the money stock outside the range should be allowed. The point is, however, that relaxation of the constraints should be a rare event. In every case when such an action is being considered, the burden of proof should rest squarely on those who believe that an unexpected movement of money outside the range is caused by money demand and not by aggregate demand. Further, the longer the condition of unusually high or low money growth persists at existing interest rates the greater should be the presumption that the interest rate is inappropriate and should be changed.

These recommendations do not call for a drastic departure from current procedures; they call primarily for greater attention to be paid to the long-run objectives of economic stabilization policy. Such objectives are designed to put short-run stabilization of money market conditions in the context of possible costs to the economy in terms of income, employment, and prices.

Truly effective implementation of policy requires that operating strategies intended to achieve desired long-term goals be set forth explicitly. Such strategies must be followed under conditions of great uncertainty about the course of the exogenous variables in the system and about the performance of our models. In such a situation it would appear to be a mistake to focus attention primarily on the uncertainties of the money market. Monetary policy decisions must come to grips with the uncertainties we face with respect to aggregate demand. A policy strategy that relies as much as possible on projections but that also combines a setting of interest rates with allowable ranges on the money growth rate appears to be most appropriate for the near future.

by Benjamin M. Friedman

TACTICS AND STRATEGY IN MONETARY POLICY

CONTENTS

INTRODUCTION

In this paper monetary policy is viewed from the standpoint of operational policy decision-making.

Section I divides the monetary policy decision process into two separate phases—strategy and tactics—applying heuristic arguments of largely intuitive appeal. The strategy phase involves quarterly decisions outlining a plan for monetary policy over the next several quarters. The tactics phase involves shorter-run technical decisions concerning implementation of the first quarter of the strategy and deals with the question of how best to adjust for apparent deviations of the monetary policy instruments from their planned targets.

Sections II, III, and IV, applying more formal analysis, take up several problems that are especially relevant at the tactics stage. Section II examines the influence of economic specification in making tactical decisions, showing that different specifications may imply no response at all to past operating misses of the monetary policy instruments or may imply compensating responses of a number of forms. Section III considers questions of stability involved in choosing the appropriate speed of tactical action. Section IV, which includes applications based on Federal Reserve data, shows the implications for monetary policy tactics of using data that are imperfect and subject to subsequent revision.

Section V briefly restates the major conclusions of Sections I through IV for monetary policy.

I. STRATEGY, TACTICS, AND THE DECISION PROCESS

As now constituted, the decision process of the Federal Open Market Committee seems to involve an independent monetary policy decision at each meeting of the Committee, held once every 3 or 4 weeks. Although Committee members may apply to these decisions as short or as long a time horizon as they see fit, the decision in fact commits the Federal Reserve System only for the time interval until the Committee's next meeting. Some three times per year, major staff reassessments of the economic outlook occur in the form of audiovisual chart shows presented to the Committee, but chart show meetings do not necessarily involve a different form either of discussion or of decision on the Committee's part.

Most currently available estimates suggest that monetary policy affects real spending only after substantial time lags. The Federal Reserve–Massachusetts Institute of Technology econometric model, for example, suggests that monetary policy actions have little effect for the first two to four subsequent quarters and that two-thirds of the effect of such action has occurred only after some 2 years.[1] The loosely anchored relationships between monetary policy and real spending decisions suggest that frequent and abrupt policy shifts will have little effect, or in any case an unpredictable effect, on real spending.

FREQUENCY OF COMMITTEE DECISIONS. The Committee in fact does not shift policy at every meeting or every other meeting. It has followed a more slowly moving procedure of establishing a monetary policy stance and then maintaining it for some months. Various shadings of this stance may occur, but a fundamental revision is likely to happen only at larger intervals. It therefore seems unnecessary to preserve an operating machinery under which the Committee may shift policy at each meeting, when in practice this potential flexibility remains virtually unused.

Maintaining this unused flexibility would not necessarily be detrimental to efficient decision making, were it not for limited resources on the part of both staff and principals. Taking

NOTE.—The author, who is Junior Fellow of the Society of Fellows, Harvard University, and Consultant, Board of Governors, Federal Reserve System, is grateful to Mrs. Irene Welch of the research staff of the Reserve Bank of Boston for carrying out the statistical computations involved in preparing the tables presented in the text.

[1] de Leeuw and Gramlich (1968).

decisions hurriedly at frequent intervals may well be inefficient if it precludes less frequent but more intensive discussions and examinations of the relevant financial and general economic developments, both observed and anticipated.

Hence, a primary reason for taking major monetary policy decisions less frequently is to permit more thorough exploration of the outlook and the available alternatives, accompanied by more meaningful Committee discussions in terms of the goals of monetary policy. Useful staff support to such Committee decisions may involve presentations along the lines of the present chart shows, expanded to include projections of the most likely consequences of several different patterns of monetary policy, as well as an analysis of the currently attainable trade-offs among different policy goals.

A further, related reason for reducing the frequency of major Committee decisions concerns the dangers and safeguards built into a decision-making process by the design of its machinery. Incremental decision-making, with each decision considered independently, may in any organization lead at times to faulty actions and missed opportunities that a more unified decision process can help to avoid. The problem is that past Committee decisions simply become part of the data, while future ones remain unconsidered; hence the true unity and interdependence of the series of decisions is not evident.

Consider, for example, a Committee decision of whether or not to move to a tight-money policy: A Committee member may well ask, under the current decision machinery, what is the cost of delaying the move until the next Committee meeting, if the move is in fact advisable at all. Given the currently available state of knowledge about economic relationships, the answer must be that the cost of this several weeks' delay is so small and uncertain as to be virtually unidentifiable. The problem arises in that the same question, asked at six successive Committee meetings, may elicit the same answer of nearly negligible cost to the incremental delay each time; yet the true cost of delaying the move for 6 months may be not only identifiable but in fact quite substantial.

Two conclusions emerge from this discussion: First, decision-making opportunities should occur with quantum time intervals great enough to render individual decisions meaningful; and, second, the relation among interdependent decisions should be explicitly evident, even when those decisions follow one another in time.

If the Committee's major policy decisions should occur less frequently than every 3 or 4 weeks, what time interval is then appropriate? Although a number of possibilities are perhaps workable, for several reasons 3 months seems to be the best. Much of the relevant economic data to be used in considering monetary policy decisions are available only on a quarterly basis; real expenditures information in the national income accounts is perhaps the leading example. Further, our knowledge of economic relationships is based largely on a quarterly discrete time conception of the economic system; judgmental analysts seem to think primarily by quarters, and the available econometric work is mostly in quarterly form. In addition, referring again to the observable impact of monetary phenomena on real spending, the quarter is probably the smallest time unit for which meaningful information is now identifiable.

STRATEGY AND THE SEQUENTIAL DECISION PROCESS. Collecting the several conclusions derived above gives a brief outline of the strategy stage of the decision-making process for monetary policy: The Open Market Committee may meet quarterly to analyze recent and prospective economic developments; to study the outlook for the foreseeable future in the light of the possible patterns of monetary policy and the projected consequences of each; to consider the attainable trade-offs among different monetary policy goals; and to take a decision on the course of monetary policy. In sum, the strategy decision considers the entire relevant economic picture and derives the best monetary policy decision to meet it. The committee may well continue to meet on its current more frequent schedule, but it would take major monetary policy decisions only quarterly.

A further question is whether the Committee should decide the course of policy only until the time of the next major decision meeting, or should instead attempt actively to include a longer time horizon in its plans. If five or six quarters into the future is the furthest ahead that analysts can reasonably look, using currently available methods, and if the lag required for monetary policy to take effect is approximately two quarters, then the furthest horizon for which the Committee can viably plan policy actions is three to four quarters into the future. Is there any advantage to the Committee's formulating a hypothetical policy for this three- or four-quarter period, which would extend considerably past the time of the next Committee meeting?

The decision systems elaborated by Holt, Theil, and Simon[2] suggest that formulating long-range plans and revising them at shorter intervals may well be more efficient than merely planning for the shorter interval between decisions. Even though in practice one may choose to plan only from January to April, for example, and wait to examine the situation in April before finalizing further plans, tracing through the anticipated course of events after April and considering April's decision in advance is a useful exercise for improving January's decision. This principle is especially valid in light of the lags associated with monetary policy, which imply that January's decision may have little or no effect on the goals of the policy before July. In addition, this system of coordinated hypothetical planning for the future helps bring into focus the unity and interdependence of the entire series of Committee decisions.

Hence at its quarterly meetings the Committee may formulate a strategy for several quarters, of which the immediate quarter becomes actual policy to be followed until the Committee's next major decision meeting. At each such meeting the Committee updates its strategy by one quarter; it revises the previous decision's hypothetical second-quarter plan to become an immediate-quarter plan, which is then the Committee's actual policy for operational purposes. In this way a sequential decision process enables the Committee to take as long a view as is possible in formulating its strategy, while preserving as much flexibility as is probably necessary.

TACTICS. Once the Committee has specified its strategy for the quarter immediately ahead, several operational problems are likely to arise which require decisions of a subordinate nature. For example, suppose that the Committee has expressed its strategy as achieving over the quarter a movement of X in M, where X is an appropriately chosen number and M is some selected financial variable (or X may be a vector of numbers and M a list of variables). In effect the Committee has specified a target path for variable M. If M were directly within Federal Reserve control, or if the operational levers available to influence M had no uncertainties attached to their use, then following the Committee's strategy would be a straightforward and unambiguous process.

In practice, however, market activity, as well as Federal Reserve operations, works to determine most of the interesting candidates for M; and a multitude of uncertainties and shifting structures characterize the entire financial system. Hence a series of subordinate decisions—a set of tactics—are necessary to adjust operating procedures in the light of unforeseen situations as they arise. Such tactics govern Federal Reserve response to sudden surprise movements of financial variables and resulting deviations of M from the target path specified in the quarter's strategy.

Since further decisions are still necessary once the Committee has formulated its strat-

[2] Holt (1962), Theil (1964), and Simon (1956).

egy, one may perhaps question the efficacy of the two-stage decision process developed here. One rationale for it is that the Open Market Committee may reserve strategy decisions to itself, while delegating tactical matters to a subordinate group subject to its review, much as it currently delegates many operating decisions to the Manager of the Open Market Account. Alternatively, if the Committee wishes to reserve both strategy and tactics for its own decisions, allocating some meetings to strategy and others to tactics is probably a more efficient use of time than the system currently in practice.

Finally, since strategy and tactics are different decisions on two distinct sets of questions, separating the two—even if only in discussion —should enhance clarity and thereby help decision-makers to operate more efficiently. A strategy is the result of an examination of the entire relevant economic outlook; it expresses the best monetary policy response to that situation. Tactics embrace the more technical operational difficulties involved in meeting the monetary policy targets specified in the strategy.

II. ECONOMIC SPECIFICATION AND APPROPRIATE TACTICAL RESPONSE

Retaining the division of monetary policy decisions into the two levels of strategy and tactics, the discussion of this and the following two sections examines several issues especially relevant for the tactics stage. An assumption which therefore underlies this discussion is that the basic elements of the prevailing monetary policy strategy are fixed inputs in evaluating a tactical problem. More specifically, assume throughout these three chapters that the Open Market Committee has identified the financial target variable (or list of variables) M and has specified a desired movement of X (where X is a vector if M is more than one variable) for the immediate quarter.

The value of M at the beginning of the quarter and the desired movement X together suffice to define a target path for M. A typical tactical problem arises if, after one month of the quarter, incoming reports indicate that M has strayed away from this target path. The basic decisions in the tactical stage of the monetary policy process involve confronting this problem and formulating appropriate Federal Reserve responses.

The following discussion explores three sets of issues related to this central tactical problem of observed deviations of M from its target path:

In this section, how does the specification of the economic transmission of the effects of monetary policy influence the appropriate tactical response?

In Section III, what precautions are necessary to prevent these responses from destabilizing, rather than stabilizing, the economy?

In Section IV, what are the implications of using data subject to revision, in evaluating the situations to which monetary policy tactics are to respond?

ECONOMIC CONTENT OF TACTICAL DECISIONS. Although tactical decisions in the sense used here may be technical and operational in nature, they do have substantial economic content. Perhaps the clearest example of this fact is the influence upon tactical decisions of one's specification of the effects of monetary policy on the economy.

Consider the following simplified illustration: The Open Market Committee has identified one financial variable M as its target variable and has set down its strategy for the quarter as a movement of X in M. For the purpose of this example, let M be some monetary aggregate and let X be equivalent to a given increase in M. ($X < 0$ implies a desired decrease in M.) Then,

$$M_1^* = M_0 + \Delta_1^* M$$

$$M_2^* = M_1^* + \Delta_2^* M$$

$$M_3^* = M_2^* + \Delta_3^* M = M_0 + X$$

$$\Delta_1^* M + \Delta_2^* M + \Delta_3^* M = X$$

where M_0 = actual value of M at the beginning of the quarter, M_i^* = desired value of M at the end of the ith month, and Δ_i^*M = desired change in M during the ith month.

For further simplicity assume that the initial intention is to spread the total movement X evenly over the quarter.[3] Then

$$\Delta_1^*M = \Delta_2^*M = \Delta_3^*M = \frac{1}{3}X$$

The Manager of the Open Market Account will then conduct open market operations over the first month in the manner that he thinks is most likely to achieve the desired movement Δ_1^*M. A large number of factors beyond the Manager's immediate control, however, also influence movements in M.[4] As a result, his ability to achieve an exact total of M_1^* at the end of the month is limited. In more general terms, the Manager may miss Δ_i^*M and M_i^* and instead achieve Δ_iM and M_i, where Δ_iM = actual change in M during the ith month, and M_i = actual value of M at the end of the ith month.

A number of responses to this situation are possible: For example, the Manager may attempt to rectify the entire error during the next month, so as to return M to its target path by the end of that month. This plan leads to a revised desired change in M in month $i + 1$:

$$\Delta_{i+1}^{**}M = \Delta_{i+1}^*M + \Delta_i^*M - \Delta_iM = M_{i+1}^* - M_i$$

where $\Delta_i^{**}M$ = revised desired change in M during the ith month. M_{i+1}^* remains unchanged.

Alternatively, the Manager may attempt to spread the correction process so as to return M to its target path only at the end of the quarter. This plan involves revising both the desired change in M in month $i + 1$ and the desired level of M at the end of the month $i + 1$:

$$\Delta_{i+1}^{**}M = \Delta_{i+1}^*M + \frac{1}{N}(\Delta_i^*M - \Delta_iM)$$

$$M_{i+1}^{**} = M_{i+1}^* - \frac{1}{N}(\Delta_i^*M - \Delta_iM)$$

where $N = 3 - i$ = number of months remaining in the quarter, and M_i^{**} = revised desired value of M at the end of the ith month. In the special case of equal desired monthly increments, mentioned above, when, with 2 months remaining,

$$\Delta_{i+1}^*M = \Delta_{i+2}^*M = \frac{1}{3}X$$

these relationships simplify to

$$\Delta_{i+1}^{**}M = \frac{1}{2}(X - \Delta_iM)$$

$$M_{i+1}^{**} = M_i + \frac{1}{2}(X - \Delta_iM)$$

In the special case that $i = 2$, that is, when the Manager has kept M to its target path for the first month of the quarter but could not prevent a deviation in the second, this plan of achieving the full correction only by the end of the quarter coincides with the earlier plan of achieving the full correction in the first possible month.

Neither of these alternatives includes any scheme for "compensation" for past deviations. If, for example, M has strayed below its target path during the first month of the quarter, one tactical response could be to force it above its target path by an equivalent amount and for an equivalent period of time. Assuming that the first month's deviation has been accumulating gradually, the revised program becomes

$$M_2^{**} = M_2^* + M_1^* - M_1$$

$$\Delta_2^{**}M = \Delta_2^*M + 2(\Delta_1^*M - \Delta_1M)$$

$$\Delta_3^{**}M = \Delta_3^*M - (\Delta_1^*M - \Delta_1M)$$

M_3^* remains unchanged.

These three limited programs by no means exhaust the possible tactical responses to a de-

[3] Note that making each movement Δ_i^*M the same differs from pursuing a constant rate of growth in each period.

[4] Among these factors are float, currency in circulation, Treasury deposits at Federal Reserve Banks, gold and foreign accounts, Federal Reserve foreign currency holdings, and so forth. See Maisel (1969).

viation of M from its target path, nor is the Manager restricted to revising his operations monthly. Weekly data reports for some financial variables and daily reports for others should help him to recognize incipient deviations quickly. Nevertheless, some deviations will almost certainly occur, and the simplified illustrations above suggest at least two questions relevant to deciding upon appropriate responses: Should the Manager correct deviations in M as rapidly as possible, or should he spread the correction process so that M returns to its target path only by the end of the quarter? Further, should he compensate for unintended deviations of M in one direction by deliberately inducing controlled deviations in the other direction, or should he simply restore M to its target path with no compensation for past errors?

ROLE OF ECONOMIC SPECIFICATION: FOUR DIFFERENT CASES. One factor determining the answers to these questions, particularly that of compensation, is the specification of the relationship between M and the economic variables that are the ultimate goals of monetary policy. In the strategy stage of the policy-decision process, the Open Market Committee has determined variable(s) M and the desired movement(s) X by referring to some relationships, however vaguely conceived, of the form

$$Y = y(M)$$

where $Y =$ the ultimate policy goal variable (or vector of variables) and y is some functional relation (or set of relations).

In general, four separate possibilities are available for this relationship; only two of these have similar implications for purposes of tactical decisions. Although the reality of the economy is perhaps closer to a continuous time mathematical representation, preservation of the discrete system with a time interval of 1 month is preferable here for ease in exposition.

The following discussion retains the framework used above, in which the set strategy for the quarter calls for a movement X in M, and the Manager sets out to achieve X in three equal monthly movements, each equal to $\frac{1}{3}X$. The object of working through the logic and algebra of these straightforward exercises is to illustrate the significant influence upon tactical decisions of one's specification of the relation $Y = y(M)$.

Case A: One unlikely specification is that Y depends on M with these properties: First, the proper argument in the relation is the movement in M, that is, ΔM, not the value of M itself. Second, there are no continuing lags in the system's response to this movement in M. This second restriction means that a ΔM in one month influences Y in one month only (not necessarily the same month); similarly, it means that Y in any month is influenced by ΔM in only one month (again not necessarily the same month). Hence, while the restriction permits Y to depend upon one lagged value of ΔM, it precludes the dependence of Y on lagged values of itself, since such a lagged response relation would enable ΔM in any given month to influence Y in a series of months through a Koyck-type distributed lag.[5]

In this case, there need be no compensation for past errors of any form. Assume, for example, that ΔM in any month influences Y as described above, with a 6-month lag. Then $\Delta_i M$ influences Y_{i+6}. If $\Delta_i M$ deviates from its specification in the Committee's strategy decision, it is of no benefit to adjust $\Delta_{i+1} M$ to compensate. Doing so merely causes Y_{i+7} to deviate from its desired value. Under the specifications of Case A, when the ith month ends, all Y through Y_{i+6} are beyond the control of monetary policy. Monetary policy can still influence Y beginning with Y_{i+7}; but these Y's are in no way affected by the error in $\Delta_i M$, and so compensation for that error is pointless and even harmful. Hence the Manager should continue to try to achieve ΔM equal to $\frac{1}{3}X$ in

[5] Koyck (1954).

each subsequent month, and the target path for M over the quarter shifts vertically to reflect M_i as its new starting point.

The restrictive specification of Case A renders it highly unrealistic, and only methodological completeness justifies its inclusion here.

Case B: A slightly less restrictive specification is that Y depends on M with these properties: First, the proper argument in this relation is the value of M itself. Second, as in Case A, there are no continuing lags in the system's response to the value of M. Again, this second restriction means that a value M in one month influences Y in one concurrent or succeeding month only; similarly, it means that Y in any month is influenced by the value M in only one concurrent or preceding month. Again, as in Case A, this restriction precludes the dependence of Y on lagged values of itself.

In this case, however, one form of compensation is in order. If M deviates from its target path in the ith month, retaining the 6-month lag assumption used above, Y_{i+6} takes on an undesired movement that is beyond the influence of monetary policy once the ith month has ended. Nevertheless, permitting M to persist in this deviation past the ith month perpetuates the undesired movements in Y past Y_{i+6}. Hence it is essential to restore M to the appropriate initial target path.

The Case B answer to the compensation question, then, is as follows: When $\Delta_i M$ has deviated from $\Delta_i{*}M$, so that M_i deviates from $M_i{*}$, $\Delta_{i+j}{**}M$ replaces $\Delta_{i+j}{*}M$ according to some scheme to compensate for the original error, where j extends to as many months as are necessary to return M to its original target path. If this correction process is to take more than 1 month, $M_{i+j}{**}$ replaces $M_{i+j}{*}$, where j extends to one less than the number of months necessary to return M to its initial target path.

Hence in Case B there is compensation in the sense of responding to $\Delta_i M$ different from $\Delta_i{*}M$ by letting $\Delta_{i+j}{**}M$ differ from $\Delta_{i+j}{*}M$ in the opposite direction. There is no compensation in the sense of responding to a level M_i different from $M_i{*}$ by letting $M_{i+j}{**}$ differ from $M_{i+j}{*}$ in the opposite direction.

The speed of adjustment conclusion for Case B, arguing narrowly from the causal effects of M on Y, is to return M to its target path as rapidly as possible, since continuing the deviation through $M_{i+j}{**}$ perpetuates the undesired effects on Y through Y_{i+j+6}.

The more interesting Cases C and D repeat the argument specifications for Cases A and B, only without the extremely restrictive assumption of no continuing lags in the response of Y to the movement ΔM (Case C) or the value M (Case D). Relaxing this restriction admits more realistic and believable specifications in which Y depends on lagged values of itself. The tactical conclusions for Case C emerge to be similar to those for Case B, while Case D introduces a new form of compensation. The formal analysis is as follows:

Case C: Here the proper argument in the relation between Y and M is the movement in M, that is, ΔM. Since Y_i may depend on a series of lagged $\Delta_{i-j}M$ (or, equivalently, on some one $\Delta_{i-j}M$ and also on Y_{i-1}), a ΔM in one month influences Y in a number of succeeding months.

In this case, as in Case B, it is necessary to provide compensating movements in ΔM, in order to return M to the original target path (or near it, as in Example 2 below). If $\Delta_i M$ has differed from $\Delta_i{*}M$, recasting the 6-month lag assumed above into a 6-month no-response period, Y_{i+6} takes on an undesired movement that is beyond the influence of monetary policy once the ith month has ended. The specification in Case C, however, indicates that the error in $\Delta_i M$ itself, if not offset by compensating revisions of $\Delta_{i+j}{*}M$ to $\Delta_{i+j}{**}M$, will lead to undesired movements in Y_{i+j+6}.

Example 1 (rectangular lag): Suppose that Y_i depends equally on $\Delta_{i-6}M$ through $\Delta_{i-11}M$, that is, the lag is rectangular and persists for two quarters after an initial no-response period of two quarters. Then, if $\Delta_i M$ has differed from $\Delta_i{*}M$, setting

$$\Delta_{i+1}{}^{**}M = \Delta_{i+1}{}^{*}M + \Delta_i{}^{*}M - \Delta_i M = M_{i+1}{}^{*} - M_i$$

returns M to its target path after only 1 month's deviation. Y_{i+6} will have an undesired component which no further monetary policy can correct; assuming no further errors in M, however, Y_{i+7} through Y_{i+11} will be on target. A problem emerges only for Y_{i+12}, which still depends on $\Delta_{i+1}M$ but not on $\Delta_i M$. If no further corrective adjustment occurs, Y_{i+12} will have an undesired element equal in size and opposite in direction to that which occurred in Y_{i+6}.

Here arises one of the few differences in compensation action conclusions between Case B and Case C: Under the former specification, the compensation in $\Delta_{i+1}{}^{**}M$, which returns M to its target path, limits the undesired movements in Y to Y_{i+6} only. With the perpetuating lags of Case C, however, the error compensation adjustment in $\Delta_{i+1}{}^{**}M$, which also returns M to its target path, causes Y_{i+12} to differ from its desired value.

If the speed of adjustment is such that the compensation occurs not just in $\Delta_{i+1}{}^{**}M$ but in $\Delta_{i+j}{}^{**}M$, where j extends to as many months as are necessary to return M to its target path, then the situation is somewhat more complex. Y takes on diminishing deviations through all Y_{i+j+5}, instead of just in Y_{i+6}; similarly, Y takes on diminishing deviations through all Y_{i+j+11}, instead of just in Y_{i+12}. As in Case B, however, it seems desirable, in light of the arguments considered here, for the speed of adjustment to be as rapid as possible, thus minimizing the deviations of Y in the two periods beginning with Y_{i+6} and Y_{i+12}.

The existence of the second deviation period for Y, beginning with Y_{i+12}, leads to a further complexity. While this second deviation period is due to the compensating tactics of monetary policy, further monetary policy tactics can offset at least part of it. Whether or not to do so depends on the specific loss attached to deviations of Y from its desired values through time. If, for example, the relevant loss function is a sum of absolute values of deviations of Y from its desired values, then, within the context of the rectangular lag on ΔM, it is a matter of indifference whether or not to offset the second deviation period. Alternatively, if the loss function is a sum of squared deviations of Y, then it is preferable to replace one large deviation with several small ones, and so this second offsetting action can potentially reduce the total loss sustained.

More formally, suppose, in line with the above discussion, that the y function includes this component:

$$Y_i = \ldots + \beta \sum_{j=6}^{11} \Delta_{i-j}M + \ldots$$

Suppose further that $\Delta_i M$ has contained an error of ϵ, that is,

$$\epsilon = \Delta_i M - \Delta_i{}^{*}M$$

and that $\Delta_{i+1}{}^{**}M$ has fully offset this error, returning M to its original target path by the end of month $i + 1$:

$$\Delta_{i+1}M = \Delta_{i+1}{}^{**}M = \Delta_{i+1}{}^{*}M - \epsilon$$

Then the only difference between Y and its desired value in the first deviation period is

$$Y_{i+6} - Y_{i+6}{}^{*} = \beta\epsilon$$

where $Y_i{}^{*}$ = the desired value of Y in period i. Hence the loss associated with the first deviation period, by using a simple quadratic penalty function, is

$$L_1 = (Y_{i+6} - Y_{i+6}{}^{*})^2 = (\beta\epsilon)^2 = \beta^2\epsilon^2$$

This loss is unavoidable once $\Delta_i M$ has differed from $\Delta_i{}^{*}M$ and occurs whether or not monetary policy attempts to offset the second deviation period in Y. If monetary policy foregoes such secondary offsetting action, the loss from the secondary deviation is

$$L_2 = (Y_{i+12} - Y_{i+12}^{*})^2 = (-\beta\epsilon)^2 = \beta^2\epsilon^2$$

One possibility for offsetting action is simply to set

$$\Delta_{i+7}{}^{**}M = \Delta_{i+7}{}^{*}M + \frac{1}{2}\epsilon$$

and

$$\Delta_{i+8}{}^{**}M = \Delta_{i+8}{}^{*}M - \frac{1}{2}\epsilon$$

The resulting secondary loss is

$$L_2 = (Y_{i+12} - Y_{i+12}^*)^2 + (Y_{i+18} - Y_{i+18}^*)^2$$
$$= \left(-\frac{1}{2}\beta\epsilon\right)^2 + \left(\frac{1}{2}\beta\epsilon\right)^2 = \frac{1}{2}\beta^2\epsilon^2$$

Hence the result of this secondary offsetting action is to reduce the loss associated with the secondary deviation by 50 per cent and the loss associated with the entire episode by 25 per cent, with the losses measured by a simple quadratic function.

Example 2 (Koyck lag): Suppose that Y_i depends on $\Delta_{i-5}M$ and all preceding ΔM, that is, $\Delta_{i-j-5}M$ for all $j > 0$, with geometrically declining weights. Then

$$Y_i = \ldots \beta \sum_{j=1}^{\infty} (1 - \lambda)^j \Delta_{i-j-5} M + \ldots$$
$$0 < \lambda < 1$$

This geometric lag pattern is probably more realistic than the rectangular pattern assumed above in Example 1. An error in the ith month of

$$\Delta_i M - \Delta_i^* M = \epsilon$$

then leads to a primary deviation in Y_{i+6} and an associated

$$L_1 = (Y_{i+6} - Y_{i+6}^*)^2 = (\beta(1 - \lambda)\epsilon)^2$$
$$= (1 - \lambda)^2\beta^2\epsilon^2$$

A compensatory tactic setting

$$\Delta_{i+1}^{**}M = \Delta_{i+1}^*M - (1 - \lambda)\epsilon$$

permits Y to sustain no deviation from its desired value through time, beginning with Y_{i+7}. Furthermore, revising Δ_{i+1}^*M to $\Delta_{i+1}^{**}M$ in this manner eliminates the secondary deviation problems inherent in the rectangular lag of Example 1. Hence the only deviation of Y from Y^* for the entire episode is that contained in Y_{i+6}.

This result highlights a second difference between the Case B and Case C compensation conclusions. Under the former specification, revised level M_{i+j}^{**} replaces M_{i+j}^* only for one less month than necessary to return M to its target path, after allowing for speed of adjustment considerations. Under the Case C specification with a geometric lag pattern, level M_{i+j}^{**} differs from M_{i+j}^* by

$$M_{i+j}^{**} = M_{i+j}^* + \lambda\epsilon$$

for all $j > 0$. This change implies a vertical shift in the entire target path for M, similar to that required in Case A, making M_{i+1}^{**} the new starting point and proceeding with movements of Δ_{i+j+1}^*M as previously planned. Hence, while Case B always involves returning M to its original target path, Case C may or may not involve such a return, depending upon the specific lag pattern involved.

The clear implication for monetary policy is that tactics become much simpler if a geometrically declining lag pattern maintains in the $Y = y(M)$ relation. Even if different lag patterns maintain, however, a corresponding simplicity in tactics may result from the introduction of uncertainty discounting into the loss function. In other words, the economy may be sufficiently stochastic that random events render planning for the more distant future increasingly futile after some point. In terms of the discussion of primary and secondary deviations of Y from Y^*, unforeseen circumstances unassociated with monetary policy may arise, causing movements in Y and at times calling for revisions in Δ^*M and M^*, thereby eliminating the rationale behind intricate plans calculated to minimize secondary deviations.

Case D: The final category of specification requires that the proper argument in the $Y = y(M)$ relation is the value M itself, as in Case B; while the Y_i may depend on a series of lagged M_{i-j}. Hence M in one month influences Y in a number of succeeding months.

A relation of this sort introduces a new dimension of compensation for previous operational errors in keeping M to its designated target path. If $\Delta_i M$ has differed from Δ_i^*M, causing M_i to differ from M_i^*, an adjustment is necessary not merely to return M to its target path but also to cause an offsetting deviation of equivalent magnitude and duration in the opposite direction. Analogously to Case C, only substituting levels of M for movements ΔM, a deviation of even one M_i from the corresponding M_i^* will cause undesired movements in a series of subsequent Y_i if not compensated. Consider again the rectangular and geometric lag examples:

Example 1 (rectangular lag): The direct analog to Case C is to compensate for a deviation of M_i from M_i^* by setting

$$M_{i+1}^{**} = M_{i+1}^* + M_i^* - M_i$$

and retaining M_{i+j+1}^* unchanged for all $j > 0$, assuming that speed of response considerations call for correcting the error entirely in the first month. This step to minimize the primary deviation in Y implies revisions in monthly movements

$$\Delta_{i+1}^{**}M = \Delta_{i+1}^*M + 2(\Delta_i^*M - \Delta_i M)$$

and

$$\Delta_{i+2}^{**}M = \Delta_{i+2}^*M - (\Delta_i^*M - \Delta_i M)$$

and retention of Δ_{i+j+2}^*M unchanged for all $j > 0$. Hence M returns to its target path only in the second month following the initial error in M_i.

This response accomplishes full compensation on M in the first month after the initial error, returning M to its original target path at the end of that month. Preserving the assumption of a rectangular lag of 6 months, this scheme restricts the primary deviation in Y to Y_{i+6} only. The argument concerning subsequent tactics to prevent secondary deviations of Y_{i+j+12} from Y_{i+j+12}^* is directly analogous to that presented for Case C, Example 1.

One assumption underlying Case D is that the value M_i represents a mean value over the ith month.[6] If M_i instead represents the level at the close of the ith month, it is important to estimate during how much of the month that level maintained, before formulating tactics. The duration and magnitude of the compensatory portion of M's actual path both must match the corresponding features of the error portion of the path. The argument works in the other direction as well; an end-of-month M_i equal to M_i^* does not indicate success of monetary policy operations if the actual level prevailing through most of the month differs substantially from that implied by the M^* path.

Example 2 (Koyck lag): Again in analogy to the Case C treatment of the geometric lag, suppose that the $Y = y(M)$ relation contains the following term:

$$Y_i = \ldots + \beta \sum_{j=1}^{\infty} (1 - \lambda)^j M_{i-j-5} + \ldots$$

If M_i has deviated from M_i^*, adjusting M_{i+1}^* by

$$M_{i+1}^{**} = M_{i+1}^* - (1 - \lambda)(M_i - M_i^*)$$

leaving M_{i+j+1}^* unchanged for all $j > 0$, confines the undesired movement in Y to Y_{i+6}. This step implies revisions in the monthly movements of

$$\Delta_{i+1}^{**}M = \Delta_{i+1}^*M - (2 - \lambda)(M_i - M_i^*)$$
$$\Delta_{i+2}^{**}M = \Delta_{i+2}^*M - (1 - \lambda)(M_i - M_i^*)$$

and leaves Δ_{i+j+2}^*M unchanged for all $j > 0$. Like Case B, Case D requires ultimately returning M to its originally specified target path.

CONCLUSIONS. To summarize the conclusions of this section, optimal monetary policy tactics depend fundamentally on the specification of the relationship between the financial variables chosen as monetary policy targets and the variables that represent the goals of the policy. Tactics may require no response at all to operating errors or very complex responses; may call for redefining a new target path for M or for retaining the original target path; or may imply the adequacy of a once-and-for-all response to operating errors or the necessity of acting to prevent future policy-induced instabilities. The one seemingly consistent conclusion in all four possible cases is that compensatory responses, if warranted at all, should take place as rapidly as possible; Section III examines this tentative conclusion more closely and exposes it to additional considerations.

Before proceeding, however, one further

[6] This usage represents a change from that introduced on p. 113 in which M_i is the actual value of M at the end of the ith month.

issue deserves explicit treatment. The above discussion, for all cases, has used a time period of 1 month and has often considered up to 12 periods into the future; a fixed strategy decision, under the program formulated in Section I, covers only 3 months.

There are two justifications for this apparent contradiction. First, these illustrations are more general in their application than the discussion—couched in more specific terms for expository purposes—may indicate. Second, considering immediate actions in terms of their implied effects on future actions—even when those future plans will be revised—is an aid to proper policy formulation. This principle holds for sketching tactical decisions beyond the point at which a new strategy will supplant the current one, as well as for formulating strategic decisions for quarters beyond the immediate one.

III. QUESTIONS OF STABILITY

The discussion in Section II reviews different possible specifications of the relationship between the instruments and the goals of monetary policy, drawing the implications of each specification for appropriate policy tactics in response to an unintended deviation of an instrument from its designated path. In those cases of specification that warrant compensatory movements in monetary policy instruments, the analysis tentatively suggests that the best tactics would always be to accomplish the full compensation as rapidly as possible. Doing so would avoid further undesired movements in the policy goal variables beyond that caused by the initial error in the instruments. The corresponding analysis for strategic shifts in policy, to offset exogenous shifts in demands and supplies in the economy, appears to be similar, also calling for as rapid a policy response as possible.

This analysis, while perhaps adequate to indicate the importance of specification of the $Y = y(M)$ relation, is too restrictive to deal effectively with the speed-of-response question. In particular, it omits considerations of stability which arise from feedback effects of Y upon M in the private economy, independent of Federal Reserve action.

A TWO-EQUATION STOCK-FLOW MODEL. To be more specific, consider a two-variable illustration of monetary policy control: Let Y be some measure of output (equal to income) of the economy, and let M represent the existing stock of some set of financial assets. Analysis that has previously treated growth models with capital stock accumulation has a monetary analog. The following model uses these familiar tools to deal with a growth model that has an accumulating stock of financial assets and to draw implications for desired speeds of response in monetary policy tactics.[7]

Suppose that the $Y = y(M)$ relationship is homogeneous of degree one; the linear forms of the four specifications of Section II may all meet this condition under certain assumptions. It then follows that growth in either of Y or M must imply an equiproportional growth in the other. For any period of time, the growth rate of Y is

$$\frac{Y_t - Y_0}{Y_0}$$

while that for M is

$$\frac{M_t - M_0}{M_0}$$

Suppressing the time unit and dealing in a continuous time framework, the corresponding rates of growth are

$$(3.1)\ \frac{1}{Y} DY = D \log Y \text{ and } \frac{1}{M} DM = D \log M$$

respectively, where D is the differential operator with respect to time. The condition of equiproportional growth, implied by the homo-

[7] This discussion follows closely the format presented in Chapter 10 of Allen (1967).

geneous degree one condition on the $Y = y(M)$ relation, is that over time

$$\frac{Y_t - Y_0}{Y_0} = \frac{M_t - M_0}{M_0}$$

In particular, if the economy satisfies this condition at every point in time,

$$D \log Y = D \log M$$

Let g indicate this common growth rate for Y and M. Then integration over time of the growth-rate equation

$$D \log Y = g$$

yields

$$\log Y = \text{constant} + gt$$

or

$$Y = Ae^{gt}$$

where A is an arbitrary constant of integration. Replacing arbitrary A with an initial condition Y_0 at time $t = 0$ gives

$$Y = Y_0 e^{gt} \tag{3.2}$$

By the same steps,

$$M = M_0 e^{gt} \tag{3.3}$$

where $M = M_0$ at time $t = 0$.

These results depend only on the homogeneous degree one properties of the $Y = y(M)$ relation. Since the model theoretically represents a real economy with a stock of financial assets, however, it is possible to impose stock and flow conditions upon the system. In equilibrium, the economy must satisfy both sets of conditions.

For a stock condition, posit a simple fixed velocity relation for $Y = y(M)$:

$$Y = vM, \quad \text{or} \quad M = \frac{1}{v}Y, \quad \text{for all } t \tag{3.4}$$

where $v > 0$.

For a flow condition, assume that income earners desire to add a fixed fraction of current income to their stock of asset M; further assume that the Federal Reserve System conducts monetary policy so as to accommodate this desire. Then

$$DM = sY \quad \text{for all } t \tag{3.5}$$

where $0 < s < 1$.

These two conditions together yield a solution for the common growth rate attainable simultaneously for Y and M, from elimination of M from equations 3.4 and 3.5:

$$sY = \frac{1}{v}DY \tag{3.6}$$

$$\therefore \frac{1}{Y}DY = D \log Y = sv$$

and so $g = sv$. The same solution results from elimination of Y from equations 3.4 and 3.5:

$$DM = s(vM) \tag{3.7}$$

$$\therefore \frac{1}{M}DM = D \log M = sv$$

Hence this model gives an attainable steady-state growth only for

$$D \log Y = D \log M = g = sv \tag{3.8}$$

EXTENSIONS OF THE MODEL. So far the model does not allow for exogenous shifts in the asset-creating propensities of the private sector. Suppose that the Federal Reserve has provided sufficient reserves to enable the stock of asset M to grow at rate $g = sv$, while income Y has also grown at $g = sv$. Further suppose that at time $t = 0$ a new asset becomes available, leading income earners to allocate to this new asset some fixed amount of the income that previously they would have allocated to accumulation of asset M. Meanwhile, suppose that the initial velocity relation $Y = y(M)$ continues to hold. This change means a shift in the flow condition from equation 3.5 to

$$sY = DM + A \text{ for all } t \geq 0 \tag{3.9}$$

where A is the fixed accumulation of the new asset. The stock condition, equation 3.4, remains unchanged.

The solution of the system now changes, to reflect the change in the flow condition. The differential equation 3.6, formed by eliminating

M from both stock and flow conditions, becomes

$$(3.10) \qquad sY - A = \frac{1}{v}DY$$

Y now follows the path through time which is consistent with the solution of differential equation 3.10. That solution is

$$(3.11) \qquad Y = \frac{A}{s} + \left(Y_0 - \frac{A}{s}\right)e^{gt}$$

where $Y = Y_0$ at time $t = 0$ (initial condition) and $g = sv$ as before.

Equation 3.11 is a generalization of the simpler path of equation 3.2, which is consistent with the model with no alternative asset, as solved in equation 3.6. $g = sv$ remains in equation 3.11 the only possible rate of steady-state growth consistent with the homogeneous degree one properties of the stock condition, but here there are more possible results. $A = 0$ leads, as expected, to the same path as before. $A = sY_0$ indicates, using the new flow condition 3.10, that the economy directs all asset creation to asset A, leaving no growth in asset M; hence, by stock condition 3.4,

$$Y = \frac{A}{s} \text{ for all } t \geq 0$$

indicating the establishment of a stationary state. $0 < A \neq sY_0$ leads to a steady growth (if $A < sY_0$) or decline (if $A > sY_0$) in Y and in M. The path of M, analogous to equation 3.11, is

$$(3.12) \qquad M = \frac{A}{g} + \left(M_0 - \frac{A}{g}\right)e^{gt}$$

where $M_0 = \frac{1}{v} Y_0$, and $g = sv$. Equation 3.12 is itself a generalization of the simpler path for M of equation 3.3, which is consistent with the model with no alternative asset, as solved in equation 3.7.

A further extension of the model is to reduce the restrictions on the exogenous financial asset accumulation A. Specifically, it is unrealistic to assume that A is constant through time. If A varies over time in a pattern indicated by some function $A(t)$, then differential equation 3.10 becomes

$$(3.13) \qquad sY - \frac{1}{v}DY - A(t) = 0$$

The solution of this equation is

$$(3.14) \qquad Y = f(t) + Be^{gt}$$

where the particular integral $f(t)$ depends on the function $A(t)$, and B is an arbitrary form determined by the initial condition Y_0.

STABILITY CONDITIONS IN CONTEXT OF THE MODEL. This machinery, developed at some length, is now available to explore problems of stability of the economy and its susceptibility to monetary policy control. Here stability bears the traditional sense of Harrod's usage, especially with reference to the "knife-edge" problem.[8]

So far the analysis has assumed fulfillment of the stock condition 3.4 both initially, giving

$$Y_0 = vM_0$$

and through all time, giving

$$Y_t = vM_t$$

for all t. Following Allen's treatment,[9] the basic stability questions arise if output Y and stock of the asset M are out of line, that is, deviate from this stock condition. Such deviations, or disequilibria, may stem from errors on the part of policy-makers or from unforeseen exogenous disturbances in the economy. The analysis here may treat the discrepancy either as existing initially, making M_0 out of line with Y_0, or as arising in the paths of M and Y through time.

Any resulting response on the part of the Federal Reserve to try to adjust M introduces a servo-mechanism control device into the system.[10] The disequilibrium situation invali-

[8] Harrod (1948).

[9] Allen (1967).

[10] A servo-mechanism is a controller which sets the magnitude and/or direction of the controlling impulse as a function of the state of the system to be controlled.

dates the stock condition 3.4; if the policy responses follow a set pattern, dictated by predetermined strategic or tactical principles, they then replace stock condition 3.4 by a new stock condition. The new condition represents both the reliance on and the accumulation of asset M in the private sector, as well as the discretionary influence of the Federal Reserve.

If the Federal Reserve responses follow a sufficiently regular pattern to permit their being expressed as a new stock condition, it is possible to analyze the resulting system to determine just what effects such Federal Reserve actions will produce, in terms of their stabilizing or destabilizing influence on the economy in its disequilibrium state. Conversely, examining different response systems in the abstract yields conditions that any actual policy scheme must meet to ensure that it stabilizes, rather than destabilizes, the economy.

This approach to stability is relevant both to the longer-term strategy decisions of the Open Market Committee and to nearer-term exercises in monetary policy tactics. As in the discussion of Section II about different forms of compensating movements, the specification of the particular relationships in the system is crucial to the conclusions derived. Further, for at least one important conclusion, the actual values of the coefficients in the relations assume a new significance.

Before illustrating these results with an example, it is best to determine the definition of stability that best fits the intent of monetary policy. Suppose that the Open Market Committee has specified a desired path of M through time, denoted M^*, and that associated with M^* is a path for Y, denoted Y^*. Suppose, further, that M^* and Y^* call for M and Y to meet the stock and flow conditions 3.4 and 3.5 at all times. Then these paths call for exponential growth of both M and Y at rate $g = sv$, and $M = \frac{1}{v} Y$ at all times.

Now suppose that some exogenous shift in the financial determinants[11] of M causes M to deviate from M^*, for example, $M > M^*$, which implies $M > \frac{1}{v} Y^*$. Call this point in time $t = 0$, and consider the problem of generating growth paths of Y and M from the initial condition $M_0 > \frac{1}{v} Y_0$.

Two alternative definitions of stability of the system are possible: The first requires these generated growth paths to converge back onto the original desired paths Y^* and M^*. This requirement is very severe and is not well suited to the current stock-flow model in which Y represents income and M the stock of a set of financial assets. It is more appropriate to a model in which Y represents the goals of policy in a more stationary form, for example, the unemployment rate and the rate of price increase, and in which M has similar characteristics and stands itself for rates of asset growth or for interest rates.

A second definition of stability, identified by Jorgenson as "stability in the sense of Harrod,"[12] requires only that the growth rates of Y and M converge over time to the rate $g = sv$. Y and M find new paths, then, which do not necessarily regress to the initially desired paths Y^* and M^*, but which do meet the conditions of the original system in that both Y and M come to grow at rate g. If the Federal Reserve can stabilize the economy in this sense, it will be offsetting the initial exogenous disturbance in the stock condition just sufficiently to allow the economy to proceed as before, only consistently with the new, shifted stock condition. In the context of the stock-flow model as developed here, with the current definitions of Y and M, this definition of stability seems appropriate.

Adopting the second, or Jorgenson–Harrod, definition of stability, consider again the model with a unique steady-state growth solution given by

(3.2, 3.3) $Y = Y_0 e^{gt}$ and $M = M_0 e^{gt}$

where $g = sv$, provided that the initial values

[11] See footnote 4, p. 113.

[12] Jorgenson (1960).

Y_0 and M_0 satisfy $Y_0 = vM_0$. Assume now, without loss of generality, that $Y_0 < vM_0$. Retaining M^* as the desired path of M, the initial condition is $M_0 > M_0^*$. For M to have achieved a level greater than its target, it must have grown at greater than the desired rate. Let

$$x = \frac{1}{M}DM$$

Then

$$x_0 = \left[\frac{1}{M}DM\right]_0 > g$$

Now assume that the Federal Reserve adopts a policy to reduce M to a new path M^{**} which will satisfy the stock condition $Y = vM$ (equation 3.4). Further suppose that the intended tactics of policy are to have the stock condition satisfied by the end of T time periods. The specific mechanics of the tactics may be as follows: A new desired path Y^{**} replaces the original path Y^*. This new path, together with the stock condition 3.4, implies some new path M^{**} for M.

Since $M_0 > \frac{1}{v} Y_0$, clearly $M_0^{**} < M_0$, since the paths Y^{**} and M^{**} proceed from Y_0 and $\frac{1}{v} Y_0$, respectively. Then the tactics call for moving M onto M^{**} by the end of T time periods. During these T time periods, therefore, there is yet a different planned target path M^{***} that the tactics indicate for M to follow; M^{***} originates at the point M_0 and converges to M^{**} at the end of the Tth time period.

Such a policy [13] involves reducing M in each period up to the Tth by an amount equal to $\frac{1}{T}(M - M^{**})$. The corresponding proportional rate of reduction, analogous to the proportional rate of growth g, is

$$\frac{1}{T} \cdot \frac{M - M^{**}}{M}$$

[13] The policy described returns M to M^{**} only asymptotically; it does not accomplish the full correction in T periods.

Combining the two, the new planned rate of growth for M is

$$g - \frac{1}{T} \cdot \frac{M - M^{**}}{M} = g - \frac{1}{T}\left(1 - \frac{1}{v}\frac{Y^{**}}{M}\right)$$

by using

$$Y^{**} = vM^{**}$$

Hence the Federal Reserve, in this disequilibrium situation, imposes in place of the unsatisfied stock condition 3.4 a growth rate for M over time of

$$\left(\frac{1}{M}DM\right)^{***} = \frac{k}{D + k}\left[g - \frac{1}{T}\left(1 - \frac{1}{M}\right)\right] \tag{3.15}$$

where

$$k = \frac{1}{T}$$

is the speed of response of the tactical response process, and the differential form is standard for simple exponential lags.[14]

Equation 3.15 and flow condition 3.5 together form a system that contains enough information to solve for x^{***}, defined now as the rate of growth of M that monetary policy tactics should achieve.

Use

$$x^{***} = \left(\frac{1}{M}DM\right)^{***} = D \log M^{***}$$

to substitute in condition 3.5 to obtain

$$Y = \frac{1}{s} Mx^{***}$$

Hence

$$\frac{1}{v}\frac{Y}{M} = \frac{x^{***}}{g} \tag{3.16}$$

Substitute 3.16 into equation 3.15 to obtain

$$x^{***} = \frac{k}{D + k}\left[g - \frac{1}{T}\left(1 - \frac{x^{***}}{g}\right)\right]$$

which is a first-order differential equation in x^{***}:

[14] For reference, see Allen (1967), pp. 88 ff.

$$(3.17)\quad Dx^{***} + k\left(1 - \frac{1}{gT}\right)x^{***} = kg\left(1 - \frac{1}{gT}\right)$$

The solution of this differential equation is

$$(3.18)\quad x^{***} = g + (x_0 - g)e^{-k[1-\left(\frac{1}{gT}\right)]t}$$

where $x^{***} = x_0$ at $t = 0$ is the initial condition of the system.

Hence if $x_0 = g$, there is no problem and $x^{***} = g$ for all t, thus giving the familiar steady-state growth solution of equation 3.3.

In the initial disturbance, or disequilibrium, case, however, $x_0 \neq g$, and so the full generalized equation 3.18 is necessary to determine x^{***}. In particular, the coefficient on t in the exponential term of the equation determines the system's behavior over time. Let

$$c = -k\left[1 - \left(\frac{1}{gT}\right)\right]$$

represent this coefficient. The speed of response factor k, constrained by $k > 0$, merely determines how fast or slow x^{***} is to follow any given pattern; it does not itself influence whether that pattern will be stable or unstable. The part of c within the brackets, in particular the relation between parameters g and T, determines the stability for x^{***} over time. Three cases arise:

Case 1: If $T = \frac{1}{g}$, then c vanishes, and so the exponential term in equation 3.18 for x^{***} remains constant at unity for all time. Hence $x^{***} = x_0 > g$ for all t. While x^{***} does not diverge further from g, it does not converge to g either, and so this case does not meet the Harrod definition of stability.

Case 2: If $T < \frac{1}{g}$, then $k > 0$ implies that $c > 0$. Since c is the coefficient on time itself, the exponential term in equation 3.18 increases through time, and the growth rate x^{***} steadily diverges from g. In policy terms, this means that the Federal Reserve response to $x_0 > g$ would have to make M grow at an ever-faster rate for all time, just to aim at returning M to M^{**} by the end of the ever-receding Tth period. This case clearly is unstable.

Case 3: If $T > \frac{1}{g}$, then $k > 0$ implies $c < 0$. Hence the exponential term in equation 3.18 decreases through time, vanishing in the limit to yield $x^{***} = g$. In policy terms, the Federal Reserve response to $x_0 > g$ would be to make M grow at $x^{***} > g$ for some time, eventually returning to the original steady-state growth rate g. This case is clearly stable, and so the policy-oriented definition of stability becomes clear:

A policy-response system is stable if a finite initial disturbance leads to a finite amount of compensation to be effected in some period of time, thereby permitting the system to return to equilibrium and to the rates of growth which maintained before the disturbance. Hence $T > \frac{1}{g}$ is necessary for the stability of the system.

Proceeding to derive the actual pattern of monetary policy, it is a straightforward exercise to use equations 3.15, 3.5, and 3.18 to obtain the target paths M^{***} and Y^{**}, and the corresponding path M^{**}. Using $x^{***} = D \log M^{***}$ and integrating 3.18 will yield

$$(3.19)\quad \log\frac{M^{***}}{M_0} = gt + \frac{1}{k}(x_0 - g)\frac{gT}{gT - 1}[1 - e^{-k[1-\left(\frac{1}{gT}\right)]t}]$$

Using 5.5 yields

$$(3.20)\quad \frac{Y^{**}}{M^{***}} = v + \frac{x_0 - g}{s}e^{-k[1-\left(\frac{1}{gT}\right)]t}$$

The target path M^{**}, representing not the path which monetary policy forces M to follow but rather that which it always seeks to make M approach by $\frac{1}{T}$ of the discrepancy per period, is simply $M^{**} = \frac{1}{v}Y^{**}$.

In the limit of the stable case, M^{***} returns to M^{**}, and x^{***} returns to g. M never returns to the original target path M^*; in the limit

$$M^{***} = M^{**} = zM_0 e^{gt} \tag{3.21}$$

where

$$\log z = \frac{1}{k}(x_0 - g)\frac{gT}{gT-1} \tag{3.22}$$

Similarly, Y^{**} never returns to its original path Y^* but rather follows the path of equation 3.20. Since $M^{***} = M^{**}$ in the limit, for the stability case, the system returns to equilibrium with the original stock condition satisfied.

CONCLUSIONS. The object of this somewhat tortuous exercise has been to illustrate the danger that the Federal Reserve System may itself destabilize the economy by causing movements in monetary policy instruments that attempt to do too much too soon. This point is relevant for decisions at both the strategic and the tactical levels. The specifications and parametric values of the economic relationships involved determine the conditions for actual stabilization.

The important result in the model used here is that $T > \frac{1}{g}$ is necessary for stability of the system. This conclusion contradicts the presumption of Section II that, in planning movements of monetary policy instruments to correct for past exogenous disturbances or errors, proper tactics call for effecting the entire compensation as quickly as possible. The analysis of this section, which includes not only the $Y = y(M)$ relation but also the feedback effects of Y on the accumulation of M, shows that this presumption is incorrect. Considerations of stability force the compensation speed of response to be less than a certain rate, as determined by both the specification of the relations involved and the values of the system's individual parameters.

IV. OPTIMAL FILTERING OF OPERATIONS DATA

The discussion of Sections II and III, while explicitly acknowledging random events in the form of disturbances to the process of monetary operations, has assumed complete certainty in the knowledge of past events. In the notation used in these sections, the actual value of the financial variable M_i, as well as its movement $\Delta_i M$, is an available datum as of the close of the ith time period.

In reality, however, the available data are merely estimates that are based on sampling and reporting machineries and are subject to revision. This information-generating process is familiar in Bayesian analysis of decisions and in control theory.[15] Using certain advance information, the estimator formulates a subjective prior probability distribution for the variable in question. He then uses the newly available sampling and reporting data to update this prior distribution into a posterior probability distribution on the same variable. When he receives yet another set of sample information, he treats this posterior distribution as a prior distribution (prior in the sense of its being prior to the second sample) and repeats the updating process to produce a new posterior probability distribution. He may repeat this process as often as new information continues to arrive, producing as many posterior distributions as there are distinct samples of data.

AVAILABLE FEDERAL RESERVE DATA. Actual practice differs from this idealized conception only by being less complete. Each Friday the Federal Reserve Board staff produces a "Perspective on Bank Reserve Utilization." This report presents, among other information, point estimates for the monthly movements in a number of monetary aggregates. These point estimates are the means of the probability distributions considered in the Bayesian formulation of the information proc-

[15] Standard references are Pratt, Raiffa, and Schlaiffer (1965) and Bryson and Ho (1969).

ess. The last Perspective of any month gives, for that month's movements in a given monetary variable M, a projection which for purposes of this discussion is equivalent to the mean of a prior probability distribution. As the month ends and more complete sample data arrive, the staff uses the newly available information to update this estimate, producing a new estimate which is then the mean of a posterior probability distribution. This new estimate appears in the first Perspective following the month's end.

As another week passes and still more sample data arrive, the staff treats the previous week's posterior distribution as the current week's prior distribution and updates it to produce a new posterior distribution for its expectation of the movement in M in the month recently ended. The mean of this second posterior distribution enters the second Perspective after the end of this month as a new, revised point estimate for the movement in M for this month.

Current practice is to repeat this process not less than eight nor more than 15 times, and so the staff estimate of a month's movement in M appears in the first eight and perhaps up to the next seven weekly Perspectives.

Although the staff may not directly conceptualize its data-revision activities within a Bayesian framework, the updating process nevertheless follows this general pattern. Similarly, while the staff may not explicitly view its point estimates as means of posterior probability distributions, the numbers generated are in each case the expected posterior values of M (posterior in the sense of following upon all information received through that time).

Since the available monetary data represent the means of probability distributions, it is likely that other parameters of these distributions also yield information of potential usefulness for monetary policy and particularly for monetary policy tactics. The problem again is that the staff does not explicitly derive these probability distributions as such and hence cannot directly quote their various parameters.

One approach—not a very good one for this application—would be to have the staff indicate its confidence in each reported estimate, perhaps by bracketing its point estimate within an interval wide enough to reduce the subjective probability of the true number's lying outside this band to one-third. Then assuming, for example, normal properties for the distribution itself, this band would be two standard deviations wide. While formulating confidence intervals in this subjective manner may be a useful procedure in developing judgmental projections of future events, it is not well suited to the problem of developing levels of confidence in reported data subject to revision.

A more direct approach is to analyze, *ex post,* the record of the staff's data estimation machinery, testing the relation between data estimates for successive weeks and the numbers later accepted as the true numbers. Tables 1 through 4 show the results of such an examination applied to Perspective reports during 1968 and the first half of 1969.[16]

In Table 1, for example, the lines correspond to different financial variables, all monetary aggregates. The first column gives, for each variable, the variance of the first reported estimate of a month's movement about the "true" value.[17] The next seven columns give, for each variable, the analogous variances for the second through the eighth estimates. For monthly changes in total reserves, for example, Table 1 shows that the first reported estimate has variance of 6,630 about the true value. By the fourth reported estimate, that is, allowing a reporting lag of 4 weeks, this variance falls to 814; by the eighth reported estimate, the variance falls to 328.

Tables 2 and 3 repeat the same format, giving, respectively, the standard deviations and average absolute errors corresponding to Table

[16] Specifically, the Perspective reports used span the period from January 1968 through July 1969.

[17] For purposes of this analysis the "true" value is the last one reported in a Perspective table, before the month is dropped from the listings.

TABLE 1: Variances of Reporting Errors
Weekly Estimates of Monthly Changes in Monetary Aggregates

Variable	Weeks after month-end							
	1	2	3	4	5	6	7	8
	Millions of dollars, squared							
Total reserves	6,630	2,570	1,510	814	810	740	641	328
Nonborrowed reserves	3,780	2,030	1,720	1,390	1,240	1,140	980	668
Total required reserves	2,860	2,300	1,550	885	884	886	872	628
	Billions of dollars, squared							
Total member bank deposits	.059	.057	.031	.037	.028	.036	.035	.001
Total money supply	.098	.050	.052	.055	.055	.065	.054	.017
Currency	.003	.006	.002	.002	.001	.000	.001	.001
Demand deposits	.088	.039	.045	.053	.055	.066	.061	.016
U.S. Government demand deposits (member banks)	.024	.009	.003	.003	.002	.004	.003	.002
Time deposits (commercial banks)	.016	.018	.013	.013	.011	.013	.007	.007
Money supply and time deposits	.135	.068	.046	.051	.046	.049	.047	.016

TABLE 2: Standard Deviations of Reporting Errors
Weekly Estimates of Monthly Changes in Monetary Aggregates

Variable	Weeks after month-end							
	1	2	3	4	5	6	7	8
	Millions of dollars							
Total reserves	81	51	39	29	28	27	25	18
Nonborrowed reserves	62	45	42	37	35	34	31	26
Total required reserves	53	48	39	30	30	30	30	25
	Billions of dollars							
Total member bank deposits	.243	.239	.176	.192	.167	.190	.187	.032
Total money supply	.313	.224	.228	.235	.235	.255	.232	.130
Currency	.055	.077	.045	.045	.032	---	.032	.032
Demand deposits	.297	.197	.212	.230	.235	.257	.247	.126
U.S. Government demand deposits (member banks)	.155	.095	.055	.055	.045	.063	.055	.045
Time deposits (commercial banks)	.126	.134	.114	.114	.105	.114	.084	.084
Money supply and time deposits	.367	.261	.214	.226	.214	.221	.217	.126

TABLE 3: Average Absolute Reporting Errors
Weekly Estimates of Monthly Changes in Monetary Aggregates

Variable	Weeks after month-end							
	1	2	3	4	5	6	7	8
	Millions of dollars							
Total reserves	57	32	25	16	15	13	9	5
Nonborrowed reserves	46	30	25	22	19	17	11	7
Total required reserves	35	27	21	13	13	12	11	9
	Billions of dollars							
Total member bank deposits	.184	.147	.111	.105	.063	.063	.053	.005
Total money supply	.279	.184	.184	.174	.142	.153	.116	.058
Currency	.026	.047	.021	.016	.005	---	.005	.005
Demand deposits	.253	.147	.137	.153	.137	.147	.111	.047
U.S. Government demand deposits (member banks)	.111	.053	.026	.032	.021	.026	.016	.011
Time deposits (commercial banks)	.111	.084	.063	.068	.053	.047	.032	.032
Money supply and time deposits	.321	.226	.174	.168	.142	.137	.116	.068

TABLE 4: Average Reporting Errors
Weekly Estimates of Monthly Changes in Monetary Aggregates

Variable	Weeks after month-end							
	1	2	3	4	5	6	7	8
	Millions of dollars							
Total reserves	−43	−26	−19	−13	−13	−12	−9	−5
Nonborrowed reserves	−28	−25	−20	−15	−18	−16	−11	−7
Total required reserves	−21	−21	−16	−8	−8	−7	−8	−6
	Billions of dollars							
Total member bank deposits	.005	−.011	.016	.011	−.011	−.021	−.032	.005
Total money supply	.058	.068	.058	.058	.047	.058	.021	.037
Currency	−.005	.005	.000	−.005	.005	.000	−.005	−.005
Demand deposits	.032	.042	.053	.058	.053	.053	.016	.037
U.S. Government demand deposits (member banks)	.047	.011	−.005	−.011	.000	−.005	−.016	−.001
Time deposits (commercial banks)	.005	−.032	−.011	−.005	−.011	−.026	−.011	−.011
Time supply and time deposits	.111	.037	.047	.053	.037	.032	.011	.037

1. Table 4 gives the corresponding mean errors; nonzero mean errors indicate bias in the reporting process and are probably due to the effect on the computations of data series revisions.[18]

As an illustration of the significance of these data, compare the standard deviations for two monetary aggregates that the Open Market Committee may wish to control, for example, the money supply and total reserves of member banks. In the first report after the end of the month, the money supply estimate is accurate to within a standard deviation of $313 million, or approximately ⅙ of a per cent on a base of some $200 billion; the total reserves estimate is accurate to within a standard deviation of $81 million, or approximately ⅓ of a per cent on a base of some $27 billion.[19] These errors correspond to a 2 and a 4 per cent annual rate of change, respectively.

By the fourth report after the end of the month, the money supply estimate is accurate to within a standard deviation of $235 million, or approximately ⅒ of a per cent, and the total reserves estimate is accurate to within a standard deviation of $29 million, or approximately ⅒ of a per cent. These errors both correspond to a 1¼ per cent annual rate of change. By the eighth report after the end of the month, the money supply estimate is accurate to within a standard deviation of $130 million, or approximately 7/100 of a per cent; the total reserves estimate is accurate to within a standard deviation of $18 million, or approximately 7/100 of a per cent. Both of these errors correspond to a 1 per cent annual rate of change.

Hence, under current reporting and estimation systems, money supply information is in the first instance more accurate than total reserves information; but this difference effectively vanishes with an allowed reporting lag of one month or longer.

CONCEPTUAL USE OF PROBABILITY DISTRIBUTION PARAMETERS. The object of the above exercise has been to obtain parameters of the successive probability distributions corresponding to successive data reports, while circumventing the tedious and somewhat inapplicable procedure of having the staff estimate these parameters subjectively. The reported data in the Perspectives are the means of these distributions. By assuming that the sampling, reporting, and updating machineries have not changed radically in the past 2 years, it is possible to accept the data in Table 1 as approximations to the variances of these probability distributions.

That such variances, or any corresponding parameters, are useful inputs in formulating

[18] The calculations reported in the tables have already made some adjustments for series revisions.

[19] The magnitude of reporting error in member bank total reserves may seem surprisingly large. These errors in fact reflect the "as-of adjustments" made within the Federal Reserve Banks to correct for accounting errors in debiting and crediting member bank accounts.

monetary policy tactics remains to be shown. Heuristically, the argument is as follows:

As elaborated earlier, there is usually an advantage to discovering operational errors in the monetary policy instrument variables and to undertaking the proper responses as quickly as possible. Even in circumstances in which considerations of stability lead to spreading compensatory reactions over some substantial period, it is usually advantageous to begin these reactions at the earliest possible time.

Simultaneously, however, basing tactical decisions on incorrect data leads to incorrect decisions. It is possible to undertake compensatory responses to errors that have not occurred, as well as to over- or underestimate the amount of correction necessary. It is possible, though less probable, to undertake a compensatory response in the wrong direction, if the data report is such as to change the signs of the true differences that have arisen between the actual and the desired values of the monetary policy instruments. Hence, from the standpoint of avoiding mistakes due to faulty data, it is best to postpone taking action until the data are more secure.

Two influences therefore oppose each other —one tending to accelerate and one to delay tactical action. The solution to the dilemma must in most cases be some compromise. Just what this answer means in operational terms, however, is not obvious. The following more formal analysis should clarify the role of the data probability distribution parameters in determining the best tactics in any given situation.

EXAMPLE OF A DATA FILTERING SCHEME. Consider, for example, a simple $Y = y(M)$ model of the form

$$(4.1) \qquad Y_i = \ldots + \beta \sum_{j=K}^{N} M_{i-j} + \ldots$$

where none of the omitted terms is a lagged value of Y. This model is the rectangular lag model of Example 1, Case D, in Section II. To recall, Case D is interesting in that operational errors in this specification call for subsequent compensatory responses in both the levels M and the changes ΔM. Here K is the number of time periods in the no-response section of the lag in the effect of M on Y, while N time periods is the total length of the lag.

More specifically, consider the case in which $K = 0$ and $N = 2$. While this lag pattern is unrealistic, it has two advantages: First, the mathematical manipulations of the problem increase in number as $(N - K + 1)^2$ increases, and a simple example should suffice to illustrate the main points of the analysis without introducing unnecessary complexities. Second, if $\beta = 1/3$, then this expression is simply an averaging term; replace Y_i on the left-hand side by some term in M, and the equation expresses the average value of M in a quarter as one-third times the sum of M in each month of the quarter. Hence the $K = 0, N = 2$ model is applicable both to tactical decisions as discussed above and to the somewhat narrower, more specific problem of achieving a predetermined average M over any given quarter.

Suppose, then, that month $i = 2$ has ended, and that the tactical problem is to select the proper plan for month $i = 3$. Suppose also that the circumstances are the following:

1. $Y_3{}^*$ is fixed, from the currently operative strategy.
2. $M_1{}^*$, $M_2{}^*$, and $M_3{}^*$ are also fixed from the currently operative strategy.
3. M_1 and M_2 are known; further, $M_1 \neq M_1{}^*$ and $M_2 \neq M_2{}^*$.
4. The loss associated with Y_3 is the simple quadratic $L_3 = (Y_3{}^* - Y_3)^2$.

In the deterministic cases considered in Sections II and III, achieving

$$(4.2) \quad M_3{}^{**} = M_3{}^* - (M_2 - M_2{}^*) - (M_1 - M_1{}^*)$$

will determine $Y_3 = Y_3{}^*$ and $L_3 = 0$.

Suppose, however, that assumption 3 above does not hold. M_1 and M_2 are not known with certainty. Instead, define $\hat{M}_i{}^j$ = value of M at the end of the ith month, as reported at the end of the jth month. Then the most recent available estimates of M_1 and M_2 are $\hat{M}_1^2$ and $\hat{M}_2^2$, namely, the current report on both values as of the close of month $j = 2$.

The tactical decision of equation 4.2 may now become

$$(4.3) \quad M_3^{**} = M_3^* - (\hat{M}_2^2 - M_2^*) - (\hat{M}_1^2 - M_1^*)$$

but acting in this fashion ignores the possibility of reporting errors, that is, the possibility that $\hat{M}_2^2 \neq M_2$ and $M_1^2 \neq M_1$.

One recourse is to apply some uncertainty discounting factor to the second and third terms in equation 4.3, in line with the classical formulations of optimal filtering. Define the variables

$$\epsilon_i \equiv M_i - M_i^*$$

$$\epsilon_{ik} \equiv \hat{M}_i^j - M_i^*, \qquad k = j - i$$

$$R_{ik} \equiv \hat{M}_i^j - M_i, \qquad k = j - i$$

Here ϵ_i = the true operating miss on M in the ith month; ϵ_{ik} = the estimated operating miss on M in the ith month, as reported k months after the end of the ith month; and R_{ik} = the reporting error in the estimate of M in the ith month, reported k months after the end of the ith month.

Then

$$(4.4) \qquad \epsilon_i = \epsilon_{ik} - R_{ik}$$

Equation 4.2, the rule with certain knowledge, is then

$$M_3^{**} = M_3^* - \epsilon_2 - \epsilon_1$$

Equation 4.3, the equivalent using reported data estimates, is

$$M_3^{**} = M_3^* - \epsilon_{20} - \epsilon_{11}$$

By using equation 4.4 and substituting,

$$M_3^{**} = M_3^* - (\epsilon_2 + R_{20}) - (\epsilon_1 + R_{11})$$

The idea of applying a filtering process to the available data is to make the operating rule

$$(4.5) \qquad M_3^{**} = M_3^* - \gamma_0\epsilon_{20} - \gamma_1\epsilon_{11}$$

where γ_k = discount factor applied to data estimates available k months after the fact, and $0 < \gamma_k < 1$, all $k > 0$.

Using the rule of equation 4.5 yields the relation between M_3^{**} and the actual previous experience of

$$(4.6) \quad M_3^{**} = M_3^* - \gamma_0(\epsilon_2 + R_{20}) - \gamma_1(\epsilon_1 + R_{11})$$

Assuming that the Manager in fact achieves this goal, so that $M_3 = M_3^{**}$, a series of manipulations yields

$$(4.7) \quad L_3 = \beta^2[\epsilon_2(1 - \gamma_0) + \epsilon_1(1 - \gamma_1) + \gamma_0 R_{20} + \gamma_1 R_{11}]^2$$

The optimal filtering problem is to choose γ_0 and γ_1 so as to minimize the expected value of L_3,

$$\begin{aligned}(4.8) \quad E(L_3) = \beta^2[&\epsilon_2^2(1 - 2\gamma_0 + \gamma_0^2) \\ &+ \epsilon_1^2(1 - 2\gamma_1 - \gamma_1^2) \\ &+ 2\epsilon_1\epsilon_2(1 - \gamma_0 - \gamma_1 + \gamma_0\gamma_1) \\ &+ 2\epsilon_2 R_{20}(\gamma_0 - \gamma_0^2) \\ &+ 2\epsilon_1 R_{11}(\gamma_1 - \gamma_1^2) + 2\epsilon_2 R_{11}(\gamma_1 - \gamma_0\gamma_1) \\ &+ 2\epsilon_1 R_{20}(\gamma_0 - \gamma_0\gamma_1) + 2R_{20}R_{11}(\gamma_0\gamma_1) \\ &+ \gamma_0^2 R_{20}^2 + \gamma_1^2 R_{11}^2]\end{aligned}$$

At this stage, several specific assumptions are necessary that are crucial to the specific results achieved, though not to the development of the argument. In other words, changing this set of assumptions would change the results of the computation without invalidating the process of deriving these results:

First, assume, as suggested above, that the probability distribution of R_{ik} reflects the recent history of k-month lagged observations on the variable M. Assume that the reporting record in the recent past for such estimates R_{ik} is unbiased (mean zero) and has variance σ_k^2. Hence

$$(4.9) \quad E(R_{ik}) = 0, \quad E(R_{ik}^2) = \sigma_k^2, \quad \text{all } i$$

Second, assume that there is no relation between an error in the reported estimate of one month's value of M and any errors in simultaneously reported estimates of values of M for other months. Hence

$$(4.10)\quad E(R_{ik}R_{jh}) = 0, \text{ all } i \neq j, \quad (i - j) = -(k - h)$$

Third, assume that there is no relation between errors in reported data estimates and the difference between actual M and target M^* for any month or for any report. Hence

$$(4.11)\quad E(\epsilon_i R_{ik}) = 0, \quad \text{all } i, k$$

Applying these three assumptions to equation 4.8 yields

$$(4.12)\quad E(L_3) = \beta^2[\epsilon_2^2(1 - 2\gamma_0 - \gamma_0^2) + \epsilon_1^2(1 - 2\gamma_1 - \gamma_1^2) + 2\epsilon_2\epsilon_1(1 - \gamma_0 - \gamma_1 + \gamma_0\gamma_1) + \gamma_0^2\sigma_0^2 + \gamma_1^2\sigma_1^2]$$

The first-order minimum conditions are

$$\frac{\partial E(L_3)}{\partial \gamma_k} = 0, \quad k = 1, 2$$

Applying these conditions yields

$$(4.13)\quad (\epsilon_2^2 + \sigma_0^2)\gamma_0 = \epsilon_2^2 + \epsilon_2\epsilon_1(1 - \gamma_1)$$

$$(4.14)\quad (\epsilon_1^2 + \sigma_1^2)\gamma_1 = \epsilon_1^2 + \epsilon_2\epsilon_1(1 - \gamma_0)$$

Solving this pair of simultaneous equations for the discount parameters yields

$$(4.15)\quad \gamma_0 = \frac{\epsilon_2^2\sigma_1^2 + \epsilon_1\epsilon_2\sigma_1^2}{\epsilon_1^2\sigma_0^2 + \epsilon_2^2\sigma_1^2 + \sigma_0^2\sigma_1^2}$$

$$(4.16)\quad \gamma_1 = \frac{\epsilon_1^2\sigma_0^2 + \epsilon_1\epsilon_2\sigma_0^2}{\epsilon_2^2\sigma_1^2 + \epsilon_1^2\sigma_0^2 + \sigma_0^2\sigma_1^2}$$

The principal remaining difficulty with this pair of equations is that the true operating misses, the ϵ_i are unknown. The solution, therefore, is to return to equations 4.13 and 4.14 and substitute the appropriate ϵ_{ik} and R_{ik} expressions from 4.4, and then to take expected values as before, using assumptions 4.9, 4.10, and 4.11. The result of these operations is the pair of equations

$$(4.17)\quad (\epsilon_{20}^2 + 2\sigma_0^2)\gamma_0 = \epsilon_{20}^2 + \sigma_0^2 + \epsilon_{20}\epsilon_{11}(1 - \gamma_1)$$

$$(4.18)\quad (\epsilon_{11}^2 + 2\sigma_1^2)\gamma_1 = \epsilon_{11}^2 + \sigma_1^2 + \epsilon_{20}\epsilon_{11}(1 - \gamma_0)$$

These equations are analogous to 4.13 and 4.14, but are operational in the sense of containing only the unknowns to be found (γ_0 and γ_1), the reported operating misses, and variances drawn from analysis of the recent history of data-reporting errors. Again, this is a simultaneous system; the operational solution analogous to equations 4.15 and 4.16 is

$$(4.19)\quad \gamma_0 = \frac{\epsilon_{11}^2\sigma_0^2 + 2\epsilon_{20}^2\sigma_1^2 + \epsilon_{20}\epsilon_{11}\sigma_1^2 + 2\sigma_0^2\sigma_1^2}{2\epsilon_{11}^2\sigma_0^2 + 2\epsilon_{20}^2\sigma_1^2 + 4\sigma_0^2\sigma_1^2}$$

$$(4.20)\quad \gamma_1 = \frac{\epsilon_{20}^2\sigma_1^2 + 2\epsilon_{11}^2\sigma_0^2 + \epsilon_{20}\epsilon_{11}\sigma_0^2 + 2\sigma_0^2\sigma_1^2}{2\epsilon_{20}^2\sigma_1^2 + 2\epsilon_{11}^2\sigma_0^2 + 4\sigma_0^2\sigma_1^2}$$

These two equations express the optimal weights to be attached to the reported errors ϵ_{20} and ϵ_{11} in making a tactical decision about M_3^{**} according to equation 4.5. Based on the relative magnitudes of ϵ_{20}, ϵ_{11}, σ_0^2, and σ_1^2 the discount parameters may vary substantially; in particular, their values are very sensitive to whether the reported errors ϵ_{20} and ϵ_{11} are in the same or opposite directions. In some cases one of the two discount parameters may be greater than 1.0. The sum of the two, however, is always less than 2.0 when the reporting error variances are nonzero. (If these variances do go to zero, there is no uncertainty factor in the reported data, and there exists no true solution for γ_0 and γ_1, as seen from equations 4.13 and 4.14.)

ALTERNATIVE SCHEMES. Equations 4.19 and 4.20 express the optimal uncertainty discount factors, consistent with the specification of the model itself in 4.1, a quadratic loss function, and an operating rule as in 4.3 and 4.5. This solution is probably the best and most workable method, but others are possible. Alternative solutions for choosing these uncertainty discount factors could take two different paths from here, one simpler and one more complex.

The simpler solution is to return to equations 4.13 and 4.14 and to make the same recent historical observations about the operating misses ϵ_i as the analysis above has done for the data-reporting variances σ_k^2. Specifically, data study may show that over some recent period the root mean-square operating miss has been some value ϵ. Further study may show that the operating miss in one month is not necessarily correlated with a miss in the next. Then applying expected values of the form

$$E(\epsilon_i) = \epsilon \text{ and } E(\epsilon_i\epsilon_j) = 0, i \neq j$$

reduces equations 4.13 and 4.14 to

$$\gamma_0 = \frac{\epsilon^2}{\epsilon^2 + \sigma_0^2} \tag{4.21}$$

$$\gamma_1 = \frac{\epsilon^2}{\epsilon^2 + \sigma_1^2} \tag{4.22}$$

This nonsimultaneous form may in fact be preferable because of its simplicity. It implies setting the γ_k on the basis of the relevant data-reporting variances in relation to the operating-miss variances of the recent past. It requires no specific calculation of new γ_k at each tactical decision, but only a periodic updating of the σ_k and ϵ values to keep them consistent with current experience.

The more complex solution than equations 4.19 and 4.20 involves reconsidering assumptions 4.10 and 4.11 in the light of further data study. First, it is possible that data-reporting errors in successive months are correlated. Second, if the staff personnel evaluating the incoming reports are aware of the targets that monetary policy operations are trying to achieve, it is possible that a given month's operating miss and that month's data-reporting error are correlated. Relaxing these assumptions would involve substituting for some terms of equation 4.8 their estimated recent values, rather than dropping them altogether as is the case in equation 4.12. Hence the resulting rules analogous to equations 4.19 and 4.20 would be more complex, though perhaps more realistic, determinants of γ_0 and γ_1.

Although the analysis above has presented only a simple example, for one particular specification of the $Y = y(M)$ relation and for one loss function, the methods developed are applicable to more general circumstances, and the changes necessary to incorporate modifications follow directly from this procedure.

Similarly, as in previous sections, the monthly time period used here is merely an expositional device. The Perspective tables and their implied probability distributions are available weekly, and Tables 1 to 4 summarize some parameters of these distributions. If, for example, tactics use rules of the form of equations 4.21 and 4.22 to set the uncertainty discount factors γ_k, then the relevant γ_k to use may change with each week; this procedure would reflect the greater confidence in data reports after the extra week's time lag.

CONCLUSION. The main point of this section is that monetary policy tactics should take account of the possibility of errors in the available current data by applying some filtering process to these data. In actual practice the filter should take the form of a set of uncertainty discount parameters to apply to data reports and estimates of particular vintages. A number of schemes, some simple and some complex, are available to compute these parameters, and there is room for choice among them; but failing to discount for data errors at all and ignoring the possibility of data revisions may lead to undesired results in monetary policy operations.

V. SUMMARY OF CONCLUSIONS FOR MONETARY POLICY

The major conclusions of Sections I through IV for monetary policy can be briefly restated as follows:

1. The monetary policy decision process should contain two phases—strategy and tactics. Strategy involves quarterly decisions outlining a plan for monetary policy over the several following quarters. Tactics involve

shorter-run technical decisions concerning implementing the first quarter of the strategy and deal with the question of how best to adjust for apparent deviations of the monetary policy instruments from their planned targets.

2. The formulation of monetary policy strategy should follow a sequential decision-making procedure, revising multiquarter strategies once per quarter. At each decision, the immediate quarter of such a strategy becomes the currently effective operating policy.

3. Tactical decisions are not purely technical. An illustration of their real economic substance is the dependence of proper tactics upon the specification of the relation between the instruments and the ultimate goals of monetary policy. Different specifications may imply no response at all to past operating misses of the monetary policy instruments or may imply compensating responses of a number of different forms.

4. In planning monetary policy tactics, as well as strategy, it is important to take account of the implications for stability of the simultaneous structure of the financial and nonfinancial system. Because of feedback relationships between instrument variables and the rest of the economy, movements in the instruments from one level to another, should they be too rapid, may in fact destabilize the economy rather than stabilize it.

5. Because the data available to monetary policy decisions contain reporting errors and are subject to revision, it is necessary to apply a set of uncertainty discount factors to the data when devising appropriate responses to apparent operating misses in the monetary policy instruments. These uncertainty discount factors should effect a compromise between the desire to react quickly so as to prevent unwanted situations from persisting and the desire to delay so as to have better data.

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CONTENTS

by William Poole

RULES-OF-THUMB FOR GUIDING MONETARY POLICY

INTRODUCTION

This study has been motivated by the recognition that the key to understanding policy problems is the analysis of uncertainty. Indeed, in the absence of uncertainty it might be said that there can be no *policy* problems, only *administrative* problems. It is surprising, therefore, that there has been so little systematic attention paid to uncertainty in the policy literature in spite of the fact that policy-makers have repeatedly emphasized the importance of the unknown.

In the past, the formal models used in the analysis of monetary policy problems have almost invariably assumed complete knowledge of the economic relationships in the model. Uncertainty is introduced into the analysis, if at all, only through informal consideration of how much difference it makes if the true relationships differ from those assumed by the policy-makers. In this study, on the other hand, uncertainty plays a key role in the formal model.

Since this study is so long, a few comments at the outset may assist the reader in finding his way through it. The remainder of this introductory section outlines the structure of the study so that the reader can see how the various parts fit together. The reader interested only in a summary of the analysis and empirical findings should read this introductory section and then turn directly to the summary in Section V. This summary concentrates on the theoretical analysis while only briefly stating the most important empirical findings. It omits completely the technical details of both the theoretical and empirical work. The reader interested in the technical details should, of course, turn to the appropriate parts of Sections I through IV. Insofar as possible these sections have been written so that the reader can understand any one section without having to wade through all of the other sections.

Section I contains the theoretical argument comparing interest rates and the money stock as policy-control variables under conditions of uncertainty. The analysis is verbal and graphical, using the simple Hicksian *IS-LM* model with random terms added. This model is general enough to include both Keynesian and monetarist outlooks, depending on the specific assumptions as to the shapes of the functions. Since the theoretical analysis emphasizes the importance of the relative stability of the expenditures and money demand functions, an examination of the evidence on relative stability appears in Section II.

Given the conclusion of Section II on the superiority of a policy operating through adjustments in the money stock, the next question is how the money stock should be adjusted to achieve the best results. While policy-makers generally look askance at suggestions for policy rules, the only way that economists can give long-run advice is in terms of rules. That is to say, the economist is not being helpful at all if he in effect says, "Look at the rate of inflation, at the rate of unemployment, at the forecasts of the Government budget deficit, and at other relevant factors, and then act appropriately." Advice requires the specification of exactly how policy should be adjusted, and for this advice to be more than an *ad hoc* recommendation for the current situation, it must involve specification of how the money stock or some other control variable should be adjusted under hypothetical future conditions of inflation, unemployment, and so forth. The purpose of Section III is to develop such a rule-of-thumb, or policy guideline, based on the theoretical and empirical analyses of Sections I and II.

A number of technical problems of monetary control are examined in Section IV. After a short introduction to the issues, the first part

NOTE.—The author is Senior Economist, Special Studies Section, Division of Research and Statistics, Board of Governors of the Federal Reserve System. Special thanks are due Miss Joan Walton for her assistance in programming and other matters, Mrs. Lillian Humphrey for assistance with the figures, and Miss Debra Bellows for typing a long and messy manuscript through several drafts. The author, of course, is wholly responsible for any remaining errors.

of this section discusses the relative merits of a number of monetary aggregates including various reserve measures, the narrowly and broadly defined money stocks, and bank credit. The second part examines whether policy should specify desired rates of change of an aggregate in terms of weekly, monthly, or quarterly averages, or in some other manner. The third part examines in a very incomplete fashion a few of the problems of adjusting open market operations so as to reach the desired level of an aggregate.

Finally, Section V consists of a summary of Sections I through IV. To avoid undue repetition, woven into this summary section are a number of general observations not examined in the other sections.

I. THE THEORY OF MONETARY POLICY UNDER UNCERTAINTY

BASIC CONCEPTS. The theory of optimal policy under uncertainty has provided many insights into actual policy problems [8, 12, 21, 25]. While much of this theory is not accessible to the nonmathematical economist, it is possible to explain the basic ideas without resort to mathematics.

The obvious starting point is the observation that with our incomplete understanding of the economy and our inability to predict accurately the occurrence of disturbing factors such as strikes, wars, and foreign exchange crises, we cannot expect to hit policy goals exactly. Some periods of inflation or unemployment are unavoidable. The inevitable lack of precision in reaching policy goals is sometimes recognized by saying that the goals are "reasonably" stable prices and "reasonably" full employment.

While the observation above is trite, its implications are not. Two points are especially important. First, policy should aim at minimizing the average size of errors. Second, policy can be judged only by the average size of errors over a period of time and *not* by individual episodes. Because this second point is particularly subject to misunderstanding, it needs further amplification.

Since policy-makers operate in a world that is inherently uncertain, they must be judged by criteria appropriate to such a world. Consider the analogy of betting on the draw of a ball from an urn with nine black balls and one red ball. Anyone offered a \$2 payoff for a \$1 bet would surely bet on a black ball being drawn. If the draw produced the red ball, no one would accuse the bettor of a stupid bet. Similarly, the policy-maker must play the economic odds. The policy-maker should not be accused of failure if an inflation occurs as the result of an improbable and unforeseeable event.

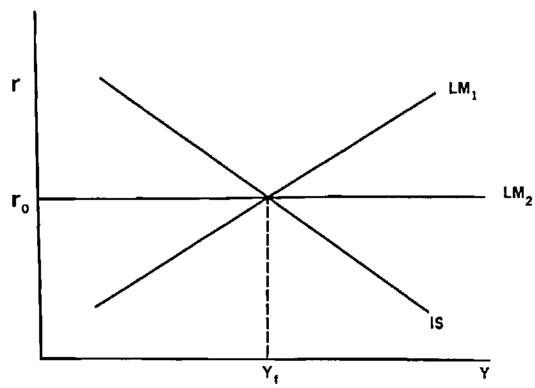
Now consider the reverse situation from that considered in the previous paragraph. Suppose the bettor with the same odds as above bets on the red ball and wins. Some would claim that the bet was brilliant, but assuming that the draw was not rigged in any way, the bet, even though a winning one, must be judged foolish. It is foolish because, on the average, such a betting strategy will lead to substantially worse results than the opposite strategy. Betting on red will prove brilliant only one time out of 10, on the average. Similarly, a particular policy action may be a bad bet even though it works in a particular episode.

There is a well-known tendency for gamblers to try systems that according to the laws of probability cannot be successful over any length of time. Frequently, a gambler will adopt a foolish system as the result of an initial chance success such as betting on red in the above example. The same danger exists in economic policy. In fact, the danger is more acute because there appears to be a greater chance to "beat the system" by applying economic knowledge and intuition. There can be no doubt that it will become increasingly possible to improve on simple, naive policies through sophisticated analysis and forecasting and so in a sense "beat the system." But even with improved knowledge some uncertainty will always exist, and therefore so will the tendency to attempt to perform better than the state of knowledge really permits.

Whatever the state of knowledge, there must be a clear understanding of how to cope with uncertainty, even though the degree of uncertainty may have been drastically reduced through the use of modern methods of analysis. The principal purpose of this section is to improve understanding of the importance of uncertainty for policy by examining a simple model in which the policy problem is treated as one of minimizing errors on the average. Particular emphasis is placed on whether controlling policy by adjusting the interest rate or by adjusting the money stock will lead to smaller errors on the average. The basic argument is designed to show that the answer to which policy variable—the interest rate or the money stock—minimizes average errors depends on the relative stability of the expenditures and money demand functions and not on the values of parameters that determine whether monetary policy is in some sense more or less "powerful" than fiscal policy.

MONETARY POLICY UNDER UNCERTAINTY IN A KEYNESIAN MODEL.[1] The basic issues concerning the importance of uncertainty for monetary policy may be examined within the Hicksian *IS-LM* version of the Keynesian system. This elementary model has two sectors, an expenditure sector and a monetary sector, and it assumes that the price level is fixed in the short run.[2] Consumption, investment, and government expenditures functions are combined to produce the *IS* function in Figure 1, while the demand and supply of money functions are combined to produce the *LM* function. If monetary policy fixes the stock of money, then the resulting *LM* function is LM_1, while if policy fixes the interest rate at r_0

FIGURE 1



the resulting *LM* function is LM_2. It is assumed that incomes above "full employment income" are undesirable due to inflationary pressures while incomes below full employment income are undesirable due to unemployment.

If the positions of all the functions could be predicted with no errors, then to reach full employment income, Y_f, it would make no difference whether policy fixed the money stock or the interest rate. All that is necessary in either case is to set the money stock or the interest rate so that the resulting *LM* function will cut the *IS* function at the full employment level of income.

Significance of disturbances. The positions of the functions are, unfortunately, never precisely known. Consider first uncertainty over the position of the *IS* function—which, of course, results from instability in the underlying consumption and investment functions—while retaining the unrealistic assumption that the position of the *LM* function is known. What is known about the *IS* function is that it will lie between the extremes of IS_1 and IS_2 in Figure 2. If the money stock is set at some fixed level, then it is known that the *LM* function will be LM_1, and accordingly income will be somewhere between the extremes of Y_1 and Y_2. On the other hand, suppose policy-makers follow an interest rate policy and set the interest rate at r_0. In this case income will be somewhere between Y_1', and Y_2', a wider range than

[1] For the most part this section represents a verbal and graphical version of the mathematical argument in [25].

[2] Simple presentations of this model may be found in [6, pp. 275–82] and [7, pp. 327–32].

FIGURE 2

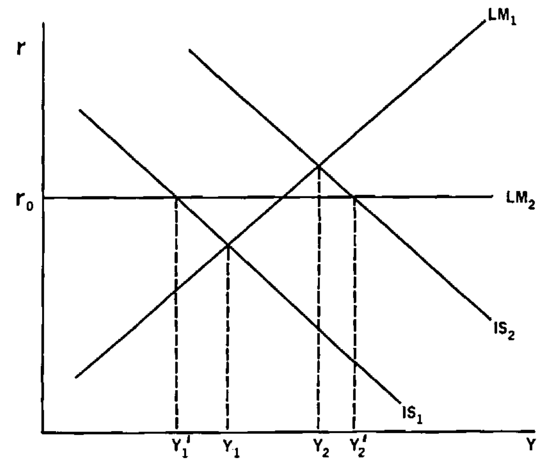
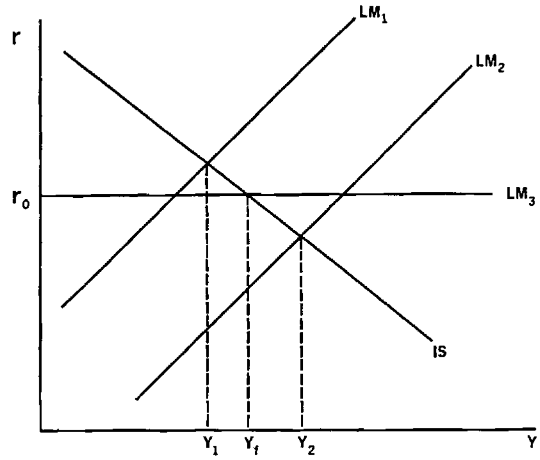


FIGURE 3



Y_1 to Y_2, and so the money stock policy is superior to the interest rate policy.[3] The money stock policy is superior because an unpredictable disturbance in the *IS* function will affect the interest rate, which in turn will produce spending changes that partly offset the initial disturbance.

The opposite polar case is illustrated in Figure 3. Here it is assumed that the position of the *IS* function is known with certainty, while unpredictable shifts in the demand for money cause unpredictable shifts in the *LM* function if a money stock policy is followed. With a money stock policy, income may end up anywhere between Y_1 and Y_2. But an interest rate policy can fix the *LM* function at LM_3 so that it cuts the *IS* function at the full employment level of income, Y_f. With an interest rate policy, unpredictable shifts in the demand for money are not permitted to affect the interest rate; instead, in the process of fixing the interest rate the policy-makers adjust the stock of money in response to the unpredictable shifts in the demand for money.

In practice, of course, it is necessary to cope with uncertainty in both the expenditure and monetary sectors. This situation is depicted in Figure 4, where the unpredictable disturbances are larger in the expenditure sector, and in Figure 5 where the unpredictable disturbances are larger in the monetary sector.

The situation is even more complicated than shown in Figures 4 and 5 by virtue of the fact that the disturbances in the two sectors may not be independent. To illustrate this case, consider Figure 5 in which the interest rate policy is superior to the money stock policy if the disturbances are independent. Suppose that the disturbances were connected in such a way that disturbances on the LM_1 side of the average *LM* function were always accompanied by disturbances on the IS_2 side of the average *IS* function. This would mean that income would never go as low as Y_1, but rather only as low as the intersection of LM_1 and IS_2, an income not as low as Y_1' under the interest rate policy. Similarly, the highest income would be given by the intersection of LM_2 and IS_1, an income not so high as Y_2'.[4]

[3] In Figure 2 and the following diagrams, the outcomes from a money stock policy will be represented by unprimed *Y*'s, while the outcomes from an interest rate policy will be represented by primed *Y*'s.

[4] The diagram could obviously have been drawn so that an interest rate policy would be superior to a money stock policy even though there were an inverse relationship between the shifts in the *IS* and *LM* functions. However, inverse shifts always reduce the margin of superiority of an interest rate policy, possibly to the point of making a money stock policy superior. Conversely, positively related shifts favor an interest rate policy.

FIGURE 4

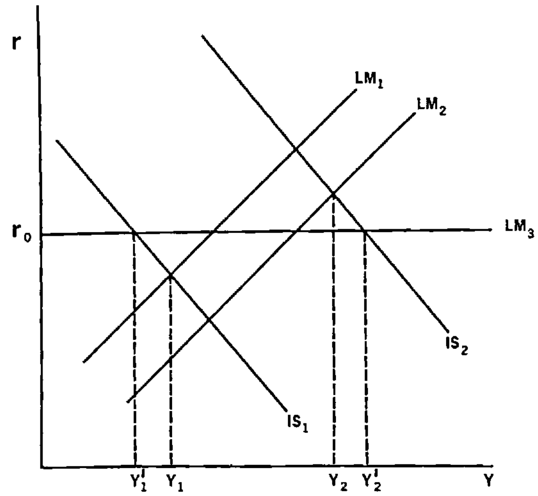
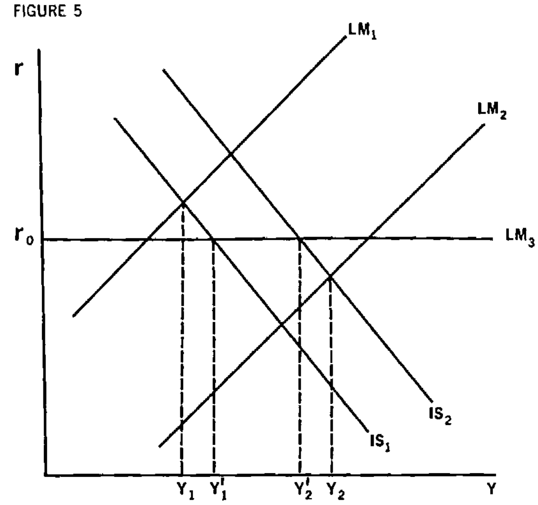


FIGURE 5



Importance of interest elasticities and other parameters. So far the argument has concentrated entirely on the importance of the relative sizes of expenditure and monetary disturbances. But is it also important to consider the slopes of the functions as determined by the interest elasticities of investment and of the demand for money, and by other parameters? Consider the pair of *IS* functions, IS_1 and IS_2, as opposed to the pair, IS_3 and IS_4, in Figure 6. Each pair represents the maximum and minimum positions of the *IS* function as a result of disturbances, but the pairs have different slopes. Each pair assumes the same maximum and minimum disturbances, as shown by the fact that the horizontal distance between IS_1 and IS_2 is the same as between IS_3 and IS_4. For convenience, but without loss of generality, the functions have been drawn so that under an interest rate policy represented by LM_2 both pairs of *IS*

FIGURE 6

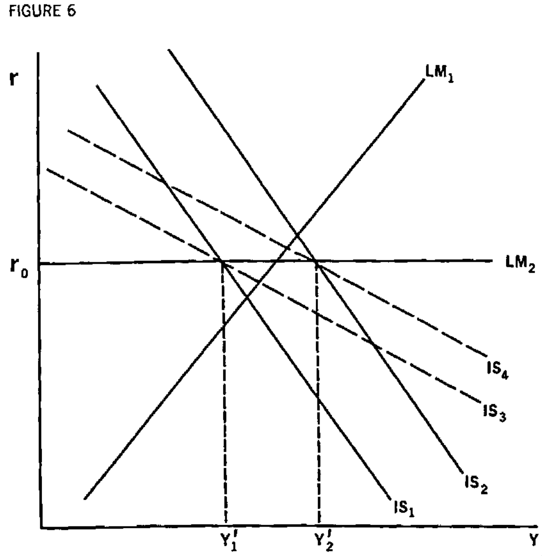
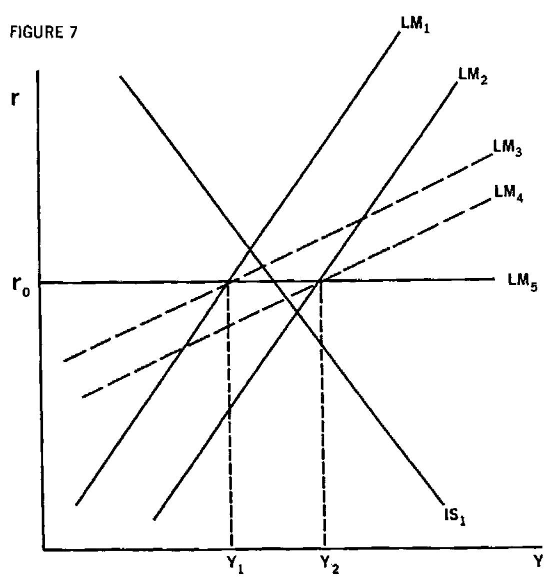


FIGURE 7



functions produce the same range of incomes. To keep the diagram from becoming too messy, only one *LM* function, LM_1, under a money stock policy has been drawn. Now consider disturbances that would shift LM_1 back and forth. From Figure 6 it is easy to see that if shifts in LM_1 would lead to income fluctuations greater than from Y_1' to Y_2'—which fluctuations would occur under an interest rate policy—then an interest policy would be preferred *regardless* of whether we have the pair IS_1 and IS_2, or the pair IS_3 and IS_4.

The importance of the slope of the *LM* function is investigated in Figure 7 for the two *LM* pairs, LM_1 and LM_2, and LM_3 and LM_4. The functions have been drawn so that each pair represents different slopes but an identical range of disturbances. It is clear that if shifts in IS_1 are small enough, then an interest rate policy will be preferred regardless of which pair of *LM* functions prevails. Conversely, if a money stock policy is preferred under one pair of *LM* functions because of the shifts in the *IS* function, then a money stock policy will also be preferred under the other pair of *LM* functions.

The upshot of this analysis is that the crucial issue for deciding upon whether an interest rate or a money stock policy should be followed is the relative size of the disturbances in the expenditure and monetary sectors. Contrary to much recent discussion, the issue is not whether the interest elasticity of the demand for money is relatively low or whether fiscal policy is more or less "powerful" than monetary policy.

To avoid possible confusion, it should be emphasized that the above conclusion is in terms of the choice between a money stock policy and an interest rate policy. However, if a money stock policy is superior, then the steeper the *LM* function is, the lower the range of income fluctuation, as can be seen from Figure 7. It is also clear from Figure 6 that under an interest rate policy an error in setting the interest rate will lead to a larger error in hitting the income target if the *IS* function is relatively flat than if it is relatively steep. But these facts do not affect the choice between interest rate and money stock policies.

The "combination" monetary policy. Up to this point the analysis has concentrated on the choice of either the interest rate or the money stock as the policy variable. But it is also possible to consider a "combination" policy that works through the money stock and the interest rate simultaneously. An understanding of the combination policy may be obtained by further consideration of the cases depicted in Figures 2 and 7.

In Figure 8 the disturbances, as in Figure 2, are entirely in the expenditure sector. As was seen in Figure 2, the result obtained by fixing the money stock so that LM_1 prevailed was superior to that obtained by fixing the interest rate so that LM_2 prevailed. But now suppose that instead of fixing the money stock, the money stock were reduced every time the interest rate went up and increased every time the interest rate went down. This procedure would, of course, increase the amplitude of interest rate fluctuations.[5] But if the proper relationship between the money stock and the interest rate could be discovered, then the *LM* function could be made to look like LM_0 in Figure 8. The result would be that income would be pegged at Y_f. Disturbances in the *IS* function would produce changes in the interest rate, which in turn would produce spending changes sufficient to completely offset the effect on income of the initial disturbance.

The most complicated case of all to explain graphically is that in which it is desirable to increase the money stock as the interest rate rises and decrease it as the interest rate falls.

[5] The increased fluctuations in interest rates must be carefully interpreted. In this model the *IS* function is assumed to fluctuate around a fixed-average position. However, in more complicated models involving changes in the average position of the *IS* function, perhaps through the operation of the investment accelerator, interest rate fluctuations may not be increased by the policy being discussed in the text. By increasing the stability of income over a period of time, the policy would increase the stability of the *IS* function in Figure 8 and thereby reduce interest rate fluctuations.

FIGURE 8

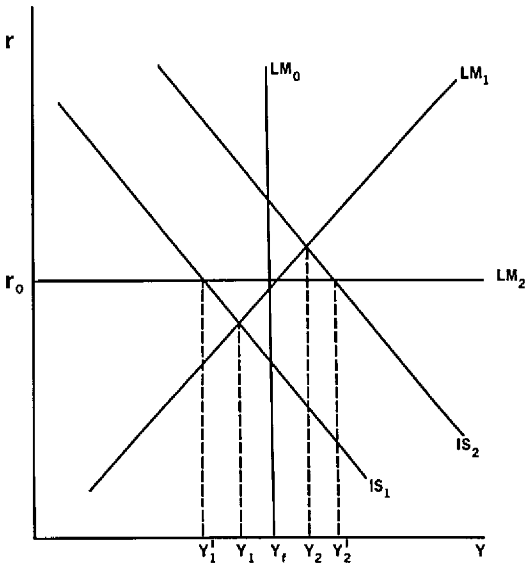
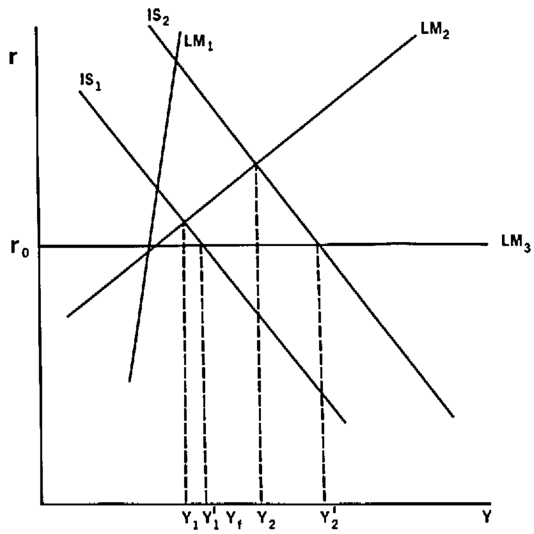


FIGURE 9



In Figure 9 the leftmost position of the *LM* function as a result of disturbances is LM_1 when the money stock is fixed and is LM_2 when the combination policy of introducing a positive money–interest relationship is followed. The rightmost positions of the *LM* functions under these conditions are not shown in the diagram. When the interest rate is pegged, the *LM* function is LM_3. If either LM_1 or LM_2 prevails, the intersection with IS_1 produces the lowest income, which is below the Y_1' level obtained with LM_3. But in the case of LM_2, income at Y_1 is only a little lower than at Y_1', whereas when IS_2 prevails, LM_2 is better than LM_3 by the difference between Y_2 and Y_2'. Since the gap between Y_2 and Y_2' is larger than that between Y_1 and Y_1', it is on the average better to adopt LM_2 than LM_3 even though the extremes under LM_2 are a bit larger than under LM_3.

Extensions of model. At this point a natural question is that of the extent to which the above analysis would hold in more complex models. Until more complicated models are constructed and analyzed mathematically, there is no way of being certain. But it is possible to make educated guesses on the effects of adding more goals and more policy instruments, and of relaxing the rigid price assumption.

Additional goals may be added to the model if they are specified in terms of "closer is better" rather than in terms of a fixed target that must be met. For example, it would not be mathematically difficult to add an interest rate goal to the model analyzed above, if deviations from a target interest rate were permitted but were treated as being increasingly harmful. On the other hand, it is clear that if there were a fixed-interest target, then the only possible policy would be to peg the interest rate, and income stabilization would not be possible with monetary policy alone.

The addition of fiscal policy instruments affects the results in two major ways. First, the existence of income taxes and of government expenditures inversely related to income (for example, unemployment benefits) provides automatic stabilization. In terms of the model, automatic stabilizers make the *IS* function steeper than it otherwise would be, thus reducing the impact of monetary disturbances, and reduce the variance of expenditures disturbances in the reduced-form equation for income. This effect would be shown in Figure 6 by drawing IS_1 so that it cuts LM_2 to the right of Y_1' and drawing IS_2 so that it cuts LM_2 to the left of Y_2'.

The second major impact of adding fiscal policy instruments occurs if both income and the interest rate are goals. Horizontal shifts in the *IS* function that are induced by fiscal policy adjustments, when accompanied by a coordinated monetary policy, make it possible to come closer to a desired interest rate without any sacrifice in income stability. An obvious illustration is provided by the case in which the optimal monetary policy from the point of view of stabilizing income is to set the interest rate as in Figure 5. Fiscal policy can then shift the pair of *IS* functions, IS_1 and IS_2, to the right or left so that the expected value of income is at the full employment level.

If the interest rate is not a goal variable, then fiscal policy actions that shift the *IS* function without changing its slope do not improve income stabilization over what can be accomplished with monetary policy alone, provided the lags in the effects of monetary policy are no longer than those in the effects of fiscal policy. An exception would be a situation in which reaching full employment with monetary policy alone would require an unattainable interest rate, such as a negative one.

These comments on fiscal policy have been presented in order to clarify the relationship between fiscal and monetary policy. While monetary policy-makers may urge fiscal action, for the most part monetary policy must take the fiscal setting as given and adapt monetary policy to this setting. It must then be recognized that an interest rate goal can be pursued only at the cost of sacrificing somewhat the income goal.[6]

[6] An interest rate goal must be sharply distinguished from the use of the interest rate as a monetary policy instrument. By a goal variable is meant a variable that enters the policy utility function. Income and interest rate goals might be simultaneously pursued by setting the money stock as the policy instrument or by setting the interest rate as the policy instrument.

All of the analysis so far has taken place within a model in which the price level is fixed in the short run. This assumption may be relaxed by recognizing that increases in money income above the full employment level involve a mixture of real income gains and price inflation. Similarly, reductions in money income below the full employment level involve real income reductions and price deflation (or a slower rate of price inflation). The model used above can be reinterpreted entirely in terms of money income so that departures from what was called above the "full employment" level of income involve a mixture of real income and price changes. Stabilizing money income, then, involves a mixture of the two goals of stabilizing real output and of stabilizing the price level.

However, interpreted in this way the structure of the model is deficient because it fails to distinguish between real and nominal interest rates. Price level increases generate inflationary expectations, which in turn generate an outward shift in the *IS* function. The model may be patched up to some extent by assuming that price changes make up a constant fraction of the deviation of income from its full employment level and assuming further that the expected rate of inflation is a constant multiplied by the actual rate of inflation. Expenditures are then made to depend on the real rate of interest, the difference between the nominal rate of interest and the expected rate of inflation. The result is to make the *IS* function, when drawn against the nominal interest rate, flatter and to increase the variance of disturbances to the *IS* function. These effects are more pronounced: (a) the larger is the interest sensitivity of expenditures; (b) the larger is the fraction of price changes in money income changes; and (c) the larger is the effect of price changes on price expectations. The conclusion is that since price flexibility in effect increases the variance of disturbances in the *IS* function, a money stock policy tends to be favored over an interest rate policy.

II. EVIDENCE ON THE RELATIVE MAGNITUDES OF REAL AND MONETARY DISTURBANCES

NATURE OF AVAILABLE EVIDENCE. Little evidence is available that directly tests the relative stability of the expenditure and money demand functions. It is necessary, therefore, to proceed somewhat indirectly. First, simulation of the FR-MIT model [7] is used to show the probable size of the effect on gross national product (GNP), the GNP deflator, and the unemployment rate of an assumed expenditure disturbance. This evidence provides some indication of the extent to which the impact of an expenditure disturbance depends on the choice between the money stock and the Treasury bill rate as monetary policy control variables. This evidence bears only on the question of what happens if an expenditure disturbance occurs, not on the relative stability of the expenditure and money demand functions. However, this approach is useful when combined with intuitive feelings about relative stability.

The second type of evidence, derived from reduced-form studies, is more directly related to the question of relative stability; nevertheless, it is not entirely satisfactory because the studies examined were not designed to answer the question at hand. To supplement these studies by other investigators, there follows a simple test of the stability of the demand for money function.

IMPACT OF AN EXPENDITURE DISTURBANCE. Simulation of the FR–MIT model provides some insight as to how the size of the impact of an expenditure disturbance depends on the choice of the monetary policy instrument. The simulation technique is necessary because the FR–MIT model is nonlinear, making it impossible to obtain an explicit expression for the reduced form.[8] However, comparison of two sets of simulations provides some interesting results. Except as indicated below, the simulations all used the actual historical values of the model's exogenous variables and all simulations started with 1962-I, a starting date selected arbitrarily.

The first set of five simulations assumes an exogenous money stock that grows by 1 per cent per quarter, starting with the actual money stock in 1961-IV as the base. To investigate the impact of a disturbance in an exogenous expenditures variable, the exogenous variable "Federal expenditures on defense goods" was set in one simulation at its actual level minus $10 billion; in another at actual minus $5 billion; and in three further simulations at actual, actual plus $5 billion, and actual plus $10 billion. This procedure produces four hypothetical observations on "disturbances" in defense expenditures, of -10, -5, $+5$, and $+10$, and the simulation provides four corresponding observations for the change in income (and other endogenous variables). By using income as an example, the change in an endogenous variable in response to a disturbance in defense expenditures is the difference between income simulated by the model when defense expenditures were set at actual historical values and when set at actual plus 10, plus 5, and so forth. The income obtained in the simulations, even when defense expenditures are set at actual levels, is not the same as the actual historical level of income both because the assumed monetary policy differs from the policy actually followed and because of errors in the model itself.

By calculating the ratio of the change in an endogenous variable to the disturbance in defense expenditures for the four observations, four estimates of the linear approximation to the reduced-form parameter, or multiplier, of

[7] For a general description of the model, see [14].

[8] See opposite column.

[8] In a reduced-form equation, an endogenous (that is, simultaneously determined) variable is expressed as depending only on exogenous and predetermined variables (variables taken as given for the current period).

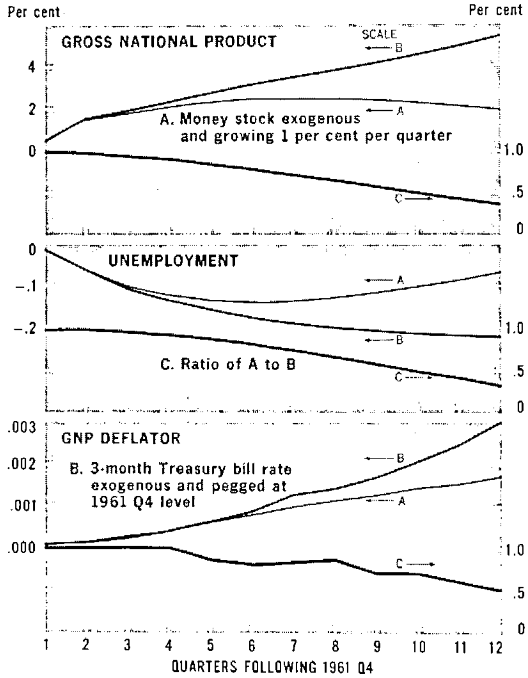
defense expenditures are obtained, and these four estimates have been averaged to produce a single estimate. Since the effects of a disturbance accumulate over time, the reduced-form parameter estimate has been calculated for the 12 quarters from 1962-I through 1964-IV. Exactly the same procedure has been used for the simulations with a fixed rate for 3-month Treasury bills. Finally, the ratio of the parameter estimates for the reduced forms under the money stock and interest rate policies has been calculated with the parameter estimates from the simulations with the exogenous money stock in the numerator of the ratio.

The reduced-form parameter estimates under the two monetary policies, and the ratios of these estimates, have been plotted in Figure 10 for 12 quarters for the reduced forms for nominal GNP, for the unemployment rate, and for the GNP deflator. The results are striking. A substantial difference appears in the parameters of reduced forms for the fourth quarter following the initial disturbance, and the differences in the parameters become steady thereafter. By the 12th quarter the reduced-form parameters for the money stock policy are only about 40 per cent of those for the interest rate policy.

The interpretation of these results is that employment, output, and the price level are far more sensitive to disturbances in defense expenditures under an interest rate policy than under a money stock policy. This conclusion presumably generalizes to expenditures variables other than defense expenditures, but the results would differ in detail because each expenditures variable enters the FR–MIT model in a somewhat different way.

It might be argued that these results suggest that there is no significant difference between interest rate and money stock policies because the reduced-form parameters are essentially identical up to about four quarters. Surely, so this argument goes, mistakes could be discovered and offset within four quarters. There are two difficulties with this argument. The first is that the FR–MIT model may overstate the length of the lags and therefore understate the differences in reduced-form parameters for the two policies for the quarters immediately following a disturbance. But the second and more important reason is that it may not be easy to reverse the effects of the disturbance after the disturbance has been discovered. With an interest rate policy, a very large change in the rate might be required to offset the effects appearing after the fourth quarter, and such a change might not be feasible, or at least not desirable in terms of its effects on security markets and on income in the more distant future.

FIGURE 10
REDUCED-FORM PARAMETER ESTIMATES FOR FEDERAL DEFENSE EXPENDITURES FROM FR-MIT MODEL



The numerical results reported above depend, of course, on the FR–MIT model, and this model is deficient in a number of respects. But any model in which, other things being equal, investment and other interest-sensitive expenditures decline when interest rates rise will show results in the same direction.

These results may be extended to analyze the significance of errors in forecasting exogenous variables. Consider an explicit expression for the reduced form for income. Let the exogenous variables such as government expenditures, perhaps certain categories of investment, strikes, weather, population growth, and so forth, be $X_1, X_2, \ldots, X_n$, and let the coefficients of these variables be $\alpha_1, \alpha_2, \ldots, \alpha_n$ when the interest rate is the policy instrument, and $\lambda_1, \lambda_2, \ldots, \lambda_n$ when the money stock is the instrument. Then the reduced form for income when the interest rate is the instrument is

$$(1)\quad Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \ldots + \alpha_n X_n + \alpha_r r + u$$

where α_r is the coefficient of the interest rate and u is the random disturbance. On the other hand, when the money stock is the instrument, the reduced form is

$$(2)\quad Y = \lambda_0 + \lambda_1 X_1 + \lambda_2 X_2 + \ldots + \lambda_n X_n + \lambda_M M + v$$

As discussed in Section II, the disturbance v_t may have either a larger or a smaller variance than the disturbance u_t. One factor tending to make v_t smaller than u_t is that a money stock policy reduces the impact of expenditures disturbances, but another factor, the introduction into the reduced form of money demand disturbances, tends to make v_t larger. The net result of these two factors cannot be determined a priori.

But in formulating policy it is not possible to reason directly from equations 1 and 2 because many of the X_i cannot be predicted in advance with perfect accuracy. For scientific purposes *ex post* it may be possible to say that a change in income was caused by a change in some X_i; for policy purposes *ex ante* this scientific knowledge is useless unless the change in X_i can be predicted. It is necessary to think of each X_i as being composed of a predictable part, $\hat{X}_i$, and an unpredictable part, E_i.

$$X_i = \hat{X}_i + E_i$$

For policy purposes the error term in the reduced form includes both the disturbances to the equation and the errors in forecasting exogenous variables. The two types of errors ought to be treated exactly alike in formulating policy. Equations 1 and 2 can then be rewritten as follows:

$$(3)\quad Y = \alpha_0 + \alpha_i \hat{X}_1 + \alpha_2 \hat{X}_2 + \ldots + \alpha_n \hat{X}_n + \alpha_r r + \alpha_1 E_1 + \alpha_2 E_2 + \ldots + \alpha_n E_n + u$$

$$(4)\quad Y = \lambda_0 + \lambda_1 \hat{X}_1 + \lambda_2 \hat{X}_2 + \ldots + \lambda_n \hat{X}_N + \lambda_M M + \lambda_1 E_1 + \lambda_2 E_2 + \ldots + \lambda_n E_n + v$$

For policy purposes the error term in the reduced-form equation 3 is the sum of the terms from $\alpha_1 E_{1t}$ through u_t and in the reduced-form equation 4 the sum of the term $\lambda_1 E_{1t}$ through v_t.

A systematic study of the importance of the E_i terms cannot be made because no formal record of errors in forecasting exogenous variables exists insofar as the author knows. However, some insight into the problem may be obtained by listing the variables that must be forecast. Which variables have to be forecast depends, of course, on the model being used. The larger econometric models generally have relatively few exogenous variables that raise forecasting problems because so many variables are explained endogeneously by the model itself. The FR–MIT model has 63 exogenous variables; some of these are relatively easy to forecast, but others are subject to considerable forecasting error. The latter include such variables as exports, number of mandays idle due to strikes, Armed Forces, and Federal expenditures. Furthermore, this model involves lagged endogenous variables in many equations; hence an inaccurate forecast of GNP next quarter will increase the error in forecasting GNP two quarters into the future, which in turn will lead to errors in forecasting GNP three quarters into the future, and so forth. Errors in forecasting exogenous variables, therefore, produce cumulative errors in forecasting GNP in future quarters.

In simpler models the forecasting problem is more severe. Consider, for example, the opposite extreme from the large econometric model, the single-equation model. Convenient representatives of such models are those spawned in the controversy over the Friedman-Meiselman paper [2] on the stability of the money/income relationship. The various definitions of exogenous, or "autonomous," spending utilized by the various authors in this controversy are as follows:

a) Friedman-Meiselman definition: Autonomous expenditures consist of the "net private domestic investment plus the government deficit on income and product account plus the net foreign balance" [2, p. 184].
b) Ando-Modigliani definition: Autonomous expenditures consist of two variables which enter the reduced form with different coefficients. One variable is "property tax portion of indirect business taxes" plus "net interest paid by government" plus "government transfer payment" minus "unemployment insurance benefits" plus "subsidies less current surplus of government enterprises" minus "statistical discrepancy" minus "excess of wage accruals over disbursement." The second variable is "net investment in plant and equipment, and in residential houses" plus "exports" [10, pp. 695, 696, and 702].
c) DePrano-Mayer definition: The basic definition is "investment in producers' durable equipment, nonresidential construction, residential construction, federal government expenditures on income and product account, and exports. One variant of this hypothesis subtracts capital consumption estimates, and the other does not" [15, p. 739]. DePrano and Mayer also tested 18 other definitions of autonomous expenditures [15, pp. 739 and 740].
d) Hester definition: Autonomous expenditures consist of the "sum of government expenditure, net private domestic investment, and the trade balance" [19, p. 366]. Hester also experimented with three other definitions involving alternative treatments of imports, capital consumption allowances, and inventory investment [19, pp. 366, 367].

To a considerable extent the diversity in these definitions is misleading because except for the Friedman-Meiselman definition all the definitions are in fact rather similar. But whichever definition is used, it is impossible to escape the feeling that inaccurate forecasting of exogenous variables is likely to be a major source of uncertainty. And while this discussion has taken place within the context of formal models, exactly the same problem plagues judgmental forecasting. Every forecasting method can be viewed as starting from forecasts of "input," or exogenous, variables and then proceeding to judge the implications of these inputs for GNP and other dependent, or endogenous, variables.

Regardless of what type of model is used, it appears that for the foreseeable future it will be necessary to forecast exogenous variables that simply cannot be forecast accurately by using present methods. As a result, it seems very likely that the error term including forecast errors has a far smaller variance in equation 4 than in equation 3. Indeed, it might be argued that as a source of uncertainty the E_i terms are far more important than the u or v terms, and therefore that the smaller size of the λ_i parameters as compared to the α_i parameters is of great importance. If the parameter estimates from the FR–MIT model are accepted, the standard deviation of the total random term relevant for policy (that is, including errors in forecasting exogenous variables) would be over twice as large under an interest rate policy as under a money stock policy. If this argument is correct, shifting from the current policy of emphasizing interest rates to one of controlling the money stock might cut average errors in half, where errors are measured in terms of the deviations of employment, output, and price level from target levels for these variables.

EVIDENCE FROM REDUCED-FORM EQUATIONS. Additional insight into the relative sizes of disturbances under interest rate and money stock policies may be obtained by examining the controversy generated by the Friedman-Meiselman paper on the stability of the money/income relationship [2]. In this paper equations almost the same as equations 1 and 2 above were estimated. The equation corresponding to equation 1 differs in that the exogenous variables were assumed to consist only of a single autonomous spending variable, as defined above. The equation corresponding to equation 2 has the same disability for our purposes, but it also did not include an interest rate as a variable.

Before examining the implications of the Friedman-Meiselman findings for this study, it should be noted that their approach was sharply criticized in papers by Donald D. Hester [19], Albert Ando and Franco Modigliani [10], and Michael DePrano and Thomas Mayer [15]. These critics particularly attacked the Friedman-Meiselman definition of autonomous expenditures, and proposed and tested the alternative definitions listed above. However, they also attacked the single-equation approach and recommended the use of large models instead.

The tests of alternative equations must be regarded as inconclusive in terms of which variable—the money stock or autonomous spending—is more closely related to the level of income.[9] Both approaches achieve values for R^2 of 0.98 or 0.99 so that the unexplained variance is very small in both cases. It seems very unlikely that the addition of an interest rate variable to the equations by using autonomous expenditures as the explanatory variable, which addition would make the equations correspond to equation 1 above, would make any substantial difference.

[9] For reasons that need not be explained here, most of this controversy was conducted in terms of equations with consumption rather than GNP as the dependent variable. In the Friedman-Meiselman study, however, results are reported for equations with GNP [2, p. 227]. Such results are also reported in [9, p. 17].

From this evidence it appears that *ex post* explanations of the level of income are about as accurate by using autonomous expenditures alone as are those by using money stock alone. But given the inaccuracies in forecasting autonomous expenditures, it must be concluded that *ex ante* explanations by using the money stock are substantially more accurate than those with forecasts of autonomous expenditures. From this evidence, the total random term in equation 4 appears to have a substantially smaller variance than the total random term in equation 3.

For the reasons mentioned by the Friedman-Meiselman critics, evidence from single-equation studies cannot be considered definitive. But neither can the evidence be ignored, especially in light of the difficulties encountered in the construction and the use of large econometric models such as the FR–MIT model.

EVIDENCE ON STABILITY OF DEMAND FOR MONEY FUNCTION. One of the shortcomings of the single-equation studies discussed above is that their authors paid too little attention to the stability of regression coefficients over time. Consider the following statement by Friedman and Meiselman:

> The income velocity of circulation of money is consistently and decidedly stabler than the investment multiplier except only during the early years of the Great Depression after 1929. There is throughout, including those years, a close and consistent relation between the stock of money and consumption or income, and between year-to-year changes in the stock of money and in consumption or income [2, p. 186].

This conclusion is based on correlation coefficients between money and income (or consumption), but what is relevant for policy is the regression coefficient, which determines how much income will change for a given change in the money stock. In the Friedman-Meiselman study, a table [2, p. 227] reports the regression coefficient for income on money as being 1.469 for annual data 1897–1958.

However, the same table reports regression coefficients for 12 subperiods, some of which are overlapping, ranging from 1.092 to 2.399.

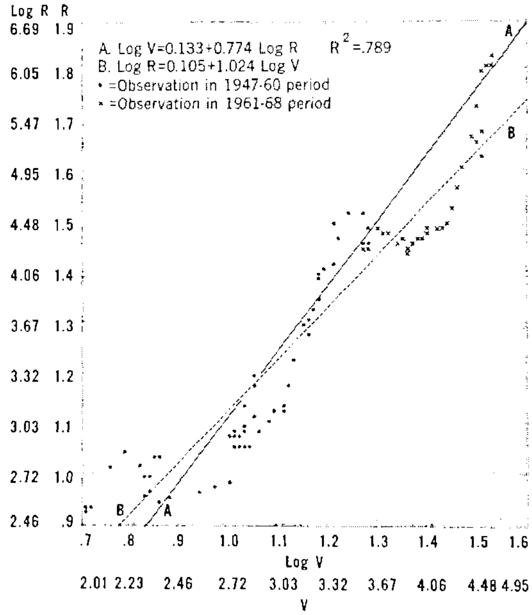
With a few exceptions, most economists agree that velocity changes can be explained in part by interest rate changes.[10] Thus, variability in the regression coefficients when income is regressed on money is not evidence of the instability of the demand for money function. To obtain some evidence on the stability of this function, the following simple procedure was used. Quarterly data were collected on the money stock, GNP, and Aaa corporate bond yields for 1947 through 1968. A demand for money function was fitted by regressing the log of the interest rate on the log of velocity, and vice versa. The regressions were run for the four periods, 1947 through 1960, 1947 through 1962, 1947 through 1964, and 1947 through 1966. The results inside each estimation period were then compared with the results outside the estimation period.

The results of this process for the 1947–60 estimation period are shown in Figure 11. The observations for 1947 through 1960 are represented by dots, and the observations for 1961 through 1968 by X's. The two least-squares regressions—log interest rate on log velocity and vice versa—fitted for the 1947–60 period have been drawn. From Figure 11 it appears that the relationship since 1960 has been quite similar to the one prior to 1960.

Table 1 presents the results of applying a standard statistical test to the regression and postregression periods to determine whether the demand for money function was stable. To understand this table, refer first to section A of the table, and to the 1947–60 estimation period. Section A reports results from regressing the log of velocity on the log of the Aaa corporate bond rate, and the first row refers to the regression for 1947 through 1960. The square of the regression's standard error of estimate is 0.00517 with 54 degrees of freedom. There were 32 quarters in the postregression

[10] For a convenient review of evidence on this subject, see [4].

FIGURE 11
VELOCITY AND INTEREST RATE REGRESSIONS
Regressions Fitted to Quarterly Data, 1947–60



period 1961 through 1968, and for this period the mean-square error of velocity from the velocity predicted by the regression is 0.00836. The ratio of the mean-square errors from regression outside to those inside the estimation period is given in the column labeled "F." Since the ratio of two mean squares has the F distribution under the hypothesis that both mean squares were produced by the same process, an F test may be used to test whether the de-

TABLE 1: Tests of the Stability of the Demand for Money Function by Using Quarterly Data

A. Log velocity regressed on log Aaa corporate bond yield

Estimation period	Regression $(SEE)^2$	Regression d.f.	Postregression MSE	Postregression d.f.	F	Significance level
1947–60.....	.00517	54	.00836	32	1.62	.10
1947–62.....	.00484	62	.00746	24	1.54	.10
1947–64.....	.00509	70	.00587	16	1.15	>.25
1947–66.....	.00502	78	.00986	8	1.96	.10

B. Log Aaa corporate bond yield regressed on log velocity

Estimation period	Regression $(SEE)^2$	Regression d.f.	Postregression MSE	Postregression d.f.	F	Significance level
1947–60.....	.00684	54	.00589	32	1.16[a]	>.25
1947–62.....	.00614	62	.00723	24	1.18	>.25
1947–64.....	.00570	70	.01162	16	2.04	.025
1947–66.....	.00537	78	.02192	8	4.08	.005

[a] MSE < $(SEE)^2$.

mand for money function has been stable. If the function has been stable, then errors from regression outside the period of estimation should be, on the average, the same size as the errors inside the period of estimation. For the 1947–60 regression being discussed, $F = 1.62$ and is significant at the 10 per cent level but not at the 5 per cent level.

Looking at Table 1 as a whole it can be seen that, for three of the regressions, the errors outside the period of estimation are not statistically significantly larger than those inside the period of estimation. Indeed, for the bond rate regression for the 1947–60 period, the errors outside the period of estimation were actually smaller, on the average, than those inside the period of estimation. Over-all, however, these results taken at face value cast some doubt on the stability of the demand for money function.

However, there is reason to believe that there are problems in applying the F test in this situation. The reason is that the residuals from regression exhibit a very high positive serial correlation as indicated by Durbin-Watson test statistics of around 0.15 for all of the regressions. What this means is that the effective number of degrees of freedom is actually less than indicated in the table, and with fewer degrees of freedom the F ratios computed have less statistical significance than the significance levels reported in the table. The only way around this problem is to run a more complex regression that removes the serial correlation of the residuals, but there is no general agreement among economists as to exactly what variables belong in such a regression. The virtue of the simple regressions of velocity on an interest rate and vice versa is that this form has been used successfully by many investigators starting in 1954 [22].

The appropriate conclusion to be drawn from this evidence would seem to be that the relationship between velocity and the Aaa corporate bond rate is too close and too stable to be ignored, but not close enough and stable enough to eliminate all doubts. However, the question is not whether an ironclad case for a money stock policy exists but rather whether the evidence taken as a whole argues for the adoption of such a policy. While there is certainly room for differing interpretations of Figure 11 and Table 1, and of the other evidence examined above, on the whole all of these results seem to point in the same direction. It appears that the money stock rather than interest rates should be used as the monetary policy control variable.

III. A MONETARY RULE FOR GUIDING POLICY

RATIONALE FOR A RULE-OF-THUMB. The purpose of this section is to develop a rule-of-thumb to guide policy. Such a rule—not meant to be followed slavishly—would incorporate advice in as systematic a way as possible. The rule proposed here is based upon the theory and evidence in Sections II and III and upon a close examination of post-accord experience.

Individual policy-makers inevitably use informal rules-of-thumb in making decisions. Like everyone else, policy-makers develop certain standard ways of reacting to standard situations. These standard reactions are not, of course, unchanging over time, but are adjusted and developed according to experience and new theoretical ideas. If there were no standard reactions to standard situations, behavior would have to be regarded as completely random and unpredictable. The word "capricious" is often, and not unfairly, used to describe such unpredictable behavior.

There are several difficulties with relying on unspecified rules-of-thumb. For one thing, the rules may simply be wrong. But an even more important factor, because formally specified rules may also be wrong, is that the use of unspecified rules allows little opportunity for cumulative improvements over time. A policy-maker may have an extremely good operating rule in his head and excellent intuition as to the application of the rule but unless this rule can be written down there is little chance that it can be passed on to subsequent generations of policy-makers.

An explicit operating rule provides a way of incorporating the lessons of the past into current policy. For example, it is generally felt that monetary policy was too expansive following the imposition of the tax surcharge in 1968. Unless the lesson of this experience is incorporated into an operating rule, it may not be remembered in 1975 or 1980. How many people now remember the overly tight policy in late 1959 and early 1960 that was a result of miscalculating the effects of the long steel strike in 1959? Since the FOMC membership changes over time, many of the current members will not have learned firsthand the lesson from a policy mistake or a policy success 10 years ago. If the FOMC member is not an economist, he may not even be aware of the 10-year-old lesson.

It is for these reasons that an attempt is made in this section to develop a practical policy rule that incorporates the lessons from past experience. The rule is not offered as one to be followed to the last decimal place or as one that is good for all time. Rather, it is offered as a guide—or as a benchmark—against which current policy may be judged.

A rule may take the form of a formal model that specifies what actions should be taken to achieve the goals decided upon by the policymakers. Such a model would provide forecasts of goal variables, such as GNP, conditional on the policy actions taken. The structure of the model and the estimates of its parameters would, of course, be derived from past data and in that sense the model would incorporate the lessons of the past.

But in spite of advances in modelbuilding and forecasting, it is clear that forecasts are still quite inaccurate on the average. In a study of the accuracy of forecasts by several hundred forecasters between 1953 and 1963, Zarnowitz concluded that the mean absolute forecast error was about 40 per cent of the average year-to-year change in GNP [26, p. 4]. He also reported, "there is no evidence that forecasters' performance improved steadily over the period covered by the data" [26, p. 5].

Not only are forecasts several quarters ahead inaccurate but also there is considerable uncertainty at, and after, the occurrence of business-cycle turning points as to whether a turning point has actually occurred. In a study of FOMC recognition of turning points for the period 1947–60, Hinshaw concluded that [1, p. 122]:

> The beginning data of the Committee's recognition pattern varied from one to nine months before the cyclical turn. . . . On the other hand, the ending of the recognition pattern varied from one to seven months after the turn. . . . With the exception of the 1948 peak, the Committee was certain of a turning point within six months after the NBER date of the turn. At the date of the turn, the estimated probability was generally below 50; it reached the vicinity of 50 about two months after the turn.

This recognition record, which is as good as that in 10 widely circulated publications whose forecasts were also studied in [2], casts further doubt on the value of placing great reliance on the forecasts.[11]

Given the accuracy of forecasts at the current state of knowledge,[12] it seems likely that for some time to come forecasts will be used primarily to supplement a policy-decision-making process that consists largely of reactions to current developments. Only gradually will policy-makers place greater reliance on formal

[11] For further analysis of forecasting accuracy, see [5].

[12] The accuracy of forecasts may now be better than in the periods examined in the studies cited above. But without a number of years of data there would be no way of knowing whether forecasts have improved, and so forecasts must in any case be assumed to be subject to a wide margin of error at the present time.

forecasting models.[13] While a considerable amount of work is being done on such models, essentially no attention is being paid to careful specification of how policy should react to current developments. While sophisticated models will no doubt in time be developed into highly useful policy tools, it appears that in the meantime relatively simple approaches may yield substantial improvements in policy. Given that knowledge accumulates rather slowly, it can be expected that carefully specified but simple methods will be successful before large-scale models will be. Careful specification of policy responses to current developments is but a small step beyond intuitive policy responses to current developments. This step surely represents a logical evolution of the policy-formation process.

POST-ACCORD MONETARY POLICY. That an operating guideline is needed can be seen from the experience since the Treasury–Federal Reserve accord. In order that this experience may be understood better, subperiods were defined in terms of "stable," "easing," or "firming" policy as determined from the minutes of the Federal Open Market Committee. The minutes used are those published in the *Annual Reports* of the Board of Governors of the Federal Reserve System for 1950 to 1968. The definitions of "stable," "easing," and "firming" periods are necessarily subjective as are the determinations of dates when policy changed.[14] The dating of policy changes was based primarily on the FOMC minutes, although the dates of changes in the discount rate and in reserve requirements were used to supplement the minutes. "Stable" periods are those in which the policy directive was unchanged except for relatively minor wording changes. In some cases the directive was essentially unchanged although the minutes reflected the belief that policy might have to be changed in the near future. While the Manager of the System Open Market Account might change policy somewhat as a result of such discussions, the unchanged directive was taken at face value in defining policy turning points.

More difficult problems of interpretation were raised by such directives as "unchanged policy, but err on the side of ease," or "resolve doubts on the side of ease." Such statements were used to help in defining several periods during which policy was progressively eased (or tightened). For example, in one meeting the directive might call for easier policy, the next meeting might call for unchanged policy but with doubts to be resolved on the side of ease, and a third meeting might call for further ease. These three meetings would then be taken together as defining an "easing" period. However, unless accompanied by other FOMC meetings clearly calling for a policy change, statements such as those calling for an "unchanged policy with doubts resolved on the side of ease" were interpreted as not calling for a policy change.

Some important monthly economic time series for the post-accord period are plotted in Figure 12. The heavy vertical lines represent periods of "stable," "easing," and "firming" policy as indicated by "S," "E," and "F" at the bottom of the figure. Except for the unemployment rate, the average of each series for each policy period has been plotted as a horizontal line.

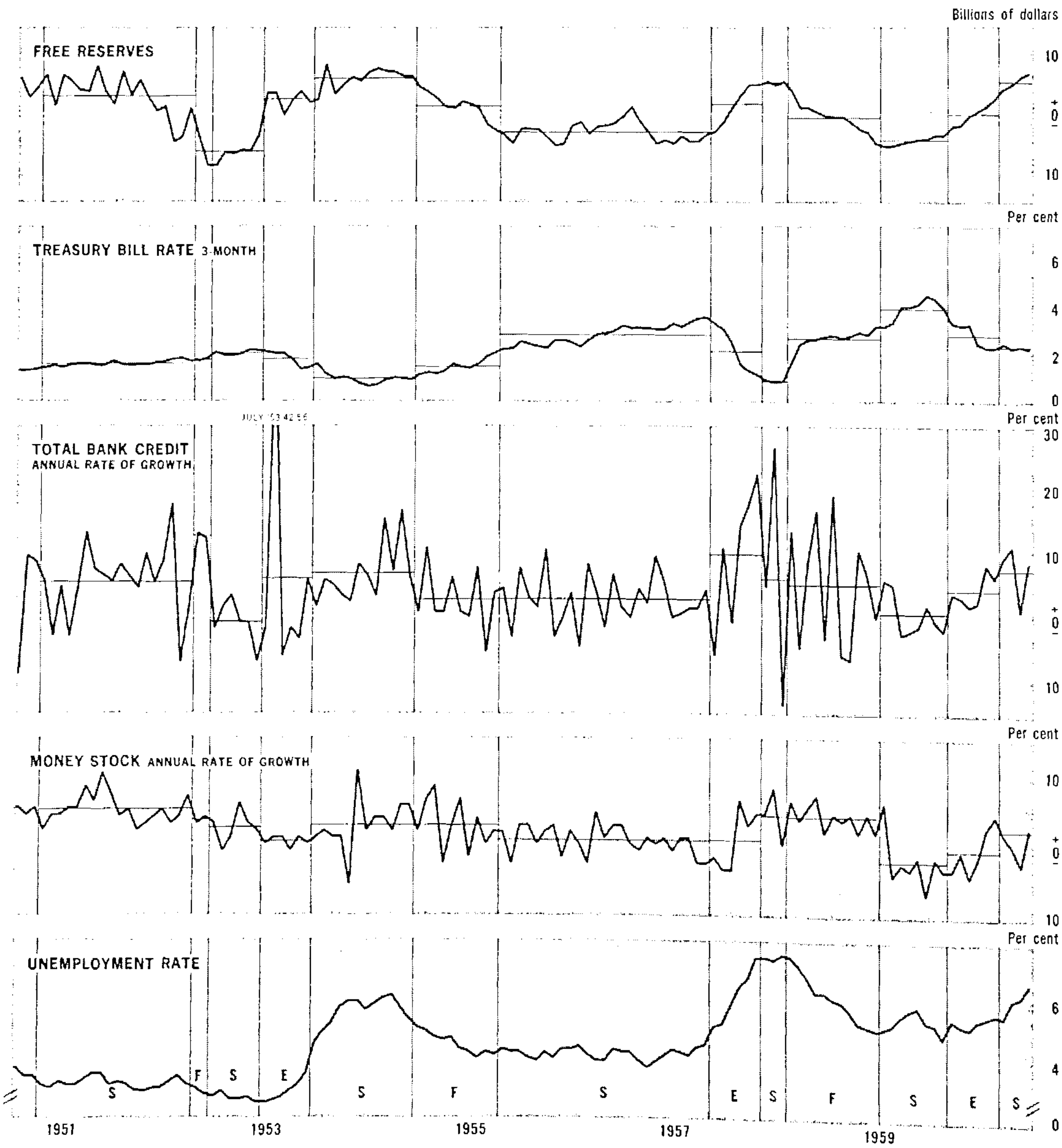
[13] It may be objected that great reliance is already placed on forecasts, at least on judgmental forecasts. However, these forecasts typically involve a large element of extrapolation of current developments. It seems fair to say that in most cases in which conditions forecast a number of quarters ahead differ markedly from current conditions, policy has followed the dictates of current conditions rather than of the forecasts.

[14] The author was greatly assisted in these judgments by Joan Walton of the Special Studies Section of the Board's Division of Research and Statistics. Miss Walton, who is not an economist, carefully read the minutes of the entire period and in a large table recorded the principal items that seemed important at each FOMC meeting. Having a noneconomist read the minutes tempered the inevitable tendency for an economist to read either too much or too little into the minutes. However, the final interpretation of the minutes rested with the author.

Two features of the post-accord experience are especially noteworthy. First, decisions to change policy have been taken about as close to the time when, in retrospect, policy changes were needed as could be expected in the light of existing knowledge.[15] There have been mistakes in timing, but the over-all record is impressive. The second major feature of this period is that policy actions, as opposed to policy decisions, have been in the correct direction if policy actions are defined by either free reserves or interest rates, but not if policy actions are defined in terms of either the money stock or bank credit.

[15] For additional views on the timing of Federal Reserve decisions, see [13] and [1].

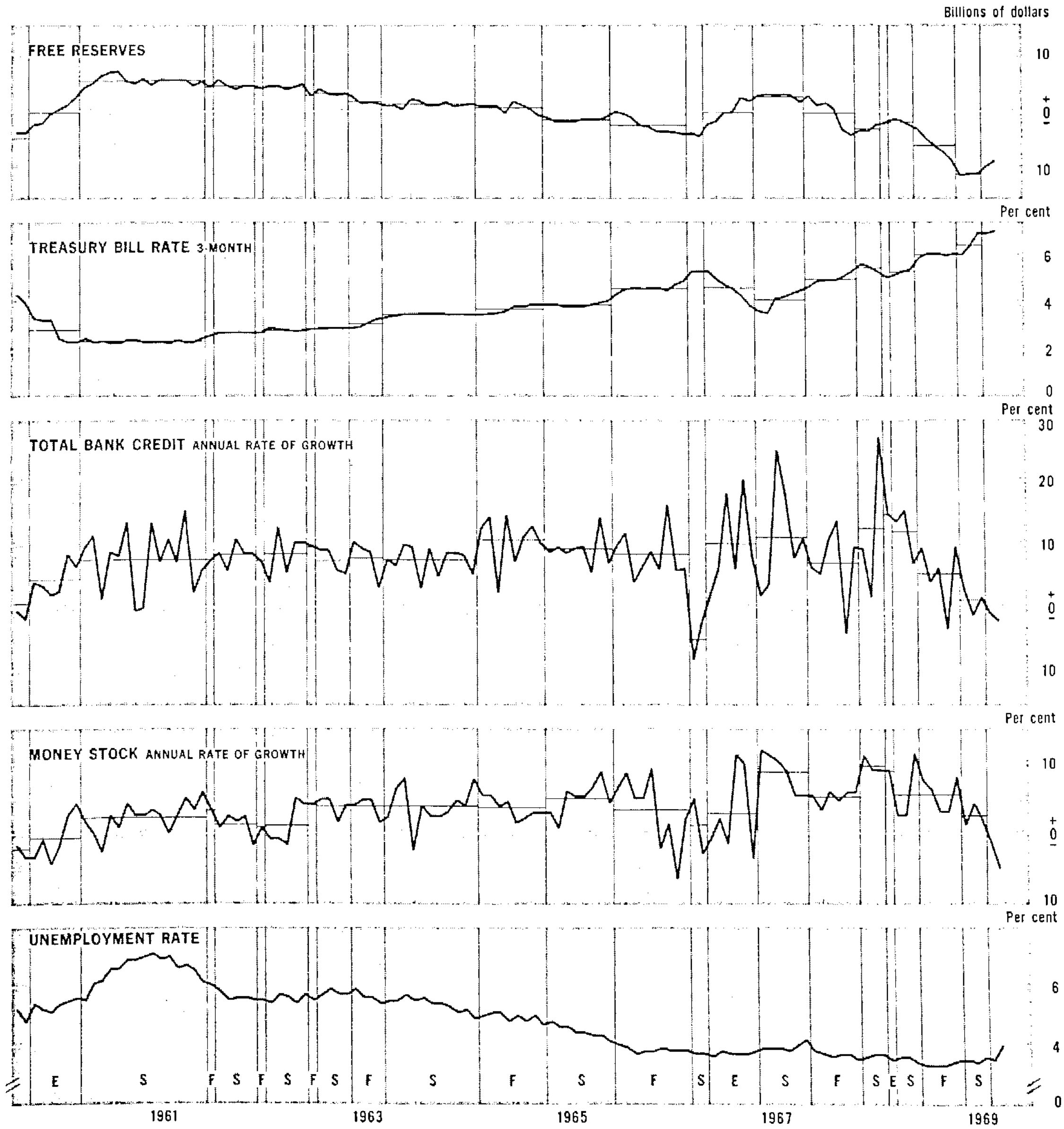
FIGURE 12
POST-ACCORD MONETARY POLICY



To examine the timing question in more detail, a useful comparison is that between business cycle turning points (as defined by the National Bureau of Economic Research) and decisions to change policy. The post-accord period begins at a time when the U.S. economy was beset by inflation stemming from the war in Korea. The dates of the principal changes in policy and of the business cycle peaks and troughs are listed in Table 2. The policy dates are those that define the beginning of the "stable," "easing," and "firming" periods indicated in Figure 12.

The decision to ease policy was made prior to the business cycle peaks of July 1953 and May 1960. The decision in 1957 was made in

FIGURE 12 (CONCLUDED)
POST-ACCORD MONETARY POLICY



the fourth month following the cycle peak in July, but as can be seen from Figure 12, the unemployment rate had not risen very much through October. Given the amount of uncertainty always present in interpreting business conditions, this lag must be considered to be well within the margin of error to be expected for stabilization policy. However, the easing policy decision in 1968 was clearly a mistake in retrospect but not in prospect given the expectations held by the majority of economists that the tax increase would significantly temper the economic boom.

TABLE 2: Dates of Principal Monetary Policy Decisions and of Business Cycle Peaks and Troughs

Business cycle		FOMC policy decisions	
Turning point	Date	Policy	Starting date
		Accord	1951—Mar. 1-2
		Firming	1952—Sept. 25
		Stable	Dec. 8
Peak	1953, July	Easing	1953—June 11
		Stable	Dec. 15
Trough	1954, August	Firming	1954—Dec. 11
		Stable	1955—Oct. 4
Peak	1957, July	Easing	1957—Nov. 12
		Stable	1958—Apr. 15
Trough	1958, April	Firming	July 29
		Stable	1959—June 16
Peak	1960, May	Easing	1960—Mar. 1
		Stable	Aug. 16
Trough	1961, February	Firming	1961—Oct. 24
		Stable	Nov. 14
		Firming	1962—June 19
		Stable	July 10
		Firming	Dec. 18
		Stable	1963—Jan. 8
		Firming	May 7
		Stable	Aug. 20
		Firming	1964—Aug. 18
		Stable	1965—Mar. 2
		Firming	Dec. 14
		Stable	1966—Sept. 13
		Easing	Nov. 1
		Stable	1967—May 2
		Firming	Nov. 27
		Stable	1968—Apr. 30
		Easing	July 16
		Stable	Aug. 13
		Firming	Dec. 17
		Stable	1969—Apr. 29

Firming policy decisions were also generally well timed. Following the 1953–54 recession, decisions to firm policy in small steps were taken from December 1954 to September 1955, as unemployment declined to about 4 per cent of the labor force. During the recovery period after the 1957–58 recession, firming decisions were taken from July 1958 to May 1959. There was also a series of firming decisions taken from the end of 1961 to 1966. Especially noteworthy are those taken from December 1965 to August 1966, in response to the beginning of inflation associated with the escalation of military activity in Vietnam. The easing policy decisions taken in late 1966 and early 1967 were fully appropriate in light of the economic slack that developed in 1967.

Even from the point of view of those who doubt the importance of fiscal policy, this record of the timing of policy decisions in the post-accord period is remarkably good. The timing record does not suggest that much attention was paid to forecasts, but this lack of attention was perhaps not unfortunate given the accuracy of forecasts during the period. From this point of view, the only real mistake was the easing decision taken in 1968. Of course, those who believe that a steady rate of growth of the money stock is better than any discretionary policy likely to be achieved in practice may read this record as supporting their thesis. But the post-accord record of the timing of policy decisions is certainly encouraging to those who believe that the lags in the effects of policy are short enough, and the effects predictable enough, to make discretionary monetary policy a powerful stabilization tool if only decisions can be made promptly.

While the System's performance in the timing of policy decisions has been commendable, the same cannot be said for the actions taken in response to the decisions. In the earlier discussion the purposely vague terms "easing," "firming," and "stable" were used to describe policy decisions. These terms were meant to convey the notions that policy-makers wanted, respectively, to accelerate, decelerate, or maintain the pace of economic advance. The question that must now be examined is whether policy actions did in fact tend to accelerate, decelerate, or maintain the level of economic activity.

Policy actions were in accord with policy decisions if these actions are measured by either the 3-month Treasury bill rate or free reserves. The bill rate rose in "firming" periods, fell in "easing" periods, and tended to remain unchanged in "stable" periods. However, there was some tendency for the bill rate to rise in "stable" periods following "firming" periods, and to fall in "stable" periods following "easing" periods, a pattern not inconsistent with the interpretation of policy being offered in this study. Similar comments apply to free reserves.

But the picture is quite different if policy actions are measured by the rate of growth of the money stock. Careful study of Figure 12 will make this point clear. The growth rate declined in response to the "firming" policy decision in late 1952, and again in the "stable" period in early 1953. This behavior was, of course, consistent with the "firming" decision. But the rate of growth declined further following the "easing" decision in June 1953 and remained low until the middle of 1954. The unemployment rate rose rapidly from its low of 2.6 per cent at the cycle peak in July 1953 to 6.0 per cent in August 1954, the cycle trough; the money stock was at the same level in April 1954, 9 months following the cycle peak and 10 months following the decision to adopt an "easing" policy, as it had been at the peak.

The same pattern that had appeared during the 1953–54 recession appeared again at the time of the 1957–58 recession. The rate of growth of the money stock declined in 1957 prior to the cycle peak. (The Treasury bill rate also rose substantially.) But after the decision to adopt an "easing" policy in November 1957, the growth rate of the money stock declined further. From October 1957 to January 1958, the money stock *fell* at a 2.9 per cent annual rate; from the cycle peak in July to October it had fallen at a 1.5 per cent annual rate.

The rate of growth of the money stock increased substantially in February 1958, and it remained at the higher level during the "stable" policy period April to July. There followed a period of "firming" policy decisions from the end of July 1958 to May 1959; however, the average growth rate of the money stock during this period was virtually identical to the average in the preceding "stable" period. But in the "stable" period from June 1959 to February 1960, the rate of growth of money, at −2.2 per cent, was much lower than in the preceding "firming" period. This rate of growth of money can hardly be considered appropriate in the light of the fact that except for one month the unemployment rate was continuously above 5 per cent. However, the picture was confused by a long steel strike.

The decision to ease policy was taken on March 1, 1960, but the rate of growth of the money stock remained negative until July. The rate of growth of money fell following the "firming" policy decisions of October 1961 and June 1962. In spite of another firming decision in December 1962 the rate of growth then increased, and it continued to rise during the "firming" period in 1963, maintaining the same rate in the following "stable" period. In August 1964, another "firming" decision was taken, and the growth rate trended down during the "firming" period from August 1964 to February 1965.

During the "stable" period from March to November 1965, the Vietnam war heated up. In the second half of 1965 the growth rate of money was 6.1 per cent compared with 3.0 per cent during the first half. The "firming" policy decision came in December, but the rate of growth of money averaged over 6 per cent for the months December through April 1966. At this point monetary growth ceased. In January 1967 the money stock was actually less than in May 1966—there having been no increase in the growth rate in the months immediately following the "easing" decision of November 1, 1966.

The growth rate of money then accelerated during the "stable" period from May through October 1967; for the period as a whole growth averaged 8.7 per cent. In the following "firming" period November 1967 through April 1968, the rate of growth of the money stock was lower but it was still relatively high at 5.1 per cent. The growth rate then rose to 9.6 per cent in the "stable" period May through July 1968 and thereafter fell to a little less than 6 per cent in the July–November 1968 period following the "easing" decision of July 16, 1968.

There ensued a "firming" period from December 1968 through April 1969. Although original figures indicated that monetary growth was relatively little during this period, a revision in the money stock series showed that the rate averaged 5.5 per cent for the period as a whole. The rate following April was lower, especially in the June–December 1969 period, which saw no net growth in the money stock.

A broadly similar view of the timing of policy actions is obtained from a careful examination of the rate of growth of total bank credit. However, as shown in Figure 12, this series is quite erratic and much more difficult to interpret than the series on the rate of growth of the money stock.

The proper way to interpret these results would seem to be as follows. When interest rates fell in a recession, policy was easier than it would have been if interest rates had not been permitted to fall. But if the money stock was also falling, or growing at a below-average rate, policy was tighter than it would have been had money been growing at its long-run average rate. Similar statements apply to rising interest rates and above-average monetary growth in a boom.

A MONETARY RULE. Given the arguments of Sections I and II on the advantages of controlling the money stock as opposed to interest rates, a logical first step in developing a policy guideline is to examine cases clearly calling for ease or restraint. Consider first a recession. To insure that monetary policy is expansionary, the rule might be that interest rates should fall *and* the money stock should rise at an above-average rate. This policy avoids two possible errors.

The first is illustrated in Figure 13. If the *IS* function shifts down from IS_1 to IS_2 while the *LM* function shifts from LM_1 to LM_2, the interest rate will fall from r_1 to r_2. The shift from LM_1 to LM_2 could be caused by a shift in the demand for money with the stock of money unchanged. But this shift could also be caused by a decline in the stock of money, perhaps because of an attempt by policy-makers to keep the interest rate from falling too rapidly. However, in terms of income it is clearly better to permit the interest rate to fall to r_3 by maintaining the stock of money fixed, and better yet to shift the *LM* function to the right of LM_1 by increasing the stock of money.

The point is the simple one that monetary policy should not rely simply on a declining interest rate in recession but should also insure that the money stock is growing at an adequate rate. The *LM* function may still shift to LM_2 in spite of monetary growth because of an increased demand for money; without the monetary growth, however, this shift in the demand for money would push the *LM* function to the left of LM_2 and income would be even lower.

The second type of error avoided by the proposed policy rule is illustrated in Figure 14. Again, it is assumed that the situation is one of recession. With a fixed money stock, an increase in the demand for money will shift the *LM* function from LM_1 to LM_2, tending to reduce income. However, if the interest rate is prevented from rising above r_1, the increased demand for money is met by an increased supply of money.

Maintaining monetary growth *and* a declining interest rate in recession insures that the contribution of monetary policy is expansive. Increases in the demand for money, unless accompanied by a falling *IS* function, are *fully* offset by preventing increases in the interest rate. The greater the fall in the *IS* function the smaller the offset to an increased demand for money. However, in no case should a fall in the *IS* function be permitted to cause a fall in the money stock.

The policy proposed does not, of course, guarantee an expansion of income. No such guarantee is possible because downward shifts in the *IS* function may exceed any specified shift in the *LM* function. But more important than theoretical possibilities are empirical probabilities. For all practical purposes the problem is not how to insure expansion in a recession but how to trade off the risks of too much expansion against too little. The discussion of Figures 13 and 14 was entirely in terms of encouraging income expansion, or limiting further declines, in the face of depressing disturbances. But disturbances may be expansionary in a recession, and such disturbances may combine with expansionary policy to create overly rapid recovery from the recession.

Consider again Figure 13, but suppose the initial position is as shown by IS_2 and LM_2. If the interest rate is not permitted to rise, a shift to IS_1 will lead to a large increase in income to the level given by the intersection of IS_1 with a horizontal *LM* function drawn at r_2. This situation can be avoided only if the interest rate is permitted to rise. The natural question is how the interest rate can be permitted to rise within a recession policy of pushing the interest rate down and maintaining above-average monetary growth. The answer is that the recession policy should be followed only if the interest rate can be kept from rising with a monetary growth rate below some upper bound.

Exactly the same analysis running in reverse applies to a policy for checking an inflationary boom. In a boom interest rates should rise and monetary growth should be below average. However, there must be a lower limit on monetary growth to avoid an unduly contractionary policy. Having presented the basic ideas behind the formulation of a monetary rule, it is now necessary to become more specific about the rule. After specifying the rule in detail, it will be possible to discuss the considerations behind the specific numbers chosen.

The proposed monetary policy rule-of-thumb is given in Table 3. The rule assumes that full employment exists when unemployment is in the 4.0 to 4.4 per cent range and that monetary growth in the 3 to 5 per cent range is consistent with price stability. At full employment the Treasury bill rate may rise or fall, either because of market pressures or because of small adjustments in monetary policy; however, monetary growth should remain in the 3 to 5 per cent range.

FIGURE 13

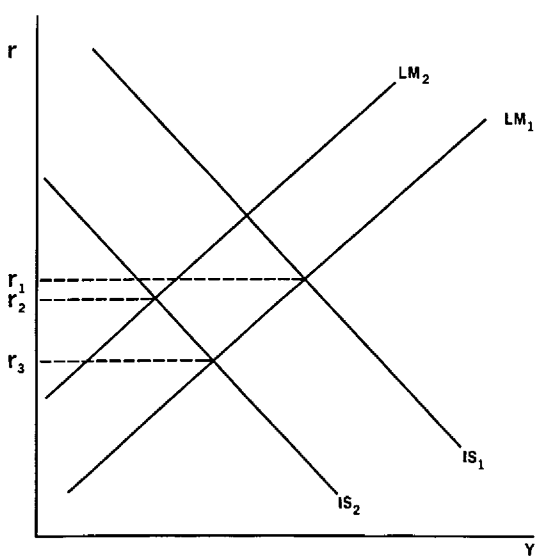


FIGURE 14

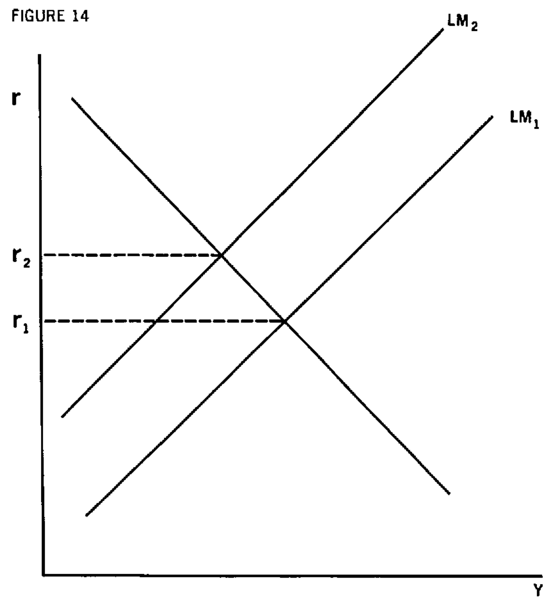


TABLE 3: Proposed Monetary Policy Rule-of-Thumb
In per cent

Unemployment rate previous month	Rule for month [1]	
	Direction of Treasury bill rate (3-month)	Growth of money stock (annual rate)
0–3.4	Rising	[2] 1–3
3.5–3.9	Rising	[2] 2–4
4.0–4.4	Rising or falling	3–5
4.5–4.9	Falling	[3] 4–6
5.0–5.4	Falling	[3] 5–7
5.5–5.9	Falling	[3] 6–8
6.0–100.0	Falling	6–8

[1] The 3-month bill rate is to be adjusted in the indicated direction provided that monetary growth is in the indicated range. If the bill rate change cannot be achieved within the monetary growth rate guideline, then the bill rate guideline should be abandoned.
[2] If the bill rate the previous month was below the bill rate 3 months prior to that, then the upper and lower limits on monetary growth are both increased by 1 per cent.
[3] If the bill rate the previous month was above the bill rate 3 months prior to that, then the upper and lower limits on monetary growth are both reduced by 1 per cent.

When unemployment drops below 4 per cent, the rule calls for a restrictive monetary policy. The bill rate should rise and monetary growth should be reduced. If the bill rate and monetary growth guidelines are not compatible, then the monetary guideline should be binding. For example, suppose that unemployment is in the 3.5 to 3.9 per cent range. If monetary growth below 2 per cent would be required to obtain a rising bill rate, then monetary growth should be 2 per cent and the bill rate be permitted to fall. If this situation persists so that the bill rate falls for several months in spite of the low monetary growth, then the limits on monetary growth should be increased as indicated in footnote 2 to Table 3. The reason for this prescription is that the bill rate on the average turns down 1 month before the peak of the business cycle [21, p. 111]. Unemployment, on the other hand, may increase relatively little in the early months following a cycle peak. Tying monetary growth to the bill rate in the way indicated in footnote 2 of Table 3 produces a more timely adjustment of policy than relying on the unemployment rate alone.

The proposed rule calls for a falling bill rate and a relatively higher rate of monetary growth as unemployment rises above the 4.0 to 4.4 per cent range. The rule for high unemployment situations calls for adjusting the monetary growth rate downward when the bill rate is consistently rising as indicated by footnote 3 to Table 3. The reasoning behind this adjustment is exactly parallel to the reasoning above for low unemployment situations.

The proposed monetary rule has the virtues of simplicity and dependence on relatively well-established economic doctrine. Because of its simplicity, the basic ideas behind the rule can be explained to the noneconomist. The simplicity of the rule also will make possible relatively easy evaluations of the rule's performance in the future if the rule is followed. With more complicated rules it would be much more difficult to know how to improve the rule in the future because it would be difficult to judge what part of the rule was unsatisfactory. Since, as has been repeatedly emphasized above, the rule is not proposed as being good for all time, it is best to start with a simple rule and then gradually to introduce more variables into the rule as experience accumulates.

In designing the rule, the attempt was made to base the rule on fairly well-established economic knowledge. There is, of course, a great deal of debate as to just what is and what is not well established. What can be done, and must be done, is to explain as carefully as possible the assumptions upon which the rule is based, with full recognition that other economists may not accept these assumptions.

First, the evidence for the importance of money is impressive. It seems fair to say that very few economists believe today that changes in the stock of money have nothing to do with business fluctuations. Rather, the argument is over the extent to which monetary factors are important. Some no doubt will feel that the 2-percentage-point ranges on monetary growth specified by the rule are excessively narrow; however, it should be noted that a 4 per cent growth rate is double a 2 per cent growth rate. Also important is the fact that the rule is meant to serve as a guideline rather than be absolutely binding. Since policy should deviate from the rule if there is good and sufficient reason—such as wartime panic buying—a further element of flexibility exists within the framework of the rule.

The rule is specified in terms of changes in the bill rate and the monetary growth rate, with the monetary growth rate being tied to the unemployment rate and to changes in the bill rate in the recent past. This formulation has been designed to avoid what seem to be the most obvious errors of the past. Over the years the monetary growth rate has been lowest at business cycle peaks and in the early stages of business contractions, and highest at cycle troughs and in the middle stages of business expansions. The highest rate of monetary growth since the Treasury–Federal Reserve accord has been during the inflation associated with escalation of military operations in Vietnam. For purposes of smoothing the business cycle, so far as this author knows, there is no theory propounded by any economist that would call for high monetary growth during inflationary booms and low monetary growth during recessions. Such behavior of the money stock could only be optimal within a theory in which money had little or no effect on business fluctuations and in which other goals such as interest rate stability were important.

Being based on the unemployment rate and bill rate changes in the recent past, the proposed monetary rule does not rely on forecasting. Nor does the rule depend on the current and projected stance of fiscal policy. Both of these factors ought to be included in applying the rule by adjusting the rate of growth of the money stock within the rule limits, or even by going outside the limits. But given the accuracy of economic forecasts under present methods, and given the current uncertainty over the size of the impact of fiscal policy (not to mention the hazards in forecasting Federal receipts and expenditures), it does not appear that these variables can be systematically incorporated into a rule at the current state of knowledge.

TESTS OF THE PROPOSED RULE. Three types of evidence on the value of the rule are examined below. The first approach involves a simple comparison of the rule with the historical record to show that the rule would generally have been more expansionary (contractionary) than actual policy when actual policy—in the light of subsequent economic developments—might be judged to have been too contractionary (expansionary). The second approach examines the cyclical behavior of the estimated residuals from a simple demand for money function to show that it is unlikely that the proposed rule would interact with the disturbances to produce an excessively inflationary or deflationary impact. Both these approaches are deficient because they rely heavily on the historical record, a record that would have been quite different had the rule been followed in the past. To avoid this difficulty, a third approach uses simulation of the FR–MIT model, but the results do not appear very useful because of shortcomings in this model.

An impressionistic examination of the rule. Broadly speaking, the results of comparing the rule with the historical record since the Treasury–Federal Reserve accord in March 1951 are these. The rule would have provided a substantially tighter monetary policy than the actual during the inflationary period from the accord until about September 1952. At that point, actual policy as measured both by the rate of growth of the money stock and by the 3-month bill rate became considerably tighter. In the last quarter of 1952, actual policy was in accord with the rule, but thereafter it tightened even further. In the 9 months following the cyclical peak in July 1953, the money stock had a zero rate of growth while the unemployment rate rose from 2.6 per cent to 5.9 per cent. Under the rule the rate of growth of the money stock would never have gone below 1 per cent and would have steadily increased as unemployment rose.

Actual policy became more expansive in the second quarter of 1954, and the cycle trough was reached in August. However, the rule would have been considerably more expansive, and it would have remained more expansive than the actual all through the 1955–56 boom. Inasmuch as the unemployment rate remained near 4.0 per cent from May 1955 through August 1957, the rule would have been too inflationary during this period. However, it can be argued that monetary policy was overly restrictive before the cycle peak in July 1957, since in the year prior to the peak the money stock grew only by 0.7 per cent. Less subject to dispute is the fact that policy was far too restrictive after the peak; in the 6 months following the peak the money stock fell at an annual rate of 2.2 per cent, and at the same time the unemployment rate rose from 4.2 per cent to 5.8 per cent.

The rule would have been considerably more expansive all during the high unemployment period of 1958–59, and it would have prevented the declines in the money stock in late 1959 and early 1960. At the peak in May 1960 the unemployment rate was 5.1 per cent, and the money stock had fallen by 2.1 per cent in the previous 12 months. Unlike the periods following peaks in 1954 and 1957, policy became more expansive immediately after the May 1960 peak, although not so expansive as called for by the proposed rule.

From the trough in February 1961 through June 1964, the unemployment rate never declined below 5 per cent. Under the rule, policy would have been more expansive than the actual policy followed throughout this period, especially as compared with the March–September 1962 period, during which the money stock fell slightly. Unemployment fell rapidly in 1965 with the Vietnam build-up; the rule would have been more expansive than actual through July 1965 and then less expansive than actual through April 1966. Indeed, in the 9-month period prior to April 1966, with the unemployment rate falling from 4.4 per cent to 3.8 per cent, monetary growth accelerated to a 6.6 per cent annual rate; the proposed rule would have first called for monetary growth in the 3 to 5 per cent range, and then in the 2 to 4 per cent range starting in February 1966, following the drop in the unemployment rate below 4.0 per cent in January. Finally, the negative growth rates of money in the 1966 credit crunch would have been avoided under the rule, as would the high rates of growth in 1967 and 1968.

This impressionistic look at the proposed rule may be supplemented by a simple scoring system for judging when the rule would have been in error. For each month during the sample period it was determined whether the rule would have been more or less expansive than the actual policy, or about the same as the actual policy. The unemployment rate 12 months from the month in question was used to indicate whether or not the policy was correct, with a desired range of unemployment of 4.0 to 4.4 per cent. The rule was deemed to have made an error if: (1) the actual policy was in accord with the rule, but unemployment 12 months later was not in the desired range; (2) the rule called for a more expansive policy than the actual, and unemployment 12 months later was below the desired range; and (3) the rule called for a less expansive policy than the actual, and unemployment 12 months later was above the desired range.

Since the latest data used in this analysis were for July 1969, comparison of the rule with actual policy ends July 1968. Starting the sample with 1952, the first full year after the accord, provides a total of 199 months. Based on the criterion described above, the rule would have been in error in 63 months. If the criterion is changed by substituting the unemployment rate 9 months ahead instead of 12 months ahead, the rule has 62 errors; using the unemployment rate 6 months ahead yields 59 errors.

Some of these errors are of negligible import. For example, in March 1953 the rule calls for a money growth rate of 2 to 4 per cent, but the actual was 1.9 per cent. Thus, the rule would have been more expansive than the actual this particular month, a mistake since unemployment was too low and inflation too high during this period. However, the rule would have been less expansive than actual in every one of the preceding 6 months and in all but one of the 6 months following this "mistake." Except for scattered errors such as the one just discussed, most of the rule errors occurred in two separate periods. The first is the 2-year period following the cycle trough in August 1954, during which time the rule would have been too expansive. The second is the last half of 1964 and the first half of 1965, when the rule would have been too expansive in light of the subsequent sharp decline in unemployment.

Unless one has completed a careful examination of the data, there is a tendency to underestimate how rapidly the economy can change. For example, from the cycle peak in July 1953 to the cycle trough 13 months later, the unemployment rate rose by 3.4 percentage points; and from the peak in July 1957 to the trough 9 months later in April 1958, it rose by 3.2 percentage points. Changes in the other direction have tended to be somewhat less rapid, but significant nonetheless. In the year following the trough in August 1954, the unemployment rate declined 2.0 percentage points, and it declined 2.2 percentage points in the year following the trough in April 1958. In January 1965 unemployment was 4.8 per cent and the problem was still one of how to reach full employment. A year later the rate was 3.9 per cent and the problem was inflation.

Thus, it appears that for the most part the rule would have been superior to policy actually followed. Of course, the rule is not infallible and would have erred on a number of occasions. But in spite of these errors—and it should be recognized that some errors are inevitable no matter what rule or which discretionary policy-makers are in charge—the proposed rule has the great virtue of turning policy around promptly as imbalances develop.

Relationship of the rule to monetary disturbances. Since the rule was developed on the basis of the theoretical and empirical analysis of Sections I and II, which emphasized the relative stability of the demand for money, it is appropriate to conduct a systematic examination of the disturbances in the demand for money. It will be recalled that the rule was formulated in such a way as to insure expansionary policy action in a recession and contractionary policy action in a boom. However, it was recognized that disturbances in the expenditure sector and/or in the monetary sector might reinforce policy actions leading to an excessively expansionary or contractionary effect on income. If there were a significant chance of these excessive effects occurring, then the rule proposed would be overly "aggressive" and a rule involving a smaller range of monetary growth rates would be in order.

To provide some evidence of the effect of disturbances in the money demand function, the residuals from the simple velocity function tested in Section II were examined carefully. The technique involved regressing velocity on the Aaa corporate bond rate, and vice versa, for the 1947–68 period and then comparing the residuals with turning points in the business cycle. The reader may make these comparisons visually from Figure 15. At the bottom of this figure cycle peaks and troughs are identified by "P" and "T," respectively.

The residuals from the estimated equations suggest that the demand for money has contractionary disturbances near business cycle peaks and expansionary disturbances near cycle troughs. The residuals have the same turning points for the regression of velocity on the interest rate as for the regression of the interest rate on velocity. The residual peaks occur at or before the cycle peaks, while the residual troughs occur at or after the cycle troughs.

To assess the significance of these findings, consider the following simple view as to the dynamics of monetary effects. In the short run, income is a predetermined variable in the demand for money function. An increase in the money stock makes the interest rate lower than it would be otherwise, and this eventually leads to expansion in investment and income. A downward disturbance in the demand for money function has the same effect.

Given this view of monetary dynamics, Figure 15 suggests the following conclusions. Shifts in the demand for money tend to be contractive in their effect on income in the late stages of a business cycle expansion, implying that a restrictive monetary policy must not be pushed too hard. Then, shortly before the cycle peak, the shifts apparently tend to become expansive. This effect is fortunate since it is only after the cycle peak that rising unemployment would trigger a policy change under the proposed rule. However, there appears to be little danger that the rule would be overly expansionary because after the cycle trough, while policy is still expansionary, contractive shifts in the demand for money occur.

Simulations of the FR–MIT model. The final technique used to test the proposed monetary rule was to simulate the FR–MIT model under the rule. As explained below, the results are of questionable value but are presented anyway for the sake of completeness and in order not to suppress results unfavorable to the proposed rule.

To simplify the computer programming, the rule used in the simulations is not exactly the same as the one proposed in Table 3 above. The proposed rule, it will be recalled, involved a bill rate guideline and a money stock guideline. If, for example, the bill rate cannot be pushed up without pushing monetary growth

FIGURE 15

RESIDUALS FROM VELOCITY REGRESSION COMPARED WITH BUSINESS-CYCLE TURNING POINTS

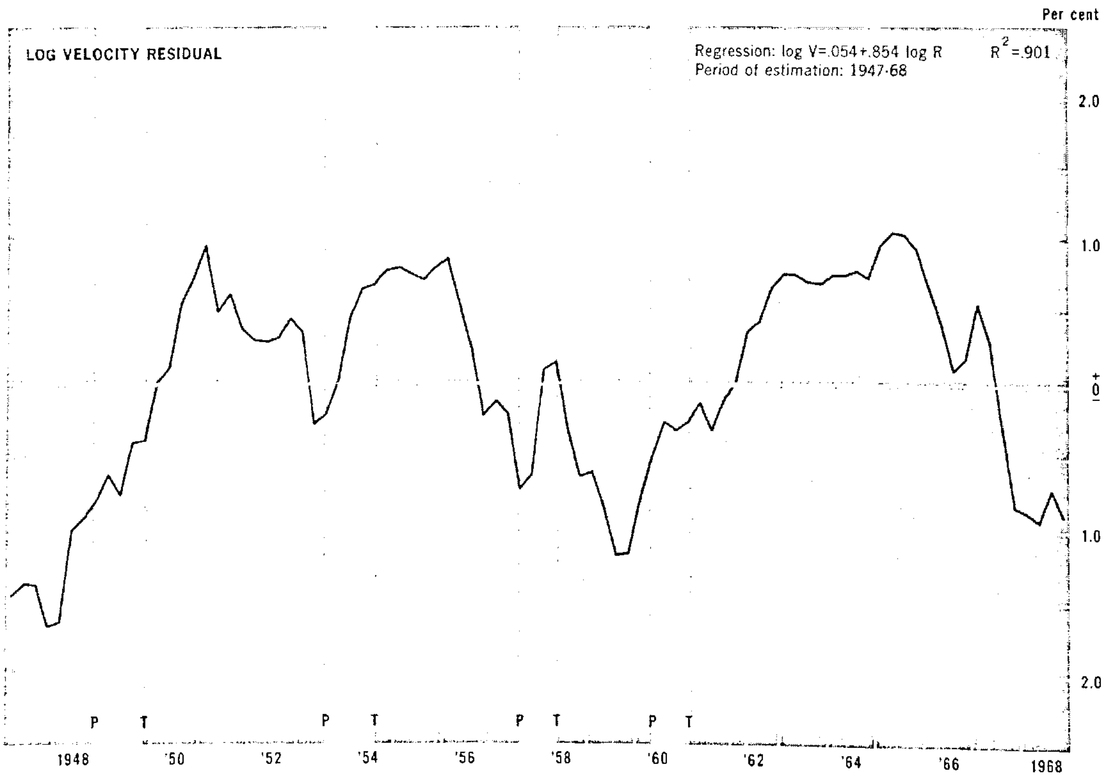
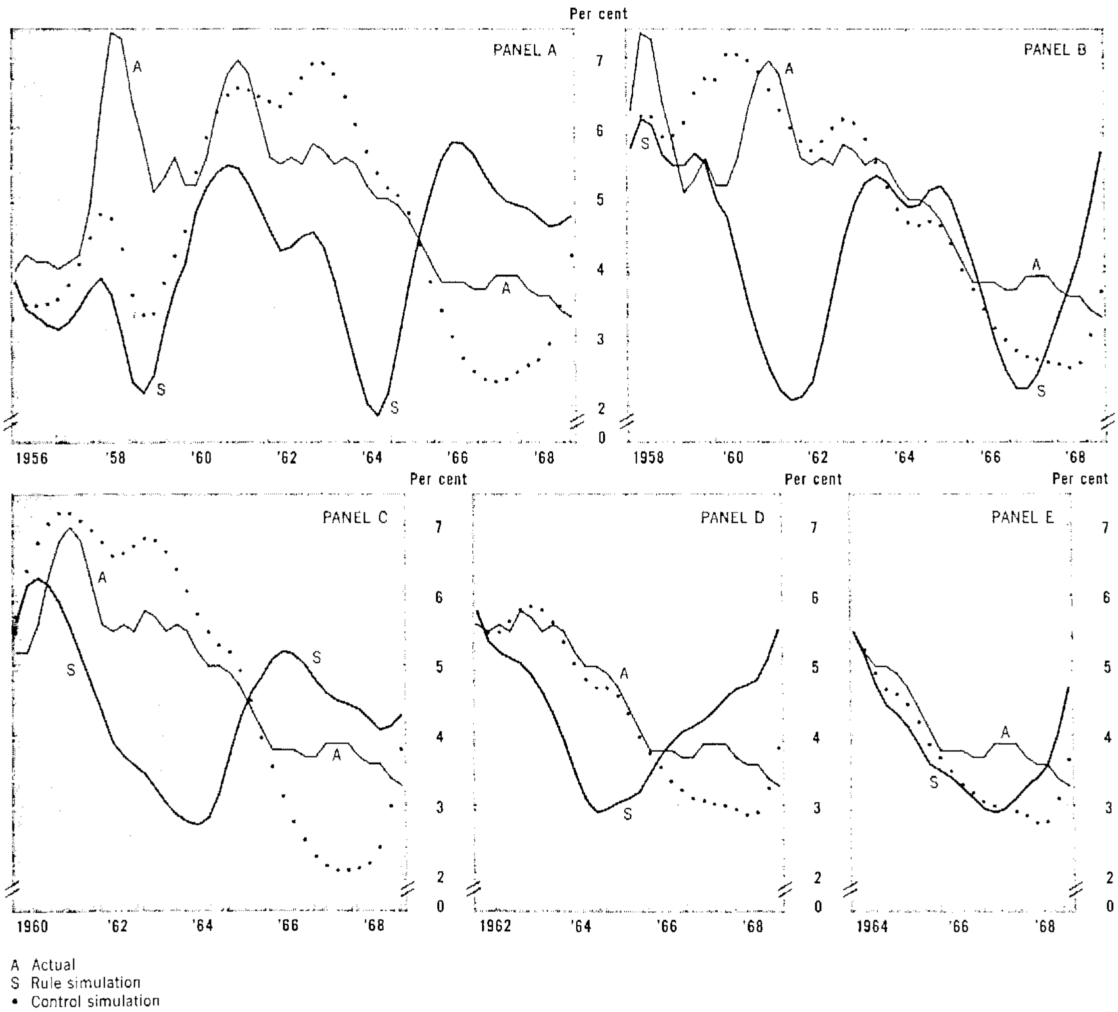


FIGURE 16
SIMULATIONS OF UNEMPLOYMENT IN FR-MIT MODEL



below the lower limit in the money guideline, the proposed rule calls for setting monetary growth at its lower limit. The simulation rule, on the other hand, ignores the bill rate guideline and simply sets the monetary growth rate at the midpoint of the range specified by the proposed rule.

Another difference, and no doubt a more important one, between the proposed rule and the simulation rule is that the simulation rule had to be specified in terms of quarterly data since the FR–MIT model uses quarterly data. In the simulation rule, the growth of the money stock depends on the level of unemployment determined by the model in the previous quarter. The growth rate of the money stock was modified by past changes in the bill rate, as in footnotes 2 and 3 to Table 3, except that the relevant bill rate change was in terms of the previous quarter compared with the quarter before that. The simulation rule, then, reacts somewhat more slowly to unemployment trends than does the proposed rule.

In order to investigate the importance of the starting point, simulations were run with starting dates in the first quarters of 1956, 1958, 1960, 1962, and 1964. The simulated unemployment rate for the five simulations is shown in the five panels of Figure 16 by the curves marked "S." The actual unemployment rate is shown by the curves marked "A," and control simulations, to be explained below, by the unconnected points.

It is clear from Figure 16 that the simulation rule for money growth produces an unstable unemployment rate. However, because of deficiencies in the model this result is probably not very meaningful. That the model is defective can be seen by comparing unemployment in the control simulations with the actual unemployment. In the control simulations all of the model's exogenous variables, including the money stock, were set at their actual levels.[16] Even with the exogenous variables set at their actual levels, the simulated level of unemployment at times differs from the actual level.

Because of the role of the stochastic disturbances in the model, especially as they feed through lagged endogenous variables, it cannot be expected that control simulations will exactly duplicate the actual results. But the fact that the control simulations differ from the actual by considerable margins over long periods of time strongly suggests that the money rule simulations do not provide much useful information on the properties of the proposed rule.

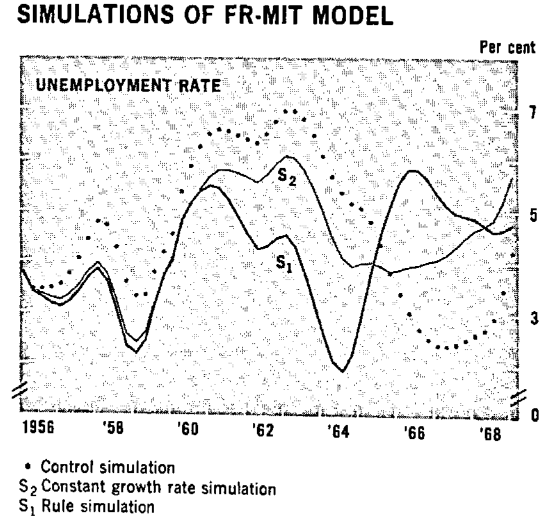
The simulations are valuable in one respect, however. An examination of Figure 16 strongly suggests that the money rule is interacting with the rest of the model to produce a cycle of 5 to 6 years. Such a cycle is particularly evident in the simulations starting in 1956 and 1958. That the monetary rule has very powerful effects in the model is shown by the simulations beginning in 1960 and 1962. In both simulations unemployment reaches a trough in 1964 and then rises in spite of the 1964–65 tax cuts and the stimulus of spending for military operations in Vietnam starting at the end of 1965.

There is no doubt that the monetary rule is too aggressive within the context of the FR–MIT model. A simulation of a perfectly steady rate of growth of money is shown in Figure 17. The rate of growth in this simulation is 2.76 per cent per year, the same as the actual rate of growth over the period 1955-IV through 1969-I. In Figure 17, the curve labeled S_2 is the simulated unemployment rate with the steady rate of growth of money. The simulated unemployment rate under the monetary rule is shown by S_1, which is the same as S in panel A of Figure 16. The unconnected points show the same control simulation as shown in panel A of Figure 16.

It appears impossible to draw any firm conclusions from the simulations. However, the simulations clearly raise the possibility that the proposed monetary rule may produce eco-

FIGURE 17

SIMULATIONS OF FR-MIT MODEL



[16] The FR–MIT model was estimated with the money stock as an endogenous variable. There are separate equations for currency and demand deposits, both of which are endogenous, while unborrowed reserves are exogenous. In the simulations the money stock was made exogenous by suppressing the equation that makes demand deposits depend on unborrowed reserves. To simulate the effects of a particular rate of growth of money, the currency equation was retained, but demand deposits were set at whatever level was required to obtain the desired rate of growth of demand deposits plus currency. In the control simulations demand deposits were set at their actual levels, but currency remained an endogenous variable and differed somewhat from actual since simulated GNP differed somewhat from actual GNP.

nomic instability. If anything, the proposed rule is too aggressive, and so policy should probably err on the side of producing growth rates in money closer to a steady 3 to 5 per cent rather than farther from the extremes in the proposed rule.

IV. SELECTION AND CONTROL OF A MONETARY AGGREGATE

BASIC ISSUES. Up to this point, the analysis has been entirely in terms of optimal control of the money stock. The theoretical analysis has been general enough that no precise definition of the money stock has been required. The empirical work, however, has used the narrow definition of demand deposits adjusted plus currency, for the simple reason that this definition seems to be the most appropriate one.

In principle there is no reason not to look simultaneously at all of the aggregates and, of course, at all other information as well. But in practice, at the present state of knowledge, there simply is no way of knowing how all of these various measures ought to be combined.[17] Furthermore, the selection of a single aggregate for operating purposes would permit the FOMC to be far more precise in its policy deliberations and in its instructions to the Manager of the Open Market Account. Thus, the best procedure would seem to be to select one aggregate as the policy control variable, and insofar as the state of knowledge permits, to incorporate other information into policy by making appropriate adjustments in the rate of growth of the aggregate selected.

[17] This point is an especially important one since those favoring simple approaches are frequently castigated for ignoring relevant information, and for applying "simplistic solutions to inherently complex problems." For this charge to be upheld, it must be shown explicitly and in detail *how* this other information is to be used, and evidence must be produced to support the proposed complex approach. As far as this author knows, there is essentially no evidence sorting out the separate effects of various components of monetary aggregates.

In principle the aggregate singled out as the control variable should be subject to exact determination by the Federal Reserve. The reason is that errors in reaching an aggregate that cannot be precisely controlled may interact with disturbances in the relationships between the aggregate and goal variables such as GNP to produce a suboptimal policy. However, as argued later in this section, this consideration is likely to be quite unimportant in practice for any of the aggregates commonly considered. Therefore, the analysis of which aggregate should be singled out will be conducted under the assumption that all of the various aggregates can be precisely controlled by the Federal Reserve.

SELECTION OF A MONETARY AGGREGATE. At the outset it must be emphasized that the various aggregates frequently discussed are all highly correlated with one another in the postwar period. This is true for total bank credit, the narrow money stock, the broad money stock (narrow money stock plus time deposits), the bank credit proxy (total member bank deposits), the monetary base (member bank reserves plus currency held by the public and nonmember banks), and several other figures that can be computed.

While these various aggregates are highly correlated over substantial periods of time, they show significantly different trends for short periods. In selecting an aggregate, the most important considerations are the theoretical relevance of the aggregate and the extent to which the theoretical notions have been given empirical support. Both of these considerations point to the selection of the narrowly defined money stock.

The most important theoretical dispute is between those who emphasize the importance of bank deposit liabilities—the "monetary" view—and those who emphasize the importance of banks' earning assets—the "credit" view. This controversy, which dates back well into the 19th century, is difficult to resolve because historically banks have operated on a fractional reserve basis and so have had both earning assets and deposit liabilities. Since balance sheets must balance, bank credit and bank deposits are perfectly correlated except insofar as there are changes in nonearning assets—such as reserves—or nondeposit liabilities—such as borrowing from the Federal Reserve System. If these factors never changed, the perfect correlation between bank deposits and bank credit would make it impossible ever to obtain evidence to distinguish between the monetary and the credit views. Since the correlation, while not perfect, has historically been very high, it has been very difficult to obtain evidence. Hence, it is still necessary to place major reliance on theoretical reasoning.

There would be little reason to examine the issue closely if we could be confident that the very high correlation between deposits and bank credit would continue into the indefinite future. But there are already substantial differences in the short-run movements of bank credit and bank deposits, and these differences are likely to become greater and of a longer-term character in the future. Banks are raising increasingly large amounts of funds through nondeposit sources such as sales of commercial paper and of capital certificates and through borrowing from the Euro-dollar market and the Federal Reserve System. (Borrowings from the System would probably expand significantly if proposed changes in discount-window administration were implemented.)

The easiest way to examine the theoretical issues is to consider some hypothetical experiments. Consider first the experiment in which the Federal Reserve raises reserve requirements by $10 billion at the initial level of deposits but simultaneously buys $10 billion in U.S. Government securities in the open market. Deposits need not change, but banks must hold more reserves and fewer earning assets. Under the monetary view the effects would be nil (except for very minor effects examined below) because deposits would be unchanged, but under the credit view the effect would be a tendency for income to contract because bank credit would be lower.

The monetary view is easily explained. Suppose first that the banks initially hold U.S. Government securities in excess of $10 billion. When reserve requirements are raised, the banks simply sell $10 billion of these securities, and this is exactly the amount being purchased by the Federal Reserve. Thus, since deposits are unchanged and bank loans to the nonbank private sector—hereinafter called simply the "private sector"—are also unchanged, there should be no effects on that sector.

Now suppose that the banks do not have $10 billion in Government securities. In this case they must sell private securities, say corporate bonds, to the private sector. The private sector obtains the funds to buy these bonds from the sale of $10 billion of Government securities to the Federal Reserve. The amount of credit in the private sector is again unchanged. The banks own fewer private securities, while the public owns more private securities and fewer Government securities.

Thus, the amount of credit extended to the private sector need not change at all even though bank credit falls. However, two minor effects are possible: First, the Federal Reserve purchase of Government securities changes the composition of portfolios. Thus, even if banks have over $10 billion of Government securities, they may be expected to adjust their portfolios by selling some Government securities and some private securities. For ease of exposition, run-offs of loans may be included in the sale of private securities. The net result, then, is that the banks have more reserves, fewer Government securities, and fewer private securities; the private sector has fewer Government securities and fewer liabilities to the banks. The private sector may have—but it will not necessarily have—fewer claims *within* the sector. It is quite possible that private units may substitute claims on other private units for the Government securities sold to the Federal Reserve.

Looked at from the liability side, those units initially with liabilities outstanding to banks may have those liabilities shifted to other private sector units. This occurs, of course, when banks sell securities to the private sector or allow loans to run off that are then replaced by firms selling commercial paper to other firms, drawing on sources of trade credit, and/or borrowing from nonbank financial institutions. A net effect can occur only when the combined portfolios of banks and the private sector contain fewer Government securities, though more reserves, than before; such a change may be looked upon as a reduction in liquidity and thereby lead to a greater demand for money and a reduced willingness to undertake additional expenditures on goods and services.

The second effect of the hypothetical experiment being discussed is that bank earnings will be reduced by the increase in reserve requirements. Banks will eventually adjust by raising service charges on demand deposits and/or reducing interest paid on time deposits. For simplicity, assume that the change in reserve requirements applies only to demand deposits so that there is no reason for banks to change the interest paid on time deposits. With higher service charges on demand deposits, lower interest rates on securities are required if people are to hold the same stock of money as before. Since the hypothetical experiment assumed that deposits did not change, interest rates must fall by the same amount as the increase in service charges, an effect that will tend to expand investment and national income.

The portfolio effect tends to contract income while the service charge effect tends to expand income. These effects individually seem likely to be small, and the net effect may well be nil. In this regard, it is interesting to note that the relationship of velocity to the Aaa corporate bond rate is about the same for observations in the 1950's as in the 1920's [22, 23] in spite of the enormous changes in financial structure and in Government bonds outstanding.

Consider another hypothetical experiment —one that is in fact not so hypothetical at the current time. Suppose that banks suddenly start issuing large amounts of commercial paper and investing the proceeds in business loans. It is possible that the loans simply go to corporations that have stopped issuing their own commercial paper. In this case the bank would be purely a middleman with no effect on the aggregate amount of commercial paper outstanding. The increase in bank credit would not represent an increase in total credit.

But, of course, banks issuing commercial paper must perform *some* function. This function is clearly that of increasing the efficiency of the financial sector in transferring funds from the ultimate savers to the ultimate borrowers. The efficiencies arise in several ways. First, under fractional reserve banking, banks have naturally developed expertise in lending. It is efficient to make use of this expertise by permitting banks to have more lendable funds than they would have if restricted to demand deposits alone. The efficiency takes the form of fewer administrative resources being required to transfer funds from savers to borrowers.

The second form of efficiency results from the fact that financial markets function best when there is a large amount of trading in a standardized instrument. For example, the shares of large corporations are much more easily marketed than those of small corporations. Many investors want, and require, readily marketable securities, and they can be persuaded to buy securities in small firms only if the yields are high. As a result funds may go to large corporations to finance relatively low-yielding investment projects while high-yielding projects available to small firms cannot be financed. Commercial banks, and other financial intermediaries, improve the allocation of capital by issuing relatively standardized securities with good markets and lending the proceeds to small firms.

The question is whether there is any effect on economic activity from an increase in bank credit financed by commercial paper—assuming that the money stock is not affected. To begin with, it must be emphasized that an increase in the efficiency of investment does not necessarily affect the total of investment. The same resources may be absorbed either in building a factory that will produce a product that cannot be sold or in building a factory to produce a highly profitable product in great demand.

Banks, and financial intermediaries in general, have the effect of reducing somewhat the cost of capital for small firms. Because intermediaries bid funds away from large corporations, the cost of capital for large corporations tends to be somewhat higher than it would be if there were no intermediaries. At this stage in the analysis the net effect on investment is impossible to predict since it depends on whether the reduction in investment by large corportions is larger or smaller than the increase in investment by small corporations.

In examining the effects of intermediation, however, another factor must be considered. Suppose it is assumed that the interest rates relevant for the demand for money are rates on high-quality securities. It was argued above that intermediation tends unambiguously to raise the yields on high-quality securities above what they otherwise would be. Since the assumption throughout has been that the stock of money is unchanged, the level of income must increase if the quantity of money demanded is to be unchanged with the higher interest rate of high-quality securities. The conclusion, therefore, is that the increase in bank credit is expansionary in the hypothetical experiment being discussed.

This conclusion, however, does not warrant the further conclusion that bank credit is the appropriate monetary aggregate for policy purposes. The effect examined above occurs when *any* financial intermediary expands. Not only is there the problem that data for all intermediaries are simply not available on a current basis but also there are serious problems in even defining an intermediary. A particularly good example of this difficulty is afforded by trade credit. A large nonfinancial corporation may advance trade credit to customers, many of whom may be small, and may also advance funds to suppliers through prepayments. The large corporation finances these forms of credit through the sale of securities, or through retained earnings diverted from its own investment opportunities and/or from dividends. In this case the large corporation is serving *exactly* the same function as the financial intermediaries are. But tracing these credit flows is obviously impossible at the present time.

Another problem with bank credit as a guide to policy is that changes in bank credit depend both on changes in bank deposits and on changes in nondeposit sources of funds. As demonstrated by the hypothetical experiments examined above, the effect of a change in bank credit depends heavily on whether or not deposits change.

One final hypothetical experiment will be considered. Suppose the U.S. Treasury sells additional Government securities to the public to finance an increase in cash balances at commercial banks. Since banks have received no additional reserves, total deposits cannot change. Deposits owned by the public are transferred to the Treasury. Bank credit is unchanged, but the impact on the private sector is clearly contractionary. The private sector holds more Government bonds and fewer deposits. Equilibrium can be restored only through some combination of a rise in interest rates and a decline in income.

The conclusion is that it appears to be fundamentally wrong for policy-makers to place primary reliance on bank credit. This is not to say that there is no information to be gained from analysis of bank and other credit flows. However, selection of bank credit as the monetary aggregate would be a mistake. Instead, information on credit flows may be used to adjust the desired rate of growth of the money stock, however it is defined, although it is not clear that the knowledge presently exists as to how to interpret credit flows.

From this analysis it appears that neither bank credit nor any deposit total that includes Treasury deposits is an appropriate monetary aggregate for monetary policy purposes. Before considering the narrow and broad definitions of the money stock, let us examine the monetary base, total reserves, and unborrowed reserves.

It is clear that different levels of the money stock may be supported by the same level of the monetary base. Given the monetary base, different levels of the money stock result from changes in reserve requirement ratios; from shifts of deposits between demand and time, which of course are subject to different reserve requirement ratios; from shifts of deposits among classes of banks with different reserve ratios; and from shifts between currency and deposits. These effects are widely understood, and they have led to the construction of monetary base figures adjusted for changes in reserve requirements. Similar adjustments are applied to total and nonborrowed reserves. If enough adjustments are made, the adjusted monetary base is simply some constant fraction of the money stock, while adjusted reserves are some constant fraction of deposits. It is obviously much less confusing to adopt some definition of the money stock as the appropriate aggregate rather than to use the adjusted monetary base or an adjusted reserve figure.

There can be no doubt that FOMC instructions to the Manager in terms of nonborrowed reserves would be more precise and more easily followed than instructions in terms of the money stock. But the simplicity of reserve instructions would disappear if adjusted reserves were used, for then the Manager would have to predict such factors as shifts between demand and time deposits, the same factors that must be predicted in controlling the money stock. No one would argue that such factors —and others such as changes in bank borrowings and shifts in Treasury deposits—should be ignored. If the FOMC met daily, instructions could go out in unadjusted form with the FOMC making the adjustments. But surely this technical matter should be handled not by the FOMC but by the Manager and his staff in order to permit the FOMC to concentrate on basic policy issues.

The only aggregates left to consider are the narrowly and broadly defined money stocks. There is a weak theoretical case favoring the narrow definition because time deposits must be transferred into demand deposits or currency before they can be spent. The case is weak because the cost of this transfer is relatively low. If the cost were zero, then there would be no effective distinction between demand and time deposits. Indeed, since time deposits earn interest, all funds would presumably be transferred to time deposits.

No strong empirical case exists favoring one definition over the other. The broad and narrow money stocks are so highly correlated over time that it is impossible to distinguish separate effects. It appears, however, that there is a practical case favoring the adoption of the narrow money stock. Time deposits include both passbook accounts, which can be readily transferred into demand deposits, and certificates of deposit, which cannot. Since CD's appear to be economically much more like commercial paper than like passbook time accounts, they ought to be excluded from the broadly defined money stock.

There is, of course, no reason why CD's cannot be excluded from the definition of money. The problem is that banks may in the future invent new instruments that will be classified as time deposits for regulatory purposes but that are not really like passbook accounts. In retrospect it may be clear how the new instrument should be treated, but the situation may be confused for a time. The same sort of problem exists with demand deposits—consider the compensating balance requirements imposed by many banks—but it seems likely that the problem will remain more serious for time deposits.

In summary, there is a strong case favoring the selection of some definition of the money stock as the monetary aggregate, and there appears to be a marginal case for preferring the narrowly defined money stock.

TECHNICAL PROBLEMS OF CONTROLLING MONEY STOCK. In the preceding sections it has been argued that the monetary policy control instrument should be the money stock. The purpose of this section is to investigate some of the technical problems in controlling the money stock. The first topic examined is that of the form of instructions to the Manager of the System Open Market Account. Following this discussion is an examination of the feedback method of control. Finally, there is an examination of the significance of data revisions. All of this discussion is in terms of the narrowly defined money stock, but much of it also applies to other aggregates.

Specification of the desired money stock. There are two major issues connected with the form of FOMC instructions to the Manager. The first is whether the desired money stock should be expressed in seasonally adjusted or unadjusted form, while the second is whether the desired money stock should be expressed in terms of a complete path week by week over time or of an average over some period of time. The first issue turns out to be closely related to the question of data revisions, and so its discussion will be deferred for the moment. It is to the second issue that we now turn.

Since required reserves are specified in terms of a statement-week average, the statement week is the natural basic time unit for which to measure the money stock, and the measure takes the form of the average of daily money stock figures over the statement week. The fact that daily data may not be available on all components of the money stock does not affect the argument; however estimated, the weekly-average figure is the most appropriate starting point in the analysis.

The weekly money stock is clearly not subject to precise control because of data lags and uncontrollable random fluctuations. Furthermore, no one believes that these weekly fluctuations have any significant impact. The natural conclusion to be drawn is that there is no point in specifying instructions in terms of weekly data but rather that some average level over a period of weeks should be used. Upon closer examination, however, this conclusion can be shown to be unjustified.

The difficulty in expressing the instructions in terms of averages can be explained very simply by two examples. To keep the examples from becoming too complicated, it will be assumed that instructions take the form of simple rates of growth on a base money stock of $200 billion. The neglect of compounding makes no essential difference to the argument.

For the first example, assume that the policy instruction is for a growth rate of 4 per cent per annum, which is $8 billion per year or about $154 million per week. If the money stock grew by $154 million per week for 8 weeks, then the figure for the eighth week would be above the base week figure by an amount representing a 4 per cent annual growth rate. The average of weeks 5 through 8 would be above the average of weeks 1 through 4 by $616 million, an amount also representing a 4 per cent annual growth rate. So far, there is no reason to favor the path specification over a specification in terms of 4-week averages.

Now suppose that the increase in weeks 1 through 4 was on schedule, but that a large uncontrollable increase of $500 million occurred in the fifth week. Starting from a base-week figure of $200 billion, the average money stock for weeks 1 through 4 would be $200.385 billion, and if the instruction were in terms of 4-week averages it would specify an average money stock of $201.001 billion for weeks 5 through 8.

Since by hypothesis the money stock grew by $154 million in each of the first 4 weeks, in the fourth week the level was $200.616 billion. The jump of $500 million in the fifth week would take the level to $201.116 billion, a figure already above the desired average of $201.001 billion for weeks 5 through 8. To reach this desired average given the jump in week 5, the money stock in weeks 6 through 8 would have to average less than $201.001 billion, and so the money stock would have to be forced below the level of the fifth week for weeks 6 through 8. Furthermore, as the reader may calculate, it would be necessary to have higher than normal weekly growth in weeks 9 through 12 if the average of these weeks were to be above the average of weeks 5 through 8 by $616 million. On the other hand, if the instruction were in terms of the desired weekly path, the instruction would read that the desired money stock in the eighth week was $201.232 billion, and therefore the Manager would not have to force the money stock down in weeks 6 through 8. Instead, he could aim for a growth of about $39 million in each of the weeks 6 through 8 to bring the level in week 8 to the desired figure of $201.232 billion.

From this example it can be seen that specification in terms of averages of levels of the money stock forces the Manager to respond to random fluctuations in a whipsawing fashion. Since week-by-week fluctuations have essentially no significance, there is no point in wrenching the financial markets in order to undo a random fluctuation. If averaging is to be used, the average should be specified in terms of the desired average weekly *change* over, say, the next 4 weeks rather than in terms of the average *level* of the next 4 weeks. Specification in terms of the average weekly change is equivalent to a specification stating that the Manager should aim for a particular target level in the fourth week.

The second example illustrating the hazards of specification in terms of the average level will show what happens when policy changes. As before, assume that the money stock in the base week is $200 billion and that the desired growth is at a 4 per cent rate in weeks 1 through 4. In this example it is assumed that there are no errors in hitting the desired money stock. Thus, the money stock is assumed to grow by $154 million per week, reaching a level of $200.616 billion in the fourth week and an average level of $200.385 billion for weeks 1 through 4.

Now suppose that in week 4 the FOMC decides on a policy change and specifies a 1 per cent growth rate for the money stock for weeks 5 through 8. If the specification were in terms of the average level, then it would require an increase in the average level of $154 million, which would bring the average level to $200.539 billion for weeks 5 through 8. But the figure for week 4 is already $200.616 billion, and so the money stock in weeks 5 through 8 would have to average less than the figure already achieved in week 4.

Thus, after a steady 4 per cent growth week by week, an average-level policy specification would actually require a negative week-by-week growth before the new 1 per cent growth rate could be achieved. On the other hand, a policy specification in terms of the weekly path would require a weekly growth of $38.5 million each week for weeks 5 through 8.

To make the point clear, this example was constructed so that the policy shift from a 4 to a 1 per cent growth rate would actually require a negative growth rate for a time on a week-by-week basis when the instructions are in terms of average levels. In general, when average levels are used, a policy shift to a lower growth rate will require in the short term a growth rate lower than the new policy rate set, and a policy shift to a higher growth rate will require a short-term growth rate above the new policy rate. Since policy-makers will typically want to shift policy gradually, the levels specification is especially damaging because it in fact instructs the Manager to shift policy more rapidly than the policy-makers had desired. It should be noted that the larger the number of weeks included in the average-level specification, the more severe this problem becomes.

Because the money stock cannot be controlled exactly, there is a natural tendency to feel that instructions stated in terms of averages are more attainable. In actuality, of course, this effect is illusory; averaging produces a smaller number to measure the errors, but does not improve control. Nevertheless, if averages are to be used in the instructions, the above examples demonstrate that the averages should be calculated in terms of weekly (or perhaps monthly) changes but not in terms of averages of levels.

Use of average changes does have one advantage, however. An instruction in this form permits the Manager to correct an error in week 1 over the next few weeks rather than instructing him to correct the error entirely in week 2. As explained above, an instruction in terms of the average weekly change over the next 4 weeks is equivalent to an instruction in terms of the desired level in week 4, leaving unspecified the desired levels in weeks 1 through 3.

Control through the feedback principle. It is useful to begin by comparing the problems of controlling the money stock with the problems of controlling interest rates. In controlling interest rates, the availability of continuous readings on rates makes it possible for the Manager to exercise very accurate control without understanding the causes of rate changes. Being in continuous contact with the market, the Manager can intervene with open market purchases or sales as soon as the Federal funds rate, the Treasury bill rate, or any other rate starts to change in an undesirable fashion. This feedback control is not exact since interest rate information arrives with some lag, and there are other lags such as the time required to decide upon and execute an open market transaction and the time it takes for the market to react to the transaction.

More precise control over interest rates could be achieved if the Manager were willing to announce Federal Reserve buying and selling prices for, say, 3-month Treasury bills available to all comers. This is essentially the way in which Government securities were pegged during World War II. In principle, there is no reason why such a peg could not be operated in peacetime, although it would certainly be desirable to change the peg frequently, perhaps as often as every day or even every hour. However, in terms of actual behavior of interest rates there is no significant difference between a frequently adjusted peg and continuous intervention by the Manager as described in the previous paragraph.

The main point of this discussion of interest rate control is to emphasize that with frequent interest rate readings it is not necessary to know exactly what causes interest rate changes. In time the Manager develops a feel for the market that enables him to guess accurately which interest rate changes are temporary and which are likely to be "permanent" and so require offsetting open market operations. Furthermore, his feel for the market will enable him to know how large the operations should be. Finally, when he guesses wrongly on these matters, his continuous contact with the market enables him to correct mistakes rapidly.

The same arguments apply to controlling the money stock. The difference between interest rate control and money stock control is a matter of degree rather than kind. Data on the money stock become available with a greater lag, and the data are more subject to revision. But since it is not necessary to control the money stock down to the last dollar, the question is whether it is technically possible to have control that is accurate enough for policy purposes. The answer to this question would certainly appear to be in the affirmative.

The weekly-average figure for the money stock is released to the public 8 days following the end of the week to which the average refers. Of course, data are available internally with a shorter lag. Since the policy rule in the previous section is based on controlling the monthly-average money stock, it would appear that the data are at the present time available with a short enough lag that feedback methods of control are feasible.

To see how feedback control would work, suppose that the Manager were instructed to come as close as possible to a target money stock of M_4* in week 4 of a 4-week operating horizon. The Manager knows that the weekly change in the money stock depends on open market purchases, *P*, which he controls, and many other factors as well, which for simplicity of exposition will be denoted by one factor, z. These factors cannot be predicted exactly, and so the Manager will think of z as consisting of a predictable part, $\hat{z}$, and an unpredictable part, u. These relationships may be expressed as

$$(5) \qquad \Delta M = \alpha P + z = \alpha P + \hat{z} + u$$

where α is the coefficient giving the change in money per dollar of open market purchases.

If there were no errors in measuring the money stock, the analysis could be completed on the basis of equation 5. But of course there are errors in measuring the money stock. To analyze the significance of measurement errors, let M_i be the money stock for week i as measured at the end of week i.[18] Also, let M_i^f be the final "true" money stock figure for week i, and let $e_i = M_i^f - M_i$.

The Manager starts out the 4-week period with an estimated money stock of M_0 for week zero. Of course, the figure for M_0 is a preliminary one, but revisions in this figure as more data accumulate will affect the estimates for the money stock in later weeks and so affect the Manager's actions in later weeks. It will be assumed that he wants to increase the money stock by equal amounts in each week to reach the desired figure of M_4^* in week 4. In week 1, therefore, he wants to produce a change in the money stock $\frac{1}{4}$ $(M_4^* - M_0)$. Substituting this figure into equation 5 we obtain

$$1/4\,(M_4^* - M_0) = \alpha P_1 + \hat{z}_1 + u_1$$

Thus, the Manager sets P_1 according to

$$(6) \qquad P_1 = \frac{1}{\alpha}\left[\frac{1}{4}(M_4^* - M_0) - \hat{z}_1\right]$$

At the end of the first week the Manager has the estimate, M_1, for the money stock for that week, and again it is assumed that he wants to spread the desired change $M^* - M_1$ equally over the next 3 weeks. Thus, the Manager sets P_2 according to

$$(7) \qquad P_2 = \frac{1}{\alpha}\left[\frac{1}{3}(M_4^* - M_1) - \hat{z}_2\right]$$

Similarly, he sets P_3 and P_4 according to equations 8 and 9.

$$(8) \qquad P_3 = \frac{1}{\alpha}\left[\frac{1}{2}(M_4^* - M_2) - \hat{z}_3\right]$$

$$(9) \qquad P_4 = \frac{1}{\alpha}[(M_4^* - M_3) - \hat{z}_4]$$

From equations 9 and 5 it can be seen that the actual money stock in week 4 is

$$(10) \quad M_4^f = M_3^f + M^* - M_3 - \hat{z}_4 + z = M_4^* + e_3 + u_4$$

This expression for the fourth week of a planning period generalizes to the nth week of a planning period of any length merely by replacing the subscript 4 by the subscript n. We can, therefore, express the annual rate of growth, g, over an n week period by

$$(11) \quad g = \frac{52}{n}\left(\frac{M_n^f - M_0^f}{M_0^f}\right) = \frac{52}{n}\left(\frac{M_n^* - M_0^f}{M_0^f}\right) + \frac{52}{n}(e_{n-1} + u_n)$$

From equation 11 it can be seen that the actual growth rate, g, equals the desired growth rate plus an error term that becomes smaller as n becomes larger.

This analysis shows that a feedback control system that continuously adjusts open market operations as data on the money stock in the recent past become available can achieve a target rate of growth with a margin of error that is smaller the longer the period over which the rate of growth is calculated. It also provides a framework in which to examine the relative importance of operating errors, the u_i, and data errors, the e_i.

[18] If a money stock estimate is not directly available at the end of week i, one can be constructed by taking the estimate from actual deposit data for week $i-1$ and adding to it a projection for the effects of open market operations and other factors for week i. This projection would, of course, come from equation 5.

To obtain an accurate estimate of the sizes of these errors is beyond the scope of this study. However, a very crude method may be used to obtain an estimate of the maximum size of the total error. Monthly money stock changes at annual rates were computed for the period January 1951 through September 1969 on the basis of seasonally adjusted data. This time period yields a total of 225 monthly changes. Then each monthly change was expressed in terms of its deviation from the average of the changes for the previous 3 months. For example, the September deviation was calculated by subtracting from the September monthly change the average of the changes for August, July, and June. The use of deviations allows in part for longer-run trends in the money stock, which trends are assumed to be readily controllable. Since the deviations were calculated over a period during which little or no attention was paid to controlling the money stock, they surely represent an upper limit to the degree of volatility in the money stock to be expected under a policy directed at control of the money stock.

These monthly deviations have a standard deviation of 3.12 per cent per annum. Applying equation 11, except for replacing 52 by 1 to reflect the fact that the rates of change were expressed at annual rates in the first place, it is found that the standard deviation over a 3-month period would be 1.04 per cent per annum. If it is assumed that these deviations are normally distributed, the conclusion is that over 3-month periods the actual growth rate would be within plus or minus 1.04 per cent of the desired growth rate about 68 per cent of the time, and would be within plus or minus 2.08 per cent about 95 per cent of the time. Inasmuch as these limits would be cut in half over 6-month periods, the actual growth rate 95 per cent of the time would be in the range of plus or minus 1.04 per cent of the desired growth rate.[19] When it is recalled that these calculations are based on an estimate of variability over a period in which very little attention was paid to stabilizing money stock growth rates, it is clear that fears as to the ability of the Federal Reserve to control the money stock accurately are completely unfounded.[20]

This conclusion justifies the approach used at the beginning of this section on the selection of a monetary aggregate, at least for the narrowly defined money stock and most probably for other aggregates as well. That approach, it will be recalled, analyzed the selection issue on the assumption that every one of the aggregates considered could be precisely controlled for all practical purposes. There can be no doubt that errors in reaching targets for goal variables such as GNP, at the present state of knowledge, are due almost entirely to incomplete knowledge of the relationships between instrument variables (such as various aggregates and interest rates) and the goal variables, and hardly at all to errors in setting instrument variables at desired levels.

Problems of data revisions and changing seasonality. Another topic that needs examination is the effect of data revisions. While weekly-average data are released with an 8-day lag, these figures are subject to revision. Not much weight can be given to early availability of data that are later revised substantially. To investigate this problem, two money stock series were compared, one "preliminary" and one

[19] If the calculations are based on the variability of the monthly changes themselves rather than on the deviations of the monthly changes, the results are not greatly changed. The standard deviation of the monthly changes over the same period used before is 3.53 per cent per annum, which yields a 95 per cent chance of the growth rate being in a range around the desired rate of plus or minus 2.36 (1.18) per cent per annum for 3-month (6-month) periods.

[20] Compare "First, however, it may be worthwhile to touch on the extensively debated subject whether the Federal Reserve, if it wanted to, could control the rate of money supply growth. In my view, this lies well within the power of the Federal Reserve to accomplish provided one does not require hair-splitting precision and is thinking in terms of a time span long enough to avoid the erratic, and largely meaningless, movements of money supply over short periods." [3, p. 75]

"final." Since the analysis below is based on published monthly data, it obviously provides little insight into the accuracy of weekly data. However, since policy instructions may be based on monthly data, the analysis is of some value in assessing data accuracy. Furthermore, the conclusions on the importance of revisions in seasonal factors can be expected to hold for the weekly data.

A "preliminary" series of monthly growth rates of the money stock was constructed by calculating the growth rate for each month from data reported in the Federal Reserve *Bulletin* for the following month. For example, the *Bulletin* dated September reports money stock data for 13 months through August; it is the annual rate of change of August over July that is called the "preliminary" August rate-of-change observation. The "final" series is the annual rate of growth calculated from the monthly money stock series covering 1947 through September 1969, reported in the Federal Reserve *Bulletin* for October 1969, pp. 790–93. Data were gathered on both a seasonally adjusted basis and an unadjusted basis for January 1961 through August 1969.

The correlation between the preliminary and final seasonally adjusted series is 0.767, while for the unadjusted series the correlation is 0.997. Another way to compare the preliminary and final series is to examine the differences in the two series.[21] For the seasonally adjusted data, the differences have a mean of 0.122 and a standard deviation of 3.704, and the mean absolute difference is 2.891. On the other hand, for the seasonally unadjusted data the differences have a mean of 0.150 and a standard deviation of 1.366, and the mean absolute difference is 0.955.[22]

These results make it abundantly clear that the major reason why the preliminary and final figures on the money stock differ is revision of seasonal adjustment factors. While such revisions may produce substantial differences between preliminary and final monthly growth rates, the differences must be lower for the average of several months' growth rates. The reason, of course, is that revision of seasonal factors must make the figures for some months higher and those for other months lower, leaving the annual average about unchanged.

The significance of revisions in seasonal factors can be understood only after a discussion of the significance of seasonality for a money stock rule. If the monetary rule were framed in terms of the seasonally unadjusted money stock, the result would be to introduce substantially more seasonality into short-term interest rates than now exists. It can be argued not only that greater seasonality in interest rates would not be harmful but also that it would be positively beneficial. Greater seasonality in interest rates would presumably tend to push production from busy, high-interest seasons into slack, low-interest seasons.

Although the argument for seasonality in interest rates could be pushed further, there is an important practical reason for not initially adopting a money rule stated in terms of the seasonally unadjusted money stock. The reason is that the rule ties the growth rate of the money stock to the seasonally adjusted unemployment rate and to the interest rate. The rule has been developed through an examination of past experience. If the seasonal were taken out of the money stock, a different seasonal would be put into interest rates, and pos-

[21] The analysis of the differences inadvertently runs from February 1961 through August 1969 while the correlation analysis runs from January 1961 through August 1969.

[22] To take account of the fact that the "final" money stock series may be further revised for months near the October 1969 publication date of this series, the analysis of differences between the preliminary and final series was also run on the period February 1961 through December 1968. The mean difference, the standard deviation of the differences, and the mean absolute difference, are, respectively, for the seasonally adjusted data 0.026, 3.779, and 2.922, while the figures for the seasonally unadjusted data are 0.038, 1.280, and 0.890. In spite of the fact that the "final" series is not really final for 1969 data, the average differences are generally larger for the longer period due to the relatively large data revisions in the middle of 1969.

sibly into the unemployment rate as well. Seasonal factors for these variables, especially for the unemployment rate, determined from past data would no longer be correct if the money stock seasonal were removed. Seasonally adjusting the unemployment index by the old factors could produce considerable uncertainty over the application of the monetary rule. Thus, application of the rule through the seasonally unadjusted money stock, if desirable at all, should only come about through gradual reduction rather than immediate elimination of seasonality. A further reason for a gradual approach would be to permit the financial markets to adjust more easily to changed seasonality.

The point of this discussion is not to urge acceptance of a rule framed in terms of the unadjusted money stock, since this step would not be initially desirable in any case. Rather, the point is to emphasize that seasonality is in the money stock only in order to reduce the seasonality of other variables, primarily interest rates. The seasonality of the money stock, unlike variables such as agricultural production, is not inherent in the workings of the economy but rather exists because the Federal Reserve wants it to exist. The money stock can be made to assume any seasonal pattern the Federal Reserve wants it to assume.

The monetary rule should be framed, at least initially, in terms of the seasonally adjusted money stock—using the latest estimated seasonal factors. In subsequent years changes in these seasonal factors should *not* result from mechanical application of seasonal adjustment techniques to the money stock data but rather should be the result of a deliberate policy choice. The policy choice would be based on the desire to change seasonality of other variables. For example, if it were thought desirable to take the seasonality out of short-term interest rates, the seasonal factors for the money stock would then be changed to take account of changes in tax dates and other factors.

Under a money stock policy, whether or not guided by a monetary rule, revised seasonal factors cannot properly be applied to past data. If the changes are applied to past data with the result that some monthly growth rates of adjusted data become relatively high while others become relatively low, the conclusion to be drawn is not that policy was mistaken as a result of using faulty seasonal factors. Instead, the conclusion is merely that seasonal policy differed in the past from current policy or from the seasonal pattern assumed by the investigator who computed the seasonal factors. Seasonal policy can be shown to be "wrong" only by showing that undesirable seasonals exist in other variables.

One final problem deserves discussion. While it appears from the analysis of seasonally unadjusted money stock data that revisions of the data are relatively unimportant, at least from the evidence for 1961–69, how should the policy rule be adjusted when there are major data revisions—as in the middle of 1969? For example, suppose that revisions indicate that monetary growth has been much higher than had been expected, and higher than was desirable. On the one hand, policy could ignore the past high rate of growth and simply maintain the current rate of growth of the revised series in the desired range. On the other hand, the policy could be to return the money stock to the level implied by applying the desired growth rate to the money stock in some past base period. The first alternative involves ratifying an undesirably high past rate of growth, while the second may involve a wrenching change in the money stock to return it to the desired growth path. The proper policy would no doubt have to be decided on a case-by-case basis. However, a useful presumption might be to adopt the second alternative, but to set as the base the money stock 6 months in the past and to return to the desired growth path over a period of several months.

Improving control over the money stock. The analysis above has shown that under present conditions the money stock can be controlled quite accurately. However, it should be emphasized that there are numerous possibilities for improving control. Although detailed treatment of this subject is beyond the scope of this study, a few very brief comments appear appropriate.

There are three basic methods for improving control. The first method is that of improving the data. The more quickly the deposit data are available, the more quickly undesirable movements in the money stock can be recognized and corrected. And the more accurate the deposit data, the fewer the mistakes caused by acting on erroneous information. It is clear that expenditures of money on expanding the number and coverage of deposit surveys and on more rapid processing of the raw survey data can improve deposit data.

The second method of improving control is through research, which increases our understanding of the forces making for changes in the money stock. For example, transfers between demand and time deposits might be more accurately predicted through research into the causes of such transfers.

The third method of improving control is through institutional changes. To reduce fluctuations in excess reserves and thereby achieve a more dependable relationship between total reserves and deposits, the Federal funds market might be improved by making possible transfers between the East and West Coasts after east coast banks are closed. Also helpful would be a change from lagged to contemporaneous reserve requirements. More radical reforms such as equalization of reserve requirements for city, country, and nonmember banks and elimination of reserve requirements on time deposits should also be considered.

V. SUMMARY

PURPOSES OF THE STUDY. The primary purpose of this study has been to argue that a major improvement in monetary policy would result through a systematic policy approach based on adjustments in the money stock. Equal emphasis has been placed on the "systematic" part and the "money stock" part of this approach. The analysis has proceeded first by showing why policy adjustments should be made through money stock adjustments, and second by showing how these policy adjustments might be systematically linked to the current business situation through a policy guideline or rule-of-thumb. A third, and subsidiary, part of this study is an analysis of the reasons for preferring the money stock over other monetary aggregates, and of some of the problems in reaching desired levels of the money stock.

It has been emphasized throughout that this policy approach is one that is justified for the intermediate-term future on the basis of knowledge now available. The specific recommendations are not intended to be good for all time. Indeed, the approach has been designed to encourage evaluation of the results so that the information obtained thereby can be incorporated into policy decisions in the future.

THE THEORY OF MONETARY POLICY UNDER UNCERTAINTY. Since policymakers have repeatedly emphasized the importance of uncertainty, it is necessary to analyze policy problems within a model that explicitly takes uncertainty into account. In particular, only within such a model is it possible to examine the important current issue of whether policy adjustments should proceed through interest rate or money stock changes.

A monetary policy operating through interest rate changes sets interest rates either through explicit pegging as was used in World War II or through open market operations directed toward the maintenance of rates in some desired range. Under such a policy the money stock is permitted to fluctuate to whatever extent is necessary to keep interest rates at the desired levels. On the other hand, a policy operating through money stock changes uses open market operations to set the money stock at its desired level while permitting interest rates to fluctuate freely.

If there were perfect knowledge of the relationships between the money stock and interest rates, the issue of money stock versus interest rates would be nonexistent. With perfect knowledge, changes in interest rates would be perfectly predictable on the basis of policy-induced changes in the money stock, and vice versa. It would, therefore, be a matter of preference or prejudice, but not of substance, whether policy operated through interest rates or the money stock.

To analyze the interest versus money issue, then, it is necessary to assume that there is a stochastic link between the two variables. And, of course, this is in fact the case. There are two fundamental reasons for the stochastic link. First, the demand for money depends not only on interest rates and the level of income but also on other factors, which are not well understood. As a result, the demand for money fluctuates in a random fashion even if income and interest are unchanged. If the stock of money is fixed by policy, these random demand fluctuations will force changes in interest and/or income in order to equate the amount demanded with the fixed supply.

The second source of disturbances between money and interest stems from disturbances in the relationship between expenditures—especially investment-type expenditures—and interest rates. Given an interest rate fixed by policy, these disturbances produce changes in income through the multiplier process, and these income changes in turn change the quantity of money demanded. With interest fixed by policy, the stock of money must change when the demand for money changes. On the other hand, if the money stock were fixed by policy, since the expenditure disturbance changes the relationship between income and interest, some change in the levels of income and/or interest would be necessary for the quantity of money demanded to equal the fixed stock.

Money stock and interest rate policies are clearly not equivalent in their effects, given that disturbances in money demand and in expenditures do occur. Since the effects of these policies are different, which policy to prefer depends on how the effects differ and on policy goals. At this level of abstraction, it is clearly appropriate to concentrate on the goals of full employment and price stability. Unfortunately, the formal model that has been worked out, which is examined carefully in Section I above, applies only to the goal of stabilizing income. If "income" is interpreted to mean "money income," then the goals of employment and price level stability are included but are combined in a crude fashion.

The basic differences in the effects of money stock and interest rate policies can be seen quite easily by examining extreme cases. Suppose first that there are no expenditure disturbances, so there is a perfectly predictable relationship between the interest rate and the level of income. In that case, a policy that sets the interest rate sets income, and policy-makers can choose the level of the interest rate to obtain the level of income desired. When the interest rate is set by policy, disturbances in the demand for money change the stock of money but not the level of income. On the other hand, if policy sets the money stock, then the money demand disturbances would affect interest and income leading to less satisfactory stabilization of income than would occur under an interest rate policy.

The other extreme case is that in which there are disturbances in expenditures but not in money demand. If policy sets the interest rate, expenditure disturbances will produce fluctuations in income. But if the money stock is fixed, these income fluctuations will be smaller. This point can be seen by considering a specific example such as a reduction in investment demand. This disturbance reduces income. But given an unchanged money demand function, with the fall in income, interest rates must fall so that the amount of money demanded will equal the fixed stock of money. The decline in the interest rate will stimulate investment expenditures, thus offsetting in part the impact on income of the initial decline in the investment demand function. With expenditures disturbances, then, to stabilize income, it is clearly better to follow a money stock policy than an interest rate policy.

The conclusion is that the money versus interest issue depends crucially on the relative importance of money demand and expenditures disturbances. It is especially important to note that nothing has been said about the size of the interest elasticity of the demand for money, or of the interest elasticity of investment demand. These coefficients, and others, determine the relative impacts of changes in money demand and in investment and government expenditures *when* the changes occur. The interest versus money issue does not depend on these matters, however, but only on the relative size and frequency of disturbances in the money demand and expenditures functions.[23]

The analysis above is modified in detail by considering possible interconnections between money demand and expenditures disturbances. It is also true that in general the optimal policy is not a pure interest or pure money stock policy, but a combination of the two. These matters, and a number of others, are discussed in Section I.

EVIDENCE ON RELATIVE MAGNITUDES OF REAL AND MONETARY DISTURBANCES. Resolution of the money versus interest issue depends on the relative size of real and monetary disturbances. Unfortunately, there is no completely satisfactory body of evidence on this matter. Indeed, because of the conceptual difficulties of designing empirical studies to investigate the issue, the evidence is unlikely to be fully satisfactory for some time to come. Nevertheless, by examining a number of different types of evidence, a substantial case can be built favoring the use of the money stock as the policy control variable.

Before discussing the evidence, it is necessary to define in more detail what is meant by "disturbance." Consider first a money demand disturbance. The demand for money depends on the levels of income and of interest rates, and on other variables. The simplest form of such a function uses GNP as the income variable, and one interest rate—say the Aaa corporate bond rate—and all other factors affecting the demand for money are treated as disturbances. To the extent possible, of course, these other factors should be allowed for, but for policy purposes these factors must be either continuously observable or predictable *in advance* so that policy may be adjusted to offset any undesirable effects on income of these other factors. Factors not predictable in advance must be treated as random disturbances.

Similarly, expenditures disturbances are defined as the deviations from a function linking income to the interest rate and other factors. These other factors would include items such as tax rates, government expenditures, strikes, and population changes. Again, for policy purposes these factors must be forecast, and so errors in the forecasts of these items must be included in the disturbance term. It is important to realize that the disturbances will be defined differently for scientific purposes *ex post* because the true values of government spending and so forth can be used in the functions once data on these items are available.

In the discussion of the theoretical issues above it was noted that an expenditure disturbance would have a larger impact on income under an interest rate policy than under a money stock policy. Simulation of the FR–MIT model provides the estimate that the impact on income of an expenditures disturbance, say in government spending, is over twice as large under an interest rate policy as under a money stock policy. An error in forecasting government spending, then, would lead to twice as large an error in income under an interest rate policy. Since there is no systematic record of forecasting errors for variables such as government spending and strikes, there is no way of producing evidence on the size of such forecasting errors. However, after listing the variables that must be forecast, as is done

[23] For a full understanding of this important point, the reader should refer to the analysis of Section I.

in Section II, it is difficult to avoid feeling that errors in forecasting are likely to be quite significant.

These real disturbances, including forecast errors in government expenditures, strikes, and so forth, must be compared with the disturbances in money demand. The reduced-form studies conducted by a number of investigators provide some evidence on this issue. These studies compare the relative predictive power of monetarist and Keynesian approaches in explaining fluctuations in income. From these studies the predictive power of both approaches appears about equal. However, the predictive power of the Keynesian approach relies on *ex post* observation of "autonomous" expenditures, and it is clear that these expenditures are subject to forecasting errors *ex ante* whereas the money stock can be controlled by policy.

The evidence from the reduced-form studies suggests that when forecast errors of autonomous expenditures are included in the disturbance term, the disturbances are larger on the real side than on the monetary side. There are many difficulties with the reduced-form approach and so these results must be interpreted cautiously. Nevertheless, the results cannot be ignored.

The final piece of evidence offered in Section II is a study by the author of the stability of the demand for money function over time. Using a very simple function relating the income velocity of money to the Aaa corporate bond rate, he found that a function fitted to quarterly data for 1947–60 also fits data for 1961–68 rather well. The reader interested in the precise meaning of "rather well" should turn to the technical discussion in Section II.

Evidence on relative stability is difficult to obtain and subject to varying interpretations. No single piece of evidence is decisive, but all the various scraps point in the same direction. The evidence is not such that a reasonable man can say that he has no doubts whatsoever. But since policy decisions cannot be avoided, the reasonable decision based on the available evidence is to adopt the money stock as the monetary policy control variable.

A MONETARY RULE FOR GUIDING POLICY. The conclusion from the theoretical and empirical analysis is that the money stock ought to be the policy control variable. For this conclusion to be very useful, it must be shown in detail how the money stock ought to be used. It is not enough simply to urge policy-makers to make the "appropriate" adjustments in the money stock in the light of all "relevant" information.

There is no general agreement on exactly what types of adjustments are appropriate. However, it would probably be possible to obtain agreement among most economists that ordinarily the money stock should not grow faster than its long-run average rate during a period of inflation and should not grow slower than its long-run average rate during recession. But many economists would want to qualify even this weak statement by saying that there may at times be special circumstances requiring departures from the implied guideline. Others would say that there is no hope at present of gauging correctly the impact of special circumstances (or even of "standard" circumstances) so that policy should maintain an absolutely steady rate of growth of the money stock.

The basic issues are, first, whether policy-makers can forecast disturbances well enough to adjust policy to offset them, and second, the extent to which money stock adjustments to offset short-run disturbances will cause undesirable longer-run changes in income and other variables. The theoretical possibilities are many, but the empirical knowledge does not exist to determine which theoretical cases are important in practice. It is for this reason that a systematic policy approach is needed so that policy can be easily evaluated and improved with experience.

Policy could be linked in a systematic way to a large-scale model of the economy. Target values of GNP and other goal variables could be selected by policy-makers, and then the model solved for the values of the money stock and other control variables (for example, discount rate) needed to achieve policy goals. While this approach may be feasible in the future, it is not feasible now because a sufficiently accurate model does not exist. Instead, policy decisions are now made largely on the basis of intuitive reactions to current business developments.

Given this situation, the obvious approach is to specify precisely how policy decisions ought to depend on current developments, and this is the approach taken in Section III. The specification there takes the form of a policy guideline, or rule-of-thumb. The proposed rule is purposely simple so that evaluation of its merits would be relatively easy. Routine evaluation of an operating guideline would over time produce a body of evidence that could be used to modify and complicate the rule. But it is necessary to begin with a simple rule because the knowledge that would be necessary to construct a sophisticated rule does not exist.

The proposed rule assumes that full employment exists when the unemployment rate is in the 4.0 to 4.4 per cent range. The rule also assumes that at full employment, a growth rate of the money stock of 3 to 5 per cent per annum is consistent with price stability. Therefore, when unemployment is in the full employment range, the rule calls for monetary growth at the 3 to 5 per cent rate.

The rule calls for higher monetary growth when unemployment is higher, and lower monetary growth when unemployment is lower. Furthermore, when unemployment is relatively high the rule calls for a policy of pushing the Treasury bill rate down provided monetary growth is maintained in the specified range; similarly, when unemployment is relatively low the rule calls for a policy of pushing the bill rate up provided monetary growth is in the specified range. Finally, the rule provides for adjusting the rate of growth of money according to movements in the Treasury bill rate in the recent past. The exact rule proposed is in Table 3 (p. 160) and the detailed rationale for the various components of the rule is explained in the discussion accompanying that table.

The rule is specified throughout in terms of 2 per cent ranges for the rate of growth of the money stock on a month-by-month basis. By expressing the rule in terms of a range, leeway is provided for smoothing undesirable interest rate fluctuations and for minor policy adjustments in response to other information. Furthermore, it is not proposed that this rule-of-thumb or guideline be followed if there is good reason for a departure. But departures should be justified by evidence and not be based on vague intuitive feelings of what is needed since the rule was carefully designed from the theoretical and empirical analysis of Sections I and II, and from a careful review of post-accord policy.

There is no way of really testing the proposed rule short of actually using it. However, it is useful to compare the rule with post-accord policy. A detailed comparison may be found in Section III, pp. 153–57. A summary comparison suggests, however, that for the period January 1952 through July 1968 the rule would have provided a less appropriate policy than the actual policy in only 63 of the 199 months in the period. The rule was judged to be less appropriate if it called for a higher—lower—rate of monetary growth than actually occurred and unemployment 12 months hence was below—above—the desired range of 4.0 to 4.4 per cent. The rule was also judged less appropriate than the actual policy if actual policy was not within the rule but unemployment nevertheless was in the desired range 12 months hence. The rule actually has slightly fewer errors if the criterion is unemployment either 6 or 9 months following the months in question.

The rule has the great virtue of turning policy around promptly as imbalances develop and of avoiding cases such as the 2.2 per cent rate of decline in the money stock from July 1957 through January 1958, during which time the unemployment rate rose from 4.2 per cent to 5.8 per cent. Furthermore, it seems most unlikely that the rule would produce greater instability than the policy actually followed. Actual policy has, as measured by the money stock, been most expansionary during the early and middle stages of business cycle expansions and most contractionary during the last stages of business expansions and early stages of business contractions. Unless a very improbable lag structure exists, the rule would surely be more stabilizing than the actual historical pattern of monetary growth.

SELECTION AND CONTROL OF A MONETARY AGGREGATE. The analysis in this study is almost entirely in terms of the narrowly defined money stock. The reasons for using the narrowly defined money stock as opposed to other monetary aggregates may be stated fairly simply.

Some economists favor the use of bank credit as the monetary aggregate because they view policy as operating through changes in the cost and availability of credit. The major difficulty with this view is that there is no unambiguous way of defining the amount of credit in the economy. And even if a satisfactory definition could be worked out, there is no current possibility of obtaining timely data on the total amount of credit or of controlling the total amount.

The definitional problem arises largely from the activities of financial intermediaries. Suppose, for example, that an individual sells some corporate debentures and invests the proceeds in a fixed-income type of investment fund, which in turn uses the funds to buy the very same debentures sold by the individual. If both the debentures and the investment fund shares are counted as part of total credit, then in this example total credit has risen without any additional funds being made available to the corporation to finance new facilities and so forth.

As another example, it is difficult to see that it would make any substantial difference to aggregate economic activity whether a corporation financed inventories through sales of commercial paper to the public or through borrowing from banks that raised funds through sales of CD's to the public. Since there are numerous close substitutes for bank credit, the amount of bank credit is most unlikely to be an appropriate figure to emphasize. Furthermore, since bank credit is only a small part of total credit there is essentially no possibility of controlling total credit, however defined, through adjustments in bank credit.

Ultimately the issue again becomes that of the stability of various functions. If the demand and supply functions for all of the various credit instruments, including those of financial intermediaries, were stable and were known, then it would be possible to focus on any aggregate that was convenient. For if all the functions were known, then there would be known relationships among various credit instruments, the money stock, and stocks and flows of goods. But the demand and supply functions for the various credit instruments are not known, and it is unlikely that they ever will be known with any degree of precision. There are two basic reasons for this state of affairs. The first, and less important, is that given the great degree of substitutability among credit instruments, substitutions are constantly taking place as a result of changes in regulations, including tax regulations. But second and more important, individual credit instruments are greatly influenced by changes in tastes and technology, factors that economists do not understand well.

As an example of the effects of regulations, consider the substitution in recent years of debentures for preferred stock as a result of the tax laws permitting deduction of interest. As examples of the effects of changes in tastes and technology, consider the inventions of new instruments such as CD's and the shares in dual-purpose investment funds. Furthermore, the relationships among credit instruments will change as attitudes toward risk change due to numerous factors including perhaps fading memories of the last recession or depression.

Money viewed as the medium of exchange

seems to be substantially less subject to changes in tastes and technology than do other financial assets. Of course, money is not immune to these problems, as shown by the uncertainty presently existing over the impact of credit cards. But a great deal of empirical work on money has been completed and the major findings have been substantiated by a number of different investigators. And the interpretation of the empirical findings is usually clear because the empirical work has been conducted within the framework of a well-developed theory of money. There is, on the other hand, no satisfactory theory of bank credit to guide empirical work and to permit interpretation of the significance of empirical findings.

For these reasons, and others, bank credit does not appear to be an appropriate monetary aggregate for policy to control. However, because bank credit and the money stock were so highly correlated in the past, it must be admitted that it probably would not have made much difference which one was used. From recent experience, however, it appears that changes in banks' nondeposit sources of funds are likely to become more, rather than less, important, and so in the future the correlation between money and bank credit is likely to be lower than in the past. If this prediction is correct, then the issue is a significant one.

As a monetary aggregate, to be used for policy adjustments, the money stock has clear advantages over the monetary base and various reserve measures. These aggregates are almost always examined in adjusted form, where the adjustments allow for such factors as changes in the currency/deposit ratio, in reserve requirements, and in shifts between time and demand deposits. The adjustments are made because the effects of these various factors are understood and are thought to be worth offsetting. The adjustments have the effect of making the base an almost constant fraction of the money stock, or making total reserves an almost constant fraction of demand deposits. It obviously makes more sense to look directly at the money stock, especially since given the nature of the adjustments it is no easier to control the adjusted base or adjusted total reserves than to control the money stock.

The final aggregate to be considered is the broadly defined money stock—the narrow stock plus time deposits. No strong case can be made against the broad money stock. From existing empirical work both definitions of money appear to work equally well. The theoretical distinction between demand deposits and passbook savings deposits depends on the costs of transferring between the two types of deposits, and these costs appear to be quite low. However, CD's do appear to be theoretically different and probably should be excluded from the definition of money. The major reason for excluding all time deposits from the definition is that in the future banks may invent new instruments that will be classified as time deposits for regulatory purposes but for which the matter of definition as money may not be at all clear.

The issue of controllability is a technical one and need not be discussed carefully in this summary. However, two conclusions may be stated. First, instructions from the FOMC to the Manager of the Open Market Account should take the form of a specified average weekly change in the money stock over the period between FOMC meetings. Such an instruction must be distinguished from one in terms of the average level of the money stock over the period between FOMC meetings. The average-level specification has several technical difficulties and should be avoided.

The second conclusion is that it is possible to control the rate of growth of the money stock over a 3-month period in a range of 1 per cent on either side of a desired rate of growth. This conclusion is based on an analysis of monthly changes in the money stock over the 1951–68 period, a period during which little or no attention was paid to stabilizing monetary growth, and it takes the historical record at face value. Assuming that efforts to control the money stock would in fact succeed in part rather than make money growth less stable than in the past, the estimate of plus or minus 1 per cent is an upper limit to the errors in controlling the growth rate of money over 6-month periods.

CONCLUDING REMARKS. The orientation throughout this study has been the redirection of monetary policy on the basis of currently available theory and evidence. The recommendations are not utopian; in the author's view they are supported by current knowledge and are operationally feasible. The approach has been in terms of what ought to be done in the near future, rather than in terms of what might be done eventually if enough information accumulates.

No effort has been made to slide over gaps in our knowledge; rather, the emphasis has been on how policy should be formed given the huge gaps in our knowledge. Indeed, it is precisely these gaps in our knowledge that lead to the conclusion favoring policy adjustments through the money stock.

It is the contention of this study that policy can be improved if there is explicit recognition of the importance of uncertainty. As much attention should be given to the consequences of errors in projections as to the projections themselves. Policy may be improved more by "don't know" answers to questions than by projections believed by no one.

This is the static view. If policy can be improved now through greater attention to uncertainty, in the long run it can be improved further only through a reduction in uncertainty. This longer view underlies the proposal for a policy rule-of-thumb. Policy successes and failures ought to be incorporated into a policy design in a form that will repeat the successes and prevent the recurrence of the failures. Policy-making will always require judgment, but the judgment will be applied to changing problems at a moving frontier of knowledge. A systematic formulation of policy will speed the accumulation of knowledge so that the policy problems of today will become the technical staff problems of tomorrow.

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APPENDIX: MONETARY AGGREGATES AND MONEY MARKET CONDITIONS IN OPEN MARKET POLICY

CONTENTS

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Monetary Aggregates and Money Market Conditions in Open Market Policy

THERE HAS BEEN WIDESPREAD discussion over the past year or so about the emphasis given to monetary and credit aggregates, as compared with traditional operating variables such as money market conditions, in the formulation and conduct of the Federal Reserve System's open market policy. This article discusses the role—in the decision-making process of the Federal Open Market Committee (FOMC)[1] and in the day-to-day conduct of Federal Reserve open market operations—of aggregates such as the money supply and bank credit, in comparison with other financial variables. Such aggregates, of course, represent only a few of the many financial variables, including interest rates and credit flows through nonbank institutions and the market directly, that are evaluated in monetary policy decisions and their implementation. And financial conditions as a whole are evaluated against the underlying purpose of monetary policy—the encouragement of a healthily functioning economy, both domestically and in relation to the rest of the world.

The policy decisions of the FOMC are based on a full-scale evaluation by Committee members of likely tendencies in critical

[1] The Federal Open Market Committee is the statutory body responsible for open market operations (purchase and sale of U.S. Government securities in the open market), the most flexible and frequently used instrument by which monetary policy affects bank reserves, bank credit, money supply, and ultimately over-all credit conditions. The FOMC consists of the seven members of the Board of Governors of the Federal Reserve System, the President of the Federal Reserve Bank of New York, and four of the remaining 11 Reserve Bank presidents serving in rotation. The Chairman of the Board of Governors has traditionally been elected by the Committee to serve as Chairman of the Open Market Committee, and the President of the Federal Reserve Bank of New York has traditionally been elected Vice-Chairman.

measures of economic performance such as output, employment, prices, and the balance of payments. In deciding on the stance of monetary policy, the Committee considers whether these tendencies in domestic economic activity and the balance of payments appear desirable, and if not, how they might be influenced by changes in financial conditions—including the pace of monetary expansion, credit availability, interest rates—and by expectational factors. Once a general policy stance is adopted, guidelines are set for the day-to-day conduct of operations in the open market. During 1970 somewhat more emphasis was placed on the behavior of monetary aggregates—such as the money supply and bank credit—in providing guidance for the day-to-day conduct of open market operations.

Since it has always been recognized that the effect of monetary policy stems from its influence on bank credit, money, interest rates, and financial flows generally, the greater emphasis placed on monetary aggregates basically represented a modification of operating procedures rather than a change in the fundamental objective of policy. Under conditions of uncertainty—for example, uncertainty about the impact on interest rates of expectational factors or about the strength of future demands for goods and services—some emphasis on the aggregates helps to guard against the risk that open market operations might in the end supply either too large or too small amounts of bank reserves, credit, and money as a result of unexpected and undesired shifts in demands for goods and services and for credit.

At the same time, however, an approach that utilizes aggregates as one operating guide must take account of shifts in the demand for money and liquidity at given levels of income. Such shifts would have to be accommodated through open market operations in order to help provide the money and liquidity demanded if interest rates and credit conditions generally were not to become unduly tight or easy. Thus, the longer-run path for monetary aggregates needs to be evaluated in relation to emerging credit conditions and tendencies in economic activity, to help determine if demands for liquidity have been properly assessed. And whatever longer-run path for the aggregates may be included as guidance for open market operations, short-run, self-correcting variations in money and credit demands need to be accommodated in order to avoid inducing unnecessary, and possibly destabilizing, fluctuations in money market conditions.

In practice, allowance has to be made—in the formulation of monetary policy and in the guides to the conduct of policy—for uncertainties with respect to both the demand for goods and the demand for money and liquidity. And trends in monetary aggregates, interest rates, and other financial variables have to be evaluated in relation to the continuing flow of evidence as to the likely course of economic activity.

DIRECTIVES OF THE FOMC

The monetary policy decisions of the FOMC—which in recent years has generally met about every 4 weeks—are embodied in the Committee's current economic policy directive, voted on near the end of each meeting. This directive is issued to the Federal Reserve Bank of New York, which, because it is located in the Nation's central money and credit market, undertakes open market operations for the Federal Reserve System. The directive is carried out by a senior officer of the Bank, who is designated by the FOMC as Manager of the System Open Market Account.

Both the form and the content of the FOMC directive have changed over the years. Since 1961 the directive has contained two paragraphs. The first paragraph has contained statements about recent key economic and financial developments, and also a general statement of current goals of the FOMC with respect to economic growth, price stability, and the balance of payments.[2] The second paragraph contains the FOMC's instructions to the Account Manager for guiding open market operations in the interval between FOMC meetings. The second paragraph is,

[2] For illustrative purposes the first paragraph of the directive issued on Dec. 16, 1969, is quoted below:

"The information reviewed at this meeting indicates that real economic activity has expanded only moderately in recent quarters and that a further slowing of growth appears to be in process. Prices and costs, however, are continuing to rise at a rapid pace. Most market interest rates have advanced further in recent weeks partly as a result of expectational factors, including concern about the outlook for fiscal policy. Bank credit rose rapidly in November after declining on average in October, while the money supply increased moderately over the 2-month period; in the third quarter, bank credit had declined on balance and the money supply was about unchanged. The net contraction of outstanding large-denomination CD's has slowed markedly since late summer, apparently reflecting mainly an increase in foreign official time deposits. However, flows of consumer-type time and savings funds at banks and nonbank thrift institutions have remained weak, and there is considerable market concern about the potential size of net outflows expected around the year-end. In November the balance of payments deficit on the liquidity basis diminished further and the official settlements balance reverted to surplus, mainly as a result of return flows out of the German mark and renewed borrowing by U.S. banks from their foreign branches. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to the reduction of inflationary pressures, with a view to encouraging sustainable economic growth and attaining reasonable equilibrium in the country's balance of payments."

in essence, a highly condensed summary of the Committee's discussion and conclusions as to the sort of operations that will be required to reach its longer-run policy goals. These directives are made public after a 3-month lag in a "record of policy actions," which also includes a résumé of prevailing economic and financial conditions and of the Committee's discussion of policy implications at the meeting.

The nature of the operating instructions in the second paragraph of the directive has changed from time to time. Money market conditions have remained as important guides in determining day-to-day open market activity. Though emphasis on various money market indicators has varied over the years in light of changing economic and financial circumstances, money market conditions have generally been construed to include member bank borrowings at the Federal Reserve discount window, the net reserve position of member banks (excess reserves of banks less borrowings from the Federal Reserve), the interest rate on Federal funds (essentially reserve balances of banks that are made available to other banks, usually on an overnight basis), and at times the 3-month Treasury bill rate.

At times when it was framing the operating instructions contained in the second paragraph of its directive solely in terms of money market conditions, the FOMC was nevertheless concerned with developments in monetary aggregates and financial conditions generally as they affect the broad objectives of policy. Beginning in 1966, the Committee supplemented the reference to money market conditions in the second paragraph with a reference to certain monetary aggregates, such as bank credit, and later the money supply.[3] The desired behavior of aggregates has been given increased emphasis since early 1970.

From mid-1966 through 1969 the reference to aggregates was generally to bank credit and was contained in a so-called proviso clause. The second paragraph of the directive issued on December 16, 1969, is illustrative:

"To implement this policy, System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining the prevailing firm conditions in the money market; provided, however, that operations shall be modified if bank credit appears to be deviating significantly from current projections or if unusual liquidity pressures should develop."

[3] There was also occasional reference to such aggregates in directives during the first half of the 1960's.

In 1970 monetary aggregates came to play a more prominent role in the phrasing of the second paragraph, and references were made to the money supply as well as to bank credit. In the directive issued on March 10, 1970, the Committee stated more directly its desires with respect to the aggregates rather than referring to them in the form of a proviso clause. The second paragraph of the directive of that date read as follows:

"To implement this policy, the Committee desires to see moderate growth in money and bank credit over the months ahead. System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining money market conditions consistent with that objective."

The operating instructions in the second paragraphs of FOMC directives are not confined to money market conditions and a desired pattern of behavior in the monetary aggregates. The System Account Manager has also been directed, when appropriate, to take account of Treasury financings, liquidity pressures, and the possible impacts of bank regulatory changes in the process of achieving satisfactory conditions in the money market and satisfactory performance of monetary aggregates.

As the nature of economic and financial problems has altered, so has the phrasing of the second paragraph of the directive. For instance, the second paragraph of the directive issued on May 26, 1970, emphasized the need to moderate pressures on financial markets; it read as follows:

"To implement this policy, in view of current market uncertainties and liquidity strains, open market operations until the next meeting of the Committee shall be conducted with a view to moderating pressures on financial markets, while, to the extent compatible therewith, maintaining bank reserves and money market conditions consistent with the Committee's longer-run objectives of moderate growth in money and bank credit."

The short-run bulge in bank credit expansion expected to result from the Board's action around midyear in suspending ceilings on maximum interest rates payable by banks on large certificates of deposit in the 30- to 89-day maturity range was taken into consideration in the phrasing of the second paragraph of the directive issued by the FOMC on July 21, 1970:

"To implement this policy, while taking account of persisting market uncertainties, liquidity strains, and the forthcoming Treasury financing, the Committee seeks to promote moderate growth in money and bank credit over the months ahead, allowing for a possible continued shift of credit flows from market to banking channels. System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining bank reserves and money market conditions consistent with that objective; provided, however, that operations shall be modified as needed to counter excessive pressures in financial markets should they develop."

And in the directive issued on August 18, 1970, an easing of conditions in credit markets was taken as an objective of open market operations parallel with desires with respect to monetary aggregates, as follows:

"To implement this policy, the Committee seeks to promote some easing of conditions in credit markets and somewhat greater growth in money over the months ahead than occurred in the second quarter, while taking account of possible liquidity problems and allowing bank credit growth to reflect any continued shift of credit flows from market to banking channels. System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining bank reserves and money market conditions consistent with that objective, taking account of the effects of other monetary policy actions."

The first and second paragraphs of all directives issued from December 16, 1969, through December 15, 1970, are shown in the appendix to indicate the variety of considerations that the FOMC takes into account in formulating its policy and framing its operating instructions.

POLICY FORMATION

The FOMC's basic concern is with the real economy—production, employment, prices, and the balance of payments. But the Committee must translate its broader economic goals into the monetary and credit variables over which the Federal Reserve has a direct influence. Thus, whatever emphasis is given to the financial variables that influence day-to-day open market operations, it is recognized that the immediate targets of day-to-day operations are not the goals of monetary policy, but rather that those targets are set with a view to facilitating the achievement of the broader financial and economic objectives of the FOMC.

In setting its immediate operating targets, the FOMC necessarily reviews past and prospective relationships between financial conditions and economic objectives. A benchmark in this review is provided several times a year in a presentation by the staff to the Committee of an interrelated set of longer-run economic and financial projections. These exercises review in detail recent economic and financial developments, assess the outlook for and impact of fiscal policy, and trace the likely patterns of change in such measures as income, output, employment, prices, and the balance of payments for a period of about a year ahead. Provisional estimates are also presented of the flow of funds—including various monetary aggregates—and interest rates expected to be consistent with these patterns of economic development. A reappraisal of current tendencies in and prospects for economic activity, financial flows and credit market conditions, and the balance of payments is presented to the FOMC by the staff on the occasion of each meeting. Included in the regular documentation is an analysis of relationships among money market variables, paths for monetary aggregates, and interest rates broadly considered for a period several months ahead.

At each FOMC meeting, most of the time is given over to a free interchange of views by Committee members of their assessment of the current economic situation and outlook and of the related appropriate monetary policies. As the discussion proceeds, each Committee member indicates his assessment of the basic tendencies in economic activity, prices, employment, and so forth; his appraisal of recent financial developments in relation to desired economic goals; and what steps might be taken through open market operations (or other policy instruments that interact with open market operations) to help achieve financial conditions suitable to economic goals.

It may develop, for instance, that most or all Committee members believe that economic prospects are deviating from those that had previously been expected and desired. If so, the Committee may wish to modify its objectives concerning money market conditions and desired rates of expansion in monetary and credit aggregates, so as to promote over-all financial and credit conditions that are more conducive to desired economic conditions. Or it may turn out that economic activity is developing about in line with expectations but seems to be entailing a pattern of financial flows different from that originally expected. Still another possibility is that the relationship that is developing between the variables specified for the System Account Manager for purposes of guiding day-to-day open market operations and broader financial flows and interest rates is not what was expected. Under any of such circumstances, the FOMC could react by changing its operating instructions.

The operating instructions in the second paragraph of the directive are expressed qualitatively. But the specific variables involved—money market conditions and monetary and credit aggregates—are typically indicated in terms of ranges in the discussion.

Over the past year the operating instructions embodying the Committee's policy thrust have changed in two general ways. First, as has been noted, somewhat more emphasis has been placed on monetary aggregates as a target for open market operations rather than as an outgrowth of such operations. Second, the time horizon for a path of monetary and credit aggregates (in relation to money market conditions and other financial variables) has been viewed as encompassing several months or, expressed in calendar quarters, at least one or two quarters ahead. Longer-run paths provide the Committee with a means for focusing on the emerging trend of growth in the money supply or in bank credit, while recognizing that, over very short-run periods of a week or a month or so, there may be irregular movements in rates of change in monetary aggregates because of erratic shifts in the public's demand for deposits and such factors as Treasury financings, a large change in U.S. Government deposits, or movements of funds between the U.S. and foreign countries.

ROLE OF MONETARY AGGREGATES

The somewhat greater use of monetary aggregates in the formulation and conduct of open market policy during the past year represents for the most part an extension of the trend of policy over the previous several years. It has always been recognized that monetary policy achieves its effects through its influence on bank credit, money supply, interest rates, and financial flows generally. But the benefits that might be expected from an increased degree of emphasis on monetary aggregates in the conduct of open market operations relate to the question of monetary control under conditions of uncertainty.

Greater emphasis on aggregates is consistent with a variety of economic theories, and it does not necessarily imply any particular judgment as to the importance for the economy of monetary flows relative to interest rates and credit conditions or relative to other influences such as fiscal policy and technological innovation. Operationally, however, by placing more emphasis on monetary aggregates in the instructions to the Account Manager, the FOMC has a greater assurance that unexpected and undesired shortfalls or excesses in the demands for goods and services in the economy, and hence in the demands for credit and money, will not lead more or less automatically to too little or too much expansion in bank reserves, bank credit, and money.

Giving more weight to monetary aggregates means, for example, that if there were an unexpected and undesired shortfall in business and consumer demand for goods and services, the Federal Reserve would continue to provide reserves to try to keep growth in money and bank credit from weakening unduly at a time when the public, with transactions demand for cash reduced, was seeking to invest excess funds in various financial assets. In the process, there would be a greater short-run decline in interest rates than would otherwise be the case. The drop in interest rates and the easing of credit conditions would help to provide financial incentives that would encourage a strengthening of demands for goods and services.

While increasing the emphasis on monetary and credit aggregates tends to increase the protection against undesired shifts in demands for goods and services, it at the same time runs the risk of reducing protection against unexpected shifts in the public's demand for cash and liquidity. Thus, for example, if the public decides to hold more liquidity relative to income than had been earlier assumed, failure to permit a faster rise in the money supply to accommodate this desire would lead to higher interest rates and tighter credit conditions as the public seeks to sell other assets to acquire cash. The tightening of credit conditions would tend to lead to a weaker GNP than desired. In contrast, the tendency toward tighter conditions could be averted if the Federal Reserve helped to meet the desire for greater liquidity by increasing its purchases of financial assets (through open market acquisitions of U.S. Government securities)—thereby providing more bank reserves to support an increase in bank deposits and in the money supply and to keep interest rates from rising.

In practice, allowance has to be made for uncertainties about both the demand for goods and services and the demand for money and liquidity. Opinions differ among professional economists as to the relative degrees of stability of these types of demand, and practical experience over the past several years suggests that there is a good deal of variation in both. There have been periods when large increases in Federal Government purchases of goods and services and/or in private sector demands for capital goods and inventories have caused marked shifts in over-all demands for goods and services at given interest rates. But there have also been periods when liquidity strains, greatly increased financial transactions, and various international uncertainties have resulted in a sizable upward shift in the demand for cash and closely related assets at given interest rates. Furthermore, open market policy not only needs to distinguish between, and take account of, shifts in both the demand for goods and services and the demand for money and liquidity at given interest rates, but also must evaluate the extent to which such shifts are transitory or more permanent.

The late spring and the summer of 1970 are an example of a period when liquidity strains in the economy—typified by rising long-term interest rates at a time when economic activity was sluggish, by the bankruptcy of a major railroad, and by a generally cautionary attitude on the part of investors toward securities, particularly commercial paper—were giving rise to considerable uncertainty and were threatening a marked erosion in confidence. Under those circumstances Federal Reserve policy stressed the need to moderate pressures on financial markets and to accommodate liquidity needs.

In late June the Board of Governors suspended maximum ceiling rates on large CD's maturing in 30- to 89-days as part of the effort to reliquify the economy. This action made it possible for banks to compete for funds and to accommodate borrowers who were not able, in the conditions of the time, to refinance their borrowings in the commercial paper market, or were not able to do so without a bank loan commitment as back-up. And open market operations during the period were conducted in such a way as to provide the reserves to sustain the very large increase in bank credit resulting from renewed ability of banks to obtain funds through issuance of certain large CD's. The FOMC's policy directives in that period (see directives of May 26 and July 21, 1970, on pp. 99 and 100) tended to subordinate, temporarily, longer-run objectives for monetary aggregates to the shorter-run liquidity needs of the economy.

In general, in evaluating the appropriateness of particular operating guidelines at a particular time, the FOMC has to make judgments about the nature of the fundamental influences that are affecting the domestic economy and the international position of the dollar. If, for example, it developed that interest rates were higher, and over-all credit conditions tighter, than expected for a given rate of increase in bank credit or money, the FOMC would have to make a judgment as to whether GNP was stronger than anticipated, whether inflationary expectations were affecting interest rates, or whether the demands for money and closely related assets had shifted at given levels of income and interest rates. Or, as another example, interest rate movements might be undesirably affecting capital flows between the United States and foreign countries; in this case judgments might have to be made as to how the various policy instruments could be adapted to such a development.

Judgments made with respect to interrelationships among policy objectives would affect not only the open market policy instrument but also other monetary policy instruments. With respect to open market policy, types of adjustments called for in operating instructions would include, for instance, whether to change the targets for aggregates and/or whether to put more stress on money or credit market conditions. Or adjustments might be called for in other policy instruments—such as the discount rate or reserve requirements, including provisions such as those recently made affecting Euro-dollar borrowings of U.S. banks—in order to achieve a variety of policy objectives more effectively.

In looking toward a desired longer-run growth rate in monetary aggregates, the FOMC has focused on money and bank credit in its operating instructions. The concept of money used for these purposes has generally been the so-called narrowly defined money supply—currency in circulation outside the banking system plus demand deposits other than U.S. Government and domestic interbank deposits—but broader definitions have also been taken into account. The determination of what rates of growth may be desired for money takes into account not only what is happening in credit markets but also the rates of growth in certain types of assets held by the public that are closely related to narrowly defined money and that the public holds as a store of value and as a source of immediate liquidity.

A number of broader concepts of the money supply and of liquidity have been utilized by economic analysts in relating money supply to economic activity. These include, in addition to the narrowly defined money supply, a concept—here termed M_2—that adds time and savings deposits other than large CD's at commercial banks to narrowly defined money; and a concept, termed M_3, that adds deposits at both mutual savings banks and savings and loan associations. And even these concepts can be broadened by adding other money-like assets, such as large marketable negotiable CD's issued by banks and other short-term marketable securities. Annual, quarterly, and monthly rates of change over the past year in the three concepts of money noted above are shown in the table below.

VARIOUS MEASURES OF MONEY: RATES OF CHANGE

Seasonally adjusted annual rates, in per cent

Period	M_1 (Currency plus demand deposits[1])	M_2 (M_1 plus coml. bank time deposits other than large CD's)	M_3 (M_2 plus deposits at S&L's and mutual savings banks)
1969	3.1	2.4	2.8
1970	5.4	8.2	7.9
1970—Q1	5.9	3.4	2.6
Q2	5.8	8.4	7.9
Q3	6.1	11.0	10.5
Q4	3.4	9.2	9.7
1970—January	9.4	2.2	1.2
February	−4.1	−1.5	−1.2
March	12.3	9.6	7.8
April	9.9	10.8	9.7
May	5.2	7.6	7.2
June	2.3	6.7	6.6
July	5.7	9.9	9.9
August	6.8	12.5	11.4
September	5.7	10.3	10.0
October	1.1	7.3	8.1
November	2.8	7.0	8.1
December	6.2	13.0	12.6

[1] Demand deposits other than interbank and U.S. Govt.

NOTE.—Monthly rates of change based on the daily-average levels outstanding. Quarterly and annual rates of changes measured from daily-average levels outstanding in end-of-period months.

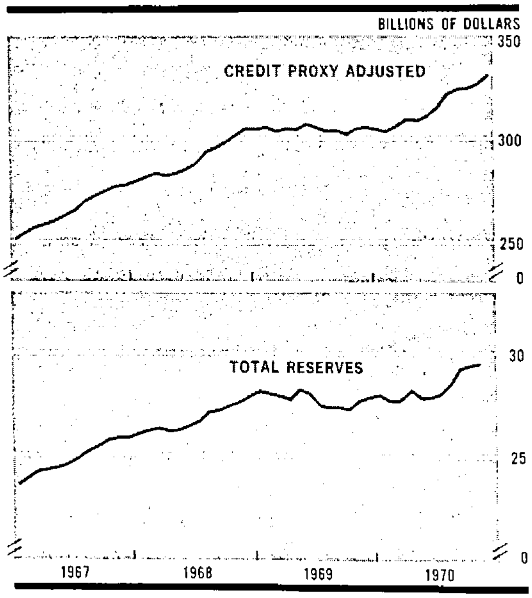
As may be seen, the rates of change for the various measures may diverge noticeably, and they may show a high degree of fluctuation over the short run. Differential tendencies in the various measures of money and liquidity have been the result in large part of sharp shifts of funds by the public between deposits and market securities when market interest rates moved above and then back below ceiling rates on deposits at banks and thrift institutions. But divergent movements, particularly in the short run, may develop even when ceiling rates are not a disturbing element. This highlights the need to evaluate a variety of money and liquidity measures, among other things, in gauging the impact of monetary policy on the economy. Moreover, the relatively large month-to-month variations in growth for any particular money measure—and variations are even larger from week to week—emphasize the need to evaluate data over some long period of time in judging the underlying tendency of the series.

As noted earlier, in addition to the money supply, the second paragraph of the directive has emphasized bank credit. A current measure of bank credit for the guidance of the Account Manager was provided by measuring bank credit from the liability side, since liability data are available more quickly and can be used to construct a series on a daily-average basis. This daily-average measure does not encompass all bank liabilities (it excludes non-member bank deposits and bank capital, for example) but it includes the most volatile ones. It encompasses not only the member bank component of deposits included in M_2 above, but also funds obtained by banks through large time CD's, U.S. Government deposits, and interbank deposits and through non-deposit sources such as Euro-dollars and commercial paper issued by bank-related affiliates. The sum of these deposits and nondeposit sources is called the adjusted credit proxy.

Inclusion of bank credit in the directive might be considered as recognition of a broader concept of money, since time and savings deposits at commercial banks are a key source of bank credit. In addition, however, the inclusion recognizes that bank credit is a key component of total credit availability and one that is immediately sensitive to open market operations.

The amount of bank credit that the FOMC is willing to encourage or to countenance depends, like the money supply, on over-all economic and financial conditions. When, for example, banks have been unable for an extended period to increase time and savings deposits because interest rate ceilings on time deposits were unrealistically low relative to market rates, it was to be expected that outstanding bank credit would grow rapidly for a time after ceiling rates again became competitive. This growth would represent mainly a shifting of credit flows from market to banking channels as banks sought to restore their previous competitive position and as the public restructured its financial asset portfolios to reflect the changed yield relationships. Federal Reserve open market operations could provide the reserves necessary to sustain the shift in the public's ability and willingness to hold time deposits relative to other assets. The accompanying chart shows monthly changes in bank credit, as

CREDIT PROXY ADJUSTED;
TOTAL RESERVES



Bank "credit proxy adjusted" is total member bank deposits plus funds provided by Euro-dollar borrowings and bank-related commercial paper. Through the first half of 1969, no data on bank-related commercial paper were available, but amounts outstanding were not thought to be growing significantly in those periods.

measured by the adjusted credit proxy, along with total bank reserves.

DAY-TO-DAY OPEN MARKET OPERATIONS

The day-to-day operations in the market by the System Account Manager have continued to be guided mainly by money market conditions, in part because the information that is available daily and continuously as to the state of the money market—for example, the Federal funds rate and dealer loan rates—reflects the interaction of the demand for and existing supply of bank reserves and hence provides a basis for making daily decisions as to whether the System should be in the market providing additional or absorbing existing reserves; and if so, by how much and through what means. But the degree to which the Manager seeks to influence money market conditions has been affected by the relationship that is presumed to exist at any given time among money market conditions, reserves, and the monetary aggregates and by the Committee's desires with respect to monetary aggregates and over-all conditions in the credit market.

Changes in money market conditions, of course, may reflect factors other than efforts to influence reserve flows in accordance with longer-run targets for monetary aggregates. Some changes in money market conditions reflect no more than shifts in the distribution of reserves among banks. Others represent the short-run effects of bulges in demand for day-to-day credit at times of Treasury financings or in tax payment periods. Yet others represent unanticipated, virtually random changes in technical factors —such as float or currency in circulation—that supply to or absorb from the market more reserves than was either expected or seemed likely to be sustained. And as in the summer of 1970, open market operations in relation to money market conditions may sometimes reflect primarily a concern with liquidity pressures in the economy.

Although recognizing that money market conditions are subject to a number of influences, the System Account Manager takes into consideration the relationship between money market conditions and the trends in bank credit and money that has prevailed in the recent past and the relationship that is expected to develop in the future in making decisions concerning reserve provision or absorption through open market operations. At the beginning of a statement week, for example, his operations may be aimed at a condition of tightness or ease in the money market roughly similar to that of previous weeks. This would mean that such variables as the Federal funds rate, dealer loan rates, the net reserve position of member banks, and borrowings by member banks from the Federal Reserve would generally tend to fluctuate within the range of recent experience—although there might be special, sometimes unforeseen developments (such as a mail strike) that could cause marked short-run changes in money market conditions.

If and as it becomes evident that monetary aggregates are running above or below the desired path, however, the Account Manager may aim at correspondingly tighter or easier money market conditions. Also, if it should turn out that the apparent new relationship was not long-lasting, the Account Manager would subsequently have to reverse the direction of his operations. Thus, to the extent that monetary aggregates are given more emphasis in the operating paragraph of the directive, money market conditions may be subject to a somewhat greater degree of fluctuation.

While the counterpart of greater sensitivity to monetary aggregates would be a somewhat greater tendency for actual money market conditions to change more frequently than otherwise, sharp short-run shifts in money market conditions are not likely to develop, in part because the FOMC is concerned with the state of money and credit markets as well as with tendencies in monetary aggregates. There are a number of reasons for the continuing role of money market conditions as a day-to-day guide for open market operations.

First, the money market reflects the pressure of demand for liquidity, and the nation's central bank has a unique responsibility for maintenance of orderly conditions in such a market.

Second, there are large and often unpredictable week-to-week and month-to-month swings in the economy's demand for money and bank credit. These demands are often self-correcting, and as a result there is little purpose in permitting the sharp fluctuations in money market conditions, and perhaps in credit markets generally, that would be likely to develop should the flow and ebb of these demands not be accommodated in Federal Reserve operations affecting bank reserves.

Third, because of the key role of the money market in quickly reflecting shifts in the need for and availability of liquid funds, presumably in large part as a result of the interaction of the public's spending decisions and monetary policy, sharp shifts in money market conditions may be interpreted by market participants as a harbinger of relatively permanent changes in credit demand or monetary policy. Investors, businessmen, and consumers may vary their credit outlook, and perhaps their economic outlook too, in response to the money market to the extent that they regard changes in the market as a signal of events to come. This prospect itself counsels caution in undertaking open market operations that lead to large short-run changes in money market conditions until it becomes fairly certain that longer-run tendencies in money supply, bank credit, and over-all credit conditions require such changes.

While there are reasons for emphasis on money market conditions, it should be stressed that money market conditions are only instrumental to the attainment of the main financial objectives of policy—flows of monetary aggregates and over-all credit conditions—that are appropriate to achievement of over-all economic goals. For the Account Manager, the day-to-day operations of the Account and the effect of these operations on the money market are made even more complex because he is aware that the FOMC generally has in mind not only some view concerning the desired longer-run trend in various monetary aggregates but also a view concerning what should be sought in the way of associated credit conditions.

These desires may sometimes turn out to be in conflict; for example, monetary aggregates as a group may be rising more rapidly than desirable while credit conditions may be tightening more than desirable. Meeting one desire by holding back on the provision of reserves in order to restrain growth in bank credit and money would tend, at least temporarily, to thwart the other desire by leading to even more tightening of credit conditions. Under such circumstances, the Account Manager would have to adjust his operations—thereby affecting day-to-day money market conditions—in line with the sense of priority among operating objectives given by the FOMC.

While the whole set of objectives would be reconsidered at the next FOMC meeting, the Account Manager's operations are monitored daily through a morning telephone conference call. This call involves the Trading Desk in New York, senior officials on the staff of the Board of Governors in Washington, and one of the Reserve Bank Presidents (serving in rotation) who is a voting member of the FOMC (other than the President of the Federal Reserve Bank of New York). Individual Board members may also participate in the call from time to time, as may the President of the New York Reserve Bank. In this call the Manager explains his program for the day, and that program, or possible alternative approaches, are discussed. As part of this process, not only are current figures on bank reserve positions, money market conditions, and broader credit conditions reported, but also information on the latest deposit and bank credit figures and how these compare with FOMC desires is appraised.

In general, as the FOMC's objectives with respect to monetary aggregates, and also over-all credit conditions, have been given increased stress in the directive to the Account Manager, the timing and extent of the System's day-to-day open market operations have, of course, been altered, with consequent effects on day-to-day money market conditions. At the same time, the Manager still takes account of the emerging tightness or ease in the money market as a factor affecting the timing and extent of day-to-day open market operations. But this emerging tightness or ease is evaluated against trends in money, bank credit, and over-all credit conditions, which are, and always have been, among the basic financial objectives of monetary policy.

APPENDIX: Current Economic Policy Directives Issued by the FOMC

Meeting held on December 16, 1969

The information reviewed at this meeting indicates that real economic activity has expanded only moderately in recent quarters and that a further slowing of growth appears to be in process. Prices and costs, however, are continuing to rise at a rapid pace. Most market interest rates have advanced further in recent weeks partly as a result of expectational factors, including concern about the outlook for fiscal policy. Bank credit rose rapidly in November after declining on average in October, while the money supply increased moderately over the 2-month period; in the third quarter, bank credit had declined on balance and the money supply was about unchanged. The net contraction of outstanding large-denomination CD's has slowed markedly since late summer, apparently reflecting mainly an increase in foreign official time deposits. However, flows of consumer-type time and savings funds at banks and nonbank thrift institutions have remained weak, and there is considerable market concern about the potential size of net outflows expected around the year-end. In November the balance of payments deficit on the liquidity basis diminished further and the official settlements balance reverted to surplus, mainly as a result of return flows out of the German mark and renewed borrowing by U.S. banks from their foreign branches. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to the reduction of inflationary pressures, with a view to encouraging sustainable economic growth and attaining reasonable equilibrium in the country's balance of payments.

To implement this policy, System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining the prevailing firm conditions in the money market; provided, however, that operations shall be modified if bank credit appears to be deviating significantly from current projections or if unusual liquidity pressures should develop.

Meeting held on January 15, 1970

The information reviewed at this meeting suggests that real economic activity leveled off in the fourth quarter of 1969 and that little change is in prospect for the early part of 1970. Prices and costs, however, are continuing to rise at a rapid pace. Most market interest rates have receded from highs reached during December. Bank credit and the money supply increased slightly on average in December and also over the fourth quarter as a whole. Outstanding large-denomination CD's held by domestic depositors have continued to contract in recent months while foreign official time deposits have expanded considerably. Flows of consumer-type time and savings funds at banks and nonbank thrift institutions have remained weak, and there apparently were sizable net outflows after year-end interest crediting. U.S. imports and exports have both grown further in recent months but through November the trade balance showed little or no further improvement from the third-quarter level. At the year-end the over-all balance of payments statistics were buoyed by large temporary inflows of U.S. corporate funds. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to the orderly reduction of inflationary pressures, with a view to encouraging sustainable economic growth and attaining reasonable equilibrium in the country's balance of payments.

To implement this policy, while taking account of the forthcoming Treasury refunding, possible bank regulatory changes and the Committee's desire to see a modest growth in money and bank credit, System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining firm conditions in the money market; provided, however, that operations shall be modified if money and bank credit appear to be deviating significantly from current projections.

Meeting held on February 10, 1970

The information reviewed at this meeting suggests that real economic activity, which leveled off in the fourth quarter of 1969, may be weakening further in early 1970. Prices and costs, however, are continuing to rise at a rapid pace. Long-term market interest rates recently have fluctuated under the competing influences of heavy demands for funds and shifts in investor attitudes regarding the outlook for monetary policy. Bank credit declined in January but the money supply increased substantially on average; both had risen slightly in the fourth quarter. Flows of time and savings funds at banks and nonbank thrift institutions have remained generally weak since year-end, and they apparently have been affected little thus far by the recent increases in maximum rates payable for such funds. The U.S. foreign trade balance improved somewhat in December, as imports fell off. The over-all balance of payments has been in substantial deficit in recent weeks. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to the orderly reduction of inflationary pressures, with a view to encouraging sustainable economic growth and attaining reasonable equilibrium in the country's balance of payments.

To implement this policy, while taking account of the current Treasury refunding, possible bank regulatory changes and the Committee's desire to see moderate growth in money and bank credit over the months ahead, System open market operations until the next meeting of the Committee shall be conducted with a view to moving gradually toward somewhat less firm conditions in the money market; provided, however, that operations shall be modified promptly to resist any tendency for money and bank credit to deviate significantly from a moderate growth pattern.

Meeting held on March 10, 1970

The information reviewed at this meeting suggests that real economic activity, which leveled off in the fourth quarter of 1969, is weakening further in early 1970. Prices and costs, however, are continuing to rise at a rapid pace. Market interest rates have declined considerably in recent weeks, partly as a result of changing investor attitudes regarding the outlook for economic activity and monetary policy. Both bank credit and the money supply declined on average in February, but both were tending upward in the latter part of the month. Outflows of time and savings funds at banks and nonbank thrift institutions, which had been sizable in January, apparently ceased in February, reflecting advances in rates offered on such funds following the recent increases in regulatory ceilings, together with declines in short-term market interest rates. The U.S. foreign trade surplus narrowed

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To implement this policy, System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining the prevailing firm conditions in the money market; provided, however, that operations shall be modified if bank credit appears to be deviating significantly from current projections or if unusual liquidity pressures should develop.

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To implement this policy, while taking account of the forthcoming Treasury refunding, possible bank regulatory changes and the Committee's desire to see a modest growth in money and bank credit, System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining firm conditions in the money market; provided, however, that operations shall be modified if money and bank credit appear to be deviating significantly from current projections.

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The information reviewed at this meeting suggests that real economic activity, which leveled off in the fourth quarter of 1969, may be weakening further in early 1970. Prices and costs, however, are continuing to rise at a rapid pace. Long-term market interest rates recently have fluctuated under the competing influences of heavy demands for funds and shifts in investor attitudes regarding the outlook for monetary policy. Bank credit declined in January but the money supply increased substantially on average; both had risen slightly in the fourth quarter. Flows of time and savings funds at banks and nonbank thrift institutions have remained generally weak since year-end, and they apparently have been affected little thus far by the recent increases in maximum rates payable for such funds. The U.S. foreign trade balance improved somewhat in December, as imports fell off. The over-all balance of payments has been in substantial deficit in recent weeks. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to the orderly reduction of inflationary pressures, with a view to encouraging sustainable economic growth and attaining reasonable equilibrium in the country's balance of payments.

To implement this policy, while taking account of the current Treasury refunding, possible bank regulatory changes and the Committee's desire to see moderate growth in money and bank credit over the months ahead, System open market operations until the next meeting of the Committee shall be conducted with a view to moving gradually toward somewhat less firm conditions in the money market; provided, however, that operations shall be modified promptly to resist any tendency for money and bank credit to deviate significantly from a moderate growth pattern.

Meeting held on March 10, 1970

The information reviewed at this meeting suggests that real economic activity, which leveled off in the fourth quarter of 1969, is weakening further in early 1970. Prices and costs, however, are continuing to rise at a rapid pace. Market interest rates have declined considerably in recent weeks, partly as a result of changing investor attitudes regarding the outlook for economic activity and monetary policy. Both bank credit and the money supply declined on average in February, but both were tending upward in the latter part of the month. Outflows of time and savings funds at banks and nonbank thrift institutions, which had been sizable in January, apparently ceased in February, reflecting advances in rates offered on such funds following the recent increases in regulatory ceilings, together with declines in short-term market interest rates. The U.S. foreign trade surplus narrowed in January and the over-all balance of payments deficit has remained large in recent weeks. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to orderly reduction in the rate of inflation, while encouraging the resumption of sustainable economic growth and the attainment of reasonable equilibrium in the country's balance of payments.

To implement this policy, the Committee desires to see moderate growth in money and bank credit over the months ahead. System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining money market conditions consistent with that objective.

Meeting held on April 7, 1970

The information reviewed at this meeting suggests that real economic activity weakened further in early 1970, while prices and costs continued to rise at a rapid pace. Fiscal stimulus, of dimensions that are still uncertain, will strengthen income expansion in the near term. Most long-term interest rates backed up during much of March under the pressure of heavy demands for funds, but then turned down in response to indications of some relaxation of monetary policy and to the reduction in the prime lending rate of banks. Short-term rates declined further on balance in recent weeks, contributing to the ability of banks and other thrift institutions to attract time and savings funds. Both bank credit and the money supply rose on average in March; over the first quarter as a whole bank credit was about unchanged on balance and the money supply increased somewhat. The U.S. foreign trade surplus increased in February, but the over-all balance of payments appears to have been in considerable deficit during the first quarter. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to orderly reduction in the rate of inflation, while encouraging the resumption of sustainable economic growth and the attainment of reasonable equilibrium in the country's balance of payments.

To implement this policy, the Committee desires to see moderate growth in money and bank credit over the months ahead. System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining money market conditions consistent with that objective, taking account of the forthcoming Treasury financing.

Meeting held on May 5, 1970

The information reviewed at this meeting indicates that real economic activity weakened further in the first quarter of 1970. Growth in personal income, however, is being stimulated in the second quarter by the enlargement of social security benefit payments and the Federal pay raise. Prices and costs generally are continuing to rise at a rapid pace, although some components of major price indexes recently have shown moderating tendencies. Most market interest rates have risen sharply in recent weeks as a result of heavy demands for funds, possible shifts in liquidity preferences, and the disappointment of earlier expectations regarding easing of credit market conditions. Prices of common stocks have declined markedly since early April. Attitudes in financial markets generally are being affected by the expansion of military operations in Southeast Asia and by concern about the success of the Government's anti-inflationary program. Both bank credit and the money supply rose substantially from March to April on average, although during the course of April bank credit leveled off and the money supply receded sharply from the end-of-March bulge. The over-all balance of payments was in considerable deficit during the first quarter. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to orderly reduction in the rate of inflation, while encouraging the resumption of sustainable economic growth and the attainment of reasonable equilibrium in the country's balance of payments.

To implement this policy, the Committee desires to see moderate growth in money and bank credit over the months ahead. System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining bank reserves and money market conditions consistent with that objective, taking account of the current Treasury financing; provided, however, that operations shall be modified as needed to moderate excessive pressures in financial markets, should they develop.

Meeting held on May 26, 1970

The information reviewed at this meeting indicates that real economic activity declined more than previously estimated in the first quarter of 1970, but little further change is projected in the second quarter. Prices and costs generally are continuing to rise at a rapid pace, although some components of major price indexes recently have shown moderating tendencies. Since early May most long-term interest rates have remained under upward pressure, partly as a result of continued heavy demands for funds and possible shifts in liquidity preferences, and prices of common stocks have declined further. Attitudes in financial markets generally are being affected by the widespread uncertainties arising from recent international and domestic events, including doubts about the success of the Government's anti-inflationary program. Both bank credit and the money supply rose substantially from March to April on average; in May bank credit appears to be changing little while the money supply appears to be expanding rapidly. The over-all balance of payments continued in considerable deficit in April and early May. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to orderly reduction in the rate of inflation, while encouraging the resumption of sustainable economic growth and the attainment of reasonable equilibrium in the country's balance of payments.

To implement this policy, in view of current market uncertainties and liquidity strains, open market operations until the next meeting of the Committee shall be conducted with a view to moderating pressures on financial markets, while, to the extent compatible therewith, maintaining bank reserves and money market conditions consistent with the Committee's longer-run objectives of moderate growth in money and bank credit.

Meeting held on June 23, 1970

The information reviewed at this meeting suggests that real economic activity is changing little in the current quarter after declining appreciably earlier in the year. Prices and costs generally are continuing to rise at a rapid pace, although some components of major price indexes recently have shown moderating tendencies. Since late May market interest rates have shown mixed changes following earlier sharp advances, and prices of common stocks have recovered part of the large decline of preceding weeks. Attitudes in financial markets continue to be affected by uncertainties and conditions remain sensitive, particularly in light of the insolvency of a major railroad. In May bank credit changed little and the money supply rose moderately on average, following substantial increases in both measures in March and April. Inflows of consumer-type time and savings funds at banks and nonbank thrift institutions have been sizable in recent months, but the brief spring upturn in large-denomination CD's outstanding at banks has ceased. The over-all balance of payments was in heavy deficit in April and May. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to orderly reduction in the rate of inflation, while encouraging the resumption of sustainable economic growth and the attainment of reasonable equilibrium in the country's balance of payments.

To implement this policy, in view of persisting market uncertainties and liquidity strains, open market operations until the next meeting of the Committee shall continue to be conducted with a view to moderating pressures on financial markets. To the extent compatible therewith, the bank reserves and money market conditions maintained shall be consistent with the Committee's longer-run objective of moderate growth in money and bank credit, taking account of the Board's regulatory action effective June 24 and some possible consequent shifting of credit flows from market to banking channels.

Meeting held on July 21, 1970

The information reviewed at this meeting indicates that real economic activity changed little in the second quarter after declining appreciably earlier in the year. Prices and wage rates generally are continuing to rise at a rapid pace. However, improvements in productivity appear to be slowing the rise in costs, and some major price measures are showing moderating tendencies. Since mid-June long-term interest rates have declined considerably, and prices of common stocks have fluctuated above their recent lows. Although conditions in financial markets have improved in recent weeks uncertainties persist, particularly in the commercial paper market where the volume of outstanding paper has contracted sharply. A large proportion of the funds so freed apparently was rechanneled through the banking system, as suggested by sharp increases in bank loans and in large-denomination CD's of short maturity—for which rate ceilings were suspended in late June. Consequently, in early July bank credit grew rapidly; there was also a sharp increase in the money supply. Over the second quarter as a whole both bank credit and money supply rose moderately. The over-all balance of payments remained in heavy deficit in the second quarter. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to orderly reduction in the rate of inflation, while encouraging the resumption of sustainable economic growth and the attainment of reasonable equilibrium in the country's balance of payments.

To implement this policy, while taking account of persisting market uncertainties, liquidity strains, and the forthcoming Treasury financing, the Committee seeks to promote moderate growth in money and bank credit over the months ahead, allowing for a possible continued shift of credit flows from market to banking channels. System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining bank reserves and money market conditions consistent with that objective; provided, however, that operations shall be modified as needed to counter excessive pressures in financial markets should they develop.

Meeting held on August 18, 1970

The information reviewed at this meeting suggests that real economic activity, which edged up slightly in the second quarter after declining appreciably earlier in the year, may be expanding somewhat further. Prices and wage rates generally are continuing to rise at a rapid pace. However, improvements in productivity appear to be slowing the rise in costs, and some major price measures are showing moderating tendencies. Credit demands in securities markets have continued heavy, and interest rates have shown mixed changes since mid-July after declining considerably in preceding weeks. Some uncertainties persist in financial markets, particularly in connection with market instruments of less than prime grade. In July the money supply rose moderately on average and bank credit expanded substantially. Banks increased holdings of securities and loans to finance companies, some of which were experiencing difficulty in refinancing maturing commercial paper. Banks sharply expanded their outstanding large-denomination CD's of short maturity, for which rate ceilings had been suspended in late June, and both banks and nonbank thrift institutions experienced large net inflows of consumer-type time and savings funds. The over-all balance of payments remained in heavy deficit in the second quarter, despite a sizable increase in the export surplus. In July the official settlements deficit continued large, but there apparently was a marked shrinkage in the liquidity deficit. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to orderly reduction in the rate of inflation, while encouraging the resumption of sustainable economic growth and the attainment of reasonable equilibrium in the country's balance of payments.

To implement this policy, the Committee seeks to promote some easing of conditions in credit markets and somewhat greater growth in money over the months ahead than occurred in the second quarter, while taking account of possible liquidity problems and allowing bank credit growth to reflect any continued shift of credit flows from market to banking channels. System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining bank reserves and money market conditions consistent with that objective, taking account of the effects of other monetary policy actions.

Meeting held on September 15, 1970

The information reviewed at this meeting suggests that real economic activity, which edged up slightly in the second quarter, is expanding somewhat further in the third quarter, led by an upturn in residential construction. Wage rates generally are continuing to rise at a rapid pace, but improvements in productivity appear to be slowing the rise in costs, and some major price measures are rising less rapidly than before. Interest rates declined in the last half of August, but most yields turned up in early September, as credit demands in securities markets have continued heavy; existing yield spreads continue to suggest concern with credit quality. The money supply rose rapidly in the first half of August but moved back down through early September. Bank credit expanded sharply further in August as banks continued to issue large-denomination CD's at a relatively rapid rate, while reducing their reliance on the commercial paper market after the Board of Governors acted to impose reserve requirements on bank funds obtained from that source. The balance of payments deficit on the liquidity basis diminished somewhat in July and August from the very large second-quarter rate, but the deficit on the official settlements basis remained high as banks repaid Euro-dollar liabilities. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to orderly reduction in the rate of inflation, while encouraging the resumption of sustainable economic growth and the attainment of reasonable equilibrium in the country's balance of payments.

To implement this policy, the Committee seeks to promote some easing of conditions in credit markets and moderate growth in money and attendant bank credit expansion over the months ahead. System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining bank reserves and money market conditions consistent with that objective.

Meeting held on October 20, 1970

The information reviewed at this meeting suggests that real output of goods and services increased slightly further in the third quarter but that employment declined and unemployment continued to rise; activity in the current quarter is being adversely affected by a major strike in the automobile industry. Wage rates generally are continuing to rise at a rapid pace, but improvements in productivity appear to be slowing the increase in costs, and some major price measures are rising less rapidly than before. Most interest rates have declined since mid-September, although yields on corporate and municipal bonds have been sustained by the continuing heavy demands for funds in capital markets. The money supply rose slightly on average in September and increased moderately over the third quarter as a whole. Bank credit expanded further in September but at a rate considerably less than the fast pace of the two preceding months. Banks continued to issue large-denomination CD's at a relatively rapid rate and experienced heavy inflows of consumer-type time and savings funds, while making substantial further reductions in their use of nondeposit sources of funds. The balance of payments deficit on the liquidity basis diminished in the third quarter from the very large second-quarter rate, but the deficit on the official settlements basis remained high as banks repaid Euro-dollar liabilities. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to orderly reduction in the rate of inflation, while encouraging the resumption of sustainable economic growth and the attainment of reasonable equilibrium in the country's balance of payments.

To implement this policy, the Committee seeks to promote some easing of conditions in credit markets and moderate growth in money and attendant bank credit expansion over the months ahead. System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining bank reserves and money market conditions consistent with those objectives, taking account of the forthcoming Treasury financings.

Meeting held on November 17, 1970

The information reviewed at this meeting suggests that real output of goods and services is changing little in the current quarter and that unemployment has increased. Part but not all of the weakness in over-all activity is attributable to the strike in the automobile industry which apparently is now coming to an end. Wage rates generally are continuing to rise at a rapid pace, but gains in productivity appear to be slowing the increase in unit labor costs. Recent movements in major price measures have been erratic but the general pace of advance in these measures has tended to slow. Most interest rates declined considerably in the past few weeks, and Federal Reserve discount rates were reduced by one-quarter of a percentage point in the week of November 9. Demands for funds in capital markets have continued heavy, but business loan demands at banks have weakened. The money supply changed little on average in October for the second consecutive month; bank credit also was about unchanged, following a slowing of growth in September. The balance of payments deficit on the liquidity basis was at a lower rate in the third quarter and in October than the very high second-quarter rate, but the deficit on the official settlements basis remained high as banks repaid Euro-dollar liabilities. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to orderly reduction in the rate of inflation, while encouraging the resumption of sustainable economic growth and the attainment of reasonable equilibrium in the country's balance of payments.

To implement this policy, the Committee seeks to promote some easing of conditions in credit markets and moderate growth in money and attendant bank credit expansion over the months ahead, with allowance for temporary shifts in money and credit demands related to the auto strike. System open market operations until the next meeting of the Committee shall be conducted with a view to maintaining bank reserves and money market conditions consistent with those objectives.

Meeting held on December 15, 1970

The information reviewed at this meeting suggests that real output of goods and services has declined since the third quarter, largely as a consequence of the recent strike in the automobile industry, and that unemployment has increased. Resumption of higher automobile production is expected to result in a bulge in activity in early 1971. Wage rates generally are continuing to rise at a rapid pace, but gains in productivity appear to be slowing the increase in unit labor costs. Movements in major price measures have been diverse; most recently, wholesale prices have shown little change while consumer prices have advanced substantially. Market interest rates declined considerably further in the past few weeks, and Federal Reserve discount rates were reduced by an additional one-quarter of a percentage point. Demands for funds in capital markets have continued heavy, but business loan demands at banks have been weak. Growth in the money supply was somewhat more rapid on average in November than in October, although it remained below the rate prevailing in the first three quarters of the year. Banks acquired a substantial volume of securities in November, and bank credit increased moderately after changing little in October. The foreign trade balance in September and October was smaller than in any other 2-month period this year. The over-all balance of payments deficit on the liquidity basis remained in October and November at about its third-quarter rate. The deficit on the official settlements basis was very large as banks continued to repay Euro-dollar liabilities. In light of the foregoing developments, it is the policy of the Federal Open Market Committee to foster financial conditions conducive to orderly reduction in the rate of inflation, while encouraging the resumption of sustainable economic growth and the attainment of reasonable equilibrium in the country's balance of payments.

To implement this policy, System open market operations shall be conducted with a view to maintaining the recently attained money market conditions until the next meeting of the Committee, provided that the expected rates of growth in money and bank credit will at least be achieved.