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Improving Monetary Control

IN RECENT YEARS MONETARY POLICY MAKERS have moved far in the direction of regarding the money stock as their principal instrument. It is a reasonable shorthand description of this change to say that policy makers now control the money stock in the light of forecasts of economic activity and movements in interest rates, whereas before 1970 they controlled interest rates in the light of forecasts of economic activity and movements in the money stock. Nonetheless, the "control" actually exercised by the Federal Reserve is not exact, whether it chooses interest rates or the money stock as its instrument. Between 1951 and 1970 control of interest rates was not exact because it was felt desirable to let market forces have a considerable impact on them. Since 1970 the money stock has not been controlled exactly because it is deemed desirable to cushion short-run movements in interest rates by permitting the money stock to fluctuate around a target path.

Experience since 1970 has added an issue to the debate over the desirability of controlling the money stock rather than the interest rate. This issue—the technical *feasibility* of controlling the money stock—is the subject of this paper. Such a question has never arisen with respect to interest rates.[1]

* The authors alone share responsibility for all views expressed and for any errors of analysis.

1. It should be emphasized that this statement refers to short-run periods. Interest rates pegged at an unchanged level in the long run produce cumulative economic movements away from equilibrium—Wicksellian cumulative movements—that ultimately

The Federal Reserve can peg the rate of interest on any debt instrument simply by announcing a price at which it will buy and sell unlimited amounts to all comers. Or, since quotations are available continuously, the Federal Reserve can simply enter the market as a buyer or seller whenever the interest rate deviates from the target level. The effects, for example, of a $50 million open market purchase of Treasury bills on interest rates can be observed directly and without lag. If that purchase does not achieve the desired end, the operation can be repeated.

Whereas interest rate control is technically relatively easy, money stock control is not. The money stock data are available only after a significant lag, and then are subject to frequent and substantial revisions. If the money stock of last week was deemed too low, it cannot be accurately known whether random influences are eliminating or aggravating the problem this week. Nor can it be known exactly how much money growth will result from, say, a $50 million open market purchase.

The technical limitations in controlling the money stock are sizable but not enormous. At present it is surely possible (if all other considerations are ignored) to hit a desired level of the average money stock for a month with a standard error of less than 1 percent.[2] The standard error of the change between any two months would therefore be less than 1.4 percent.[3] If the two months were a year apart, the standard error on the annual rate of growth would be less than 1.4 percent, but could amount to an annual rate of as much as 5.6 percent for the growth rate over three months. As this example illustrates, control over the rate of growth of the money stock over very short periods of time may be highly inaccurate under current institutional arrangements.

Three major responses to this state of affairs may be identified. One is to argue that short-run variations in the rate of growth of money don't matter anyway; with a policy of staying as close as possible to a target path for

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force the abandonment of a fixed peg. But the possibility of a Wicksellian cumulative movement, although relevant to the *wisdom* of pegging the interest rate in the short run, seems irrelevant to the *feasibility* of doing so.

2. At current levels of the money stock (M_1 definition, that is, demand deposits plus currency), 1 percent equals about $2.4 billion. A monthly money market model developed at the Federal Reserve Board has a demand deposit equation with a standard error of $0.591 billion and a currency equation with a standard error of $0.093 billion.

3. Assuming the errors on the two monthly levels are statistically independent, the standard error of the change between the two months equals the square root of the sum of the squared standard errors for the two months.

the money stock, the actual rate of growth will, over a year or two, be very close to the target rate.

A second response argues that the policy makers should abandon attempts to control the money stock and instead aim at a variable that really can be controlled, such as some other aggregate like the monetary base or unborrowed reserves, or else some interest rate.

A third response is the search for better control methods that could narrow the deviation between the actual and target levels of the money stock.

This paper develops the third type of response. In analyzing the technical problems of controlling the money stock and making proposals for dealing with them, we assume the desirability of improving monetary control. The case for better monetary control is no more closely related to monetarist doctrine than is the case for improving the governmental budget process to fiscalist doctrine. In fact, of course, those who view technical problems of monetary control as serious also tend to assign less importance to monetary policy and to give greater weight to the *objective* of stable interest rates, while those who downplay such problems tend to take the opposite positions. Whatever the relative importance assigned to monetary and fiscal policy, we believe it is important that all policy instruments be controlled as precisely as possible.

The topic of the next section is the theoretical importance of accurate monetary control. The basic question analyzed is, In what ways are errors in achieving a desired level of the money stock costly? The answer is that imprecision in monetary control tends to magnify fluctuations in both income and interest rates, and perhaps also to increase the likelihood of policy errors.

Since errors in reaching money stock targets impose stabilization costs, it is natural to look for methods to improve monetary control. This paper concentrates almost exclusively on technical problems of control. Virtually no attention is paid to the important question of the appropriate definition of money. Although demand deposits plus currency—M_1—is the definition of money used here, it will often be obvious how the choice of a different definition would affect the reform proposals. Nor is there an examination below of the possible side effects, such as those on bank competition and the efficiency of financial markets, of proposals to improve control although careful analysis of the possible side effects of any proposal would be required before it is adopted.

In searching for methods to improve control, we break down the overall

problem into several parts. First, the structure of reserve requirements is analyzed in an effort to answer the following question: If the total reserves of member banks of the Federal Reserve System could be controlled perfectly, how precise would be control over member bank deposits?

Second, the control of member bank reserves is evaluated to determine the significance of changes in reserves occurring from such factors as fluctuations in float and in currency held by the public.

Finally, measurement errors in the money stock data are considered. Historically, revisions of the data have arisen from such factors as the correction of clerical errors, new estimates of nonmember bank deposits, and changes in the definition of money. However, it is found that revisions of seasonal adjustment factors account for much larger revisions in the short-run rate of growth of the seasonally adjusted money stock than do revisions in the underlying data. Seasonality issues are, therefore, central to the appraisal of short-run monetary control.

Theoretical Importance of Money Stock Control

Most analyses of monetary policy assume that the money stock is subject to precise control and then seek to determine the path for the money stock that is optimal to pursue the basic objectives of national economic policy—full employment, price stability, and long-run growth—and subsidiary objectives such as interest rate stability, avoidance of undue sectoral impacts, and the like. In this section a different approach is taken: The existence of errors in achieving the target path for the money stock is explicitly recognized and the importance of these errors for the objectives of monetary policy is evaluated.

Some theoretical insight into this problem can be obtained from an extension of a simple model one of the authors has presented elsewhere.[4] This model addresses the question as to whether stability of the economy is more likely to be obtained by a monetary policy that controls interest rates or by one that controls the money stock. The basic conclusion of the analysis was that if disturbances originate primarily in the *IS* function that summarizes the real sectors of the economy—in consumption and investment behavior

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

and in government spending and taxation—the money stock is the proper control instrument. But if the *LM* function, reflecting the monetary sector, is the source of disturbances, the interest rate is the proper control variable. More generally, the choice of instrument depends on the *relative* importance of real versus monetary disturbances.

The original model assumed that the monetary authorities could control the money stock precisely and, accordingly, that all monetary disturbances were caused by shifts in the public's demand for money. The extension of the model takes the form of analyzing the effects of errors in controlling the money stock.

A linear version of the monetary sector of the simple Keynesian model has the following equations:

$$L = b_0 + b_1 Y + b_2 r + v, \qquad b_1 > 0,\ b_2 < 0; \tag{1}$$

$$M = M^* + e; \tag{2}$$

$$L = M, \tag{3}$$

where L = the demand for money
Y = income
r = the interest rate
v = a random disturbance
M = the actual supply of money
M^* = the supply of money desired by the monetary authorities
e = a random disturbance.

The coefficients b_1 and b_2 have signs as suggested by the theory of the demand for money. Equation (3) is the equilibrium condition requiring that the quantity of money demanded equal the quantity of money supplied.[5]

Equations (1), (2), and (3) can be combined to produce

$$Y = \frac{1}{b_1}[M^* - b_0 - b_2 r - (v - e)]. \tag{4}$$

This equation is a stochastic *LM* function with random terms from both the

5. More specifically, equation (2) could make the supply of money a function of income, the interest rate, and a monetary policy variable subject to precise control, such as the monetary base. The entire model could then be solved in terms of the monetary policy control variable. The more articulated version of equation (2) makes possible analysis of the significance of the signs and sizes of the parameters of the money supply function. Because these parameters seem unlikely to be of much practical importance, that approach is not pursued here.

demand and supply of money functions. The addition of the stochastic *IS* function, equation (5), closes the model.

$$Y = a_0 + a_1 r + u, \qquad a_1 < 0, \tag{5}$$

where u is a random disturbance.

The policy problem is now that of choosing between the interest rate and an imperfectly controlled money stock as the policy instrument. Once this choice is made, the *IS* and *LM* functions may be combined to produce a solution for income in terms of the parameters, the stochastic disturbances, and either r or M^*. The formal structure of the problem is identical to that in which it is assumed to be possible to control M precisely, except that the solution for income embodies M^* instead of M and the random disturbance $(v - e)$ instead of v.

The earlier paper[6] shows that, with a quadratic loss function arising from income instability, the loss from following a money stock policy is

$$L_M = (a_1 b_1 + b_2)^{-2}(a_1^2\sigma_v^2 - 2a_1 b_2 \sigma_{uv} + b_2^2 \sigma_u^2). \tag{6}$$

This same equation gives the loss from income instability under imperfect monetary control if σ_w^2 is substituted for σ_v^2 and σ_{uw} for σ_{uv}, where $w = v - e$. Since the loss, L_r, under an interest rate policy is simply σ_u^2, a money stock policy is superior to an interest rate policy if $L_M/L_r < 1$, or

$$(a_1 b_1 + b_2)^{-2}\left[a_1^2\left(\frac{\sigma_y^2 + \sigma_r^2 - 2\sigma_{ve}}{\sigma_u^2}\right) - 2a_1 b_2\left(\frac{\sigma_{uv} - \sigma_{ue}}{\sigma_u^2}\right) + b_2^2\right] < 1. \tag{7}$$

The question now is that of the impact of imperfect monetary control, as represented by the random error e, in the loss function.

As equation (7) demonstrates, the random error e can theoretically reduce the loss from income instability if σ_{ve} and σ_{ue} are of the right sign and magnitude. In all probability, however, imprecise monetary control decreases income stability. Only if σ_{ve} is positive and larger than $\sigma_e^2/2$ would σ_w^2 be less than σ_v^2.[7] Analysis of the covariance term σ_{ue} points in the same

6. Poole, "Optimal Choice," p. 205.

7. The argument for a positive σ_{ve} is that banks would tend to respond to a random increase in the demand for money by making additional loans and holding smaller excess reserves, thereby increasing the supply of money. This effect would be offset to the extent that the increased demand for money involved an increased demand for currency, which tends to reduce the supply of money. While σ_{ve} may well be positive, these considerations and others point to a fairly small value for this covariance.

direction. If anything, σ_{ue} is probably positive since a positive u—an autonomous increase in investment, for example—might be associated with an increase in bank loans to finance the additional spending. Since a_1 and b_2 are both negative, $2a_1b_2\sigma_{ue}$ is likely to be positive, thus decreasing the attractiveness of a monetary control policy.

The theoretical possibility that the sizes and signs of σ_{ve} and σ_{ue} might be such as to make imperfect monetary control better than precise control makes clear the need for a careful search for obscure repercussions before adopting proposals to improve monetary control. Nevertheless, these possibilities seem so unlikely to be realized in practice that a strong prima facie case emerges for the assumption throughout the rest of this paper that imprecise monetary control has genuine costs with respect to macroeconomic stabilization objectives. Indeed, the costs arising from imperfect monetary control could be sufficient to make an optimal interest rate policy superior to an optimal money stock policy even though the latter would be superior if money control were precise.

This simple model is built around the single objective of minimizing the variance of income around the desired level, Y_f. Given this objective, equation (8) shows the implications of the model for interest rate stability as measured by the variance, σ_r^2, of the interest rate:

$$(8) \qquad \sigma_r^2 = (a_1b_1 + b_2)^{-2}[b_1^2\sigma_u^2 + \sigma_v^2 + \sigma_e^2 + 2b_1(\sigma_{uv} - \sigma_{ue}) - 2\sigma_{ve}].$$

It is clear that the variance of the interest rate is higher with imperfect monetary control unless $\sigma_e^2 - 2(b_1\sigma_{ue} + \sigma_{ve}) < 0$.

When control of the money stock is imperfect, therefore, banking disturbances—the random factor, e—cause greater variability in both income and interest rates. The existence of banking disturbances increases the attractiveness of an interest rate policy, through which the monetary authorities can both augment the stability of the financial markets and shield economic activity from disturbances in the demand and supply of money. The economic dislocations caused from time to time by instability in the banking system support this line of reasoning.

But we know far more about stabilizing the banking system and controlling the money stock than about stabilizing income, employment, and the price level. Therefore, the choice between a stabilization policy based on monetary aggregates and one based on interest rates ought not to be swayed by imprecision that, at very low cost, could be significantly reduced by institutional reforms. We now turn to these reforms.

Reserve Requirements

At the present time member banks of the Federal Reserve System are required to hold reserves equal to or greater than specified percentages of various bank liability items. If reserves were required only against demand deposits, if the requirement consisted of a constant fraction—say, 20 percent—of demand deposits for all banks, and if banks held no excess reserves, control over reserves would provide precise control over demand deposits. In this textbook example, a $1,000 increase in reserves would produce a $5,000 increase in deposits. The purpose of this section is to examine the extent to which this simple textbook relationship breaks down in practice.

The relationship between demand deposits and reserves varies for four major reasons. First, the reserve requirement varies according to the amount of demand deposits in a given bank and according to the class of the bank (reserve city or country). Second, a number of items other than demand deposits are subject to reserve requirements. Third, banks hold a varying amount of excess reserves. And, fourth, at present reserve requirements are based on deposits lagged two weeks, thereby introducing variability into the relationship between reserves and deposits in the same week.

The structure of reserve requirements against demand deposits is quite complex and subject to fairly frequent revision.[8] At the present time a bank computes its gross demand deposits as the sum of (a) interbank demand deposits (that is, deposits that are owed to another commercial bank); (b) U.S. government demand deposits; and (c) all other deposits. From this total the bank subtracts cash items in the process of collection and items due from other commercial banks (the interbank deposits of those banks) to obtain net demand deposits, the magnitude against which reserve requirements are assessed.

As of August 1972, the reserve requirements against net demand deposits for a reserve city bank were 17 percent on the part under $5 million, and 17.5 percent on the remainder; the corresponding figures for a country bank were 12.5 percent and 13 percent. With this structure of requirements, a shift of $1,000 of demand deposits from a reserve city to a country bank, both of which have deposits over $5 million, would reduce required reserves

8. The details of these requirements are specified by the Federal Reserve's Regulation D.

by $45, thereby supporting additional demand deposits of about $346 at a country bank, or about $257 at a reserve city bank. Thus, under current arrangements, deposits can fluctuate widely even though aggregate bank reserves are constant.

Another source of disturbance stems from reserve requirements on nonmoney bank liabilities. These include U.S. government and interbank demand deposits, commercial paper issued by bank affiliates, Eurodollar borrowings, and time and savings deposits (hereafter referred to simply as "time deposits" unless there is reason to distinguish between the two).

Study of these matters is complicated by the fact that the "old" system of reserve requirements outlined above is in the process of being replaced.[9] The new system, given below, effectively abolishes the distinction between reserve city and country banks. The requirements against time deposits, Eurodollars, and commercial paper are not affected.

Net demand deposits (millions of dollars)	*Reserve requirement (percent)*
First 2	8
2–10	10
10–100	12
100–400	13
Over 400	17.5

The current reserve requirement is 3 percent of savings deposits and certain time deposits, 3 percent of other time deposits up to $5 million, and 5 percent of other time deposits above that amount. For purposes of reserve requirements, commercial paper issued by bank affiliates is added to net demand deposits if it has an original maturity of less than 30 days, and to time deposits if the original maturity is 30 days or more. The reserve requirement for Eurodollar borrowings is 20 percent of the amount above a specified base.[10]

With the exception of Eurodollars, deposits subject to reserve requirements are averaged over a "statement" week running from Thursday

9. The new requirements became fully effective on November 16 following a transitional week, November 9 through 15, in which the requirements were between the new and the old levels.

10. The Board of Governors has proposed to reduce the reserve requirement on Eurodollar borrowings to 10 percent and to eliminate the reserve-free base. (See Federal Reserve Press Release, September 7, 1972.)

through Wednesday. Deposits are measured as of the close of business each day, and since a seven-day week is used, Friday's deposits count also for Saturday and Sunday for a bank not open on weekends. Holidays are treated in the same fashion.[11] Eurodollar reserve requirements are based on a four-week average. Finally, in any given statement week required reserves are based on deposits two weeks earlier.

To study the effects of these complicated reserve requirements—both old and new—we have analyzed weekly average data for individual member banks for the period from October 7, 1970, through November 3, 1971.[12] These are the actual dates of the deposit items, which, under the lagged requirements system now in effect, give rise to required reserves two weeks later.

The analysis was conducted under the assumption that M_1 appropriately defines "the" money stock. Under this definition the money stock consists of the sum of (a) private nonbank demand deposits at all commercial banks less cash items in the process of collection and Federal Reserve float;[13] (b) foreign demand balances at Federal Reserve Banks; and (c) currency outside the Treasury, Federal Reserve Banks, and vaults of all commercial banks. In controlling M_1 the principal strategy must be to control the member bank portion of item (a)—hereafter referred to simply as "member bank demand deposits." The nature of that task is indicated by the stability of the ratio that *total* required reserves bears to these deposits.

The analysis of the individual bank data reveals that this ratio was reasonably stable over the sample period, and would have been even more stable had the new reserve requirements been in effect.[14] Under the old re-

11. A desirable reform would be to base reserve requirements on a weekly average of business days. The present procedure distorts the markets by giving extra weight to Friday and preholiday figures.

12. These dates refer to the Wednesdays of statement weeks. The sample period was selected to avoid major changes in reserve requirements. Its beginning was dictated by the lowering from 6 to 5 percent of the reserve requirement on time deposits in excess of $5 million, effective the statement week of October 7, 1970; its end by the unavailability, at the time the statistical analysis was done, of the historical tapes of member bank data beyond November 3, 1971. The period is not quite "pure," however, because the Eurodollar requirement was changed in January 1971.

13. Strictly speaking, the term "private" is a misnomer since state and local government deposits are included. The technically correct term is "demand deposits other than interbank and U.S. Treasury."

14. The aggregate reserve ratio under the old requirements can, of course, be calculated from the published aggregate data. However, the individual bank data are required to analyze the sources of variance in the total ratio and to calculate what aggregate required reserves would have been under the new reserve requirements.

quirements, the ratio of total required reserves to demand deposits averaged a little over 24 percent. The standard deviation of this percentage over the fifty-seven-week sample period was 0.44, and its coefficient of variation —the ratio of the standard deviation to the mean—was 0.44/24.34 = 0.018, or 1.8 percent. If, contrary to fact, the variability of the required reserve ratio had arisen solely from variability of the deposit mix with total reserves fixed, the variability of the required reserve ratio would have been associated with a standard deviation of demand deposits of about 1.8 percent, or $2.7 billion at the current level of member bank deposits.[15] Week by week, and even month by month, such disturbances can produce very high (or very low) annual rates of growth.

This calculation is presented only to provide some feel for the significance of the standard deviation—0.44 percentage point—of the required reserve ratio. As explained in a later section, with the system of lagged reserve requirements it is impossible to fix the total dollar amount of reserves at a predetermined level. Moreover, the analysis here is of the variability of the *required* reserve ratio; if *total* reserves were fixed under a system of simultaneous required reserves the variability in excess reserves probably would offset part of that in the required reserve ratio, thereby reducing the variability of the ratio of *total* reserves to demand deposits.

Under the new reserve requirements the standard deviation of the reserve ratio is lower—about 0.37 percent instead of 0.44 percent. However, since the average level of the ratio is also lower—21.64 percent—the reduction in the coefficient of variation of the required reserve ratio is only from 1.8 to 1.7 percent.

To examine the new requirements more closely, it is useful to divide the total dollar figure of required reserves for all member banks into the dollar amounts required against (a) demand deposits; (b) Treasury deposits; (c) net interbank deposits; (d) time deposits; (e) Eurodollars; and (f) commercial paper.[16] This procedure yields an identity with total required reserves

15. For the derivation, see Maurice G. Kendall and Alan Stuart, *The Advanced Theory of Statistics*, Vol. 1 (2d ed., London: Charles Griffin, 1963), p. 232.

16. As explained earlier, Regulation D specifies a reserve requirement against the sum of items (a), (b), and (c). Since the reserve requirements are based on the size of the sum, some arbitrary procedure must be employed to assign items to size—and therefore to requirement—brackets. In this study the dollar required reserves against the three items have been separated by first calculating item (a) as if net interbank and Treasury deposits were both zero, then calculating item (b) at the margin given actual demand deposits and Treasury deposits of zero, and finally calculating item (c) at the margin given demand and net interbank deposits. This procedure was selected because of interest in the effects of eliminating reserve requirements on Treasury deposits.

on one side and six separate items on the other. Dividing the identity by total demand deposits yields the identity that the ratio of total required reserves to demand deposits equals the sum of the ratios for the six separate items. A variance-covariance matrix of the six item ratios can then be used to indicate the extent to which each of the items contributes to the total variance. Since the variance of the total ratio is equal to the sum of the variances of the six item ratios plus twice their covariances with one another, it is natural to discuss the empirical results in terms of variances and covariances. The analysis has been run in terms of both levels and weekly first differences.

It is clear that the specification of different requirements for different sizes of deposits causes negligible difficulty. In levels, the variance of the percentage of reserves required on demand deposits relative to demand deposits is only 0.0021 out of the total variance of 0.1403 under the new requirements. Systematic shifts of deposits between banks of different sizes are simply not very important.

The real problem is caused by shifts in the ratios of other items to demand deposits. In terms of levels, the biggest source of variability is time deposits with a reserve percentage variance of 0.1101. Under the new requirements Treasury deposits and net interbank deposits have reserve percentage variances of 0.0308 and 0.0209, respectively, while the corresponding figures for Eurodollars and commercial paper are 0.0003 and 0.0015. These variances, along with the mostly small covariances, sum to the total variance of 0.1403 under the new requirements.

The analysis of the variability of the level of the required reserve ratio suggests the extent of the "defensive" open market operations necessary to prevent shifts in the ratio from affecting member bank demand deposits. If defensive operations could fix demand deposits precisely at a predetermined level, then (by an argument parallel to that used above for the assumption of fixed reserves) the standard deviation of bank reserves under the old reserve requirements would be 1.8 percent, or about $600 million at the current level of member bank reserves. To this extent, defensive open market operations could be eliminated and the precision of monetary control improved if the structure of reserve requirements were reformed.

The analysis in terms of levels somewhat exaggerates the control problem arising from variability in the required reserve ratio. Longer-run trends in the deposit mix add to the variance in levels, but to the extent that they can be predicted their effects can be offset. Analysis of the weekly first differ-

ences of the required reserve ratio provides a measure of the control problem for a given week under the assumption that the ratio for the previous week is known. However, lags in data availability make this an unrealistic assumption, and so the first difference analysis somewhat understates the control problem.

Compared with the variances in levels of 0.1403, the variance of total required reserves as a percentage of demand deposits in first differences is 0.0931, the largest shares of which are contributed by Treasury deposits—0.0306—and net interbank deposits—0.0406. Time deposits contribute only 0.0091, and the structure of demand deposits only 0.0020.

PROPOSALS FOR REFORM OF RESERVE REQUIREMENTS

The possibilities for reform to improve control focus on Treasury, net interbank, and time deposits, since the other items, in either levels or first differences, contribute little to the total variance. Treasury deposits do not make the largest contribution to the variance of the level of the ratio of reserves to demand deposits, but they are difficult to predict and therefore to offset. Time deposits make the largest contribution in levels, but behave smoothly and are relatively predictable, as their relatively small contribution to variance in first differences suggests.

The elimination of the reserve requirements against some of these items appears to be desirable. These requirements are holdovers from the days when required reserves were viewed as reserves—funds available to meet emergencies. But it is now widely recognized that required reserves serve this function only to a small degree: With, say, a 15 percent reserve requirement, a $1,000 cash drain from a bank releases only $150 of reserves.

Reserve requirements are now correctly viewed in the context of enhancing monetary control by making the reserve ratio more stable and predictable than it would be in the absence of requirements. A poorly designed set of reserve requirements can, however, make the ratio of total reserves to deposits *more* rather than less volatile because the requirements on nonmoney items produce instability. One example might be the reserve requirement against time certificates of deposit (CDs). Since a bank has no obligation to redeem CDs before maturity, it seems likely that voluntarily held reserves against them would be minimal. Because the amounts outstanding fluctuate over time, so do the reserves held against them, and thus so do total required reserves relative to demand deposits.

The most logical candidate for the elimination of reserve requirements is Treasury deposits. Here, reserves serve no safety function at all since banks accepting Treasury deposits must post 100 percent collateral against them in the form of government securities. Taking account of the variance of reserves against Treasury deposits as a percentage of demand deposits plus the covariance of this percentage with other items, under the new arrangements exempting Treasury deposits from the reserve requirements would reduce the variance of the total reserve ratio by 0.0422 in levels (out of a total of 0.1403) and by 0.0496 in first differences (out of a total of 0.0931).

Some might object that removing requirements on Treasury deposits would increase interest rate fluctuations in the money markets. The argument runs that when, for example, taxes are paid, the initial impact is to reduce demand deposits and to increase Treasury deposits. If no reserves were required on Treasury deposits, this shift would release reserves that the banks would use, at least initially, to buy short-term securities. The reverse would occur when the Treasury drew down its deposits to make payments to the public for goods and services.

This objection, however, is based on an incomplete analysis of what happens when Treasury deposits change under the current system. A corporation that pays, say, $100,000 in taxes ordinarily will put the accumulated tax funds in short-term securities such as Treasury bills. When the taxes are due, the bills will be sold and the funds will reside only momentarily in private demand deposits. In a before-and-after comparison, private demand deposits will be down $100,000, Treasury deposits up $100,000, and both the quantity of bills outstanding and excess reserves of the banking system unchanged. However, the bill rate must be higher if the nonbank private sector is to be in equilibrium holding the same quantity of bills but smaller demand deposits.

Now consider the same case under a system without reserve requirements on Treasury deposits. If the reserve requirement on private demand deposits is 15 percent, the banking system will have $15,000 of excess reserves just after the taxes are paid. Through the usual multiple expansion in response to excess reserves, the system can expand private deposits and bank assets by $100,000. For simplicity, suppose the banks simply buy $100,000 of Treasury bills from the nonbank public. In this case, the before-and-after comparison shows the nonbank public with unchanged demand deposits, and with both bill holdings and tax liabilities down by $100,000. Since the bills were earmarked for taxes in the first place, there is every reason to believe that portfolio balance is achieved at the original bill rate.

The same basic argument holds when the Treasury floats a bond issue and puts the proceeds initially into Treasury deposits at commercial banks. Without reserve requirements on Treasury deposits, the bonds could be sold with no initial impact on interest rates if they were sold directly to banks. The banks would simultaneously buy the bonds and credit the Treasury deposits. The outcome is essentially identical when the Treasury floats the issue publicly: Deposits are transferred from the public to the Treasury, and banks use the resulting excess reserves to buy assets from the public, thereby restoring demand deposits to the initial level.

When the process moves in reverse—the Treasury draws down its deposits and makes disbursements to the public or retires debt—the same conclusion emerges: Reserve requirements on Treasury deposits reinforce the impact on the money market of fluctuations in such deposits.

This conclusion finds support in the analysis of the sources of variability of the relationship between total required reserves and demand deposits. The covariance between (new) reserves required against demand deposits as a percentage of demand deposits and (new) reserves required against Treasury deposits as a percentage of demand deposits is actually very slightly positive. This result holds for both levels and first differences and is explained by the fact that the Federal Reserve cushions the interest rate impact of tax dates and Treasury financings, thereby producing a near-zero covariance between demand and Treasury deposits rather than a negative one.

The situation with respect to net interbank deposits is more complex. For the banking system as a whole, net interbank deposits are, of course, zero, but for Federal Reserve member banks they are positive. Monetary control clearly would improve if all banks were required to be members of the Federal Reserve System. Under current arrangements, however, fluctuations in net interbank deposits at member banks probably in part reflect those in nonmember bank deposits relative to member bank deposits. Interbank deposits in part serve to meet the nonmember bank reserve requirements established by the various state banking authorities. In order to stabilize M_1, and not just its member bank demand deposit component, it is therefore appropriate that increases in deposits at nonmember banks that lead to larger net interbank deposits at member banks should absorb reserves and exert downward pressure on member bank deposits. Unfortunately, it is impossible to confirm this argument because of the lack of data on nonmember banks.

The final issue, and the most difficult one, is the desirability of reserve

requirements against time deposits. Of the 0.1403 variance in levels of total new required reserves to demand deposits, time deposits contribute 0.0794 (including covariances). In first differences, of the total of 0.0931 the time deposit contribution is 0.0149.[17] These figures are large enough to support a tentative conclusion that elimination of reserve requirements against time deposits would be desirable if the M_1 definition of money is accepted. If the M_2 definition is accepted, control over M_2 could obviously be improved by equalizing reserve requirements on all deposit items included in M_2 and abolishing them on everything else.[18]

The importance of improved accuracy of monetary control may certainly be questioned with respect to so fine a matter as reserve requirements on time deposits. A perfectly reasonable position would be simply to accept the imprecision in monetary control resulting from time deposit fluctuations.

LAGGED RESERVE REQUIREMENTS

Since September 18, 1968, required reserves for a given statement week have been based on deposits two weeks earlier. On its face this system seems to be attractive since in a given week the individual bank knows exactly the dollar amount of required reserves. With contemporaneous reserve requirements, the bank faces uncertainty about its precise required reserves since its internal accounting system cannot process all deposit changes instantaneously and in some cases may not for several days.

17. Because of the covariance between time and Treasury deposits, these figures include 0.0045 in the levels and 0.0092 in the first differences that are also included in the figures given above for the contribution of Treasury deposits.

18. Another possibility would be to work with a weighted average of M_1 and M_2 and set the reserve requirement on time deposits at a level appropriate to the weighted average selected. If $M = wM_1 + (1 - w)M_2$, where w is the weight given M_1, then $M = wM_1 + (1 - w)(M_1 + TD) = M_1 + (1 - w)TD$, where TD is time deposits other than large CDs. Suppose further that the required reserve ratios against demand and time deposits are set at r_1 and r_2, respectively, such that $r_2/r_1 = (1 - w)$. Examples of such calculations confirm that, provided that they are not accompanied by changes in excess reserves, shifts between demand and time deposits will not affect the weighted average M. Several problems beset this approach. There is little in economic theory to determine the correct value for w. If w were selected simply so that $(1 - w) = r_2/r_1$ under existing reserve requirements, w would have to be changed whenever shifts in reserve requirements altered r_2/r_1, and these changes would produce discontinuities in the M series. Furthermore, even if r_2/r_1 remained constant, without a convincing economic argument for using a weighted average it would be impossible to defend the M series against the charge that it was constructed simply to obtain a nice smooth series!

This argument fails to take account of two factors, however. First, under neither system can a bank predict its close-of-business reserve position—the difference between reserves held and reserves required—with perfect accuracy. Last-minute deposit inflows or outflows from check-clearing are at the same time last-minute reserve inflows or outflows. Under a contemporaneous system, a last-minute reserve flow produces some offset, although a small one, in required reserves. In managing its reserve position the average bank probably finds this offset much more important than is the uncertainty generated by accounting lags.

The second factor neglected by the argument for lagged reserve requirements is the secondary impact of individual bank adjustments on the system as a whole. Under the present system required reserves in any given week are a fixed number of dollars since nothing can be done to affect deposits outstanding two weeks ago. By hook or by crook, this quantity of reserves must be found for the banking system as a whole. If a bank short of reserves adjusts by selling some assets, its gain in reserves must mean a loss to some other bank. Individual bank adjustment does not contribute to banking system adjustment. The game is "Old Maid" when there are excess reserves in the system as a whole, and "Young Beauty Queen" when there are deficient reserves!

Under a system of contemporaneous reserve requirements, secondary adjustment can lead to a reduction in the dollar amount of required reserves if there is a reserve shortage. The banking system as a whole can reduce a reserve shortage in a given week with a fixed quantity of reserves if individual banks sell assets to the nonbank public and thereby decrease the deposits upon which reserve requirements are based.

The practical possibilities for this secondary adjustment in the short run are limited, but not insignificant. Many corporate financial officers with sharp pencils are quite prepared to buy short-term, highly liquid assets and hold them for a few days if the yield is attractive. A temporary increase in interest rates caused by reserve stringency holds the promise of capital gains if yields are expected to fall back in a few days. The demand for demand deposits may be quite interest elastic in the very short run around the expected or "normal" level of the interest rate.

In any event, lagged reserve requirements preclude both primary and secondary adjustments since current deposit changes do not affect current required reserves. With lagged reserve requirements, attempts by individual banks to adjust to a reserve shortage will exert pressure on the money market until interest rates are bid up sufficiently either to induce some banks to

borrow the needed reserves from the Federal Reserve, or to force the Federal Reserve to create the needed reserves through an open market purchase or some other technique.[19] In the case of a reserve surplus, the downward pressure on the money market continues until banks become willing to hold excess reserves, or the Federal Reserve intervenes to destroy some.[20]

To obtain some evidence on the influence of lagged reserve requirements on the stability of money growth and money market conditions, we have examined the weekly behavior of M_1 (not seasonally adjusted), the federal funds rate, and free reserves before and after the introduction of lagged reserve requirements. The "before" period runs for 246 statement weeks from January 1, 1964, through September 11, 1968, the "after" period for 197 statement weeks from September 25, 1968, through June 28, 1972. For the money stock, the standard deviation of the percent per week change in unadjusted M_1 was 1.01 in the "before" period and 1.07 in the "after" period.

In judging money market stability, perhaps the best summary measure is the variability of the weekly change in the federal funds rate. The standard deviation of this variable rose from 0.26 percentage point in the "before" period to 0.34 in the "after" period. Another useful measure is free reserves, the difference between excess reserves and borrowings from the Federal Reserve.[21] The standard deviation of the weekly change in free reserves was $124 million in the "before" period and $244 million in the "after" period.

These findings thus reveal slightly less stability in both money growth and money market conditions since adoption of the lagged reserve require-

19. Offering a third alternative under the current system, Regulation D provides that a bank may carry over to the next week excess or deficient reserves up to 2 percent of the requirement. This provision was introduced at the same time as the system of lagged reserve requirements.

20. "The new rules, by eliminating current changes in required reserves as a source of change in desired reserves, have increased the work done by price [that is, federal funds rate] movements in adjusting desired reserves." Warren L. Coats, Jr., "The September, 1968, Changes in 'Regulation D' and their Implications for Money Stock Control" (Ph.D. thesis, University of Chicago, 1972). The Coats study contains much analysis and evidence relevant to this paper.

21. In calculating free reserves in the "after" period, excess reserves have been adjusted to reflect the significant carry-over provisions of the reserve requirement regulations. In the "after" period, the average level of excess reserves was about $214 million while the average level of carry-over reserves was about $93 million. The carry-over figures are published in the H.4.1 weekly Federal Reserve release, "Factors Affecting Bank Reserves and Condition Statement of F.R. Banks."

ments system. They do not show conclusively whether the lagged system has made control a little less or a little more precise. The control problem depends both on the stability—and therefore the predictability—of the relationships among total reserves, free reserves, the funds rate, and the money stock, and on the source of disturbances to the system. The lagged reserve requirements system in all probability reduces the stability of short-run functional relationships and to that extent the precision of week-by-week control. In controlling the money stock, the Federal Reserve must attempt to affect deposits in a given week by changing reserves. Since total reserves in a given week must equal or exceed the required reserves given by deposits two weeks earlier, control must be exercised by changing the extent to which total reserves are supplied through the discount window relative to the excess reserves in the banking system. An open market sale tends to reduce the excess reserves of banks in a surplus position, and to increase the borrowings of banks in a shortage position. The "free reserves" of the banking system decline. The problem is to know how the decline in free reserves will affect *current* deposits in the banking system.

The relationship between free reserves and deposits is likely to be less stable with lagged reserve requirements. If, as noted earlier, a bank attempts to adjust to a shortage of reserves by selling assets to the public, the resulting reduction in deposits does nothing to ease the reserve shortage for the banking system as a whole. At this point two conflicting forces come into play. As the money markets tighten, banks may decide simply to borrow the needed reserves from the Federal Reserve. To the extent that they do, the reserve shortage does not reduce the current deposits of the banking system. This effect would be the more likely the firmer were bank expectations that money market rates were only temporarily high, because, rather than sell assets to the public at the capital loss implied by the temporarily high rates, the banks would borrow instead from the Federal Reserve. On the other hand, if rate expectations are revised upward, the banks will be more likely to adjust by selling assets to the nonbank public. But this process may be overdone. Current deposits may fall below the level appropriate to the current level of bank reserves because the reduction in current deposits does not reduce current required reserves and therefore does not ease the reserve shortage causing the upward pressure on the money markets.

On the whole it seems likely that the response of the banking system in creating (destroying) deposits in the face of a reserve excess (shortage) will

be weaker and less predictable under the system of lagged reserve requirements than under the contemporaneous requirements system.[22] Stability of short-run relationships, however, is not the whole story; the source of a change in bank reserve positions is also important. Suppose, for example, that there is a surge in bank loans and therefore in deposits. Other things equal, in two weeks a reserve shortage will occur. In this case it would be desirable for banks to react strongly to the reserve shortage to reduce deposits and thereby wipe out the unwanted surge. Better yet, under either the lagged or the contemporaneous systems, would be bank reactions that forestall a deposit surge in the first place. But strong and predictable bank reactions to changed reserve positions are detrimental to deposit stability when the source of disturbance is on the reserve side through, for example, changes in the deposit mix, as discussed earlier in this section, or through fluctuations in items such as float, to be discussed in the following section. Thus, the lagged requirements system will be preferable if reserve positions are disturbed principally from the reserve side rather than the deposit side and if bank reactions are weaker under this system.

Even if this last proposition is true, the system of lagged requirements will be inferior to the contemporaneous requirements system if most of the reserve disturbances can be eliminated. Since a major theme of this paper is that reserve disturbances can be eliminated for all practical purposes, the conclusion is that requirements ought to be placed on a contemporaneous basis in order to improve the accuracy of monetary control. In any event, the lagged requirements system does not make reserve management any easier for the banks and does tend to intensify money market instability.

Provision and Use of Member Bank Reserves

In the previous section we examined the stability of member bank demand deposits in light of the structure of reserve requirements, taking member bank reserves as given. We now turn to the determination of aggregate member bank reserves.

The analysis is based on the accounting statement of sources and uses (supplying and absorbing items) of reserve funds (Tables A-4 and A-5 in the *Federal Reserve Bulletin*). The various items from this accounting state-

22. This conclusion is based on the a priori argument sketched above and on evidence presented in Chapter 4 of the Coats dissertation cited earlier.

ment have been combined into seven composite items in such a way as to preserve the accounting identity. The only part of this procedure requiring special mention is that to obtain a composite item consisting of total member bank reserves requires adding member bank vault cash reserves—an item not included in the basic sources and uses identity—to member bank reserves on deposit at Federal Reserve Banks.[23] To maintain the accounting identity, vault cash reserves are also added to the composite currency item appearing on the other side of the identity.

The composite item, total member bank reserves, is identically equal to six other items, the exact definitions of which are given later. These six items, in the order in which they are analyzed below, are (1) Federal Reserve float; (2) composite currency account; (3) miscellaneous items consisting of net foreign assets held by the Federal Reserve and the Treasury plus the net value of Federal Reserve and Treasury accounts not included elsewhere; (4) member bank borrowings from Federal Reserve Banks; (5) rounding error item necessary to maintain the identity precisely; and (6) the Federal Reserve's open market portfolio.

This procedure involves no behavioral hypotheses other than those implicit in the construction of the various composite categories. For example, fluctuations in float cannot validly be said to "cause" fluctuations in total member bank reserves because a change in float may be offset by a change in another item on the right-hand side of the identity. Such an offset would be indicated by a negative covariance between float and the other item. Even more significant, the variance of member bank reserves contributed by the noncontrollable items is not always undesired: When the Federal Reserve wishes to change member bank reserves it can often simply permit, say, a currency drain to do the job without relying on open market operations.

Nonetheless, if a reformed system could prevent a noncontrollable item from affecting member bank reserves, the unwanted fluctuations would be eliminated and open market operations could be used to change reserves by the required amount. In this sense, evidence on the sources of variance

23. All of the items in the sources and uses identity are end-of-day figures; the *Bulletin* provides data in the form of weekly averages of end-of-day figures. Vault cash reserves do not appear in the basic identity because under the current reserve requirements their amount for a given statement week consists of average holdings of vault cash two weeks earlier. Prior to September 12, 1968, vault cash reserves consisted of the average of opening-of-day vault cash (equivalent to the previous day's end-of-day amount) so that vault cash reserves equaled vault cash with a one-day lag.

of total member bank reserves can point to areas in which reform might be desirable.

Total member bank reserves and the various right-hand-side items in the reserves identity described above have been processed through the computer to obtain a variance-covariance matrix. Because of the shift to lagged reserve requirements, the total sample period has been split into "period A," which extends for the 246 statement weeks from the week of January 1, 1964, through the week of September 11, 1968; and "period B," for the 171 statement weeks from the week of September 25, 1968, through December 29, 1971. There are thus 245 observations of weekly first differences in period A and 170 in period B. The data are in millions of dollars.

To estimate the probable contribution of a proposed reform to reducing variance calls for allocation of the covariance terms to avoid double-counting, and this is done by assigning the covariance terms to the items in the order in which they are discussed. The order selected to some extent is arbitrary, and to some extent reflects the authors' judgment as to which of the reforms are less controversial and thus of higher priority.

The findings for the two periods are reported in the two parts of Table 1. The variables have been denoted as X_1, X_2, . . . , X_6, and these symbols serve as column heads. The variables X_1 through X_5 will be discussed in turn; X_6 is the government and agency securities portfolio (plus a small amount of bankers' acceptances) and is treated somewhat differently from the other items.

To understand how the table is organized, consider the X_1 column. The entry in the X_1 row is the variance of X_1. The entries in the X_2 through X_5 rows are twice the covariances of X_1 with these other variables. The subtotal row gives the sum of the variance and covariances. In the absence of open market operations, the subtotal would represent the "contribution" of X_1 to the total variance of member bank reserves. The X_6 row is twice the covariance of X_6 and X_1 and shows the extent to which open market operations offset the contribution shown by the subtotal. The last row gives the sum of the subtotal and X_6 rows. Finally, the entries in the "total" row are added to give the "grand total." The grand total is, of course, simply the variance of total member bank reserves.

The results suggest that the introduction of lagged reserve requirements has substantially increased the variance of the weekly change in member bank reserves. (Hereafter, unless the analysis in terms of levels is explicitly mentioned, the phrase "weekly change" will be omitted.) In the first half

Table 1. Matrix of Factors Contributing to Variance of Member Bank Reserves, Two Periods, 1964–71

First differences of weekly observations, in millions of dollars

Period and variable[a]	*Variable*[a]						*Grand total*
	X_1	X_2	X_3	X_4	X_5	X_6	
	Period A: January 1, 1964–September 11, 1968						
X_1	82,256	...	...	...	...	...	...
X_2	−16,620	81,261	...	...	...	...	...
X_3	1,380	−33,486	39,358	...	...	...	...
X_4	−10,715	−15,303	2,608	17,819	...	...	...
X_5	12	42	−17	1	2	...	...
Subtotal	56,313	32,514	41,949	17,820	2	...	...
X_6	−103,412	−110,793	−28,612	28,592	−41	140,061	...
Total	−47,099	−78,279	13,337	46,412	−39	140,061	74,393
	Period B: September 25, 1968–December 29, 1971						
X_1	155,071	...	...	...	...	...	...
X_2	−164,688	127,825	...	...	...	...	...
X_3	−1,744	−23,559	77,198	...	...	...	...
X_4	−22,409	−9,791	−31,761	53,846	...	...	...
X_5	−44	−38	29	−6	8	...	...
Subtotal	−33,814	94,437	45,466	53,840	8	...	...
X_6	−88,441	−55,685	−79,614	30,219	359	194,624	...
Total	−122,255	38,752	−34,148	94,059	367	194,624	161,399

Source: Derived from data in *Federal Reserve Bulletin*, relevant issues, pp. A-4, A-5.

a. X_1 = Federal Reserve float.
X_2 = composite currency—member bank vault cash reserves minus the sum of (a) member and nonmember bank vault cash and (b) the currency component of M_1.
X_3 = gold stock plus special drawing rights plus Treasury currency outstanding plus Federal Reserve loans other than to member banks, minus the sum of (a) foreign deposits at Federal Reserve Banks; (b) Treasury cash holdings; (c) Treasury deposits at Federal Reserve Banks; (d) other deposits at Federal Reserve Banks; (e) other Federal Reserve accounts.
X_4 = member bank borrowing from Federal Reserve Banks.
X_5 = sum of all rounding errors in reserves identity.
X_6 = U.S. government and agency securities bought outright and by repurchase agreement, and bankers' acceptances held by Federal Reserve Banks.

The sum of X_1 through X_6 is equal to total member bank reserves.

of the sample period, the variance of member bank reserves was 74,393; in the second half, the variance was 161,399. No doubt some of this increased variance is simply a scale effect from the growth in the level of member bank reserves from an average of $22.8 billion in the first half to $28.5 billion in the second half. But such a scale effect can account for an increase in variance of only about 56 percent rather than the increase of 117 percent actually observed.

The variance of the Federal Reserve's government securities portfolio (hereafter referred to as "government securities") is 140,061 and 194,624 in periods A and B, respectively, exceeding the corresponding variances for member bank reserves in both cases. Open market operations clearly have a substantial "defensive" element designed to offset the impact on bank reserves of fluctuations in other items. However, the increase in the government securities variance between period A and period B is only 39 percent. Defensive operations were apparently relatively less important in the second than in the first period. The growth in the open market variance was actually less than would be expected from the scale effect, and in period B the variance was smaller relative to that of member bank reserves than it was in A.

The items accounting for the variance of member bank reserves may now be examined in turn, and suggestions for reform to reduce variance will be presented.

FLOAT

Float (X_1) arises from the fact that, when a member bank sends a check to the Federal Reserve for collection, the Fed on average credits the bank's reserve account before debiting the account of the bank upon which the check is drawn. The reduction of Federal Reserve float depends primarily on regulatory changes and investments in modern data processing equipment. Such reforms as the proposed amendments to Regulation J and the establishment of regional check processing centers should sharpen monetary control since fluctuations in float are difficult to predict accurately and, therefore, to offset through open market operations.

Although Table 1 makes plain that the net contribution of float is negative, especially in period B,[24] it would be desirable nonetheless to reduce float. Much of the negative contribution is due to defensive open market operations (X_6) and to member bank borrowing (X_4), both of which might be curtailed if float were reduced. The offset from the com-

24. The explanation for the large negative covariance with X_2 for period B is that, for poorly understood and apparently independent reasons, float and vault cash both have intramonthly patterns in which the float peak is approximately two weeks later than the vault cash trough. At the time of the shift to lagged reserve requirements these patterns were exploited by lagging vault cash reserves by two weeks so that the fluctuations in float and vault cash reserves would tend to cancel out.

posite currency item (X_2) would be unnecessary if the reserve regulations for vault cash were reformed as suggested below.[25]

CURRENCY

The impact of currency on member bank reserves is complex. Three different currency components—the currency component of M_1, member bank vault cash, and nonmember bank vault cash—have been subtracted from member bank vault cash reserves to form the "composite currency" variable (X_2).

As was true of float, fluctuations in composite currency have been offset by defensive open market operations and member bank borrowing. However, the negative covariance between X_6 and X_2 is more than accounted for by the covariance between X_6 and the M_1 currency component of X_2. The M_1 currency component enters X_2 with a negative sign; the covariance between M_1 currency itself and X_2 is positive. To an unknown extent the negative covariance between X_2 and X_6 simply reflects positive covariances among M_1, the currency component of M_1, and X_6 rather than defensive operations. Part of the covariance between X_2 and X_6 should, therefore, appear in the X_6 column of the table, and part remain in the X_2 column.

The aim of the institutional arrangements should be to insulate M_1 from the effects of currency drains. The use of lagged rather than current vault cash in bank reserves in period B insulates bank reserves from currency drains to the extent that banks do not replenish vault cash by drawing down reserves on deposit at Federal Reserve Banks, but this scheme does not necessarily eliminate the impact on M_1. The easiest method of insulating M_1 from vault cash drains (or inflows) would be to deduct vault cash from gross demand deposits in calculating net demand deposits subject to reserve requirements. This proposal is equivalent to counting as reserves a percentage of vault cash that is equivalent to the required reserve ratio against demand deposits. Under this proposal, a currency drain would in the first instance force a bank to reduce deposits by the same dollar amount as the currency drain, thus leaving the money stock unchanged. If the bank then replenished its vault cash by drawing down reserves on deposit at the Federal Reserve—a step that, if not offset, would eventually

25. Besides control problems, float also produces a bias of unknown extent in the measured money stock, as discussed in the next section.

lead to a further decline in deposits—the Fed could easily offset the impact on M_1 by an open market operation. The appropriate magnitude is the currency shipment times the quantity one minus the marginal reserve ratio on net demand deposits. For a perfect offset, the Fed has only to make sure that its own internal accounting system quickly transfers to its open market desk information on its currency shipments to banks.[26]

For a simple example of the effect of this proposal, suppose a bank's customers cash checks for $10,000 against their demand deposits, which have a reserve requirement of 20 percent. The currency component of M_1 would be up, and the demand deposit component down, by $10,000. Under the proposal, neither the bank's net deposits subject to reserve requirements nor its reserves would have changed. If the bank replenished its vault cash by, say, $5,000 by reducing its reserves on deposit at the Fed, then the Fed could buy $4,000 ($5,000 times 0.8) of Treasury bills to offset exactly the effect of the currency drain on member bank reserves.

This proposal would eliminate the impact of currency drains on M_1 precisely with no need for banks to report additional data and with no significant adverse side effects.[27] Under the current system a currency drain may lead banks to begin the adjustment process involving a multiple contraction of deposits before the Fed has the data that show what is happening. With large reserves of vault cash at the present time, banks have no need to replenish vault cash in the face of a currency drain, but they must begin to adjust reserve positions since the smaller vault cash is this week the smaller vault cash reserves will be in two weeks.

MISCELLANEOUS ITEMS

The items lumped together in variable X_3—listed in the note to Table 1—are far from trivial in size and general economic significance. However,

26. For a similar proposal, see Lloyd M. Valentine, "A Proposal for the Automatic Neutralization of Currency Flows," *American Economic Review*, Vol. 68 (March 1958), pp. 111–18.

27. Other things equal, counting only part of vault cash as reserves would tend to reduce bank earnings. If it were desirable to do so, this effect could be offset by reducing the required reserve ratio, just as the new reserve requirements proposals offset the effects of the proposed revisions in Regulation J. The only genuine cost would be the tendency to increased shipments of currency and coin between member banks and the Federal Reserve Banks, and even this could be avoided if the Federal Reserve held some of its currency and coin in the member banks.

monetary policy can exercise control over these items only to the extent of partially offsetting their fluctuations through open market operations. Since all of them appear on the books of either the Federal Reserve or the Treasury, the accounting systems of both agencies should be designed to transmit to the open market desk information on changes in these items as rapidly as possible.

BORROWING

The contribution of member bank borrowing (X_4) to total variance was substantial in both periods. To a considerable extent, as has been noted above, borrowing has offset fluctuations in other items. Suppression of these unwanted fluctuations through the reforms discussed above would obviate the need for such offsets. The positive covariance between borrowing and open market operations is probably due to the fact that both the commercial banks and the Federal Reserve act to offset other items and both react in the same direction when market interest rates change.[28]

The link between member bank borrowing and the existence of reserve requirements is obviously close. The cost to a bank of borrowing from the Fed is the cost the bank must bear when it fails to meet the reserve requirements through its own resources or through borrowing in the private market. Borrowing thus permits some penalty short of closing down the bank to be assessed when reserve requirements are not met.[29]

Monetary control should aim to regulate borrowing so as to minimize its impact on the money stock. We favor tying the discount rate to some money market rate so that it would always be above money market rates by some margin. The imposition of a penalty discount rate should be more acceptable if the adoption of the other proposals discussed in this paper

28. The tendency for the latter reactions to produce procyclical fluctuations in the money stock is one of the arguments favoring greater policy attention to the money stock. During period B, much of which was characterized by greater policy attention to the money stock, the correlation between X_4 and X_6 was 0.15, whereas for period A the correlation was 0.29.

29. The profit-maximizing view of bank borrowing behavior expressed in this paragraph has long been disputed by those who believe that banks borrow primarily because they get caught short as a result of fluctuations beyond their control. This opposing view, it seems to us, is based on an incomplete understanding of the implications of profit-maximizing behavior under uncertainty. For an exposition of this point, see William Poole, "Commercial Bank Reserve Management in a Stochastic Model: Implications for Monetary Policy," *Journal of Finance*, Vol. 23 (December 1968), pp. 769–91.

substantially reduce the reserve fluctuations affecting the banking system as a whole. Disturbances affecting individual banks, but not the system as a whole, can be handled through the interbank federal funds market rather than the discount window. If the discount rate were always above money market rates, the tendency of borrowing to contribute procyclically to the reserve base would be largely eliminated as would the problems the Federal Reserve has in administering the discount window.

GOVERNMENT SECURITIES PORTFOLIO

The Federal Reserve's government securities portfolio is, of course, the principal instrument of monetary policy, but as can be seen from the negative covariances in the X_6 row of the table, a substantial percentage of open market operations is defensive in nature. Indeed, the table understates the extent of defensive operations because disturbances of the type discussed in the previous section are also offset to some degree.

The magnitude of open market operations is substantial. In period B the standard deviation of the change in the Fed's government securities portfolio was $441 million. The direct costs to the Federal Reserve of this trading—the internal administrative costs and the yield spreads charged by dealers in government securities—as well as the costs of imperfect monetary control and greater money market instability could be substantially reduced by the proposals examined above.

Measurement Error

Measurement error in the seasonally adjusted money stock consists both of error in the underlying unadjusted data and in the seasonal adjustment factors applied to them. The importance of data revisions is indicated by an analysis of "preliminary" and "final" data on the monthly average money stock over the 1961–70 period.[30] The "preliminary" figure is the first report for a given month in a *Federal Reserve Bulletin*—for example, the September figure carried in the October *Bulletin*. The "final" data were

30. The analysis of rates of change of the money stock also uses data for December 1960, so that four quarterly and twelve monthly rate of change observations are available for 1961.

taken from the tables in the articles on the annual revisions of the money stock series in the November 1971 and December 1970 *Bulletins.*[31]

Measurement error has great relevance for policy. Suppose, for the sake of the present argument, that the preliminary series is regarded as an early estimate of the final series, which in turn is regarded as the best possible estimate of the "true" series. Since, after all, it is the preliminary series that must be used in day-to-day policy management, the question turns on how accurately the preliminary series predicts the final series. The lower the accuracy of the preliminary series, the less reliable the money stock as an instrument of monetary policy.

In the analysis below several techniques are used to compare the preliminary and final series and to investigate the sources of the discrepancies between the two. Since most of the analysis is conducted on rates of change, to avoid confusion the term "difference" has been reserved for the difference between the two series (or their respective rates of growth) while the term "rate of change" refers to the difference between two months (or quarters) of a given series, always expressed at annual rates.

The value of the preliminary rate of growth for predicting the final rate is shown by the regression of the second on the first. Using seasonally adjusted data and rates of change over quarterly intervals, the regression has a constant term of 1.22, a slope coefficient of only 0.788, an R^2 of 0.679, and a standard error of 1.33.[32] To the extent that the sample period is representative, a preliminary rate of growth of, say, 10 percent for a quarter would produce a point estimate of the final rate of growth of 1.22 plus 0.788 times 10.0, or 9.10 percent. However, the standard error implies a one-in-three

31. Data are available earlier publicly from "Federal Reserve Statistical Release H.6" (weekly), and even sooner internally. Defining data from the *Bulletin* as "preliminary" was convenient from the point of view of data collection and is fully satisfactory for analyzing the importance of revisions. The quotation marks used up to this point remind the reader that data are available even before the "preliminary" publication, and that still further revisions will most likely alter the "final" figures. They will be dropped hereafter, however. It should be noted that the preliminary rate of growth series is computed from the monthly money stock figures shown in a given *Bulletin*. For example, the preliminary rate of growth for September is calculated from the August and September figures as reported in the October *Bulletin*. Unless indicated otherwise, all rates of growth are expressed at annual rates. The rate of quarterly growth is defined by taking the change in the monthly average level of the money stock in the last month of the quarter over the last month of the previous quarter.

32. The same regression with constant term suppressed has a coefficient of 1.018 and a standard error of 1.47.

chance that the final rate of growth will be *outside* the range 7.77 to 10.43 percent. This range is great enough to warn against strong policy action, for example, to slow money growth one quarter on the grounds that the 10 percent growth reported for the previous quarter was too high.

The situation is even worse with respect to rates of monthly change of seasonally adjusted data. The regression of final on preliminary has an R^2 of only 0.55; the constant term is 2.32 and the regression coefficient, 0.478. With a standard error of 2.40 the predictive value of this regression is obviously low.

That the difficulties are caused to a considerable extent by the seasonal adjustment is shown by the superiority of the results using unadjusted data. Using quarterly data, the regression of the final on the preliminary rate of change has a constant term of 0.53, a regression coefficient of 0.972, an R^2 of 0.989, and a standard error of 1.13. Using monthly unadjusted data, the regression yields an R^2 of 0.990, a constant term of 0.42, a slope coefficient of 0.970, and a standard error of 1.70.

The seasonally adjusted money stock is, of course, revised to reflect revisions in both the underlying data and the seasonal factors. The relative importance of these two sources of revision is indicated by an analysis of the time series of differences between final and preliminary rates of change of seasonally adjusted quarterly data. The variance of this series, 1.99, may be divided into three parts: (1) the variance of the difference between the final and preliminary rates of change of unadjusted data, 1.33; (2) the variance of the difference between the rates of change of the final and preliminary seasonal factors, 1.48; and (3) twice the covariance between the first and second, -0.82.[33]

According to this evidence, revisions in underlying data and in seasonal factors are of roughly equal importance in explaining those in the rate of quarterly growth of the seasonally adjusted money stock. When the same

33. Algebraically, if Y_t and y_t are, respectively, the final seasonally adjusted and unadjusted money stock figures, and if X_t and x_t are the corresponding preliminary figures, the seasonal factors are $S_{yt} = y_t/Y_t$ and $S_{xt} = x_t/X_t$. Thus, if

$$\left[\log \frac{Y_t}{Y_{t-1}} - \log \frac{X_t}{X_{t-1}}\right] = A, \quad \left[\log \frac{y_t}{y_{t-1}} - \log \frac{x_t}{x_{t-1}}\right] = B, \quad \text{and}$$

$$\left[\log \frac{S_{yt}}{S_{y(t-1)}} - \log \frac{S_{xt}}{S_{x(t-1)}}\right] = C,$$

then $A \equiv B - C$. By a standard theorem in statistics, Var $(A) \equiv$ Var (B) + Var (C) − 2Cov(B, C). (Natural logarithms are used throughout since their first differences are approximately equal to percentage differences.)

analysis is performed on rates of monthly change it is found that the difference between the final and the preliminary rates of change for seasonally adjusted monthly data has a variance of 14.14. Of this variance only 3.17 is contributed by the difference between the final and the preliminary rates of change for seasonally unadjusted monthly data; 12.21 arises from the difference between the final and the preliminary rates of monthly change of seasonal factors, and −1.24 from the covariance of these two items. The significance of the negative covariance terms will be discussed below.

If the final series provides a measure of the money stock appropriate for policy purposes, the above analysis demonstrates that the preliminary series is far from fully satisfactory. Naturally, the longer the period considered, the more accurately will the preliminary rates of growth predict the final rates. Furthermore, very short-run fluctuations in money growth probably have little impact on aggregate economic activity. But a real problem exists if the growth rate of money over a period as short as three months is important, because abnormally high or low growth draws responses from the financial markets that tend to produce abnormal money growth over longer periods.[34] In any event, data errors can only complicate monetary management.

ERRORS IN THE UNDERLYING DATA

For the unadjusted data, a reasonable assumption is that the final series is more accurate than the preliminary series; only the revisions arising from definitional changes are sometimes questionable. The most important revisions in recent years have been connected with the troublesome commercial bank account, "cash items in the process of collection." Cash items, and the similar item, "Federal Reserve float," on the books of the Federal Reserve System, arise from the check-clearing process and both are deducted from gross private demand deposits to obtain the demand deposit component of the money stock.[35] The measurement problem arises because both cash

34. The findings discussed above confirm those of an earlier study based on data through the middle of 1969. Since that study preceded the 1970 change in the definition of the money stock, the findings here cannot be ascribed primarily to a nonrecurring definitional change. For the earlier study, see William Poole, "Rules-of-Thumb for Guiding Monetary Policy," in *Open Market Policies and Operating Procedures—Staff Studies* (Board of Governors of the Federal Reserve System, 1971), pp. 135–89, esp. pp. 176–77.

35. For the reasons underlying this treatment, see, "A New Measure of the Money Supply," *Federal Reserve Bulletin*, Vol. 46 (October 1960), pp. 1108–12.

items and float incorporate some transactions not associated with private demand deposits; deducting all cash items and float thereby introduces a downward bias into the money stock series.[36]

Measurement error due to cash items connected with, first, Eurodollar borrowing and, second, the activities of agencies and branches of foreign banks operating in the United States and of subsidiaries of U.S. banks organized under the Edge Act, was found to be important in 1969 and 1970, and led to substantial revisions in the money stock series in those years.[37] Perhaps in part because of the practical impossibility of separating cash items and float into the categories that should and should not be deducted from gross deposits, the money stock concept itself was changed at the time of the 1970 revision to include the liabilities of foreign agencies and Edge Act corporations. As cash items and float shrink in the future through changes in Federal Reserve regulations and improvements in data processing facilities, the effect is likely to be a reduction of current downward biases and therefore an overstatement of rates of growth of the money stock.

Another important source of measurement error is the estimation of nonmember bank deposits. Reports from nonmember banks are available only twice a year on call dates; between call dates data are estimated on the assumption that, after adjusting for trend, these deposits are a constant fraction of the deposits of country member banks. The problem is growing worse. According to data from December call dates, nonmember banks accounted for 16 percent of total demand deposits adjusted in 1947; by 1961 the ratio had risen to 18 percent, and it rose to 24 percent in 1971.

As some measure of the seriousness of the problem, the revisions of the money stock arising from the call date information have a standard deviation of $379 million as calculated from the twenty-three call dates from June 1960 through June 1971. This standard deviation is about 1.4 percent of average nonmember bank demand deposits over this period. Since the call dates are six months apart, the standard deviation of the estimation

36. The problem would not, of course, arise if money were defined to include gross deposits rather than deposits net of cash items and float. While definitional problems are beyond the scope of this study, this particular problem would be eliminated by the reduction in cash items and float that is desirable on other grounds in any case.

37. See "Revision of Money Supply Series," *Federal Reserve Bulletin*, Vol. 55 (October 1969), pp. 787–803; and, "Revision of the Money Stock," *Federal Reserve Bulletin*, Vol. 56 (December 1970), pp. 887–909. Edge Act subsidiaries engage in international banking.

errors amounts to an annual rate of about 2.8 percent of nonmember bank deposits, or of about 0.6 percent with respect to total commercial bank demand deposits at the present time.

Although the error of 0.6 percent at annual rate seems small, the nonmember bank error is a significant portion of the total measurement error affecting the unadjusted data. It will be recalled that the regression of the final on the preliminary rate of quarterly change using unadjusted data has a standard error of 1.13. The errors generated by the tardy data on nonmember banks are growing and must be reduced eventually if monetary control is to become more precise.

ERRORS IN SEASONAL ADJUSTMENT

While the revisions of the underlying data generally can be accepted as improving accuracy, it is an open question whether the final seasonal factors are more accurate than the preliminary ones. The revisions occur because the method of seasonal adjustment—the Census X-11 program plus "professional review" by Federal Reserve statisticians—determines the seasonal factor using data for several years before and, when available, after the month in question. Of course, none of the "after" data are available when the preliminary series is constructed but as time passes the additional data enter calculations of revised seasonal factors for the final series.

The most important analytical point to be made is that the seasonal adjustment of variables controlled by policy must be carefully distinguished from that of variables that are not controlled. The aim of seasonal adjustment of data on noncontrolled variables is to eliminate recurrent seasonal patterns so that cyclical and other patterns may be more easily identified. But seasonal patterns of policy-controlled variables result from what the policy makers do. For a noncontrolled variable, the problem is optimal *estimation* of seasonal factors; for a controlled variable the problem is optimal *determination.*

This point is relevant because the 1970 policy shift involving heavier emphasis on the money stock relative to interest rates has not been accompanied by any change in the seasonal adjustment procedure. Under current procedures, the selection of seasonal factors for the money stock is equivalent to the selection of a seasonal policy. Such policy in one year ought not to hinge, for example, on a change in policy the previous year that X-11 builds into estimated seasonal factors. If policy makers deliberately (or acci-

dentally) spurred money growth in the first half of a year and then restrained it in the second, the seasonal factors calculated by X-11 for the next year would be affected. Whether or not there were any reason in the second year to make unadjusted money growth higher in the first half and lower in the second half, the use of the standard seasonal factors would tend to produce this result.

This problem is not simply hypothetical. Seasonally adjusted money growth was higher in the first half than in the second half of both 1970 and 1971. The ex post revisions of the seasonal factors will bring the growth rates in the two halves of each year closer together than originally reported. That the seasonal factors do change is indicated by the following table, which shows the growth rates[38] for the first and second halves of 1970 calculated from the preliminary and revised data on the seasonally adjusted money stock, as reported by the January 1971 and November 1971 issues of the *Federal Reserve Bulletin.*

	1970	
Issue	*First half*	*Second half*
January 1971 *Bulletin*	6.0%	4.8%
November 1971 *Bulletin*	5.7	5.3

The seasonally adjusted money stock series reported in the January 1972 *Federal Reserve Bulletin* shows growth rates of 10.2 and 2.4 percent, respectively, for the first and second halves of 1971. The disparity between these rates will probably narrow in the annual revision of the annual money stock series to be published in the *Federal Reserve Bulletin* in the fall of 1972. These revised seasonal factors ought not to be mechanically incorporated into policy making in 1973.

The Federal Reserve should, at the end of each year, explicitly decide the seasonal policy for the next. This policy can be most conveniently expressed in terms of a set of seasonal factors, which will allow stabilization decisions to be made in terms of the resulting seasonally adjusted money stock. The same seasonal factors would be used in constructing the final money stock series since they describe the current seasonal policy. The fact that such seasonal factors would in general differ from those produced by the X-11 program is irrelevant.

38. Continuously compounded annual rates of growth from December 1969 to June 1970 and from June 1970 to December 1970.

One side effect of the use of predetermined seasonal factors would be a less smooth final money stock series. The negative covariance between revisions in the underlying data and in the seasonal factors is one manifestation of the smoothing performed by the X-11 technique. If revision of the underlying data tend to produce an outlier, revision of the seasonal factor for that observation tends to eliminate it. The overall extent of smoothing is indicated by the fact that the variance of the rate of quarterly change of the final series is 5.48 percent, while the variance of the preliminary seasonally adjusted rate of quarterly change series is 6.07 percent; the corresponding figures for rates of monthly change are 12.79 and 30.97, respectively, for final and preliminary. Smoothing through revision of seasonal factors is also the reason why the slope coefficients in the regressions reported above of final on preliminary rates of change are so far below unity.

That smoothing pure and simple is involved is suggested by the seasonal factors for the money stock over the postwar period. They yield no evidence of major changes in M_1 seasonals except for the shift of the tax date from March 15 to April 15 in 1955. To support the changing seasonals model it would be necessary to show, for example, that the seasonal factors computed by X-11 have a recognizable trend. Instead, as shown in Figures 1 and 2, the fluctuations in the money stock seasonals appear to have occurred in a narrow range and to have served primarily to smooth the final seasonally adjusted series.

Smoothing may well be justified insofar as the purpose of seasonal adjustment is to obtain the best possible estimate of the trend-cycle component of a series. For this purpose it does not really matter how much of the remainder of the series is called "seasonal" and how much "irregular." Thus the final seasonally adjusted money stock may be a very satisfactory estimate of the trend-cycle component, plus random noise that may consist of "smoothed irregular."[39] But an unsmoothed series seems more desirable to avoid the incorporation of irregular components into seasonal factors and to permit the analyst to smooth according to his own purposes.

The argument for smoothing the money stock is that one outlier—even several—is no cause for concern. This point of view, however, should find

39. This argument is our interpretation of recent work on the theory of seasonal adjustment. See D. M. Grether and M. Nerlove, "Some Properties of 'Optimal' Seasonal Adjustment," *Econometrica*, Vol. 38 (September 1970), pp. 682–703; Marc Nerlove, "Spectral Analysis of Seasonal Adjustment Procedures," *Econometrica*, Vol. 32 (July 1964), pp. 241–86.

Figure 1. Rate of Growth of Monthly Seasonally Adjusted Money Stock, 1961–70

Percent annual rate

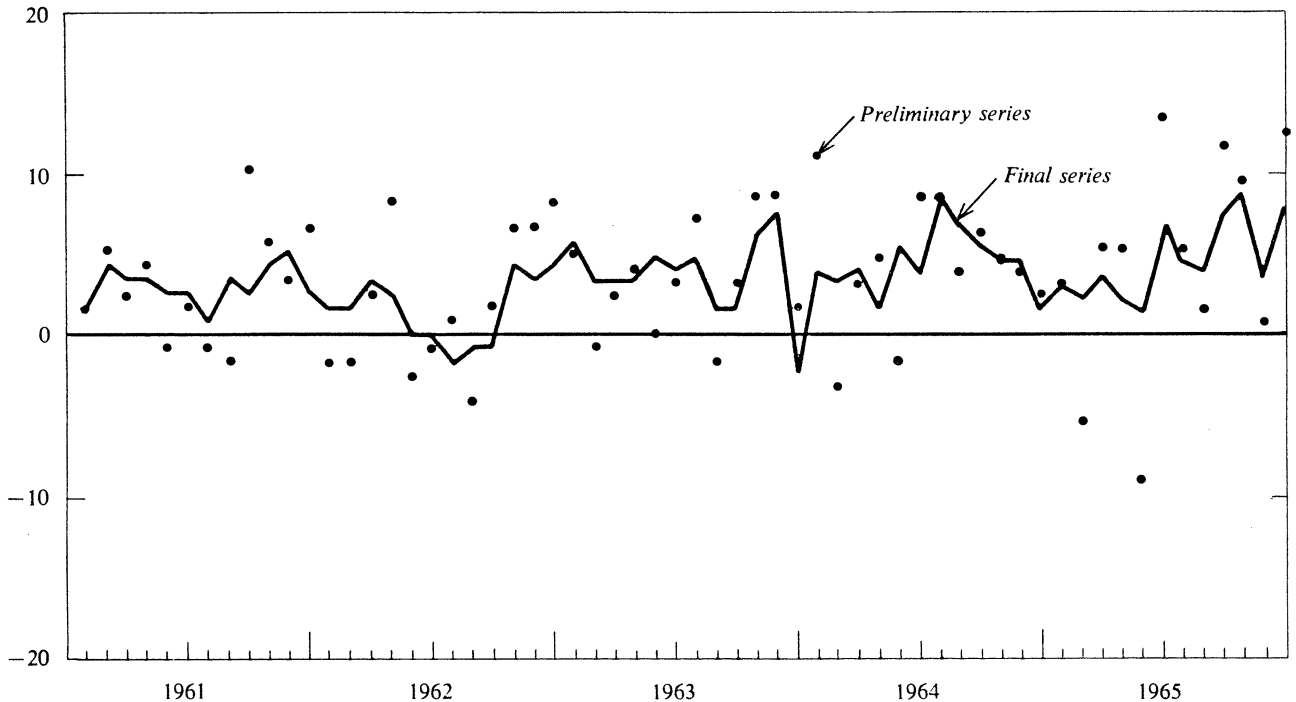
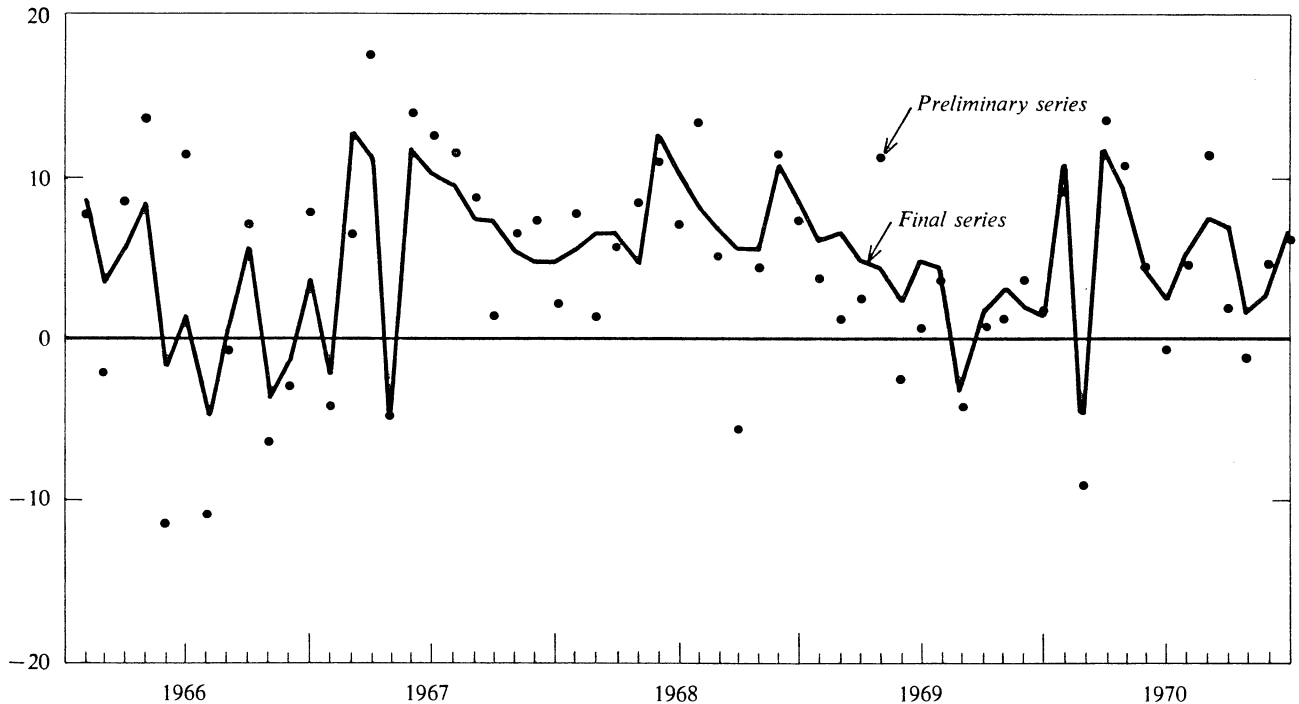


Figure 1. (*continued*)

Percent annual rate



Sources: Preliminary series, *Federal Reserve Bulletin*, issues in which first estimate for a given month is published, with changes calculated from the preceding month as reported in that issue; final series, *Federal Reserve Bulletin*, Vol. 57 (November 1971) and Vol. 56 (December 1970), table in article, "Revision of the Money Stock," in each issue.

Figure 2. Seasonal Factors for the Preliminary and Final Money Stock Series, Monthly, 1961–70

Seasonal factors

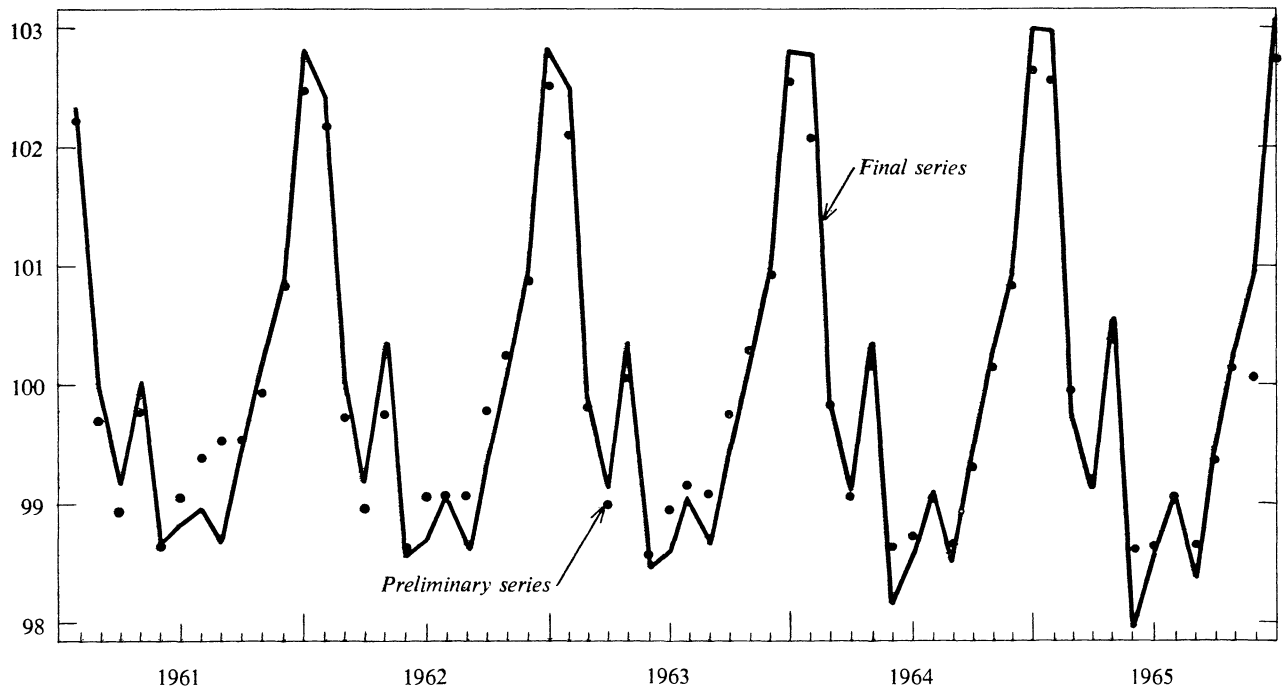
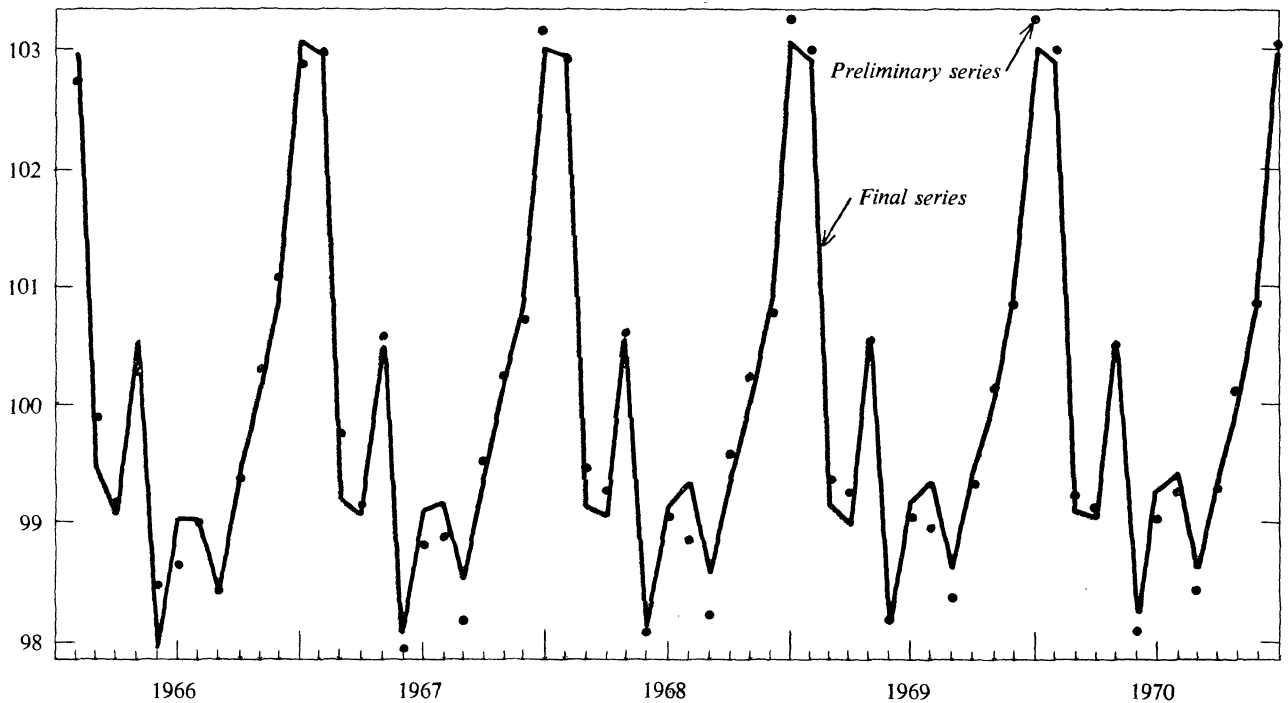


Figure 2. (*continued*)

Seasonal factors



Source: Board of Governors of the Federal Reserve System.

expression in the way policy reacts to outliers rather than in the way the data are reported. Outliers are frequently signals that something is happening that requires remedial action; they ought to be investigated rather than artificially smoothed away; one of the dangers of the X-11 model is that outliers are all too easily explained away by a superficial appeal to changing seasonals.

The realization that most of the revisions in seasonal factors for the money stock are connected with smoothing actually makes the task of policy determination somewhat easier. Since the factors have changed relatively little in the past, seasonal goals should be readily achievable once they are established. Unfortunately, little work has been done on this question.

Tentatively, we conclude that efficient resource allocation requires the monetary authorities to eliminate seasonality in interest rates arising from seasonality in the demand for money, while giving full scope to seasonality in interest rates arising from that in aggregate demand. Seasonal fluctuations in interest rates arising from the arbitrary selection of tax dates can serve no useful function, while those arising from the Christmas shopping season may tend to reallocate demand and production into slack seasons. In terms of the simple Keynesian model of the economy, monetary policy should remove seasonality from the *LM* function but not counter seasonality in the *IS* function.

Until the full analysis of optimal seasonality for monetary policy is worked out, a freeze on the money stock seasonal factors at current values probably would be desirable. As can be seen from Figure 2 and Table 2, these factors have not changed dramatically in recent years; rather they have tended to cluster around the factors computed by a version of the X-11 program that generates fixed seasonal factors, using data for the 1955–71 period.

This inherited pattern of money stock seasonals, however, is associated with substantial interest rate seasonals, as the last column of Table 2 suggests. This amount of seasonality in interest rates is not surprising: Federal Reserve policy over this period generally sought to damp interest rate movements—both cyclical and seasonal—except when it deliberately aimed at pushing interest rates one way or the other. Thus, a seasonal pattern remained because movements in rates were damped rather than eliminated.

Further analysis may show that either more or less interest rate seasonality would be optimal. Some insight into the magnitudes can be gained from estimation of two polar cases: the additional interest rate seasonality

Table 2. Seasonal Factors for Money Stock and Treasury Bill Rate, 1955–71 Period

Month	*Variable factors for final money stock (range over 1961–71)*	*Fixed factors (estimated 1955–71)*	
		Money stock	*Three-month Treasury bill rate*
January	102.3–103.0	102.5	104.8
February	99.0–100.0	99.8	100.0
March	99.0– 99.2	99.1	96.0
April	100.0–100.6	100.3	95.7
May	98.0– 98.6	98.4	94.0
June	98.6– 99.2	99.1	95.2
July	99.0– 99.4	99.2	94.3
August	98.4– 98.7	98.7	99.3
September	99.3– 99.5	99.4	103.2
October	99.9–100.3	100.0	104.6
November	100.8–101.0	100.8	105.3
December	102.8–103.0	102.7	107.5

Sources: Same as for Figures 1 and 2.

that would occur if money seasonality were eliminated, and vice versa. These calculations rely on estimates of the interest elasticity of the demand for money and estimates of the money stock and bill rate seasonals. Studies reviewed by Laidler suggest an interest elasticity of demand for M_1 with respect to the short rate of interest of -0.17 to -0.20.[40] Since maximum and minimum money stock seasonals are currently about 3 percent above and 2 percent below the yearly average, respectively, in the absence of money seasonals the interest elasticity estimates would imply interest rate seasonals of five to six times this amount in addition to the seasonality already present. For a Treasury bill rate averaging 5 percent over the year, the additional seasonal fluctuation would range between 0.75 to 0.90 percentage point above, and two-thirds of this amount below, the 5.0 percent average. Eliminating the interest rate seasonal would require widening the range of the money stock seasonal 1.2–1.5 percent at the high end and 1.0–1.2 percent at the low end. These estimates of the increased seasonality in one series resulting from eliminating that in the other are by no means insignificant, but neither are they large relative to the cyclical variability in the two.

40. David E. W. Laidler, *The Demand for Money: Theories and Evidence* (International Textbook, 1969), Ch. 8.

In sum, should elimination of seasonals from either the money stock or the bill rate be deemed desirable to promote economic efficiency, no practical difficulty should arise in doing so.[41]

To promote clear policy analysis, the Federal Reserve should select each year a set of factors to represent the seasonal aspects of monetary policy. With this approach, the rate of money growth can in principle be divided into four parts: (a) growth for long-run needs and for cyclical stabilization; (b) growth for seasonal stabilization; (c) growth in response to short-run, unpredictable developments in the financial markets; and (d) random, unintended growth due to the inevitable errors in reaching policy targets and in the underlying data. The preliminary and final seasonal factors for the money stock would always be identical. Decisions on seasonal policy would be explicit and they would be made by the Federal Reserve rather than by a computer program.

Summary

As the arguments favoring increased policy attention to the money stock have gained acceptance, the ability of the Federal Reserve to control the money stock has become a more prominent issue. The simple theoretical model presented earlier in this paper demonstrates that imprecise monetary control tends to aggravate the instability of both income and interest rates. In order to present a broad view of the control problem an effort has been made to analyze all of the major sources of control errors and construct as comprehensive a list of reforms as possible. While analysis has been concentrated on the technical aspects of the proposed reforms, it must be recognized that implementation of reform must await analysis of the entire range of economic effects of the reforms. Since extremely accurate control seems possible within the present institutional framework, the proposed reforms do not go outside it. For example, in designing reforms, we have

41. Several studies have found substantially lower interest elasticities of demand for money than those discussed by Laidler. An estimate as low as -0.05 would point to interest rate seasonals in the absence of money stock seasonals of about four times those discussed in the text. Especially in the seasonal context, these low estimates seem implausible for a variety of reasons. Nevertheless, they suggest that a transition period is in order if seasonals are taken out of the money stock in order to test the reactions in the financial markets.

ignored the fact that a system of 100 percent reserve requirements would eliminate disturbances arising from fractional reserve banking, and that freely flexible foreign exchange rates would protect the domestic money stock from foreign influences.

The improvement of monetary control calls for separate reforms no one of which can, by itself, solve the control problem. And so, in the order of the discussion in the paper, here is the reform shopping list:

(1) Eliminate reserve requirements against Treasury deposits in commercial banks.

(2) Require all nonmember banks to adhere to the Federal Reserve reserve requirements specified for member banks.

(3) If M_1 is accepted without qualification as the definition of money for policy purposes, eliminate reserve requirements on time and savings deposits.

(4) Abandon lagged reserve requirements in favor of contemporaneous reserve requirements.

(5) Amend regulations and invest in additional data processing equipment to reduce Federal Reserve float to the greatest extent possible.

(6) Change the treatment of vault cash in the reserve requirements so that only a percentage, equaling the marginal reserve requirement on demand deposits for each bank, is allowed as reserves.

(7) Set the discount rate so that it is always above money market rates of interest, and end administrative control over member bank borrowing.

(8) Until item (2) is implemented, require all nonmember banks to furnish deposit and vault cash data to the Federal Reserve more frequently.

(9) Determine seasonal factors for the money stock as an expression of the seasonal aspects of monetary policy rather than by standard seasonal adjustment techniques. Since these seasonal factors would define seasonal monetary policy they would not be subject to later revision.

Comments and Discussion

David Fand: The Poole and Lieberman paper, "Improving Monetary Control," offers a menu of recommended changes to improve the implementation of monetary policy. This informed and timely analysis of our present complicated reserve requirements suggests that our banking laws and regulations were not designed to facilitate monetary control; indeed, until recently, the money stock was not considered among the primary objectives of monetary policy. The inherited system of reserve requirements complicates the relation between reserves and deposits and necessitates "defensive" operations. Poole and Lieberman make an excellent case for reforms to improve the central bank's control of money.

I have three specific comments on the paper. I wonder whether a "domestic" money concept—the official money stock less dollar balances held by foreigners or other central banks—should not receive more consideration. "Domestic" money—that is, money available for the purchase of goods and services in the United States—may be more relevant for analyzing American economic activity than the official series. One recent attempt to calculate domestic money suggests that its movements may not coincide with the official money series.

Poole and Lieberman assume that lagged reserve requirements may interfere with monetary control. This is certainly a plausible hypothesis, but not self-evident, since it does depend on bank portfolio behavior. It would be desirable, therefore, to investigate its effects on monetary control. Some very preliminary studies for the Canadian money supply suggest that lagged reserve requirements do not appear to lessen monetary control.

The paper utilizes supply of, and demand for, reserves as a framework to outline changes that would improve monetary control. But it may be desirable to cast this analysis in terms of a money supply function (or a money

multiplier framework) in order to consider systematically all the factors that affect the money stock.

This paper on "improving money stock control" also reveals the distance traversed in the past decade. At such a session ten years ago, the paper would have focused on whether there was any point to controlling money. The Fed, it was argued, can control banks, but not intermediaries; and its actions to restrict bank deposits were neutralized by offsetting expansion of intermediary claims. Our experience in the 1960s suggests that tight credit may have an even more restrictive effect on the intermediaries; hence, the concern with disintermediation. Perhaps because of the accelerating inflation, we are now discussing the mechanics of controlling money and relatively less its possible futility.

A frequent question is why so very few countries and central banks have attempted to control the money stock, and the suggestion is that such control is either undesirable or impossible. I question this conclusion and suggest that governments have not focused on controlling money because it is, historically speaking, a relatively new issue of policy.

Monetary policy as one of the main tools in stabilization policy is a subject that developed after World War I. The mechanics of central banking, such as the effect of open market operations on bank reserves, was not discovered until the 1920s, and was certainly not understood at the time that the Federal Reserve System was first set up. And the Federal Reserve was expected to provide an elastic currency and to facilitate the legitimate needs of business, but not to control the money stock.

During the twenties the Federal Reserve, in its famous *Tenth Annual Report*, defined its primary role to accommodate commerce and business; and emphasized its responsibilities for credit policy rather than money. The Federal Reserve partially accepted a real-bills view of central banking. During the controversies surrounding price level stabilization in the 1920s, the Fed objected to having a price stability objective written into the Federal Reserve Act.

After the Great Depression, money was assumed to have very little impact on economic activity, and only after the monetary revival in the 1950s did monetary policy begin to receive any real attention. Thus, it is only in the last decade that the question of controlling money has been perceived as a central banking issue.

Central banking history in the United States reveals two distinct approaches: One approach views the primary responsibility of the central

bank in terms of the legitimate needs of business and orderly credit markets; the other, in terms of the macroeconomic effects of changes in deposits. If the bankers' approach emphasizes "accommodation" and the credit aspects of central banking, the economists' approach emphasizes "control" and the monetary effects of central banking.

The recent changes in the Federal Open Market Committee directive from a relative emphasis on money market conditions to the aggregates can be traced back to the accommodation and control approaches that first surfaced in the 1920s. This issue does not involve monetarism and fiscalism, but relates to the "quantitative" and "qualitative" approaches, or what Lauchlin Currie called "the monetary theory vs. the commercial loan theory of banking."[1] The influence of economists on central banking policy has become more significant in the last decade, and they tend to favor the control over the accommodation view. This is perhaps one reason why the monetary aspects of central banking are currently receiving more emphasis, and why the money stock control question was not on the policy agenda until very recently.

In conclusion, let me emphasize that the role of money stock control in stabilization policy is far from settled. That better control of money is desirable is not really in dispute but this does not tell us the extent to which our stabilization performance may thereby be improved. This, in my opinion, is the important question for the future.

Stephen M. Goldfeld: I found the Poole-Lieberman paper interesting and stimulating. I would like to compliment the authors especially for attacking such a broad range of issues. Indeed, in terms of policy recommendations per square inch, it outdistances any other paper that I have read recently.

In the first part of the paper, Poole's earlier model is extended to the case in which monetary control is imperfect rather than precise. The authors illustrate well the consequences of that slippage and show that it creates the presumption that improved control of the money supply increases the stability of income and interest rates. That presumption becomes the key rule of the game for the rest of the paper.

Of necessity, however, that simple aggregate model cannot tell us how best to control money or how much we can gain by controlling it better.

1. Lauchlin Currie, *The Supply and Control of Money in the United States* (Harvard University Press, 1934), p. 34.

Hence the paper has to step outside the model to support and evaluate its recommendations; it does so in terms of a variety of more or less separate and unintegrated considerations. For example, the benefits of the proposals to remove reserve requirements on time deposits and government deposits are evaluated by analyzing the variance of total reserves and then examining the variance of required reserves on various types of deposits, taking proper account of all the covariances. These calculations are above question and they are illuminating. But they are nonetheless subject to different interpretations.

I can offer several reasons why one should be cautious in treating these calculations as indicative of the gains from implementing these proposals. First, eliminating reserve requirements on time deposits, for example, would not necessarily generate the benefits that Poole and Lieberman cite, because banks might well hold some reserves against these deposits voluntarily and hence keep the effective reserve ratio on time deposits above zero. Second, to the extent that the Federal Reserve deliberately offsets deviations in government deposits or time deposits with open market operations or other actions, no instability is transmitted to the money supply. The covariances shed some light on the extent to which such an offset took place in the sample period, but they are not conclusive evidence. As Poole and Lieberman themselves point out, part of the predictable variation that could have been offset by the Federal Reserve might, indeed, simply have been allowed to occur as a deliberate choice of a convenient way of conducting monetary policy. For example, if government deposits were changing in the right direction and that helped to move the money stock in the desired manner, the policy makers might simply have let the change happen without offsetting it. To make judgments on the importance of various types of disturbances, one ideally needs to know how well the Federal Reserve predicted them over the sample period and, given that prediction, how they consciously acted to allow or prevent them from occurring. Obviously that kind of knowledge is not available, but results obtained without it must be interpreted with care.

In their variance analysis, the authors choose a weekly period as the time unit. There is no way to defend (or to criticize) that choice because there is no consistent theoretical model to guide such a choice. The weekly variance presumably assumes that policy makers should attempt to control money on a weekly basis, but nothing in the paper gives us any reason to prefer that over a daily or monthly criterion. And the differences in the empirical re-

sults might be large if the calculations were performed on different time units.

Controlling the money supply is obviously not the authors' only policy objective. If it were, Poole and Lieberman would not merely recommend the abolition of reserve requirements on time deposits, but would go to the extreme position of applying a 100 percent reserve requirement on demand deposits—a reform that would clearly make the money stock subject to perfect control. I infer that the authors would not be enthusiastic about certain changes in the structure of the financial system that would follow from 100 percent reserve requirements. Neither would I. A different kind of world would prevail with 100 percent reserves and in that world the control of the money supply might be less relevant and less interesting.

The proposal for abolition of reserve requirements on time deposits is a more relevant and reasonable proposal; but, by the same token, it also would alter the structure of the financial system as well as contributing to improved control of the money stock. In evaluating the Poole-Lieberman proposal, I would feel more confident if I had a clearer view of the likely impacts on the financial structure and, in turn, on economic stability. My concern can be illustrated with one specific example: If the reserve requirement on time deposits were lowered to zero, the banks would become able and willing to increase interest payments on time deposits, given any set of interest rates on short-term securities. Presumably the interest rate on time deposits would move up relative to market interest rates and would move more nearly parallel to them thereafter. Depending on the relative importance of time deposit rates and market interest rates as determinants of the demand for money, the interest elasticity of the demand for money would be changed. It is not clear whether such changes would facilitate or impede economic stability, but certainly that issue should be evaluated along with the benefits of improved monetary control. Another side effect of dropping reserve requirements on time deposits would be the strengthening of the competitive position and profitability of commercial banks relative to other intermediaries. This may be a minor issue; but it deserves some consideration.

I understand why the authors want to focus solely on the objective of improving monetary control; but the point I want to emphasize is that they cannot really abstract from all other considerations, and in fact they do not do so consistently. The accuracy of monetary control is not the only interesting question; the broader questions of the benefits stemming from im-

proved monetary control and the possible costs of implementing more precise controls are important. These added tasks require a much more comprehensive and elaborate model of the economy than the authors or anyone else now has available; I hope that Poole and Lieberman will contribute further to our knowledge by moving in that direction in the future.

General Discussion

F. Thomas Juster emphasized the importance of the span of time over which the money supply deviates from the target. The cost of imperfect control of money has to be negligible over time periods of an hour or a day, Juster observed, but obviously becomes sizable over some longer, meaningful span of time. He doubted that the relevant period was as short as a week, as the paper implicitly assumed by studying the variance of weekly observations. On the other hand, Juster felt that very short-run swings in interest rates could be costly.

In a similar vein, Franco Modigliani reported that James Pierce of the Federal Reserve Board staff had found that the particular profile of a money supply path obtained over a six-month period has little lasting effect thereafter. In other words, the economic and financial impact from the third quarter on will be very much the same regardless of whether a given money increase in the first two quarters was generated by smooth growth or uneven growth within those quarters. Although Modigliani cautioned that these findings were tentative, he suggested that they reinforced Goldfeld's and Juster's comments on the need to determine the relevant time period for monetary control before definite conclusions are reached on the desirability of major institutional reforms.

William Poole explained his use of weekly data, noting that Federal Reserve regulations cover weekly activities and hence data are generated on a weekly basis. He understood the concern about the relevant time period, but he emphasized that the paper addressed a different set of questions. The present institutional structure of banking has been developed over decades; virtually no attention has ever been given to the ways that structure impedes or facilitates monetary control. The empirical work in the paper catalogs the nature and sources of the problems of controlling money, as they relate to the institutional structure. Documenting the sources of weekly variance is not the same as arguing that money should be controlled on a

weekly basis, Poole emphasized. He did feel that, if the money stock fluctuated, it should do so for a good reason—such as a conscious desire to smooth interest rate movements or to stimulate the economy—and not because of mistakes or unforeseen shifts. Charles Lieberman added that, from an eclectic point of view, those who emphasize the importance of interest rate fluctuations should favor reforms to reduce the impact on interest rates of money supply disturbances. Also, since private financial and business executives watch the movements of the money stock closely as indicators of economic activity and of Federal Reserve policy, erratic fluctuations in these variables can destabilize economic expectations and behavior.

John Kareken agreed that the authors presented a strong case that the adoption of their reforms would contribute to the stability of GNP. By cutting the variance of the money stock for a given volume of reserves, the reforms should also reduce the variance in GNP for a given stock of reserves. But Kareken felt that, unless and until these reforms were made, the presence of "banking disturbances" really argued for exercising short-run monetary control through the federal funds rate rather than through the stock of reserves.

Stephen Goldfeld questioned the conclusion of Lieberman and Kareken on the contribution of the reforms to economic stability. He contended that the effect on the variation of income was ambiguous, and only quantitative examination of all the factors involved could resolve the issue.

Kareken also reinforced the authors' criticisms of lagging reserve requirements. The lagged requirement was initiated by the Federal Reserve for two quite different reasons: to attract a larger membership of commercial banks into the system and to ease the task of hitting a free reserve target. However, now that free reserves receive less attention from the monetary authorities, Kareken saw little reason for keeping the lagged system. Similarly, Modigliani agreed with Poole and Lieberman that the reserve requirements on Treasury deposits should be abolished. But he and several of the panel concluded that further study would be required before the reserve requirement on time deposits should be changed or eliminated.