Money Stock Control

ALBERT E. BURGER*

The Federal Reserve stated in 1960, when it began publishing a separate and distinct money stock series, that:

> The amount of money in existence and changes in this amount influence the course of economic developments. . . .
>
> The Federal Reserve System has primary responsibility for regulating the total volume of money available to meet the public's demands.[1]

Over the next 10 years a major controversy developed over whether the Federal Reserve recognized or placed enough emphasis on its responsibility for controlling the growth of the money stock. The related question of which operating strategy to follow in controlling the money stock was pushed to the background.

Economists can argue at great lengths over the extent to which the Federal Reserve tried to control money in the past. However, one thing is clear: since early 1970, the Federal Open Market Committee (FOMC) has moved in several stages to a position of placing more emphasis on controlling the money stock, relative to other objectives, than had previously been the case. Along with this move, there have been increased scrutiny of the current operating strategy and an analysis of the problems involved in controlling growth rates of monetary aggregates.

In the spring of 1969 Chairman Martin appointed a subcommittee within the Federal Reserve under the leadership of Governor Sherman Maisel to study means of improving open market operations. The Maisel Committee focused on the problem that, if money market conditions are the primary target of open market operations, then the FOMC has no clear and definite way of giving instructions to the Manager of the System Open Market Account. The Committee's primary concern was more with improving the performance

*Economist, Federal Reserve Bank of St. Louis

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[1] "A New Measure of the Money Supply," Federal Reserve *Bulletin* (October 1960), p. 1102.

of open market operations to accomplish the FOMC's goals, rather than with the technical aspects of open market operations.[2] One of these studies, "Short-Run Targets for Open Market Operations," prepared by Richard G. Davis, dealt primarily with the short-run operating procedures. The series of studies prepared for the Maisel Committee was published by the Federal Reserve in 1971.[3] Since that time there has been considerable additional research and discussion within the Federal Reserve System on the problem of controlling monetary aggregates.

In this paper, the control of one monetary aggregate, the money stock, is considered. It is assumed that the Federal Open Market Committee has chosen a growth path for the money stock it expects to be consistent with its policy objectives for output, employment, and prices. All the problems relating to how the growth path was chosen are ignored. The control problem is to use open market operations to achieve that growth path for money. This involves predicting the effects of open market operations on the money stock. Because of information lags and random weekly fluctuations in money, the Federal Reserve does not aim open market operations directly at the money stock, but picks an operating target intermediate between open market operations and the money stock. The two main candidates for this operating target have been the Federal funds rate and some reserve aggregate.

A general reserve aggregate-multiplier approach is used to derive a control procedure the FOMC could use to achieve a desired growth path for money. The connecting link between the reserve aggregate, be it total reserves, nonborrowed reserves, the monetary base, or some variant of these, and the money stock is called a multiplier. The money stock control procedure involves predicting the effect on the money stock of setting the reserve aggregate at a given value. The form of the control procedure developed in this article is quite general and could also be applied to the problem of controlling other aggregates such as M_2 or bank credit.

This is not the only approach that could be taken to the problem of controlling the money stock. Other economists within the Federal Reserve have attacked the problem from a different approach. The

[2] Andrew F. Brimmer, "The Political Economy of Money: Evolution and Impact of Monetarism in the Federal Reserve System," *American Economic Review* (May 1972), p. 350.

[3] *Open Market Policies and Operating Procedures — Staff Studies* (Washington, D.C.: Board of Governors of the Federal Reserve System, 1971).

method developed in this paper, however, provides a framework within which several aspects of money stock control can be analyzed, and perhaps, most importantly, provides a minimum standard of control against which other proposed methods can be compared.[4]

The determination of the money stock is summarized in a multiplier-base expression of the following form:[5]

$$M_1 = mB$$

where "M_1" is the money stock (demand deposits plus currency held by the nonbank public), "B" is the net source base, and "m" is the money multiplier. The net source base (B) can be controlled by Federal Reserve open market operations. Sometimes this base concept is referred to as the nonborrowed base to denote that member bank borrowings are excluded. *The net source base is taken as the control variable in the procedure set forth in this article.* In its day-to-day operations this would be the variable toward which the Desk would primarily direct its open market operations.[6] It is assumed that, using open market operations, the Desk can set the net source base at the value it desires for a monthly period.

On a daily basis, the Federal Reserve has information on the value of the previous day's net source base. This information comes from totaling the sources of the base, as shown in Table I. Special care

[4]James Pierce and Thomas Thomson have also studied the problem, with their monthly money market model using the Federal funds rate as the control variable. Richard Davis has used a reduced form relationship that takes the demand deposit component of the money stock as the variable to be explained. His reduced form equation includes nonborrowed reserves (or alternatively the Federal funds rate), business sales, Government deposits and a variable to capture the effects of Regulation Q. See James L. Pierce and Thomas D. Thomson, "Some Issues in Controlling the Stock of Money," pp. 115-136 in this volume.

[5]The specific procedure presented in this paper is designed within the framework of a non-linear money supply hypothesis developed by Karl Brunner and Allan Meltzer:

$$m = \frac{1+k}{(r-b)(1+t+d)+k}$$

where k, t, and d, respectively, are the ratios of currency held by the public, time deposits, and U.S. Government demand deposits at commercial banks to the demand deposit component of the money stock.

The variables r and b, respectively, are the ratios of bank reserves and member bank borrowings to commercial bank deposit liabilities (excluding interbank deposits). See Karl Brunner and Allan H. Meltzer, "Liquidity Traps for Money, Bank Credit, and Interest Rates," *Journal of Political Economy* (January/February 1968), pp. 1-37, and Albert E. Burger, *The Money Supply Process* (Belmont, California: Wadsworth, 1971).

[6]The Manager of the System Open Market Account may be referred to as the "Account Manager" or the "Desk," meaning the Trading Desk of the New York Federal Reserve Bank.

TABLE I

SOURCES AND USES OF THE NET SOURCE BASE, THE SOURCE BASE, AND THE MONETARY BASE, JANUARY 1970*

(millions of dollars)

Sources

Federal Reserve holdings of Government securities	$56,346
Federal Reserve float	3,442
Gold stock plus special drawing rights	11,296
Treasury currency outstanding	6,856
Other Federal Reserve assets	2,114
Less:	
Treasury cash holdings	655
Treasury deposits at Federal Reserve Banks	1,206
Foreign deposits at Federal Reserve Banks	170
Other deposits at Federal Reserve plus Federal Reserve liabilities and capital	2,686
Equals:	
NET SOURCE BASE	$75,337
Plus:	
Federal Reserve discounts and advances	965
Equals:	
Source base	$76,302
Plus:	
Reserve adjustment	3,172
Equals:	
Monetary base	$79,474

Uses

Member bank deposits at Federal Reserve Banks less discounts and advances	$22,615
Currency held by banks	6,622
Currency held by the public	46,100
Equals:	
NET SOURCE BASE	$75,337
Plus:	
Federal Reserve discounts and advances	965
Equals:	
Source base	$76,302
Plus:	
Reserve adjustment	3,172
Equals:	
Monetary base	$79,474

*Data are not seasonally adjusted.

should be taken to distinguish between the sources and uses of the base. To get its bearings on the base, the Desk does not have to estimate excess reserves and currency. This would be the case only if the Manager of the System Open Market Account had to rely solely on information about the uses of the base. By collecting the data on the sources of the base, which come from the books of the Federal Reserve and the Treasury, a closer estimate can be obtained on a short-run basis.

The money multiplier (m) is the connecting link between the net source base and money stock. Changes in the multiplier reflect portfolio decisions by banks and the public, Treasury actions, and Federal Reserve policy actions such as changes in reserve requirements and the discount rate. The multiplier is not constant. Therefore, under this proposed procedure, the Federal Reserve must estimate the multiplier to determine how much base to supply to achieve a desired path for the money stock.

Forecasting the Money Multiplier

The procedure used to forecast the money multiplier was set up to require a minimum amount of forecasted information. If some of the inputs into the multiplier forecasting process must be predicted, additional sources of error are added. The procedure used in this paper takes as inputs only those variables that the Federal Reserve could be assumed to know without error. In essence, this is a very mechanical method that does not attempt to incorporate any information the Federal Reserve might have about expected movements of key factors such as Treasury deposits in the forecast month. Therefore, the results of the procedure should not be viewed as an indication of the best control the Federal Reserve could attain. Instead, they provide a standard against which other procedures could be evaluated. Any alternative procedure should be able to perform at least as well as this simple, mechanical method.

A not seasonally adjusted M_1 multiplier is forecast. The regression equation used to forecast the money multiplier uses the lagged 3-month moving average of past values of the multiplier $(m_{t-1} + m_{t-2} + m_{t-3})/3$, the lagged percentage change in the market yield on 3-month Treasury bills $[TB_{t-1} - TB_{t-2}]/TB_{t-2}$, and seasonal dummy variables.

The coefficients used to forecast each month's multiplier are estimated by least squares using the previous 36 months' observations. Each month the coefficients are re-estimated by adding the most recent month and dropping the first month of the previous 36 observations. In making the forecasts ρu_{t-1} term is added, where u_{t-1} is the lagged value of the error in the estimate of the money multiplier and ρ is the correlation coefficient for consecutive error terms in the equation during the sample period.[7] This procedure is an extension of the procedure used in an article co-authored with Lionel Kalish and Christopher Babb.[8] The major modification is to remove the reserve adjustment magnitude and include the lagged percentage change in the Treasury bill rate.

Variables that may have an important influence on the value of the multiplier are excluded by the criterion used to restrict the set of eligible regressors. The influences of these variables are impounded in the error term, and the question may arise as to whether their exclusion is likely to seriously bias the estimated coefficients of the included variables. One important excluded effect is contemporaneous changes in interest rates. The method for forecasting the money multiplier takes into account only the lagged effects of changes in interest rates on the multiplier. Open market operations in the current month influence interest rates in the current month, and this impact effect on the multiplier is not included in the forecasting procedure. If the impact or current month interest rate effects of open market operations on the multiplier are substantial, then an improvement in forecasting might result from including projections of interest rates in the forecasted month. However, since these impact interest rate effects on the money multiplier appear to be small, and projecting interest rates involves an unknown error, only lagged interest rate effects were included.[9]

[7] Rho is estimated as $1-\frac{DW}{2}$, where DW is the Durbin-Watson statistic. The absolute mean value of ρ over the 1964-71 period was .47, no value of ρ exceeds .75 and only 27 of the 96 values of ρ exceed .60.

[8] Albert E. Burger, Lionel Kalish III and Christopher T. Babb, "Money Stock Control and Its Implications for Monetary Policy," Federal Reserve Bank of St. Louis *Review* (October 1971), pp. 6-22, available as Reprint # 72.

[9] Robert H. Rasche has surveyed the empirical evidence on interest sensitivity of the money multiplier, beginning with studies by Teigen, DeLeeuw, Goldfeld and Kane, and Brunner and Meltzer and ending with recent evidence provided by the Federal Reserve—M.I.T.—Pennsylvania econometric model and a financial market model by Thomson and Pierce. Rasche concludes that the accumulated empirical evidence indicates that the interest elasticity of the money supply relationship during the sample period of these studies appears to be extremely low, with the impact elasticity in the range of 0.10 to 0.15. Hence the short-run feedback effects through interest rate changes which would be generated by policy changes in reserve aggregates are weak and should cause little difficulty for controlling the money stock through control of a reserve aggregate. See Robert H. Rasche, "A Review of Empirical Studies of the Money Supply Mechanism," Federal Reserve Bank of St. Louis *Review* (July 1972), pp. 11-19.

Two other effects are changes in Treasury deposits in the current month and reserve requirement changes. Changes in Treasury balances are primarily determined by current tax receipts and expenditures of the Government and are probably uncorrelated with the regressors used to estimate the multiplier. Reserve requirement changes are infrequent and it is unlikely there is significant correlation between them and the regressors. One excluded variable that could bias the coefficients is Regulation Q ceiling rates. There could be a sizeable correlation between a variable capturing the effect of Regulation Q and the lagged 3-month average of the multiplier when the ceiling rate is effective. The basic problem is the appropriate means of specifying the effect of Regulation Q. A varied selection of candidates was tried in the research for this paper, but at present no satisfactory proxy has been developed.

Simulating the Control Procedure

The results of simulating this procedure over the 8-year period 1964-71 are presented in Table V at the end of the article. Since no forecasting errors are involved in the independent variables, the results of these simulations indicate how well the procedure would have worked over the 1964-71 period. When comparing these results with results from other methods, care must be taken to determine whether any of the variables used in the alternative procedures must be forecast. For example, an alternative which stresses the demand for money might include income or some proxy such as business sales in the forecasting period as an independent variable. If simulations of this type of procedure use actual values for income or its proxy, the errors will be biased downward to the extent that forecasting errors for income have not been taken into consideration.

The results in Table V were generated in the following manner: the forecasted not seasonally adjusted money multiplier was multiplied by the actual not seasonally adjusted net source base to obtain not seasonally adjusted money (NSAM).[10] Then NSAM was multiplied by the implicit seasonal factor for that month to obtain the

[10]In the previous article, Burger, Kalish, Babb, "Money Stock Control and Its Implications for Monetary Policy," a desired growth path for M_1 was chosen. Then, the money multiplier was forecast and the net source base was set to achieve the desired M_1. The controlled M_1 was computed by multiplying the actual (historical) multiplier by the controlled value of the net source base. Errors were computed by comparing controlled and desired M_1. In this article the net source base is set at its actual (historical) values. The money stock the FOMC would have expected, given the forecasts of the money multiplier, is computed by multiplying the forecasted multiplier by the actual net source base. Errors are computed by comparing this projected value of M_1 with actual (historical) M_1.

seasonally adjusted money stock. The regression equation used to forecast the multiplier was estimated using not seasonally adjusted data, and the implicit seasonal factor was computed by dividing actual seasonally adjusted money by actual not seasonally adjusted money. There is a different regression equation used to obtain the coefficients to forecast each month, hence, 96 regression equations. Therefore, the results of these equations are not reported. The results for January 1970 are reported in Table II to illustrate the procedure and to aid in reproducing the results.[11]

The example in Table II may be analyzed in the following manner. Using the forecasting procedure, the Federal Reserve would have forecast the January 1970 money multiplier to be 2.80095. Hence, if they had set the NSA net source base at $75.337 billion, then they would have expected seasonally adjusted money to equal $205.126 billion. The NSA net source base was $75.337 (see Table I) and actual money was $205.500 billion. Therefore, using this procedure would have resulted in underestimating the effect of their actions by $374 million.

There are several ways of evaluating the simulation results reported in Table V. One approach is to look at the monthly errors and compute the mean square forecasting error, root mean-square forecasting error, and mean and absolute mean forecasting errors. As shown at the end of Table V, the root mean square monthly forecasting error over the whole period is $1.07 billion, the absolute mean percent forecasting error is 0.45 percent.[12] The mean forecasting error is $140 million and the mean percent forecasting error is 0.1 percent, which indicate that the procedure, on average, does not substantially over-or underestimate the money stock associated with a set value of the net source base.

A sharp distinction must be made between forecasting money one month in advance and controlling money. The evaluation of the performance of a money stock control procedure should not be based solely on monthly errors. For example, a half a percent error in one month, converted to an annual rate becomes a 6 percent error.

[11]The mean value of the coefficient on the lagged 3-month moving average of the multiplier is .8867, and is significant in all regressions as indicated by a range of t-values of approximately 5 to 15. The coefficient on the lagged percent change in the Treasury bill rate is generally insignificant in the first 4½ years of the sample period and generally significant in regressions used to estimate coefficients for forecasting the last 3½ years, this final period having a mean value of .1128.

[12]The percent forecasting error for each month is forecasted minus actual money divided by actual multiplied by 100.

TABLE II

EXAMPLE OF THE PROCEDURE USED TO FORECAST THE MONEY STOCK

Period: January 1970

Regression equation based on 36 months ended December 1969:[1]

$$m = 0.79566 + \underset{(5.06)}{0.72002\ MAV} + \underset{(2.70)}{0.11888\ TB} + .00932\ D_j \qquad R^2 = .87 \quad SE = .01170$$

MAV = lagged 3-month moving average of the money multiplier
TB = lagged percent change in Treasury bill rate
D_j = seasonal dummy for January

Data used to forecast January 1970 multiplier:

MAV = 2.77206 = average of October-December, 1969
TB = 0.07873
ρ = 0.4836
ρu_{t-1} = −0.00933

Forecast of the multiplier:

$$2.80095 = 0.79566 + (0.72002)(2.77206) + (0.11888)(0.07873) + 0.00932 - 0.00933$$

Forecast of seasonally adjusted money:

Actual net source base (NSA) for January 1970 = $75.337
Forecasted not seasonally adjusted money = ($75.337) (2.80095) = $211.015

$$\text{Seasonal factor} = \frac{\text{Actual SA Money}}{\text{Actual NSA Money}} = \frac{205.500}{211.400} = 0.97209$$

Forecasted seasonally adjusted money = ($211.015) (0.97209) = $205.126

Forecasted minus actual seasonally adjusted money = $205.126 − $205.500 = $−.374

[1]The equation was estimated by least squares using not seasonally adjusted data. Numbers in parentheses are t-values.

This does not necessarily imply that using this method would result in that magnitude of error over a relevant control period. Errors do not tend to accumulate, and positive errors are offset by negative ones. Computing consecutive 3-month moving averages of forecasted and actual money over the 1964-71 period results in a mean percent error of .07 percent and an absolute mean percent error of .31

percent. A comparison of errors for 3-month moving averages with monthly errors is presented in Figure I. Only 12 percent of the total errors for 3-month moving averages are greater in absolute value than 0.5 percent, compared to 28 percent of the monthly errors. These results also support the conjecture that over a relevant control period this simple control procedure would result in relatively close control over the money stock. In other words, if the desired level of the money stock can be expressed as an average for a 3-month period the procedure should permit its achievement with only small errors.

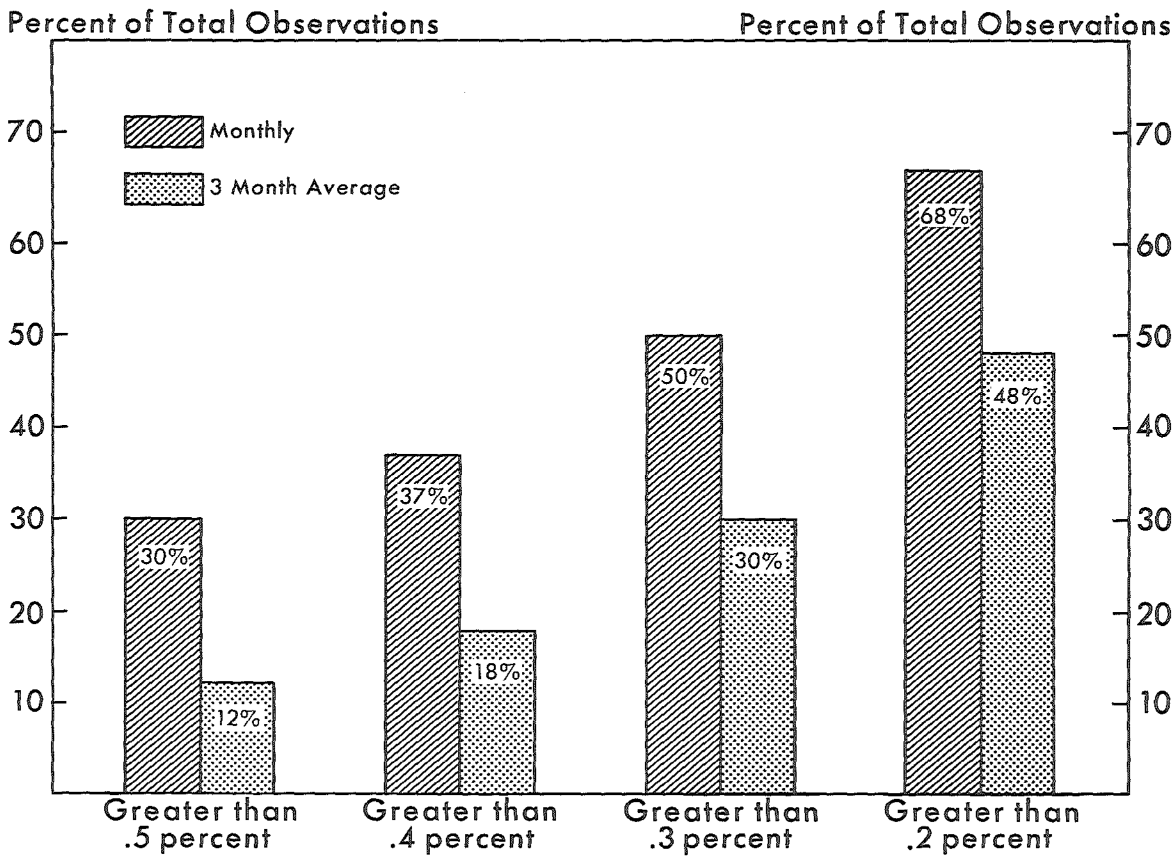
Another means of analyzing the effectiveness of the control procedure is to compare the expected growth rates of the money stock resulting from simulating the control procedure with actual growth rates of the money stock. The simulated monthly values of the money stock are what the FOMC would have expected from setting the net source base at its historical values if it had been using this procedure to forecast the money multiplier.

In this way, an analysis can be made of the effectiveness of the control procedure at times when there were marked reversals in the growth rate of the money stock. During the period 1964-71 there were at least 6 marked changes in the growth rate of the money stock. Table III presents a comparison of actual growth rates of money and the growth rates that the FOMC would have expected if it had been using the control procedure over these periods.

For example, beginning in mid-1966 the growth rate of money slowed markedly. By setting the net source base at its historical values, the FOMC would have expected, given the forecasts of the money multiplier, that the money stock would have grown at a 1.1 percent annual rate from the average of 3 months ended May 1966 to the average of 3 months ended December 1966. The actual growth rate of the money stock over this same period was 0.2 percent. In early 1967 the FOMC moved to a much more expansionary policy. Simulating the control procedure results in an expected growth rate of the money stock of 7.1 percent from the average of 3 months ended December 1966 to the average of 3 months ended January 1969. The actual growth rate of money associated with setting the net source base at its historical values was 7.2 percent over this period.

Figure I

Distribution of Forecasting Errors



Federal Reserve Induced Impediments to Money Stock Control

The 1964-71 period presented an especially difficult period for money stock control. A significant part of this difficulty was introduced by Federal Reserve actions. During this 8-year period there were several major reversals in the direction of the influence of Federal Reserve policy actions on the money stock.[13] In addition, reserve requirements were changed 7 times and lagged reserve requirements were introduced in this period. The Federal Reserve also permitted Regulation Q ceiling rates to frequently restrain banks from responding in a competitive manner to changes in market rates.[14]

The money stock control procedure developed in this article is not designed to capture the *initial* effects of these actions by the Federal Reserve. Because a lagged 3-month moving average of the multiplier is used, a sharp reversal of policy may cause a change in the money multiplier that is not immediately captured by the procedure used to forecast the multiplier. For example, at times of sharp reversals in the growth rate of the money stock relatively larger forecasting errors occur. After mid-1966 the forecasting procedure substantially overestimates the multiplier, and the opposite occurs in early 1967. Also, a similar tendency seems to have been in effect in 1971 as errors tended to be negative in the first half of the year and positive in the second half. The exact size and direction of this effect depends upon a number of factors; however, given the characteristics of the procedure used to forecast the multiplier, it does seem likely that a substantial change in the thrust of open market policy on the money stock will introduce additional problems for accurately predicting the initial influence of open market actions on the money stock.

The results shown in Table III and discussed at the end of the previous section, however, show that the FOMC could quite accurately engineer sharp changes in the growth path of money over a

[13] Policy actions resulted in an acceleration of the base from late 1965 through mid-1966 followed by a deceleration of the base through the end of 1966. This was followed by a renewed acceleration during 1967-68, followed by a deceleration in 1969, then a more rapid growth in 1970. A rapid acceleration in the growth rate of the base over the first half of 1971 again was followed by a rapid deceleration in the second half of 1971.

[14] The secondary market yield on large 6-month CDs exceeded the Regulation Q ceiling rate in the 8-month period from June 1966 through January 1967, the 9-month period from November 1967 through July 1968, and the 24-month period from November 1968 through October 1970.

TABLE III

ACTUAL COMPARED TO EXPECTED RATES OF MONEY GROWTH[1]

Period	Actual Growth Rate of Money[2]	Growth Rate of Money Expected Using the Control Procedure[3]
3 months ended 5/66 to 3 months ended 12/66	0.2%	1.1%
3 months ended 12/66 to 3 months ended 1/69	7.2	7.1
3 months ended 1/69 to 3 months ended 2/70	3.4	3.7
3 months ended 2/70 to 3 months ended 12/70	5.4	5.0
3 months ended 12/70 to 3 months ended 7/71	9.4	9.5
3 months ended 7/71 to 3 months ended 12/71	2.4	3.2

[1]Periods were chosen on the basis of a significant change in the growth rate of the money stock.

[2]Simple annual rates.

[3]Computed by comparing 3-month average of actual money in the initial period to 3-month average of forecasted money in the terminal period.

longer period of time. The same results point out that, in the initial stages of a marked change in the desired growth path of money, the FOMC should not abandon the procedure just because initially it results in larger than average monthly errors. However, given that policymakers are also concerned with the possibility of large movements in short-term interest rates, large monthly errors may make the task of returning to the desired money stock path more difficult. The author conjectures that most methods for predicting the influence of open market operations on the money stock would tend to show relatively larger errors at times when the target growth of money is markedly changed. Again, the point should be emphasized that it is the performance of the procedure over a period of several months that is crucial.

With regard to reserve requirements, there is clear evidence that reserve requirement changes create substantial difficulties for predicting the growth path of money with this technique. The root mean square forecasting error for months when reserve requirements were changed and the following month[15] is about 63 percent larger than for the whole sample period, $1.74 billion compared to $1.07 billion.

If reserve requirements are raised the money multiplier is decreased and hence the money stock resulting from simulating this procedure would be expected to exceed actual money, resulting in positive errors. In July and September 1966 reserve requirements were raised and the period July–October 1966 encompasses some of the largest positive forecasting errors of the sample period. Likewise, large positive forecasting errors occur following the raising of reserve requirements in mid-January 1968 and in mid-April 1969. Several of the largest negative forecasting errors followed lowering of reserve requirements in March 1967 and in October 1970.

Although the exact magnitude of the influence of Regulation Q ceilings is difficult to isolate empirically, it can be conjectured from theoretical analysis that this regulatory policy added to errors in money stock control. For example, as market interest rates rise above Regulation Q ceiling rates, this results in a marked reversal in the growth of time deposits, hence reducing the amount of reserves absorbed by time deposits and therefore influencing the growth of the money stock.

Comparison of RPDs and the Net Source Base as Operating Targets

Prior to 1972, a key element of open market strategy had been use of a configuration of measures of money market conditions as an operating guide for the Manager of the System Open Market Account. At the start of 1972 the Federal Open Market Committee began a series of steps that moved open market operating strategy decidedly closer to a reserve aggregate approach. At the January 11 FOMC meeting, it was decided that:

> In the interest of assuring the provision of reserves needed for adequate growth in monetary aggregates, the Committee decided that in the

[15]Most reserve requirement changes occurred in the middle of a month. Hence, their potential influence carried over to the following month. The dates of reserve requirement changes and the amount of reserves released or absorbed are as follows: July 1966 ($420 million), September 1966 ($445 million), March 1967 (–$850 million), January 1968 ($550 million), April 1969 ($660 million), October 1969 – introduction of a 10 percent marginal reserve requirement on certain foreign borrowings by banks ($400 million), October 1970 (–$500 million).

period until its next meeting open market operations, while continuing to take appropriate account of conditions in the money market, should be guided more by the course of total reserves than had been customary in the past.[16]

At the February 15 meeting, the FOMC modified its reserve aggregate target from total member bank reserves to reserves available to support private nonbank deposits (RPDs) – defined specifically as total member bank reserves less those required to support Government and net interbank deposits.[17] "This measure was considered preferable to total reserves because short-run fluctuations in Government and interbank deposits are sometimes large and difficult to predict and usually are not of major significance for policy. It was deemed appropriate for System open market operations normally to accommodate such changes in Government and interbank deposits."[18]

The move toward guiding open market operations more by an RPD target than an interest rate target is a major constructive development, especially to those individuals who emphasize the System's role in controlling the growth of the money stock. However, RPDs are only one among several reserve aggregates that might serve the same purpose. In choosing a reserve aggregate as an operating target for controlling money it seems desirable to pick one that (1) has the most predictable relationships to money stock and (2) is easiest for the Desk to track in its day-to-day operations. The first criterion concerns picking the target path for the reserve aggregate. The second criterion concerns how well the Desk can stay on that path.[19]

[16]"Record of Policy Actions of the Federal Open Market Committee," Federal Reserve *Bulletin* (April 1972), p. 394.

[17]Deposits subject to reserve requirements include all time and savings deposits, and net demand deposits which are defined as total demand deposits less cash items in process of collection and demand balances due from domestic commercial banks. Net interbank demand deposits include all demand deposits due to domestic and foreign commercial banks and due to mutual savings banks, less demand balances due from domestic commercial banks. In the April 1972 revision of the reserve series, net interbank deposits were revised to reflect the netting of a portion of cash items in process of collection against interbank deposits. Formerly, all cash items were netted against other private demand deposits.

[18]"Record of Policy Actions of the Federal Open Market Committee," Federal Reserve *Bulletin* (May 1972), p. 459.

[19]See Charlotte E. Ruebling, "RPDs and Other Reserve Operating Targets," Federal Reserve Bank of St. Louis *Review* (August 1972), pp. 2–7.

Choosing the Growth Path for an Operating Target -- Although the Federal Reserve has not made public the method used in selecting the RPD path, there are at least two ways this path could be chosen. One approach would be to predict the RPD-money stock multiplier, a procedure very similar to the one discussed in this paper. The simulation of this money stock control procedure was repeated wherein an RPD-money multiplier was predicted in the same manner as a base-money multiplier. Not seasonally adjusted RPDs were used as the control variable instead of not seasonally adjusted net source base. The results with RPDs were substantially worse. For example, the root mean square forecasting error for money over the 1964-71 period was \$1.60 billion using RPDs, compared to \$1.07 billion with the net source base as the control variable.[20]

An alternative procedure stresses that RPDs are reserves used to support private member bank deposits, one component of which, member bank private demand deposits, is a part of the money stock. This alternative first takes a projected value for GNP over the forecasting horizon. It then assumes that the effect of alternative growth rates of money on financial conditions could be worked out without any effects on GNP during the forecasting period. A relationship between M_1 and interest rates is then developed, and this relationship, along with other factors, is used to project a pattern of member bank time, demand, government, and interbank deposits.[21] From these results a growth path for RPDs could then be developed.

RPDs can be expressed:

$$RPDs = TR - rD^G - rD^{IB} = rD + r^tT + ER$$

where TR = total member bank reserves

D^G = member bank U.S. Government demand deposits

D^{IB} = member bank net interbank demand deposits

[20]The root mean square forecasting error and absolute mean forecasting error respectively using not seasonally adjusted RPDs as the control variable for selected periods are: 1964-71 (\$1.60, \$1.16), 1966-71 (\$3.30, \$1.39), 1969-71 (\$3.45, \$1.44), 1970-71 (\$2.13, \$1.20). These results may be compared to the results reported at the end of Table V.

[21]For a discussion of this type of procedure see Stephen H. Axilrod and Darwin L. Beck, "Role of Projections and Data Evaluation with Monetary Aggregates as Policy Targets," in this volume.

D = member bank private demand deposits

T = member bank time deposits

ER = excess reserves

r = reserve requirement against D^G, D, D^{IB}

r^t = reserve requirement against time deposits

Therefore, to select a path for RPDs consistent with the member bank demand deposit component of the money stock (D), which, given the projected paths of the currency and nonmember bank deposit components of the money stock, would result in the desired money stock growth, requires that the Federal Reserve estimate the path of time deposits (T) and member bank excess reserves (ER). At present there is no means to evaluate how accurately the Federal Reserve can make forecasts of the currency, nonmember bank deposit component of the money stock, member bank time deposits and excess reserves.

Predicting the relationship between any reserve aggregate and the money stock involves explicitly or implicitly predicting a multiplier relationship. Therefore, some evidence on the stability of the overall relationship between RPDs, other reserve aggregates and money can be obtained by comparing the stability of the multiplier relationships. In Table IV regressions using the appropriate reserve aggregate multiplier as the dependent variable and the 3-month moving average of past values of the multiplier and the lagged percent change in the Treasury bill rate as independent variables are presented. Since RPDs, nonborrowed reserves, and total reserves include only member bank reserves and exclude currency, these multipliers were computed on the basis of the member bank deposit component of the money stock.[22] The base-money multipliers were computed on the basis of the total money stock.

All equations were run with seasonally adjusted data. The dependent variables in the regression equations are not the same, hence the R^2 cannot be used to compare the relative performance of the equations. Therefore, the coefficient of variation – the ratio of the

[22]Other private member bank demand deposits were used for the member bank component of the money stock. Other private member bank demand deposits are defined as member bank demand deposits subject to reserve requirements less member bank demand deposits due to the U.S. Government and net interbank demand deposits.

TABLE IV

COMPARISON OF THE PREDICTABILITY OF RESERVE AGGREGATE MULTIPLIERS: MONTHLY DATA 1966–1971*

Multiplier	Equation	Statistics	Coefficient of Variation
Demand Deposits/RPD:	0.32393 + 0.93034 MAV + 0.01002 TB (25.18) (.13)	R^2 = .90 SE = .04141 mean = 4.846	.00855
Demand Deposits/ Nonborrowed Reserves:	0.36433 + 0.91707 MAV + 0.20899 TB (18.51) (2.26)	R^2 = .84 SE = .04977 mean = 4.542	.01096
Demand Deposits/ Total Member Bank Reserves:	0.46849 + 0.89213 MAV + 0.03163 TB (17.39) (.36)	R^2 = .81 SE = .04753 mean = 4.436	.01071
M_1/Net Source Base:	0.23630 + 0.91301 MAV + 0.08248 TB (20.55) (3.16)	R^2 = .87 SE = .01367 mean = 2.762	.00495
M_1/Source Base:	0.28572 + 0.89438 MAV + 0.04446 TB (18.25) (1.66)	R^2 = .84 SE = .01393 mean = 2.738	.00509
M_1/Monetary Base:	0.28481 + 0.88936 MAV + 0.06311 TB (14.66) (3.42)	R^2 = .77 SE = .00996 mean = 2.582	.00386

*Demand deposits used in the reserve multipliers are the member bank demand deposit component of the money stock. All seasonally adjusted data are used. Numbers in parentheses are t-values. TB is the lagged percent change in the Treasury bill rate, MAV is the lagged 3-month moving average of the multiplier. The coefficient of variation was computed by dividing the standard error by the mean of the dependent variable.

TABLE V

RESULTS OF SIMULATING THE MONEY STOCK CONTROL PROCEDURE 1964–1971

Date		Forecasted NSA Multiplier	Actual NSA Multiplier	Forecasted SA Money	Actual SA Money	Forecasted Minus Actual	Percent Forecasting Error[1]
				(billions of dollars)			
1964	J	2.949	2.943	$154.409	$154.100	$.309	0.2%
	F	2.924	2.906	155.470	154.500	.970	0.6
	M	2.885	2.871	155.772	155.000	.772	0.5
	A	2.906	2.896	155.714	155.200	.514	0.3
	M	2.851	2.836	156.708	155.900	.808	0.5
	J	2.835	2.823	157.055	156.400	.655	0.4
	J	2.816	2.832	156.573	157.500	–.927	–0.6
	A	2.828	2.834	158.072	158.400	–.328	–0.2
	S	2.850	2.850	159.096	159.100	–.004	0
	O	2.873	2.871	159.851	159.700	.151	0.1
	N	2.896	2.873	161.573	160.300	1.273	0.8
	D	2.885	2.879	160.829	160.500	.329	0.2
1965	J	2.925	2.921	161.113	160.900	.213	0.1
	F	2.888	2.869	162.308	161.200	1.108	0.7
	M	2.848	2.852	161.473	161.700	–.227	–0.1
	A	2.878	2.882	161.759	162.000	–.241	–0.1
	M	2.822	2.807	163.111	162.200	.911	0.6
	J	2.801	2.813	162.403	163.100	–.697	–0.4
	J	2.805	2.805	163.663	163.700	–.037	0
	A	2.802	2.803	164.149	164.200	–.051	0
	S	2.816	2.836	164.001	165.200	–1.199	–0.7
	O	2.847	2.848	166.326	166.400	–.074	0
	N	2.866	2.848	167.919	166.900	1.019	0.6
	D	2.865	2.861	168.217	168.000	.217	0.1
1966	J	2.902	2.903	169.122	169.200	–.078	0
	F	2.861	2.850	170.374	169.700	.674	0.4
	M	2.834	2.850	169.544	170.500	–.956	–0.6
	A	2.866	2.886	170.520	171.700	–1.180	–0.7
	M	2.813	2.805	172.023	171.500	.523	0.3
	J	2.812	2.819	171.245	171.700	–.455	–0.3
	J	2.814	2.763	174.146	171.000	3.146	1.8
	A	2.802	2.765	173.405	171.100	2.305	1.3
	S	2.804	2.779	173.421	171.900	1.521	0.9
	O	2.792	2.778	172.215	171.400	.815	0.5
	N	2.807	2.769	173.502	171.200	2.302	1.3
	D	2.774	2.782	171.210	171.700	–.490	–0.3
1967	J	2.816	2.785	173.290	171.400	1.890	1.1
	F	2.727	2.734	172.748	173.200	–.452	–0.3
	M	2.703	2.753	171.626	174.800	–3.174	–1.8
	A	2.745	2.774	172.289	174.100	–1.811	–1.0
	M	2.687	2.726	173.301	175.800	–2.499	–1.4
	J	2.718	2.753	175.085	177.300	–2.215	–1.2
	J	2.717	2.741	177.084	178.700	–1.616	–0.9
	A	2.738	2.746	179.222	179.800	–.578	–0.3
	S	2.772	2.763	181.488	180.900	.588	0.3
	O	2.779	2.771	182.198	181.700	.498	0.3
	N	2.777	2.774	182.593	182.400	.193	0.1
	D	2.790	2.793	182.872	183.100	–.228	–0.1

TABLE V (cont'd)

Date		Forecasted NSA Multiplier	Actual NSA Multiplier	Forecasted SA Money	Actual SA Money	Forecasted Minus Actual	Percent Forecasting Error[1]
				(billions of dollars)			
1968	J	2.826	2.811	$184.870	$183.900	$ .970	0.5%
	F	2.767	2.746	186.351	184.900	1.451	0.8
	M	2.757	2.755	186.003	185.900	.103	0.1
	A	2.787	2.794	186.089	186.600	−.511	−0.3
	M	2.725	2.749	186.888	188.500	−1.612	−0.9
	J	2.764	2.766	189.922	190.100	−.178	−0.1
	J	2.737	2.752	190.322	191.400	−1.078	−0.6
	A	2.746	2.740	192.960	192.500	.460	0.2
	S	2.769	2.764	193.727	193.400	.327	0.2
	O	2.779	2.762	195.518	194.300	1.218	0.6
	N	2.771	2.781	195.289	196.000	−.711	−0.4
	D	2.797	2.812	196.383	197.400	−1.017	−0.5
1969	J	2.841	2.833	198.937	198.400	.537	0.3
	F	2.783	2.784	199.432	199.500	−.068	0
	M	2.797	2.802	199.909	200.300	−.391	−0.2
	A	2.832	2.834	200.867	201.000	−.133	−0.1
	M	2.783	2.749	203.870	201.400	2.470	1.2
	J	2.776	2.783	201.692	202.200	−.508	−0.3
	J	2.767	2.784	201.666	202.900	−1.234	−0.6
	A	2.760	2.753	202.933	202.400	.533	0.3
	S	2.774	2.774	202.746	202.700	.046	0
	O	2.773	2.776	203.022	203.200	−.178	−0.1
	N	2.773	2.764	204.133	203.500	.633	0.3
	D	2.794	2.776	204.991	203.700	1.291	0.6
1970	J	2.801	2.806	205.126	205.500	−.374	−0.2
	F	2.745	2.736	205.371	204.700	.671	0.3
	M	2.748	2.757	206.048	206.700	−.652	−0.3
	A	2.787	2.777	209.043	208.300	.743	0.4
	M	2.725	2.715	209.750	209.000	.750	0.4
	J	2.755	2.736	210.799	209.400	1.399	0.7
	J	2.728	2.732	210.027	210.300	−.273	−0.1
	A	2.709	2.700	212.295	211.600	.695	0.3
	S	2.734	2.709	214.761	212.800	1.961	0.9
	O	2.714	2.725	212.179	213.100	−.921	−0.4
	N	2.722	2.732	212.852	213.600	−.748	−0.4
	D	2.741	2.744	214.553	214.800	−.247	−0.1
1971	J	2.765	2.741	217.184	215.300	1.884	0.9
	F	2.687	2.690	217.425	217.700	−.275	−0.1
	M	2.696	2.705	218.929	219.700	−.771	−0.4
	A	2.730	2.732	221.044	221.200	−.156	−0.1
	M	2.690	2.679	224.688	223.800	.888	0.4
	J	2.705	2.718	224.401	225.500	−1.099	−0.5
	J	2.722	2.714	228.057	227.400	.657	0.3
	A	2.699	2.703	227.683	228.000	−.317	−0.1
	S	2.707	2.697	228.426	227.600	.826	0.4
	O	2.711	2.699	228.705	227.700	1.005	0.4
	N	2.710	2.700	228.505	227.700	.805	0.4
	D	2.720	2.715	228.624	228.200	.424	0.2

[1] Forecasted minus actual ÷ actual x 100.

TABLE V (cont'd)

SUMMARY RESULTS

	1964	1965	1966	1967	1968	1969	1970	1971
Mean Square Forecasting Error	$.4747	$.4359	$2.2479	$2.6592	$.8710	$.8942	$.8299	$.7744
Root Mean Square Forecasting Error	.6890	.6602	1.4993	1.6307	.9333	.9456	.9110	.8800

SUMMARY RESULTS FOR SELECTED PERIODS

Levels	1964-1971	1966-1971	1969-1971	1970-1971
Mean Square Forecasting Error	$1.1483	$1.3795	$.8328	$.8021
Root Mean Square Forecasting Error	1.0716	1.1745	.9126	.8956
Mean Error	.1404	.1114	.2743	.2865
Absolute Mean Error	.8273	.9220	.7379	.7725

Percent Forecasting Error	1964-1971	1966-1971	1969-1971	1970-1971
Mean Error	.0760%	.0514%	.1306%	.1375%
Absolute Mean Error	.4469	.4876	.3528	.3625

standard error to the mean of the dependent variable – is reported for each equation. The results in Table IV do not provide any basis for a conjecture that past data provide evidence for a more stable relation between RPDs and money stock than between the net source base and money stock. The coefficients of variation show that the standard error of estimate is much larger relative to the mean of the RPD-member bank demand deposit multiplier than for the net source base-money stock multiplier.[23] Also, using RPDs to control money would require estimating the currency and nonmember bank component of the money stock, which would add additional errors to the process of picking the appropriate RPD path. The t-values on the coefficients of the lagged 3-month moving averages of the multipliers indicates that the net source base-money stock multiplier is approximately as stable relative to its 3-month moving average as the RPD-member bank demand deposit multiplier.

These results are not conclusive evidence on the relative predictability of base-money relationships versus RPD-money relationships. There may exist a method of relative RPDs to money which past evidence indicates would have permitted the Federal Reserve to have more accurately predicted the effect of an RPD target on money than the results in this paper indicate for a base target. Also, there may be other money stock control procedures in which both the net source base and RPDs perform better.

Tracking the Operating Target – The second criterion concerns the information required by the Desk to track its reserve aggregate on a daily basis. RPDs require information that would appear to be considerably more difficult to project than the net source base data. Referring back to the formula for RPDs on page 48, it can be seen that the following have to be estimated to track RPDs: Government demand deposits, interbank demand deposits, member bank borrowings, currency demands of the public and nonmember banks, and float.[24] Referring back to Table I, it can be seen that all the data for

[23] These results are not specific to the 1966-71 period. An analysis of the 1964-71 period and 3-year subperiods within the 1966-71 period show that consistently the coefficient of variation for the RPD multiplier is about twice as great as that for the net source base multiplier.

[24] Richard G. Davis discusses the characteristics of short-run operating targets in "Short-Run Targets for Open Market Operations," *Open Market Policies and Operating Procedures – Staff Studies* (Washington, D.C.: Board of Governors of the Federal Reserve System, 1971) pp. 37-69. He points out additional difficulties that may arise when, in addition to the operating transactions, behavior of factors such as Treasury deposits at commercial banks must be forecast and other factors such as member bank borrowing and excess reserves, which are functionally related to open market operations, must be forecast.

tracking the net source base comes from the daily records of the Federal Reserve and the Treasury. The most troublesome component on a daily basis, which is common both to RPDs and net source base, would be Federal Reserve float.[25]

Conclusions

A simple procedure for determining the effect on the money stock of setting the net source base at a given value was presented. This proposed method was not intended to be the definitive answer to the money stock control problem. It does, however, provide a useful framework within which several aspects of money stock control can be analyzed.

The results of simulating the procedure over an 8-year period suggest that, using a method for forecasting the net source base-money multiplier which relies only on past, known data, the Federal Open Market Committee could exercise close control over the growth of the money stock. The simulation results indicate that errors resulting from using this method to determine the effect on the money stock of setting the net source base at a given value do not tend to accumulate, signifying that use of this procedure would not result in "loss of control over money" for a prolonged period. An analysis of errors for 3-month moving averages and periods of marked shifts in policy support the conclusion that the growth of the money stock could be set at about the rate desired by the Federal Open Market Committee.

[25]Proposed changes in the Federal Reserve's check collection procedures are expected to reduce substantially the average level of Federal Reserve float, from about $3 billion to around $1 billion. The only sizeable component that would remain would be transportation float. One would expect that even this component would be predictable, within limits, by monitoring such factors as weather conditions and rail or truck strikes. For a discussion of this change, see "Recent Regulatory Changes in Reserve Requirements and Check Collection," Federal Reserve *Bulletin* (July 1972), pp. 626-630.

DISCUSSION

JAMES S. DUESENBERRY*

When one comes upon a paper like this, one always has a basic decision to make. This is essentially a statistical exercise, and one must decide whether to go for statistical nit-picking or for the big picture. When I was Mr. Burger's age, I went in enthusiastically for the nit-picking, but as age overcomes me, I become more and more of a big-picture man and more and more vague. I remember John Williams, whom some of you know, made a great reputation for wisdom with one line. Whatever anybody ever said, he always responded, "It's more complicated than that." That will be my message.

Burger's Forecasting Formula

One statistical point, I think, is worth mentioning. Mr. Burger's paper begins with the calculation of a familiar formula about the relationship between M_1 and his net source base. This involves the ratio of currency to demand deposits, the ratio of time deposits to demand deposits, and the average demand deposit reserve ratio. The last ratio turns out, of course, to depend on the member-bank share of deposits and the composition of deposits by class of bank. Finally he has to include the ratio of borrowings to deposits. One rather anticipates, after he has put that formula down, that the procedure for predicting the money supply or the money multiplier will be to analyze the determinants of each one of those ratios and then put them all together. And just a glance at that formula will show that that would be a very, very complicated kind of operation. Instead of

*Professor of Economics, Harvard University, and Chairman of the Board of Directors of the Federal Reserve Bank of Boston.

that, Mr. Burger proceeds with a formula which is much simpler, in which there is very little direct connection between any of those ratios which appear in the multiplier formula and the outcome. We have to think a bit about what exactly he has done here from a statistical point of view. It is, of course, another reduced form. He has created a forecasting formula which is not an attempt to analyze the structure of the underlying system but rather to exploit – I think quite ingeniously – the statistical properties of the underlying world. His formula is one which is arranged so that it can pick up trends in the money multiplier, and do so in such a way that the trend can be stronger or weaker or even, in principle, change direction. I do not know if it ever did change direction in the historical period covered. The trend depends very largely on the difference between the constant term and some number multiplied by the lag multiplier and that difference can be either positive or negative depending on the relative magnitudes of those two variables. So first, he can have a lot of flexibility in reflecting on the trend over the last three years, which helps considerably. Secondly, he has an interest-rate variable and thereby picks up net effects of interest-rate movements on this whole constellation of ratios. For example, the interest rate is presumably associated with the time deposit/demand deposit ratio. Instead of trying to estimate the interest-rate effects on the ratios one at a time and put them back together, he just boils them into a single item. Finally, he has a correction for the fact that there would be error runs if he did not have an auto-regressive corrector. But he includes a term to eliminate that. This means the formula will work to the extent that the structure changes slowly and retains the statistical properties which it had in the past.

I think that is a very ingenious way to put together a practical forecasting formula. One might think that going at it structurally would be better and that is true, in principle. If you know exactly what the right structure is – just which variables come in in just which way, then you would always do better to use the structural approach. But if you make one mistake in specifying that structure, it may turn out that you will do better with this kind of forecasting formula than you would with an apparently more analytical approach. I think it is all to the good and really very important for us to use these approaches in parallel; that is, to get the best dirty forecasting formula that we can, and at the same time to be working on the analytical structure so that we make sure that we have all the relevant variables somewhere represented in that forecast. These are not competitive, but complementary, approaches.

Randomness

Now the real message from this paper is partly about the power of averaging and partly about the statistical properties of the changes in the multiplier. What the paper really says is that the "randomness" in the system partly has serial correlation; a random error in one direction will be there partly the next time and you can take advantage of that. It also says that the random error which is not taken into account in that way is fairly large in terms of one-month observations which when multiplied by 12 may look rather frightening. But the second part of the message is that if you are content to average over six months, or even three months, then even a rather simple prediction formula will produce fairly modest errors.

The significance of that observation, of course, depends on the significance of short-run movements in the monetary variables. You might live in a world where every month's movement was terribly significant and would cause a quick action someplace else; or you might live in a world where the response to changes in monetary variables occurred with some rather long distributed lags so it really did not make any difference whether you had a big number this month and a small one next month. Most of that will wash away. The little experiment in the Pierce paper seems to show that if you take a St. Louis point of view – and some people do – good control over a six-month period will probably yield good enough control over GNP and other economic variables. I think if you performed exactly the same type of experiment with almost any other model – say the FRB-MIT model – you would come out with a very similar result. Almost all models and almost all the underlying series suggest that you can have varying inputs bouncing around from month to month but that will have very little significance as long as you have control over, say, the growth of the three-month average from the fourth quarter to the following second quarter. I think if we were to reach agreement on that, we would conclude that if M_1 is the thing we want to control, then we can probably control it well enough for all practical purposes.

RPDs

That opens up, of course, the question of what we should be controlling, but I will close that up quickly since I don't really want to do all that over again. Also, I am going to come back to it in a slightly different form because the last bit of Mr. Burger's paper is on

RPDs and, I have a few thoughts about RPDs. When I read Mr. Burger's paper, it reminded me of a story about the Frenchman who visited New York. His American guide showed him the various New York phenomena. He showed him the George Washington Bridge and said, "What do you think of that?" And the Frenchman said, "It makes me think of sex." He said, "Why?" The visitor replied, "Everything makes me think of sex." Well, when I read Mr. Burger's paper, it got to RPDs, and it turned out that RPDs made him think of M_1. The point of that is that I don't really think that the argument in favor of using RPDs as the basis for the directive is the efficiency of RPDs as a predictor of M_1. They might, since they are related to net source base and monetary base and so on, be a good predictor, but that is not the basis on which I would have selected them. And I don't think it is the basis on which they were selected.

Multiple Policy Objectives

I think the real argument is in the peculiar flexibility of the RPD formulation. It seems to me it meets two basic facts. One is that multiple objectives of policy are inevitable – for reasons I will come to in a minute – and the second is that you can't really tell the Trading Desk to achieve multiple objectives. If you do, you put a lot of responsibility on the Trading Desk to select the mix of objectives. Now I don't want to spend a lot of time on this, but it does seem to me that it is pretty clear that many people on the FOMC and in and out of the System think that the world is pretty complicated, like John Williams always said, and that it is changing. Policy has to respond to a whole constellation of data coming in and you have to decide what you want to do in the light of some compromise on a great number of variables that have to be considered. You have to give some weight to M_1, M_2, various interest rates, and a lot of other things. If that is the case, you need to try to find a form of instruction to the Desk which will specify how it is to respond to the directive to influence a variety of different objectives.

Secondly, even among those who know there is only one objective, it turns out that each one of them knows a different thing. Some of them know that M_1 is the right thing; some of them know that M_2 is the right thing. Some of them are like the man who took up the cello. He started practicing the cello, and after a while his wife said, "You know, I've been watching you play and since you took this up I've taken an interest and have watched other people play. I've noticed that other people keep moving the bow around in different places, and they move their fingers up and down the board. You keep your fingers in the same place on the finger board, and you keep your bow on the same string all the time. How come?" He responded, "Those other people are looking for the note; I have found it." Well, in our little orchestra, there are several people who have found the notes, but different ones. It produces a certain amount of dissonance. So I think that the real beauty of the RPD formula is that each member can make his own compromise. That is, for any given value of the RPD directive, he can ask himself, "What constellation of M_1, M_2, bill rate, and what-not will emerge?", apply his own weights to those and make his own compromise as to what he thinks would be the best value for that controllable variable. The other fellows can do the same. Then they have to compromise with one another. But then what the desk gets is a fairly definite instruction rather than one telling it that it somehow has to compromise between several different, conflicting – and possibly inconsistent – objectives. I think that is a very useful step forward.

This suggests to me some further lines of research, because, if indeed the FOMC members are going to be stuck with the task which I ran through so briskly – of saying, for a given value of RPDs in the next three weeks, what to expect in terms of this whole constellation of variables – they need some light on what they can expect. Perhaps we ought to be directing our research somewhat to assess the risks and uncertainties that are involved. I think one can select a target in terms of RPDs only by knowing both what you expect to be the outcome in terms of that whole combination of interesting variables and also what you think would be the errors in each of them. And I think maybe we have to advance now from finding the relationship between "something or other" and M to finding the relationship between RPDs and quite a variety of things. Maybe in a few years we will be reporting on the pragmatic treatment of RPDs.