A Study of Money Stock Control

Working Paper No. 11

A Study of Money Stock Control

Lionel Kalish III

Preface

The Brunner-Meltzer "Nonlinear Money Supply Hypothesis" is the monetary framework used in this paper. It is recommended (but not necessary) that the reader be familiar with this work. An analysis and development of the hypothesis was written by Albert E. Burger and is available in the form of Working Paper #7 at the Federal Reserve Bank of St. Louis.

Introduction

In 1968 the House of Representatives' Committee on Banking and Currency sent a questionnaire to 73 well-known monetary economists, requesting their views on the structure of the Federal Reserve System and its monetary policy and actions. Almost 68 per cent of the economists felt that the Federal Reserve should place more emphasis on monetary aggregates as targets of policy and indicators of action. Two situations motivated this widespread desire for a change in the operating procedure of the Federal Reserve. First, many economists felt the Federal Reserve had failed under current operating procedures to achieve sufficient economic stabilization. 1/ Second, there exists significant economic research which offers evidence supporting the importance of the influence of monetary aggregates on the economy. 2/

1/ Economic stabilization should be viewed as a policy directed at many goals. Some of these goals are growth of the national product, employment of all resources, stable prices, equilibrium in the balance of payments, and a financial climate which does not threaten existing financial institutions.

2/ See the following examples: Leonall Andersen and Jerry Jordan, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization", St. Louis Federal Reserve Review, Vol. L, (November 1968): Michael De Prano and Thomas Mayer, "Tests of the Relative Importance of Autonomous Expenditures and Money", pp. 729-752, American Economic Review, Vol. LV, September 1965, #4; Albert Ando and Franco Modigliani, "The Relative Stability of Monetary Velocity and the Investment Multiplier", pp. 693-728, American Economic Review, Vol. LV, September 1965, #4; Milton Friedman and David Meiselman, "Reply to Ando and Modigliani and to De Prano and Mayer", pp. 753-785, American Economic Review, Vol. LV, September 1965, #4.

Research has concentrated mainly on the link between monetary aggregates and total spending and prices in the economy, and on the inter-relationship among the different monetary aggregates. 3/ One aspect of choosing the best target variable, however, has not had as much research devoted to it. That is the question of how well the Federal Reserve could be expected to control the growth of a monetary aggregate.

Many economists have simply assumed the money stock could be controlled. Professor Carl F. Christ made the following statement to Congress without providing any supporting evidence, theoretical or empirical:

> It is pretty clear that the Federal Reserve can control the stock of money within narrow limits. I mean they can make the stock of money come within plus or minus one-half per cent of any desired level 99 weeks out of 100." 4/

When economists have presented evidence about monetary control, it has been inconclusive and has generally followed from the economist's point

---

3/ Economists still do not agree on a particular monetary aggregate which would serve as the best target variable. The best aggregate would be fully controllable, consistent with present economic theory, and would have a predictable relationship with the real economy. Although we can ascertain these desired properties, there are no generally accepted tests to evaluate them jointly for the aggregates, and those procedures which have been used indicate only that no aggregate excels in all factors. Some economists prefer bank credit, while others use money plus time deposits or total reserves. The money stock (currency plus private demand deposits) has been chosen for this study. The nature of the problems inherent in controlling it are similar to those in controlling any aggregate.

4/ Carl F. Christ, Statement before Subcommittee on Domestic Finance of the Committee of Banking and Currency, Compendium on Monetary Policy Guidelines and Federal Reserve Structure", (Washington D.C.: U.S. Government Printing Office, 1968), p. 111.

of view on the overall subject of monetary aggregates. For example, Governor Sherman Maisel, who has been a critic of the use of the money stock as a target for monetary policy, recently made the following statement at the University of Michigan:

> The growth of money supply in any period is the result of actions taken by the Federal Reserve, the Treasury, the commercial banks and the public. Over a longer period, the Fed may play a paramount role, but this is definitely not the case in the short run. To the best of my knowledge, the Fed has not and probably would have great difficulties controlling within rather wide limits the growth of the narrowly defined money supply in any week or month. 5/

Professor Allan H. Meltzer, a proponent of the use of monetary aggregates as a target for monetary policy, suggests the Federal Reserve would have good control because of the high statistical correlation between the change in the money stock and change in the base.

> Evidence from past periods suggests that the monetary base is the most important determinant of the money supply, and that there is a high degree of association between the base and the money stock. The degree of association and the extent to which money can be controlled by controlling the base varies with the length of the period. Our analysis suggests that even if policy retains its short-term focus, most changes in money can be controlled. In the past 85% of the variance of the monthly change in money--currency and demand deposits--results from changes in the monetary base and changes in Treasury deposits at commercial banks in the current and previous month. Even in periods of substantial variability in the growth rate of money and sizeable defensive operations, monthly changes in money were dominated by current and past changes in the base. 6/

5/ Sherman J. Maisel, "Controlling Monetary Aggregates", University of Michigan, March 11, 1969.

6/ See Allan Meltzer, "Controlling Money", in the Federal Reserve Bank of St. Louis Review, May 1969.

This paper has two purposes. First, it will attempt to clarify the meaning of "controlling" the growth of the money stock. Second, it will attempt to measure the minimal degree of control which the Federal Reserve could be expected to have over the growth of the money stock.

THE MEANING OF CONTROL

A General Method of Control

The money stock, M_1, is the product of two variables:

$$M_1 = m_1 B$$

The money multiplier, m_1, reflects the asset portfolio decisions of economic units independent of the Federal Reserve (the Treasury, private banks, and individuals), 7/ and B is the monetary base, which is controllable by the Federal Reserve in any given month. 8/ To control the growth of the money stock, the money managers would specify a desired level of the money stock, forecast the money multiplier for that period, and adjust the monetary base appropriately. For example, if the desired level of money stock for tomorrow is $180 billion, and the forecasted multiplier is 2.5, then the money managers would adjust the monetary base to $180/2.5 = $72 billion

---

7/ Other approaches for analyzing the factors affecting the money stock are available. Two of them are the Friedman-Schwartz-Cagan approach and the "reserves available" approach. A description and analysis of all three methods can be found in "Three Approaches to Money Stock Determination" by Leonall Andersen (Reprint #24, St. Louis Federal Reserve Bank.

The Brunner-Meltzer framework was chosen for this paper for it is most detailed. The factors such as interest rates and expectations underly the monetary behavior of banks and the public are specified and enter directly into the money multiplier. This becomes important for sophisticated forecasting of the multipliers, and for an analysis of how changes in the base can affect the multipliers.

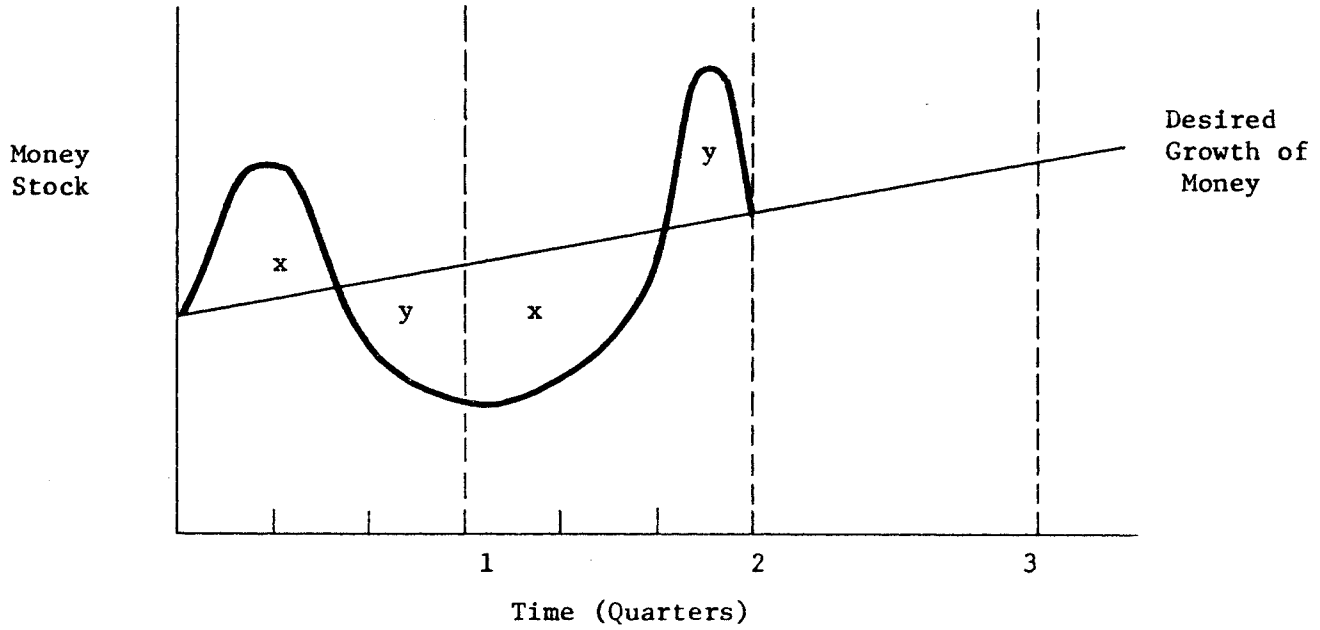
8/ See Appendix I for an elaboration of this statement.

to achieve the desired goal. It is evident that the degree of control is directly related to how well the multiplier can be forecasted, and the Federal Reserve's ability to control the base.

The Optimal Multiplier

The first problem which must be considered is for what time period it is most reasonable to forecast the multiplier. A specific value for the multiplier exists at every point in time, but it is not possible for the Federal Reserve to adjust instantaneously. An average multiplier is the best that the monetary authorities can hope to forecast, be it for a year, quarter, month, week, or day. A minimum average period for the multiplier would be limited by how long it takes the Federal Reserve to adjust the base accurately and by how often new information about the money stock becomes available. The maximum acceptable time period for calculating the multiplier would be determined by a trade-off between the predictability of different length multipliers and whatever the accepted relationship between the money stock and the economy is. If short-term multipliers (such as weekly) were completely unpredictable, then it would be impossible to control the money stock weekly with any degree of accuracy. On the other hand, the longer the average period the multiplier is, the longer the fluctuations of the money stock the Federal Reserve must be willing to accept. For example, in Chart I, although the Federal Reserve may have achieved the desired money stock goal by the end of the quarter, the possibly large and lengthy

fluctuation in the interim might have adverse effects on the real economy. 9/



Of course, the same problem exists no matter for what time period the multiplier is chosen, but most monetary authorities would probably agree that the shorter the period the less chance that fluctuation will have adverse affects on the real economy. 10/ Many experts in the field (including Brunner, Meltzer, and Maisel) feel that the most feasible period of control is a quarter.

9/ Achieving the desired goal of quarterly money stock control does not mean that the money stock has to be on the desired growth line, MoMx, on the last day of the quarter, but that the average of the money stock over the quarter has to grow at a rate equal to the slope of MoMx. On Chart I this means that the area labelled X must be equal to the area labelled Y.

10/ The influence of different length fluctuations of monetary aggregates on the real economy has not been adequately studied. Research employing the permanent income hypothesis suggests that short changes that are viewed as transitory may have a relatively small real effect.

Forecasting Multipliers

In the past the multiplier has not changed radically from period to period. The chart on the following page plots the monthly multipliers from 1958 to 1967. A similar pattern could be made for average multipliers of weekly and quarterly periods. As the seasonally adjusted multipliers indicate, a great deal of the movement in the multipliers has been of a regular seasonal nature. Even though the differences in the magnitudes of the multipliers seem small, they are highly significant. If the monetary base were $50 billion, the difference between the largest and smallest multiplier would have resulted in a difference of $10 billion in the money stock. Therefore, control of the money stock is very dependent on the accuracy of the forecasts of the multiplier.

There are many ways the Federal Reserve could forecast multipliers. One method which could be used if they assumed that the multipliers behaved in a stable fashion (possibly fluctuating around a mean or changing only slowly), would be to consider them constant or equal to some average of past multipliers.

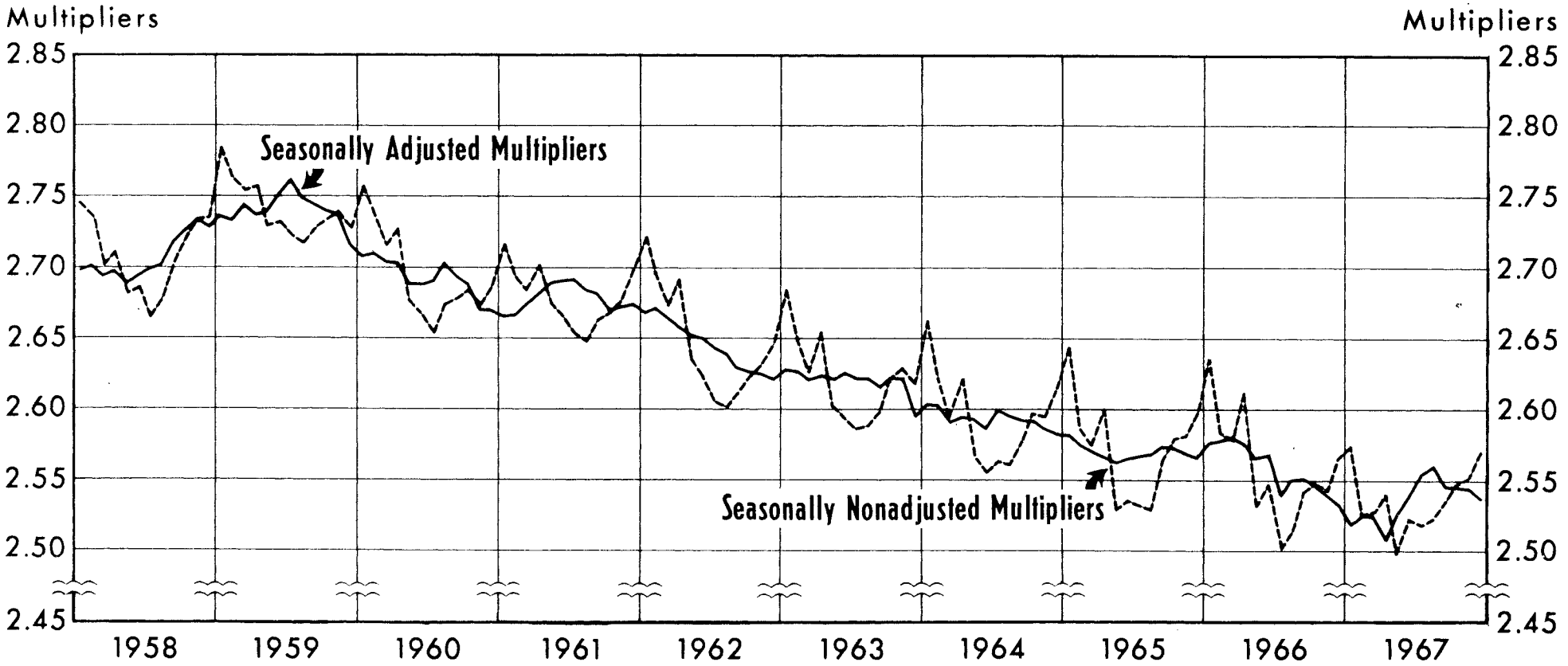
A much more sophisticated approach would be to predict the parameters of the multiplier separately and then consolidate them for a forecast. The parameters of the multiplier are the Treasury deposit ratio (d), the weighted average effective reserve requirement ratio (r), the currency ratio (k), and time deposit ratio (t).

$$m_1 = \frac{1 + k}{r\ (1 + t + d) + k}$$

Each parameter is dependent on real factors such as expectations,

Money Multipliers

MONTHLY AVERAGES OF DAILY FIGURES



Seasonally adjusted multipliers were calculated by dividing the seasonally adjusted money stock by the seasonally adjusted base.

Prepared by Federal Reserve Bank of St. Louis

interest rates, and institutional structures.

To forecast by this method would involve four steps:

1. Estimate the partial derivatives of the multiplier with respect to the parameters:

$$\frac{\partial m_1}{\partial t}, \quad \frac{\partial m_1}{\partial d}, \quad \frac{\partial m_1}{\partial r}, \quad \frac{\partial m_1}{\partial k}$$

2. Forecast the real factors in the economy which influence the parameters. These include interest rates and expectations.

3. Estimate the changes in the parameters:

$$dk, \; dt, \; dr, \; dd$$

4. Consolidate these calculations into a forecast of the change in the multiplier.

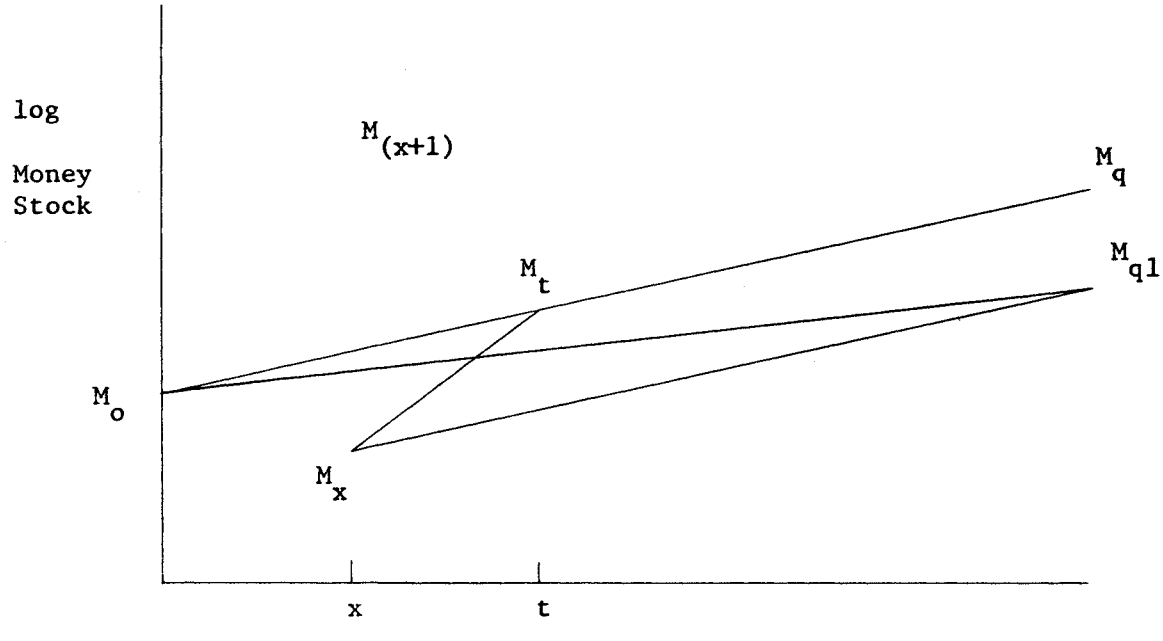
$$dm_1 = \frac{\partial m_1}{\partial t} dt + \frac{\partial m_1}{\partial k} dk + \frac{\partial m_1}{\partial r} dr + \frac{\partial m_1}{\partial d} dd$$

Although little research has been done in the area of forecasting multipliers, there has been some work done in explaining the past behavior of factor influencing the parameters. 11/ In this paper only naive methods have been used to forecast the multiplier. It is the prime purpose of this paper to demonstrate the degree of monetary control which can be expected even in the absence of more precise estimating procedures.

11/ Philip Cagan, "The Demand for Currency Relative to the Total Money Supply" (Journal of Political Economy, 1965). Jerry Jordan, The Market for Deposit-Type Financial Assets, St. Louis Federal Reserve Bank, Working Paper #8, March 1969. Peter Frost, "Banks' Demand for Excess Reserves," U.C.L.A., Dissertation for the Degree of Doctor of Philosophy, 1966.

Interpretations of an Open Market Committee Directive of Steady Monetary Growth

There are two major ways the desk managers could interpret a directive of steady monetary growth after an error in forecasting a multiplier has resulted in missing the target. Each interpretation has distinct implications. If the directive calls for the money stock to increase 4 per cent annually, the objective could be represented by a straight line on semi-log paper. (The desired rate of growth is the line MoMq on Chart III.) If all forecasts of the multipliers were perfect, the money stock would fall on this line every period. Suppose, however, in period (x) the money managers err and the money stock misses the line (Mx on Chart III). How then should the directive be interpreted? We will examine two possibilities.



One way is to grow along $MxMq_1$. This would mean that the money managers would attempt to increase the money stock at a 4 per cent annual rate in every period regardless of the level of the money stock in the preceding period. Two possible reasons for this approach are:

1. The desk managers feel that in each period the forecasting errors would be distributed normally with zero mean. Therefore, in the long run this approach would result in an average money stock growth line of MoMq.

2. The money managers might want to minimize accelerations and decelerations in the growth of the money stock. Growing along $MxMq_1$ requires the money stock to accelerate only once from MoMx.

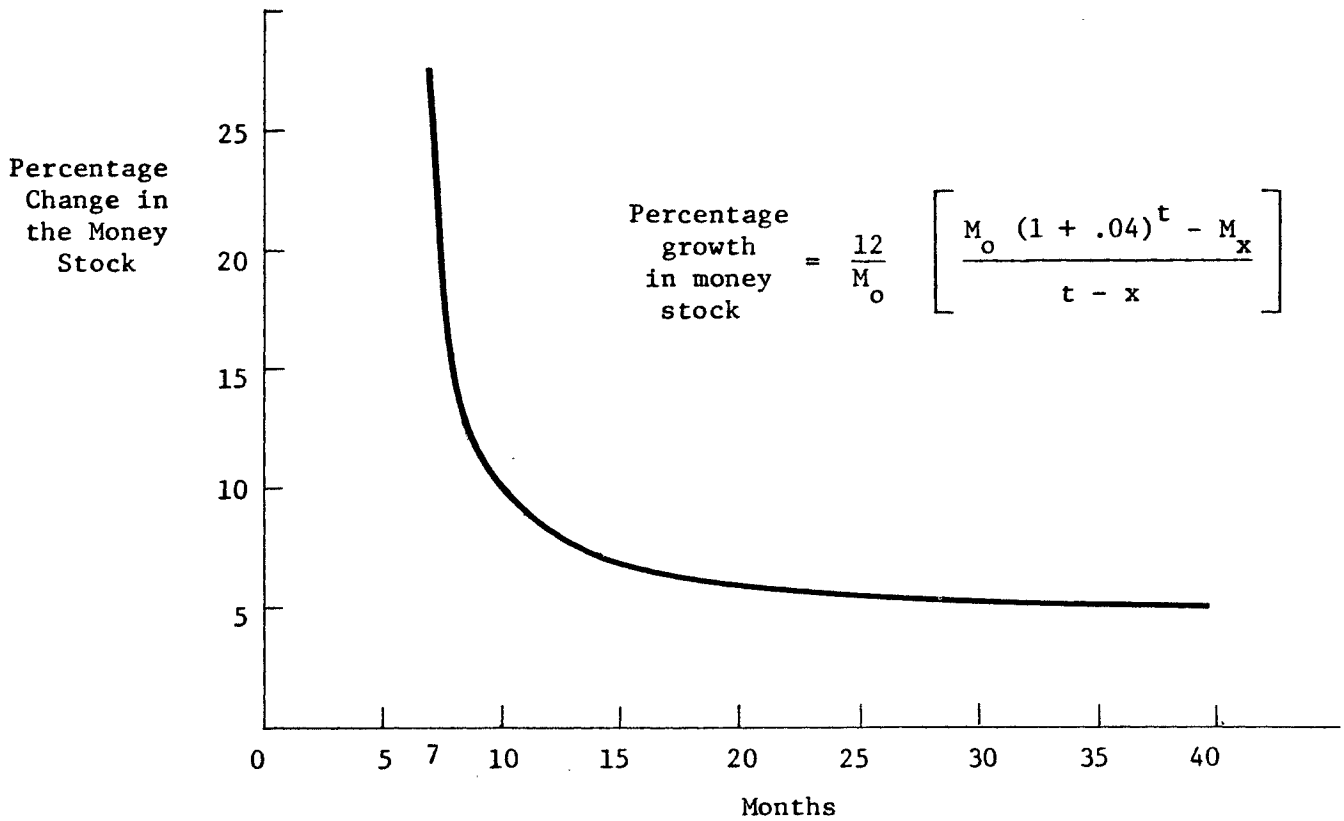
The implication of this interpretation is that it increases the probability that one might end up with a growth rate different from the desired (like $MoMq_1$).

A second interpreation would be to make an active attempt to reattain the original growth line (MoMq) in a specific period (t) (MxMq). The implications of this view are as follows:

1. Money stock growth would have to accelerate not only at Mx, but it would have to decelerate at period (t).

However, it is possible to attenuate this interpretation by moving (t) outwards from x which means the desired rate of growth (MxM_t) approaches (MoMq) as (t) approaches infinity. Chart IV shows how rapidly the desired rate of growth achieves the 4 per cent annually compounded rate as (t) gets larger. Chart IV assumes that:

Mo = 100
Mx = 100
x = 6



In other words, rather than trying to attain the long-run growth line in one month, which calls for a 28 per cent annual growth rate of the money stock in that month, they could attempt to reach it in the twenty-fourth month (eighteen months hence) which would be consistent with a 5-1/2 per cent desired annual growth rate of money in the next month.

2. If all errors are normally distributed with a zero mean, then there is a danger that this interpretation could magnify errors. For example, if:

a. The money managers tried to get back to MoMq by a specific period (x + 1); and

b. The desk managers underestimated the multipliers in (x + 1) by the same amount that they overestimated in x;

then M (x + 1)'s vertical distance from MoMq would be greater than Mx's vertical distance.

The choice of interpretation is as much one of social values as of economic theory. The monetary authorities must weigh the different social costs (inflation, unemployment, etc.) which might result from overshooting or undershooting the line, and from a fluctuating growth rate versus a steady growth rate.

CONTROL OF THE MONEY STOCK

How well can the Federal Reserve expect to control the growth of the money stock? In an attempt to arrive at some answer to this question, a simulation model was developed to compare different ways of controlling the money stock.

An outline of how the model works is as follows:

1. The target of the desk managers is to make the money stock grow at a constant rate. Specifically, it was assumed the desired growth of nonseasonally 12/ adjusted money stock is a simple 4 per cent per year. A compound growth rate would have been more correct theoretically, but I felt that the straight rate of growth would not make a noticeable difference in the short periods discussed. Also, the results of the simulations are not dependent on the 4 per cent level or the fact that the desired level is not changed. Essentially, the same results would have occurred no matter what the numerical value of the desired rate of change or if the desired

---

12/ It was found that one could control non-seasonally adjusted money as well as adjusted by predicting the seasonal factors in the multipliers.

rate had been altered each period. 13/

2. The next period multiplier is forecast from past data. This could be done by judgment, regression analysis, or some naive method like considering the multiplier a constant.

3. The desired money stock level for the period must be determined. The model can do this according to any of the interpretations which we previously examined.

4. The base is adjusted in accord with the desired money stock and the predicted multiplier.

13/ There are two prevalent views among economists concerning the constancy of the desired rate of change of the money stock. One view is that the desired rate of change should never be altered (seasonally or cyclically). This view assumes that the "judgment" of the monetary authorities is such that their changes in the rate would have worse effects on the real economy than the constant desired rate. The contrary view holds that the monetary authorities have enough knowledge to seasonally and cyclically alter the desired growth rate so that the economic goals of the government could be better achieved than if the rate were held constant.

The important thing to note in regard to this paper is that this particular issue is not related to the ability to control the money stock. Different desired rates of change mean only that the monetary authorities aim for different money stock levels, and combined with the same forecasted multiplier the only difference will be a different change in base. For example, if there were seasonal patterns in the multipliers and if the monetary authorities decided not to accommodate these patterns the changes in the base would be much greater than if they allowed the desired money stock to change seasonally. This is because in the first case they would have to negate the influence of the seasonal changes of the multipliers on the money stock by changing the base in a counter-seasonal fashion.

In this paper the desired rate of change of the money stock (non-seasonally adjusted) is always assumed constant. Since in the last ten years there do seem to be distinct seasonal movements in the money multipliers this accounts for a good deal of the changes in the base.

5. The financial sector of the economy is simulated by assuming the actual historical multipliers are still the true multiplier. The model then takes this actual multiplier and multiplies it times the "controlled" base and the result is the "controlled" money stock level.

The model then moves to the next period. It is important to note that after the first period, the monetary base that is operated on is the "controlled" one generated in step 4.

An Example

Working through an example will make the simulation technique a bit clearer. We will assume that the monetary authorities have been directed to achieve a constant 4 per cent annual growth rate of the money stock, and have accepted the following operating procedures as optimal towards this end.

1. Next month's multiplier will be equal to the average multiplier in the preceding twelve months.
2. The desired growth rate of money in any month will be at a 4 per cent annual rate (or .04/12 = .0033 per cent) no matter what the level of the money stock in the preceding month. (Interpretation one on page 14.)

January 1958 will be the first month of simulated control. On December 31, 1957 the monetary authorities have the following information.

A. The preceding twelve multipliers

Jan. 1957	2.777	July	2.689
Feb.	2.765	Aug.	2.706
March	2.743	Sept.	2.705
April	2.729	Oct.	2.706
May	2.722	Nov.	2.715
June	2.715	Dec.	2.702

B. The average money stock in December--$140 billion.

C. The average level of the monetary base in December--$51 billion.

From this information they can determine all they need to know to control the money stock.

1. January's multiplier will be equal to the average multiplier in the twelve preceding months--2.720.

2. The desired average money stock in January will be 140 (1.0033) = $140.46 billion.

3. To achieve this desired money stock the monetary authorities will cause the monetary base to average $\frac{\$140.46}{2.720}$ = $51.6 billion in January. The average monetary base will have to be increased .6 billion dollars.

However, the actual multiplier which did occur during January, 1958 was 2.744. This means that the money stock for that month would have been:

The Base After Our Change		Actual Multiplier		Actual Money Stock in Jan.
(51.6)	X	(2.744)	=	$141.59

which is more than the desired money stock of $140.46 billion.

The monetary authorities are now concerned with February.

1. To forecast February's multipliers the observation from January 1957 is dropped and January 1958 is added. The predicted multiplier for February is 2.720.

2. The desired money stock is $141.59 (1.0033) = $142.06 billion. 14/

3. The monetary base consistent with this goal is $\frac{\$142.06}{2.721}$ = $52.23 billion. On the last day of February they would check how well they had done, and move on to the next month.

Criticism of Simulation Model

The reason for undertaking such a simulation is that the Federal Reserve has never explicitly tried to control the money stock Therefore, there is no precise idea of how well they could do or what would be the best operating procedure for control. Even though there might not be anything better, the failings of such a simulation should be noted and studied. There are two basic failings:

1. The future will not be like the past. This is a criticism which all scientific policy recommendations must bear, and one must recognize its existence. Its relevance is more than likely in this particular case because the monetary structure will probably change when the Federal Reserve money managers operate under different rules. On the other hand, the future monetary structure may be even more stable if steady monetary growth is achieved.

14/ If the operating procedure had been to aim for the long run growth line each month the desired money stock in February would have been (140) (1.0066) = $140.92. If this were the case the desired base would have been $51.7 billion which means the monetary authorities would have only had to increase the base $.1 billion in February.

2. A more specific criticism is that it may be meaningless to assume that the actual multipliers are still valid if they are highly dependent on how the base was actually changed.

The significance of this criticism depends on the strength of the relationship between the base and the multipliers. Theoretically the relationship depends on the following two elasticities. 15/

$$E(m_1, B) = E(m_1, i) \cdot E(i, B)$$

There are three factors which determine the second elasticity:

1. The (short-run) impact effect of changes in B on credit market interest rates. The impact effect is:

$E(i, B) < 0$

2. Feedback effects from the real sector to the credit market. (An increase (decrease) in base increases (decreases) demand for credit.) The feedback effects of increases (decreases) in B act to raise (lower) interest rates.

$E(i, B) > 0$

3. Long-run or price expectation effects of a change in base money. This depends upon the change in the price level resulting from the effects in the real sector of base-induced changes in the monetary aggregates. These effects operate to raise (lower) interest rates as the base expands (contracts).

$E(i, B) > 0$

15/ Burger, p. 41.

The elasticity of the multiplier with respect to the interest rate can be written as:

$$E(m_1, i) = E(m_1, e) \cdot E(e, i) + E(m_1, b) \cdot E(b, i) + E(m_1, t) \cdot E(t, i)$$

b = borrowings from discount window
e = excess reserves
t = time deposit ratio

The signs of the first two products are positive and their numerical values vary as the interest rate level changes. Conversely the sign of the third product changes as interest rate levels approach legal ceiling rates, but its numerical value behaves similarly changing with the interest rate levels.

Because of the differences in signs and the changes in numerical values we can see that it is possible that the overall relationship between the two might not be very strong. To evaluate the relationship three tests were applied.

First, we regressed monthly first differences (and lagged first differences) of the multiplier on the first differences (and lagged first differences) of the base. Monthly data were used because it is monthly monetary control which will be attempted. The results were from 1958-1968:

$$\Delta m_t^1 = .00183 + .004\ \Delta B_t$$
$$(.98) \quad \text{(t-values in parenthesis)}$$

$$R^2 = -.007 \qquad \text{D-W} = 2.4$$

$$(\log m_t^1 - \log m_{t-1}^1) = -.00058 + .07\ (\log B_t - \log B_{t-1})$$
$$(.70)$$

$$R^2 = .004 \qquad \text{D-W} = 2.4$$

The second test was the same as the first except it lagged the change in the multiplier one month after the change in the base. This test assumed it might take private portfolios some time to adjust to changes in the base.

$$\Delta m^1_t = - .005 + .02\ \Delta B_{t-1}$$
$$(5.06)$$

$R^2 = .16$ D-W = 2.4

$$(\log m^1_t - \log m^1_{t-1}) = -.0018 + .45\ (\log B_{t-1} - \log B_{t-2})$$
$$(4.9)$$

$R^2 = .15$ D-W = 2.4

The third test was an attempt to fit a nonlinear relationship. The change in the multiplier was considered to be a function of the square of the changes in the base in the preceding month.

$$\log \Delta m^1_t = - 4.19 + .14 \log \Delta B_t$$
$$(2.9)$$

$R^2 = .06$ D-W = 1.6

The relevant statistics in these tests would be a high R^2 and significant coefficients. The proper signs for the coefficients depend on the real economic factors which were constantly changing from 1958 to 1968.

Of the three tests the second demonstrated the strongest relationship. Although the R^2 was relatively low the coefficients were highly significant. What do these results mean in terms of the simulative technique? Although the relationship between the two variables does not appear strong enough to invalidate the

entire technique, it should be kept in mind as a caveat. 16/

Simulations of Different Methods of Control

The procedure for simulation was to attempt monthly control first; if adequate control could not be achieved monthly, then quarterly control would be attempted. All methods of control were tried first on the period 1958-1962, if reasonable control was attained the method was used to control money from 1963-1968. It cannot be said that these periods represent an easy time in which to control the money stock for many monetary problems occurred; recessions, large strikes, the bite of Regulation Q, and wars.

Many methods of control were tried. Some of the different operating rules are listed below:

1. The forecasted multiplier was assumed a constant and equal to the average multiplier from 1953 to 1957.
2. The forecasted multiplier was dependent on an average of previous multipliers, seasonals, interest rates, and Regulation Q.
3. Steady growth was interpreted to mean a constant rate of growth each month, or to mean that it was desired to get back to the original growth line each month. (The interpretation on page 14).
4. Absolute limits were placed on how much the base could

16/ It is not clear whether the change in the base would bring the actual multipliers closer to the forecasted multiplier or further away.

It should also be noted that the average change in the base which is consistent with the operating procedures used later in this paper is not much different in size than the actual average changes in the base, and thus probably would not have caused much difference in the multipliers.

be changed each month. This is similar to moving M(t) out as in the second interpretation.

There were approximately 20 different combinations of these rules which were simulated.

In order to have a guide for choosing which method of control is better than another some norms must be established. They are:

1. The average and variance of the deviation of the actual money stock from the desired. If the money stock were perfectly controlled, this actual and desired would always be equal and the average deviation would be zero.

2. The average and variance of the six month rate of change of the money stock. In our model if the growth of the money stock were controlled perfectly the average sixth month rate of change would be two per cent and the variance around this mean would be zero.

3. The average number of consecutive months in which the money stock is continually on one side of the long run desired growth line. This, too, would be zero if the money stock were controlled perfectly.

For an operating procedure to be considered better than another it must be better for all three norms or better for at least one and equal for the remaining norms.

Case I

The following operating procedures gave relatively poor results:

1. Next month's multiplier is assumed to be equal to the average multiplier in the preceding twelve months.

2. Each month it is desired for the money stock to grow a constant .04/12 = .0033 per cent.

Chart I shows the money stock which resulted from this method. This degree of control from 1958 through 1962 could be summarized as follows:

1. The average deviation of the actual monthly money stock from the desired was $9.13 billion. The variance around this mean was $38 billion. The average desired money stock during this period was about $150 billion.
2. The average six month rate of change was .35 per cent with a variance of 18 per cent.
3. The average number of months consistently on one side of the line was about 15 months. 17/

Case II

A relatively successful method of control had these operating rules:

1. Each month's forecasted multiplier is considered a function of the average multiplier in the previous six months and monthly dummy variables. In order to account for changing seasonals, only three years of observations were used for the first prediction, and for each succeeding prediction the latest observation was added and the first dropped.
2. Each month the desired money stock is on the long-run steady growth line as in the second interpretation.
3. The monetary base is not allowed to change by more than $1 billion in any month.

17/ Appendix II contains the Tables which show the monthly numeric values which resulted.

The statistical results of the procedure are as follows:

1. The average deviation of the actual money stock from the desired was $.90 billion, and the variance around this mean was $.48 billion. The average money stock in this period was about $160 billion.

2. The average six month rate of change was 1.51 per cent and the variance was .8 per cent.

3. The average run of months which the actual money stock was consistently above or below the desired line was 3-1/2 months. 18/

Case III

The best control was achieved with the same operating procedures of Case II without any limitations on how much the base could change in one month.

Chart II shows the results from 1958-1962, and Chart III the results from 1963 to 1969. Statistically the results are:

1. The average deviation of the actual money stock from the desired was $.89 billion, and the variance around this mean was $.44 billion.

2. The average six month rate of change generated by the model was one and seven tenths per cent, and the variance of the rate of change was one per cent.

3. The average run of months which the actual money stock was consistently above or below the desired level was three months.

18/ See Appendix II.

The middle tier on charts II and III show the actual percentage changes in the base which would have been consistent with this method of control. Approximately, the largest change in the base in any one month would have been $2 billion. 19/

In the beginning of this paper it was noted that the monetary authorities would have to accept any money stock fluctuations which occurred between forecasts of the multiplier. In order to get some idea of the magnitude of this problem with respect to monthly control the weekly multipliers were examined in 1967 to see how much they varied from the monthly. Chart IV plots the weekly multipliers. It was found that the average deviation of a weekly multiplier from its corresponding monthly multiplier was less than 1 per cent and the variance was less than 1/2 of 1 per cent. The bottom tier shows the weekly money stock which would have occurred given our third method of monthly control.

Conclusion

The results demonstrated in this paper are not intended as the final answer to the question of monetary control. The correct answer lies somewhere between the views of Professor Christ and Governor Maisel. Monetary control will certainly be more difficult

---

19/ An interesting aspect of the third method of control is that the average amount of securities bought and sold by the Federal Reserve under our method of control would not be much different than what actually occurred. From 1966 to 1969 our procedures call for an average change in securities of $700 million a month whereas the actual average change was about $500 million. This assumes the other components of the base (e.g. float) would have changed in the same way as they did. The standard deviation of the change was much greater in our model but that is mainly due to the fact that we negated seasonal changes in money by changing the base.

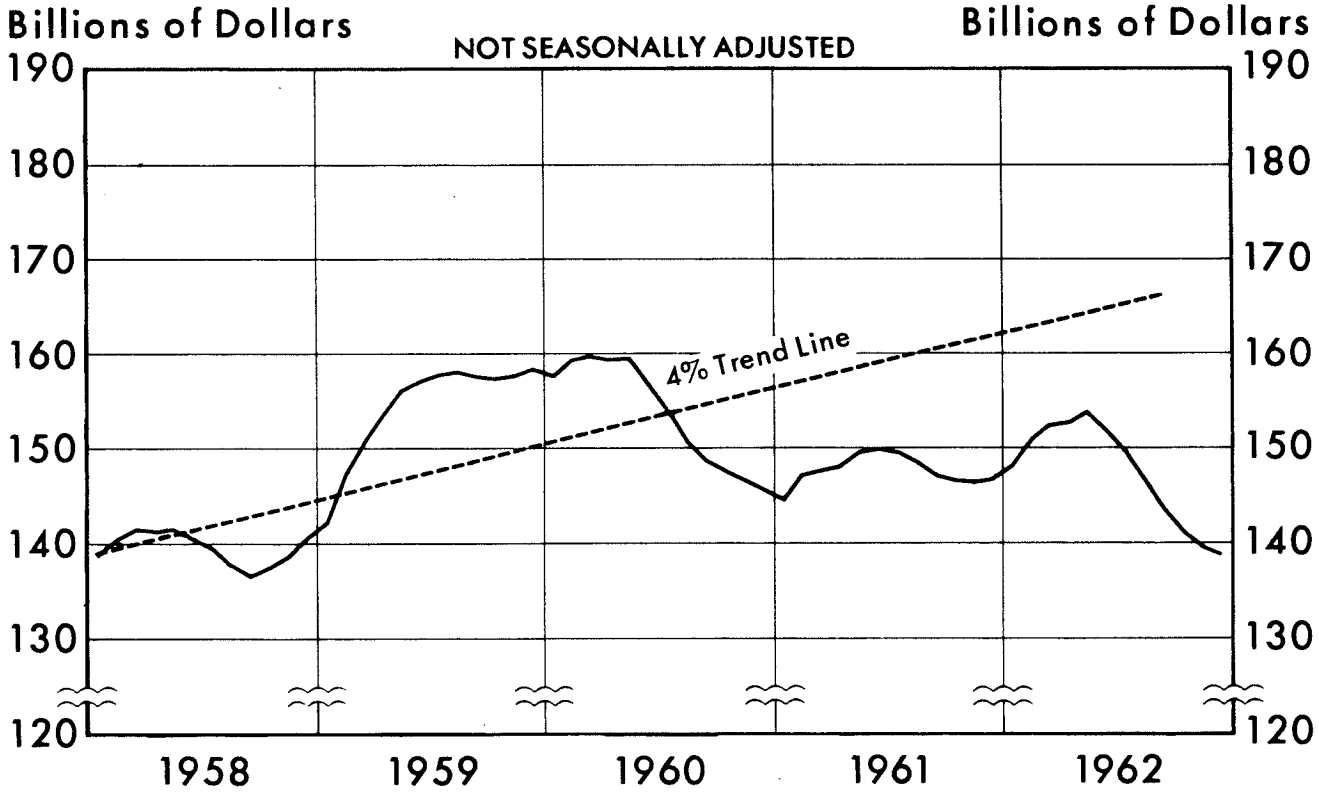
than Professor Christ assumed, and contrary to Governor Maisel's opinion, it is possible to attain some control of the growth of the money stock from month to month.

The model is meant to present confidence limits of the level of success the Federal Reserve money managers could expect in controlling the money stock. The upper limit is perfection. The lower limit is the degree of control which I achieved in my third set of operating procedures.

Sophisticated forecasting techniques could probably achieve better control than the lower limit. But, if not, the money managers could rely on the third operating procedures with the confidence that it will do at least as well as shown by this paper over the last eleven years.

Chart 1

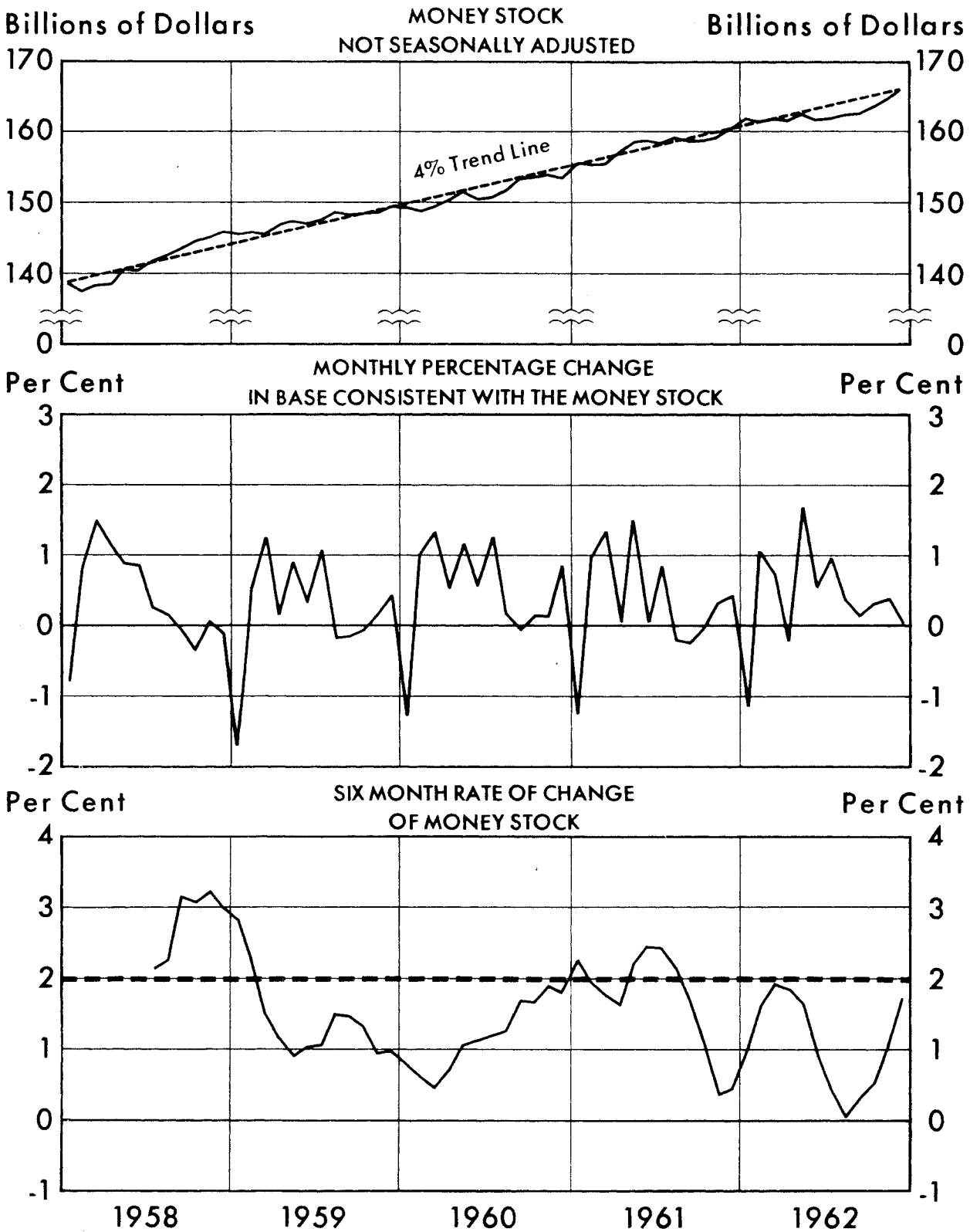
Money Stock - Case I



Prepared by Federal Reserve Bank of St. Louis

Chart 2

Money Stock Control - Case III

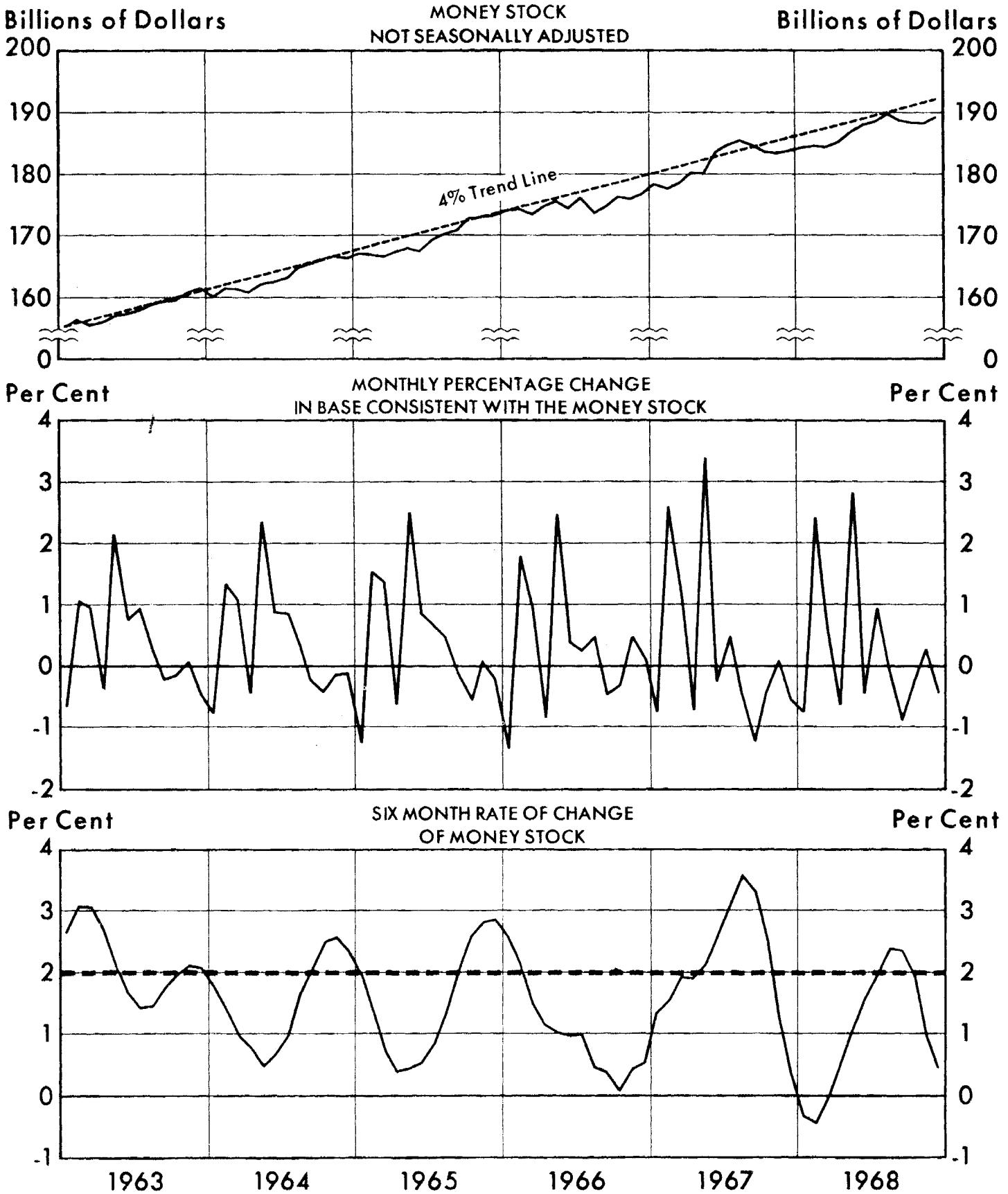


$$\text{Six month change in money stock} = \frac{(M_t + M_{t-1} + M_{t-2}) - (M_{t-6} + M_{t-7} + M_{t-8})}{(M_{t-6} + M_{t-7} + M_{t-8})}$$

Prepared by Federal Reserve Bank of St. Louis

Chart 3

Money Stock Control - Case III



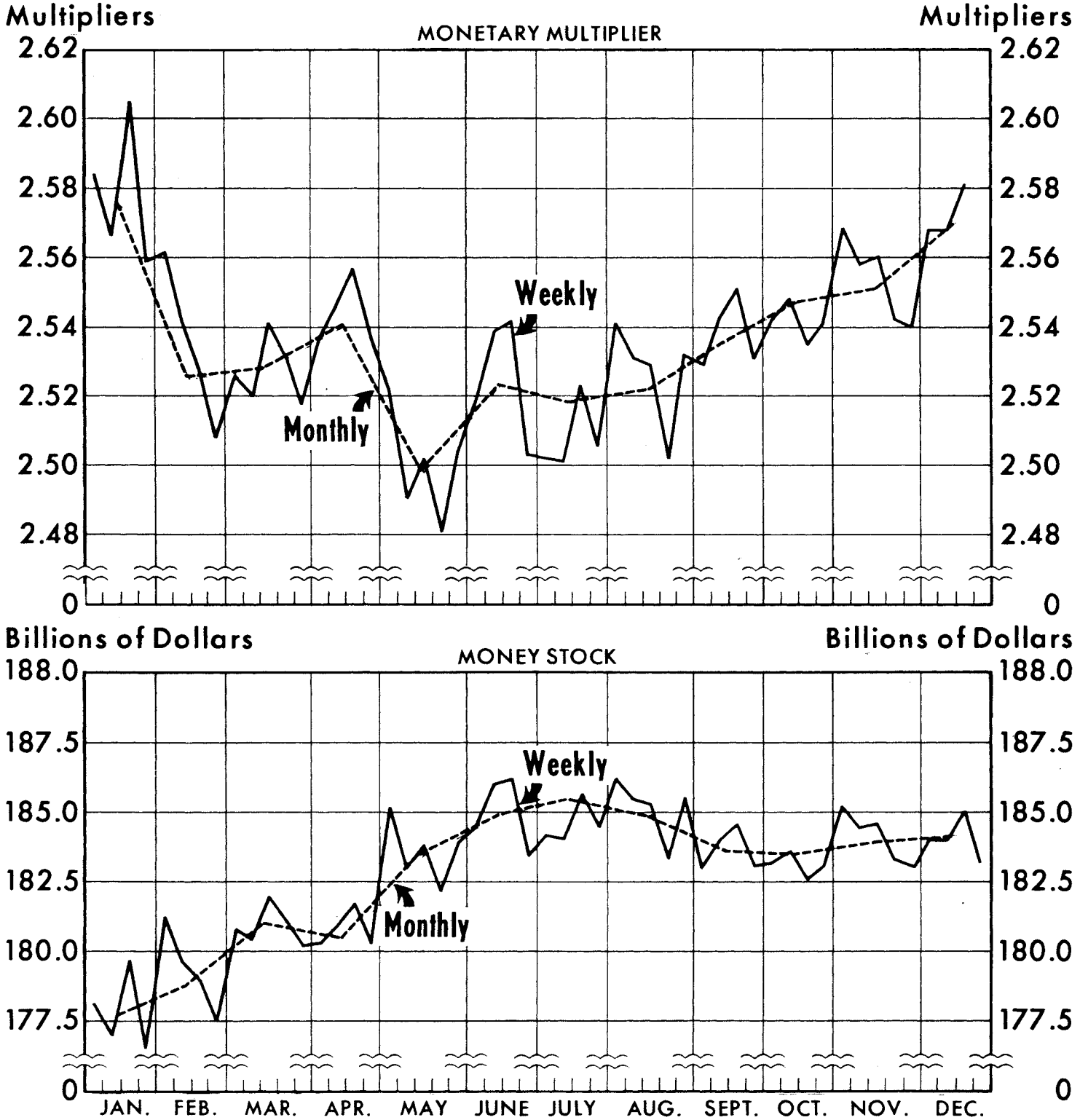
$$\text{Six month change in money stock} = \frac{(M_t + M_{t-1} + M_{t-2}) - (M_{t-6} + M_{t-7} + M_{t-8})}{(M_{t-6} + M_{t-7} + M_{t-8})}$$

Prepared by Federal Reserve Bank of St. Louis

Chart 4

Weekly Figures

NOT SEASONALLY ADJUSTED



Prepared by Federal Reserve Bank of St. Louis

APPENDIX I

The Federal Reserve's ability to control the monetary base is, in many ways, a problem similar to controlling the money stock. [1/] The lack of absolute control derives from three factors: not all components of the monetary base or the money stock are under the direct control of the Federal Reserve (e.g., float in the case of the base and excess reserves in the case of money); the behavior of these independent factors are not, under the present circumstances, absolutely predictable; and there is a lag in information about the behavior of these factors.

If the Federal Reserve wanted the monetary base to remain unchanged, and they predicted float was going to increase $20 million in the next two days, their procedure would be to decrease their portfolio of securities by that amount (20 million). But, if their prediction was not correct (float only increased $15 million) and the Fed did not know about the error in prediction as it happened because of an information lag, the base would decrease by $5 million, even though the Fed had desired the base to remain unchanged.

The differences between controlling the money stock and the monetary base are due to conceptual framework and magnitude. Conceptually, there is no part of the money stock which is completely controllable by the Federal Reserve, while the securities portfolio of the base is completely controllable. As for the magnitudes, the lag in information about base factors is much shorter, and the predictions

---

1/ In this section of the paper I have benefitted greatly from suggestions made by Richard Erb of the staff of the Board of Governors. However, the responsibility for the results is mine alone.

of the base factors are much better than predictions of money stock components, given the present state of knowledge. 2/

Once all the information is available about the sources of the base, the amount of securities could be altered immediately and the desired base attained. Therefore, the only error in the base would be the error in forecasting between any periods of information (which are daily). Consequently, as the period of control lengthens and the over-all change in the monetary base increases, the error in the last day becomes increasingly insignificant and the Federal Reserve approaches complete control of the base. This is not necessarily true of the money stock, because even after information has been received about the state of the money stock, the Federal Reserve cannot be sure that their operations will result in the desired money stock level.

Some insight into the extent of this problem can be gained by examining the Federal Reserve's prediction of the sources of the base. Over the last three years, Wednesday's predictions of the sources of the base had an average deviation from the actual figures on Wednesday of $12 million, and a standard deviation of $40 million. In comparison, the unadjusted source base's average monthly change in this period was $550 million, so the average error in controlling the change in the base monthly is about 2 per cent.

There are two points which minimize the importance of the lack of absolute control of the base on the control of the money stock.

2/ It should also be noted that although the Federal Reserve receives information with a fairly short lag, revisions in the data often continue for two or three weeks.

First, it is quite possible that the errors in adjusting the base could be helpful in controlling the money stock if those errors are compensated for by the errors in predicting the money multipliers. For example, if the multiplier was underestimated and the base changed less than desired, the results might be perfect. Second, the magnitude of the problem, with respect to controlling the money, is reduced to an insignificant degree because of the fact that the monetary authorities are trying only to attain average levels of the base. An example will demonstrate how minute this problem becomes.

If the monetary authorities desired the monetary base to average $61 billion in the month of January, and up until the last day of January the base averaged $60.9 billion, then the desired base on the last days would be equal to $64 billion. 3/ Now let us suppose that the monetary authorities lost complete control on the last day and missed the $64 billion by $100 million (which is more than two standard deviations away from the norm). The question is: How much would they have missed the desired base for the month?

$$\frac{(64.1) + 30\ (60.9)}{31} = 61.003$$

They missed the desired level by only $.003 billion. Due to this, I think it is clear that the average monetary base can be controlled in any month.

3/ X = the last day's base $\quad \frac{30\ (60.9) + X}{31} = 61$

APPENDIX II

The following tables are the monthly figures generated by the three methods of control.

CASE I

1. Forecasted Multiplier equals the average multiplier in preceding twelve months.

2. Desired money stock equaled $\frac{.04}{12}$ growth from the money stock in preceding month.

1958-1962

Date	Multiplier Forecast	Multiplier Actual	Per Cent Change in Base	Money Stock	Percentage Change in Money Stock over last 6 months
1958					
Jan.	2.723	2.744	1.12	138.8	
Feb.	2.720	2.737	1.22	140.4	
Mar.	2.718	2.701	1.03	141.7	
Apr.	2.714	2.681	- .15	141.3	
May	2.713	2.694	.25	141.6	
June	2.709	2.685	- .70	140.4	2.5
July	2.707	2.656	- .48	139.6	1.1
Aug.	2.705	2.661	-1.18	137.8	- .8
Sept.	2.702	2.703	- .57	136.9	-2.1
Oct.	2.702	2.720	.36	137.4	-2.9
Nov.	2.703	2.734	.94	138.8	-2.3
Dec.	2.705	2.734	1.39	140.8	-1.1
1959					
Jan.	2.708	2.782	1.31	142.7	1.1
Feb.	2.711	2.762	2.98	147.2	3.9
Mar.	2.713	2.754	2.16	150.5	6.8
Apr.	2.717	2.756	1.68	153.3	9.1
May	2.721	2.729	1.62	156.0	10.2
June	2.725	2.732	.47	156.9	10.4
July	2.729	2.722	.44	157.9	9.3
Aug.	2.734	2.717	- .09	158.1	7.3
Sept.	2.738	2.728	- .40	157.6	4.9
Oct.	2.739	2.732	- .09	157.6	2.9
Nov.	2.740	2.740	.04	157.7	1.4
Dec.	2.741	2.726	.29	158.2	.5

Date	Multiplier Forecast	Multiplier Actual	Per Cent Change in Base	Money Stock	Percentage Change in Money Stock over last 6 months
1960					
Jan.	2.740	2.757	- .17	157.9	.2
Feb.	2.738	2.738	1.04	159.4	.3
Mar.	2.736	2.716	.40	159.9	.8
Apr.	2.733	2.727	- .30	159.2	1.1
May	2.730	2.676	.22	159.4	1.1
June	2.726	2.668	-1.51	156.7	.3
July	2.720	2.653	-1.61	153.9	-1.1
Aug.	2.715	2.673	-1.95	150.6	-3.3
Sept.	2.711	2.678	-1.07	148.7	-5.2
Oct.	2.717	2.684	- .74	147.4	-6.6
Nov.	2.703	2.673	- .37	146.6	-6.8
Dec.	2.697	2.686	- .55	145.5	-6.4
1961					
Jan.	2.694	2.715	.04	145.4	-5.1
Feb.	2.690	2.693	1.25	147.1	-3.3
Mar.	2.687	2.684	.56	147.7	-1.4
Apr.	2.684	2.709	.32	148.1	0
May	2.683	2.674	1.32	149.9	1.3
June	2.683	2.666	.02	149.9	2.3
July	2.682	2.654	- .28	149.5	2.6
Aug.	2.683	2.648	- .71	148.4	1.7
Sept.	2.680	2.662	- .89	147.0	.4
Oct.	2.679	2.668	- .29	146.5	- .8
Nov.	2.678	2.676	- .04	146.3	-1.7
Dec.	2.678	2.695	.25	146.8	-2.1
1962					
Jan.	2.679	2.721	.95	148.2	-1.5
Feb.	2.679	2.690	1.91	151.0	.2
Mar.	2.680	2.673	.93	152.5	2.2
Apr.	2.675	2.691	.12	152.6	3.6
May	2.677	2.635	.85	153.9	4.4
June	2.674	2.623	-1.12	151.9	3.9
July	2.670	2.605	-1.44	149.5	2.1
Aug.	2.666	2.601	-1.94	136.4	- .9
Sept.	2.662	2.611	-1.96	143.3	-3.7
Oct.	2.658	2.624	-1.45	141.0	-6.1
Nov.	2.654	2.631	- .81	139.7	-7.5
Dec.	2.651	2.646	- .40	138.9	-7.8

CASE II

1. Forecasted multiplier is a function of the average of the multipliers in preceding six months, and monthly variables. Three years of observations are used to make each forecast.

2. Desired money stock is always on the 4 per cent trend line from the money stock in the first months of control.

3. The base is not allowed to change more than $\pm$ $1 billion in any month.

1958-1962

Date	Multiplier Forecast	Multiplier Actual	Per Cent Change in Base	Money Stock	Percentage Change in Money Stock over last 6 months
1958					
Jan.	2.776	2.745	- .81	138.8	
Feb.	2.763	2.737	.82	137.7	
Mar.	2.733	2.701	1.45	138.4	
Apr.	2.710	2.711	1.17	138.6	
May	2.695	2.682	.89	140.7	
June	2.680	2.685	.88	140.4	1.67
July	2.656	2.664	1.24	141.8	2.12
Aug.	2.661	2.678	.14	142.5	2.26
Sept.	2.672	2.704	- .08	143.4	3.16
Oct.	2.689	2.720	- .33	144.7	3.09
Nov.	2.696	2.734	.06	145.1	3.21
Dec.	2.708	2.735	- .12	145.9	3.00
1959					
Jan.	2.764	2.783	-1.70	145.8	2.82
Feb.	2.758	2.763	.52	145.8	2.27
Mar.	2.733	2.754	1.24	145.5	1.51
Apr.	2.737	2.757	.16	146.9	1.16
May	2.722	2.730	.90	147.2	.91
June	2.721	2.732	.32	147.1	1.02
July	2.702	2.723	1.03	147.7	1.04
Aug.	2.716	2.718	- .18	148.7	1.48
Sept.	2.728	2.728	- .16	148.2	1.47
Oct.	2.739	2.733	- .09	148.5	1.31
Nov.	2.743	2.740	.18	148.6	.93
Dec.	2.740	2.727	.40	149.3	.99

Date	Multiplier Forecast	Multiplier Actual	Per Cent Change in Base	Money Stock	Percentage Change in Money Stock over last 6 months
1960					
Jan.	2.785	2.758	-1.29	149.2	.8
Feb.	2.765	2.738	1.04	148.9	.6
Mar.	2.737	2.716	1.32	149.4	.4
Apr.	2.731	2.728	.51	150.1	.7
May	2.708	2.676	1.17	151.5	1.0
June	2.701	2.668	.55	150.4	1.1
July	2.676	2.653	1.25	150.8	1.2
Aug.	2.680	2.674	.16	151.8	1.2
Sept.	2.690	2.678	- .07	153.2	1.6
Oct.	2.694	2.684	.16	153.4	1.6
Nov.	2.698	2.674	.14	153.9	1.8
Dec.	2.683	2.687	.84	153.6	1.8
1961					
Jan.	2.725	2.716	-1.24	155.6	2.2
Feb.	2.708	2.694	.95	155.3	1.9
Mar.	2.680	2.684	1.33	155.5	1.7
Apr.	2.687	2.710	.02	157.1	1.6
May	2.656	2.675	1.48	158.6	2.2
June	2.662	2.666	.05	158.9	2.4
July	2.648	2.655	.82	158.5	2.4
Aug.	2.661	2.648	- .20	159.1	2.1
Sept.	2.676	2.663	- .25	158.3	1.7
Oct.	2.684	2.668	- .02	158.8	1.1
Nov.	2.683	2.676	.31	159.1	.3
Dec.	2.680	2.700	.41	160.1	.4
1962					
Jan.	2.718	2.722	-1.13	161.9	.9
Feb.	2.698	2.696	1.05	161.6	1.6
Mar.	2.686	2.674	.72	161.8	1.9
Apr.	2.699	2.692	- .21	161.6	1.8
May	2.662	2.635	1.65	162.3	1.6
June	2.655	2.623	.54	161.6	.9
July	2.638	2.606	.95	161.8	.4
Aug.	2.635	2.602	.36	162.2	.1
Sept.	2.638	2.611	.16	162.6	.3
Oct.	2.638	2.624	.30	163.4	.5
Nov.	2.635	2.631	.39	164.7	1.1
Dec.	2.642	2.646	0	165.8	1.7

1963-1968

Date	Multiplier Forecast	Multiplier Actual	Per Cent Change in Base	Money Stock	Percentage Change in Money Stock over last 6 months
1963					
Jan.	2.669	2.683	- .68	155.1	2.6
Feb.	2.649	2.649	1.05	156.2	3.1
Mar.	2.634	2.626	.92	155.8	3.0
Apr.	2.652	2.654	- .38	155.9	2.6
May	2.604	2.601	1.69	156.9	2.1
June	2.593	2.594	.76	157.2	1.7
July	2.577	2.585	.93	157.9	1.4
Aug.	2.579	2.588	.23	158.8	1.5
Sept.	2.592	2.598	- .21	159.4	1.8
Oct.	2.603	2.621	- .14	159.7	1.9
Nov.	2.611	2.628	.59	160.9	2.1
Dec.	2.631	2.618	- .46	161.4	2.1
1964					
Jan.	2.661	2.661	- .79	160.0	1.7
Feb.	2.633	2.622	1.34	161.4	1.4
Mar.	2.613	2.594	1.07	161.2	.9
Apr.	2.633	2.621	- .47	161.1	.7
May	2.581	2.567	1.61	162.1	.4
June	2.566	2.555	.88	162.4	.6
July	2.552	2.562	.85	163.1	.9
Aug.	2.551	2.561	.35	164.9	1.6
Sept.	2.565	2.577	- .25	165.4	2.0
Oct.	2.584	2.596	- .44	166.1	2.5
Nov.	2.595	2.595	- .13	166.6	2.5
Dec.	2.606	2.612	- .12	166.3	2.3
1965					
Jan.	2.648	2.643	-1.28	167.1	1.9
Feb.	2.617	2.586	1.51	166.9	1.4
Mar.	2.589	2.573	1.34	165.8	.7
Apr.	2.613	2.600	- .61	167.2	.4
May	2.557	2.528	1.55	167.9	.4
June	2.542	2.535	.86	167.4	.5
July	2.533	2.533	.66	169.2	.8
Aug.	2.528	2.529	.48	170.2	1.3
Sept.	2.539	2.563	- .13	170.8	2.0
Oct.	2.561	2.578	- .57	172.9	2.5
Nov.	2.567	2.580	.05	172.9	2.8
Dec.	2.580	2.599	- .21	173.1	2.8

Date	Multiplier Forecast	Multiplier Actual	Per Cent Change in Base	Money Stock	Percentage Change in Money Stock over last 6 months
1966					
Jan.	2.624	2.636	-1.38	174.0	2.5
Feb.	2.585	2.582	1.51	174.0	2.1
Mar.	2.568	2.578	.97	173.5	1.4
Apr.	2.598	2.612	- .88	174.9	1.1
May	2.543	2.532	1.47	175.6	1.0
June	2.541	2.547	.36	174.4	.9
July	2.542	2.502	.24	176.1	1.0
Aug.	2.537	2.511	.48	173.4	.4
Sept.	2.555	2.541	- .45	174.9	.4
Oct.	2.571	2.547	- .31	176.2	.1
Nov.	2.566	2.544	.46	176.1	.4
Dec.	2.570	2.565	.10	176.6	.5
1967					
Jan.	2.597	2.574	- .75	178.3	1.3
Feb.	2.538	2.524	1.45	177.6	1.5
Mar.	2.517	2.528	1.12	178.6	1.9
Apr.	2.542	2.540	- .73	180.9	1.9
May	2.466	2.497	1.41	180.4	2.1
June	2.478	2.522	- .25	183.5	2.6
July	2.474	2.518	.46	184.8	3.0
Aug.	2.492	2.522	- .44	185.3	3.5
Sept.	2.531	2.536	-1.26	184.8	3.3
Oct.	2.548	2.547	- .42	183.5	2.5
Nov.	2.554	2.550	.07	183.5	1.2
Dec.	2.576	2.570	- .59	183.9	.4
1968					
Jan.	2.602	2.594	- .73	184.2	- .3
Feb.	2.547	2.533	1.40	184.6	- .4
Mar.	2.541	2.528	.52	184.6	0
Apr.	2.564	2.566	- .62	185.2	.4
May	2.500	2.515	1.37	186.8	1.0
June	2.518	2.530	- .45	188.2	1.5
July	2.502	2.526	.90	188.5	1.9
Aug.	2.511	2.515	- .06	189.9	2.3
Sept.	2.540	2.531	- .89	188.9	2.3
Oct.	2.552	2.534	- .23	188.4	1.9
Nov.	2.552	2.541	.25	188.2	1.0
Dec.	2.571	2.570	- .46	189.3	.4

CASE III

1. Forecasted multiplier is a function of the average of the multipliers in preceding six months, and monthly variables. Three years of observations are used to make each forecast.

2. Desired money stock is always on the 4 per cent trend line from the money stock in the first months of control.

1958-1962

Date	Multiplier Forecast	Multiplier Actual	Per Cent Change in Base	Money Stock	Percentage Change in Money Stock over last 6 months
1958					
Jan.	2.776	2.745	- .80	138.8	
Feb.	2.763	2.737	.81	137.7	
Mar.	2.733	2.701	1.44	138.4	
Apr.	2.710	2.711	1.17	138.5	
May	2.695	2.682	.88	140.7	
June	2.680	2.685	.87	140.4	
July	2.656	2.664	1.23	141.8	2.1
Aug.	2.661	2.678	.14	142.5	2.2
Sept.	2.672	2.704	- .07	143.4	3.1
Oct.	2.689	2.720	- .32	144.6	3.0
Nov.	2.696	2.734	.06	145.0	3.2
Dec.	2.708	2.735	- .12	145.9	3.0
1959					
Jan.	2.764	2.783	-1.70	145.8	2.82
Feb.	2.758	2.763	.52	145.8	2.27
Mar.	2.733	2.754	1.24	145.5	1.51
Apr.	2.737	2.757	.16	146.9	1.16
May	2.722	2.730	.90	147.2	.91
June	2.721	2.732	.32	147.1	1.02
July	2.702	2.723	1.03	147.7	1.04
Aug.	2.716	2.718	- .18	148.7	1.48
Sept.	2.728	2.728	- .16	148.2	1.47
Oct.	2.739	2.733	- .09	148.5	1.31
Nov.	2.743	2.740	.18	148.6	.93
Dec.	2.740	2.727	.40	149.3	.99

Date	Multiplier Forecast	Multiplier Actual	Per Cent Change in Base	Money Stock	Percentage Change in Money Stock over last 6 months
1960					
Jan.	2.785	2.758	-1.29	149.2	.8
Feb.	2.765	2.738	1.04	148.9	.6
Mar.	2.737	2.716	1.32	149.4	.4
Apr.	2.731	2.728	.51	150.1	.7
May	2.708	2.676	1.17	151.5	1.0
June	2.701	2.668	.55	150.4	1.1
July	2.676	2.653	1.25	150.8	1.2
Aug.	2.680	2.674	.16	151.8	1.2
Sept.	2.690	2.678	- .07	153.2	1.6
Oct.	2.694	2.684	.16	153.4	1.6
Nov.	2.698	2.674	.14	153.9	1.8
Dec.	2.683	2.687	.84	153.6	1.8
1961					
Jan.	2.725	2.716	-1.24	155.6	2.2
Feb.	2.708	2.694	.95	155.3	1.9
Mar.	2.680	2.684	1.33	155.5	1.7
Apr.	2.687	2.710	.02	157.1	1.6
May	2.656	2.675	1.48	158.6	2.2
June	2.662	2.666	.05	158.9	2.4
July	2.648	2.655	.82	158.5	2.4
Aug.	2.661	2.648	- .20	159.1	2.1
Sept.	2.676	2.663	- .25	158.3	1.7
Oct.	2.684	2.668	- .02	158.8	1.1
Nov.	2.683	2.676	.31	159.1	.3
Dec.	2.680	2.700	.41	160.1	.4
1962					
Jan.	2.718	2.722	-1.13	161.9	.9
Feb.	2.698	2.696	1.05	161.6	1.6
Mar.	2.686	2.674	.72	161.8	1.9
Apr.	2.699	2.692	- .21	161.6	1.8
May	2.662	2.635	1.65	162.3	1.6
June	2.655	2.623	.54	161.6	.9
July	2.638	2.606	.95	161.8	.4
Aug.	2.635	2.602	.36	162.2	.1
Sept.	2.638	2.611	.16	162.6	.3
Oct.	2.638	2.624	.30	163.4	.5
Nov.	2.635	2.631	.39	164.7	1.1
Dec.	2.642	2.646	0	165.8	1.7

1963-1968

Date	Multiplier Forecast	Multiplier Actual	Per Cent Change in Base	Money Stock	Percentage Change in Money Stock over last 6 months
1963					
Jan.	2.668	2.683	- .68	155.1	2.6
Feb.	2.649	2.649	1.05	156.2	3.1
Mar.	2.633	2.626	.92	155.8	3.0
Apr.	2.652	2.654	- .38	155.9	2.6
May	2.604	2.601	2.13	156.9	2.1
June	2.593	2.594	.76	157.1	1.7
July	2.577	2.585	.93	157.9	1.4
Aug.	2.579	2.588	.23	158.8	1.5
Sept.	2.592	2.598	- .21	159.4	1.7
Oct.	2.604	2.621	- .14	159.7	1.9
Nov.	2.611	2.628	.05	160.8	2.1
Dec.	2.631	2.618	- .46	161.3	2.0
1964					
Jan.	2.661	2.661	- .79	160.0	1.1
Feb.	2.633	2.622	1.34	161.3	1.4
Mar.	2.613	2.594	1.06	161.2	.9
Apr.	2.633	2.621	- .46	161.1	.7
May	2.581	2.566	2.34	162.1	.5
June	2.566	2.555	.88	162.4	.6
July	2.552	2.562	.85	163.1	.9
Aug.	2.551	2.561	.34	164.9	1.6
Sept.	2.565	2.577	- .24	165.4	2.0
Oct.	2.584	2.596	- .43	166.1	2.5
Nov.	2.595	2.595	- .13	166.5	2.5
Dec.	2.606	2.612	- .12	166.2	2.3
1965					
Jan.	2.648	2.643	-1.28	167.2	1.9
Feb.	2.616	2.586	-1.51	166.9	1.3
Mar.	2.589	2.573	1.34	165.8	.7
Apr.	2.613	2.600	- .61	167.2	.3
May	2.557	2.528	2.50	167.9	.4
June	2.542	2.535	.86	167.4	.5
July	2.533	2.533	.65	169.3	.8
Aug.	2.528	2.529	.48	170.2	1.3
Sept.	2.539	2.563	- .13	170.8	2.0
Oct.	2.561	2.578	- .17	172.8	2.5
Nov.	2.567	2.580	.05	172.9	2.8
Dec.	2.580	2.599	- .21	173.1	2.8

Date	Multiplier Forecast	Multiplier Actual	Per Cent Change in Base	Money Stock	Percentage Change in Money Stock over last 6 months
1966					
Jan.	2.624	2.636	-1.38	174.0	2.6
Feb.	2.585	2.582	1.77	174.0	2.1
Mar.	2.568	2.578	.97	173.5	1.5
Apr.	2.598	2.612	- .88	174.9	1.2
May	2.543	2.532	2.46	175.7	1.0
June	2.541	2.547	.36	174.5	.9
July	2.542	2.502	.24	176.2	1.0
Aug.	2.537	2.511	.48	173.4	.5
Sept.	2.555	2.541	- .45	174.9	.4
Oct.	2.571	2.547	- .31	176.2	.1
Nov.	2.566	2.544	.46	176.1	.4
Dec.	2.570	2.565	.11	176.7	.5
1967					
Jan.	2.597	2.574	- .74	178.3	1.3
Feb.	2.538	2.524	2.59	177.6	1.5
Mar.	2.517	2.528	1.12	178.7	1.9
Apr.	2.542	2.540	- .73	180.1	1.9
May	2.466	2.497	3.37	180.5	2.1
June	2.478	2.522	- .25	183.5	2.6
July	2.474	2.518	.47	184.8	3.0
Aug.	2.492	2.522	- .44	185.4	3.5
Sept.	2.531	2.536	-1.26	184.8	3.3
Oct.	2.548	2.547	- .42	183.5	2.5
Nov.	2.554	2.550	.07	183.5	1.3
Dec.	2.576	2.570	- .59	183.9	.3
1968					
Jan.	2.602	2.594	- .73	184.2	- .4
Feb.	2.547	2.533	2.41	184.6	- .4
Mar.	2.541	2.528	.52	194.6	0
Apr.	2.564	2.566	- .62	185.2	.4
May	2.500	2.515	2.81	186.8	1.0
June	2.518	2.530	- .45	188.2	1.5
July	2.502	2.526	.90	188.5	1.9
Aug.	2.511	2.515	- .06	189.9	2.3
Sept.	2.540	2.531	- .89	188.9	2.3
Oct.	2.552	2.534	- .23	188.4	1.9
Nov.	2.552	2.541	.25	188.2	1.1
Dec.	2.571	2.570	- .46	189.3	.4