The Demand for Money, Statistical Results and Monetary Policy

By William J. Frazer, Jr.
Federal Reserve Bank of Chicago[1]

I. Introduction

The subject—the demand for money—came to the forefront of monetary economics in the late 1950's and early and mid 1960's. References to the subject, as a somewhat distinct area of study, appear in earlier monetary literature, but much of the more recent work coincides with the availability of the modern electronic computer for handling large amounts of data. It is particularly distinguished by references to the demand for money and several prospects: that of identifying empirical demand functions for money; and that of effecting changes in the flow of expenditures for the current output of goods and services by controlling some possible determinant of the demand for money, such as the rate of interest. The data analyzed have been, for the most part, for the United States economy, possibly for a variety of reasons: the availability of large amounts of relatively high quality data, an early empirical tradition in economics[2], and the widespread availability of modern electronic computers.

[1] The author is a Senior Economist, Federal Reserve Bank of Chicago, with leave from the University of Florida. The preliminary draft of the article, moreover, was prepared while the author was active as an associate professor, University of Florida. For this and other reasons, therefore, the Federal Reserve Bank of Chicago is absolved from any responsibility for the views set forth in this article. Even so, the author wishes to express his appreciation to some his colleagues at the Federal Reserve Bank of Chicago for their comments on a pre-publication draft of the article. These included George G. Kaufman, John A. Doukas, William E. Gibson, Larry R. Mote, and Alice J. Landt.

[2] The empirical tradition in economics in the United States began with *Thorstein Veblen* (1857–1929), and continued through *Wesley C. Mitchell* (1874–1948) and the National Bureau of Economic Research. It is more than coincidence that the parent of the recent outpouring of empirical literature on the demand for money——namely, *Milton Friedman*—had early ties with the empirical tradition in the United States, and that the National Bureau of Economic Research published his monumental work (with *Anna Jacobson Schwartz*), as well as some other related works. See *Milton Friedman* and *Anna Jacobson Schwartz*, A Monetary History of the United States, 1867–1960 (Princeton University Press, for the National Bureau of Economic Research, 1963). For a review article on the latter work, see *Allan H. Meltzer*, "Monetary Theory

The statistical results concerning the demand for money have involved primarily regression analysis, estimates of coefficients for single equation models, and some attempts at joint estimations for both demand and supply functions[1]. The estimates to a large extent, have centered about an association between the velocity of money (Y/M) and the rate of interest (r)[2], and/or the demand function $M = f(r, Y)$ or the linear relation in the logarithms between the stock of money (M), the rate of interest (r) and income $(Y = rW)$ or

and Monetary History", Schweizerische Zeitschrift für Volkswirtschaft und Statistik, December 1965, pp. 404–422.

For some other related works sponsored by the National Bureau, see *Milton Friedman*, "The Demand for Money: Some Theoretical and Empirical Results", Journal of Political Economy, August 1959; and *Philip Cagan*, Determinants and Effects of Changes in the Stock of Money, 1875–1960 (Columbia University Press, for the National Bureau of Economic Research, 1965).

[1] See, e.g., *Ronald L. Teigen*, "Demand and Supply Functions for Money in the United States: Some Structural Estimates", Econometrica, October 1964, pp. 476–509; *Ronald L. Teigen*, "The Demand for and Supply of Money", Readings in Money, National Income and Stabilization Policy, eds., *Warren L. Smith* and *Ronald L. Teigen* (Homewood, Illinois: *Richard D. Irwin*, Inc., 1965), pp. 44–76.

[2] The analyses dealing with the association between velocity and the rate of interest have been roughly speaking in two classes—one dealing with liquidity preference analysis and another dealing with the *Tobin-Latané* explanation for switching "transactions" balances between cash and liquid securities in response to a rise in the rate of interest. In the first class, one may include the following: *Martin Bronfenbrenner* and *Thomas Mayer*, "Liquidity Functions in the American Economy", Econometrica, October 1960, pp. 810–834; *Robert Eisner*, "Another Look at Liquidity Preference", Econometrica, July 1963, pp. 532–533; and *Allan H. Meltzer*, "Yet Another Look at the Low Level Liquidity Trap", Econometrica, July 1963, pp. 545–549. Especially early empirical studies in the latter area were due to *A.J. Brown* and *Avram Kisselgoff*. See *A.J. Brown*, "Interest, Prices and the Demand Schedule for Idle Money", Oxford Economic Papers, No. 2, May 1939, reprinted in *T. Wilson* and *P.W.S. Andrews*, eds., Oxford Studies in the Price Mechanism (London: Oxford University Press, 1951), pp. 31–51; and *Avram Kisselgoff*, "Liquidity Preference of Large Manufacturing Corporations", Econometrica, October 1945, pp. 334–344.

One may include the following as examples of the 2nd class: *Henry A. Latané*, "Cash Balances and the Interest Rate—A Pragmatic Approach", Review of Economics and Statistics, November 1954, pp. 456–460; *Henry A. Latané* "Income Velocity and the Interest Rates: A Pragmatic Approach", Review of Economic Statistics, November 1960, pp. 445–449; *Carl F. Christ*, "Interest Rates and 'Portfolio Selection' among Liquid Assets in the U.S.", in Measurement in Economics (Stanford, California: Standford University Press, 1963), pp. 201–217.

For some other papers containing results supporting the existence of a velocity-interest rate association, see *Stephen W. Rousseas*, "Velocity Changes and the Effectiveness of Monetary Policy, 1951–1957", Review of Economics and Statistics, February 1960, pp. 27–36; and *L.R. Klein*, "Stocks and Flows in the Theory of Interest", The Theory of Interest Rates, eds., *F.H. Hahn* and *F.P.R. Brechling* (London: Macmillan and Company Ltd., 1965), pp. 147–151.

wealth (W)[1]. The predominant portion of the relationships posited between the variables, however, are implicit in the standard liquidity preference model[2] or in a version of the standard model with modification to accommodate switching between broad classes of assets such as fixed-claim assets and others with a residual claim against future income[3]. A mass of results, in fact, suggests the following single equation models as first approximations to the aggregate relations[4]:

$$\ln M = \ln k + \alpha \ln r + \beta \ln Y, \quad \alpha < 0, \ \beta \approx 1; \tag{1}$$

$$\ln (Y/M) = \ln k + \alpha \ln r, \quad \alpha > 0. \tag{2}$$

Equation (2) is essentially of the same form as equation (1)[5], and relations of

[1] See *Allan H. Meltzer*, "The Demand for Money: The Evidence from the Time Series", Journal of Political Economy, June 1963, pp. 219–246; *T. J. Courchene* and *H. T. Shapiro*, "The Demand for Money: A Note from the Time Series", Journal of Political Economy, October 1964, pp. 505–507; and *Allan H. Meltzer*, "A Little More Evidence from the Time Series", Journal of Political Economy, October 1964, pp. 505–507.

See, also, *Gregory C. Chow*, "On the Long-Run and Short-Run Demand for Money", Journal of Political Economy, April 1966, pp. 111–127; and *David Laidler*, "Some Evidence on the Demand for Money", Journal of Political Economy, February 1966, pp. 58–68.

[2] See the first group of references in footnote 2, 2nd page of the article.

[3] See *William J. Frazer, Jr.*, "Some Comments on Professor Ritter's Interpretations of Keynes and Changes in Income Velocity", Schweizerische Zeitschrift für Volkswirtschaft und Statistik, September 1963, pp. 75–78; and *William J. Frazer, Jr.*, "Monetary Analysis and the Postwar Rise in the Velocity of Money", Schweizerische Zeitschrift für Volkswirtschaft und Statistik, December 1964, pp. 587–590.

[4] There are interesting results concerning the demand for money by sectors of the economy. These have a variety of implications for explanations about the behavior of the aggregates and for an improved understanding of the behavior of the sectors of the economy vis-à-vis the whole, but for the present I wish to abstract from the analysis and behavior of the sectors. On sector demand relations, see, e.g., *William J. Frazer, Jr.*, "Firms Demands for Money: The Evidence from the Cross-Section Data", Staff Economic Studies (Washington, D.C.: Board of Governors of the Federal Reserve System, 1967); *Allan H. Meltzer*, "The Demand for Money: A Cross-Section Study of Business Firms", Quarterly Journal of Economics, August 1963, pp. 405–421; *Richard T. Selden*, "The Postwar Rice in the Velocity of Money: A Sectoral Analysis", Journal of Finance, December 1961, pp. 483–534; *Louis De Alessi*, "The Demand for Money: A Cross-Section Study of British Business Firms", Economica, August 1966, pp. 288–299; *Michael J. Hamburger*, "The Demand for Money by Households, Money Substitutes and Monetary Policy", Journal of Political Economy, December 1966, pp. 600–623; *Tong Hun Lee*, "Income, Wealth, and the Demand for Money: Some Evidence from Cross-Section Data", Journal of the American Statistical Association, September 1964, pp. 746–762; and *Tong Hun Lee*, "Substitutability of Non-Bank Intermediary Liabilities for Money: The Empirical Evidence", Journal of Finance, September 1966, pp. 441–457.

[5] E. g., equation (2) may be written $\ln Y - \ln M = \ln k - \alpha \ln r$ and equation (1) follows, after re-arranging terms.

the type involved in equation (1) are also implied by the liquidity-preference demand relation.

Questions raised in the present context include the following: whether changes in interest rates cause changes in velocity, or vice versa, or whether both sets of changes are due to some other factor; whether regression results to date suggest the prospect of exercising control over expenditures directly by manipulating an independent variable such as the rate of interest. An absence of the prospect of control over expenditures generally and the velocity of money via the manipulation of independent variables need not suggest, of course, the absence of some possible monetary policy effect on aggregate expenditures and related measures. The absence of such an effect, nevertheless, may suggest that many of the interpretations of the empirical demand relations being presented are misleading, with respect to both the effects of possible policy changes and the role of policy-making officials.

I propose to deal with the latter questions and a number of others—after, first, reviewing some definitions and indicators of changes in monetary policy and, then, outlining some monetary theory, single equation models and statistical results. Although I draw on the mass of statistical results due to other analysts, the articles and other papers presenting the results fail in large part to deal with the following: the present interpretation of the results to date; the implications of the interpretation and results for the effects of changes in credit and monetary policies; and the role of monetary officials (e.g., the policy-making officials of the central bank, or Federal Reserve System, as in the United States).

II. Indicators of Changes in Credit and Monetary Policy

Definitions of credit and monetary policy are set forth in this section, along with a review of some indicators of changes in credit and monetary policy. This is done preliminary to demonstrating, in this section, the possibility of using the rate of interest and the income velocity of money as substitute variables for one another in regression analyses involving the ensuing: the demand for money and the prospect of exercising control over the rate of interest and expenditures for the current output of goods and services via control over the money stock.

The terms "credit policy" and "monetary policy", may be used, in the first place, with reference to the Federal Reserve's (or some other central bank's) objectives with respect to credit and monetary conditions, respectively. Credit conditions, furthermore, may mean the conditions with respect to the ease or tightness of credit, and monetary conditions may mean conditions surrounding

the changes in the stock of money. In a fractional reserve banking system, as in the United States, these conditions are closely related, but there are some factors operating to cause slight discrepancies between the two sets of conditions at times[1]. Even so, the conditions in question are closely related and indicators for the conditions exist.

The more widely accepted indicators of money market and credit conditions in the United States have included selected short-term interest rates and "free reserves" or "net borrowed reserves" (i.e., the reserves of the commercial banks less the legally required reserves and the reserves borrowed from the Federal Reserve Banks). The rates usually cited are those on Treasury bills, commercial paper and Federal funds (i.e., the rate on trading among commercial banks of reserves on deposit at the Federal Reserve). As rates, these latter indicators are independent of equal proportional changes in both the supply of and demand for the instrument being traded. The use of the absolute measure for "free reserves", on the other hand, is not independent of the size of operations. Most meaningfully, it should be viewed in relation to the size of commercial banking operations.

In the Federal Reserve's use of the latter indicator, however, some criticisms have arisen. Most notably the bankers have a preference for excess reserves or liquidity that may at times shift and give rise to changes in the willingness to lend or invest, in relation to a given volume of reserves[2]. Such shifts in relation to special events, in fact, have been cited by *Friedmann* and *Schwartz* in their monumental monetary history of the United States as serving at times as a contributing cause to deep depressions. Reviewing their history *Meltzer* notes, e.g.,—somewhat along the lines of a liquidity preference analysis as applied to bankers and their preference for reserves—that at times "reduction in interest rates raised the banks' desired short-run reserve position" and that "substantial increase in the discount rate in 1920 and again in 1931 is described in terms of its effect on market interest rates and banks' desired reserve positions"[3]. Even so, these are rather major events, of a type

[1] There are in the United States, for example, currency and time deposit drains —where, in the first instance, an increase in the currency to demand deposit ratio affects the level of bank reserves and where, in the second instance, an increase in the ratio of time to demand deposits affects the money stock differently from commercial bank reserves. See *William J. Frazer, Jr.*, and *William P. Yohe*, Introduction to the Analytics and Institutions of Money and Banking (Princeton, New Jersey: D. Van Nostrand Company, Inc. 1966), pp. 39–48.

[2] See, e.g., *Frazer* and *Yohe*, op.cit., pp. 567–568; and the references cited in the latter work. See, also, *George R. Morrison*, Liquidity Preference of Commercial Banks (Chicago: University of Chicago Press, 1966).

[3] See *Meltzer*, "Monetary Theory and Monetary History", op.cit., p. 419. For a liquidity preference model ot the type suggested for bankers and bank reserves, see *Frazer* and *Yohe*, op.cit., pp. 568–571.

not likely to have occurred in the post-World War II United States and, in any event, the reserve position of banks and the bankers' attitudes toward it are reflected in the various rates of interest prevailing in the financial markets of the type functioning in the United States since 1951, the end of the era of pegged interest rates[1]. Thus, there are possibly no compelling reasons for not using "the interest rate" as an indicator of credit conditions, under the sorts of conditions that have come to prevail.

In the analyses of changes in "the rate", one may think of an upward and downward moving structure of rates or a "vector of all interest rates"[2]. In this case, short-run changes in the so-called indicators of money market conditions are reflected in changes in the structure of rates, following some switching and arbitrage transactions. Thus, for credit conditions, the rate of interest is cited as an indicator—a rise in the rate reflecting credit tightness and a decline reflecting credit ease.

On the stock of money side, changes in the reserve position are reflected in changes in monetary conditions, and the latter may be represented by changes in the money stock in relation to changes in income (i.e., by changes in the income velocity of money). Monetary tightness, neutrality and ease, in such a case, are respectively represented by a rising, constant and declining income velocity of money, if we carry over the terminology applying to changes in the rate of interest. There are complications, however, in that money as distinct from credit may not be tight, for example, when rates are rising and credit is tight. As we note below, credit is tight relative to its availability and the demand for it, but when velocity is rising money is easy in a sense, given certain phenomena and a particular use of language. Money is easy in the sense that it is being disposed of at a faster rate or in the sense that attempts are being made by the holders of assets to draw down balances relative to income (or assets). In other words, borrowing units seek more credit as a liability, but they are seeking money balances as a means of effecting expenditures with the result that these spending units facilitate a rise in expenditures and ultimately a rise in velocity.

Now, to the extent that credit and monetary conditions are closely related and to the extent that the rate of interest and the velocity of money are substitute variables, the rate of interest and the income velocity of money should be highly correlated. To deal with this prospect, high-grade corporate bond yields (r) have been regressed on the income velocity of money (V_y) and vice versa,

[1] The events and developments of the post-World War II years in the United States are recorded in *Frazer* and *Yohe*, op.cit., Chapter 24.

[2] *Bronfenbrenner* and *Mayer* refer to such a vector. See their discussion of long rates versus short rates in liquidity preference analysis (*M. Bronfenbrenner* and *Thomas Mayer*, "Rejoinder to Professor Eisner", Econometrica, July 1963, pp. 540–542).

after a logarithmic transformation. The quarterly data used and contained in the appendix and the resulting regression equations and coefficients of determination are as follows:

(all series, seasonally adjusted)

Period:

1952–1965 $\ln r = -0.12 + 1.21 \ln V_y$, $r^2 = .86$

1948–1965 $\ln r = 0.02 + 1.09 \ln V_y$, $r^2 = .89$

1952–1965 $\ln V_y = 0.25 + 0.71 \ln r$, $r^2 = .86$

1948–1965 $\ln V_y = 0.11 + 0.81 \ln r$, $r^2 = .89$

(series, seasonally, adjusted except Aaa bond yields)

Period:

1952–1965 $\ln r = -0.02 + 1.11 \ln V_y$, $r^2 = .83$

1948–1965 $\ln r = 0.07 + 1.04 \ln V_y$, $r^2 = .88$

1952–1965 $\ln V_y = 0.22 + 0.75 \ln r$, $r^2 = .83$

1948–1965 $\ln V_y = 0.08 + 0.84 \ln r$, $r^2 = .88$

As these results indicate: there is a close association between the rate of interest and velocity; changes in one variable parallel changes in the other variable; and the variations in the dependent variables are largely accounted for by variations in the independent variables, as revealed by the coefficients of determination (r^2s). As the analysis and the results suggest, one variable may substitute for the other reasonably well. The results are entirely consistent with the prospect that both variables simply reflect the same changes in the setting—namely, changes in credit and monetary policies.

At times there are suggestions that changes in the credit and monetary policy of the central bankers are reflected in their uses of the instruments for controlling bank credit generally. In the United States these instruments include the discount rate, legal reserve requirements, and open market operations. However, the suggestions of viewing the uses of the instruments as indicators of changes in credit policy generally need not bother us, since the instruments are typically used in such a way as to render impossible their use as indicators of general credit policy[1]. For example: open market purchases of securities may be made as a means of increasing bank reserves at time when legal reserve requirements are being raised to constrain the expansion of credit; the discount rates at the respective reserve banks may be changed,

[1] For a review of the uses of the general credit controls in the United States, see *Frazer* and *Yohe*, op.cit., Chapter 8.

simply to bring them in line with market rates of interest; and in any event, substantial changes may be brought about in credit conditions simply by the monetary officials' inactions, as when gold flows out of the country and reduces bank reserves or as when a withdrawal of currency by the public reduces bank reserves[1].

III. Some Monetary Theory, Single Equation Models and Statistical Results

An elementary, simultaneous-equation model is reviewed in this section. It is reviewed, in part, in order to set forth the single-equation, regression model it implies and, in part, in order to introduce a means of avoiding the identification or simultaneous-equation-bias problem (i.e., the problem of identifying a demand schedule from time series data as distinct from a supply schedule or some sort of mongrel schedule). Statistical results are then reviewed and shown to be consistent with the monetary theory and interpretations of monetary phenomena dealt with in this section.

The elementary model is a standard liquidity preference model, with modification[2]:

$$\text{Demand:} \qquad M_d = cY + \frac{bY}{r}, \tag{3}$$

$$\text{Supply:} \qquad M_s = \gamma,$$

$$\text{Equilibrium:} \qquad M_s = M_d.$$

$$\text{The rate of interest:} \qquad r = \frac{bY}{\gamma - cY}. \tag{4}$$

where M_d is the demand for money as a function of income (Y) and the rate of interest (r), M_s is the exogenously determined stock of money and c, b and γ are parameters. Equation (3) is written so that the quantities of money demanded for satisfying the various motives all increase in proportion with income.

[1] For a review of the bank reserve equation and the prospect of changes in credit conditions coming about without action on the part of monetary officials, see *Frazer* and *Yohe*, op. cit., Chapter 10.

[2] One modification simply involves the introduction of income (Y) as a factor in the term for speculative balances—i.e., bY/r. This would seem reasonable since one would expect higher income or wealthier units to hold more balances in anticipation of a rise in interest rates. Another modification involves the relevance of the model to situations involving a form of speculation or switching between broad classes of assets, including real capital rather than simply switching between cash and bond-type assets.

The model in this form also facilitates an analysis of switching between broad classes of assets rather than between cash and bonds. From equation (4), furthermore, it is apparent that equal percentage changes in income and the stock of money (γ) are consistent with a constant rate of interest, and that other than equal proportional changes in income and the stock of money result in parallel changes in the rate of interest and the income velocity of money (i.e., Y/γ). The latter are changes in credit and monetary policies as indicated in the preceding section.

Given a neutral credit or monetary policy, the rate of interest in equation (4) does not change. With the rate of interest constant, the demand for money as defined by equation (3) is a function of income and, as a result of this fact and equation (4), any deviations in the demand for money about the linear relation between the stock of money and income are completely accounted for by changes in the rate of interest (i.e., changes in monetary policy). A demand function is identified—i.e., a demand surface in three space is specified and a money-supply plane parallel to the $r-Y$ plane traces out the demand surface as the money supply changes. According to the definition of monetary policy, the actual policy as distinct from any intended policy is right on target, as a result of action or inaction, design or accident.

The analysis facilitated by the present form for the liquidity preference function concerns switching between broad classes of assets—those with a fixed claim against future income, such as cash and bonds, and those with a residual claim, such as inventories, plant and equipment. As long as monetary policy is neutral (i.e., $r = \text{const.}$) the following changes occur: broad classes of assets expand in equal proportion; the stock of money demanded increases in equal proportion to income, as in equation (3); and money balances increase in equal proportion to wealth or total assets, since $W = Y/r$. Under these conditions the rates of return for relating the prospective streams of returns to given additions to the various classes of assets are equal, after allowance for risk factors and liquidity elements. Factors affecting the prospective returns disproportionately, however, give rise to switching with the view to avoiding losses and realizing gains. Prospective price increases, for example, affect adversely the returns from fixed-claim assets and favorably the returns from real capital goods; and greater certainty about the future affects the flow of returns (or utility) from holding money balances. These factors impinging on prospective returns may result in a change in monetary policy and switching. In the latter example, the switching would likely be out of the fixed claim type of assets —both cash balances and bonds. The switching, in these examples, gives rise to increased expenditures, and possibly output, employment and prices. Other factors may be cited—the tax credit and so on—and the reverse sets of changes may be illustrated.

In the analysis and the latter example, velocity and the rate of interest are responding to the same changes in the setting. Also, as the switching proceeds from fixed-claim assets to residual-claim assets, as in a period of greater than average economic growth, all the absolute amounts for the various categories of assets increase, but those for the fixed-claim type increase less than in proportion to the residual-claim type of assets.

A mass of regression results appears to support the preceeding monetary analysis and the analysis itself provides some basis for understanding the results. Among the most widely cited regression results are those due to *Henry Latané*[1]. In a 1960 article[2], *Latané* was able to extend his earlier results from simple regression analysis of annual, time series data to cover the period 1909–1958. He reported on these after regressing proportionate cash balances on the rate of interest (i.e., the rate on high-grade corporate bonds) and after effecting a logarithmic transformation of the data. He then noted that a linear relation between the logarithms for proportionate cash balances and the rate of interest, with a slope of about -1, was consistent with a linear relationship between income velocity (i.e., the reciprocal of M/Y) and the rate of interest. In other words his results suggested the following: approximately equal proportionate changes in the velocity of money and the rate of interest; and an equation of the form of equation (2) above, with elasticity coefficients similar to those for equation (2).

Carl Christ drew upon *Latané's* earlier results[3] and found even without excluding un-representative years for the period 1919–1952, the inverse rate of interest explained 76 percent of the variation in proportionate cash balances[4]. He says, "as the years went by, I plotted the new data on *Latané's* graph and something happened that is very remarkable in the brief history of econometric equations: the new points were closer to the regression lines than the points of the sample period!" He then fitted the same regression equation by least squares to data for a longer period, 1892–1959, and found

$$k = \frac{M}{Y} = 0.131 + 0.716\,\frac{1}{r},$$

where $Y = GNP$ as in *Latané's* regressions. The slope of 0.72 in this equation was almost the same as *Latané's* 0.80 ,when expressing the ratios as percentages and prior to a logarithmic transformation of the data. A portion of *Christ's* results appears as follows:

[1] For reference to *Latané's* results see *Friedman* and *Schwartz*, op.cit., pp. 646–654; *Meltzer*, "The Evidence from the Time Series", p. 221 and pp. 238–239; *Christ*, op.cit., pp. 201–217; and *Klein*, op.cit., pp. 147–151.

[2] See *Latané*, "Income Velocity and Interest Rates", op.cit., pp. 445–449.

[3] See *Latané*, "Cash Balances and the Interest Rate", op.cit., pp. 456–460.

[4] See *Christ*, op.cit., pp. 201–217.

Period	Dependent Variable	Regression Coefficient	Coefficient of Determination
1919–1952	k	0.795	0.76
1892–1959	k	0.716	0.76

Christ attempted to explain these results in terms of switching from money balances to bonds in response to a rise in the rate of interest. He even suggested the prospect of the monetary authorities effecting a rise in expenditures (i.e., the velocity of money) by raising the rate of interest[1]. Such an interpretation of the results, however, would be somewhat in contrast to the present interpretation whereby both velocity and interest rates are indicators of changes in credit and monetary policies, although *Christ* is probably closer to the present view than some others. Others, for example, have analyzed data for the money stock, interest rates and income and concluded without sufficient qualification that an open market purchase would increase the money stock and lower interest rates[2].

[1] See *Christ*, op.cit., p.204. I have dealt elsewhere with the standard explanation for the velocity interest rate association as it applies to the non-financial corporate business sector. I have presented an alternative explanation and shown that there is a positive association between velocity and interest rates but no negative association between the rate of interest and the ratio of cash to government security holdings. See *William J. Frazer, Jr.*, The Demand for Money (Cleveland, Ohio: The World Publishing Company, 1967), Capter 7.

[2] *Hendershott* says, e.g., that "if the response of money holders to interest rate changes is virtually immediate, an open market purchase will shift interest rates to a lower level until the effect of the lower rates on the supply of new securities feeds back on the interest rates". Continuing, he says, "But if there is a considerable lag in response, a purchase will produce a fluctuation in interest rates—a downward movement will be followed by a return toward the pre-purchase interest rate level". See *Patric H. Hendershott*, "The Demand for Money: Speed of Adjustment, Interest Rates and Wealth—A Sequal", Staff Economic Studies (Washington, D. C.: Board of Governors of the Federal Reserve System, 1965), pp. 1–2. *Hendershott*'s study is a sequal to *Frank de Leeuw*'s "The Demand for Money, Speed of Adjustment, Interest Rates, and Wealth", Monetary Process and Policy: A Symposium, ed., *George Horwich* (Homewood, Illinois: Richard D. Irwin, Inc., 1967).

The latter analysts deal with lagged relations between time series. *De Leeuw*, for example, observes changes in a long-term rate of interest that lead inverse changes in real per capita demand deposits and deals with so-called adjustment lags. He says, "to the naked eye, then, there seems to be some simple evidence of a lagged reaction of money holdings to interest rates". The lagged relation and the adjustment phenomena dealt with by *de Leeuw* and *Hendershott*, too, however, could be nothing more than changes in variables resulting from a sort of switching phenomena as outlined in this article.

The present view, further, helps explain why *Friedman* and *Schwartz* deemphasize the rate of interest as a determinant of velocity and resort to such factors as greater certainty about the future[1]. In referring to the effect of expected price changes on the value of real capital goods and suggesting a rise in velocity in response to a form of switching from money to real assets, *Friedman* and *Schwartz* note that changes in the interest rate and changes in price expectations are not additive, since "the postwar change in interest rates reflects the change in price expectations"[2]. In terms of equation (4) and the switching phenomena just outlined, for example, income is rising and so is velocity (i.e., Y/γ) and the rate of interest. Referring to their view, Meltzer notes, that "of principal interest in the light of recent studies is the authors' [*Friedman's* and *Schwartz'*] rejection of interest rates as an important influence in the explanation of the movement of velocity"[3].

One of *Meltzer's* equations resulting from regressing the deflated money stock (M/p) on the rate of interest (r) and deflated income (Y/p) for the periods 1900–1958 is as follows: $\ln (M/p) = \text{const.} - 0.79 \ln r + 1.05 (Y/p)$, $\overline{R} = .98$, where $\overline{R}$ is the multiple correlation coefficient. He notes that if $Y = rW$, "there exists a definition of income for which the income and wealth $[W]$ constraints give precisely the same results"[4]. In his representative results for 1900–1958, $\ln M = -1.65 - 0.781 \ln r + 1.01 \ln W$, $\overline{R} = .994$, where W is non-human wealth, $\ln M/p = -1.48 - 0.949 \ln r + 1.11 \ln W/p$, $R = .992$. Note in the latter instances, that his interest elasticity and wealth elasticity coefficients are approximately -1 and 1 respectively.

Using annual data for one period 1900–1958 and effecting a regression similar to the preceding one, Courchene and Shapiro get $\ln M/p = \ln a - 1.001 \ln r + 1.150 (W/p)$, $R^2 = .98$. They note, as *Meltzer* readily recognizes, that his estimates "concerning the relative size of various elasticities... are to a large extent merely a function of the autocorrelation in the disturbance term, probably arising from the serial correlation present in the time series"[5]. Regressing the deflated money stock on the rate of interest and real income for the period 1900–1958, following a logarithmic transformation of the data, *Courchene* and *Shapiro* obtain the following representative equation[6]:

$$\ln (M/p) = \ln a - 0.674 \ln r + 0.971 \ln (Y/P), R^2 = .98.$$

[1] See *Friedman* and *Schwartz*, op.cit., p.645.

[2] *Friedman* and *Schwartz*, op.cit., p.659.

[3] See *Meltzer*, "Monetary Theory and Monetary History", op.cit., p.410.

[4] See *Meltzer*, "Evidence from the Time Series", op.cit., p.232 and p.225.

[5] *Courchene* and *Shapiro*, op.cit., p.499.

[6] See *Courchene* and *Shapiro*, op.cit., p.500. *Meltzer* uses *NNP* as a definition of income and *Courchene* and *Shapiro* use *GNP*.

Many additional regression results could be shown. With respect to those shown, nevertheless, there is a good bit of consistency between the results and monetary analysis and interpretation of results outlined earlier. Apparently, velocity and the rate of interest are responding to similar changes in the setting and the arguments in the multiple regressions are correlated to some extent, as the analysis leads us to expect. Variations in the arguments in the multiple regressions, even so, account for almost all of the variation in the stock of money held as indicated by the multiple correlation coefficients and the coefficients of determination.

IV. The Conduct of Monetary Policy and the Role of the Monetary Officials

The definitions, analysis and results of the preceeding sections hold certain implications for the conduct of monetary policy and the role of the monetary officials. These implications concern the following: a stable, constant-employment growth in income; the route by which the monetary authorities exercise major effects on the changes in the flow of income and output; and the functions of a governing body of monetary officials.

A stable, constant-employment growth in income. The elementary model and related analysis set forth above suggest that the product of the average of prices and output (i.e., $Y = PQ$) is what the monetary officials make it. If they vary the stock of money at the same rate as income in constant prices, the result is stable prices in a market economy with average wage and profit changes equal to the growth in productivity. There is a built-in dynamic—a tendency for output to grow in an economy with a constant level of employment, given a neutral monetary policy. Technological change displaces some workers, they get re-employed and this is a source of growth in output with a neutral monetary policy, under reasonably competitive conditions at a given level of employment.

But what about the effect of monetary policy on variations in output or on the growth rate for income? In the analysis set forth—the definition of monetary policy and so on—a neutral monetary policy has no effect in the positive sense, in the sense that it contributes something in other than a passive way. It can contribute to the assurance of stable prices and permit that to take place that would ordinarily take place.

The Friedman monetary rule. In view then, of the latter implications of the above analysis, one may ask: Why not the *Friedman* monetary rule? As the reader will recall, Prof. *Friedman* suggests a 3 or 4 or more percent growth rate for the money supply, depending on the growth in real output and possi-

bly with seasonal deviations from the constant rate[1]. He sees this as a better alternative than relying upon changes in monetary policy as effected in the past by monetary officials. As *Meltzer* says, in his review of the *Friedman-Schwartz* monetary history, *Friedman* will not be unhappy, "if the reader of *A Monetary History* concludes that errors in policy at crucial episodes in history suggest that rules would have done better than judgement[2].

A possible reason for not simply adopting the *Friedman* rule is the following: the actions, antics and inactions of the monetary officials may have desirable effects beyond those implied by monetary policy—mainly, they can affect the degree of certainty about the future. A greater degree of certainty about the future would, of course, increase velocity. It would, therefore, be a change in policy, but if the money stock were expanded at a faster rate with the view to attempting to offset the rise in velocity[3], the policy may be inflationary and destabilizing under the condition of rising velocity, depending on the level of employment and other factors. In terms of equation (4) and the analysis of the previous section, for example, the rate of change in the money stock may be increasing, but balances are being drawn down in relation to income and the increase in the rate of change in the money stock contributes to a further rise in income. This results via an expectations effect—such as the effect of a price-level change on expenditures—so that velocity rises further (i.e., Y/γ) and so does the rate of interest [i.e., $r = bY/(\gamma - cY)$]. The additional expansion in the money stock, on the one hand, contributes to tighter credit conditions, in the sense that credit is tighter relative to the availability of funds at the bank. The additional expansion, on the other hand, contributes to easier money, in the sense that there is a more feverish effort to draw down on balances relative to income or assets.

Another question, then, is why countercyclical or stabilizing changes in credit policy, as possibly implied by the indicator of changes in policy and the data in the appendix? The answer, in view of the analysis, is that the countercyclical changes in monetary policy possibly reduce the changes in expectations, either with respect to excessive buoyancy or inadequate buoyancy. At least this is likely to be true as long as there is no increase in the rate of expansion in the money stock during a period of rising interest rates and rising velocity of

[1] See *Milton Friedman*, Capitalism and Freedom (Chicago: University of Chicago Press, 1962), pp. 54–55. See, also, *Milton Friedman*, A Program for Monetary Stability (New York City: Fordham University Press, 1959), pp. 91–99.

[2] *Meltzer*, "Monetary Theory and Monetary History", op. cit., p. 418.

[3] There are a number of mechanical ways in which an increase in expenditures may come about via an increase in the turnover of balances. Analysis by Ettin provides the basis for one such list. See *Edward C. Ettin*, "A Quantitative Analysis of the Relationships Between Money and Income", Weltwirtschaftliches Archiv, March 1966, pp. 122–123.

money, after allowance for seasonal factors and very short-period irregularities. Credit or monetary policy, then, apparently has its major effects on the levels of income, output and employment, via its effect on the degree of buoyancy in expectations.

Monetary policy-effects beyond those resulting from adherence to rules. One may note, that the smooth countering of deviations in expenditures from some smooth, extrapolated growth curve for real output is itself a form of rule. He may even inquire further into the possibility of the effects of changes in monetary policy beyond those on the degree of buoyancy in expectations. But there are no such effects, as implied by the present indicator for changes in policy and the preceeding analysis. The chairman of the Board of Governors or a similarly highly placed official in the monetary system may exert independent effects via their individual pronouncements, especially in response to possibly unstabilizing pronouncements from other quarters—the executive, or legislative branches of government, as in the United States. But these effects are beyond those of monetary policy as outlined above, unless there is a net reponse in the velocity of money as a result.

Why a Board of Governors? Why, in view of the apparently rather narrow range of the effects of monetary policy, do we have a Board of Governors? Do they exist just to over-see research and administer the Reserve Systems? The earlier analysis would suggest that their main function is deciding on the timing of the changes in monetary policy and the extent of the changes, consciously or unconsciously with the view to varying the degree of buoyancy in expectations. In the United States these changes would possibly be effected with the view to achieving national economic goals such as maximum employment, production and purchasing power.

V. Summary

A number of developments have contributed to the emphasis on the demand for money in the recent monetary literature—the availability of the modern computer for handling large amounts of data, the prospect of exercising some control over expenditure by manipulating a determinant of the demand for money, and so on. For the most part, the variables dealt with have been those involved in elementary monetary models, but some controversy has evolved over the variables to be included as determinants of the demand for money in an operational sense.

Estimates of demand relations have centered about the association between the velocity of money and the rate of interest and/or a demand function for money including the rate of interest and income (or wealth). A variant of the

liquidity preference model, in fact, may be written so as to imply the more frequently dealt with demand relations. In solving such a model for the rate of interest, the rate of interest is shown to vary directly with income velocity, and disproportionate changes or switching are shown to give rise to velocity changes and parallel (or identical) changes in credit and monetary policy. Indeed, changes in both interest rates and velocity are viewed as changes in credit and monetary policy. Regression results, as well as analysis, support the interchangibility of the changes in interest rates and velocity.

A host of previous regression results and some present results indicate a strong velocity-interest rate association. Previous multiple regression results also indicate that variations in the stock of money demanded are almost fully accounted for by variations in the rate of interest and in income (or wealth) in the computational sense. These latter results have admittedly intercorrelation in the independent variables, but both sets of results have suggested the prospect of varying the rate of interest to change the quantity of money demanded and expenditures for the current output of goods and services. *Christ*, e.g., deals with the prospect "that changes in the velocity of money in response to interest rate fluctuations my be substantial enough to be of concern to the monetary authorities in their attempts to stabilize the economy". Others have suggested, without making some necessary qualifying statements, that expansion in the stock of money reduces interest rates. The present analysis leads elsewhere, however, in that changes in the rate of interest and changes in velocity simply reflect the same changes in the setting—i.e., changes in monetary policy—and in that expansion of the rate of increase in the money stock raises interest rates and the velocity of money further at times of rising interest rates.

Changes in expectations and the flow of expenditures give rise to changes in velocity, unless the monetary authorities effect a neutral monetary policy. Greater certainty about the future and prospective changes in prices are factors cited as giving rise to changes in velocity by analysts such as *Friedman* and *Schwartz*. They say, further, that the rate of interest is not additive to these factors, because "change in interest rates reflects the changes in price expectations". *Meltzer*, on the other hand, rebukes them for not including the rate of interest. The present analysis and review of statistical results tend to support the *Friedman-Schwartz* type of analysis.

The present analysis and results hold certain implications for the conduct of monetary policy. They also shed light on the role of the monetary officials. Given the present notions of monetary policy, a neutral monetary policy turns out to be nothing more than an application of *Friedman's* monetary rule. The stock of money is expanded at the appropriate rate for accommodating the growth in real output. In this sense, monetary policy has no effect. It permits that to

take place that would ordinarily take place without the disrupting effects of possibly destructive discretionary policy changes. There is the prospect, nevertheless, that stabilizing changes in monetary policy reduce destabilizing changes in expectations, either with respect to excessive buoyancy or inadequate buoyancy in prospective streams of returns from additional assets with a residual claim against future income such as inventories, plant and equipment. The latter changes in monetary policy would be exclusive of such non-stabilizing instances as when an increased rate of change in the money stock parallels rising interest rates and rising velocity. The analysis leads to the conclusion that monetary policy has its major effects on the level of income, output and employment, via its differential effects on prospective returns from additions to broad classes of assets—notably assets with a fixed claim against future income, such as cash and bonds, and the assets with a residual claim against future income. Changes in the rate of change in the stock of money, and the actions, inactions and pronouncements of the monetary officials exercise their major effects on expenditures via their differential effects on the prospective streams of returns from additions to the broad alternative classes of assets. Prospective price level changes, degrees of certainty about the future, and so on, have such differential effects.

In the present context there are no effects of monetary policy per se other than those exerted via expectations. The analysis, in this context, suggests that the main function of the monetary officials is deciding upon and influencing the timing of the changes in monetary policy and the extent of the changes with the view to effecting the most appropriate growth rate in real income and the levels of prices and employment conducive to its maintenance (and the attainment of other economic goals). This function would be performed consciously or unconsciously by the monetary officials.

Year and Quarter	(1) Gross National Product (GNP) * $	(2) Money Stock (M)† $	(3) Income Velocity of Money (V_y) (1) ÷ (2)	(4) Aaa Bond Yields (r)♦ %
1948: 1	248.0	113.0	2.19	2.86
2	255.6	112.1	2.27	2.77
3	265.2	112.2	2.36	2.81
4 (Peak) §	263.9	111.8	2.36	2.81
1949: 1	258.5	111.2	2.32	2.72
2	255.2	111.3	2.29	2.69
3	257.1	111.0	2.31	2.62
4 (Trough)	255.0	111.0	2.29	2.59
1950: 1	266.0	112.0	2.37	2.60
2	275.4	113.6	2.42	2.59
3	293.1	114.9	2.55	2.62
4	304.5	115.9	2.62	2.66
1951: 1	318.0	117.1	2.71	2.72
2	325.8	118.2	2.75	2.86
3	332.8	119.7	2.78	2.88
4	336.9	121.9	2.76	2.95
1952: 1	339.5	123.5	2.74	2.98
2	339.1	124.5	2.72	2.90
3	345.6	125.8	2.74	2.93
4	357.7	127.0	2.81	2.99
1953: 1	364.2	127.5	2.85	3.10
2	367.5	128.4	2.86	3.29
3 (Peak)	365.8	128.6	2.84	3.25
4	360.8	128.7	2.80	3.14
1954: 1	360.7	129.1	2.79	2.98
2	360.4	129.4	2.78	2.86
3 (Trough)	364.7	130.6	2.79	2.86
4	373.4	131.9	2.82	2.88
1955: 1	386.2	133.5	2.89	3.01
2	394.4	134.3	2.93	3.04
3	402.5	134.8	2.98	3.07
4	408.8	135.1	3.02	3.08
1956: 1	410.6	135.5	3.02	3.14
2	416.2	135.9	3.06	3.30
3	420.6	135.9	3.09	3.38
4	429.5	136.6	3.14	3.61

* GNP is at an annual rate (in billions of dollars). The series includes changes in definitions of components reflected in the August 1965 revision by the Department of Commerce.

† The quarterly amounts for the money supply series are averages of daily figures. The money supply (in billions of dollars) consists of the following: (1) demand deposits at all commercial banks other than those due to domestic commercial banks and the U. S. Government, less cash items in the process of collection and Federal Reserve float; (2) foreign demand balances at

Bond Yields, 1948–1965 (seasonally adjusted data)

Year and Quarter	(1) Gross National Product (*GNP*) * $	(2) Money Stock (*M*)† $	(3) Income Velocity of Money (V_y) (1) ÷ (2)	(4) Aaa Bond Yields (*r*) ♦ %
1957: 1	436.9	136.8	3.19	3.77
2	439.9	136.9	3.21	3.83
3 (Peak)	446.3	136.9	3.25	4.01
4	441.5	136.2	3.24	3.91
1958: 1	434.7	136.0	3.19	3.67
2 (Trough)	438.3	137.6	3.18	3.63
3	451.4	139.0	3.24	3.81
4	464.4	140.7	3.30	4.00
1959: 1	474.0	142.0	3.33	4.18
2	486.9	143.1	3.40	4.40
3	484.0	143.6	3.36	4.43
4	490.5	142.6	3.43	4.49
1960: 1	503.0	141.2	3.56	4.58
2 (Peak)	504.7	140.4	3.59	4.49
3	504.2	140.8	3.58	4.28
4	503.3	141.0	3.56	4.27
1961: 1 (Trough)	503.6	141.6	3.55	4.27
2	514.9	142.6	3.60	4.32
3	524.2	143.4	3.65	4.40
4	537.7	144.9	3.70	4.39
1962: 1	547.8	149.1	3.67	4.40
2	557.2	146.2	3.80	4.34
3	564.4	145.9	3.86	4.29
4	572.0	146.9	3.89	4.25
1963: 1	577.0	148.4	3.88	4.05
2	583.1	149.7	3.89	4.30
3	593.1	151.3	3.92	4.48
4	603.6	152.8	3.94	4.27
1964: 1	614.0	153.8	3.99	4.55
2	624.2	154.8	4.03	4.52
3	634.8	157.3	4.03	4.83
4	641.1	159.2	4.02	4.32
1965: 1	657.6	160.0	4.11	5.39
2	668.8	160.9	4.15	4.59
3	681.5	163.1	4.17	5.14
4	697.2	166.2	4.19	4.53

F. R. Banks; and (3) currency outside the treasury, the F. R. Banks, and the vaults of all commercial banks.

♦ Bond yields are averages of daily figures expressed as a percent per annum.

§ Peaks and troughs are turning points in reference cycles as reported by the National Bureau of Economic Research.

Source of data: Board of Governors of the Federal Reserve System.