Short-Run Money Growth Volatility: Evidence of Misbehaving Money Demand?

SCOTT E. HEIN

THE last two years have been anything but tranquil for the U.S. economy. Interest rates, for example, have been high and volatile. Twice during this period they rose to record levels: the prime rate hit 20 percent in April 1980, then rose to 21.5 percent in January 1981. Two recessions have occurred during this brief period, one of which apparently still lingers. Significant financial changes have taken place with an influx of deposits into money market mutual funds and an outflow from small time and savings deposits. The nationwide legalization of NOW accounts in early 1981 also resulted in a sizable reallocation of funds. Amid all of these developments, money growth also has been quite volatile.

Should the volatility of short-run money growth be a matter of concern? There appear to be two distinct schools of thought with regard to this question. One school argues that such volatility is not really a problem. It holds that "the need for precise short-run money supply control is technically questionable."[1] The other school argues that such volatility damages the economy. For example, Milton Friedman, in evaluating monetary policy over the last couple of years has written that "the yo-yo swings in monetary growth affected the economy directly, as well as through interest rates. Each surge in monetary growth was followed after some months by an acceleration in spendable income, output and employment; and each decline in monetary growth, by a retardation."[2]

Somewhat surprisingly, the two schools do not disagree about theoretical issues. Both schools agree that, in theory, the desirability of stabilizing short-run money growth depends on the stability of the public's demand for money. Achieving stable money growth benefits the economy only if the public's demand for money does not change unexpectedly.

The issue that separates the two schools of thought is chiefly an empirical one: has money demand been reasonably stable? Those who argue that the volatility of short-run money growth in the past has not been a problem hold that money demand has been subjected to a series of unpredictable shifts. According to this reasoning, holding the rate of money growth in a tight band would have imposed significant costs on the economy. Suppose, for example, the public wants to hold larger money balances. If such a preference is thwarted by an adherence to pre-established monetary targets, the economy would be subjected to unnecessary restraint. Individuals seeking to build their money balances will reduce their demand for goods and services and financial assets, resulting in an economic slowdown.

The other school argues that money demand has been basically stable. In this view, as Friedman contends, rapid money growth overstimulates the economy, ultimately causing inflation, while sluggish money growth imposes undue restraint.

[1]Stephen H. Axilrod and David E. Lindsey, "Federal Reserve System Implementation of Monetary Policy: Analytical Foundations of the New Approach," *American Economic Review Papers and Proceedings* (May 1981), p. 252. Also, see George W. McKinney, Jr., "The Name of the Game," *Economic View from One Wall Street* (February 26, 1982).

[2]Milton Friedman, "The Yo-Yo Economy," *Newsweek* (February 15, 1982). Also, see Milton Friedman, "The Federal Reserve and Monetary Instability," *Wall Street Journal*, February 1, 1982.

This article examines the evidence to determine whether money demand behavior over the last two years has been erratic enough to justify the observed volatility in money growth.

MONEY GROWTH AND THE DEMAND FOR MONEY

Chart 1 provides evidence on short-run (quarterly) money growth volatility. The chart plots, for each quarter since II/1962, quarterly money growth (at an annual rate) less the average of money growth over the prior 12 quarters. Thus, for example, the −2.0 percent reading for III/1962 shows that money grew 2 percentage points less in that quarter than its average growth rate in the previous three years.

The volatility shown in this chart has two different dimensions. One dimension is simply the *magnitude* of the deviation from trend. For example, in the third quarter of 1980, money grew at a rate 8 percentage points above trend, the largest positive deviation in the last 20 years. In the second quarter of 1980, money grew at a rate over 10 percentage points below trend, the largest negative deviation in the last 20 years. Thus, according to such a measure, money growth has been quite volatile over the last two years.

The second dimension is the *frequency* with which deviations of money growth relative to trend change signs. The chart shows that money growth relative to trend frequently has changed sign from positive to negative, and vice versa, over the last two years. This fluctuation stands in sharp contrast to the historical norm whereby money growth usually is above or below trend for several quarters in a row. Thus, the increased frequency of change of quarterly money growth relative to trend also supports the view that money growth over the last two years has been volatile.

The increased volatility in money growth alone does not demonstrate that the demand for money was unstable. Such a conclusion implicitly holds that the growth of the nominal money stock is completely demand-determined, ignoring completely the actions taken by monetary authorities. Since monetary authorities can change bank reserves, reserve requirements or the discount rate, it is entirely possible that changes in nominal money growth reflect their actions, instead of shifts in the public's desired money holdings. In other words, monetary authorities "can 'create' a product without necessarily being limited by the demand for it."[3] Thus, one should not necessarily interpret changes in money growth as shifts in money demand.

A CONVENTIONAL MONEY DEMAND EQUATION AND THE EVIDENCE OF SHIFTS

One can analyze money demand on a more sophisticated basis by using econometric techniques. This article provides no new analysis on this topic; instead it describes how such evidence can be evaluated.

Economic theory holds that nominal money balances *relative to* the general price level (generally called "real" money balances) are the relevant quantity measure for demand analysis (just as standard demand theory explains the demand for physical goods and services, *not* the dollar value of those goods and services). Thus, when one focuses on real money, one recognizes that the usefulness of money clearly depends on the price of goods and services. For example, if the quantity of money that people hold remains unchanged while the average price of goods and services fall, a given stock of money will have greater value; that is, it will permit the purchase of more goods and services. Thus, the economically meaningful measure is the money stock relative to the average price of goods and services.[4]

Analysts commonly hypothesize that real money balances move opposite to a change in market interest rates and in tandem with a change in real income. A change in market interest rates negatively affects the demand for real balances, because it represents the opportunity cost of holding money. If market interest rates rise, individuals forgo more interest income by holding money and thus are expected to desire less money balances. As real income rises, however, individuals will want larger real money balances to purchase more goods and services. Thus, a change in real income is expected to have a similar effect on desired real money balances.

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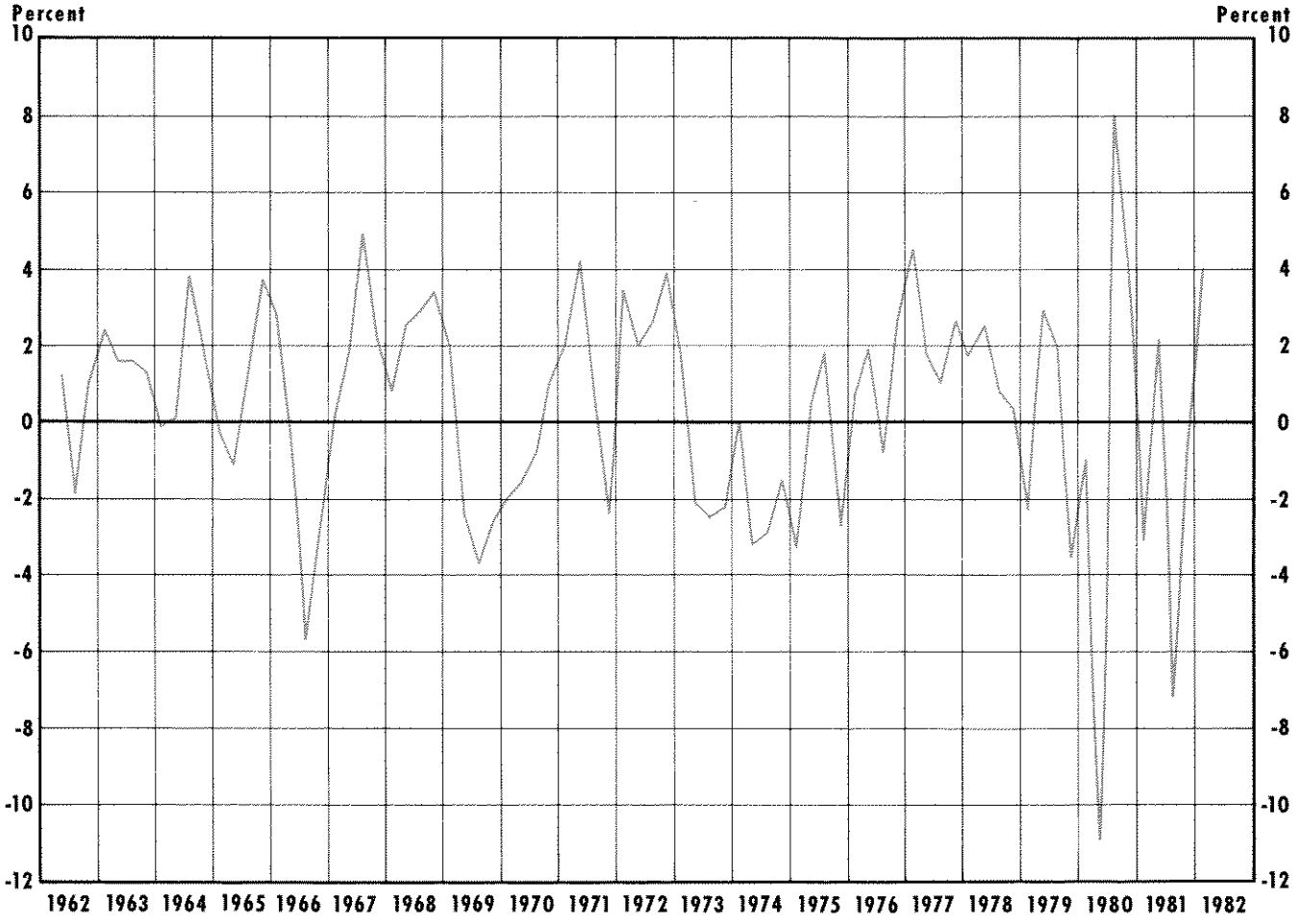
[3]Stephen H. Axilrod, "Monetary Policy, Money Supply, and the Federal Reserve's Operating Procedures," *Federal Reserve Bulletin* (January 1982), p. 13.

[4]For a discussion of the interpretation of changes in real balances, see A. B. Balbach and Denis S. Karnosky, "Real Money Balances: A Good Forecasting Device and a Good Policy Target?" this *Review* (September 1975), pp. 11-15.

Chart 1
Quarterly M1 Growth Relative to Trend



A Typical Empirical Money Demand Equation

To empirically investigate the demand for money, the relationship between real money balances $(M/P)_t$ and current interest rates (i_t), real income (y_t), and lagged real balances $(M/P)_{t-1}$, is estimated using multiple regression analysis. The equation to be estimated is typically written as:

$$(1) \quad (M/P)_t = \beta_0 + \beta_1 i_t + \beta_2 y_t + \beta_3 (M/P)_{t-1} + \epsilon_t.$$

The coefficients β_0, β_1, β_2 and β_3 show how desired real money balances respond to changes in the respective independent variables. The residual, ϵ_t, is assumed to be a *random variable* that fluctuates about zero. It represents the *unexplained* variation of actual real money balances from that predicted by the combination of the estimated regression coefficients and the values of the independent variables.

Last period's real balances are usually included in empirical estimations of money demand to capture an assumed adjustment process. Because of relevant transaction costs of adjusting real money balances, it is usually presumed that actual balances only slowly adjust to desired levels. The lagged value of real balances is included to capture such an adjustment process. By including lagged real money balances in the equation, we are assuming actual real balances only partially adjust to current changes in interest rates or real income.

A common procedure used in evaluating the behavior of money demand is to consider how well

an empirical relationship such as equation 1 simulates or predicts actual real money balances beyond the estimation period.[5] Chart 2 plots the level of real money balances simulated with equation 1 and the actual real money balances for the out-of-sample interval I/1980-I/1982.[6] Table 1 summarizes these results using a variety of statistical measures.[7]

THE SECOND QUARTER OF 1980

Much hoopla has been made of the difference between the simulated real balances in the second quarter of 1980 and the actual balances at that time. Real money balances in that period turned out to be almost $7 billion below what equation 1′ predicted. Such a finding has been interpreted as evidence that money demand shifted downward significantly in II/1980.

Simulation Errors and Shifts

Equating a "shift" with a simulation error, however, is clearly inappropriate. Deviations of real balances from predicted or simulated values *do not* provide evidence of a behavioral shift in the relationship. Recall that when the equation is estimated, it is assumed that actual real money balances will fluctuate *randomly* around its predicted or simulated level. By assumption, the actual and simulated real money balances will usually deviate from each other by some unknown random value. Thus, we should expect similar fluctuations to occur out-of-sample. When considering only *one* simulation error, it is impossible to ascertain whether one is observing a shift (as represented by a change in one of the coefficients), or simply a large random fluctuation.[8]

When the deviations are consistently one-sided, however, one can conclude that a "shift" in the behavioral relationship has occurred (i.e., one of the coefficients, β_0, β_1, β_2 or β_3, has changed). Chart 2, however, shows no evidence of consistent one-sided errors. Thus, there is little evidence from these simulations to indicate a "shift" in the behavioral relationship.

Moreover, recognize that if policymakers incorrectly equate prediction errors with shifts in money demand, then they will view any observed behavior in real money balances as *correct*. Thus, in either the case of rapid or slow money growth, no corrective action would be called for. However, if these disturbances are not true shifts in money demand, policymakers will actually allow money growth to fluctuate more than necessary.

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[5]This procedure apparently dates back to Stephen M. Goldfeld, "The Case of the Missing Money," *Brookings Papers on Economic Activity* (3:1976), pp. 683-730. One crucial difference between Goldfeld's evidence and more recent interpretations is that Goldfeld provided evidence of sustained one-sided simulation error. Logically, Goldfeld's findings suggest a shift. More recent discussions incorrectly deduce a shift from a single period's simulation error. This point is subsequently more fully developed. For a more recent application, see Brian Motley, "Innovation and Money Demand," Federal Reserve Bank of San Francisco *Weekly Letter* (January 1, 1982).

[6]Estimating equation 1 in natural log (ln) form yields the following coefficient estimates and summary statistics for the I/1960-IV/1979 sample period (absolute value of t-statistics in parentheses):

$$(1') \quad \ln (M/P)_t = \underset{(1.41)}{0.34} + \underset{(3.94)}{0.07} \ln y_t - \underset{(3.27)}{0.01} \ln RCP_t + \underset{(13.69)}{0.85} \ln (M/P)_{t-1} - \underset{(3.89)}{0.02} D1$$

$$\bar{R}^2 = 0.94$$

where M is M1, P is the GNP deflator, y_t is real GNP, and RCP is the commercial paper rate.[5] The estimated coefficient on $\ln y_t$ (0.07) indicates that a 1 percent increase in real income this quarter is usually associated with a 0.07 percent increase in real money balances. In a similar vein, the interest rate coefficient suggests that a 1 percent increase in interest rates (for example, from 10.0 percent to 10.1 percent) will lead to a 0.01 percent decline in real balances. Finally, the coefficient on lagged real balances (0.85) indicates that real balances will adjust to desired levels at a rate of 15 percent (1.00-0.85) per quarter. Thus, the long-run response to changes in interest rates and real income is much higher than the short-run response. In the out-of-sample simulations reported below, these coefficients along with actual values of the right-hand side variables are used to project the dependent variable.

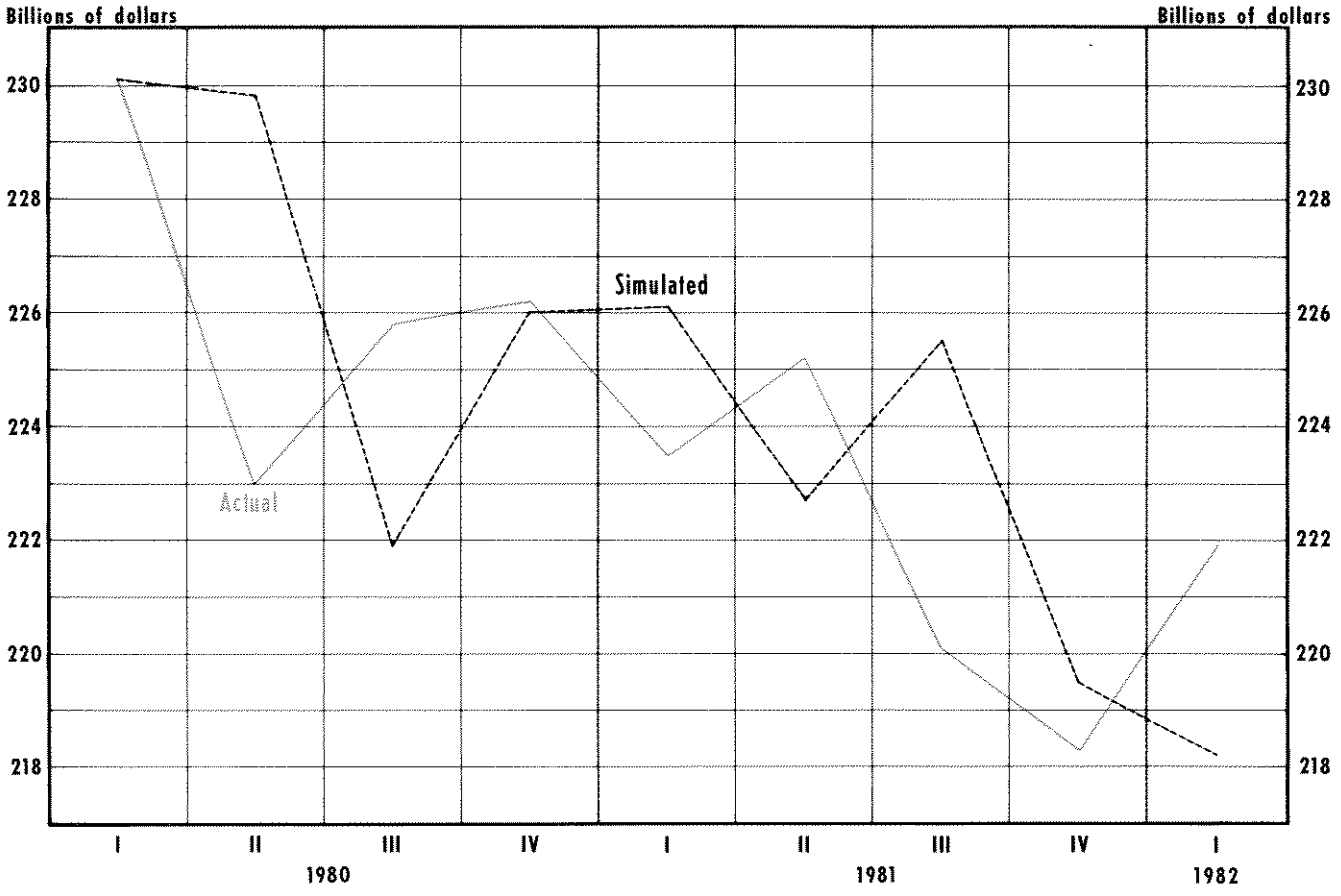
This relationship is similar to that in R. W. Hafer and Scott E. Hein, "The Shift in Money Demand: What Really Happened?" this *Review* (February 1982), pp. 11-16. However, the passbook rate variable is excluded since its coefficient was insignificant. The equation was estimated using the Hatanaka two-step procedure to correct for first-order serial correlation in the residuals. D1 is a dummy variable that takes on a value of 1 after I/1974, capturing a one-time shift in the demand for money. The standard error of the estimated regression is 0.0045 and the estimate of the serial correlation coefficient is 0.35.

[7]The equation simulates the natural log of real M1 balances. Table 1 presents the antilog of these simulated values, that is, levels of real money balances. Such a transformation, being nonlinear, will not yield optimal predictions. However, it does yield a better "feel" for the size of errors.

These simulations are static (when actual values of the lagged dependent variable are used) rather than dynamic (when predicted values of the lagged dependent variable are used). See Scott E. Hein, "Dynamic Forecasting and the Demand for Money," this *Review* (June/July 1980), pp. 13-23, where it is argued that static forecast errors provide a better foundation from which to judge shifts in the demand for money.

[8]This is true regardless of the size of the error, because there is always a positive probability of drawing from the extreme tails of a normal probability distribution.

Chart 2
Actual and Simulated Real M1



Other Evidence of a Money Demand Shift

Few who argue that a shift occurred in II/1980 base their case on the one simulation error of chart 2, however. Two auxiliary arguments also are used to support the notion that there was a downshift in money demand. One argument is that a downshift occurred "in response to the very high and record levels of short-term interest rates reached in early spring."[9] This argument holds that a sharp rise in interest rates, especially one that pushes rates beyond previous peaks, causes firms and individuals to institute new cash management techniques.[10] These techniques, once in place, lead to *permanent decreases* in desired real money balances relative to a given level of real income and interest rates. In other words, money demand shifts downward following a sharp rise in interest rates. Such an argument has been used to explain the abnormal behavior of money demand since 1974 and is used now to bolster the evidence of another downshift.

Chart 2 proves false this explanation of the II/1980 decline in real balances. Were there actually a decline in the demand for real cash balances caused by individuals and firms instituting new cash management techniques in response to high interest rates, one should observe a level of real money balances that is *consistently* below simulated levels following the "downshift."

[9]Axilrod and Lindsey, "Federal Reserve System Implementation of Monetary Policy," p. 251.

[10]One of the earliest espousals of this hypothesis can be found in Richard D. Porter, Thomas D. Simpson, and Eileen Mauskopf, "Financial Innovation and the Monetary Aggregates," *Brookings Papers on Economic Activity* (1:1979), pp. 213-29.

Table 1

Out-of-Sample Simulations of a Money Demand Equation (billions of dollars, seasonally adjusted)

Date	Actual (M_t/P_t)	Simulated (M_t/P_t)	Error[1]
I/1980	$230.1	$230.1	0.0
II/1980	223.0	229.8	−6.8
III/1980	225.8	221.9	3.9
IV/1980	226.2	226.0	0.2
I/1981	223.5	226.4	−2.9
II/1981	225.2	222.7	2.5
III/1981	220.1	225.5	−5.4
IV/1981	218.3	219.5	−1.2
I/1982	221.9	218.2	3.7

Summary Statistics	
Mean error:	0.6717
Mean absolute error:	2.9621
Root-mean-squared error:	3.6635
Theil's inequality coefficient:	0.0164
Fraction of error due to	
(A) Bias:	0.03
(B) Variation:	0.03
(C) Co-variation:	0.94

[1]Actual less simulated

If this shift were permanent, as this argument suggests, the prediction error should remain negative for all quarters after II/1980. Chart 2 shows, however, that the equation does *not* consistently overpredict real balances after II/1980. Actual real balances in III/1980, instead, were slightly higher than the relationship would suggest. Further, real balances were slightly higher, on average, than the equation implies for the full III/1980-I/1982 period. Thus, one cannot empirically support the argument that a persistent, sizable downshift in money demand was precipitated by record interest rates in II/1980.

The second argument in support of a money demand downshift in II/1980 contends that the imposition of credit controls in March 1980 was responsible for a decrease in desired real balances. Such an argument contradicts economic theory, however. With credit controls explicitly limiting the extension of bank credit, individuals and business firms would desire larger money balances for anticipated transactions or precautionary purposes. Thus, theory suggests an increase in money demand during this period, not a decrease.

Thus, both auxiliary arguments in favor of a behavioral shift in money demand in II/1980 lack either logical foundation or supportive empirical evidence. Moreover, if there was a behavioral shift in money demand, the excess supply (supply exceeding demand) of money must have been offset by an increase in demand elsewhere. In other words, if economic participants actually wanted less money balances, they must have desired more of something else in exchange. There is little evidence, however, of increased demand for labor, goods and services, or financial assets in the economy.

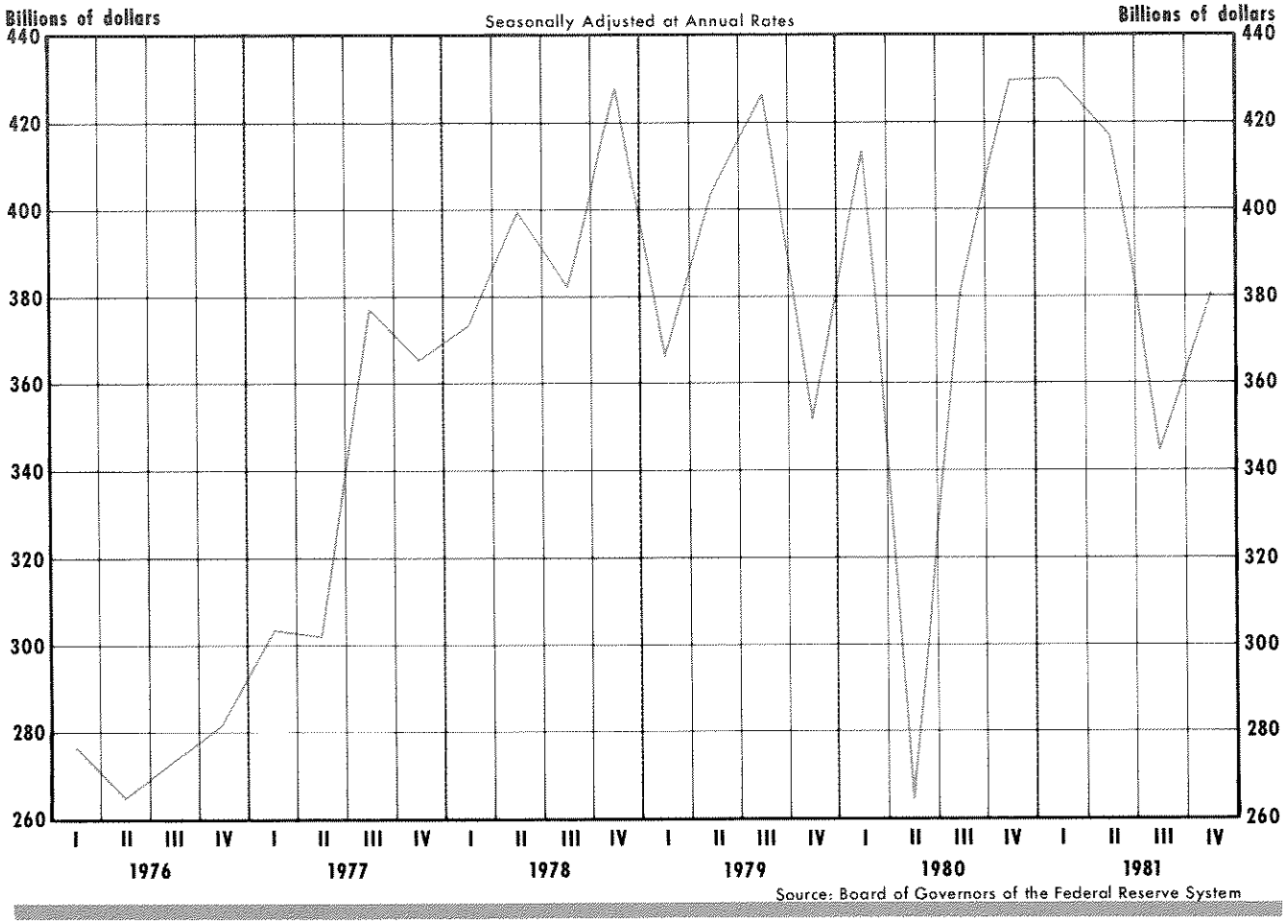
Further, the generally declining interest rates in this period do not necessarily suggest a behavioral downshift in money demand as many insist. Declining interest rates do suggest an excess supply of credit, which can come about either because of an increase in credit supply or a decrease in credit demand. Only an increase in the supply of credit (as individuals become more willing to give up money today in exchange for a promise of money in the future) would be consistent with the notion of a downshift in money demand in II/1980, since there is no evidence of an increased demand elsewhere which would be required to offset the decreased demand for *both* credit and money. Yet, there appears little evidence of an increased supply of credit in this period. Chart 3 shows that the total funds raised by nonfinancial sectors *declined* markedly in II/1980. Thus, the fall in rates in the second quarter of 1980 is better explained by weakening credit demands associated with the recession, rather than the increased supply of credit.

If No Shift, Then What?

If money demand did not shift in II/1980, why were real money balances low relative to predicted levels? Perhaps the irregular behavior occurred on the "supply side." Robert Weintraub has suggested, for example, that slow money growth resulted from an unexpected decline in the money multiplier (the ratio of M1 balances to the monetary base), in response to a sizable shift in the desired currency holdings, as consumers became wary about the acceptability of credit cards during the control pe-

Chart 3

Credit Market Funds Raised by Nonfinancial Sectors



Source: Board of Governors of the Federal Reserve System

riod.[11] Such a change would drive up the currency-deposit ratio and reduce the money multiplier.

If the money multiplier declines, banks have to reduce the amount of deposits they create for a given amount of source base (or bank reserves). According to Weintraub's hypothesis, M1 balances declined because monetary authorities did not anticipate the *increased* demand for currency and offset it by increasing the base. Therefore, the observed decline in real money balances was due, not to a reduction in the *demand* for real balances, but to this unanticipated change in the supply of money caused by an increased demand for currency as a result of the credit controls.

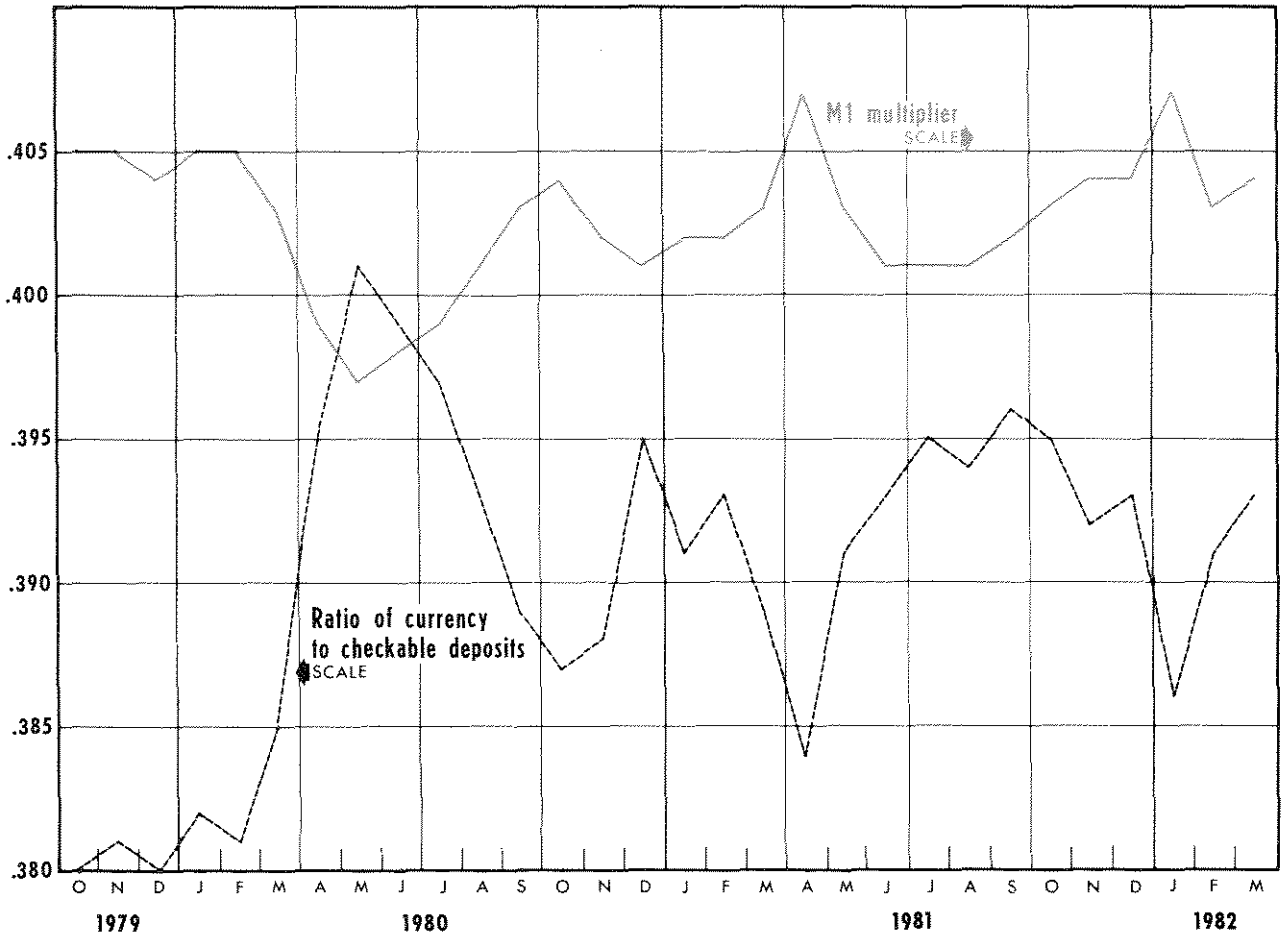
[11]Robert Weintraub, *The Impact of the Federal Reserve System's Monetary Policies on the Nation's Economy* (Second Report), Staff Report of the Subcommittee on Domestic Monetary Policy, House Committee on Banking, Finance and Urban Affairs, 96 Cong. 2 Sess. (Government Printing Office, 1980), p. 17.

Although individuals wanted to hold as much, if not more, M1 balances following the imposition of the credit controls, the banking system precluded these demands from being satisfied. Once credit controls were removed, the Weintraub hypothesis suggests, the multiplier would come back within its historical ranges (see chart 4). Thus, real money balances could be expected to return to more historical levels as well. This is indeed what happened: actual real balances rose to about $226 billion in III/1980 (see chart 2).

Therefore, one can interpret the behavior of real balances in II/1980 as evidence of a supply-side limitation, not a decrease in the demand for money. In this light, the large simulation error is merely evidence of temporary disequilibrium. Real money balances deviated from predicted levels, not because individuals desired less money, but because monetary authorities did not anticipate the effect of

Chart 4

M1 Multiplier and Ratio of Currency to Total Checkable Deposits



credit controls on the way people decided to hold their money.

John Judd and John Scadding also argue that "the rapid monetary deceleration in the second quarter of 1980 (as well as the rapid growth in the first and third quarters) was caused, not by a money-*demand* shift, but by a money-*supply* 'shock'."[12] While disagreeing with Weintraub about the mechanics of the supply shock (Judd and Scadding trace the supply shock to the contraction in bank loans that followed the Special Credit Control Program of 1980), Judd and Scadding, like Weintraub, recognize that "changes in the *supply* of money can dominate short-run movements in the monetary aggregates."[13] The important point here is not to differentiate between the Weintraub and Judd-Scadding hypotheses, but to recognize that both views explain the contraction in money growth by supply-side occurrences. Thus, deviations of actual real balances from those simulated by a money demand equation may be evidence of supply shocks, rather than demand shifts as many suggest.

[12]John P. Judd and John L. Scadding, "Liability Management, Bank Loans, and Deposit 'Market' Disequilibrium," Federal Reserve Bank of San Francisco, *Economic Review* (Summer 1981), p. 21.

[13]Ibid., p. 22.

THE NATIONWIDE "NOW" EXPERIENCE IN 1981: ANOTHER SHIFT?

The simulated values of real money balances also allow an evaluation of the impact of the nationwide legalization of NOW accounts on the demand for money. It has been argued that the introduction of NOW accounts might result in an increased demand for M1 balances, supposedly because of the explicit interest paid on such balances.[14]

The Federal Open Market Committee (FOMC) apparently believed such a result likely. In the first place, the FOMC increased the targeted growth ranges for M1 balances in 1981. In addition, the staff of the Federal Reserve Board of Governors developed a "shift-adjusted" M1 measure that would subtract the "artificially induced" demand resulting from the nationwide introduction of NOW accounts. This adjustment was determined, in large part, by surveying new NOW account depositors about the original source of the funds they deposited into these accounts. Asking such a question, however, provides little, if any, information about desired money holdings.[15] An analysis of a conventional money demand relationship should be a better vehicle to address this issue.

If the nationwide legalization of NOW accounts had actually resulted in an increased desire to hold M1 balances, the conventional money demand relationship should have *consistently underpredicted* real balances after the nationwide introduction of these accounts. In other words, actual (real) M1 balances should have been consistently above the level simulated by the equation, as individuals held larger-than-expected balances. In chart 2, where observed (not shift-adjusted) real money balances are shown, however, no consistent underprediction occurred during the last five quarters. In fact, the equation slightly *overpredicts* real money balances. Thus, it does not appear that the nationwide legalization of NOW accounts increased desired M1 balances in any important way.[16]

CONCLUSION

Many analysts of monetary policy have used the recent financial innovations and the volatility of money growth as ammunition against pre-established monetary growth targets. These innovations supposedly have caused unpredictable swings in money demand. The behavior of actual money growth has been taken as evidence of such swings.

This article offers a counter argument. To begin with, swings in money growth are reliable indicators of money demand only to the extent that the supply of money has not itself been shocked. In the face of such shocks, large fluctuations in money growth cannot be interpreted as evidence of money demand shifts. The second quarter of 1980 was an episode of unusual money growth caused, not by shifting money demand, but rather by supply-side occurrences. M1 balances fell because the banking system was unable to support the public's desired deposit levels. The lesson learned from this episode is that

[14]Much of the discussion about the impact of NOW accounts has centered on the minimum balance requirements of such accounts. Since minimum balance requirements are higher on NOW accounts than on conventional demand deposits, it has been argued that M1 will grow. David E. Lindsey, "Nonborrowed Reserve Targeting and Monetary Control," paper presented at Economic Policy Conference on "Improving Money Stock Control: Problems, Solutions, and Consequences," has correctly pointed out, however, that the issue is one of money demand. No adjustment need be made if the demand for M1 remains unchanged.

[15]See John A. Tatom, "Recent Financial Innovations: Have They Distorted the Meaning of M1?" this *Review* (April 1982), pp. 23-35. Some have argued that the shift adjustment was developed to capture the *sources* of NOW inflows rather than the *uses*. Such an adjustment should *not* have been incorporated in the targeting of the money aggregates then!

[16]While no apparent irregularities exist when M1 is used, this is not the case when the shift-adjusted measure is employed. Many have recognized this fact. See, for example, Motley, "Innovation and Money Demand;" and John Wenninger, Lawrence Radecki and Elizabeth Hammond, "Recent Instability in the Demand for Money," Federal Reserve Bank of New York *Quarterly Review* (Summer 1981), pp. 1-9, where many explanations of such anomalous behavior are provided. The point of the present article, however, is that such explanations are not required. A puzzle exists only when the questionable shift-adjusted measure is used. Just because individuals are moving funds from savings to NOW accounts does not indicate, as the shift-adjustment procedure suggests, that *more* M1 balances are desired. There are always people moving funds from savings accounts to demand deposits. Such movement of funds, however, have never before been taken to suggest that the demand deposit measure should be adjusted. Why should such movements of funds now provide any more useful information? While it is clearly possible that the introduction of explicit interest payments on checkable deposits did result in an increased demand for M1 balances, surveying individuals to find out where funds for new NOW accounts came from is not going to be useful in addressing such an issue. Examining a money demand equation, which is a useful procedure, shows no evidence of an increased demand.

one-time deviations of real money balances from predicted levels do not necessarily indicate a shift in money demand. Such a deviation could just as well denote a temporary money market disequilibrium, caused by the growth of the money supply or a random fluctuation.

One precondition for a "shift" in money demand is a set of consistent, one-sided prediction errors, derived from an estimated money demand relationship. A conventional money demand equation, however, shows evidence of neither sustained periods of overprediction (a downshift) nor sustained periods of underprediction (an upshift) in the underlying empirical relationship. Thus, while significant financial innovations have occurred in the last two years, there is little evidence that these innovations resulted in money demand shifts. The M1 measure continues to have significant economic and policy content.