Money Growth Volatility, Uncertainty, and High Interest Rates

By David W. Berson

It is widely known that interest rates have remained relatively high in the United States throughout the past few years. With the marked slowing in inflation, however, high nominal interest rates have meant real interest rates have been well above their historical averages. Although nominal rates have declined somewhat since mid-1982, they are nonetheless still high relative to inflation.

Analysts are agreed that high real interest rates have numerous adverse consequences. They hurt the economy in the short run by reducing interest-sensitive spending, causing reductions in production and employment. By slowing investment spending, they reduce economic growth in the longer run. This slower growth reduces incomes from levels that would have been reached otherwise, and slows gains in productivity, thereby putting upward pressure on prices.

Although there is general agreement that high real interest rates are bad for the economy, there is no general agreement about the causes of high interest rates. Traditional explanations cite restrictive Federal Reserve policy, prospects for large government budget deficits, and the slow adjustment in inflation expectations as the primary factors causing high interest rates.[1] In contrast, some analysts argue that much of the problem is due to the volatility of money growth. Their main contention is that the cause of the variation in money growth has been poor implementation of the Federal Reserve's monetary control procedures since they were changed in October 1979.[2] A common thread running through these arguments is that volatility in money growth has created uncertainty about the direction of Federal Reserve policy. Uncertainty, in turn, can affect interest rates in two ways. It can increase the demand

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[1] See, for example, Martin Feldstein, "Government Deficits and Aggregate Demand," *Journal of Monetary Economics,* January 1982, pp. 1-20; Charles Webster, "The Effects of Budget Deficits on Interest Rates," *Economic Review,* Federal Reserve Bank of Kansas City, May 1983; William DeWald, "Federal Deficits and Real Interest Rates: Theory and Evidence," *Economic Review,* Federal Reserve Bank of Atlanta, January 1983, pp. 20-29; and Lindley Clark, "Are Real Interest Rates Too High Or Too Low?" *The Wall Street Journal,* March 29, 1983.

[2] See, for example, articles on operating procedures by Allan Meltzer and Robert Rasche in the *Journal of Money, Credit, and Banking,* February 1982.

for money, which—in the absence of accommodative Federal Reserve policy—causes interest rates to rise. Or, it can raise inflationary expectations, which cause lenders to impose a premium on interest rates.[3]

This article examines the arguments that money growth volatility has been a major factor contributing to the recent high interest rates. The first section describes the conditions that made it necessary for the Federal Reserve to change its operating procedures. Results of the change are examined, and the rise in interest rates since the change is investigated. The second section discusses a standard model of interest rate determination in an economy without uncertainty. This model is then combined with a consensus model of the economy to show the pattern and magnitude of interest rate movements. The third section explores the effects of uncertainty in determining interest rates. Several possible relationships are investigated, and the theory proposed by Angelo Mascaro and Allan Meltzer is analyzed in depth. The results of their theory are compared with results obtained from other studies. The primary conclusion of this article is that the balance of evidence does not lend strong support to the view that money growth volatility has been a major factor contributing to high interest rates in recent years.

Recent history of high interest rates

The recent high interest rates in the United States had their precursors in the late 1970s. This section examines the rise in inflation and interest rates in the late 1970s and the Federal Reserve's response in changing its monetary control procedures. The changes are described, as are the effects of the changes, including the rise in real and nominal interest rates.

State of the economy in 1978-79

The U.S. economy expanded strongly in 1978 and early 1979, bringing sharp increases in inflation and nominal interest rates. Both had fallen sharply as a consequence of the 1973-75 recession, but as the expansion continued into its fourth year, the economy began to approach its full employment limits. Inflation, as measured by changes in the consumer price index, increased from 4.8 percent in 1976 to 13.0 percent in September 1979. Higher inflation contributed to a sustained rise in interest rates. For example, from 1976 to September 1979, the rate on 3-month Treasury bills rose from 5.0 percent to 10.2 percent, and the yield on 10-year constant maturity Treasury bonds increased from 7.6 percent to 9.3 percent.

Rising inflation contributed to a sharp fall in the value of the dollar in world currency markets. From the beginning of 1977 to September 1979, the value of the dollar fell more than 17 percent against other currencies on a trade-weighted basis. By increasing the price of foreign goods in U.S. markets, the decline in the dollar contributed to inflation in the United States.

Change in monetary control procedures

Against this backdrop of increasing inflation, rising interest rates, and a declining dollar, the Federal Reserve announced a change in its monetary control procedures on October 6, 1979. The Federal Reserve had been using the federal funds rate, the rate that banks pay other

[3] For a detailed exposition of these positions, see Angelo Mascaro and Allan Meltzer, "Long- and Short-Term Rates in a Risky World," mimeo, December 1982, and Angelo Mascaro and Allan Meltzer, "The Effects of Volatile Money Growth on Interest Rates and Economic Activity," reprinted in *The Congressional Record*, September 21, 1982, pp. S11932-S11934.

financial institutions for very short-term loans, as the operating variable for achieving its longer run objectives. The federal funds rate was set to keep the growth of money and credit within ranges that were believed consistent with the desired levels of production, employment, and inflation. For example, when the Federal Reserve wanted to slow an increase in money growth, it increased the federal funds rate by selling securities, which drained reserves from the banking system. With fewer reserves available to support lending, the federal funds rate would rise, tending to boost other short-term interest rates and so reduce money growth.

The change in operating procedures altered the way the Federal Reserve went about achieving its longer run objectives. Instead of using the federal funds rate as its operating variable and letting reserves adjust, the Federal Reserve established a path for nonborrowed reserves thought to be consistent with targets for growth of monetary and credit aggregates. Under the new operating procedures, the federal funds rate and other interest rates were allowed to adjust to whatever level was necessary to achieve the desired growth of money and credit.

The primary goal of the change in operating procedures was to improve control over the money stock and thereby improve the chances of lower inflation and inflation expectations.[4] Relying on the long-run relationship between monetary growth and inflation, the Federal Reserve planned a gradual reduction in the growth rates of the monetary aggregates to lower inflation. Also, inflationary expectations were expected to subside as markets saw the Federal Reserve slowing the growth of monetary aggregates.

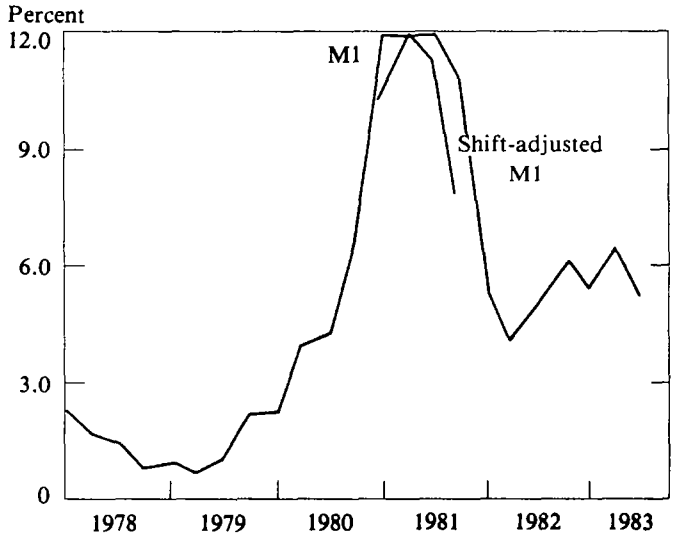
The change in procedures was expected to give the Federal Reserve more effective control over slowing the growth of monetary aggregates. By controlling nonborrowed reserves instead of the federal funds rate, the Federal Reserve believed it would be better able to meet its monetary growth targets. In turn, better control of the money stock would give the Federal Reserve more control in stabilizing economic activity when there were shocks to the economy resulting from changes in spending or shifts in inflation expectations. If, for example, spending were to increase rapidly—as it did in 1978 and 1979—holding to a money stock target would increase interest rates and tend to offset some of the increase in spending. This reduction in aggregate spending was expected to lower inflation. Also, the reduction in inflation brought about by the change in procedures was expected to strengthen the dollar. A lower inflation rate would make domestic goods more competitive in foreign markets, and a slower growth in aggregate spending would slow the growth of imports. Between these two effects, the value of the dollar would rise in world currency markets.

These goals appear to have been met, given the experience of the past four years. The growth of the monetary aggregates slowed appreciably until well into 1982, and inflation slowed dramatically. Growth of M1, the narrowest of the money stock measures and the one used to measure transactions balances, slowed from 7.4 percent in 1979 to 5.1 percent in 1981. This slowing continued in 1982, as the M1 measure of the money stock grew at an annual rate of only 5.4 percent through July.[5] In-

[4] For a complete discussion of the goals of the change in operating procedures, see Federal Reserve Staff Study, *New Monetary Control Procedures,* Vols. 1 and 2, Board of Governors of the Federal Reserve System, February 1981.

[5] These growth rates are fourth quarter to fourth quarter measures of shift-unadjusted, seasonally adjusted M1. Using a shift-adjusted measure of M1-B, which takes account of the impact of structural changes on M1 of the extension of NOW accounts nationwide, the fall in growth rates is

CHART 1
Variability of M1 Growth
(1977:IV-1983:II)



Note: Variability of M1 growth is measured as a four-quarter moving average of changes in M1 growth rates.

flation, as measured by the CPI, fell from 13.3 percent in 1979 to only 3.9 percent in 1982 and has remained low so far in 1983. As expected, lower inflation has been accompanied by strengthening of the foreign exchange value of the U.S. dollar.

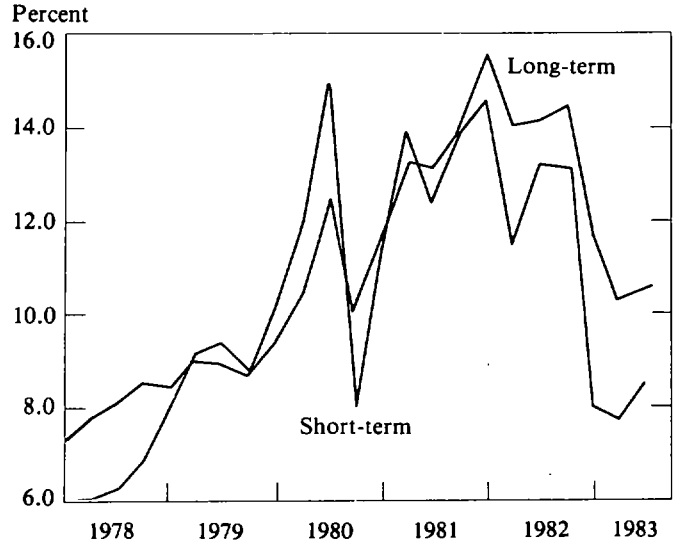
While these improvements were welcomed, some of the developments after the change in monetary control procedures were not. One was the increase in the variability of interest rates; another was the greater variability of monetary growth; and a third was the very high level of interest rates that has prevailed for much of the last four years. It was expected that interest rates would swing more when nonborrowed reserve growth rather than the federal funds rate was used as the operating variable for achieving monetary growth objectives. Under the new procedures, for example, with the Federal Reserve no longer increasing nonborrowed reserves when the demand for money increased, interest rates would rise to equilibrate the demand for money with its supply. The expected result that followed directly from the policy change, therefore, was wider swings in interest rates.

It had not been expected, however, that growth of the money stock would vary more than under the previous procedure. The belief was that by using a nonborrowed reserve aggregate operating variable, the Federal Reserve would be able to achieve smoother growth in the money stock. As Chart 1 shows, this has not been the case.[6] Variability in money growth

even more dramatic—from 7.4 percent in 1979 to 2.3 percent in 1981, a decline of 69 percent. Through July 1982, the annualized growth rate was a negative 0.3 percent.

6 Variability in this case is defined to equal $[(\Delta M1G^2_{-1} + \Delta M1G^2_{-2} + \Delta M1G^2_{-3} + \Delta M1G^2_{-4})/4]^{1/2}$, where $\Delta M1G$ is the change in the growth rate of M1. It is

CHART 2
Nominal Interest Rates
(1977:IV-1983:I)



began increasing almost immediately after the change in procedures was announced. Critics have cited this increase in the volatility of money growth as evidence that the Federal Reserve has not operated well under the new procedures. This volatility subsided after the first year of the new operating procedures, but remained higher than before the change.

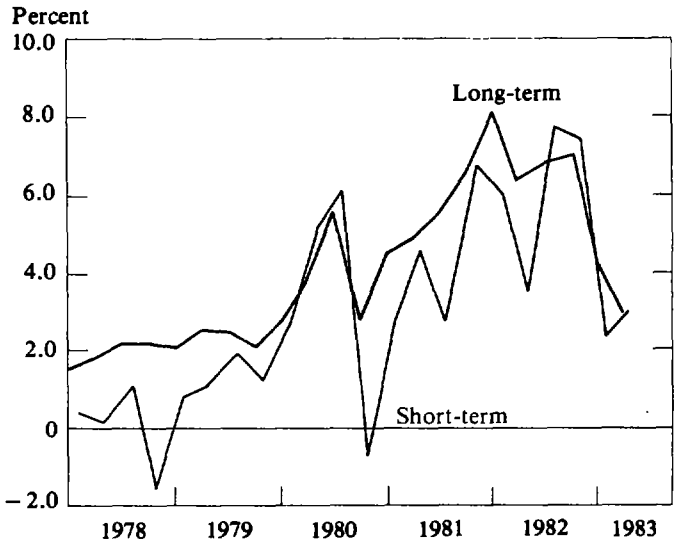
From the standpoint of monetary policy, the most important development since the change in operating procedures has been the sharp rise of interest rates. Chart 2 shows nominal interest rates on 3-month and 10-year Treasury securities since 1978. Although nominal interest rates were high in 1978 and 1979, they rose sharply after the monetary control procedures were changed. Not until mid-1982, when the severity of the recession reduced borrowing demands and the Federal Reserve pursued a less restrictive reserves policy, did interest rates show a sustained decline.

Real interest rates also were high over much of this period.[7] The real rate of interest is the actual rate charged for borrowing or lending

similar to the measure of variability used by Mascaro and Meltzer, although they deal with unexpected portions of the money stock.

[7] In practice, there is no one correct way to measure real rates. With tax effects ignored, they should be measured by the nominal rate less the **expected** rate of inflation over the life of the investment. The difficulty with this definition is that there is no agreement on how to determine the expected inflation rate. Given this difficulty, this article uses as the real rate the actual nominal rate minus the average of an inflation forecast. The models used in forecasting come from a moving ARIMA estimation. See Douglas Pearce, "Comparing Survey and Rational Measures of Expected Inflation: Forecast Performance and Interest Rates," *Journal of Money, Credit, and Banking,* November 1979, pp. 447-56. For a quarterly model, the expected rate of inflation for 3-month Treasury bills is simply the one-quarter-ahead forecast. For 10-year constant maturity Treasury bonds, the measure is the mean of the 10-year forecast.

CHART 3
Real Interest Rates
(1977:IV-1983:I)



less the expected rate of inflation over the term of the debt instrument. It measures the return from lending, or the cost of borrowing, in terms of the purchasing power of the loan amount. From 1958 through 1979, the real rate on 3-month Treasury bills averaged only 0.6 percent, and the real return on 10-year constant maturity Treasury bonds averaged 1.9 percent.[8] In 1981, however, long-term real rates rose to an average of 6.3 percent, and short-term real rates, to 4.8 percent. (See Chart 3.)

Inadequacy of standard models in explaining high interest rates

Standard models of the economy have proven inadequate in explaining the high level of interest rates in recent years. The slowing of monetary growth after October 1979 would be expected to lead to a temporary increase in interest rates. However, empirical estimates of standard models have not explained the magnitude or duration of higher interest rates.

A model of interest rate determination

Short-term interest rates are determined in standard economic models by the interaction of the demand for and supply of money. Thus, it is necessary to analyze equilibrium conditions in the money market to understand why slower money growth leads to a temporary rise in interest rates.

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[8] These figures are the averages over the corresponding periods of quarterly data. The quarterly figures were determined by using the beginning of quarter nominal rate rather than averages of rates. Using averaged rates can give misleading results. See Frederic Mishkin, "Monetary Policy and Long-Term Interest Rates," *Journal of Monetary Economics,* January 1981, pp. 29-55.

The demand for money depends primarily on income and interest rates. One of the main uses for money is to pay for goods and services.[9] As income rises, the size and number of transactions tend to increase, creating a positive relationship between income and the demand for money. There is an opportunity cost, however, in holding money for transactions. This cost is the interest that has to be foregone for not holding those money balances in higher yielding assets. As this cost increases with a rise in the overall level of interest rates, the demand for money tends to decline as interest rates rise.

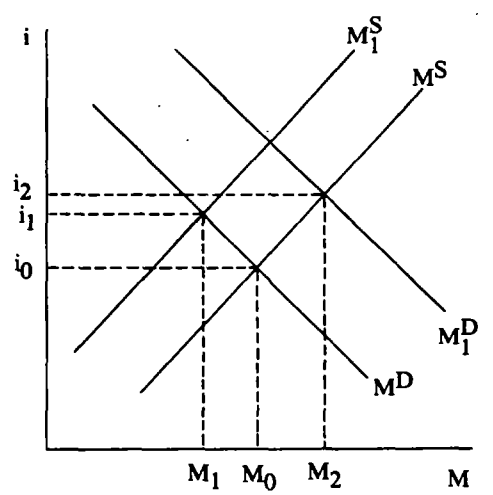
The supply of money depends on several factors, some of which the Federal Reserve cannot control. Through its use of the discount rate, required reserve ratios, and open market operations that affect the amount of nonborrowed reserves in the banking system, the Federal Reserve has partial control of the money supply. These instruments of monetary policy are not enough, however, to control the money supply completely. How depository institutions and the general public behave determines to what extent these instruments affect the supply of money.

Since the behavior of the public and financial institutions cannot be controlled, the money stock can vary unpredictably in the short run. For example, banks might decide to hold more excess reserves, thereby reducing the amount of reserves available to expand the money supply. Moreover, since an increase in market interest rates, given the level of the discount rate, increases the incentive of banks to borrow at the discount window, financial institutions will have increased reserves causing the supply of money to be positively related to the interest rate. Thus, the Federal Reserve influences but cannot completely control the behavior of depository institutions in expanding or contracting the supply of money.

The money stock and interest rate are determined through the interaction of money demand and money supply. In Figure 1, the supply of money is represented by M^S and the demand for money is represented by M^D. Given these relations, only if the interest rate is i_0 will the amount of money demanded equal the amount of money supplied. Only at that point is the money market in equilbrium.

A reduction in nonborrowed reserves in the banking system brought about by an open market sale of securities by the Federal Reserve reduces the supply of money and increases interest rates. If the public and the banking system continued to behave as before, a reduction in nonborrowed reserves would shift the

FIGURE 1
Determination of the equilibrium interest rate and money stock



[9] For a detailed description of this explanation of the demand for money, see William Baumol, "The Transactions Demand for Cash: An Inventory Theoretic Approach," *Quarterly Journal of Economics*, November 1952, pp. 545-56; and James Tobin, "The Interest-Elasticity of Transactions Demand for Cash," *Review of Economics and Statistics*, August 1956, pp. 241-47. There are other ways to derive the demand for money, but this is sufficient to show an interest elasticity.

money supply function to M_1^S, causing an increase in interest rates and a decrease in the money stock. A comparable shift in the money supply function could also result, however from changes in banking system behavior. If banks decided to increase their holdings of excess reserves, the money supply function would decline, producing a similar fall in the money stock and a rise in interest rates, all without any action by the Federal Reserve.

Changes in the money demand function would also affect interest rates and the money stock, without action by the Federal Reserve. For example, an increase in income or in the public's preference for money relative to other assets would result in a shifting of the money demand function to M_1^D. In the absence of any additional behavioral changes or Federal Reserve policy actions, this causes an increase in both interest and the money stock.

A model of the economy and recent interest rate movements

The model of interest rate determination presented above can be combined with a model of the overall economy to describe the movements in interest rates, production, and prices since 1979. One reason for the change in monetary control procedures was to enhance the likelihood of reducing the growth rate of the money stock and thereby to reduce both actual and expected inflation. Within a standard model, therefore, analysis of the high level of interest rates since 1979 focuses on the Federal Reserve policy decision to strengthen procedures for slowing the growth rate of the money stock.

The Federal Reserve can slow growth of the money stock by slowing the growth of nonborrowed reserves available to the banking system. In the absence of any offsetting behavioral responses, a reduction in nonborrowed reserves reduces the supply of money and, given the short-run level of money demand, raises both nominal and real interest rates. Since financial markets clear almost instantly, nominal rates rise quickly. This initial rise in interest rates is only slightly impeded by a reduction in the quantity of money demanded, since money demand is not very sensitive to interest rates in the short run. Many analysts believe that inflation expectations change slowly so that real interest rates rise initially by the same amount as nominal rates. This increase in real rates increases the real cost of borrowing and, thus, lowers spending on business investment, consumer durables, and housing. These spending reductions happen over time, however, because of contractual obligations and other factors that cause a lag between changes in interest rates and changes in spending decisions. As spending is gradually reduced, income and money demand decline. The reduction in money demand lowers short-term interest rates from the high levels caused by the initial Federal Reserve policy actions.[10]

Long-term interest rates also fall from their temporarily higher levels, though they fall more slowly. As aggregate spending is reduced, price increases are also reduced, eventually lowering inflationary expectations. With less expected inflation, the interest rate on long-term securities is lowered because a lower inflation premium is believed necessary to protect the real value of the securities. How quickly real rates return to normal depends on the relative speeds of adjustment of inflation expectations and changes in money demand. The important point, however, is that monetary restraint

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[10] For more detailed descriptions of this overshooting process, see J. Harold McClure, "Whiplash Effects in New Classical and Neo-Classical Models: Two Monetary Explanations of the Recent Ups and Downs of Interest Rates," mimeo, Claremont Graduate School, November 1982, and Ronald Teigen, "A Critical Look at Monetarist Economics," *Review*, Federal Reserve Bank of St. Louis, January 1972, pp. 10-25.

causes an overshooting of both short and long-term interest rates for some period before full adjustment occurs.

This behavioral model gives a consistent explanation for the general pattern of interest rate movements since 1979. The sharp increase in interest rates in 1980 and 1981 and the subsequent decline since mid-1982 form precisely the kind of overshooting pattern of interest rate movements the model implies would occur in response to restrictive policy actions intended to reduce monetary growth. An important question, however, is whether the model can explain the magnitude and duration of the higher interest rates.

The biggest increases in interest rates were in 1981 and early 1982, when growth of the money stock was only slightly less than in 1980. Also, the actual rate of inflation and expectations of future inflation fell rapidly over this period.[11] It seems unlikely, according to this model, that interest rates would rise sharply and remain high when growth in the money stock was declining slowly and inflation expectations were falling fairly quickly. Indeed, predictions of interest rate levels from mainstream econometric models were uniformly too low. For example, one large forecasting firm projected the interest rate on 3-month Treasury bills at 8.0 percent for 1980 and 11.4 percent for 1981. The actual annual interest rates were 11.5 percent for 1980 and 14.1 percent for 1981.[12]

Two other explanations have been offered for the magnitude and duration of the increase in interest rates over that period. One such explanation is that high federal budget deficits, both actual and prospective, pushed interest rates up. The idea that budget deficits tend to raise interest rates is conceptually appealing, but there is little empirical evidence that they actually have a significant effect on interest rates.[13] A second possible explanation is that inflation expectations did not fall as a result of the recession and may, in fact, have risen because of the 1979 oil supply shock. As noted above, however, the evidence shows a lessening of inflation expectations over much of this period. Thus, neither of these additional explanations seems to account adequately for interest rate increases after 1979. Another explanation is needed for the persistently high level of interest rates since 1979.

Uncertainty and interest rates

Some analysts attribute the persistence of high interest rates since 1979 to the increase in money growth variability after the change in Federal Reserve operating procedures. As noted above, neither the increased variability of money growth nor the unprecedented increase in interest rates had been anticipated to result from adoption of a reserve aggregate operating procedure to slow monetary growth. The simultaneous occurrence of these two developments, which cannot be adequately explained within a standard model of the economy, led some to wonder whether increas-

11 See *The Decision-Makers Poll,* A. G. Becker Paribas, July 7, 1983, pp. 2-4. There is evidence, however, that the fall in money stock growth was actually greater than the M1 figures would imply. A shift-adjusted measure of M1, which takes account of the shift in asset holdings in 1981, shows the fall in money stock growth as much more pronounced. By this measure, money growth, which has fallen to 6.6 percent in 1980, fell to only 3.4 percent in 1981. It is difficult to determine what the appropriate measure of money as a transactions balance was for the 1980-82 period, given the new monetary accounts introduced and the shifting of assets between them. It is still unlikely, however, that the fall in money growth accounts for all the increase in interest rates over that period.

12 These figures are taken from the March 1979 and March 1980 Wharton Quarterly Econometric Model, Baseline Forecasts.

13 Webster, pp. 25-28.

ed money growth variability might not somehow have caused the higher interest rates.

Uncertainty could provide a link between money growth variability and the level of interest rates. Interest rates can be thought of as the reward for postponing consumption or, equivalently, as the price of investing to increase future income. Viewed in this way, uncertainty about the future might reasonably be expected to raise interest rates. To the extent that increased variability in money growth leads to greater uncertainty, therefore, that variability could contribute to higher interest rates.

This section analyzes the ways that uncertainty might affect interest rates. A model suggesting that Federal Reserve policy actions are the primary cause of uncertainty—and, therefore, higher interest rates than necessary—is examined. Shortcomings of this model as an explanation for high interest rates since 1979 also are analyzed. Finally, results of other studies of the effects of uncertainty on interest rates are examined.

Why does uncertainty affect interest rates?

John Maynard Keynes hypothesized that people hold wealth in the form of money beyond what is needed for transactions because they are uncertain about future interest rates.[14] He divided the demand for money into transactions, speculative, and precautionary demand. Transactions demand is simply the need for cash to carry out current transactions. Since transactions increase with income, this demand depends positively on income. Speculative demand pertains to money held as an asset instead of securities because of an expectation of capital losses if securities are held. If there is an expectation of future interest rate increases, holders of securities will attempt to shift their asset holdings from bonds to money to avoid the expected capital losses. Thus, demand depends inversely on the interest rate. Precautionary demand is for funds to use in an emergency, to take advantage of unforeseen opportunities, or to use against future money-valued liabilities. This demand could not be met easily by holding securities. Securities could lose some of their value, and often they are not instantly convertible into money for transactions purposes.

Both the speculative and precautionary demands depend on uncertainty. An increase in uncertainty increases money holdings for speculative purposes, because future securities prices become more difficult to forecast and the risk of capital losses becomes greater. It increases the precautionary demand because more unforeseen emergencies and opportunities could arise.[15] As shown in Figure 1, such an increase in money demand increases interest rates unless offset by a commensurate increase in money supply.

Milton Friedman and Anna J. Schwartz addressed the issue of uncertainty and the demand for money by hypothesizing that people hold more of their assets in the form of money when

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14 John Maynard Keynes, *The General Theory of Employment, Interest, and Money,* London: Macmillan, 1936, pp. 166-72 and 194-209.

15 Tobin extended this analysis of the effect of uncertainty on the demand for money and made explicit the increase in money demand that results from an increase in uncertainty. In his model, people are assumed to be trying to maximize their well-being, which depends on the return from their assets and the riskiness of the assets. He assumed that the additional benefits of wealth decline as wealth increases and that people are risk averse. Given these assumptions, Tobin showed that an increase in risk, as measured by the spread on prospective asset yields, increases the demand for money, which tends to increase interest rates. See James Tobin, "Liquidity Preference as a Behavior Towards Risk," *The Review of Economic Studies,* February 1958, pp. 65-86.

conditions are uncertain than when they expect economic conditions to be stable.[16] This behavior, they figured, is because of the versatility of money, which provides flexibility in meeting emergencies and taking advantage of opportunities. The greater the uncertainty about the future, the greater the benefit of flexibility and the greater the demand for money. As a result, if there is no change in the money supply, interest rates rise when conditions become more uncertain. Friedman and Schwartz concluded that the postwar trend of lower demand for money—and the corresponding upward trend in the velocity of money—was due largely to the stability of postwar economic conditions.

Other studies have considered the effect of uncertainty on both sides of the market for loanable funds.[17] On the lending (supply) side of the market, since an increase in uncertainty about expected inflation implies additional uncertainty about the real return from lending, risk averse investors will increase the nominal interest rate by more than the increase in expected inflation. On the borrowing (demand) side, increased uncertainty about expected inflation means a reduction in investment spending. This reduction in expenditures reduces the demand for money and, so, tends to lower interest rates. These studies criticize others that fail to separate the two effects and estimate only the risk premium on interest rates.

16 Milton Friedman and Anna J. Schwartz, *A Monetary History of the United States: 1867-1960,* Princeton University Press for the National Bureau of Economic Research, 1963, pp. 672-75.

17 Maurice D. Levi and John H. Makin, "Fisher, Phillips, Friedman and the Measured Impact of Inflation on Interest," *The Journal of Finance,* March 1979, pp. 35-52; and John H. Makin, "Real Interest, Money Surprises, Anticipated Inflation, and Fiscal Deficits," mimeo, University of Washington and National Bureau of Economic Research, June 1982.

Money growth volatility models

Mascaro and Meltzer present evidence in two recent studies that uncertainty has increased interest rates since 1979.[18] Building on the theories of Keynes and Friedman and Schwartz, they hypothesize that an increase in uncertainty increases the demand for money. The increase in money demand tends, in turn, to increase interest rates, as individuals shift from real capital to money and short-term securities. The shift out of real assets unambiguously raises long-term interest rates, since as the demand for long-term debt instruments falls, the price of long-term debt falls and its yield increases. The effect on short-term interest rates in their model is theoretically ambiguous, however. The increase in the demand for money tends to raise short-term rates, while the increase in the demand for short-term securities tends to lower them. Mascaro and Meltzer find, however, that their model gives an empirical result of an increase in short-term interest rates as a result of uncertainty.[19]

Variability in income can result from variability in any of several factors. Nominal income is equal to the product of the money stock and the velocity of money, which is defined as the ratio of income to the money stock. Using this relationship, Mascaro and Meltzer

18 See references in footnote 3.

19 They distinguish between three causes of uncertainty. First, the rate of inflation may be incorrectly forecast, with the result that the real value of assets may not be correctly anticipated and a less than optimal allocation be made between real and nominal assets. Second, changes in regulatory rules and laws, or the formation of cartels, may affect the growth of output and, thus, the expected return from real capital. Third, monetary policy, if improperly used, may increase the effects of real shocks—and, therefore, uncertainty—even if it is used in an attempt to reduce fluctuations in economic activity resulting from the shocks. If these are the only sources of instability in the economy, their sum is the variability of nominal national income.

argue that uncertainty regarding nominal income growth must result either from uncertainty about money growth or uncertainty about velocity.[20] They further argue that uncertainty about money growth is due to unexpected changes in monetary policy or slippages in monetary control procedures. Lenders are compensated for increased uncertainty by the addition of a risk premium to the interest rate they charge. The greater the uncertainty about money growth, the more difficult it is for market participants to distinguish between large transitory control errors and unannounced changes in planned money growth. The results are interest rates that are higher than they would be otherwise.

In their empirical results, Mascaro and Meltzer find that both money growth volatility and velocity volatility add a significant risk premium to nominal interest rates. They find, however, that the effect of money growth volatility is much greater. Over the 1969-82 period, they find velocity volatility added a risk premium of up to almost 1-1/2 percentage points, with the highest premium after 1979. They estimate that a reduction of about a half percentage point in long-term rates is the most that could reasonably be expected from reductions in velocity volatility. In contrast, they find money growth volatility added a risk premium of 4 to 6 percentage points over the same period, again with the highest premium after 1979. According to their empirical estimates, reduction in money growth variability to the average level of the 1977-79 period would reduce long-term rates 2 to 3 percentage points. Thus, Mascaro and Meltzer conclude that money growth volatility has been a major factor contributing to the high interest rates since 1979. Moreover, since they assume that money growth is largely controlled by the Federal Reserve, they argue that changes in Federal Reserve operating procedures to smooth this growth would result in a decline in interest rates.

The model that Mascaro and Meltzer use implies that money growth volatility increases both short and long-term interest rates. Milton Friedman argues, however, that variability of money growth affects only short-term rates.[21] He finds some correlation between money growth variability and fluctuations in short-term interest rates and possibly between money growth variability and high short-term rates. However, he explains the level of long-term rates as the sum of a real return and an expected inflation rate, without being affected by variability of money growth. Expected inflation is the mean of a low and a high inflation scenario. Low inflation would occur if federal expenditures are reduced and the Federal Reserve maintains moderate money growth. High inflation would occur if both federal expenditures and money growth increased at rates comparable to those in past recoveries. Since market participants are uncertain which result will occur, they form an implicit weighting of the two possibilities. Friedman simply assigns a weight of one-half to each of the two.

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[20] Since, by definition, $Y = M \cdot V$, where Y equals nominal national income, M equals the nominal money stock, and V equals the income velocity of money, $y = m + v$ can be written with lower case letters to indicate growth rates. The variability of national income growth is then var y = var m + var v + 2 covar (m,v), where var is the variance and covar is the covariance. If the covariance between m and v is assumed to be zero, total variations in the level of output are due to changes in money growth and changes in money demand growth (velocity growth). Changes in money demand growth theoretically pick up all of the changes in the economy other than money stock growth. Mascaro and Meltzer later relax the assumption that the corvariance is zero and find it does not change their results.

[21] See, for example, Milton Friedman, "Interest Rates and the Budget," *Newsweek*, June 28, 1982, p. 70; and "The Yo-Yo Economy," *Newsweek*, February 15, 1982, p. 72.

Shortcomings of the money growth volatility models

These studies of money growth volatility have several shortcomings, the most basic being the assumption by both Friedman and by Mascaro and Meltzer that all volatility in the money stock is caused by Federal Reserve actions. As demonstrated in Figure 1, the money stock is jointly determined by the supply of and demand for money, which depends in part on the actions of depository institutions and on the asset preferences of households and firms. If changes in the money stock do cause uncertainty, money stock volatility may be the correct measure of that uncertainty. However, changes in the money stock should not be interpreted as being caused solely by the Federal Reserve, especially when no evidence is presented that money supply rather than money demand factors are responsible for those changes.

Another shortcoming of these models occurs, in the Mascaro and Meltzer studies, with the use of velocity volatility to represent all uncertainty other than that caused by money growth. The problem arises because the causality between velocity and interest rates may run strongly from interest rates to velocity, the opposite of what Mascaro and Meltzer assumed. An increase in interest rates causes people to economize on money balances and increase their demand for other financial and real assets. The reduction in money balances leads to an increase in velocity as money demand falls relative to GNP.

An additional problem with the velocity volatility term is the high correlation between it and the money growth volatility term in some situations. For example, a sudden change in asset preferences by the public would cause unexpected changes in both money growth and velocity. It becomes difficult in this case to interpret what the coefficients on these two terms imply about their effect on interest rates, since both reflect the same underlying behavior. For these reasons, it is difficult to interpret the significance of an observed relationship between interest rates and velocity in a simple model of the type used by Mascaro and Meltzer. A more complete model that includes policy variables affecting the position of the money supply curve, such as nonborrowed reserves and the discount rate, would be required to allow distinction between money demand and money supply disturbances. Omitting these policy variables biases the results toward attributing uncertainty primarily to unanticipated actions by the Federal Reserve.

A third shortcoming of these money growth volatility models is their failure to account for special factors that may have affected the variability of money growth since 1979. Mascaro and Meltzer recognize that much of the increase in variability of money growth since 1979 is due to the imposition and removal of credit controls. As Chart 1 shows, much of the increase in volatility can be accounted for by the period of credit controls. Neither they nor Friedman, however, make an attempt to adjust the variability of money growth for those events, which cannot be called Federal Reserve policy actions in the usual sense. They also do not take into account difficulties in seasonal adjustment of recent money stock data. Seasonal adjustment procedures do not allow immediate adjustment for changing seasonal patterns. Reestimation of seasonal factors in subsequent years often tends to smooth variability. The Federal Reserve has estimated that incomplete seasonal adjustments accounted for most of the measured increase in money growth volatility from October 1979 to October 1980.[22] Thus, much of the variability

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22 Federal Reserve Staff Study, Vol. 1, pp. A5-A7. An experimental seasonal adjustment procedure for M1

of M1 as measured in Chart 1 is accounted for by incomplete seasonal adjustment.

Nor do Mascaro and Meltzer or Friedman consider the effects of changing asset preferences by the nonbank public. The period since the change in monetary control procedures has been marked by financial innovation and deregulation resulting in new accounts and cash management techniques being developed. These changes caused shifts between the types of assets the public wants to hold, which also caused movements into and out of the money stock. A shift-adjusted measure of the money stock was developed for 1981 in an effort to account for the introduction of nationwide NOW accounts. Use of this measure of the money stock reduces somewhat the volatility of money growth at the beginning of this period, although volatility still increased after the change in monetary control procedures. (See Chart 1.)

The fourth shortcoming in these models is the assumption they make that uncertainty is caused primarily by money growth volatility. A Federal Reserve study showed that during the year following the change in procedures, the correlation between fluctuations in short-term interest rates and the levels of the rates was greater than the correlation between fluctuations in the unexpected portion of the money stock and the level of short-term rates.[23] This correlation was updated for this article, and the result remains the same. During the period from the change in procedures to early 1983, the correlation coefficient between the variability in the growth rate of the money stock and the interest rate on 3-month Treasury bills is 0.39, while the correlation between variability in that interest rate and its level is 0.69. This, of course, does not prove that one or the other volatility measure causes interest rates to be higher than they would be otherwise. It seems plausible, however, that risk premiums in interest rates should be related to fluctuations in those rates and, therefore, uncertainty about those rates. This connection is important because most economists believe that tighter control of the money stock results in greater variability of interest rates.[24] If reducing the variability of money growth tends to increase the variability of interest rates—and if this increase in interest rate variability causes increased uncertainty about future rates and thus causes risk premiums to be imposed—the final result of increased monetary control could be an increase in interest rates.

Results of other studies

Several studies have found evidence that uncertainty lowers interest rates and that uncertainty did not increase after the change in

developed by the Board staff which is potentially more accurate than the current procedure shows that although volatility increased over this period, the magnitude of the increase is not as great as when measured using the current seasonal adjustment procedure. Using the current seasonal adjustment procedure, the standard deviation of monthly M1 growth was 4.8 in 1979, rising to 11.1 in 1980, and then falling to 9.2 in 1981 and 8.6 through September 1982. The experimental seasonal adjustment procedure found that the standard deviation of M1 growth rose to only 10.3 in 1980 and fell to 8.8 in 1981 and 7.0 through September 1982. See David A. Pierce, Michael R. Grupe, and William P. Cleveland, "Seasonal Adjustment of the Weekly Monetary Aggregates: A Model-based Approach," Federal Reserve Staff Study, No. 125. These figures use money stock figures and seasonal adjustment factors current as of October 1982. In addition, Mascaro and Meltzer do not consider the volatility of broader monetary aggregates. For example, the volatility of M2 was not significantly greater after the change in procedures (from 1980 to the first quarter of 1983) than it was in the period immediately preceding the change (1978 and 1979).

23 See "Volcker Responds to Treasury Study," *The Congressional Record,* Senate, September 21, 1982, p. S11932.

24 See William Poole, "Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macro Model," *Quarterly Journal of Economics,* May 1970, pp. 197-216.

monetary control procedures. These results clearly differ from the results Mascaro and Meltzer obtained.

Two studies by Levi and Makin of both the supply and demand sides of the loanable funds market have found demand had a relatively larger impact on interest rates than supply.[25] The net effect, according to these studies, is that uncertainty lowers interest rates because uncertainty reduces interest-sensitive expenditures on the demand side by more than the increase in risk premiums demanded by the suppliers of funds.

A study by Fieleke on international comparisons of the correlation between variability of money growth and levels of interest rates did not provide strong evidence of such a linkage.[26] This study looked, in part, at fluctuations in economic activity and money growth and at the level of interest rates in the seven large western industrialized nations from 1970 to 1980. It found very little relationship between the stability of money growth and the level of long-term interest rates. In fact, Japan, the country with the most unstable money growth over this period, had the lowest average interest rates.

Another study by Smirlock looked at the relationship between the demand for money and inflation uncertainty.[27] Use of standard money demand equations showed a significant negative effect of inflation uncertainty on money demand. This result is explained by the possibility of higher opportunity costs of holding money if inflation increased. Thus, this empirical study contradicts the theoretical findings of Keynes and of Friedman and Schwartz, which hypothesized a positive relationship between uncertainty and money demand. If the negative relationship found in this study is correct, then, to the extent that uncertainty is reduced by smoothing of money growth by the Federal Reserve, interest rates would rise through an increased demand for money.

One way to determine if uncertainty has increased is to determine if a liquidity premium has been added to long-term rates. This premium would be expected if increased uncertainty about future interest rates made estimates of debt yields less precise. The greater the uncertainty, the greater the difficulty of forecasting. To induce individuals to hold long-term debt, a liquidity premium would have to be paid to the holders of this debt to induce them to sacrifice the liquidity of money or short-term debt. The results, then, would be an increase in long-term rates relative to short-term rates. Under these circumstances, market participants might expect the new monetary control procedures to increase the risk of capital losses on long-term securities by making interest rates more variable.

The staff of the Board of Governors investigated this possibility after the first year of the control changes and found no evidence of liquidity premiums having increased.[28] By this measure, it appears that uncertainty did not increase as a direct result of the change in monetary control procedures, even though money growth became more volatile.

Conclusion

This article has investigated the high interest rates since the change in Federal Reserve monetary control procedures in October 1979. As stated, the change in monetary control pro-

25 Levi and Makin,and Makin.

26 Norman Fieleke, "Fluctuations in Economic Activity and the Money Supply: An Overview," *New England Economic Review,* May/June 1982, pp. 5-14.

27 Michael Smirlock, "Inflation Uncertainty and the Demand for Money," *Economic Inquiry,* July 1982, pp. 355-63.

28 *New Monetary Control Procedures,* p. A11.

cedures arose as a response to increasing inflation rates and a declining dollar. The slowing of inflation and the increase in the value of the dollar were two of the expected results of the change, but some of the developments which also occurred were unexpected. Money growth became much more variable after the change in operating procedures, and interest rates went to levels higher than most analysts expected—and remained at these high levels for some time. Some analysts have claimed that increased variability of the money stock caused by the change in procedures has been a primary cause of the high rates because of an increase in uncertainty which resulted when money growth became more variable.

This article shows that the idea of uncertainty increasing the demand for money had its precursors in the works of Keynes and of Friedman and Schwartz. Mascaro and Meltzer combined this idea with the assumption that Federal Reserve actions have caused an increase in uncertainty since 1979. Their empirical estimates suggest that volatility in money growth resulting from inadequate monetary control procedures has contributed significantly to high interest rates in recent years.

The shortcomings in the methodology used by Mascaro and Meltzer cast doubt on the validity of their finding, however. Contrary to their assumption, the Federal Reserve does not have complete control of the money stock, at least in the short run, since the money stock responds to changes in both the demand for money and the behavior of the public and the banking system. Mascaro and Meltzer also failed to account for special factors that have affected the variability of money growth, such as inherent difficulties in seasonal adjustment, changing asset preferences of the public, and the imposition and removal of credit controls. Velocity volatility as a measure of changes in nonmoney demand affecting interest rates is shown to have been a poor measure. Moreover, the level of interest rates is more closely correlated with variability of interest rates than with variability of money growth. Thus, reducing money growth variability, as Mascaro and Meltzer recommend, might actually increase interest rate variability and, therefore, the level of interest rates.

This article did not find a convincing explanation for the magnitude of recent interest rate changes in either a standard model of interest rates or in the money growth volatility studies of Mascaro and Meltzer. Despite the shortcomings suffered by their models, as well as the evidence from other studies, there remains a line of theory which supports the idea that money growth volatility increases interest rates. However, in order to properly test the proposition that money growth volatility has been a significant cause of high interest rates, it will be necessary to eliminate the problems in the Mascaro and Meltzer studies.

Other explanations for the levels of high interest rates may be found in the decontrol and innovation in financial markets which occurred in recent years. The removal of interest rate ceilings on loans may have changed the responsiveness of borrowing and spending to interest rates. Instead of high rates leading to a "credit crunch" in which lending activity was brought to a halt, high rates may simply reduce the quantity of loans demanded. To reduce loan demand sufficiently, it now may be necessary to raise interest rates to very high levels. Similarly, the removal of ceiling rates on deposits may have changed financial markets and interest rate behavior in ways that analysts have not yet fully understood. Continuing decontrol and innovation make it difficult to determine the effects of these changes. However, until these areas are thoroughly investigated, the magnitude and duration of high interest rates will remain an unsolved problem.

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