The Federal Reserve's Operating Procedures and Interest Rate Fluctuations

By Carl E. Walsh

On October 6, 1979, the Federal Reserve announced a major change in its monetary policy operating procedures. While leaving the basic goals of monetary policy unchanged, the new procedures were designed to achieve these goals by focusing on reserve aggregates rather than the federal funds rate as a guide for the conduct of monetary policy.[1] Before October 1979, the Federal Reserve had acted between meetings of the Federal Open Market Committee (FOMC) to keep movements in the federal funds rate within narrow bounds. By widening the range of permissible variation for the federal funds rate, the new operating procedures were expected to lead to some increase in interest rate volatility. While the Federal Reserve's change in its operating procedures has not ended controversy over the best method of conducting monetary policy,[2] there has been a large increase in interest rate volatility in the period since October 6, 1979.

The purpose of this article is twofold. The first is to show why the shift to a reserve aggregates operating procedure would be expected, in the absence of any structural change in the behavior of financial markets, to produce greater fluctuations in interest rates. The second purpose is to suggest that the shift in operating procedures may have resulted in structural changes in behavior that have made interest rates more responsive to financial market shocks, thereby contributing to greater interest rate volatility. These changes in the behavior of the public help explain why interest rates have been more volatile since October 1979 than was generally expected.

In the first section of the article, measures of interest rate volatility are presented to docu-

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[1] Board of Governors of the Federal Reserve System, *Federal Reserve Bulletin,* October 1979, p. 830. For a discussion of the new operating procedures, see J. A. Cacy, "Monetary Policy in 1980 and 1981," *Economic Review,* Federal Reserve Bank of Kansas City, December 1980, pp. 18-25; and Stephen H. Axilrod and David E. Lindsey, "Federal Reserve System Implementation of Monetary Policy: Analytical Foundations of the New Approach," *American Economic Review,* May 1981, pp. 246-52.

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[2] See, for example, the debate between Robert H. Rasche, Allan H. Meltzer, Stephen H. Axilrod, and Peter D. Sternlight, *Journal of Money, Credit, and Banking,* February 1982, pp. 119-47.

ment the change in interest rate behavior that has occurred since October 1979. This is followed by a discussion of some of the views concerning expected interest rate movements under a reserve aggregates operating procedure expressed by economists prior to the Federal Reserve's procedural shift. This section also presents some evidence to suggest that the change in the Federal Reserve's operating procedures was accompanied by structural changes in financial markets. The third section presents a model of interest rate determination to illustrate why interest rates would be expected to fluctuate over a wider range after October 1979. The fourth section suggests that the induced structural adjustments by the public have added to the increase in interest rate volatility which accompanied the change to an aggregates operating procedure.

MEASURES OF INTEREST RATE VOLATILITY

The greatly increased volatility of interest rates of all maturity lengths which followed the Federal Reserve's October 1979 shift to a reserve aggregates operating procedure is evident from Chart 1. The chart plots weekly average levels of the federal funds rate, the 3-month U.S. Treasury bill rate, and the rate on 20-year U.S. government bonds. Tables 1 and 2 present alternative measures of pre- and post-October 1979 volatility for various interest rates. Table 1 gives the standard deviations for five different interest rates for weekly observations for the year immediately before and for the year immediately following the announced policy shift. The large increase in interest rate volatility is evident in the roughly four- to

Chart 1
INTEREST RATES
(Weekly Averages: 1978-81)

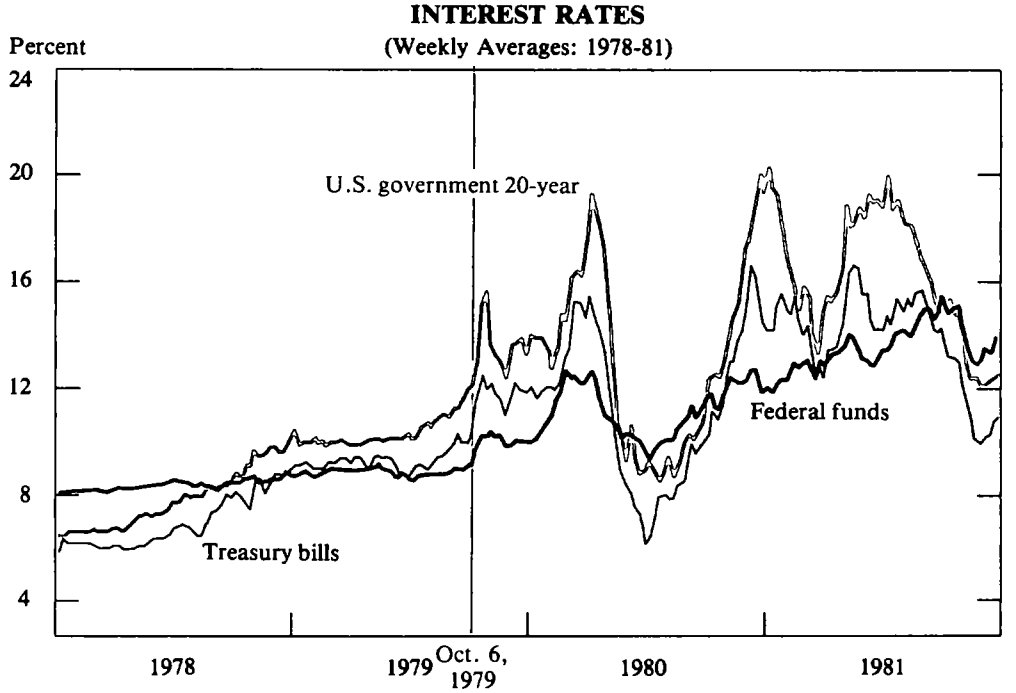

Table 1
STANDARD DEVIATIONS OF INTEREST RATES*
(Weekly)

Interest Rate	Sample Period 1978:41-1979:40†	1979:41-1980:40
Federal funds rate	60.90‡	291.54
3-month Treasury bills	55.59	240.03
6-month Treasury bills	38.47	227.73
12-month commercial paper	61.99	276.64
20-year U.S. government bonds	17.08	86.09

*The standard deviation for an interest rate r_t is equal to

$$\left\{\frac{1}{51}\sum_{t=1}^{52}(r_t-\bar{r})^2\right\}^{1/2}$$

where $\bar{r}=\frac{1}{52}\sum_{t=1}^{52} r_t$ is the mean.

†The sample period runs from the 41st week of 1978 to the 40th week of 1979, which is equal to the year immediately prior to the week of October 6, 1979.
‡Measured in basis points.

Table 2
UNPREDICTABLE INTEREST RATE VOLATILITY*
(Weekly)

Interest Rates	Sample Period† 1978:1-1979:40	1980:1-1981:40
Federal funds rate	15.19‡	83.57
3-month Treasury bills	19.78	64.96
6-month Treasury bills	14.53	53.18
12-month commercial paper	13.01	74.86
20-year U.S. government bonds	6.20	29.59

*Root-mean-squared errors from a regression of each interest rate on 12 past values of itself.
†The sample period runs from the first week of either 1978 or 1980 to the 40th week of the following year.
‡Measured in basis points.

fivefold increase in the standard deviations of all five interest rates in the year after the Federal Reserve changed its operating procedures.

While the standard deviations in Table 1 measure the gross volatility of actual interest rates, another approach would be to focus on the volatility of unpredictable changes in interest rates. Such an approach would measure the extent to which increased interest rate volatility contributes to uncertainty.[3] One such measure would be the standard deviation of the difference between the weekly average of an interest rate and the value of that interest rate that would have been predicted based upon the information contained in past values of the interest rate. This measure of interest rate volatility is reported in Table 2.[4] According to Table 2, the proportionate increase in unpredictable volatility has been even greater than the rise in gross volatility for the federal funds rate and the 12-month commercial paper rate. Both Tables 1 and 2 reflect the large rise in volatility which was apparent from Chart 1.

PRE-OCTOBER 1979 VIEWS ON POTENTIAL INTEREST RATE VOLATILITY

In the years before the Federal Reserve changed its operating procedures, many

[3] This argument is made by Peter A. Tinsley et al., "Money Market Impacts of Alternative Operating Procedures," *New Monetary Control Procedures*, Federal Reserve Staff Study, Vol. II, Board of Governors of the Federal Reserve System, February 1981.

[4] The sample periods differ in Tables 1 and 2 since for Table 2 the first week of the post-October 6, 1979, period that could be predicted using 12 lagged values, all from the reserve aggregates operating procedure period, was 1980:1.

economists argued that interest rates might actually be less volatile under operating procedures that focused on reserve aggregates rather than the federal funds rate. Others held that interest rate fluctuations would increase under a reserve aggregates operating procedure but argued that the increase in volatility would be small.[5] There seem to have been two explanations offered for these views.

The first explanation was that interest rate instability was due to the use by the Federal Reserve of a federal funds operating target. It was argued that using an interest rate target leads to instability in the growth rate of the money supply. Fluctuations in the monetary growth rate produce instability in the economy, which in turn causes interest rate volatility.[6] Thus, according to this view, procedures that allow the federal funds rate to vary but stabilize the monetary aggregates would lead to more stable interest rates.[7] Regardless of the validity of this view, it is not relevant for understanding the likely effects on short-term volatility (weekly or monthly, for example) of a change to a reserve aggregates operating procedure. Such a change could lead to more stable interest rates when measured by changes in yearly averages but could simultaneously lead to the very large weekly interest rate volatility observed in Chart 1. This article deals only with this short-run volatility.

The second explanation for the view that a reserve aggregates operating procedure would not lead to a large increase in interest rate volatility relied on the possibility of structural change occurring in financial markets that would tend to dampen interest rate fluctuations.[8] The term structure relationship linking short-term and long-term interest rates was the most commonly mentioned possibility for structural change.[9] Because long-term interest rates are, according to the expectations theory of the term structure, equal to an average of expected future short-term rates, any change in short-term interest rates that causes the expected future short-term rate to change will lead to a change in long-term interest rates.[10] Under the old operating procedure, changes in short-term interest rates had a relatively large impact on longer term rates. This was because most changes in short-term interest rates signaled a basic change in monetary policy and were viewed as permanent. Such changes therefore had a large impact on expected future short-term rates. Under the new operating pro-

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5 For a discussion of alternative views concerning potential interest rate volatility, see Raymond Lombra and Frederick Struble, "Monetary Aggregate Targets and the Volatility of Interest Rates: A Taxonomic Discussion," *Journal of Money, Credit, and Banking,* August 1979, pp. 284-300.

6 This is the view argued in Robert E. Weintraub, "Review of Monetary Aggregates and Monetary Policy," *Journal of Money, Credit, and Banking,* August 1976, pp. 401-05.

7 Weintraub's optimism is still shared by those who feel that, if the Federal Reserve controlled aggregates more closely, interest rate volatility would decline. In a recent debate on monetary policy, Robert Rasche said, "I might say that to the extent we have a well-defined monetary target, and thus the markets understand what the Federal Reserve is trying to do, there is a good chance that we would in fact see reduced interest rate volatility below the kind of thing we have seen in the last year" *(Journal of Money, Credit, and Banking,* February 1982, p. 137).

8 This argument was made by Richard G. Davis, "Short-Run Targets for Open Market Operations," *Open Market Policies and Operating Procedures—Staff Studies,* Board of Governors of the Federal Reserve System, July 1971, pp. 37-69; and by James L. Pierce and Thomas D. Thomson, "Some Issues in Controlling the Stock of Money," *Controlling Monetary Aggregates II: The Implementation,* Conference Series No. 9, Federal Reserve Bank of Boston, September 1972, pp. 115-36.

9 For examples of this view, see Davis, Lombra, and Struble; and Pierce and Thomson as cited above; and John P. Judd and John L. Scadding, "Conducting Effective Monetary Policy: The Role of Operating Instruments," *Economic Review,* Federal Reserve Bank of San Francisco, Fall 1979, pp. 23-37.

10 For a discussion of theories of the term structure of interest rates, see Burton G. Malkiel, *The Term Structure of Interest Rates: Expectations and Behavior Patterns,* Princeton, N.J.: Princeton University Press, 1966.

cedures, changes in short-term rates signal basic policy actions less often and are therefore more likely to be quickly reversed. Hence, under an aggregates policy, changes in short-term interest rates will have a smaller effect on expected future short-term rates. This means that long-term interest rates will respond less to a change in short-term rates than they did under the pre-October 1979 operating procedures. According to this argument, while an aggregates operating procedure would cause short-term rates to become more volatile, it would not necessarily cause greater volatility for long-term interest rates. The evidence from Tables 1 and 2, however, indicates that interest rates of all maturity lengths have been much more volatile since the change in operating procedures.

Besides these theoretical arguments, some empirical attempts were made to assess the likely interest rate volatility that would result if the Federal Reserve changed its operating procedures.[11] One such attempt, using 1967-68 data, estimated that a hypothetical policy producing steady increments in nonborrowed reserves would increase the absolute weekly change in the federal funds rate by a factor of from 3 to 4.[12] This figure was obtained by using an estimate of the empirical relationship between the federal funds rate and free reserves to calculate the value of the funds rate implied by the hypothetical policy. Free reserves are equal to total reserves minus required reserves and borrowed reserves. Free reserves and the federal funds rate are empirically related because an increase in the federal funds rate increases the opportunity cost of holding free reserves. This causes banks to reduce their free reserves.

The accuracy of this estimate of interest rate volatility can be judged by comparing the actual average absolute weekly change in the federal funds rate in the year prior to October 6, 1979—14 basis points—to the actual figure for the year after the policy shift—70 basis points. This was a fivefold increase compared to the three- to fourfold increase predicted. The earlier estimate therefore understated the actual rise in interest rate volatility. However, it is not valid to make inferences about the results of the 1979 policy shift based on the free reserves-federal funds rate relationship that existed in the 1967-68 period. This is because the change in September 1968 from current to lagged reserve accounting affected the linkage between free reserves and the funds rate. To make valid inferences, the relationship must be reestimated using post-1968 data. A reestimation using data for the period immediately prior to the October 6, 1979, change in operating procedures produces an even greater understatement of the post-October 1979 rise in interest rate volatility than did the earlier estimate.[13] Moreover, a further reestimation of the free reserves-federal funds rate relationship using post-October 1979 data discloses a large structural shift in the rela-

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11 Besides the paper by Davis, see John H. Ciccolo, "Is Short-Run Monetary Control Feasible?" *Monetary Aggregates and Monetary Policy,* Federal Reserve Bank of New York, October 1974; and Robert S. Pindyck and Steven M. Roberts, "Optimal Policies for Monetary Control," *Annals of Economic and Social Measurement,* January 1974, pp. 207-37.

12 See Davis. The actual average absolute weekly change for the period studied by Davis was 15 basis points, while under the reserve aggregates policy this measure of volatility was estimated to increase to 55 basis points.

13 Davis estimated the equation $r_{ff} = b_0 + b_1 R_f + b_2 r_{dis}$, where r_{ff} is the federal funds rate, R_f is free reserves, and r_{dis} is the discount rate. The estimated value of b_1 plays the key role in Davis' analysis. Large values of b_1 produce large estimates of interest rate volatility. Davis' estimate of b_1 was -0.002. Reestimating this equation for 1978:1-1979:40 produced a value for b_1 of -0.0003. Using this value to estimate potential interest rate volatility under a hypothetical policy of steady increments in nonborrowed reserves would indicate that a reserve aggregates policy would produce little increase in interest rate volatility.

tionship.[14] The shift is in the direction of producing greater interest rate volatility.

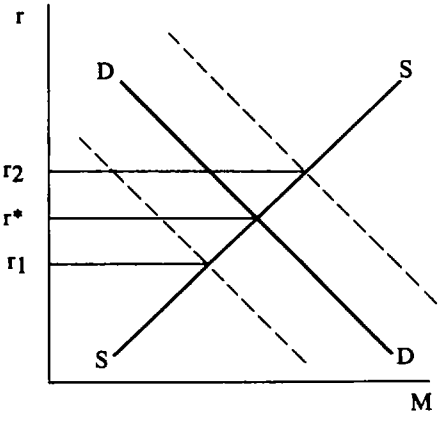
The possibility of such structural change was recognized by most economists considering the potential effects of a reserve aggregates procedure. They generally cautioned against using empirical models estimated during a period in which the Federal Reserve followed a federal funds procedure to draw inferences about how the economy would behave under a reserve aggregates procedure.[15] Further evidence of structural change has been found by V. Vance Roley in a study of interest rates and money supply announcements.[16] He found that interest rates are much more responsive to unanticipated money supply changes in the post-October 1979 period than they were in the pre-October 1979 period. Roley attributes almost 30 percent of the increase in interest rate volatility to the change in the market's response to money surprises.[17] Such structural change in financial markets as has occurred since the Federal Reserve changed its operating procedures appears to have worked to increase interest rate volatility, not to dampen it, as some economists expected.[18] In the next two sections of the article, the impact on interest rate volatility of the change in the Federal Reserve's operating procedures is analyzed.

INTEREST RATE MOVEMENTS UNDER ALTERNATIVE OPERATING PROCEDURES

This section shows that, in the absence of any structural change, the shift in operating procedures would be expected to increase the volatility of interest rates. The next section shows that the shift in procedures may have caused a structural change that has added further to interest rate volatility.

Figure 1 is a graphical presentation of the model of interest rate determination that will be used in the analysis. The line labeled DD represents the demand for money, giving for each value of the interest rate the amount of money the public wishes to hold. DD is drawn with a downward slope, indicating that higher interest rates are associated with a lower demand for money. There are two mutually reinforcing theoretical reasons for expecting DD to be downward sloping. The first focuses on the need to hold money to facilitate day-to-day transactions. Deciding how much money to

Figure 1
INTEREST RATE FLUCTUATIONS AND SHIFTS IN MONEY DEMAND



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14 The estimated value of b_1 (see footnote 13) jumped from -0.0003 to -0.0013 when data from 1979:41 to 1981:28 were used. The actual volatility of interest rates, which reflected the high value of -0.0013, was much greater than Davis' methodology would have predicted using the preshift value of -0.0003.

15 See, for example, Davis, pp. 57-58; Lombra and Struble, p. 292; and Benjamin M. Friedman, "Empirical Issues in Monetary Policy: A Review of Monetary Aggregates and Monetary Policy," *Journal of Monetary Economics*, January 1977, pp. 87-101.

16 V. Vance Roley, "The Response of Short-Term Interest Rates to Weekly Money Announcements," mimeo, Federal Reserve Bank of Kansas City, April 1982.

17 Approximately 26 percent of the increased volatility was attributed to the greater volatility of unanticipated money, and 44 percent was unexplained. See Roley.

18 See footnote 8.

hold for such purposes is a type of an inventory problem. As with other types of inventories, the interest rate represents an important component of the cost of holding money. When this cost goes up as the interest rate rises, the public desires to reduce its money holdings.[19]

The second reason focuses on money as one among various financial assets. Investors allocate their wealth among the various assets, each of which differs in terms of expected return, maturity, risk, and marketability, with the objective of maximizing the expected holding period return on their portfolio consistent with their attitudes toward risk. The return on any asset whose maturity exceeds an investor's holding period is subject to risk because of the possibility of unanticipated changes in market interest rates. When interest rates change, investors adjust their assessments of the expected holding period rates of return on the various assets and reallocate their portfolios. As the interest rates and expected rates of return on nonmoney assets rise, the public will respond by reducing its holdings of money.[20] Again, the result is a negative relationship such as DD between money holdings and interest rates.

Also drawn in Figure 1 is an upward sloping short-run money supply curve, labeled SS. Such a relationship results because, as interest rates rise, banks attempt to reduce their holdings of free reserves, either by reducing excess reserves or increasing their borrowings from the Federal Reserve. This in turn tends to increase the amount of money supplied to the public.[21]

Given both the quantity of money demanded and supplied as functions of the interest rate, the equilibrium interest rate is determined so that demand equals supply. This occurs at the interest rate denoted r^* in Figure 1.

Changes in income, which affect money demand, or changes in Federal Reserve policy instruments (such as nonborrowed reserves or the discount rate), which affect the money supply, produce systematic shifts in either DD or SS. These shifts, in turn, result in movements in the equilibrium interest rate. In addition, random disturbances may cause short-run shifts in the demand for money. Such disturbances, if the supply of money remains unchanged, lead to movements in the short-term interest rate. This is illustrated in Figure 1, where the dashed lines represent bounds for the shifting position of the money demand function for any particular short period such as a week. Given these bounds, the short-term interest rate will fluctuate within the range r_1 to r_2.

When the Federal Reserve is using an interest rate operating target, however, interest rate movements may not span the entire range from r_1 to r_2 because the Federal Reserve engages in open market operations to prevent wide interest rate fluctuations. For example, when a random disturbance shifts money demand to the right, putting upward pressure on interest rates, the Federal Reserve increases nonborrowed reserves, shifting the money supply curve also to the right, thereby partly offsetting the fluctuation in money demand. Thus, the interest rate will tend to move within a narrow range such as r_3 to r_4 in Figure 2.

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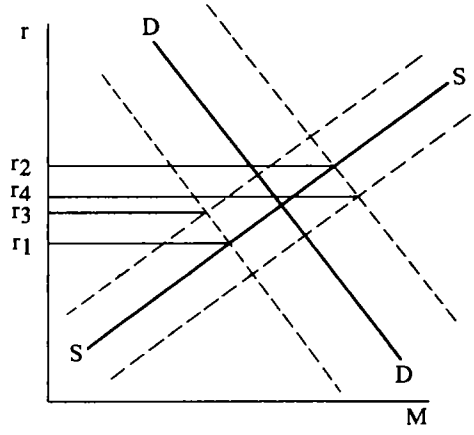
19 The inventory approach to the demand for money is developed in W. Baumol, "The Transactions Demand for Cash—An Inventory Theoretic Approach," *Quarterly Journal of Economics*, November 1952, pp. 545-56; and J. Tobin, "The Interest Elasticity of the Transactions Demand for Cash," *Review of Economics and Statistics*, August 1956, pp. 241-47. For a modern treatment, see Anthony M. Santomero and John J. Seater, "Partial Adjustment in the Demand for Money: Theory and Empirics," *American Economic Review*, September 1981, pp. 566-78.

20 This view is discussed in J. Tobin, "Liquidity Preference as Behavior Towards Risk," *Review of Economic Studies*, February 1958, pp. 65-86.

21 Models of bank behavior are surveyed in E. Baltensperger, "Alternative Approaches to the Theory of the Banking Firm," *Journal of Monetary Economics*, January 1980, pp. 1-37.

Figure 2
INTEREST RATE FLUCTUATIONS PARTIALLY OFFSET BY OPEN MARKET OPERATIONS



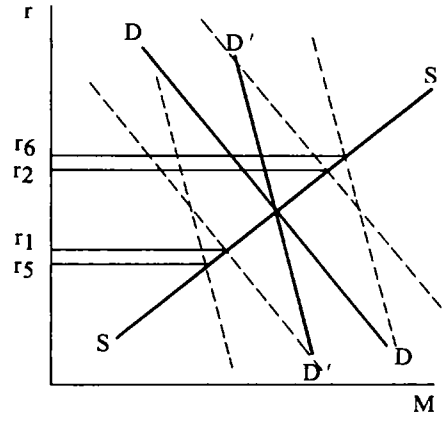
Under a reserve aggregates operating procedure, the Federal Reserve does not intervene to offset money demand shifts, and the interest rate tends to move within the wider range from r_1 to r_2.[22] In the absence of any structural change in the money market, therefore, the October 1979 shift to a reserve aggregates procedure would tend to result in greater interest rate volatility.

EFFECTS OF THE CHANGE IN OPERATING PROCEDURES ON THE DEMAND FOR MONEY

This section shows that the change in operating procedures may have caused a structural change in the money market. The analysis first explains how the degree of money market volatility depends in part on the slope of the demand for money function. Then it is shown how the procedures may have affected this slope.

[22] If there also were weekly shifts in money supply around the average money supply curve, SS, the total range within which interest rates might be expected to move would be wider still.

Figure 3
EFFECTS OF A STEEPER MONEY DEMAND FUNCTION



In general, the degree of interest rate volatility depends upon two aspects of the money market: the frequency and magnitude of the shocks to money demand (i.e., the width of the dashed lines around DD),[23] and the relative slopes of DD and SS, because the slopes will determine how much interest rates must adjust in response to a given shock. The role of this second factor is illustrated in Figure 3. The black lines in that figure reproduce Figure 1, which shows that the interest rate tends to fluctuate within the range r_1 to r_2. The blue line D'D' in Figure 3 shows a steeper demand curve. With money demand shocks the same

[23] The extent to which interest rate fluctuations in recent months can be attributed to the Federal Reserve's new operating procedures was one issue examined by the Federal Reserve staff in its two volume study, *New Monetary Control Procedures.* See the review of this study by Stephen M. Goldfeld, *Journal of Money, Credit, and Banking,* February 1982, pp. 148-55. The conclusion reached in that study was that the first year after the introduction of the new procedures was atypical, subject to larger than normal shocks (for example, the credit controls of 1980). The greater volatility of interest rates could therefore at least partially be attributed to nonpolicy sources.

size as before,[24] the interest rate tends to move over a wider range, r_5 to r_6. A steeper money demand curve, therefore, leads to greater interest rate volatility. A relatively steep money demand curve indicates that changes in the interest rate cause relatively small changes in the quantity of money demanded. Thus, the interest rate will have to make relatively large changes to equilibrate money demand to money supply.

An examination of the determinants of the money demand curve's slope indicates that the change in the Federal Reserve's operating procedures may have caused it to become steeper, thereby contributing to interest rate volatility. The demand for money is a function of the expected rate of return on nonmoney assets. Thus, a relationship such as DD in Figure 1 between the rate of interest and the quantity of money demanded reflects two underlying linkages. First, changes in the market rate of interest provide information to investors on the basis of which they may revise their forecast of the expected rate of return. Second, any revision in the expected rate of return produces a change in the demand for money. In Figure 1, DD graphically summarizes the combination of these two relationships. Structural changes either in the link between the market interest rate and the expected rate of return or in the link between the expected rate of return and the quantity of money demanded will affect the slope of the money demand curve. It is likely that the alteration in operating procedures has led to structural change in both these relationships.

With regard to the relationship between the market interest rate and the expected rate of return, when the Federal Reserve acted to stabilize interest rates, changes in market rates of interest tended to be relatively small and infrequent. Any changes in the federal funds rate that did occur reflected policy changes and were permanent. That is, investors did not expect changes in interest rates to be quickly reversed. In this environment, any changes in the market rate would have a large effect on investors' assessment of the expected rate of return.

Under the new reserve aggregates operating procedure, the market interest rate varies over a wider range than formerly. Changes in the market rate are more likely to be due to random shocks to money supply or demand and, hence, to be temporary. Investors expect changes in the interest rate to be quickly reversed. Under these conditions, changes in the interest rate will cause relatively small revisions in the expected rate of return, smaller revisions than under an interest rate operating procedure.[25] This structural change in the relationship between the rate of interest and the expected return has caused the money demand curve to become steeper. In other words, as the expected return becomes less responsive to interest rate changes due to a shift in the Federal Reserve's operating procedures, money demand responds less to changes in the market interest rate.

Economic theory suggests that the October 1979 shift in procedures also affect the second part of the linkage between the interest rate and money demand—the relationship between the expected rate of return and the demand for money. Money demand is likely to have become less sensitive to changes in the expected rate of return because the change in procedures has increased the riskiness of interest-earning assets.

To understand why the change in the second linkage has occurred, it is useful to analyze an example involving only two financial assets,

[24] That is, they lead to the same horizontal displacement of the demand curve.

[25] This is similar to the argument discussed earlier for a structural shift in the term structure of interest rates. See the references in footnote 9.

money and a Treasury bill whose maturity length is greater than the typical investor's holding period. Investing in the bill involves risk since the actual holding period return is unknown. The demand for money depends not only on the expected holding period return on the bill but also on the risk involved in holding it as reflected in the likelihood of unanticipated interest rate movements.[26] As holding bills becomes more risky, an investor will react more cautiously to changes in the expected return on bills and make smaller portfolio adjustments. An increase in the riskiness of bills because of greater interest rate volatility causes the demand for money to become less responsive to changes in the expected return on bills.[27]

This result remains valid in a situation involving many financial assets. In general, an increase in the riskiness of interest-bearing financial assets tends to reduce the portfolio response induced by a change in expected rates of return. When holding interest-earning assets is subject to greater risk, a larger increase in the expected rate of return is required to induce investors to hold larger amounts of such assets as they must be compensated for the greater risk.

Increased interest rate volatility is likely, therefore, to produce a fall in both the responsiveness of the quantity of money demanded to changes in the expected rate of return and the responsiveness of the expected rate of return to changes in the market rate of interest. Hence, changes in the market interest rate will have smaller effects on the demand for money under the new operating procedure than was true under the federal funds operating procedure. Since money demand is less sensitive to interest rate changes, larger movements in interest rates will be required to produce a given change in money demand—i.e., the money demand curve has become steeper.

By changing its operating procedures to allow greater fluctuations in interest rates, the Federal Reserve has induced a structural change that has made interest rates more sensitive to money market shocks. This structural change has tended to amplify the increase in interest rate volatility that might have been expected under a reserve aggregates operating procedure.

This argument is consistent with the possibility, as discussed earlier, that the term structure relationship may also have undergone a structural change so that long-term interest rates are now less volatile for a given degree of short-term interest rate volatility.[28] However, the rise in short-term interest rate fluctuations has been so large that it has, as was shown in Tables 1 and 2, resulted in an absolute increase in the volatility of long-term interest rates.

SUMMARY AND CONCLUSIONS

Despite the expectations of many economists, the Federal Reserve's October 1979 change in its operating procedures has been followed by a large increase in interest rate volatility. This article has argued that the rise in interest rate volatility was underestimated because economists failed to anticipate that the change in procedures would give rise to structural changes in financial market behavior. A consideration of economic theory suggests that interest rate volatility was increased by these structural changes.

The article's argument is a specific example

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26 The demand for money will also depend upon the level of wealth.

27 See Carl E. Walsh, "Interest Rate Volatility and Monetary Policy," Research Working Paper 82-03, Federal Reserve Bank of Kansas City.

28 There is some evidence that long-term interest rates are now less responsive to changes in the federal funds rate. Interest rates of various maturities were regressed on a constant and the federal funds rate for the period 1978:41 to 1979:40 and for the period 1980:41 to 1981:40. For every interest rate, the coefficient on the federal funds rate was smaller in the second period.

of a recent, fundamental criticism which has been directed at the use of empirical relationships to evaluate economic policy.[29] The observed relationships captured by empirical models depend, in part, on the behavior of policymakers. The response of individuals to a change in interest rates, for example, depends in part on their expectations about future interest rates. These expectations, in turn, depend on the way the Federal Reserve is expected to act in the future. A change in the Federal Reserve's operating procedures, by affecting these expectations, will change the response of individuals to current interest rates. Empirical estimates of economic behavior obtained during a period in which the Federal Reserve followed certain procedures may not accurately reflect the way individuals behave during a period in which the Federal Reserve follows different procedures.

This criticism directed at the use of empirical models for policy evaluation has continued relevance since some economists have proposed further changes in the Federal Reserve's conduct of monetary policy, such as returning to contemporaneous reserve accounting or establishing the discount rate as a penalty rate. To correctly evaluate alternative operating procedures or other policy changes, and to assess the likely effects on the Federal Reserve's ability to control monetary aggregates or to stabilize interest rates, it is necessary to recognize that the public adjusts its behavior in response to changes in the behavior of the Federal Reserve.

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29 This criticism is commonly called the Lucas critique, after Robert E. Lucas, Jr., "Econometric Policy Evaluation: A Critique," *The Phillips Curve and Labor Markets,* ed. by K. Brunner and A. H. Meltzer, Amsterdam: North Holland, 1976. See also the editors' introduction in *Rational Expectations and Econometric Practices,* ed. by Robert E. Lucas, Jr., and Thomas J. Sargent, Minneapolis: University of Minnesota Press, 1981.