

NBER WORKING PAPER SERIES

FEDERAL RESERVE BEHAVIOR SINCE 1980:
A FINANCIAL MARKETS PERSPECTIVE

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Working Paper No. 2608

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
June 1988

We are grateful to Thomas Mayer and Gordon Sellon for helpful comments, to Steven R. Thorley for research assistance, and to the National Science Foundation (Grant No. SES-8408603) for research support. This paper was prepared for Thomas Mayer (ed.), The Political Economy of American Monetary Policy. This research is part of NBER's research program in Financial Markets and Monetary Economics. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

NBER Working Paper #2608
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ABSTRACT

The financial market's understanding of Federal Reserve behavior is used to examine recent changes in monetary policy. Changes in the level of interest rates in response to specific types of economic information are primarily considered. Differences in the volatility of interest rates across periods provide additional evidence on changes in monetary policy regimes. The results indicate that monetary policy changed several times since 1980 with respect to either the Federal Reserve's targets, its desire to achieve its targets, or its operating procedures. The different regimes correspond to Federal Reserve statements about changes in policy. In this context, then, the evidence suggests that policy was credible.

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FEDERAL RESERVE BEHAVIOR SINCE 1980:

A FINANCIAL MARKETS PERSPECTIVE*

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Knowledge of actual Federal Reserve behavior is important in studies of monetary policy and financial markets for at least two reasons. First, the interpretation of variables chosen to represent the monetary policy process may be marred if they do not correspond to variables actually used by the Federal Reserve to implement monetary policy or to gauge its performance. Accordingly, the Federal Reserve's choices regarding targets, intermediate targets, and instruments may play a key role in research design.¹ Unfortunately, information regarding these choices is not always easy to obtain. Relevant Federal Reserve policy statements, such as the FOMC policy directive, are released with a substantial delay and often are ambiguous.² Thus, additional knowledge regarding actual Federal Reserve behavior may have a methodological payoff.³

Second, the recurrent issue of policy credibility requires an assessment of the extent to which Federal Reserve statements find a reflection in the beliefs and behavior of economic agents. While credibility potentially has a variety of interpretations, all would seem to require that a shift in stated policy objectives and instruments be associated with at least some change in market behavior. Thus, additional knowledge regarding Federal Reserve behavior, and the financial market's reaction to it, may help illuminate the credibility issue.

This paper examines actual Federal Reserve behavior from a financial markets perspective. Movements in interest rates are used as the metric in this exercise. The underlying presumption is that financial market participants fully understand Federal Reserve behavior. This position is sensible for two reasons. First, many financial market participants are former Federal Reserve officials and economists. Second, given the key role of the Federal Reserve in influencing interest rates in at least the short-run, market participants have a strong incentive to study Federal Reserve behavior.

Following this introductory section, a framework for examining monetary policy is presented in the first section. Within this framework, several different types of monetary policy regimes are

distinguished. In the second section, the implications of the different monetary policy regimes on the behavior of interest rates are discussed. The third section presents empirical results on actual Federal Reserve behavior. The period beginning in 1980 and ending in early 1987 is considered. This period is interesting in that Federal Reserve statements indicate that monetary policy changed several times. Thus, specific instances of Federal Reserve behavior can be analyzed in terms of the credibility of policymakers. The main conclusions are summarized in the final section.

I. The Monetary Policy Framework

Several aspects of monetary policy are reviewed in a stylized framework in this section. The long-run objectives of monetary policy are first considered. These long-run objectives involve both the targets and intermediate targets of policy over a given year. Next, several features pertaining to short-run monetary policy are discussed. It is argued that to interpret Federal Reserve behavior correctly, the short-run implementation of monetary policy must be examined. Different types of short-run policies are distinguished both by the type of operating procedure implemented by the Federal Reserve and by the desire to offset deviations from the targets.

A. Monetary Policy Objectives

The uncertainties facing the Federal Reserve make monetary policy a particularly challenging task, even apart from outside political pressures. The first choice facing policymakers is to decide whether policy should be based directly on a set of ultimate targets, such as output, employment, inflation, and foreign exchange rates, or on an intermediate target. Potential intermediate targets include monetary and credit aggregates, as well as other indicators from financial markets, including interest rates.

In the mid to late 1970s, the intermediate target procedure was progressively made more of a formal part of Federal Reserve policy. Coinciding with this adoption, the Federal Reserve initiated a series of annual targets for monetary and credit aggregates. This procedure was formalized further under the Humphrey-Hawkins Act in 1978, which imposed a single non-overlapping calendar year policy period on the Federal Reserve.

By the early 1980s, the intermediate target procedure was firmly entrenched. Nevertheless,

some ambiguities were apparent. One area of ambiguity involved the appropriate weights to be placed on the various intermediate targets, particularly M1 and M2, in formulating policy. A second area involved uncertainties about the proper definition of the narrowly defined money stock, M1. Despite problems in determining an appropriate definition for M1, and the related problem of erratic M1 velocity, M1 was the main focus of monetary policy. One reason for the use of M1 was its timeliness. Preliminary M1 data are available weekly with a lag of about 1-1/2 weeks, while data on broader monetary aggregates are available only monthly. Many of the components of the broader aggregates are, however, available weekly. A second was that M1 was the traditionally preferred monetary aggregate because of its intended link with transactions balances. Another reason was that the reserve requirements applied to non-M1 components of the broader aggregates are either zero or very low, implying a potentially loose relationship between reserves and the broader aggregates.

Because of the continuing erratic behavior of M1 velocity, the Federal Reserve virtually abandoned its intermediate target procedure by the mid-1980s. In the record of policy actions at the November 2, 1987 FOMC meeting, for example, the FOMC's domestic policy directive listed the behavior of the monetary aggregates last among four items that could cause the Federal Reserve to change current pressure on reserve positions. The first three items were the strength of the business expansion, inflationary pressures, and developments in foreign exchange markets. Thus, policymakers were looking directly at measures of economic performance. It also is noteworthy that the items in this list occasionally change order. Developments in foreign exchange markets, for example, had been listed first a few months earlier.

The above is clearly a casual interpretation of monetary policy objectives in the 1980s. It does, nevertheless, suggest several hypotheses about Federal Reserve behavior. These hypotheses are tested in the third section. However, to interpret Federal Reserve behavior more precisely, the short-run implementation of policy must be considered.

B. Short-Run Monetary Policy

The Federal Reserve's short-run monetary policy can be described in terms of two factors. The first concerns the rate at which the Federal Reserve attempts to offset any deviation from its target or

intermediate target. The second is the type of operating procedure adopted. This latter area involves the choice of an instrument, or operating target, to conduct monetary policy.

The view of monetary policy advanced here is that the Federal Reserve does not initiate short-run shocks to the monetary aggregates; it merely reacts to them. This view seems particularly appropriate prior to February 1984, when contemporaneous reserve requirements (CRR) were adopted. Under the lagged reserve requirement (LRR) system in effect from 1968 to that time, there was no direct link between bank reserves and M1 in a given week. As a consequence, the money stock was essentially demand determined, and monetary shocks reflected shifts in the public's demand for money.⁴

Given that observed monetary shocks represent new information to both the public and the Federal Reserve, the relevant issue for policymakers is to determine the desired adjustment toward the monetary target. Casual evidence suggests that this adjustment speed may have changed at least twice since the late 1970s. In particular, the Federal Reserve committed itself more closely to M1 targets in October 1979, implying that any deviation from the monetary targets would be offset more quickly than before. In October 1982, the Federal Reserve de-emphasized its monetary targets, implying slower adjustment speeds.

At the same time that the Federal Reserve changes adjustment speeds, it may also change its operating procedures. The choice of operating procedures, however, is logically independent of the desired rate of adjustment. That is, any of the three most prominent types of operating procedures -- the federal funds rate, nonborrowed reserves, and borrowed reserves procedures -- can potentially yield virtually the same rate of adjustment.⁵ Nevertheless, the adoption of a federal funds rate, or money market conditions, operating procedure is frequently interpreted as an abandonment of monetary targets. Similarly, the adoption of the nonborrowed reserves, or reserves aggregate, procedure in October 1979 is often viewed as being consistent with a greater desire to offset monetary shocks. As discussed in the next section, actual interest rate behavior can be used to infer both the type of operating procedure adopted by the Federal Reserve and the desired rate at which monetary shocks are offset.

II. Implications for Interest Rates

Market interest rate data are used to represent the actions of financial market participants. It is further assumed that market participants fully understand Federal Reserve behavior. As a consequence, the Federal Reserve's reaction function can be inferred under this rational expectations assumption. Moreover, changes in the estimated reaction function can be used to infer changes in monetary policy regimes.

Three aspects of interest rate behavior are considered here. These are the volatility of interest rates, the response of interest rates to weekly M1 announcements, and the response of interest rates to new information about inflation, economic activity, and exchange rates. Differences in the volatility of interest rates in different periods are used to infer changes in Federal Reserve operating procedures. Similarly, changes in the response of interest rates to M1 announcements also are used to infer changes in operating procedures as well as different degrees of emphasis on M1 targets. Finally, the response of interest rates to other economic information is used to infer the targets of monetary policy during a particular period.

A. Volatility of Interest Rates

The volatility of the federal funds rate depends on disturbances affecting the market for reserves, Federal Reserve intervention in the reserves market through open market operations, and the market's perception of the type of operating procedure being used. If the market believes that the Federal Reserve will offset shocks affecting the reserves market through open market operations, and the shocks are in fact offset fairly quickly, the federal funds rate will be relatively stable over a short period, such as a week. If disturbances in either the demand for or supply of reserves are not expected to be offset, however, the federal funds rate will move quickly to clear the reserves market. Different operating procedures imply different behavior for the federal funds rate through these channels.⁶

Under the federal funds rate procedure, the Federal Reserve offsets most shocks affecting the reserves market to keep the federal funds rate relatively stable over a given period, such as a week. Even under this procedure, however, the federal funds rate would be expected to exhibit some volatility

over time. In particular, to offset deviations in money growth from its target, the Federal Reserve may initiate discretionary changes in the rate. Nevertheless, in comparison to the other operating procedures discussed below, the federal funds rate should be relatively more stable under this procedure.

Under the nonborrowed reserves procedure, most disturbances affecting the reserves market, and therefore the federal funds rate, are not offset. Instead, the nonborrowed reserves path is maintained over a given period and the federal funds rate fluctuates in response to shocks either to the demand for or supply of reserves. As a result, the federal funds rate would be expected to be more volatile under this procedure.

The final procedure considered is the borrowed reserves procedure. Under this procedure, the Federal Reserve can be characterized as attempting to achieve a certain level of discount window borrowing over a given period. In this case, unanticipated changes in either required or excess reserves are accommodated by changing nonborrowed reserves. If the demand for required reserves is higher than expected, for example, the federal funds rate rises initially and borrowing increases to equate supply and demand in the reserves market. To offset the increase in borrowing, nonborrowed reserves are increased until the federal funds rate falls to its previous level. In contrast, if a shock originating in the demand for borrowed reserves occurs in which borrowing is higher than expected at every level of the federal funds rate, this disturbance is at most partially offset and the federal funds rate falls. The decline in the federal funds rate serves to reduce the demand for borrowed reserves. So, this source of disturbances in the reserves market causes fluctuations in the federal funds rate. In comparison with the other procedures, the borrowed reserves procedure implies more short-run volatility in the federal funds rate than the federal funds rate procedure and less volatility than the nonborrowed reserves procedure.⁷

The volatility of other interest rates, such as the 3-month Treasury bill yield, also depends on the type of operating procedure employed by the Federal Reserve, although to a lesser extent. The 3-month Treasury bill yield depends on both the current federal funds rate and the rate expected in future weeks. If the current week's federal funds rate fluctuates, then some of this volatility is reflected in the Treasury bill yield.

Treasury bill yields also fluctuate if financial market participants change their assessments about the federal funds rate in future weeks. Monetary targets are important in examining this link. If new information about either money or the economy suggests, for example, that the future level of the money stock will be higher than previously expected, the Treasury bill yield may rise if the market expects the Federal Reserve to offset this increase. In this instance, the market expects the Federal Reserve to attempt to achieve a particular monetary target, and the magnitude of the increase in interest rates reflects the desired speed of short-run adjustment back to the target level. Alternatively, if the Federal Reserve places little or no weight on a particular monetary target, the market will expect future levels of the federal funds rate to be as previously predicted. So, for a given monetary disturbance, the greater the Federal Reserve's commitment to achieve a particular monetary target, the greater the coinciding fluctuation in longer term yields.

B. Response to Money and Economic Announcements

The response of interest rates to money and economic announcements provides further evidence on the type of operating procedure adopted by the Federal Reserve, as well as the degree of emphasis placed on various targets and intermediate targets of policy. In particular, the response of the federal funds rate depends on the type of operating procedure. The response of longer-term yields depends somewhat on the operating procedure, but it depends more importantly on the intermediate target or target of policy. The responses to M1 announcements and other economic announcements are considered separately below.

First, consider the response to the federal funds rate to weekly M1 announcements. The response depends directly on the type of operating procedure employed by the Federal Reserve. In particular, the response depends on whether the corresponding shock to the market for reserves is offset. The reserves market is affected by unanticipated announced changes in M1 initially through the market's assessment of the demand for required reserves. Under the LRR system in effect before February 1984, required reserves depended on the level of the money stock two weeks previously, the statement week corresponding to the current week's money announcement data. Under the CRR system adopted in February 1984, required reserves depend on the current money stock, with a lag of

two days.⁸ As a consequence, the money announcement data under CRR do not coincide with the current reserves periods. Unanticipated announced changes in M1 may still affect the demand for reserves, however, if the unanticipated changes have persistent effects on future levels of the money stock. That is, the current week's demand for reserves would be affected if a positive money announcement surprise causes market participants to raise their assessments of the current week's money stock.

Under the federal funds rate procedure, the federal funds rate should not respond to money announcement surprises. In this case, market participants expect the Federal Reserve to accommodate the implied shock in the reserves market. In contrast, the federal funds rate should increase in response to a positive money announcement surprise under the nonborrowed reserves procedure. This rise is due to a higher assessment of the demand for reserves that is not expected to be accommodated through Federal Reserve open market operations. Similar to the federal funds rate procedure, the federal funds rate should not respond to money announcement surprises under the borrowed reserves procedure. This behavior follows because the Federal Reserve accommodates shocks to the demand for reserves under this operating procedure.

The response of Treasury bill yields and other longer term yields to money announcement surprises depends partly on the response of the federal funds rate. Most of the response, however, depends on the extent to which the market expects the Federal Reserve to offset the shock in the future. In particular, the response is greater the more quickly the Federal Reserve acts to offset the money surprise. So, the response to the Treasury bill yield to money announcement surprises can be used to determine whether the Federal Reserve is perceived to be attempting to achieve its M1 target.⁹

The response of Treasury bill yields to unanticipated announced changes in economic activity and inflation may operate through the same channels as money announcements if these other economic announcements provide information useful in predicting money demand. In particular, if either real economic activity or inflation is higher than expected, the market may raise its assessment of the current and future week's demand for money. Interest rates, then, would be expected to rise in response to this new information about the domestic economy if the market does not expect the

Federal Reserve to accommodate the increased demand. A similar direct link between exchange rate movements and the demand for money is not evident.

The primary effect of new information about economic activity, inflation, and foreign exchange rates on interest rates is likely due to the direct value of this information. That is, if policymakers are placing more weight on their targets, and less weight on their intermediate monetary targets, new information about the economy and exchange rates may cause immediate interest rate movements. If inflation is announced to be higher than expected, for example, policymakers may adopt more restrictive policies, causing interest rates to rise immediately. The effect could be the same for an unexpectedly large increase in economic activity, especially during the later stages of an economic expansion when concern about future inflation is growing. Moreover, if the Federal Reserve is focusing directly on the value of the dollar in currency markets, new information about exchange rates may lead to immediate interest rate movements. Depending on the Federal Reserve's emphasis on this type of direct information about its ultimate targets, the response of interest rates may have varied over different periods.

III. Empirical Results

The various aspects of interest rate behavior discussed in the previous section are used below to test hypotheses about the behavior to the Federal Reserve in conducting monetary policy. Three separate periods are examined since 1980. The first actually begins in October 1979, when the Federal Reserve announced a new operating procedure along with an increased emphasis on the monetary aggregates. This new procedure corresponds to the nonborrowed reserves procedure discussed in the previous section. The second period begins in October 1982, when the Federal Reserve announced the abandoned the nonborrowed reserves procedure in favor of the borrowed reserves operating procedure. At that time, somewhat less emphasis also may have been placed on the monetary aggregates -- specifically M1 -- as intermediate targets. The third period begins in February 1984, coinciding with the implementation of CRR. Because of the uncertainties regarding the effects of CRR among other factors, the Federal Reserve may have de-emphasized the role of the monetary aggregates further in

this period.¹⁰ Another period, beginning in October 1977 and ending in October 1979, also is examined to compare the monetary policy regimes in the 1980s with monetary policy in the late 1970s. Prior to October 1979, the federal funds rate procedure was in effect.

A. Volatility of Interest Rates

The volatility of the federal funds rate and the 3-month Treasury bill yield is examined over four periods in Table 1. As is apparent in the table, the weekly volatility of the federal funds rate

TABLE 1

is consistent with the changes in operating procedures hypothesized previously. In particular, in comparison to the pre-October 1979 period, the standard deviation of weekly percentage changes in the federal funds rate was about four times as large in the October 1979 - October 1982 period. This behavior is consistent with a switch to the nonborrowed reserves procedure from the federal funds rate procedure. The volatility then declined to about half that of the October 1979 - October 1982 period in both of the periods after October 1982. Despite this decline, the volatility since October 1982 is significantly larger than that experienced prior to October 1979, suggesting that the Federal Reserve did not return to the federal funds rate procedure.¹¹ Instead, the evidence is consistent with the adoption of the borrowed reserves procedure.

Similar to the volatility of the federal funds rate, the volatility of the 3-month Treasury bill yield also increased significantly following October 1979. In contrast to the federal funds rate, however, volatility after October 1982 returned to pre-October 1979 levels. While some portion of the volatility of the Treasury bill yield should reflect the volatility of the federal funds rate, a larger part can be attributed to changes in the market's expectation about future monetary policy. As a result, the increased volatility of the Treasury bill yield in the October 1979 - October 1982 period is consistent with a greater commitment of the Federal Reserve to offset a given shock affecting the money stock, while the decline in volatility after October 1982 suggests the opposite. Other evidence, however,

allows more direct inference about this possible shift.

B. Response to Money and Economic Announcements

To provide further evidence on changes in monetary policy operating procedures, hypotheses discussed in the previous section about the response of the federal funds rate to money announcement surprises are first tested. Then, to determine the market's assessment of the Federal Reserve's targets and intermediate targets, the response of the 3-month Treasury bill yields to money and other economic announcements is examined empirically.

The usual efficient markets model is used to estimate the responses of both the federal funds rate and the 3-month Treasury bill yield. This model relates daily changes in interest rates to unanticipated announced changes in money and other economic variables. With the exception of the exchange rate variable, unanticipated changes are measured as the difference between announced and expected values. The expected values are taken from a survey conducted by Money Market Services, Inc. The survey data are further adjusted, however, to take into account information from the time of the survey to the time of the announcement.¹² If the Federal Reserve -- and therefore the market -- views new information about a particular variable as being relevant for policy, the estimated response of interest rates should be significant.

The estimated response of the federal funds rate to the unanticipated component of weekly M1 announcements is reported in Table 2. The only statistically significant response occurs in the January

TABLE 2

1980 - October 1982 period, consistent with the nonborrowed reserves procedure.¹³ In the two post-October 1982 periods, the response is insignificantly different from zero, consistent with either the federal funds rate or borrowed reserves procedures. Although estimates are not reported here, previous studies find that the response also is insignificantly different from zero prior to October 1979 [e.g., Roley and Walsh (1985)]. Combined with the evidence from Table 1, the results support the hypothesis that the Federal Reserve operated under a federal funds rate procedure prior to October 1979, and then implemented the nonborrowed reserves procedure during the October 1979 - October

1982 period. After October 1982, the combined evidence from Tables 1 and 2 suggests that the Federal Reserve adopted the borrowed reserves procedure.

To determine the relative importance of various targets and intermediate targets of monetary policy, the response of the 3-month Treasury bill yield to a set of economic variables is estimated in Table 3. In addition to weekly M1 announcements, the unanticipated components of monthly announcements of the producer price index, consumer price index, industrial production, and the unemployment rate are considered. Daily changes in the yen/dollar exchange rate also are included to estimate the significance of foreign exchange rate factors. Yen/dollar rate changes are measured as the difference in closing and opening quotes in the Tokyo market each day. Thus, such movements in the Tokyo market can be regarded as news to traders in New York, since these movements are recorded when the New York market is closed.

TABLE 3

The results in Table 3 indicate that the role of M1 targets successively diminished over the three periods since 1980, and the differences across periods are significant at the 5 percent level. Moreover, since February 1984, the response of the 3-month Treasury bill yield to weekly M1 announcements is insignificantly different from zero.¹⁴ While the role of M1 has decreased, the results suggest that the effect of direct information about the domestic economy has increased over time. As indicated by the reported F-statistics, the hypothesis that new information about inflation, unemployment, and output does not affect interest rates can be rejected at the 5 percent level in the February 1984 - September 1986 period. The most significant variable during this latter period is industrial production, suggesting that the Federal Reserve was looking directly at the performance of the economy in conducting policy. Finally, yen/dollar exchange rate movements are not estimated to have had significant effects overall, though intermittent effects cannot be ruled out.¹⁵

IV. Conclusions

This paper exploited the financial market's understanding of Federal Reserve behavior in considering changes in monetary policy. In particular, both interest rate volatility and the financial market's perception of the Federal Reserve's reaction function were used to examine several monetary policy regimes over the last decade. One regime began in October 1979, when the Federal Reserve adopted a nonborrowed reserves operating procedure and placed greater emphasis on M1. Prior to October 1979, the federal funds rate operating procedure was in effect. In October 1982, monetary policy shifted to a borrowed reserves operating procedure and a diminished role for M1. Finally, in February 1984, still less weight was placed on M1 as an intermediate target of policy, with more weight placed directly on the performance of the domestic economy. These different periods correspond to Federal Reserve statements about changes in policy, and, as a whole, the evidence suggests that actual changes were made. To that extent, the evidence suggests that policy was credible.

To analyze the motives surrounding the Federal Reserve's formulation and implementation of monetary policy, it seems particularly worthwhile to study these specific episodes on a case study basis. Such a study may reveal the relative importance placed on political and economic factors influencing Federal Reserve behavior. In brief, it appears that both factors are important. The change in policy in October 1979, for example, was driven by the desire to increase interest rates to defend the dollar in foreign exchange markets and to reduce inflation in the U.S. A slowdown in the growth of the monetary aggregates also was desired to reduce inflation in the future. Under the federal funds rate procedure in effect prior to October 1979, the Federal Reserve would be blamed for a sharp rise in interest rates. To deflect such criticism, policymakers adopted a procedure in which "the market determines rates," the nonborrowed reserves procedure. At the same time, there was some hope that this procedure would allow closer control of M1 and hence reduce the prospects of continued high inflation.

Similar economic and political choices were made in 1982. In particular, by October 1982, the behavior of both M1 and the economy was seemingly becoming more unpredictable, and the Federal Reserve's independence was being threatened by the Congress. Policymakers decided to weaken the

link between M1 and interest rates, thereby reducing interest rate volatility. Nevertheless, the advantage of some interest rate volatility due to market factors was the lack of blame attached to the Federal Reserve for a particular level of interest rates. As a consequence, the borrowed reserves procedure was adopted, in which the federal funds rate fluctuated in response to errors in the borrowings function. In this sense, the Federal Reserve could continue to claim that it was not targeting a particular level of interest rates. A macroeconomic justification for the borrowed reserves procedure is not, however, readily apparent, as the added volatility of interest rates created by random shifts in discount window borrowing creates no clear benefit.¹⁶

The third regime in the 1980s appears to have been due primarily to an economic decision based on the uncertainties of the economic environment. In particular, the implementation of CRR in February 1984 had the potential of affecting the behavior of an already unpredictable money stock as well as altering the previous relationships between reserves and money. This change was a delayed product of the nonborrowed reserves regime, as closer monetary control was more likely under CRR than LRR. Because of the added uncertainties surrounding CRR and the continuing erratic behavior of M1 velocity, policymakers de-emphasized their monetary targets further, and the borrowed reserves procedure was maintained.

In sum, the behavior of the Federal Reserve in conducting monetary policy is best described by considering the Federal Reserve's operating procedures, targets, and desire to achieve its targets. Changes in these factors led to at least three different policy regimes in the 1980s.¹⁷ In these regimes the importance to the Federal Reserve of tight monetary control increased initially and subsequently became negligible. The lasting inheritance of the regime shift that began in October 1979 is the Federal Reserve's substantially greater willingness to tolerate interest-rate volatility. Regardless of the specific details of the operating procedures adopted, there apparently has been no reversion to the federal funds rate procedure employed in the late 1970s.

FOOTNOTES

- * We are grateful to Thomas Mayer for helpful comments, to Steven R. Thorley for research assistance, and to the National Science Foundation (Grant No. SES-8408603) for research support.
1. The terminology used here for targets, intermediate targets, and instruments of policy follows B. Friedman (1975).
 2. Mayer (1987) and Goodfriend (1986) discuss issues relating to the disclosure of the FOMC's policy directive in detail.
 3. One example, among many possible illustrations, would be the avoidance of confusion between use of an interest rate instrument to achieve a particular policy target and interest rate targeting, where the level of an interest rate itself is the policy objective.
 4. For further discussion on this issue, see LeRoy (1979), Hetzel (1982), and Roley (1987).
 5. The nonborrowed reserves procedure is potentially slightly faster because of federal funds rate movements in the current week. This property is discussed further in the next section. Also see Roley (1987).
 6. For a more detailed discussion of these operating procedures, see Roley (1987).
 7. A variant of the federal funds rate procedure, which apparently was introduced following the sharp decline of the stock market on October 19, 1987, is intermediate between the federal funds rate procedure described above and the borrowed reserves procedure. In contrast to the earlier funds rate procedure, in which the Federal Reserve entered the reserves market almost daily to add or drain reserves in order to keep the funds rate close to target, open market operations under the variant procedure are relatively sparse and generally limited to adding or draining reserves, but not both, during a reserves maintenance period. In this regard, the variant resembles the borrowed reserves procedure. The main difference is that there is no explicit target for borrowed reserves, so that shocks to banks' demand for borrowed reserves do not (in principle) affect the funds rate. Some market participants have described the variant

procedure as a "fuzzy" funds rate target, since the allowable deviation of the actual rate from the target is larger than under the earlier funds rate procedure. The Federal Reserve has announced its intention to revert to the borrowed reserves procedure at some point in the future.

8. Also, reserve computation and maintenance periods are two weeks in length, while they lasted one week under LRR. The response under 2-week CRR is examined in detail by Roley (1987).
9. Considerable evidence suggests that the response of Treasury bill yields to M1 announcements is a response in the real rate, not expected inflation. One type of evidence is from the response of foreign exchange rates to M1 announcement surprises. In particular, the dollar appreciates in response to positive money announcement surprises. See, for example, Cornell (1982), Engle and Frankel (1984), and Hardouvelis (1984).
10. The introduction of CRR introduced at least two uncertainties. First, the previous relationship describing the demand for reserves changed, leading to uncertainties about the effects of various shocks on the federal funds rate. Second, the stochastic behavior of the money stock itself was potentially affected, as it was no longer entirely demand determined in a given week.
11. The test of the hypothesis that the two post-October 1982 periods have the same volatility as the pre-October 1979 period yields F-statistics of 3.88 (64, 100) and 5.29 (154, 100), which are significant at the 5 percent level.
12. The change in the Treasury bill yield over the previous five business days is used as a proxy for this information. See Roley (1983).
13. The results are qualitatively the same when the estimation period starts in October 1979 instead of January 1980. See Roley and Walsh (1985). To conform with the results in Table 3, the January 1980 starting period was used. This date was chosen because of the availability of data for the exchange rate variable used in Table 3.
14. In a specification analogous to that used in Table 2, the response of the Treasury bill yield to money announcement surprises also was examined over additional subperiods. In particular, starting with September 29, 1977, the response was estimated for overlapping 26 week periods,

beginning every 13 weeks. The first two estimation periods, for example, were September 29, 1977 - March 23, 1978 and December 29, 1977 - June 22, 1978, respectively. The results from these regressions generally support the beginning and ending dates of the subsamples used in the tables. In particular, all responses after the June 1982 - December 1982 period were estimated to be smaller than those of this period. Moreover, the responses in both the June 1983 - December 1983 and September 1983 - March 1984 periods were statistically significant at the 5 percent level, but the estimated responses starting with the December 1983 - June 1984 period were not significant. This result is consistent with a change in the response around the beginning of 1984.

15. Positive and negative movements also were considered separately, but the statistical significance of the results did not change.
16. The borrowed reserves procedure was implemented under LRR. Under CRR, however, this procedure may be capable of offsetting shocks from money and factors supplying reserves. See, for example, Roth and Seibert (1983).
17. And, as noted in footnote 7, a fourth regime may have begun following the October 19, 1987 stock-market crash.

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TABLE 2

Response of the Federal Funds Rate to M1 Announcements

Estimation Period	Coefficient Estimates			Summary Statistics			F(m,n)
	Constant	UM1	EM1	\bar{R}^2	SE	DW	
Jan. 1980- Oct. 1982	0.0277 (0.0515)	0.0994* (0.0228)	-0.0121 (0.0291)	0.11	0.59	2.70	--
Oct. 1982- Feb. 1984	0.0413 (0.0272)	0.0137 (0.0128)	0.0016 (0.0122)	-0.01	0.20	1.76	10.71* (1,203)
Feb. 1984- Feb. 1987	-0.0872* (0.0191)	0.0103 (0.0103)	-0.0089 (0.0055)	0.01	0.22	1.97	0.04 (1,219)

Notes: The precise estimation period dates are: January 1, 1980 - October 5, 1982; October 6, 1982 - February 1, 1984; and February 2, 1984 - February 28, 1987. Observations in the last week of each year are deleted to avoid the influence of excessive year end interest rate movements. Numbers in parentheses are standard errors of estimated coefficients. Equations are estimated in the form:

$$\Delta RFF_t = b_0 + b_1 UM1_t + b_2 EM1_t + e_t$$

where b_0 , b_1 , and b_2 are estimated coefficients and e_t is a random error term.

* Significant at the 5 percent level.

ΔRFF_t = change in the federal funds rate from the day of the money announcement to the next business day.

UM1 = money announcement surprise, defined as $M1 - EM1$, where M1 is the announced change in the narrowly defined money stock, in billions of dollars.

EM1 = expected announced change in the narrowly defined money stock, based on the survey measure provided by Money Market Services, Inc.

\bar{R}^2 = multiple correlation coefficient corrected for degrees of freedom.

SE = standard error.

DW = Durbin-Watson statistic.

F(m,n) = F-statistic with (m,n) degrees of freedom for the hypothesis that the response coefficient, b_1 , is the same as that estimated in the previous period. In this test, the estimated equations are weighted by their standard errors.

TABLE 1

Volatility of Interest Rates

Interest Rate	Standard Deviations of Weekly Percentage Changes			
	Oct. 1977- Oct. 1979	Oct. 1979- Oct. 1982	Oct. 1982- Feb. 1984	Feb. 1984- Feb. 1987
Federal Funds rate	0.019	0.077	0.037	0.043
F(m,n)	--	16.89*	4.36*	1.37*
p-value		(150, 99)	(150, 64)	(154, 64)
		0.00	0.1×10^{-12}	0.05
3-month Treasury bill yield	0.027	0.058	0.026	0.021
F(m,n)	--	4.62*	5.08*	1.53*
p-value		(150, 99)	(150, 64)	(64, 154)
		0.2×10^{-13}	0.9×10^{-15}	0.01

Notes: The interest rate quote on the day following each week's money announcement is used to form weekly percentage changes. The number in the first row and first column, for example, denotes a standard deviation of weekly percentage changes of 1.9 percent. The last weekly observation of each year is deleted to avoid the influence of excessive year end interest rate movements.

* Significant at the 5 percent level.

F(m,n) = F-statistic with (m,n) degrees of freedom for the hypothesis that the variance is the same as that in the previous period.

TABLE 3

Response of the 3-month Treasury Bill Yield to New Economic Information

Estimation Period	Unanticipated Change in:					Summary Statistics				Tests		
	Constant	PPI	CPI	IP	UNEM	MI	YEN	R ²	SE	DW	F ₁ (m,n)	F ₂ (m,n)
Jan. 1980-	-0.0079	0.0290	-0.2048	0.0305	-0.1964	0.0842*	0.0029	0.07	0.28	1.70	--	0.48
Oct. 1982	(0.0107)	(0.1620)	(0.1929)	(0.1084)	(0.2438)	(0.0109)	(0.0112)					(4,694)
Oct. 1982-	0.0033	-0.0921	-0.2048	0.0558	-0.1758	0.0346*	0.0100	0.11	0.09	1.55	16.59*	1.34
Feb. 1984	(0.0047)	(0.0763)	(0.1651)	(0.0751)	(0.1358)	(0.0055)	(0.0067)				(1,1024)	(4,330)
Feb. 1984-	-0.0058*	-0.0075	-0.0056	0.1820*	-0.0800	0.0019	-0.0069	0.02	0.08	1.89	21.95*	4.85*
Sept. 1986	(0.0029)	(0.0443)	(0.1066)	(0.0431)	(0.0689)	(0.0043)	(0.0051)				(1,992)	(4,662)

Notes: See the notes in Table 2. The last period ends on September 29, 1986, due to the availability of yen/dollar exchange rate data. Equations are estimated in the form:

$$\Delta RTB_t = b_0 + b_1 UPPI_t + b_2 UCPI_t + b_3 UIP_t + b_4 UNEM_t + b_5 UMI_t + b_6 YEN_t + e_t$$

where the U's indicate that only the unanticipated components of the data are included. Unanticipated values of the first five variables are calculated using survey data provided by Money Market Services, Inc.

RTB_t = change in 3-month Treasury bill yield from 3:30 p.m. to 3:30 p.m. on successive business days.

PPI = percentage change in the producer price index.

CPI = percentage change in the consumer price index.

IP = percentage change in the industrial production index.

UNEM = percentage of labor force unemployment.

YEN = change in the yen/dollar exchange rate from open to close in the Tokyo market on day t.

F₁(m,n) = F-statistic with (m,n) degrees of freedom for the hypothesis that the response coefficient, b₅, is the same as that estimated in the previous period. The relevant estimated equations are weighted by their standard errors.

F₂(m,n) = F-statistic with (m,n) degrees of freedom for the hypothesis that b₁ = b₂ = b₃ = b₄ = 0.