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FEDERAL RESERVE CREDIBILITY AND THE MARKET'S RESPONSE TO THE WEEKLY M1 ANNOUNCEMENTS

by

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Abstract

This paper provides new evidence on the issue of Federal Reserve System credibility by examining the response pattern of asset prices to the weekly M1 announcements under different operating procedures and monetary policy regimes in the September 1977 to December 1984 period. It is found that the response of asset prices to money surprises represented revisions of inflationary expectations in the pre-October 6, 1979, period and that the Federal Reserve was not credible. On the contrary, the response of asset prices to money surprises represented revisions of real interest rates in the post-October 6, 1979, period and the Federal Reserve was credible. Furthermore, the evidence shows that the October 1982 return to an interest-rate-smoothing procedure did not result in any loss of the System's credibility, suggesting that credibility, once attained, does not depend on the short-run operating procedure.

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This paper provides evidence on the issue of the Federal Reserve System's credibility by examining the market's reaction to the weekly M1 announcements under alternative monetary policy regimes and different operating procedures. Federal Reserve crediblity is defined in this study as the market's perception of the System's commitment to its goal of price stability. The degree of credibility depends on the past behavior of policymakers and on the institutions of policy.

The Federal Reserve formulates and executes monetary policy through the use of annual targets for the monetary aggregates. The market's perception of Federal Reserve credibility depends on the System's rate of success in hitting past targets. This would not necessarily be true if there were large shifts in money demand and if the "target misses" offset shifts in money demand. The test, of course, is whether or not the inflation goals were achieved.

The institutions of policy include the short-run operating procedure, the instruments and the feedback rules used to achieve monetary targets. The institutions of policy determine the degree of flexibility policymakers have to deviate from announced plans. Institutions that provide flexibility allow the Federal Reserve to address goals other than price stability.

Credibility becomes an issue when the Federal Reserve deviates from its announced inflation goal in the pursuit of other goals. The lack of credibility becomes especially important when the System embarks on a policy of disinflation. If announcements of lower money growth and lower future inflation are widely believed, then there are good reasons to think that the real costs of a disinflation policy will be lower.

Cukierman and Meltzer (1982) argue that "...credibility may be low either because of systematic differences between announced and actual policy or because of poor implementation of the policy." Meltzer (1978) argues that the lack of efficient operating procedures for controlling the money stock has contributed to low credibility of Federal Reserve policy announcements. He suggests that better procedures for controlling money would improve the System's credibility.

This study examines the Federal Reserve's credibility as revealed in market reaction to the M1 announcement. Our sample period, September 1977 to December 1984, includes significant changes in monetary policy regimes and operating procedures. We compare and analyze the pattern of response of short- and long-term interest rates and of spot and forward exchange rates to the money announcements before and after each of the changes in operating procedures.

Hardouvelis (1984) examined the response of asset prices to the M1 announcement for the September 1977 to June 1982 period. He concluded that the Federal Reserve did gain credibility in the post-October 6, 1979, period, but that it fell short of establishing full credibility. We provide new evidence on the issue of credibility during the earlier period of federal funds targeting and extend the evidence to include the experience with the most recent change in the operating procedure, the switch to the borrowed reserve targeting.

We present significant evidence that weekly surprises in M1 led to revisions of inflation expectations during the pre-1979 period, indicating that policy was not credible. As far as we know, this is the only significant evidence, outside of episodes of hyperinflation, to show that inflation expectations were revised in response to new information about monetary growth.

Evidence is presented to show that the October 6, 1979, change in operating procedures was accompanied by a fundamental change in the market's perception of the System's commitment to ending inflation. We show that the response of short- and long-term asset prices to M1 surprises represent revisions of real interest rates during this period and that the Federal Reserve was credible. Furthermore, it is shown that the Federal Reserve's decision to return to an interest-rate-smoothing procedure in October 1982 did not lead to a loss of credibility, at least not through the end of 1984.

I. Policy Regimes, Operating Procedures, and the M1 Announcements

Extensive research on money stock announcements over the last five years has led to a predominance of two hypotheses to explain the market's response to M1 announcements. The first hypothesis asserts that a surprise in the money stock announcement contains information about future money supply growth. Cornell (1983a) calls it the expected inflation hypothesis, in which a money stock surprise is expected to be incorporated in future levels of the money stock. The expected inflation hypothesis can be stated as the hypothesis that policy is not credible. As a result, an unexpected increase in the money stock leads to an increased inflation premium in market interest rates (the Fisher effect) and to a depreciation of the dollar against major foreign currencies.[1]

The second hypothesis asserts that money stock surprises contain information about money demand shocks. This is called the policy anticipation hypothesis. This hypothesis, developed by Urich and Wachtel (1981), Urich (1982), Roley and Walsh (1983), Nichols, Small and Webster (1983), and Engel and Frankel (1984), is based on the assumptions that prices adjust sluggishly and that the Federal Reserve uses a partial adjustment procedure to achieve its monetary targets. An increase in money demand thus creates a liquidity

shortage that dissipates gradually over time. During the transition period, real interest rates must rise to clear the money market. The policy anticipations hypothesis assumes that policy is credible. The public expects deviations of the money stock from the preannounced targets to be completely offset, but only after an extended period of time.'

Cornell (1983b), Hardouvelis (1984), and Loeys (1984) combine these two hypotheses. The combination hypothesis states that short-term policy is credible (the market believes the System is committed to the annual target), but long-term policy is not (the market is not convinced that the System will continue to choose targets over the long run that guarantee price stability). These studies argue that the liquidity effect dominates in the short run and that the inflation premium effect dominates in the long run. Following a positive surprise in the money stock, short-term nominal interest rates rise because the market expects the Federal Reserve to partially offset the deviations above the money supply target. However, because the System is not expected to offset the money stock surprise completely, inflationary expectations and long-term interest rates rise.

The pattern of response of interest rates to money stock announcements is, in principle, consistent with all these hypotheses. The inability to distinguish between alternative hypotheses based on the response of the interest rates alone has led researchers to examine the response of other asset prices as a source of additional information. Cornell (1983b), Engel and Frankel (1984), and Hardouvelis (1984) show that one can distinguish whether the response of market interest rates to a surprise in the weekly announcement of M1 is due to a change in the real interest rate, or to a change in the inflation premium, by observing the simultaneous response of the foreign exchange value of the dollar.

If an increase in the market interest rate is accompanied by a depreciation of the dollar, the increase in market interest rates is due to an increase in the inflation premium. If an increase in the market interest rate is accompanied by an appreciation of the dollar, the increase in market interest rates is due to an increase in the real interest rate.[3]

If real interest rates rise on the announcement of an unexpected increase in the money stock, we conclude that policy is credible. If only nominal rates rise, then we conclude that current policy is viewed as inflationary; that is, policy is not credible.

In this paper, we distinguish between monetary policy regimes and operating procedures. A policy regime change is defined as a change in the objective function of the policy authority. If the objective function is a weighted average of different goals, then the policy change may be a shift in the relative weights for the different goals.

A change in the operating procedure is defined as a change in the technique employed by monetary authorities to achieve the annual targets. Many different operating procedures could be used to achieve the same objectives; also, one operating procedure could be used to achieve very different objectives. Changes in operating procedures may lead to changes in the response of short-term asset prices to money stock surprises.[4] However, there is not likely to be a significant change in the response of long-term asset prices to a surprise change in the money stock, unless there is a perceived change in the objective function of the Federal Reserve System.

Our findings show that the response of short-term asset prices supports the expected inflation hypothesis in the pre-October 6, 1979, period of federal funds targeting, but that it is more consistent with the policy anticipation hypothesis in the post-October 6, 1979, period. We conclude that the October 6, 1979, change in procedures was also a fundamental change in the

System's policy toward inflation. The stronger evidence to support these results comes from the foreign exchange market. Following a positive money stock surprise, the spot and forward values of the dollar against the German mark depreciated in the pre-October 6, 1979, period and they appreciated in the post-October 6, 1979 period. Based on this evidence, we argue that the October 6, 1979, announcement was not only a change in the operating procedure, but also a fundamental change in policy.

The nonborrowed reserve procedure was officially abandoned in October 1982. Since that time, the Federal Reserve has used a borrowed reserve targeting procedure. The borrowed reserve procedure may be described as an interest-rate smoothing procedure.[5] However, the return to an interest-rate smoothing procedure does not necessarily mean that the System has returned to an inflationary policy regime. The response of asset prices following an unexpected increase in M1 in the most recent period indicates that the Federal Reserve was able to return to an interest-smoothing operating procedure in October 1982 without any apparent loss of credibility.

Furthermore, we offer an explanation in the next section for two puzzles in the literature related to the response of long-term interest rates to money stock announcements. The first puzzle, raised by Cornell (1983a,b) and Hardouvelis (1984), is why, if the pre-October 1979 period were one of inflationary monetary policy, longer-term forward interest rates did not respond to money stock surprises in the pre-October 1979 period.

The second puzzle is why the response by long-term interest rates was so strong after October 6, 1979. Roley and Walsh (1983) argue that the reaction of long-term interest rates to money stock surprises represents changes in the real interest rate. A positive money surprise generates anticipation of future tightening of money growth which, assuming slow price adjustments, raises short-term real interest rates via the liquidity effect and long-term real rates via the expectations theory of the term structure.

The problem with this explanation is that it cannot explain the strong reaction of long-term forward interest rates unless we assume that the liquidity effect lasts for several years. On the other hand, Cornell (1983a), Hardouvelis (1984), and Loeys (1984) argue in favor of the expected inflation hypothesis. The major evidence in support of this hypothesis has been Hardouvelis' finding that the expected future value of the dollar against major foreign currencies five years ahead depreciates following a positive money stock surprise. Hardouvelis constructed the expected future spot exchange rates by assuming that the open interest-rate parity condition holds between the rates of return on various Euromarket securities and on the rate of return on Eurodollar securities maturing in five years.

There are two general criticisms of these findings. First, open interest-rate parity is an arbitrage condition and does not depend on whether changes in nominal interest rates are due to changes in the expected real rate differential or to changes in the expected inflation differential. If the response of the five-year Eurodollar rate reflects a change in the real interest rate, then the depreciation of the dollar obtained by Hardouvelis represents an expected real depreciation of the dollar needed to equalize the rates of return across securities denominated in different currencies. This result cannot be used to distinguish between the expected inflation hypothesis and the policy anticipation hypothesis.[6]

Second, the argument that the significant response to long forward rates in the post-October 1979 period reflects revisions of the inflationary premium is not satisfactory. The period before October 1979 was more inflationary, yet the strong reaction of long-term interest rates is obtained in the post-October 1979 period. If Hardouvelis' hypothesis is correct, this finding implies that the market was more concerned about the Federal Reserve pursuing inflationary policies in the post-October 1979 period than in the pre-October 1979 period.

II. Empirical Results

The empirical results are organized in three sections corresponding to the Federal Reserve's different operating procedures. Before describing the results, we briefly review the data and the empirical model used in this analysis.

The Data. M1 is the figure first published by the Federal Reserve in the H.6 press release. The expected change in M1 is calculated using the median of a survey taken by Money Market Services.' The expected changes (MMSP) are in billions of dollars. The expected change in M1 is calculated as:

$$EM_t = \log (M1_{t-1} + MMSP_t) - \log (M1_{t-1}),$$

where t refers to the week of the announcement rather than the statement week for which M1 was calculated. The unexpected change in M1 is calculated as:

$$UM_t = \log (M1_t) - \log (M1_{t-1} + MMSP_t).$$

We have used first-published numbers rather than revised numbers in making these calculations. This amounts to treating the revision as an unexpected change.[8]

We used the M1 series that was published in the H.6 release. When the definition of M1 changed, our measure changed. Overlapping data were used to splice the series in early 1980, when the Federal Reserve changed the definition of M1 to include other checkable deposits.

The interest rates and exchange rates come from the data banks of Data Resources Inc. The original source for the interest rates is the H.15 release. The domestic interest rates included in this study are the coupon-equivalent yield on three- and twelve-month Treasury bills; and the constant maturity yield on three-year, seven-year, and thirty-year Treasury bonds. We have also calculated implied forward rates using the formula in Shiller, Campbell, and Schoenholtz (1983).

The original source for the exchange rates is the Bank of America. We examine the reactions of the dollar/mark spot rate, the three-month dollarlmark forward rate, and the twelve-month dollar/mark forward rate to money stock announcements. The exchange rates are expressed as bids reflecting opening prices in the New York markets. Rates are quotes in U.S. terms (dollars per deutschemark). The change is measured as the first difference of the logarithm.

Since the H.6 release (Money Announcement) was made on various days throughout the sample period, we collected daily data. A "before-announcement" rate was taken as the last available value before the announcement. The "after-announcement" rate was taken as the first available value after the announcement. There are always at least 24-hours between the "before" and "after" quote. This leaves time for other factors to affect the asset price. The major effect of this procedure is to reduce the R^2 in the estimate of equation (1) (below). However, there is no reason for the parameters of equation (1) to be biased unless these other factors are correlated with the surprise in the money stock announcement.

The Model. The announcement studies are based on the efficient market hypothesis that states that the current asset price will reflect all publicly available information. Changes in prices should reflect only new information. The empirical model used in studies of money stock announcements takes the following form:

$$(1) \quad \Delta A_{it} = a_0 + a_1 UM_t + a_2 EM_t + e_t,$$

where

ΔA_{it} = change in the i^{th} asset price from before the announcement to after the announcement.
UM_t = surprise in the money stock announcement at time t,
EM_t = expected change in the money stock at time t, and
e = random error.

Under the efficient market hypothesis, if expectations are rational, then a_0 and a_2 will be zero, and the error term will be random. If the money

stock is an important factor in determining the i^{th} asset price, a_i will be significant. In other words, under the efficient market hypothesis, only the unanticipated component of the M1 announcement should influence ΔA_{it} because the price before the announcement should already reflect all relevant publicly available information.

The full sample period starts on September 28, 1977, and ends on December 20, 1984. The model was estimated separately for three different subperiods: the federal funds rate operating procedure from the beginning of the sample period until October 6, 1979, the nonborrowed reserve operating procedure period from October 6, 1979, until October 5, 1982, and the borrowed reserve operating procedure period from October 12, 1982, to December 31, 1984.

Revised Expectations for M1. Preliminary estimates of equation (1) for different interest rates yielded coefficients for the survey expectation measure, a_2, that were statistically different from zero. Rather than conclude that the markets were inefficient in processing this information, we followed the Roley (1983) methodology, with a modification suggested by Hein (1985), to improve the survey forecast by accounting for the new information released between the time the survey is taken and the time of the money stock announcement.

The survey used in this study was conducted on Tuesdays. A revised expectation measure is constructed that reflects the availability of new information from Tuesday to Thursday or Friday. The revised expectation measure is defined as the fitted value of the regression of the change in M1 on a constant, on the expected change in M1, and the change in two interest rates: the three-month Treasury bill and the thirty-year Treasury bond. The change in interest rates is measured from the end of the day the survey median is published to the market close on the day of the announcement using the H.15 as the source for our interest rates). We presume that changes in these two

interest rates capture most of the relevant new information between the day of the survey and the money stock announcement.

Following Hein (1985), the coefficient on expected M1 is constrained to unity. The residuals from the regression represent the surprises in the money stock. This equation was estimated separately for each subperiod and the results are reported in table 1. On average, the change in the three-month bill yield and the thirty-year bond yield add new information to the survey measure, but the low R^2 signifies that their contribution is rather small. It appears that only the change in the long-term yield provided new information during the September 29, 1977 to October 5, 1979, period.

Colinearity between the long and short rates results in low t-statistics for the two periods after October 1979. We decided to include both rates because doing so led to smaller prediction errors even though the t-statistics are low. When included separately, each of the interest rates was found to be statistically significant.

The empirical results presented in this section are based on estimates of the parameters of equation (1). The revised expectation measu're is used to construct the expected changes in the money stock.[9] The money stock announcement was made at 4:15 or 4:30 p.m. E.S.T. Estimates of a_1 and a_2 are reported tables 2 and 3. Results using domestic interest rates are shown in the top blocks, implied forward rates in the middle blocks, and foreign exchange rates in the bottom blocks of tables 2 and 3. The estimates of $a_{,,}$ the coefficient on the expected change in M1, are shown in table 3. The majority of the coefficients are not statistically different from zero with a few exceptions. It appears that accounting for the new information, which is available after the survey is taken, but before the time of the money stock announcement, improves the efficiency of the survey forecast.

Tests for Structural Shift. We have assumed throughout that there were structural shifts each time the Federal Reserve changed its operating procedures. We have constructed Wald Statistics to test whether or not there was a change in parameters every time there was a change in the operating procedure.[10] This is a large-sample test that was used instead of a Chow test because we have unequal sample sizes and heteroskedasticity in the residuals of the interest-rate equations. The stability tests are reported in table 4.

September 1977 to October 1979: The Expected Inflation Hypothesis Reconsidered

Before October 1979, the Federal Reserve used an interest-rate targeting procedure to achieve the monetary targets. Surprises in the money stock were automatically accommodated in the short run. For the years of our analysis, 1977 to 1979, these deviations accumulated on the plus side and carried M1 to or above the upper limit of the target range. At year-end, the Federal Reserve based the next calendar year's monetary targets on the actual fourth-quarter average level for M1, allowing the targets to drift upward over time. During this period, money grew at or above the top of the target ranges and inflation accelerated.

In spite of this record of accelerating money growth and accelerating inflation, studies by Roley and Walsh (1983), Urich (1982), and Urich and Wachtel (1981) conclude that the response of short-term interest rates to the unexpected change in M1 can be explained by the policy anticipations hypothesis. Only Cornell (1983a) argues that the expected inflation hypothesis explains the response of short-term rates in this period before October 1979.

The results from the pre-October 1979 period, presented in table 1, support the expected inflation hypothesis. The estimate of a, was positive

and significant at a 5 percent critical level for all of the domestic interest rates. All of the implied forward rates responded positively to the money stock surprises, but only in the case of the three-month-ahead, nine-month rate was the response significantly different from zero at the 5 percent level.

The interest-rate results as such do not tell us anything about the credibility of policy. To decide whether or not the market viewed policy as credible, we look at the reaction in the foreign exchange market. The dollar depreciated relative to the deutschemark following a positive money stock surprise.

The response in the spot and three-month-forward market was not statistically significant. However, the estimated response in the twelve-month forward exchange market, following a positive surprise in the money stock announcement, was statistically significant at the 5 percent level. These findings provide support for the hypothesis that policy was not credible before October 1979.

When we look only at the last year before the October 1979 change in policy regime, when inflation was accelerating, we see a much stronger response in the spot-and forward-exchange markets. In the year before the Federal Reserve's policy change, there was a statistically significant depreciation of all exchange rates following a positive money stock surprise. For instance, the simultaneous rise in the three-month Treasury bill and depreciation of the three-month forward exchange rate implies that the rise in the Treasury bill was due to an increase in inflation expectations as posited by Cornell (1983b) and not due to the policy anticipation hypothesis as suggested by Roley and Walsh (1983), Urich (1982), and Urich and Wachtel (1981).

The unanswered question is why long-term interest rates did not respond to the surprise in M1 over this period. One explanation is that the variance of

expected money growth and expected inflation rose as the forecast horizon lengthened. For example, if policy led to a money supply growth that had characteristics of a random walk, the variance of expected inflation and expected money growth would grow with the forecast horizon. At long horizons, the variance of expected money growth would be so large that a typical weekly change in the money stock would be small relative to the market's perception of the standard deviation of the expected inflation forecast. Therefore, one would expect no significant reaction of long-term rates to a weekly change in M1.

October 1979 to October 1982: The Policy Regime Change

In the post-October 1979 period, the Federal Reserve announced that it was placing more emphasis on reducing inflation. To lend credibility to the announcement, the System also switched to a reserve-based operating procedure. The nonborrowed reserve procedure induced large interest-rate changes in response to deviations of money from target. Under this procedure, it appeared that the Federal Reserve was trying to reverse deviations of M1 from the target path more quickly. Thus, the change in procedures lent credibility to the System's announcement that it had switched to a policy of disinflation.

During the period of the nonborrowed reserve operating procedure, the reactions of all domestic interest rates were much greater than before. In the earlier period, a 1 percent positive surprise in the money stock led to a seven basis-point increase in the three-month Treasury bill rate and to a 1.5 basis point increase in the thirty-year Treasury bond rate. In the period of nonborrowed reserve targeting, the reactions of these rates were considerably stronger, 36 and 11.5 basis points, respectively.

There was also a dramatic change in the response in exchange markets. The

dollar appreciated sharply against the deutschmark in spot and forward markets following a positive money stock announcement. This was a sharp reversal from the earlier period. Structural stability tests are presented in the first column of table 4. These results show a significant change in structure for all equations, except for the seven-year ahead, twenty-three-year implied-forward interest rate.

In sensitivity tests using moving regressions, we found that the structural shift occurred very quickly, within weeks of the change in operating procedures. This result indicates that the Federal Reserve can gain credibility very quickly with a change in operating procedures, even after a long period of missing pre-announced targets and accelerating inflation.

These results have been presented by others. Engel and Frankel (1984) and Roley and Walsh (1983) argue in favor of the policy anticipations hypothesis. Under nonborrowed reserve targeting, an exogenous money-demand shock will automatically force more banks to go to the discount window. This money-demand shock will be completely offset if the Federal Reserve maintains its nonborrowed reserve target. Therefore, given sluggish price adjustment, a positive money stock surprise generates anticipations of future excess money demand. This excess demand will raise short-term real interest rates via the liquidity effect and long-term real interest rates via the expectations theory of the term structure. Engel and Frankel (1984) support this hypothesis for the period of nonborrowed reserve targeting with evidence from the foreign exchange market.

While observers generally expected short-term rates to respond more quickly to deviations of M1 from target, most were surprised at the strength of the reaction by long-term rates. The puzzle in this period is why the longer-term, implied-forward interest rates responded to the weekly money stock announcements. Neither the expected liquidity-effect explanation nor the expected inflation hypothesis is entirely satisfactory.

There are two views about the real world process generating the real interest rate. In the conventional view, which underlies most of the published empirical work in this area, the process generating the real interest rate has a deterministic trend. If the real interest rate is not treated as a constant in the short run, then it is assumed to return to some "normal", deterministic trend in the long run. Under this view, long-term real interest rates should not respond to weekly surprises in the money stock.

In the alternative view, the process generating the real interest rate is assumed to have a stochastic trend. In general, shocks that affect the real interest rate will have both temporary and permanent components.[11] Market participants will continually revise their expectations about the term structure of real interest rates as information about real shocks becomes available. The real shocks that affect expected real interest rates will also affect short-run movements in the money stock. When monetary policy is credible, and the variance of money supply shocks is small relative to the variance of real shocks, market participants will perceive unexpected changes in the money stock as reflecting real shocks and revise expected real interest rates accordingly.

Both Seigel (1985) and Walsh (1985) present models in which the long-term real interest rates respond to the M1 announcement. In both cases, the long-term real interest rate effect occurs because stochastic shocks to real output may persist indefinitely. Litterman and Weiss (1985) and Nelson and Plosser (1982) present empirical support for the notion that real output and real interest rates may be more accurately represented by stochastic rather than deterministic trends. Holland (1984) provides supporting evidence for the hypothesis that real interest rates across the term structure tend to move together. Using survey measures of inflation expectations, he shows that the one- and ten-year expected real interest rates are nearly equal and tend to move together.

October 1982 to December 1984: Policy Remains Credible

There was another change in operating procedures in October 1982. The Federal Reserve switched from nonborrowed reserve targeting to borrowed reserve targeting, which is an interest-rate-smoothing procedure. This period is interesting, because it allows us to test whether the change in the operating procedure can be viewed as a change in the policy regime. After October 1982, the System began to target borrowed reserves. If market participants perceived this change as only a technical change, with no implications for the monetary policy regime, only the response of short-term interest rates should have been affected. There should have been no significant change in the response of longer-term asset prices.

As shown in table 2, the pattern of response of asset prices to money stock innovations in the post-October 1982 period was similar to the pattern of response observed in the post-October 6, 1979, period. The main difference is that the short-term interest rate response became weaker. This result is consistent with a change in short-run operating procedures with no change in the public's perception of the Federal Reserve's commitment to the inflation goal.

The stability tests reported in the center column of table 4 show that there was a statistically significant change in the parameters of the equations for the short-term interest rates but not for the long-term rates or for the exchange rates. Also, the response of asset prices did not return to the pattern that prevailed in the pre-October 1979 period. We have compared the models from the two periods of interest-rate-smoothing. As shown in table 4, there is a significant difference between the market's perception of policy in the early period and its perception in this latest period. Only in the case of the three-month treasury bill and the thirty-year bond can we not reject the hypothesis of no-change in structure (see the third column of table

4). Evidently, market participants believed the Federal Reserve would maintain a disinflationary policy despite its returning to an interest-rate-smoothing procedure.

III. Conclusions

We have presented evidence to show that the policy regime change in October 1979 led to a fundamental change in the way market participants perceived the weekly M1 announcement. Before October 1979, unexpected changes in M1 were expected to lead to permanent changes in the money stock. Inflation expectations and nominal interest rates rose in response to an unexpected increase in M1 while the foreign exchange value of the dollar depreciated. After October 1979, the weekly announcement of M1 was perceived to reflect real shocks as real interest rates were revised upward and the foreign exchange value of the dollar appreciated in response to an unexpected increase in M1.

We find that there was a structural shift in the models for short-term interest rates every time there was a change in the short-run operating procedure. There was a structural shift in all the models following the October 1979 change in operating procedures, indicating a shift in policy regime as well as in operating procedure.

There was no shift in the long-term interest rate equations or in the foreign exchange rate equations following the October 1982 change in operating procedures. The stability tests are consistent with the hypothesis that the Federal Reserve's credibility survived a return to an interest-rate-smoothing operating procedure in October 1982. Thus, we have shown that while the short-run operating procedure can be used to gain credibility quickly, it is not necessary to maintain this short-run procedure once credibility has been attained.

Notes

1. Roley and Walsh (1983) have formally derived the relationship between charges in interest rates and money stock surprises under the expected inflation hypothesis. Engel and Frankel (1984) have extended the analysis to include the exchange rate.

2. Roley and Walsh (1983) have employed a controversial test to discriminate between the expected inflation hypothesis and the policy anticipations hypothesis based on the correlations between M1 and past surprises in the weekly announcement of M1. Roley and Walsh found that past surprises in M1 were completely offset by the Federal Reserve in less than a year both pre- and post-October 6, 1979. They interpret the decaying pattern of correlations between log(M1) and past surprises in log(M1) as support for the policy anticipation hypothesis.

3. See Engel and Frankel (1984) for a theoretical derivation of these results.

4. This is because the operating procedures determine the slope of the reserve supply curve which, in turn, determines whether money demand disturbances are absorbed by changes either in the quantity or in the price of reserves.

5. For a detailed discussion of this procedure see Wallich (1984) and Gilbert (1985).

6. On the other hand, one could say that Hardouvelis assumes that the real rate of interest is constant.

7. We thank Mark Porter and Money Market Services for generously providing the survey data.

8. See Roley (1983) for a discussion of this issue.

9. When the unrevised expectation measure is used, the estimated values of a_1 are qualitatively similar to those presented in this paper. The main effect of revising the M1 forecast is to reduce the significance of the estimated values of a_2. These results are presented in Gavin and Karamouzis (1984).

10. See Silvey (1975), pp. 115-116.

11. See Nelson and Plosser (1982) for a discussion of deterministic versus stochastic trends in economic data.

References

Cornell, Bradford. "Money Supply Announcements and Interest Rates: Another View," Journal of Business, vol. 56 (January 1983a), pp. 1-23.

Cornell, Bradford. "The Money Supply Announcements Puzzle: Review and Interpretation," American Economic Review, vol. 73 (September 1983b), pp. 644-57.

Cukierman, Alex, and Allan H. Meltzer. " A Positive Theory of Credibility and Monetary Inflation," Manuscript, Carnegie-Mellon University, November 1982.

Engel, Charles, and Jeffrey Frankel. "Why Interest Rates React to Money Announcements: An Explanation from the Foreign Exchange Market," Journal of Monetary Economics, vol. 13 (January 19841, pp. 31-39.

Gavin, William T., and Nicholas V. Karamouzis. "Monetary Policy and Real Interest Rates: New Evidence from the Money Stock Announcements," Working Paper 8406, Federal Reserve Bank of Cleveland, December 1984.

Gilbert, R. Alton. "Operating Procedures for Conducting Monetary Policy," Review, Federal Reserve Bank of St. Louis, vol. 67 (February 19851, pp. 13-21.

Hardouvelis, Gikas A. "Market Perceptions of Federal Reserve Policy and the Weekly Monetary Announcements." Journal of Monetary Economics, vol. 14 (September 19841, pp. 225-40.

Hein, Scott E. "The Response of Short-term Interest Rates to Weekly Money Announcements: A comment," Journal of Money Credit, and Banking, vol. 17 (May 19851, pp. 264-270.

Holland, A. Steven. "Real Interest rates: What Accounts for their Recent Rise?" Review, Federal Reserve Bank of St. Louis, vol. 66 (December 19841, pp. 18-29.

Litterman, Robert B., and Laurence Weiss. "Money, Real Interest Rates, and Output: A Reinterpretation of Postwar U.S. Data," Econometrica, vol.53 (January 1985), pp. 129-156.

Loeys, Jan. "Market Perceptions of Monetary Policy and the Weekly M1 Announcements." Working Paper 84-2. Federal Reserve Bank of Philadelphia, 1984. Forthcoming in the Journal of Monetary Economics.

Meltzer, Allan H. "The Conduct of Monetary Policy Under Current Monetary Arrangements," Journal of Monetary Economics, vol. 4 (April 19781, pp. 371-388.

Nelson, Charles R., and Charles I. Plosser. "Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications," Journal of Monetary Economics, vol. 10 (September 19821, pp. 139-62.

Nichols, Donald A., David H. Small, and Charles E. Webster, Jr. "Why Interest Rates Rise when an Unexpectedly Large Money Stock is Announced," American Economic Review, vol. 73 (June 19831, pp. 383-88.

Roley, V. Vance. "The Response of Short-term Interest Rates to Weekly Money Announcements," Journal of Money, Credit and Banking, vol. 15 (August 1983), pp. 344-54.

Roley, V. Vance, and Carl E. Walsh. "Monetary Policy Regimes, Expected Inflation, and the Response of Interest Rates to Money Announcements," NBER Working Paper No. 1181 (August 19831. Forthcoming in Quarterly Journal of Economics.

Shiller, Robert J., John Y. Campbell, Kermit L. Schoenholtz. "Forward Rates and Future Policy: Interpreting the Term Structure of Interest Rates," Brookings Papers on Economic Activity, (1:1983), pp. 173-217.

Siegel, Jeremy J. "Money Supply Announcements and Interest Rates: Does Policy Matter?" Journal of Monetary Economics, vol. 15 (March 1985), pp. 163-176.

Silvey, S.D. Statistical Inference, New York: Halsted Press, 1975.

Urich, Thomas J. "The Information Content of Weekly Money Supply Announcements," Journal of Monetary Economics, vol. 10 (July 19821, pp. 73-88.

Urich, Thomas J., and Paul Wachtel. "Market Response to the Weekly Money Supply Announcements in the 1970s," Journal of Finance, vol. 36 (December 19811, pp. 1063-72.

Wallich, Henry C. "Recent Techniques of Monetary Policy," Economic Review, Federal Reserve Bank of Kansas City, vol. 70 (May 1984) pp. 21-30.

Walsh, Carl E. "Monetary Information and Interest Rates," NBER Working Paper No. 1589 (March 1985).

Table 1 The Revised Expectation of the Expected Money Stock

$$\Delta \text{Log}(M1)_t = \text{constant} + EM_t + b_1\,\Delta R3M_t + b_2\,\Delta R30Y_t + e_t.^{a}$$

Period	Constant	b_1	b_2	$\bar{R}^2$	F-Stat.	Durbin Watson
Sep. 19, 1977 - Oct. 5, 1979	-0.0009 (-2.21)	-0.2942 **(-0.75)**	2.813 **(2.68)**	0.04	3.65	1.83
Oct. 6, 1979 - Oct. 5, 1982	0.0008 **(2.11)**	0.2102 (2.05)	0.361 **(1.66)**	0.09	9.08	2.09
Oct. 12, 1982 - Dec. 31, 1984	0.0002 **(0.78)**	0.188 (0.63)	0.506 **(1.59)**	0.05	3.09	2.34

[a] Where

$EM_t = \log (M1_{t-1} + MMSP_t) - \log (M1_{t-1})$,

$\Delta R3M_t$ = change in the three-month Treasury bill yield from the time of the survey to the time of the M1 announcement,

$\Delta R30Y_t$ = change in the thirty-year Treasury bond yield from the time of the survey to the time of the M1 announcement, and

e_t = random error.

The t-statistics are in parentheses.

Table 2 Impact of Money Stock Surprises on Asset Prices (a_1)

	Operating target			
	Federal funds		Non-	
Dependent variable	9/78 to 9/79	9/77 to 9/79	borrowed reserves	Borrowed reserves
3-month Treasury	0.125	0.065	0.363	0.131
	(3.00)	(2.69)	(6.02)	(5.07)
12-month Treasury	0.099	0.062	0.346	0.163
	(3.59)	(4.17)	(7.17)	(5.11)
3-year govt. bond	0.047	0.033	0.261	0.135
	(2.84)	(3.44)	(6.76)	(4.48)
7-year govt. bond	0.034	0.027	0.184	0.140
	(2.69)	(3.37)	(5.93)	(4.92)
30-year govt. bond	0.009	0.016	0.116	0.102
	(0.97)	(2.74)	(4.15)	(3.84)
9-month-forward rate 3-months ahead	0.090	0.069	0.340	0.174
	(3.28)	(4.28)	(7.07)	(4.93)
2-year-forward rate 1-year ahead	0.018	0.014	0.210	0.118
	(0.94)	(1.27)	(5.74)	(3.72)
4-year-forward rate 3-years ahead	0.022	0.021	0.096	0.146
	(1.26)	(1.93)	(3.42)	(4.73)
23-year-forward rate 7-years ahead	-0.015	0.005	0.092	0.104
	(-1.70)	(0.72)	(2.46)	(2.17)
Dollar/mark spot exchange rate	0.158	0.045	-0.160	-0.148
	(2.36)	(0.90)	(-2.71)	(-2.22)
Dollar/mark 3-month-forward exchange rate	0.179	0.061	-0.123	-0.137
	(2.48)	(1.18)	(-2.15)	(-2.06)
Dollar/mark 12-month-forward exchange rate	0.384	0.172	-0.072	-0.119
	(2.71)	(2.00)	(-1.27)	(-1.76)

NOTE: The period of nonborrowed reserve targeting was September 1979 to September 1982; the period of borrowed reserve targeting was September 1982 to December 1984. The t-statistics are shown in parentheses.

Table 3 Impact of Expected Money Stock Changes on Asset Prices (a_2)

	Operating target			
	Federal funds		Non-borrowed reserves	Borrowed reserves
Dependent variable	9/78 to 9/79	9/77 to 9/79		
3-month Treasury	0.137	-0.023	-0.167	-0.038
	(1.18)	(0.89)	(-1.95)	(-1.49)
12-month Treasury	0.125	-0.018	-0.127	-0.047
	(1.64)	(-1.07)	(-1.85)	(-1.49)
3-year govt. bond	0.083	-0.010	-0.051	-0.053
	(1.81)	(-0.97)	(-0.92)	(-1.76)
7-year govt. bond	0.005	-0.010	-0.061	-0.055
	(0.13)	(-1.23)	(-5.93)	(4.92)
30-year govt. bond	-0.004	-0.009	-0.108	-0.053
	(-0.17)	(-1.45)	(-2.73)	(-2.00)
9-month-forward rate 3-months ahead	0.121	-0.016	-0.113	-0.050
	(1.59)	(-0.99)	(-1.66)	(-1.43)
2-year-forward rate 1-year ahead	0.060	-0.005	-0.005	- 0.056
	(1.11)	(-0.45)	(-0.10)	(-1.78)
4-year-forward rate 3-years ahead	-0.074	-0.011	-0.074	-0.057
	(-1.55)	(-0.95)	(-1.85)	(-1.86)
23-year-forward rate 7-years ahead	-0.013	-0.007	-0.171	-0.071
	(-0.52)	(-0.97)	(-3.91)	(-1.48)
Dollar/mark spot exchange rate	0.323	0.007	-0.039	-0.026
	(1.75)	(0.13)	(0.46)	(0.39)
Dollar/mark 3-month-forward exchange rate	0.343	0.017	-0.045	0.027
	(1.72)	(0.31)	(0.56)	(0.41)
Dollar/mark 12-month-forward exchange rate	0.880	0.049	0.068	0.035
	(2.25)	(0.53)	(0.84)	(0.52)

NOTE: The period of nonborrowed reserve targeting was September 1979 to September 1982; the period of borrowed reserve targeting was September 1982 to December 1984. The t-statistics are shown in parentheses.

Table 4 Parameter Stability Tests[a]

Dependent variable	Federal funds rate vs. nonborrowed res.	Nonborrowed vs. borrowed	Borrowed vs. federal funds
3-month Treasury	20.99[b]	14.63[b]	6.74
12-month Treasury	29.52[b]	11.25[b]	13.47[b]
3-year govt. bond	35.23[b]	8.15[b]	12.34[b]
7-year govt. bond	29.17[b]	3.00	16.45[b]
30-year govt. bond	14.37[b]	3.72	11.58[b]
9-month-forward rate 3-months ahead	28.41[b]	8.96[b]	13.91[b]
2-year-forward rate 1-year ahead	30.33[b]	4.92	9.46[b]
4-year-forward rate 3-years ahead	17.33[b]	4.75	19.57[b]
23-year-forward rate 7-years ahead	2.79	5.81	4.66
Dollar/mark spot exchange rate	17.34[b]	0.11	10.29[b]
Dollar/mark 3-month-forward exchange rate	13.78[b]	0.02	9.94[b]
Dollar/mark 12-month-forward exchange rate	14.74[b]	0.59	13.16[b]

a. The sample period for federal funds targeting is September 1977 to September 1979, the period for nonborrowed reserve targeting is September 1979 to September 1982, and the period for borrowed reserve targeting is September 1982 to December 1984. Data presented in this table are Chi-squared statistics with 3 degrees of freedom.

b. Reject the null hypothesis of no-change in structure at a 5 percent critical level.