NOTES, COMMENTS, REPLIES

Does the Federal Reserve Respond to Errant Money Growth? Evidence from Three Monetary Regimes

A Note by David R. Hakes and Edward N. Gamber

Many studies regarding Fed behavior have concentrated on revealing the macroeconomic objectives that have most influenced monetary policy.[1] With the rekindling of the monetarist school and the establishment of growth targets for the monetary aggregates in the early 1970s, a related question arises: Has the Fed responded with corrective action when they have missed their short-run money growth target in the preceding period or are these money growth targets purely cosmetic?

Casual observation of past movements in the inflation rate might suggest that the Fed paid little attention to money growth during the late 1970s, devoted great attention to money growth from 1979 through 1982, and views money growth somewhere between the two extremes post-1982 (Wallich 1984). We produce evidence for the period 1975.1–1987.8 that does not support the preceding description of Fed behavior.[2] Further, our empirical evidence yields some insights into the source of the "money supply announcement puzzle" by lending support for what has been termed the "policy anticipation effect."

1. Method

We utilize a reaction function approach to test the hypothesis that the Fed responds to its most recent money growth error with a corrective movement in its policy instrument. The Employment Act of 1946 charges the federal government with engaging in policies that promote high employment, high growth, and stable prices. Therefore, we estimate the following reaction function which relates the

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[1]See the survey article by Barth, Sickles, and Weist (1982). For references to later studies, see Havrilesky (1990) and Hakes (1990).

[2]Results of previous studies are mixed. Abrams, Froyen, and Waud (1980) found that the Fed paid more than just lip service to the money growth targets in the early 1970s while Lombra and Kaufman (1984) found that errant money growth had no impact on monetary policy in the early 1970s. Hoelscher (1990) and Kaufman and Lombra (1986) find evidence that the Fed responded to both the M1 and M2 targets during the 1979–1982 period.

Both DAVID R. HAKES *and* EDWARD N. GAMBER *are assistant professors of economics at the University of Missouri-St. Louis.*

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change in the Federal Reserve's policy instrument (*PI*) to proxies of these macroeconomic policy objectives and the difference between actual and targeted money growth (*MT*):

$$\Delta PI_t = b_0 + b_1 \Delta U_{t-1} + b_2 \Delta \ln(PPI)_{t-1} + b_3 \Delta \ln(IP)_{t-1} + b_4 MT_{t-1} + e_t \quad (1)$$

where the employment objective is the civilian unemployment rate (U), the price objective is the producer price index (*PPI*), and the growth objective is the industrial production index (*IP*). The error term, e_t, is assumed to have the desired properties after the data series are made stationary. Thus, the *PPI* and the *IP* are transformed into first differences of the logs of the levels (that is, monthly growth rates) while U is simply first differenced.[3]

The independent variable of particular interest is the proxy for errant money growth (*MT*). This variable is generated by subtracting the annualized rate of monthly M1 and M2 growth from their targeted rates. The short-run targets for M1 and M2 are obtained from the Record of Policy Actions of the Federal Open Market Committee and are measured as the mean of the range of tolerance.

The model is estimated over the period of 1975.1–1987.8. This period is divisible into three distinct monetary policy regimes where each regime is defined by the operating procedures employed by the Fed. Therefore, the dependent variable (*PI*) employed in the reaction function is the policy instrument that the Fed appeared to have utilized during each regime. We employed the federal funds rate (*FFR*) for 1975.1–1979.9, nonborrowed reserves (*NBR*) for 1979.10–1982.9 and borrowed reserves (*BR*) for 1982.10–1987.8.[4] While the Fed never explicitly announced that it was targeting the federal funds rate during the 1970s, the announcement in October 1979 regarding the change in operating procedures stated that the Fed would place "greater emphasis in day-to-day operation on the supply of bank reserves and less emphasis on confining short-term fluctuations in the federal funds rate" (*Federal Reserve Bulletin*, October 1979, p. 830). This statement has generally been used to define the policy instrument for both periods. The policy instrument for the post-1982.10 period is not as clearly stated, but is generally recognized as borrowed reserves (Wallich 1984).

Under the hypothesis that the Fed "leans against the wind" (Barth, Sickles, and Weist 1982) the expected signs for the subperiod of 1975.1–1979.9 where the Fed utilized the federal funds rate as its policy instrument are $b_1 < 0$ and $b_2, b_3, b_4 > 0$.

[3]The reaction functions estimated in this paper are "backward looking" in that we assume that the Fed responds to past information. We also estimated "forward-looking" reaction functions with data generated from a full sample period VAR and a rolling VAR. These results (not reported here) were robust with regard to the Fed's response to money growth errors. See McNees (1986).

[4]Hakes (1990) argues that the Chairman of the Fed makes a difference in the formulation of monetary policy. Therefore, this study stops at the end of the Volcker term. The October 1979 and the October 1982 partitions pose few problems in this regard. The pre-1979 subperiod, however, overlaps both the Miller and Burns chairmanships, but the Miller and Burns periods have not been shown to be different (Hakes 1988).

The positive sign on *MT* (b_4) implies that the Fed attempts to correct its errors so that if money growth exceeds the target and *MT* is positive, the Fed should move to tighten its policy instrument, thus raising the federal funds rate. In the second subperiod, 1979.10–1982.9, the policy instrument employed is nonborrowed reserves. For this policy instrument the expected signs are reversed ($b_1 > 0$ and b_2, b_3, $b_4 < 0$) because while an increase in the federal funds rate is contractionary, an increase in nonborrowed reserves is expansionary. During the 1982.10–1987.8 subperiod, we assume that the Fed employed a borrowed reserve operating procedure. An increase in borrowed reserves implies a tightening of monetary policy assuming that the borrowing function of the depository institutions remains stable (Thornton 1988). Thus, the expected signs of the coefficients are again reversed so that $b_1 < 0$ and b_2, b_3, $b_4 > 0$.

2. The Empirical Results

The regression results for equation (1) for the 1975.1–1979.9 subperiod are reported as equations (1.1) and (1.2) for both measures of money in Table 1. All coefficients enter with the expected sign. Monetary policy appears to be countercyclical with regard to economic growth when utilizing either definition of money because the *IP* coefficient is positive and significant. With regard to the price objective, the coefficient on *PPI* is positive in both equations but significant only in equation (1.1) which employed M1 as the money target. The *MT* coefficients are positive and significant at the 1 percent level which suggests that the Fed did respond to errant money growth during this subperiod.

The results of estimating equation (1) for the 1979.10–1982.9 subperiod are reported as equations (1.3) and (1.4) in Table 1. With respect to the macroeconomic objectives of policy, the coefficient on the producer price index carries the expected negative sign and is highly significant. This result is consistent with the view that Volcker was concerned with fighting inflation. The coefficient on the industrial production index is negative as expected and significant in equation (1.4) which includes errant M2 growth. Since the Fed is generally expected to engage in countercyclical policy, the expected coefficient on unemployment is positive. This coefficient, however, is negative and significant. This result may suggest that the Fed was willing to pursue an anti-inflationary policy with its NBR target while accommodating movements in unemployment. This policy would be reasonable given that there were two recessions lasting officially twenty-two months during this three-year period and given that the unemployment rate also increased in twenty-four months during this period. Alternatively, the negative coefficient on unemployment could result from unstable money demand. That is, if the Fed employed an interest rate as a short-run policy indicator, then a rise in unemployment would cause money demand to fall putting downward pressure on interest rates, which, in turn, would cause the Fed to respond with a tightening of their nonborrowed reserves instrument. Or the results with respect to unemployment could be simply spurious. The coefficients on errant M1 and M2 money growth are again properly signed and significant at the 1 percent level.

TABLE 1

REACTION FUNCTION ESTIMATES

Equation	Time Period	Dependent Variable	Constant	*U*	*PPI*	*IP*	M1	M2	R^2	D-W
(1.1)	1975.1–1979.9	*FFR*	−0.123	−0.218 (−1.64)	13.872 (2.21)*	9.840 (2.72)**	0.0336 (5.59)**		0.58	2.13†
(1.2)	1975.1–1979.9	*FFR*	−0.108	−0.093 (−0.60)	8.455 (1.15)	8.869 (2.06)*		0.0309 (2.57)**	0.38	2.40†
(1.3)	1979.10–1982.9	*NBR*	811.84	−3066.01 (−3.21)**	−71769.5 (−2.82)**	−19543.1 (−1.07)	−52.73 (−3.15)**		0.43	1.61
(1.4)	1979.10–1982.9	*NBR*	642.79	−3068.16 (−3.73)**	−49839.2 (−2.14)*	−34668.8 (−2.08)*		−157.15 (−4.58)**	0.55	1.59
(1.5)	1982.10–1986.5	*BR*	−33.58	6.98 (0.02)	25734.5 (0.87)	1891.69 (0.11)	6.05 (0.31)		0.03	1.99†
(1.6)	1982.10–1987.8	*BR*	−27.41	−32.77 (−0.08)	15123.2 (0.69)	2013.82 (0.15)		−2.68 (−0.15)	0.03	1.98†
(1.7)	1979.10–1982.9	*FFR*	−0.15	−2.938 (−2.44)**	52.89 (1.32)	14.05 (0.56)	0.079 (3.20)**		0.53	1.76†
(1.8)	1979.10–1982.9	*FFR*	0.18	−3.477 (−2.91)**	21.19 (0.48)	30.78 (1.16)		0.169 (2.81)**	0.51	1.86†

NOTES: Figures in parenthesis are *t*-ratios.

† The D-W statistic results from correction for first-order serial correlation using the Prais-Winsten method.

* Significant at the 0.05 level

** Significant at the 0.01 level

The results of estimating equation (1) for the post-1982.10 subperiod are reported as equations (1.5) and (1.6) in Table 1. Equation (1.5) is estimated over the subperiod of 1982.10–1986.5 because the Fed stopped reporting M1 targets in 1986, while equation (1.6) is estimated over the subperiod of 1982.10–1987.8. The fit is clearly poorer than the other subperiods. Indeed, no coefficients are found to be significant. Because the fit in this subperiod is so poor, we estimate the reaction function utilizing other possible policy indicators: federal funds rate, reserve restraint (federal funds rate-discount rate), free reserves, and nonborrowed reserves. None of these estimations, however, generate any significant coefficients. Indeed, no estimation generates a significant coefficient on either prices or errant money growth, yet the 1980s was a period of relatively low inflation. As an explanation, real business cycle theorists might argue that the relatively low inflation that occurred in the 1980s was due to repeated positive supply shocks (oil and technology) and not due to constraints placed on aggregate demand by the Fed.[5] Alternatively, the poor results in the post-1982 subperiod may simply be an indication of the Fed engaging in an eclectic policy of simultaneously monitoring interest rates, reserves and macroeconomic objectives, or it could be due to our inability to properly define the Fed's reaction function for this subperiod.

To summarize, we find errant money growth to be significant in the 1975–1979 and 1979–1982 subperiods, but not in the post-1982 subperiod. An issue remains: Did the size of the Fed's response to errant money growth differ from the 1975–1979 subperiod to the 1979–1982 subperiod? To address this issue, we estimate equation (1) utilizing the federal funds rate as the policy indicator for the 1979.10–1982.9 subperiod so that the coefficients on errant money growth might be compared to the 1975.1–1979.9 subperiod.[6]

The additional estimations for the 1979.10–1982.9 subperiod are reported as equations (1.7) and (1.8) in Table 1.[7] Again, errant money growth is significant at the 1 percent level and has the expected positive sign. If we compare equations (1.1) and (1.2) to equations (1.7) and (1.8), it is clear that the size of the coefficient on errant money growth is much larger in the second subperiod—more than twice as large for errant M1 growth, and more than five times as large for errant M2 growth. In the 1975–1979 subperiod, a rate of growth of M1 or M2 of 1 percent above the midpoint of the target range for last month implies an increase in the federal funds rate of approximately three basis points this month. In the 1979–1982 subperiod, a

[5]Plosser (1989) shows that the 1980s is a period of positive technology shocks where "technology" includes external oil price shocks.

[6]Abrams, Froyen, and Waud (1980) have argued convincingly that the federal funds rate is a useful short-run policy indicator regardless of the actual policy instrument employed by the Fed. The reliability of the federal funds rate as a short-term policy indicator is further supported by the fact that the actual average funds rate was nearly the mean of the range of tolerance and never outside the range of tolerance for any month during the sample period regardless of the proclaimed policy instrument. In addition, Thornton (1988) produces evidence for the post-1982 period that suggests that the Fed has employed the borrowed reserves procedure in such a way as to make it similar to a federal funds operating procedure.

[7]Estimates employing the federal funds rate as the policy indicator over this period generate a significant and countercyclical sign on unemployment. This may suggest that the finding of a significant but procyclical sign on unemployment when nonborrowed reserves are utilized as the policy indicator is spurious.

rate of growth of M1 of 1 percent above the midpoint of the target range for last month implies an increase in the federal funds rate of nearly eight basis points, while an equivalent error on M2 would raise the federal funds rate nearly seventeen basis points. These results suggest that the Fed's response to money growth errors was greatest during the 1979–1982 subperiod. Indeed, the difference in the magnitude of the Fed's response to errant money growth across periods is statistically significant at the 10 percent level for M1 and the 1 percent level for M2.[8]

We estimate two additional model specifications. First, to determine whether the Fed responded with greater vigor when they missed their money growth target by a greater amount, the square of errant money is included in the reaction function. The coefficient on the square of errant money is insignificant, thus we find no evidence of a nonlinear relationship. Second, we include slope and intercept dummies that correspond to positive and negative deviations from the targets in the model to test whether the Fed responded differently to positive or negative errant money growth. The coefficients on the dummies are insignificant which suggests that the Fed's response to errant money growth was symmetric.

3. Implications for the Money Supply Announcement Puzzle

The degree of Fed response to errant money growth may provide insight into the source of the "money supply announcement puzzle." With regard to interest rates, the puzzle is as follows. When announced money growth for the week exceeds expected growth, the liquidity effect would suggest that interest rates should fall. However, in reality, interest rates immediately rise.

There are a set of generally accepted explanations for this result (Sheehan 1985). One has been termed the "policy anticipation effect" or the "expected liquidity effect." It argues that when announced money growth exceeds expected money growth, economic agents anticipate that the Fed will tighten monetary policy in response to potentially excessive monetary growth, thereby causing interest rates to rise.

If the "policy anticipation effect" is a valid explanation of the puzzle, we would expect the money supply announcements to have their greatest impact on interest rates during the 1979–1982 subperiod when the Fed was most vigorously correcting for its past monetary errors. We would also expect the money supply announcements to have an effect on interest rates in the pre-1979 subperiod since the Fed was responding to its monetary errors during this subperiod, albeit less vigorously than 1979–1982. Since we find no evidence that the Fed corrected for its monetary errors post-1982, we would expect little or no money supply announcement effect in this subperiod.

[8]The only policy instrument that the Fed can absolutely control (if they choose) is nonborrowed reserves. For this reason, we estimated all periods utilizing nonborrowed reserves as the policy indicator instead of the federal funds rate. The results concerning errant money growth are robust with respect to this change in specification for the 1979–1982 and the 1982–1987 periods. Employing nonborrowed reserves as the policy indicator in the 1975–1979 period, however, does not generate significant coefficients on errant money growth. This may be because the Fed actually targeted the federal funds rate as hypothesized, and a federal funds operating procedure makes nonborrowed reserves uncontrollable during periods of unstable money demand.

Recent evidence on the response of interest rates to money supply announcements is largely consistent with a "policy anticipation effect."[9] Hafer and Sheehan (1990) demonstrate that for a variety of short-term and forward interest rates "unexpected money had a greater average impact during the period 1979–82 than either before or after. Indeed, the finding of greater response during 1979–82 is consistent across rates" (1990, p. 583). Further, they argue that the rise in the impact of unanticipated money on interest rates started significantly prior (one year or more) to the October 1979 change in operating procedures. This evidence is also consistent with our finding that the Fed responded to errant money growth on both sides of the October 1979 partition, but that the Fed responded with greater vigor post-1979. Regarding the post-1982 period, the work of Hafer and Sheehan suggests that a small money supply announcement effect may remain. Since we find no evidence that the Fed responded to errant money growth during this period, the remaining money supply announcement effect may be the sum of the other proposed sources to the puzzle besides the policy anticipation effect—the expected inflation, reserve requirement, and real activity effects (Sheehan 1985).

4. Summary

Estimates of the reaction functions employed in this paper suggest that the Fed responded in a corrective manner to errant money growth in both the 1975.1–1979.9 and 1979.10–1982.9 subperiods, with the greater response occurring in the 1979.10–1982.9 subperiod. We find no evidence that the Fed responded to errant money growth in the 1982.10–1987.8 subperiod. Further, the results of this study combined with recent evidence regarding the money supply announcement puzzle provide empirical support for the existence of a "policy anticipation effect."

LITERATURE CITED

Abrams, Richard K., Richard Froyen, and Roger N. Waud. "Monetary Reaction Functions, Consistent Expectations, and the Burns Era." *Journal of Money, Credit, and Banking* 12 (February 1980), 30–42.

Barth, James, Robin Sickles, and Phillip Weist. "Assessing the Impact of Varying Economic Conditions on Federal Reserve Behavior." *Journal of Macroeconomics* 4 (Winter 1982), 47–70.

Federal Reserve Bulletin. Washington, D.C.: Board of Governors of the Federal Reserve System (various issues).

Hafer, R. W., and Richard G. Sheehan. "The Response of Interest Rates to Unexpected Weekly Money: Are Policy Changes Important?" *Southern Economic Journal* 56 (3) (January 1990), 577–93.

Hakes, David R. "October 1979: Did the Federal Reserve Change Policy Objectives?" *Journal of Economics and Business* 40 (May 1988), 159–67.

[9]The money supply announcement literature is based on weekly "unanticipated money" and the present study is based on monthly "errant money." The correlation between these concepts is greatest if the responses to the Money Market Services survey (which are often used to generate "unanticipated money") represent the public's perception of the Fed's short-term money growth target.

———. "The Objectives and Priorities of Monetary Policy under Different Federal Reserve Chairmen." *Journal of Money, Credit, and Banking* 22 (August 1990), 327–37.

Havrilesky, Thomas. "The Influence of the Federal Advisory Council on Monetary Policy." *Journal of Money, Credit, and Banking* 22 (February 1990), 37–50.

Hoelscher, Gregory. "1979–1982: Rules or Discretion in Monetary Policy?" *Economic Inquiry* 28 (April 1990), 249–56.

Kaufman, Herbert M., and Raymond E. Lombra. "The Effect of Changes in the Federal Reserve's Policy Rule on the Stochastic Structure Linking Reserves, Interest Rates, and Money." *Southern Economic Journal* 52 (April 1986), 1080–87.

Lombra, Raymond E., and Herbert M. Kaufman. "The Money Supply Process: Identification, Stability and Estimation." *Southern Economic Journal* 50 (April 1984), 1147–59.

McNees, Stephen K. "Modeling the Fed: A Forward-Looking Monetary Policy Reaction Function." Federal Reserve Bank of Boston, *New England Economic Review* (November/December 1986), 3–8.

Plosser, Charles I. "Understanding Real Business Cycles." *Journal of Economic Perspectives* 3 (Summer 1989), 51–77.

Sheehan, Richard G. "Weekly Money Announcements: New Information and Its Effects." Federal Reserve Bank of St. Louis, *Review* (August/September 1985), 25–34.

Thornton, Daniel L. "The Borrowed-Reserves Operating Procedure: Theory and Evidence." Federal Reserve Bank of St. Louis, *Review* (January/February 1988), 30–50.

Wallich, Henry C. "Recent Techniques of Monetary Policy." Federal Reserve Bank of Kansas City, *Economic Review* 69 (May 1984), 21–30.