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ABSTRACT

Evidence on the relationship between unanticipated money and interest rates has been provided by two types of studies. First, several researchers have investigated the relationship using quarterly data. Second, a number of researchers have examined the effect of money announcement surprises on interest rates. In both instances, the correlation between money surprises and interest rates has usually been found to be non-negative. This paper first provides an interpretation of the correlation between unanticipated money and interest rates in terms of Federal Reserve policy objectives and operating procedures. Then, the correlation of unanticipated money and both short- and long-term interest rates is examined over weekly intervals, combining several aspects of the previous quarterly and announcement studies. In addition, the distinction between unpredicted and unperceived money also is considered.

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UNANTICIPATED MONEY AND INTEREST RATES

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The relationship between money and interest rates is of fundamental importance to economic policymakers. In the absence of the liquidity trap, Keynesian theory emphasized the negative relationship between money and interest rates, thereby providing a role for the monetary authority to engage in countercyclical policy. Milton Friedman's accelerationist theory, however, questioned the efficacy of monetary policy activism. This theory predicted that increases in money growth would lead to identical increases in long-term interest rates. As a result, money growth and interest rates would be expected to exhibit positive correlation.

With the advent of rational expectations and efficient markets theories, the focus of this debate has shifted to the correlation of unanticipated money and interest rates. Despite the change in emphasis, the issues remain largely unchanged. In particular, do unanticipated increases in money lower real interest rates and hence stimulate economic activity? Or, alternatively, do unanticipated increases merely lead to similar rises in expected inflation, leaving real rates virtually constant?

Evidence on the relationship between unanticipated money and interest rates has been provided by two types of studies. First, several researchers have investigated the relationship using quarterly data. Among these, Frederic Mishkin (1981, 1982) found no evidence of negative correlation. Instead, his results indicated either positive or zero correlations for both short- and long-term interest rates.[1]

Second, a number of researchers have examined the effect of money announce-

ment surprises on interest rates. Again, these studies have uniformly found positive correlations between surprises in announced money and both short- and long-term interest rates. In contrast to Mishkin, who very cautiously interprets his results, researchers examining the effects of weekly money announcements have typically preferred one of two common explanations for the positive correlation. One explanation advanced by a number of researchers is that the positive correlation resulted from short-run Federal Reserve policy (see, for example, Jacob Grossman, Thomas Urich and Paul Wachtel, and Roley). Under this hypothesis, the Federal Reserve attempts to offset short-run deviations in money growth due to shifts in money demand. The other explanation, advanced by Bradford Cornell, suggests that the positive correlation is due to associated changes in expected inflation.

The purpose of this paper is first to provide an interpretation of the positive correlation between unanticipated money and interest rates in terms of Federal Reserve policy objectives and operating procedures. Then, the correlation of unanticipated money and both short- and long-term interest rates is examined over weekly intervals. This empirical investigation combines some of the aspects of Mishkin's quarterly studies with those of the money announcement studies. In addition, the distinction between unpredicted and unperceived money, emphasized by Robert Barro and Zvi Hercowitz, is also considered.

I. Federal Reserve Policy and Unanticipated Money

Unanticipated changes in money have been frequently interpreted as discretionary changes induced by the Federal Reserve. If institutional features of Federal Reserve policymaking are taken into account, however, this interpretation is only one of several possible alternatives. To consider the potential sources of unanticipated money, the role of Federal Reserve policy in general and monetary targets in particular should be examined.

As is well known, the Federal Reserve has targets for a set of monetary and credit aggregates for both annual and shorter periods. A set of annual targets is announced for each calendar year in conjunction with the Humphrey-Hawkins Act. While the Federal Reserve has the opportunity to change these long-run targets at a mid-year review, this opportunity has seldom been used. Moreover, at the mid-year review, the Federal Reserve is required to specify preliminary annual targets for the following calendar year. Thus, explicit annual targets, along with statements by Federal Reserve officials, pertaining to trend monetary growth, enable the public to infer the long-run goals of current monetary policy.

Short-run monetary targets are set throughout the year at meetings of the Federal Open Market Committee (FOMC). These targets are usually set such that future money growth will eventually fall within the annual target ranges. In contrast to the annual targets, however, current short-run objectives are in principal unknown to the public until around the time of the next FOMC meeting. Thus, the public must assess the Federal Reserve's short-run objectives on the basis of observed policy actions.

A third relevant feature of monetary policy concerns the time at which monetary information becomes available to the Federal Reserve. Because of reporting lags, data on the narrowly defined money stock are available only shortly before the Federal Reserve's weekly money announcements. As a result, contemporaneous money is unknown to the Federal Reserve in any given statement week.

What do these institutional features imply about unanticipated money growth? One implication is that there are three potential sources of money surprises. First, unanticipated money may reflect changes in the Federal Re-

serve's long-run monetary targets. Such changes, however, would most likely reflect changes within the stated target ranges. Second, money surprises may either result from the public's misconception of short-run monetary policy objectives or unanticipated changes in these objectives. Finally, unanticipated money growth may reflect weekly fluctuations unknown to both the public and the Federal Reserve.

Depending on which of these sources is most prevalent, the positive correlation between money surprises and interest rates may be interpreted several different ways. If unanticipated money results from discretionary changes in the Federal Reserve's long-run targets, or trend money growth in general, such unanticipated changes would be expected to be correlated with changes in expected inflation. In turn, the response of long-term interest rates, and perhaps to some extent short-term interest rates as well, would be due to changes in expected inflation.

If, however, unanticipated money does not reflect changes in long-run policy objectives, it is difficult to ascribe the response of interest rates to changes in expected inflation. Instead, the positive correlation between unanticipated money and interest rates may be due to the Federal Reserve's desire to offset short-run deviations in money growth. Again, such deviations only become apparent to the Federal Reserve after the statement week in which they occur. In this case, we have demonstrated in an earlier paper that the observed positive correlation between unanticipated announced changes in money and both short- and long-term interest rates may be explained in a model incorporating such policy responses. Our evidence further suggested that the Federal Reserve offsets short-run deviations in money within one year, implying that unanticipated money does not relate to changes in trend money growth.

In this same study, we also considered the possible effects of different Federal Reserve operating procedures on the correlation between unanticipated

announced changes in money and interest rates. The larger positive correlation found after October 1979 -- when the Federal Reserve shifted from a federal funds rate to a nonborrowed reserves operating procedure -- could be explained by two factors. In particular, following Walsh, greater volatility in short-term interest rates may have led to a reduction in the interest rate elasticity of the demand for money. Thus, if shifts in money demand are persistent, larger movements in interest rates would be required to return money to its long-run target. Moreover, money announcements also provide information about the aggregate demand for required reserves because of lagged reserve accounting. With the adoption of the reserves aggregate operating procedure in October 1979, this factor also helps to explain the increased positive response of short-term interest rates to positive surprises in announced money.

II. Empirical Evidence

As mentioned, evidence suggesting positive, or at least nonnegative, correlation between unanticipated money and interest rates has been provided by both quarterly studies and investigations of the response to weekly money announcements. The empirical investigation reported here attempts to combine some of the aspects of these different approaches. In particular, movements in interest rates are measured over an entire statement week. This enables the role of the money announcement occurring in a statement week to be determined. The hypothesis underlying this approach is that the money announcement is used to revise the estimate of the current week's money stock. The correlation of this revision, as well as the expectational error that remains, with both short- and long-term interest rates is then empirically examined. The amount of unperceived money in the current statement week is further decomposed into the forecast error associated with the money stock as first announced and as eventually revised.

The basic specification used to examine the response of interest rates to unanticipated money may be represented as

$$\Delta R_t = b_0 + b_1 \cdot UM_t + b_4 \cdot M_t^e + u_t \quad (1)$$

where ΔR_t is the change in either the 3-month Treasury bill yield (R3M) or the 10-year constant-maturity Treasury security yield (R10Y) from 3:30 p.m. on Wednesday of the previous statement week (t-1) to 3:30 p.m. on Wednesday of the current statement week (t); UM_t is the difference between the log of the actual level of the narrowly defined money stock in week t and its expected level as of the end of week t-1; M_t^e is the log of the expected level of the money stock in week t as of week t-1; u_t is a random error term uncorrelated with all publicly available information in week t-1; and the b_i are coefficients to be estimated.[2] Under the hypothesis of rational expectations, the effect of anticipated money equals zero ($b_4 = 0$).

Unanticipated money (UM_t), defined to equal the log of week t's actual money stock minus the log of the market's expectation prior to the Friday announcement, can be decomposed into three separate factors:

$$UM_t = M_t - M_t^b = (M_t - M_t^p) + (M_t^p - M_t^a) + (M_t^a - M_t^b) \quad (2)$$

where M_t is the log of the actual narrowly defined money stock (as of October 1983), M_t^b is the expectation of M_t before the Friday announcement, M_t^a is the expectation after the announcement, and M_t^p is the initially announced value of M_t. M_t^p is the figure released on Friday of week t+2.

To form the expectation of the current week's narrowly defined money stock, a simple autoregressive process is used. However, to take advantage of available survey data on the level of the money stock to be announced in the current statement week, the current week's expected money stock before the announcement is taken as the fitted value of

$$(3) \qquad M_t^p = a_0 + a_1 \cdot M_{t-2}^s + \sum_{i=2}^{m} a_i \cdot M_{t-i-1}^p + v_t$$

where M_{t-2}^s is a survey measure for the money announcement in week t; v_t is a random error term; and the a_i are coefficients to be estimated.[3] The expectation of the current week's money stock after the money announcement is then taken as the fitted value of

$$(4) \qquad M_t^p = a_0' + a_1' \cdot M_{t-2}^p + \sum_{i=2}^{m} a_i' \cdot M_{t-i-1}^p + e_t$$

where e_t is a random error term and the other variables are defined as before. Thus, v_t is used to represent unanticipated money in week t as initially announced in week t+2, and e_t is used as the measure of unanticipated money after M_{t-2}^p becomes known.

Equation (2) can now be rewritten as

$$(5) \qquad UM_t = (M_t - M_t^p) + e_t + (v_t - e_t).$$

This formulation highlights data revisions, following Barro and Hercowitz, and expectations revisions in response to the new information about M_{t-2}^p available during week t. Note that $v_t - e_t$ simply represents the revision in the estimate of the current week's money stock due to the weekly money announcement. If $a_i = a_i'$, this measure equals the money announcement surprise.[4] In contrast, both e_t and $(M_t - M_t^p)$ are unperceived in the aggregate throughout the current statement week. To allow different responses to the different components of unanticipated money, the specification examined empirically is

$$(1') \qquad \Delta R_t = b_0 + b_1 \cdot (v_t - e_t) + b_2 \cdot e_t + b_3 \cdot (M_t - M_t^p) + b_4 \cdot M_t^e + u_t.$$

To further allow for different interest rate response due to different Federal Reserve operating procedures, equation (1') is estimated separately for

the pre- and post-October 1979 periods. For the pre-October 1979 period -- beginning with the statement week of September 29, 1977 and ending with the statement week of October 5, 1979 -- the estimation results are

$$(5)\quad \Delta R3M_t = \underset{(5.745)}{-9.850} - \underset{(14.813)}{17.567}(v_t - e_t) + \underset{(4.764)}{4.313}e_t - \underset{(3.096)}{2.403}(M_t - M_t^p) + \underset{(0.981)}{1.692}M_t^e + u_t$$

$$\bar{R}^2 = .019 \qquad SE = .300 \qquad DW = 2.056$$

$$(6)\quad \Delta R10Y_t = \underset{(2.023)}{-1.855} - \underset{(5.229)}{4.182}(v_t - e_t) + \underset{(1.682)}{1.857}e_t - \underset{(1.093)}{0.063}(M_t - M_t^p) + \underset{(0.346)}{0.320}M_t^e + u_t$$

$$\bar{R}^2 = -.009 \qquad SE = .106 \qquad DW = 1.728$$

where standard errors of estimated coefficients are in parentheses, SE is the standard error, $\bar{R}^2$ is the multiple correlation coefficient corrected for degrees of freedom, and DW is the Durbin-Watson statistic. The estimation results for both the 3-month and 10-year yields fail to indicate a significant response to any of the categories of unanticipated or anticipated money. In contrast to weekly money announcement studies, the impact of this new information $(v_t - e_t)$ is insignificant. However, this result is not totally unexpected in light of the small intervals used previously to obtain estimated responses to money announcement surprises. Similarly, measures of unperceived money are not statistically significant in either regression.

For the post-October 1979 period -- beginning with the statement week of October 8, 1979 and ending with the statement week of October 13, 1982 -- the estimation results are[5]

$$(5')\quad \Delta R3M_t = \underset{(7.288)}{2.802} + \underset{(16.951)}{38.960}^*(v_t - e_t) + \underset{(8.132)}{47.062}^*e_t + \underset{(10.366)}{10.198}(M_t - M_t^p) - \underset{(1.200)}{0.479}M_t^e + u_t$$

$$\bar{R}^2 = .227 \qquad SE = .714 \qquad DW = 2.027$$

$$(6') \quad \Delta R10Y_t = 5.410 - 6.607(v_t - e_t) + 16.649^{*}e_t + 0.896(M_t - M_t^p) - 0.897M_t^e + u_t$$

$$(3.783) \quad (8.799) \qquad (4.222) \qquad (5.381) \qquad (0.623)$$

$$\bar{R}^2 = .128 \qquad SE = .370 \qquad DW = 1.788$$

where asterisks indicate statistical significance at the 5 percent level. These estimation results differ sharply from those obtained in the pre-October 1979 period. First, the money announcement surprise significantly affects the 3-month yield. The estimated coefficient implies that a 1 percent money surprise causes the 3-month yield to increase by almost 39 basis points. Second, changes in both the 3-month and 10-year yields are significantly correlated with the expectational error remaining after the current week's money announcement, but not with the error associated with subsequent data revisions. In the case of the 3-month yield, for example, a 1 percent positive surprise results in over a 47 basis points increase.

Because e_t is unperceived during week t, it is not likely that its effect on interest rates can be attributed to any induced revision of expected inflation. This positive response can, however, be interpreted in terms of short-run reserve adjustment by banks to weekly fluctuations in private sector money demand. An upward shift in money demand can exert a contemporaneous upward effect on interest rates, even under lagged reserve accounting, as individual banks begin to adjust their reserve position. Prior to October 1979, the Federal Reserve would have prevented rates from moving.

To summarize, no significant correlation between interest rates and unanticipated money was found in the pre-October 1979 period. Not even announced money surprises were found to significantly affect interest rates over weekly periods. This result is, however, probably due to the substantially larger variance in the change in interest rates when moving from daily to weekly intervals. In the post-October 1979 period, announced money surprises nevertheless

had a significant positive correlation with the 3-month yield. Moreover, another component of unanticipated money -- measuring the expectational error remaining after the current week's money announcement -- was statistically significant and positively correlated with changes in both short- and long-term interest rates. The most plausible explanation of this response is again based on bank reserve adjustment and the anticipated reaction of the Federal Reserve to short-run deviations in money growth.

The nature of money market shocks which characterize the post-October 1979 sample period has led to a positive correlation, as Friedman predicted, between money shocks and interest rates. This correlation, however, has little, if anything, to do with expected inflation.

FOOTNOTES

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1. In contrast to the positive correlation found in most studies, John Makin's results suggest negative correlation. His use of averaged interest rate data, however, may account for at least some of the difference.

2. Following James Pesando, the random-walk model is used to represent weekly movements in interest rates. This approximation is likely to be good for the 10-year yield, but it may be somewhat inadequate for the 3-month yield.

3. The source of the survey data is Money Market Services. As discussed below, separate autoregressions were estimated for the pre- and post-October 1979 periods. For all autoregressions, however, the last value of the money stock included is M_{t-5}. Also, despite the notation, lagged values of the money stock include revisions known as of the beginning of week t.

4. The hypothesis that $a_i = a_i'$ in both the pre- and post-October 1979 periods could not be rejected at the 5 percent significance level.

5. The estimation period ends in October 1982 due to the Federal Reserve's apparent de-emphasis of the reserves-aggregate operating procedure around that time.

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