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THE RESPONSE OF INTEREST RATES  
TO THE FEDERAL RESERVE'S  
WEEKLY MONEY ANNOUNCEMENTS:  
THE 'PUZZLE' OF ANTICIPATED MONEY

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Weekly Money Announcements: The "Puzzle" of Anticipated Money

ABSTRACT

Researchers, using the survey conducted by Money Market Services, Inc., have found that the anticipated component in the Federal Reserve's weekly money supply announcement is negatively correlated with the post-announcement change in market yields. We prove that eliminating a (downward) bias in the measure of anticipated money can, in theory, eliminate this puzzle, but that improving the efficiency of an already unbiased measure cannot. We find, using Canadian as well as U.S. interest rate data, that correcting the downward bias in the survey measure reduces, but does not eliminate, the role of anticipated money.

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## I. Introduction

In recent years, researchers have examined in detail the impact of the Federal Reserve's weekly money supply announcement on interest rates. (See, for example, Grossman (1981), Urich (1982), Urich and Wachtel (1981), Roley (1983, 1986a,b,c), Cornell (1983), and Roley and Walsh (1985)). These researchers have established that both short-term and long-term interest rates tend to rise when the change in the money supply exceeds the change anticipated by market participants, and conversely.<sup>1</sup> In conducting their empirical tests, researchers have relied heavily on the survey data on the expected announced change in the money supply compiled by Money Market Services, Inc. Indeed, the availability of these data has served as perhaps the most important catalyst to this research program.

There is, however, an anomalous finding in this empirical literature. When the post-announcement change in the interest rate is regressed on both the unanticipated and the anticipated change in the money supply, the coefficient of the anticipated change is consistently negative and often statistically significant. This must be seen as a puzzle, for the following reason. The interval over which the post-announcement change in the interest rate is calculated is very short, typically not more than 24 hours and occasionally as short as one-and-one-half hours.<sup>2</sup> If the change in an interest rate is measured over a very short interval relative to its maturity, the predictable component in the change should be minimal, and increasingly so as the length of the interval is reduced (Pesando (1979)). Intuitively, if one could predict - on the basis of known information - changes in an interest rate over so

short an interval, arbitrage activities should quickly eliminate this dependence and so eliminate the attendant opportunity to earn sizeable trading profits.

The purpose of this paper is to address the puzzle posed by this anomalous finding. There are four main tasks. First, we confirm the existence of the puzzle, using data on Canadian as well as U.S. interest rates. Second, we show that the estimated coefficients of the anticipated change in the money supply imply arbitrage opportunities that are important in an economic sense. There is a puzzle. Third, we prove that eliminating a (downward) bias in the measure of anticipated money could, in theory, eliminate the puzzle, but that improving the efficiency of an already unbiased measure could not. Fourth, we investigate the extent to which eliminating the downward bias in the median response to the survey conducted by Money Market Services, Inc. serves, in fact, to eliminate the significance of anticipated money.

To anticipate our findings, we confirm the negative - and frequently significant - coefficient of anticipated money. We illustrate, using the crucial subperiod from October 1979 to October 1982, that exploiting the estimated relationship would have significantly improved the returns earned by economic agents. We show that there is a downward bias in the median response to the survey forecast, and that this bias is often significant or marginally so. Correcting the survey measure for this bias reduces the importance of, but does not eliminate, the significance of anticipated money. We include a brief discussion of alternative explanations for the puzzle, and then summarize our findings.

## II. The Impact of Anticipated Money on Interest Rates: Canadian and U.S. Evidence

In Table 1, we present regressions of the post-announcement change in interest rates on unanticipated and anticipated changes in the money supply, for U.S. and Canadian 90-day Treasury bills and for 20-year U.S. government and Government of Canada bonds. The anticipated (percentage) change in the money supply is calculated from the median response to the surveys conducted by Money Market Services, Inc.

We examine the sample period from October 11, 1979 to September 5, 1985. We thus omit from consideration the period from September 1977 (the beginning of the survey) to October 1979, since the literature suggests that anticipated money did not matter prior to this time. (See, for example, Grossman (1981) and Roley (1983).) The window for the long-term bonds and for U.S. Treasury bills is from 3:30 p.m. on the day of the announcement to 3:30 p.m. on the following business day; for Canadian Treasury bills, from 3:30 p.m. on the day of the announcement to 10:30 a.m. the following business day.<sup>3</sup> Following Roley (1986a,b,c), we look at three subsamples, which correspond to dates of apparent shifts in the U.S. monetary regime. These are October 1979 to October 1982, when the Federal Reserve replaced the federal funds rate with nonborrowed reserves as its operating instrument; October 1982 to October 1984, when the Federal Reserve replaced nonborrowed reserves with borrowed reserves as its operating instrument and probably de-emphasized M1 targeting; and from February 1984, when the Federal Reserve adopted contemporaneous reserve requirements and (probably) further de-emphasized M1 targeting, to the end of our sample in September 1985.

The U.S. results confirm those of prior researchers. The coefficient of unanticipated money is always positive and significant, while the coefficient of anticipated money is always negative and often significant.<sup>4</sup> The results using Canadian interest rates are similar. There is some evidence that the Bank of Canada smoothed the response of bill rates on announcement days, especially in the first subperiod. For long-term bonds, the Canadian and U.S. results are remarkably similar.<sup>5</sup> From the perspective of the "puzzle," the first subperiod, from October 1979 to October 1982, is the most troublesome. Anticipated money is significant in explaining the post-announcement change in all interest rates except for Canadian Treasury bills.

### III. Economic Significance of the Coefficients of Anticipated Money

To illustrate that the significance of the coefficients of anticipated money does indeed constitute a "puzzle," it is useful to identify the profit opportunities associated with a simple trading rule. Because the coefficients of anticipated money are the largest, we focus below on the U.S. results for the October 1979 to October 1982 subsample.

Consider two strategies. The first, the benchmark strategy, is to buy bills or bonds on the day of the announcement, and to sell on the following business day. The second is to buy bills or bonds on the day of the announcement if the expected change in the money supply is positive, since yields will on average fall, and to close the position on the following business day. If the expected change is negative, the bills or bonds will be sold short and the position closed on the following day. (We make no explicit allowance for transactions costs.

One can, however, think of the second strategy as characterizing the strategy of a buyer whose decision is to purchase before or after the announcement, and a seller whose decision is to liquidate before or after the announcement.)

If applied to Treasury bills, the benchmark strategy produces an annualized holding-period return, averaged over the 156 observations in the subsample, of minus 185 per cent. For this same interval, from 3:30 p.m. on the announcement day to 3:30 p.m. on the following business day, the benchmark strategy produces a holding-period return that averages minus 86 per cent when applied to U.S. government bonds. (These negative returns reflect the tendency, on average, for the post-announcement charge in interest rates to be positive during this subsample, as evidenced by the constant terms in the regressions reported in Table 1.) If an investor followed the second or informed strategy, exploiting the predictive content of anticipated money, he would have earned an average annual return of 162 per cent on Treasury bills, and 123 per cent on U.S. government bonds. The increase in the holding-period return is significant at the 5 per cent level for Treasury bills, and at the 1 per cent level for the U.S. government bonds.<sup>6</sup>

We could, of course, simulate the use of the predictive content of anticipated money in different ways. For example, the investor might implement the informed strategy only if the absolute value of the anticipated change in money exceeds its mean. In essence, the investor applies a filter and only acts if the information contained in the anticipated money change is larger than average. If this filter is applied, then the mean return (for the 66 "active" observations) rises to

254 per cent for Treasury bills, and to 166 per cent for long-term bonds.

In short, an investor who could postpone or accelerate a purchase, or do likewise for a sale, could have significantly improved his returns by acting on the information contained in the known value of anticipated money. The fact that this information was not fully reflected in prices and yields, and thus of no value in predicting subsequent changes, is a puzzle.

#### IV. The Non-Rationality of the Survey Forecasts: A Clarifying Theorem

Can non-rationality of the (widely-used) median response to the survey conducted by Money Market Services, Inc. "explain" the puzzle of anticipated money? We prove below two important propositions: first, eliminating a (downward) bias in the measure of anticipated money can, in theory, solve the puzzle; and second, improving the efficiency of an already unbiased measure cannot.

Let  $\Delta R_t$  denote the change in the interest rate subsequent to the announcement, let  $EM_t^*$  denote the anticipated change in the money supply conditional upon all known information, and let  $UM_t^*$  denote the corresponding measure of the unanticipated change in the money supply.

We are interested in the following model:

$$\Delta R_t = b_0 + b_1 UM_t^* + b_2 EM_t^* + u_t \quad (1)$$

Our maintained hypothesis is that positive money surprises serve to raise interest rates ( $b_1 > 0$ ), and that anticipated changes in the money supply exert no impact on interest rates ( $b_2 = 0$ ). We thus hypothesize that  $\Delta R_t$  is uncorrelated with all information known to economic agents prior



to the announcement. This accords with the predisposition of most observers to believe that the market will efficiently assimilate all relevant information into the pre-announcement structure of interest rates.

Suppose, however, that the researcher has access to a measure of anticipated money which does not fully exploit all known information and which has a bias as shown below:

$$EM_t^* = \alpha + \beta EM_t + v_t \quad (2)$$

If  $\beta > 1$ , then the measure available to the researcher is biased downward, and conversely if  $\beta < 1$ . The researcher estimates the equation:

$$\Delta R_t = c_0 + c_1 UM_t + c_2 EM_t + e_t \quad (3)$$

In the true model given by equation (1), the coefficient ( $b_2$ ) of anticipated money is equal to zero. We prove below that the coefficient  $c_2$  in (3) is  $\begin{matrix} < \\ = \\ > \end{matrix} 0$  as  $\beta \begin{matrix} > \\ = \\ < \end{matrix} 1$ .

Note first that  $c_2$  can be expressed as follows:

$$c_2 = \frac{\text{var}(UM_t) \cdot \text{cov}(\Delta R_t, EM_t) - \text{cov}(UM_t, EM_t) \cdot \text{cov}(\Delta R_t, UM_t)}{\text{var}(UM_t) \cdot \text{var}(EM_t) - (\text{cov}(UM_t, EM_t))^2} \quad (4)$$

The denominator of (4) must be positive, so that the sign of  $c_2$  must be the same as the sign of the numerator. Further,  $\text{cov}(\Delta R_t, EM_t)$  must be zero since  $EM_t$  is known and, by hypothesis,  $\Delta R_t$  is

uncorrelated with all known information. Thus the sign of  $c_2$  will reflect only the sign of the second term in the numerator.

The actual change in the money supply ( $\Delta M_t$ ) must, by construction, equal  $EM_t^*$  plus  $UM_t^*$  as well as  $EM_t$  plus  $UM_t$ . We can thus rearrange (2) to obtain:

$$UM_t = UM_t^* + \alpha + (\beta-1)EM_t + v_t \quad (5)$$

Note that  $\text{cov}(UM_t^*, EM_t)$  must equal zero since  $UM_t^*$  is uncorrelated with any information available to agents prior to the announcement. Thus  $\text{cov}(UM_t, EM_t)$  equals  $(\beta-1)\text{var}(EM_t)$ . Note also that  $\text{cov}(\Delta R_t, UM_t)$  equals  $\text{cov}(\Delta R_t, UM_t^*)$  since  $UM_t^* = UM_t + (EM_t^* - EM_t)$  and  $(EM_t^* - EM_t)$  is uncorrelated with  $\Delta R_t$  by hypothesis since it represents known information. Thus, from (1), we have  $\text{cov}(\Delta R_t, UM_t) = b_1 \text{var}(UM_t^*)$ . These results imply that the second term in the numerator of (4) is:

$$-\text{cov}(UM_t, EM_t) \cdot \text{cov}(\Delta R_t, UM_t) = (1-\beta)\text{var}(EM_t) \cdot b_1 \text{var}(UM_t^*) \quad (6)$$

Our first proposition is that  $c_2 \begin{matrix} \leq \\ > \end{matrix} 0$  as  $\beta \begin{matrix} \geq \\ < \end{matrix} 0$ , which follows immediately from (6). If, for example, the measure of anticipated money used by the researcher is biased downward ( $\beta > 1$ ), then the coefficient of anticipated money in (3) will be negative.

Our second proposition also follows immediately from (6). If the measure of anticipated money is unbiased ( $\beta = 1$ ), then  $c_2 = 0$ . The degree of inefficiency of an unbiased forecast, equal to  $\text{var}(v_t)$  in (2), cannot cause the coefficient of anticipated money in (3) to be negative.<sup>7</sup>

These two propositions provide the following perspective on the puzzle of anticipated money. If the measure of anticipated money used by the researcher has a downward bias, then correcting this bias may eliminate the negative coefficient if the true coefficient of anticipated money is zero. However, an attempt to improve the efficiency of an already unbiased measure, perhaps by incorporating additional information that becomes available between the date of the forecast and the date of the announcement, should have no such effect.

This point has not been made previously in the literature. Indeed, it appears to be the source of some confusion. Roley (1983), for example, adjusts the raw survey forecasts beginning with the money announcement on February 8, 1980 to reflect the fact that the survey is no longer taken on the day previous to the Friday announcement, but three days before (Tuesday). Roley assumes that movements in the Treasury bill yield over the intervening three days capture the change in the market's expectation of the money supply announcement. He finds that replacing the raw survey forecast with an adjusted forecast, which uses this information, eliminates the significance of the coefficient of anticipated money. Hein (1985) points out that Roley's correction implicitly eliminates a downward bias in the survey forecast. Hein re-estimates Roley's correction, no longer constraining it to eliminate bias, and finds that the coefficient of anticipated money remains significant.<sup>8</sup> Hein does not appear to appreciate the precise nature of this result. For example, he refers interchangeably (page 268) to Roley's "implicit correction for inefficiencies in the survey forecast" and the fact that Roley has corrected for the tendency of the survey

forecasts "to underestimate, in absolute value, nonzero money stock changes."<sup>9</sup>

Clark, Joines and Phillips (1985) argue that the survey expectation does not appear to incorporate fully the information contained in "social security weeks." While it may be genuinely useful to incorporate this information into the proxy for anticipated money, our result shows that this suggestion to improve the survey forecast cannot be considered an explanation of the puzzle.<sup>10</sup>

## V. Some Empirical Evidence

In this section, we first perform standard tests for the unbiasedness of the median response to the survey conducted by Money Market Services, Inc.<sup>11</sup> Let  $\Delta M_t^E$  denote the forecast change in the money supply according to this survey, and let  $\Delta M_t$  denote the actual change that is subsequently announced. The standard test for unbiasedness is an F-test of the null hypothesis  $\beta_0 = 0$  and  $\beta_1 = 1$  in the following regression:

$$\Delta M_t = \beta_0 + \beta_1 \Delta M_t^E + e_t \quad (7)$$

Our estimates of this equation, for the full sample and for each of the subsamples, are presented in Table 2. In the subsample from February 1984 to September 1985, as well as for the full sample, there is a significant downward bias in the forecasts. In the subsample October 1979 to October 1982, where the coefficients of anticipated money are the largest, the median survey forecast has a downward bias, but it is not significant.

We utilize, for each subsample, the fitted values from the regressions presented in Table 2 as our revised measure of anticipated money. By construction, the bias in the survey measure of anticipated money is thus eliminated for each subsample.

We next rerun the regressions of the post-announcement change in interest rates on both anticipated and unanticipated money. Substituting the revised measures of anticipated and unanticipated money will affect only the coefficients (and the standard errors) of anticipated money and the constant term.<sup>12</sup> Thus we present, in Table 1, the estimates of the coefficients ( $c_2^*$ ) of anticipated money after we have corrected the median response for bias. As we expect, in light of the downward bias in the survey median for all subperiods, the t-statistics for anticipated money decline in all of the twelve regressions. In the subsample February 1984 to September 1985, where the downward bias is the strongest, the coefficient of anticipated money ceases to be significant in the regression for Canadian Treasury bills. For the subsample October 1979 to October 1982, the significance of anticipated money in the regressions for U.S. Treasury bills, and for U.S. government and Government of Canada bonds, remains, although at a somewhat reduced level. For these regressions, the solution to the puzzle of anticipated money must be sought elsewhere.

We can provide, however, no alternative explanation that meets with our satisfaction. In terms of an economic explanation, we can only note that the subperiod October 1979 to October 1982 was characterized by the unprecedented level and volatility of interest rates, and followed an abrupt and dramatic shift in the operating procedures of the Federal

Reserve. In spite of the significant arbitrage profits to be earned from exploiting the predictive content of anticipated money, agents may have been too risk averse to act upon this information.

There exists, as well, the possibility that these results may be a statistical artifact. If we systematically delete observations from the October 1979 to October 1982 subsample, we find that the significance of anticipated money is extremely sensitive to four observations. If these four observations are deleted from the regression for U.S. Treasury bills, the t-statistic for anticipated money declines from 2.24 to 1.36.<sup>13</sup>

## VI. Summary and Conclusions

Data on the anticipated change in the money supply compiled by Money Market Services, Inc. have served as a catalyst to the rapidly-expanding literature on the impact of money "surprises" on financial markets. Somewhat paradoxically, researchers have found that the anticipated component in the Federal Reserve's weekly money supply announcement exerts a persistently negative effect on the post-announcement change in market yields.

In this paper, we have clarified the extent to which the non-rationality of the (widely-used) median response to the survey may underlie this puzzle. We prove that eliminating a (downward) bias in the measure of anticipated money can, in theory, eliminate this puzzle, but that improving the efficiency of an already unbiased measure cannot. We find, using Canadian as well as U.S. interest rate data, that correcting the downward bias in the survey measure reduces, but does not eliminate,

the significance of anticipated money.

## Footnotes

1. There is, however, disagreement in the interpretation to be assigned to the market's response to the news contained in the announcement. Cornell (1983), for example, has suggested that it may be only the nominal interest rate that rises in response to a positive surprise, to reflect a higher inflation premium. Urich and Wachtel (1981) and Roley and Walsh (1985), for example, argue that it is the real interest rate that rises in response to a positive surprise, to reflect the anticipation that the Federal Reserve will counteract - not accommodate - the surprise.
2. Roley (1983) uses the one-and-one-half hour interval (from 3:30 p.m. to 5:00 p.m. on the day of the announcement). Urich and Wachtel (1981) utilize a half-day interval, from the afternoon before the announcement to the morning after.
3. For Canada, the Treasury bill data are from the Bank of Canada's data bank or quote sheets. The data for long-term bonds are the yields on individual and heavily-traded bonds with a maturity of approximately 20 years (the 9 1/2's of 2001 for October 1979 to October 1982, and the 10 1/4's of 2004 for October 1982 to September 1985), from daily quote sheets provided by R. Hannah of the Securities Department of the Bank of Canada. For the United States, the bond yields are for the 20-year constant maturity bond from the Federal Reserve's H.15 release, made available to us through DRI Canada, and the bill data are from the Bank of Canada. The source of the money supply data is the Federal Reserves H.6 release. The data on the anticipated change in narrowly-defined money compiled by



Money Market Services, Inc. were made available to us through the courtesy of Vance Roley. In our empirical work, we use the percentage change in narrowly-defined money. To construct this percentage change, we use the preliminary (not the revised) data on the money supply.

4. The results also support the choice of subsamples. For the U.S. Treasury bills, the test statistics for structural change in the response to unanticipated money are significant (at least) at 10 per cent. We use the Wald test statistic which is asymptotically distributed as  $\chi^2(1)$  because the standard F-test is inappropriate in the presence of heteroscedasticity. The values of our test-statistic are 3.67 (for the break between the first and second subperiods) and 5.98 (for the break between the second and third). There is, of course, abundant evidence of a structural change in October 1979. See, for example, Loeys (1985).
5. The Bank of Canada (1980) sought, in 1980, to attenuate the response of short-term interest rates in Canada to movements in U.S. rates, given the increased volatility of the latter after the October 1979 shift in the monetary regime. The results in Table 1 provide evidence of this smoothing, at the short end of the maturity spectrum, in light of the increased volatility of interest rates on announcement days. Any smoothing of the response of short-term interest rates by the Bank of Canada will, of course, have repercussions on the foreign exchange value of the Canadian dollar. An analysis of the (perhaps) changing reaction function of the Bank of Canada is beyond the scope of the present paper.

6. The relevant t-statistics, with 155 degrees of freedom, are 2.32 for Treasury bills and 3.30 for U.S. government bonds.
7. Note that  $\text{var}(v_t)$  does not appear explicitly in (6). We can, however, readily rearrange (6) to obtain:

$$\frac{1-\beta}{\beta^2} (\text{var}(EM_t^*) - \text{var}(v_t)) \cdot b_1 \text{var}(UM_t^*) \quad (F1)$$

From (F1), it follows explicitly that  $c_2 = 0$  if  $\beta = 1$  regardless of the value of  $\text{var}(v_t)$ .

8. For the period February 8, 1980 to October 15, 1982, Roley estimates the following "revision" (bracketed figures are standard errors):

$$\Delta M_t = 0.2768 + 1.2016(\Delta M_t^E) + 1.2624(RF_t - RT_t) + u_t \quad (F2)$$

(0.1872) (0.1216) (0.3472)

where  $\Delta M_t$  is the actual change in the money supply,  $\Delta M_t^E$  is the forecast change in the Tuesday survey, and  $RF_t$  and  $RT_t$  are the three-month bill yields on Friday and Tuesday, respectively. Roley uses the fitted values from (F2) to proxy the market's expectation, and finds that anticipated money no longer exerts a significant negative impact on the post-announcement change in three-month bill yields. Hein (1985) shows that when he reruns (F2) with the coefficient of  $\Delta M_t^E$  constrained to unity, then anticipated money remains a significant determinant of the post-announcement change in yields. Note, as anticipated by the theorem we derive in the text, Roley's "correction" does involve the elimination of a downward bias in the median response to the survey conducted by Money Market Services, Inc.

9. Roley (1985), in his reply to Hein, raises arguments similar to the

ones made in this paper.

10. We have assumed throughout that the coefficients  $\alpha$  and  $\beta$  in (2) are constant. With time varying values of  $\alpha$  and  $\beta$ , the interpretation of the coefficients in (3) may be sample-specific. It is difficult to say anything about the impacts of bias and inefficiency in this case without being very specific about the nature of the time variation in the parameters.
11. Many researchers have examined the rationality of these forecasts. See, for example, Grossman (1981), Hafer (1983), Ulrich and Wachtel (1984), and Engel and Frankel (1984).
12. Let  $\Delta\hat{M}_t = \hat{\beta}_0 + \hat{\beta}_1\Delta M_t^E$ , where " $\hat{\phantom{x}}$ " denotes the OLS estimate. We have two fitted regressions:

$$\Delta R_t = \hat{c}_0 + \hat{c}_1(\Delta M_t - \Delta M_t^E) + \hat{c}_2\Delta M_t^E + e_{1t}$$

$$\Delta R_t = \hat{c}_0^* + \hat{c}_1^*(\Delta M_t - \Delta\hat{M}_t) + \hat{c}_2^*\Delta\hat{M}_t + e_{2t}$$

Using the definition of  $\Delta\hat{M}_t$ , we see that the regressors in the two equations span the same space. Therefore,  $e_{1t} = e_{2t}$ . Also, since the difference between  $(\Delta M_t - \Delta M_t^E)$  and its orthogonal projection onto the constant and  $\Delta M_t^E$  is exactly  $(\Delta M_t - \Delta\hat{M}_t)$ , the coefficients  $\hat{c}_1$  and  $\hat{c}_1^*$  are numerically identical as are their estimated standard errors.

13. These results are from regressions of the post-announcement change in the interest rate on anticipated money and a constant. Note that if the true coefficient of expected money is zero, excluding unanticipated money from the regression is tantamount to eliminating any bias. Belongia, Hafer and Sheehan (1986) partition the sample 1978-1983 into 6-month subsamples, and then run regressions of the

post-announcement change in U.S. Treasury bills on both expected and unexpected changes in money. Belongia et. al. find that anticipated money is significant (and negative) at the 5 per cent level only for the subsample corresponding to the first half of 1981. They find that by dropping the observation for May 1, 1981 (one of the four observations deleted after our search), the significance of anticipated money is eliminated for this subsample. In conducting their analysis, Belongia et. al. employ a variation of the correction suggested by Roley (1983).

Table 1

THE IMPACT OF UNANTICIPATED AND ANTICIPATED MONEY ON POST-ANNOUNCEMENT  
INTEREST RATE CHANGES

$$\Delta R_t = c_0 + c_1(\Delta M_t - \Delta M_t^E) + c_2(\Delta M_t^E) + u_t$$

Interest Rate	Sample Period	$c_0$	$c_1$	$c_2$	$c_2^*$	SEE	$R^2$	DW	BP
Treasury Bills (U.S.)	Oct. 11/79- Oct. 1/82	0.06 (0.03)	32.56* (5.48)	-29.51* (9.86)	-21.70* (8.59)	0.38	0.21	2.08	0.89
	Oct. 8/82- Jan. 27/84	0.01 (0.01)	18.84* (3.35)	-5.75 (3.00)	-2.80 (3.32)	0.11	0.33	1.98	1.13
	Feb. 3/84-Sept. 5/85	0.02 (0.01)	7.62* (3.59)	-6.70 (3.95)	-2.26 (2.49)	0.10	0.06	2.06	0.82
Treasury Bills (Canada)	Oct. 11/79- Oct. 1/82	0.02 (0.01)	6.37* (1.78)	-4.63 (3.20)	-3.25 (2.79)	0.12	0.08	1.68	11.44
	Oct. 8/82- Jan. 27/84	0.01 (0.01)	4.55* (1.78)	-1.43 (2.03)	-0.71 (1.78)	0.06	0.09	1.67	2.78
	Feb. 3/84-Sept. 5/85	0.01 (0.01)	3.75* (1.74)	-4.14* (1.92)	-1.69 (1.21)	0.05	0.08	2.13	6.95
Government Bonds (U.S.)	Oct. 11/79- Oct. 1/82	0.03* (0.01)	11.63* (2.53)	-15.68* (4.55)	-12.24* (3.96)	0.18	0.17	2.04	0.52
	Oct. 8/82- Jan. 27/84	0.01 (0.01)	14.49* (3.06)	-7.99* (3.47)	-5.30 (3.03)	0.10	0.28	2.16	4.10
	Feb. 3/84-Sept. 5/85	0.01 (0.01)	7.98* (3.91)	-6.61 (4.30)	-2.09 (2.71)	0.11	0.06	2.05	3.19
Government Bonds (Canada)	Oct. 11/79- Oct. 1/82	0.05* (0.01)	9.94* (2.53)	-15.59* (4.55)	-12.38* (3.96)	0.18	0.14	1.90	3.72
	Oct. 8/82- Jan. 27/84	0.00 (0.01)	11.93* (3.24)	-4.60 (3.67)	-2.62 (3.21)	0.10	0.18	1.70	3.46
	Feb. 3/84-Sept. 5/85	0.02 (0.01)	5.66 (3.46)	-6.15 (3.81)	-2.49 (2.40)	0.10	0.04	2.11	0.98

Notes:  $\Delta M_{t,t}^E = \log(M_{t,t}^E) - \log(M_{t-1,t-1}^E)$ , and  $\Delta M_t = \log(M_t) - \log(M_{t-1})$ , where  $M_{t,t}^E$  is the median response to the Money Market Services, Inc. survey. Asterisks denote significance at 5 per cent level. Bracketed figures are standard errors. BP is the Breusch-Pagan statistic which tests for heteroskedasticity and is asymptotically distributed  $\chi^2(2)$ .  $c_2^*$  is the coefficient of  $\Delta M_{t,t}^E$  when the survey median has been corrected for bias within each subperiod. For the first and last subperiods, the standard errors for Canadian Treasury bills are calculated according to White (1980), due to significant BP-statistics. (See Breusch and Pagan (1979).) Second subperiod Canadian Treasury bill results have been corrected for first-order serial correlation using the Cochrane-Orcutt procedure since originally the DW-statistic was 1.19.

Table 2

TESTS OF THE UNBIASEDNESS OF THE MEDIAN RESPONSE TO THE  
SURVEY OF MONEY MARKET SERVICES, INC.

$$\Delta R_t = \beta_0 + \beta_1 \Delta M_t^E$$

Sample Period	$\hat{\beta}_0$	$\hat{\beta}_1$	SEE	R <sup>2</sup>	DW	F-TEST ( $\beta_0=0,$ $\beta_1=1$ )
Oct.11/79-Sept. 5/85	0.0004 (0.0003)	1.2051* (0.0837)	0.00	0.40	2.00	5.41*
Oct.11/79- Oct. 1/82	0.0007 (0.0005)	1.1439 (0.1446)	0.01	0.29	1.95	1.95
Oct. 8/82- Jan.27/84	0.0004 (0.0005)	1.1360 (0.1376)	0.00	0.50	2.24	1.34
Feb. 3/84-Sept. 5/85	-0.0005 (0.0004)	1.4488* (0.1109)	0.00	0.68	2.28	8.42*

Notes: Asterisks denote significance at 5 per cent level. Bracketed figures are standard errors. F-test ( $\beta_0 = 0, \beta_1 = 1$ ) is distributed F(2, n-2).

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