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The Reaction of Stock Prices to Unanticipated Changes in Money: A Note

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MUCH OF THE PAST work on the money-stock market relationship centered on the question of whether money is a leading indicator of stock prices. Studies by Sprinkel [22], Homa and Jaffee [10], and Hamburger and Kochin [8] supported the view that past increases in money lead to increases in equity prices. The implication of this work was that investors could earn above normal profits by using a trading strategy based on the observed behavior of the money stock. This contradicts the efficient markets hypothesis which asserts that current asset prices reflect all available information so that no such trading strategy can exist. Subsequent research by Cooper [3], Pesando [17], Rozeff [21], and Rogalski and Vinso [19] has shown that past money changes do not contain predictive information on stock prices, upholding the efficient markets view.

This paper investigates whether the response of common stock prices to weekly money announcements is consistent with the efficient markets hypothesis. Unlike the above research, therefore, the focus is on the very short-run response of stock prices to both anticipated and unanticipated announced changes in money. Recent work by Berkman [1], Grossman [7], Urich and Wachtel [25], and Roley [20] indicates that short-term interest rates respond only to the unexpected component of the announcement, with short-term rates rising when the announced change in money exceeds the expected change.[1] Berkman also examined the reaction of stock prices, finding that an unanticipated increase in the money supply depressed share prices. Lynge [13] found that positive money announcements lowered stock prices, but since he did not distinguish expected from unexpected money growth, his results do not bear directly on the efficient markets issue.

In investigating the response of stock prices to weekly money announcements, survey data on market participants' forecasts of the announced weekly change

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[1] Using the same survey data as those used here, Urich and Wachtel [25] obtain this result in tests over individual years, but not over the entire period corresponding to the availability of the survey data. Using a different time interval to measure changes in short-term interest rates, Grossman [7] and Roley [20] find that anticipated announced changes in money as represented by the survey data are not statistically significant over the same sample period.

are used to distinguish expected from actual changes in money. Following tests of the efficient markets hypothesis using these data, two further questions are examined. First, has the reaction of stock prices changed since the Federal Reserve altered its monetary control procedures in October 1979? Second, does the impact of unexpected money on stock prices extend beyond the opening quotes?

The paper is organized as follows. In the first section, the theoretical framework linking money and stock prices is reviewed. The data on money announcements, the survey measure of expected money changes, and changes in stock prices are described in the second section. In the third and fourth sections, the empirical results are presented, while the final section summarizes the main conclusions.

I. Theoretical Framework

There are at least two explanations of the negative relation between stock price changes and unanticipated announced weekly changes in money. One explanation is that when the money supply rises faster than was expected, agents revise upwards their expectations of future inflation which in turn depresses stock prices. In terms of this channel, Feldstein [5] argues that increased inflation decreases real after-tax profits because of the nonindexation of inventory and depreciation charges, and this will tend to depress stock prices. Empirical support for this link between inflation and stock prices is reported by Summers [24] in an analysis of firm data. An increase in expected inflation will also depress stock prices if it raises the expected return on an alternative asset such as owner-occupied housing: Hendershott and Hu [9] and Summers [23] provide evidence that this effect was significant in the 1970s. Finally, higher anticipated inflation will cause stock prices to fall if, as Modigliani and Cohn [14] contend, investors mistakenly compare the nominal return on bonds, swelled by inflation, to the earnings-price ratios of stocks (a real rate of return).[2]

An alternative explanation of the response of stock prices to unexpected changes in the money supply is based on investors' expectations of the reaction of the Federal Reserve to the surprise. In particular, if market participants believe that the Federal Reserve will move rapidly to offset a surge in money, they will be led to anticipate higher short-term interest rates as a result of an unanticipated increase in the money supply.[3] The anticipation of higher short-term interest rates in the future may cause longer term yields to rise immediately with a subsequent negative impact on stock prices. Since this explanation rests on anticipations of the future actions of the Federal Reserve, asymmetries in the

[2] A number of empirical studies have found a negative relationship between inflation and stock prices, including those by Bodie [2], Jaffee and Mandelker [11], Nelson [16], and Fama and Schwert [4]. The results in these studies are in sharp contrast to the traditional view that stock prices are either unaffected by or perhaps positively related to expected inflation. See, for example, Williams [26].

[3] With lagged reserve accounting, short-term rates may rise even in the absence of overt Federal Reserve actions if market participants increase their assessment of the excess demand for reserves in the current statement week. See Grossman [7] and Roley [20] for more detailed descriptions of these arguments.

response of stock prices to unanticipated announced changes in money or changes in the response of stock prices due to different Federal Reserve operating procedures would not be unlikely.

To investigate the relationship between stock prices and money supply announcements, the change in stock prices is assumed to be a linear function[4]

$$\Delta SP_t = a + b(\Delta M_t^a - \Delta M_t^e) + e_t \tag{1}$$

where

ΔSP_t = change in stock prices observed after the money announcement, in percent;
ΔM_t^a = announced change in the money stock, in percent;
ΔM_t^e = expected change in the money stock, in percent; and
e_t = random error term

The basic proposition of the efficient markets theory is that only the unexpected change in money should influence stock prices so that the data should not reject the restriction that the coefficients on ΔM_t^a and ΔM_t^e sum to zero. The hypothesized behavior of security market participants outlined above further stipulates that b should be negative.

II. The Data

The weekly data used in this paper begin on 29 September 1977, and end on 29 January 1982. Specific details about the data on announced changes in money, expected money, and stock prices follow.

Changes in the Money Stock

The money stock data consist of announced weekly changes in the narrowly defined money stock as reported in the Federal Reserve's H.6 release. A reported change corresponds to the estimate of the level of the money stock for the statement week ending on Wednesday of the previous calendar week minus the revised estimate of the previously reported level of the money stock. To form percentage changes, a reported dollar change is divided by the revised estimate of the previous week's announced level. Until 31 January 1980, the data used here correspond to announced changes in "old M1" on Thursdays at 4:10 P.M. Since then, the announcements have been made on Fridays at 4:10 P.M. For this period, the data employed are those for M1-B, and more recently, M1, where the definition of this latter aggregate is equivalent to that of M1-B.[5] Over the entire sample period, money announcements were made after the stock market closed.

[4] Several alternative specifications were also empirically examined. The empirical results from these specifications are briefly contrasted to those of (1) in the third section.

[5] Announced changes in M1-B are analyzed here because of the emphasis placed on M1-B by the Federal Reserve policymakers and market participants. It should also be noted that the M1-B data for 1981 are not the shift-adjusted M1-B figures which reflect the introduction of nationwide NOW accounts. While the Federal Reserve's target range was in terms of shift-adjusted M1-B, weekly announced changes were not shift adjusted.

Expected Changes in the Money Stock

The measure of the expected change in the money stock is the median forecast of about 60 money market participants who are surveyed each week by Money Market Services, Inc.[6] When the money announcement was made on Thursdays, this firm solicited forecasts of the change in M1 on both Tuesdays and Thursdays. The Thursday median prediction is used here as the measure of the expected change during this period. Since 8 February 1980 (when the Federal Reserve switched to Friday announcements), the survey has been conducted only on Tuesdays, and the aggregate predicted until the beginning of 1982 was M1-B, and since then, M1. The median of these anticipated changes is used as the measure of the market's expected change for this period.[7] To form percentage changes, a dollar change from the survey is divided by the (unrevised) level of the money stock announced in the previous week, which is the most recent money stock information available to investors from the Federal Reserve.

Based on the results of other studies, the survey expectations measure appears to be rational. Grossman [7] examined the survey data for the pre-October 1979 period, and found that they were efficient and outperformed a simple autoregressive model in predicting weekly money changes.[8] For the post-October 1979 period, Roley [20] found that the null hypotheses of unbiasedness and efficiency could not be rejected at the 5 percent level of significance, and that the survey data again outperformed an autoregressive forecasting equation.

Stock Prices

To represent the response of stock prices to weekly money supply announcements, an index of closing stock prices on the day of an announcement is subtracted from opening prices on the first business day following an announcement. Specialists' opening prices, which attempt to balance supply and demand for each stock, are used to form the change in stock prices resulting from a money supply announcement. Since market participants have overnight (or over the weekend for the latter part of the sample) to plan their response to the new information in the announcement, their buy and sell orders given to the specialists

[6] We are grateful to Mr. Raul A. Nicho of Money Market Services, Inc., for supplying the survey data.

[7] An alternative measure was also used for this latter era which adjusted the Tuesday forecast to take account of relevant information which became available between Tuesday and the Friday announcement. Following Roley [20], this new information was assumed to be reflected by the change in the 3-month Treasury bill yield from 3:30 P.M. on Tuesday to 3:30 P.M. on Friday. To capture this new information, the announced money change was regressed on the median predicted change and the change in the Treasury bill yield. The fitted values from this regression formed the "revised" expectations of weekly changes in money. However, despite the difference between estimation results using the survey and revised expectations measures for the Treasury bill market found by Roley [20], the two expectations measures yielded virtually the same results for the stock market. Thus, only empirical results using the survey measure are reported in what follows.

[8] The basic notion behind the efficiency test is that if weekly changes in money are generated by an autoregressive process, the market's expectation should be generated by the same process. See, for example, Modigliani and Shiller [15] and Pesando [17]. While Grossman [7] could not reject efficiency, unbiasedness could be rejected. However, adjusting the survey measure by an additive constant to eliminate the bias did not significantly change any of the results reported below.

for each stock should reflect this new information.[9] The possibility that the effect of unanticipated money persists is, however, explored in Section IV. The particular stock index employed is the Dow Jones Industrial Average (DJIA).[10] Thus, the dependent variable is the percentage change of the Friday opening value of the DJIA from its Thursday close for the period up to 31 January 1980, and the percentage change of the Monday opening from the Friday close for the remainder of the sample period.[11]

III. Estimation Results

The model is estimated and tested over three subperiods. The first period begins on 29 September 1977, when the money survey was initiated, and ends on 4 October 1979, two days before the Federal Reserve announced the switch in its operating procedures. Period two covers the weeks after the policy change when the money announcement was still made on Thursdays. Period three starts on 7 February 1980, when the money announcement was shifted to Friday and runs to 29 January 1982. Observations were dropped if the money announcement was not made on the usual day or if a holiday intervened between the announcement day and the next business day.[12]

Table I presents the estimates of the linear-response model (1) for each of the subperiods. Dummy variables were added to the model to allow for the possible effects of changes in the Federal Reserve's discount rate announced after the stock market closed.[13] The reported F-statistics test the hypothesis that the coefficients on ΔM_t^a and ΔM_t^e sum to zero so that only unanticipated changes in

[9] For evidence that opening prices are as representative of equilibrium prices as subsequent intraday transactions prices, see Garbade and Sekaran [6].

[10] The DJIA was used because opening prices of broader stock price indices, such as the Standard and Poor's 500, are not publicly available. Since opening prices are calculated by specialists in each stock, the use of the DJIA may also be preferable given the large trading volumes of the stocks included in this index.

[11] We are grateful to Morgan Lynge, Jr., for the DJIA data through 1979. The observations for 1980–2 are from *Barron's*.

[12] Four observations were dropped in the first time period, three in the second, and 13 in the third.

[13] The discount rate dummy variables are defined as follows:

D_1 = 1 when discount rate raised ¼ point
= 0 otherwise
D_2 = 1 when discount rate raised ½ point
= 0 otherwise
D_3 = 1 when surcharge raised 3 points
= 0 otherwise
D_4 = 1 when discount rate lowered 1 point
= 0 otherwise
D_5 = 1 when surcharge lowered 1 point
= 0 otherwise
D_6 = 1 when discount rate lowered 1 point and surcharge lowered 1 point
= 0 otherwise

The estimated coefficients on changes in the discount rate–with one exception–imply a negative relationship between changes in the discount rate and stock prices. For example, the lowering of both the discount rate and the surcharge by one percentage point on 30 October 1981, is estimated to have raised the DJIA by over 1 percent.

Table I

Estimated Effect of Unexpected Money on Stock Prices

$$\Delta SP_t = a + b(\Delta M_t^a - \Delta M_t^e) + \sum_i d_i D_{it} + e_t$$

	Estimated Coefficients[a]								Summary Statistics			Test Statistics[b]	
Time Period	a	b	d_1	d_2	d_3	d_4	d_5	d_6	$\bar{R}^2$	SER	$DW(i)$	$F(n_1, n_2)$	MS
1.1 29 September 1977–4 October 1979 $n = 102$	−.0001 (−0.21)	−.2861 (−3.98)	−.0003 (−0.10)	−.0018 (−0.80)					.124	.0032	1.81(4)	0.16(1, 97)	.688
1.2 11 October 1979–31 January 1980 $n = 14$	−.0001 (−.13)	−.4540 (−1.48)							.084	.0039	1.79(3)	.001(1, 11)	.970
1.3 8 February 1980–29 January 1982 $n = 88$	−.0009 (−2.19)	−.3985 (−5.71)			−.0093 (−2.34)	−.0015 (−0.38)	.0002 (0.05)	.0129 (3.26)	.323	.0039	1.66(13)	2.65(1, 81)	.103

[a] Numbers in parentheses are t-statistics.

[b] Null hypothesis is that the coefficients on ΔM_t^a and ΔM_t^e sum to zero.

Definitions:

$DW(i)$ = Durbin-Watson statistic adjusted for i gaps

$F(n_1, n_2)$ = F-statistic with n_1 and n_2 degrees of freedom

MS = marginal significance level, which is the probability of obtaining that value of the F-statistic or higher under the null hypothesis

money affect stock prices. As these test statistics indicate, this implication of the efficient markets hypothesis cannot be rejected at conventional significance levels although the marginal significance level for the third period is close to 10 percent.

The results from Table I also support the theories, discussed in Section I, which predict that unexpected changes in the money stock have a negative impact on stock prices. In particular, an unanticipated increase in money of one percentage point is associated with a subsequent fall in the DJIA of about .35 percent. Moreover, the coefficients on unanticipated money are statistically less than zero at the 1 percent level except for the middle period which has only 14 observations.

Other variants of the simple linear-response model yield results similar to those in Table I. In particular, specifying announced money supply surprises in dollar amounts while maintaining the percentage change specification for stock prices also leads to negative responses of stock prices to unanticipated money and to rejection of the hypothesis that anticipated money affects stock prices at the 5 percent level of significance. Similarly, specifying both dependent and independent variables in changes rather than percentage changes yields these same results.

Additional specifications also generally provide results similar to those in Table I. In particular, substituting surprises in money supply levels in their percentage $[(M_t^a - M_t^e)/M_{t-1}^a)]$ or dollar $(M_t^a - M_t^e)$ amounts for the measure of money surprises in (1) again supports the efficient markets hypothesis, with one exception.[14] Relaxing the linear response assumption by adding a quadratic term for these various measures of money surprises also results in only minor differences. For example, the hypothesis that anticipated money affects stock prices could not be rejected in only one of these nonlinear specifications.[15] Thus, the estimation and test results reported in Table I appear to be robust.

IV. A Further Examination of the Stock Price Response

Two aspects of the response of stock prices to money surprises are considered in this section. First, the evidence concerning any change in the response as a result of the Federal Reserve's adoption of a reserve-aggregate monetary control procedure is reviewed. Second, the question of whether the stock price response is complete within one day is examined.

The Change in Federal Reserve Policy

Following Lucas [12], a great deal of attention has recently been focused on the question of whether estimated economic relationships are invariant to shifts

[14] The exception arises in the first subperiod using $(M_t^a - M_t^e)$ as the measure for unanticipated money. In this case the test statistic analogous to that reported in Table I is $F(1, 97) = 5.80$ which has a marginal significance level of 0.017. To construct expected money supply levels, it is assumed that investors do not expect any revision in the previous week's announced level of money, i.e., $\Delta M_t^e = M_t^e - M_{t-1}^a$. In contrast, the announced change in money equals $\Delta M_t^a = M_t^a - M_{t-1}^r$, where M_{t-1}^r is the Federal Reserve's revised estimate of the previous week's announced level of the money supply.

[15] This result again occurs for the first subperiod using $(M_t^a - M_t^e)$ as the measure for unanticipated money. The associated test statistic is $F(2, 95) = 3.19$ which has a marginal significance of 0.045. In this test, anticipated money was entered as a quadratic function.

in policy regimes. The impact of the Federal Reserve's announced change in operating procedures on 6 October 1979, on financial relationships provides an excellent opportunity to investigate this important issue. Evidence that the shift in Federal Reserve operating procedures has affected the response of Treasury bill yields to unanticipated announced changes in money is reported by Roley [20]. While it might be expected that the largest impact of this change in policy regimes would appear in the Treasury bill or federal funds markets, it is nevertheless of interest to examine whether the change in policy regimes has affected other financial markets not directly linked to the implementation of monetary policy. For example, if shifts in monetary policy regimes only significantly affect relationships in those markets related directly to the implementation of monetary policy, then the analysis of the effects of future policy regime shifts on the economy would be greatly simplified.

The equality of stock price responses in the pre- and post-October 1979 periods was tested for both the linear-response model (1) and the other models mentioned in the previous section. In the case of the basic model (1), the hypothesis that the response was the same in the one pre-October 1979 period and the latter of the two post-October 1979 periods cannot be rejected even at the 40 percent significance level.[16] In other specifications involving combinations of absolute and relative changes in stock prices and money surprises as well as nonlinear responses, the hypothesis that the response of stock prices to unanticipated announced changes in the money supply remained unchanged could be rejected in only one instance.[17]

In an attempt to further isolate the effect of monetary policy, money surprises were disaggregated according to the relation of money growth to the Federal Reserve's long-run ranges.[18] Following Urich and Wachtel [25], surprises were divided into three groups: positive surprises when money was above its target range, negative surprises when money was below the range, and all other surprises. These disaggregated money surprise variables were then substituted into the linear-response model (1). In within subperiod tests, the results indicated that the estimated coefficients on the disaggregated surprises are not significantly different. Moreover, in tests across the first and third subperiods, the equality of the estimated coefficients on the three categories of surprises cannot be rejected. However, the hypothesis that the response of stock prices to positive money

[16] The F-statistic is equal to 0.523 with (1,192) degrees of freedom. As is the case for all tests across subperiods reported in this paper, the estimated equation for the pooled sample was corrected for heteroscedasticity by weighting the observations in each subperiod by the reciprocal of the estimated standard error from the subperiod regression. Because of the limited number of observations in the second subperiod, the estimated equation for this period is not included in the test.

[17] This hypothesis could be rejected at the 5 percent level of significance for the specification involving changes in stock prices (ΔSP_t) and money surprises in terms of levels ($M_t^a - M_t^e$) in the quadratic response model.

[18] While Urich and Wachtel [25] employ short-run ranges, the Federal Reserve's long-run ranges are used here. Long-run ranges are used for two reasons. First, market participants probably made more accurate assessments of the long-run ranges. Second, the short-run ranges (and later, paths) were, in principle, set to be consistent with eventually obtaining money growth within the long-run ranges.

Table II

Stock Price Responses after the Market Opens

$$\Delta SP_t = a + b(\Delta M_t^a - \Delta M_t^e) + e_t$$

	Time Period	Dependent Variable	Estimated Coefficients		Summary Statistics		
			a	b	$\bar{R}^2$	*SER*	$DW(i)$
2.1	29 September 1977–4 October 1979 $n = 101$	$\Delta SP1$	.0008 (3.14)	.0531 (1.00)	.000	.0024	2.00(5)
2.2		$\Delta SP2$	.0012 (1.17)	−.0639 (0.27)	−.009	.0103	1.76(5)
2.3	11 October 1979–31 January 1980 $n = 14$	$\Delta SP1$	−.0007 (−0.56)	.1855 (0.52)	−.06	.0047	1.40(3)
2.4		$\Delta SP2$	.007 (.1759)	−1.7093 (−1.60)	.11	.0134	.95(3)
2.5	8 February 1980–29 January 1982 $n = 88$	$\Delta SP1$	−.0010 (−3.60)	−.1771 (−3.88)	.139	.0026	1.46(13)
2.6		$\Delta SP2$	−.0007 (−0.64)	−.1155 (−0.65)	−.007	.0102	1.44(13)

Definitions:

$\Delta SP1$ = *DJIA* at 11:00 minus its opening value on the day after the money announcement, in percent

$\Delta SP2$ = closing *DJIA* minus its opening value on the day after the money announcement, in percent

surprises remained unchanged when money growth is above its long-run range can be rejected at the 5 percent level of significance.[19]

Speed of Stock Price Adjustment

In order to investigate whether the effect of unanticipated money on stock prices persists beyond the opening prices of the day after the announcement, the linear-response model was reestimated using two alternative dependent variables. The first, ΔSP1, is the percentage change in the DJIA from the opening quotes to 11:00 A.M. EST, one hour after the market opens. The second, ΔSP2, is the percentage change in the DJIA from the opening to the close for the day after the announcement.

Table II presents the estimated models for each subsample. As these results indicate, the only evidence of persistence occurs in the third period when the dependent variable is ΔSP1, and the estimated response is substantially smaller than the initial reaction (compare Equation 2.5 with Equation 1.3). Thus, these results generally support the view that the response of stock prices to money surprises is immediate.

[19] The *F*-statistics for the three within-subperiod tests are 0.468 (2, 96), 0.661(1, 11), and 2.035 (2, 80) with marginal significance levels of 0.634, 0.538, 0.135, respectively. In the across-subperiod test involving all three estimated coefficients, the *F*-statistic is 1.777(3,176) with marginal significance level of 0.151. For the across-subperiod test involving only positive money surprises when money growth is above its long-run range, the *F*-statistic is 5.191(1,176) with marginal significance level of 0.023.

V. Summary and Conclusions

This paper has examined the short-run reaction of stock prices to weekly money supply announcements. Several conclusions emerge from this empirical investigation. First, stock prices respond only to the unanticipated change in the money supply as predicted by the efficient markets hypothesis. Second, an unanticipated increase in the announced money supply depresses stock prices while an unanticipated decrease elevates stock prices. Third, the stock price response does not depend on the relationship of the money supply to the long-run ranges of the Federal Reserve, and there is only limited evidence that the stock price response changed as a result of the Federal Reserve's switch to a reserve-aggregate approach to monetary control in October 1979. Finally, the stock price response is essentially complete early in the subsequent trading day.

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