NBER WORKING PAPER SERIES

THE REACTION OF STOCK PRICES TO UNANTICIPATED CHANGES IN MONEY

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Working Paper No. 958

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
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August 1982

NBER Working Paper #958
August 1982

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ABSTRACT

This paper investigates the short-run effect of unexpected changes in the weekly money stock on common stock prices. Survey data on money market participants' forecasts of money changes are employed to construct the measure of unanticipated movements in the money stock. The results indicate that an unexpected increase in money depresses stock prices and, consistent with the efficient markets hypothesis, only the unexpected part of the weekly money announcement causes stock price fluctuations. The October 1979 change in Federal Reserve operating procedures appears to have made stock prices somewhat more sensitive to large money surprises.

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Revised
July 1982

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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 [23], Homa and Jaffee [11], and Hamburger and Kochin [9] 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 [18], Rozeff [22], and Rogalski and Vinso [20] 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 prediction of 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 [8], Urich and Wachtel [26], and Roley [21] 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 are used to distinguish expected from actual changes in money. Using these data, the usual representation of the efficient markets model is generalized by allowing the possibility that responses to unanticipated money are both nonlinear and asymmetric. Three further questions are then considered: has the reaction of stock prices changed since the Federal Reserve altered its monetary control procedures in October 1979; does the impact of unexpected money on stock prices extend beyond the opening quotes; and do stock prices move in anticipation of the money announcement.

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

At least two explanations are consistent with the notion that stock prices are negatively related to unanticipated announced weekly changes in money. One explanation is that when money rises faster than expected, agents revise upward their expectations of future inflation. In turn, higher expected inflation is thought to depress stock prices through a number of channels. Feldstein [6] argues that inflation decreases real after-tax profits because of the nonindexation of inventory and depreciation charges. Lower expected profits require equity prices to drop in order for stock to provide a competitive return. Empirical support for this view is reported by Summers [25] in an analysis of firm data. Increased expected inflation would also depress stock prices if it raises the expected return on an alternative asset such as owner-occupied housing. Hendershott and Hu [10] and Summers [24] provide evidence that this effect was significant in the 1970s. Finally, higher anticipated inflation would cause stock prices to fall if, as Modigliani and Cohn [15] 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 interpretation is that the response of stock prices to unexpected money reflects agents' expectations of the reaction of the Federal Reserve to the surprise. In particular, market participants may believe that the Federal Reserve will move rapidly to offset a surge in money with the consequence of higher short-term interest rates. Moreover, 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.[3/] Through either of these channels, the anticipation of higher rates in the very near future prompts sales of short-term securities immediately after the announcement, forcing rates to rise. Since the stock market closes before the announcement but the money market resumes trading after the announcement, stock market participants will have already observed the rise in short-term rates associated with the money surprise when planning their activity for the next business day. If some holders of stock view short-term securities as substitutes in their portfolios, the higher short-term yields will cause these agents to place sell orders, and opening stock prices will likely fall below the closing prices of the day before. Since this theory hinges on market participants guessing the future actions of the Federal Reserve, asymmetries in response or changes in response due to different Federal Reserve operating procedures would not be unlikely.

As a first step in investigating the reaction of stock prices to announced weekly changes in money, the usual linear model is employed. This model may be represented as

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

where ΔSP_t = change in stock prices observed after the money announcement

ΔM_t^a = announced change in the money stock

ΔM_t^e = expected change in the money stock

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 September 29, 1977, and end on January 29, 1982. Specific details about the data on announced changes in money, expected money, and stock prices follow.

A. Changes in the Money Stock

The money stock data consist of announced weekly changes in the narrowly defined money stock, in billions of dollars, as reported in the Federal Reserve's H.6 release. Both a revised estimate of the previous week's announced level and the change in money for the statement week ending on Wednesday of the previous calendar week are reported. Until January 31, 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.[4/] Over the entire sample period, money announcements were made after the stock market closed.

B. 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.[5/] 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 February 8, 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.[6/]

Based on the results of other studies, the survey expectations measure appears to be rational. Grossman [8] 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.[7/] For the post-October 1979 period, Roley [21] 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.

C. Stock Prices

Since the efficient markets theory asserts that current stock prices reflect all available information, the change in stock prices should be from just before the announcement to the first observation of prices after the announcement. For stock prices, this amounts to subtracting the closing prices on the day of the announcement from the opening prices on the first business day following the 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 reactions should be reflected in the buy and sell orders given to the specialists for each stock before the market opens. Hence, the specialists' opening prices, which attempt to balance supply and demand for each stock, should embody all the effects of the money surprises.[8/] 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).[9/] Thus, the dependent variable is the Friday opening value of the DJIA less its Thursday close for the period up to January 31, 1980, and the Monday opening less the Friday close for the remainder of the sample period.[10/]

III. Estimation Results

In this section, the effects of anticipated and unanticipated announced changes in money are examined using the basic linear model of equation (1). The robustness of the results from this model is then checked by testing for reactions to announced revisions of the money stock and for nonlinear responses.

All models are estimated and tested over three subsamples. The first period begins on September 29, 1977, when the money survey was initiated, and ends on October 4, 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 February 7, 1980, when the money announcement was shifted to Friday, and runs to January 29, 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.[11/]

A. Basic Model

Table I presents the estimates of the simple linear-response model (1) for each of the subsamples. 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.[12/] 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 money affect stock prices. As these test statistics indicate, this implication of the efficient markets hypothesis cannot be rejected at conventional significance levels.

The results from Table I also support the theories, given in section I, which predict that unexpected changes in the money stock have a negative impact

Table I
ESTIMATED EFFECT OF UNEXPECTED MONEY ON STOCK PRICES

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

	Time Period	Estimated Coefficients[a/]								Summary Statistics			Test Statistics[b/]	
		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	September 29, 1977 -October 4, 1979 n = 102	-.024 (-.089)	-.610 (-3.620)	-4.450 (-1.684)	-1.648 (-.890)					.148	2.579	1.75(4)	0.20(1,97)	.660
1.2	October 11, 1979- January 31, 1980 n = 14	-.248 (-.264)	-.649 (-1.052)							.008	3.342	1.91(3)	0.06(1,11)	.811
1.3	February 8, 1980- January 29, 1982 n = 88	-.926 (-2.272)	-.757 (-5.195)			-6.510 (-1.738)	-1.778 (-.475)	.386 (.103)	11.103 (2.965)	.276	3.721	1.52(13)	1.42(1,81)	.235

[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:

ΔSP_t = opening Dow Jones Industrial Average after the money announcement minus its previous close

ΔM_t^a = announced change in the money stock

ΔM_t^e = expected change in the money stock

D_{it} = discount rate dummy variables (see footnote 12)

e_t = random error term

n = number of observations

$\bar{R}^2$ = multiple correlation coefficient corrected for degrees of freedom

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

on stock prices. In particular, an unanticipated increase in money of $1 billion is associated with a subsequent fall in the DJIA of about .7 points. 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.

B. More Generalized Models

The model used above imposes several implicit constraints which, if not appropriate, might bias the estimated effects of anticipated and unanticipated money. This section relaxes two such constraints and reestimates the effects.

One constraint involves the reaction of stock prices to revisions in the previous week's announced level of the money stock. The basic model (1) assumes that stock prices react only to unanticipated changes in money, although new information about the level is also announced. If this information also affects stock prices the model becomes

$$\Delta SP_t = a' + b'(\Delta M_t^a - \Delta M_t^e) + c'(M_{t-1}^r - M_{t-1}^a) + \sum_i d_i D_{it} + e_t \qquad (2)$$

where M_{t-1}^r = revised estimate of M_{t-1} announced at time t

M_{t-1}^a = level of the money stock announced at time t-1

D_{it} = dummy variable associated with a change in the discount rate at time t.

Furthermore, an equal response to both the unexpected change and the announced revision, i.e., $b' = c'$, means that agents respond to the errors in predicting the current level of money stock and not just to the unanticipated changes in money. In this case the model becomes[13/]

$$\Delta SP_t = a + b(M_t^a - M_t^e) + \Sigma d_i D_{it} + e_t \qquad (3)$$

where M_t^e = predicted level of the money stock at time t.

When equation (2) is estimated, the hypothesis that $b' = c'$ is never rejected by the data implying that equation (3) is preferred.[14/]

The response to anticipated money is therefore reexamined by estimating equation (3) and testing the constraint that the coefficients on M_t^a and M_t^e sum to zero. Panel A of Table II presents these results. The reported F-statistics are for the hypothesis that only a surprise in the level of money matters—as opposed to the expected level—and this hypothesis cannot be rejected at high significance levels. Thus, this specification also supports the efficient markets hypothesis.

The other constraint which is considered is that the response of stock prices is linear. This restriction can be relaxed by specifying a quadratic functional form

$$\Delta SP_t = a + (b_1 + b_2|UML_t|)UML_t + (c_1 + c_2 M_t^e)M_t^e + \Sigma d_i D_{it} + e_t \qquad (4)$$

where $UML_t = M_t^a - M_t^e$.

Equation (4) allows both the unexpected and expected money levels to affect stock prices nonlinearly. If only the unanticipated level matters, the coefficients on M_t^e, c_1 and c_2, should be jointly equal to zero.

Panel B of Table II presents the estimates of equation (4) for each subsample, with the restriction imposed that c_1 and c_2 are zero. The reported F-statistics indicate that this hypothesis cannot be rejected at the 5 percent significance level. The estimated model for the first period strongly supports the nonlinear specification and implies that the stock price response

Table II

A. EFFECT OF UNEXPECTED MONEY STOCK LEVELS ON STOCK PRICES

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

Time Period	Estimated Coefficients								Summary Statistics			Test Statistics	
	a	b	d_1	d_2	d_3	d_4	d_5	d_6	$\bar{R}^2$	SER	DW(i)	$F(n_1,n_2)$ [a/]	MS
2.1 September 29, 1977 -October 4, 1979 n = 102	.045 (.169)	-.602 (-3.469)	-4.661 (-1.761)	-1.694 (-.910)					.140	2.592	1.70(4)	0.13(1,97)	.718
2.2 October 11, 1979- January 31, 1980 n = 14	-.385 (-.434)	-.620 (-1.251)							.042	3.285	1.62(3)	0.01(1,11)	.919
2.3 February 8, 1980- January 29, 1982 n = 88	-.751 (-1.897)	-.915 (-5.939)			-7.817 (-2.156)	-.894 (-.247)	-.395 (-.109)	10.994 (3.046)	.327	3.587	1.66(13)	2.35(1,81)	.125

B. NONLINEAR EFFECT OF UNEXPECTED MONEY STOCK LEVELS ON STOCK PRICES

$$\Delta SP_t = a + (b_1 + b_2|UML_t|)\cdot UML_t + \sum_i d_i D_{it} + e_t$$

	a	b_1	b_2	d_1	d_2	d_3	d_4	d_5	d_6	$\bar{R}^2$	SER	DW(i)	$F(n_1n_2)$ [b/]	MS
2.4 September 29, 1977 -October 4, 1979 n = 102	.012 (.045)	-1.518 (-3.468)	.355 (2.271)	-4.474 (-1.725)	-1.243 (-.678)					.175	2.539	1.75(4)	2.83(2,84)	.062
2.5 October 11, 1979- January 31, 1980 n = 14	-.523 (-.546)	.122 (.078)	-.290 (-.500)							-.022	3.393	1.53(3)	0.54(2,9)	.602
2.6 February 8, 1980- January 29, 1982 n = 88	-.861 (-2.184)	-1.480 (-4.414)	.129 (1.889)			-8.314 (-2.323)	-.172 (-.048)	-.897 (-.250)	11.508 (3.229)	.348	3.532	1.73(13)	2.44(2,79)	.092

[a/] Null hypothesis is that coefficients on M_t^a and M_t^e sum to zero

[b/] Null hypothesis is that coefficients on M_t^e and M_t^e are both zero in equation (4)

Definitions: See Table I.

M_t^a = announced level of the money stock

M_t^e = expected level of the money stock

$UML_t = M_t^a - M_t^e$

diminishes for larger surprises. For the third period, the nonlinear term is smaller and is only significant at the 10 percent level.[15/]

IV. A Further Examination of the Stock Price Response

Three aspects of the response of stock prices of 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. Finally, the behavior of stock prices prior to the weekly money announcement is investigated.

A. Did the Response Change in the Post-October 1979 Period?

As a result of the Federal Reserve's adoption of new monetary control procedures in October 1979, Roley [21] finds that 3-month Treasury bill yields have become much more responsive. Thus, if stocks and money market instruments are close substitutes, stock prices may be more responsive as a result. However, if investors are more concerned about the inflation consequences of an unanticipated change in money, the reaction of stock prices may be the same, or even less, than before. In particular, if the new procedures correspond to a greater commitment by the Federal Reserve to reduce inflation, any given surprise may contain less information about future inflation since it may be offset in the near future. Thus, it is not possible, *a priori*, to predict whether the reaction of stock prices should increase in the post-October 1979 period.

The equality of stock price responses in the pre- and post-October 1979 periods was tested for both the basic model (1) and the nonlinear model. In the case of the basic model, the hypothesis that the response was the same in the one pre-October 1979 period and the two post-October 1979 periods

cannot be rejected even at the 50 percent significance level.[16/] For the nonlinear specification, however, this hypothesis is rejected at the 10 percent level, and the hypothesis that the response in the first and third periods is the same is rejected at the 5 percent level.[17/] As is apparent in panel B of Table II, stock prices appear to have reacted less sharply to small surprises and more sharply to large surprises after the Federal Reserve began employing the reserve-aggregate approach to monetary control.

To further investigate 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 [26], 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. Both the basic model (1) and the nonlinear model were estimated with these additional terms. In each case, the results indicated that the coefficients on the disaggregated surprises are not significantly different.[19/] Since Urich and Wachtel [26] and Roley [21] found significantly different Treasury bill yield responses when money was outside Federal Reserve policy ranges, the lack of such differences for stock prices appears to provide some support for the expected inflation channel. Nevertheless, the tests across periods using the nonlinear model did suggest that the response differed in the pre- and post-October 1979 periods. Thus, it appears that no clear choice between the policy expectations and expected inflation channels can be made.

B. Is the Stock Price Response Complete Within One Day?

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 and nonlinear models were reestimated using two alternative dependent variables. The first, ΔSP1, is the 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 change in the DJIA from the opening to the close for the day after the announcement.

Panel A of Table III presents the estimated nonlinear 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 3.5 with equation 2.6).[20/] Thus, these results generally support the view that the response of stock prices to money surprises is immediate.

C. Do Stock Prices Move in Anticipation of Money Announcements?

The final area examined here concerns the movement of stock prices to money announcements. If the stock market is efficient, and if investors view money announcements as a source of significant information, then stock prices may respond to any new information related to the forthcoming announcement.[21/]

To investigate this aspect of stock price behavior, it is assumed that equilibrium stock prices at the close of day i may be represented as

$$SP_i = \alpha \cdot E(M^a | \Omega_i) + E(\underline{X} | \Omega_i)\underline{\beta} \qquad (5)$$

where SP_i = closing stock prices on day i

M^a = announced level of the money stock on Friday at 4:10 p.m.

$\underline{X}$ = 1×k vector of variables

Ω_i = information set used by investors on day i

Table III
FURTHER PROPERTIES OF THE STOCK PRICE RESPONSE

A. Stock Price Responses After the Market Opens

$$\Delta SP_t = a + (b_1 + b_2|M_t^a - M_t^e|)(M_t^a - M_t^e) + e_t$$

	Time Period	Dependent Variable	Estimated Coefficients			Summary Statistics		
			a	b_1	b_2	$\bar{R}^2$	SER	DW(i)
3.1	September 29, 1977 -October 4, 1979 n = 102	ΔSP1	.624 (3.171)	.327 (.984)	-.086 (-.722)	-.008	1.948	2.02(5)
3.2		ΔSP2	.941 (1.056)	-.462 (-.311)	.050 (.093)	-.017	8.860	1.76(5)
3.3	October 11, 1979- January 31, 1980 n = 14	ΔSP1	-.727 (-.670)	1.503 (.846)	-.566 (-.863)	-.106	3.842	1.35(3)
3.4		ΔSP2	-1.102 (-.357)	1.589 (.314)	-1.794 (-.960)	.147	10.945	.65(3)
3.5	February 8, 1980 -January 29, 1982 n = 88	ΔSP1	-.918 (-3.532)	-.565 (-2.557)	.042 (.932)	.132	2.386	1.39(13)
3.6		ΔSP2	-.637 (-.642)	-.346 (-.410)	.026 (.148)	-.019	9.116	1.43(13)

B. Stock Price Responses Before the Announcement

$$M_t^a - M_t^e = a + b(SP_{F,t} - SP_{T,t}) + c(R_{F,t} - R_{T,t}) + e_t$$

			a	b	c	$\bar{R}^2$	SER	DW(i)
3.7	February 8, 1980 -January 29, 1982 n = 88	$M_t^a - M_t^e$	1.723 (2.604)	-.006 (-.330)	.280 (2.544)	.054	2.414	1.91(11)

Definitions:

ΔSP1 = DJIA at 11:00 minus its opening value on the day after the money announcement
ΔSP2 = closing DJIA minus its opening value on the day after the money announcement
$SP_{F,t}$ = Friday closing DJIA
$SP_{T,t}$ = Tuesday closing DJIA
$R_{F,t}$ = 3-month Treasury bill yield, Friday at 3:30 p.m. EST (Source: Federal Reserve Bank of New York, "Quote Sheet of Closing Rates")
$R_{T,t}$ = 3-month Treasury bill yield, Tuesday at 3:30 p.m. EST (Source: ibid.)

$E(\ldots|\Omega_i)$ = expectation conditional on Ω_i

$\alpha, \underline{\beta}$ = scalar and k×1 vector of coefficients.

Thus, the effect of new information on equilibrium stock prices from Tuesday—the day of the money survey in the third period—to just before the money announcement on Friday may be expressed as

$$SP_F - SP_T = \alpha \cdot [E(M^a|\Omega_F) - M^e] + [E(\underline{X}|\Omega_F) - E(\underline{X}|\Omega_T)]\underline{\beta} \qquad (6)$$

where $M^e = E(M^a|\Omega_T)$, which is represented by the market survey measure.

Also, if expectations are rational, then

$$M^a = E(M^a|\Omega_F) + e_F \qquad (7)$$

where e_F = random error uncorrelated with any information in Ω_F.

A consistent estimate of the effect of new information concerning the money announcement on stock prices may therefore be obtained by combining equations (6) and (7) and estimating[22/]

$$M^a - M^e = (1/\alpha) \cdot (SP_F - SP_T) - (1/\alpha)[E(\underline{X}|\Omega_F) - E(\underline{X}|\Omega_T)]\underline{\beta} + e_F. \qquad (8)$$

To implement this specification empirically, the additional assumption is made that changes in the expectations of other relevant variables may be represented solely by the change in the 3-month Treasury bill yield from Tuesday to Friday; i.e.,

$$M^a - M^e = a + b \cdot (SP_F - SP_T) + c \cdot (R_F - R_T) + e_F \qquad (8')$$

where R_T, R_F = 3-month Treasury bill yield at 3:30 p.m.

on Tuesday and Friday, respectively,

and the coefficient definitions follow from (8).

The estimation results for equation (8′) are reported in panel B of Table III. The results indicate that the movement in stock prices prior to the announcement is not significantly related to the unexpected part of the money announcement, unlike the movement in interest rates. This result could follow either if stock prices do not reflect new information concerning the announced level of money which became available during the week or if stock prices move in response to new information about a variety of other relevant factors, thereby causing a low correlation between money surprises and stock prices.

IV. Summary and Conclusions

This paper has examined the short-run reaction of stock prices to weekly money announcements. The results of this analysis can be summarized as follows: (1) stock prices respond only to the unexpected change in the money stock as predicted by the efficient markets theory; (2) an unexpected increase in money depresses stock prices; (3) stock market participants take into account the revisions in the level of the money stock as well as unexpected changes; (4) the stock price response is symmetric with respect to the sign of the money surprise and does not depend on the relationship of money to the long-run target ranges of the Federal Reserve; (5) the stock price response appears to be nonlinear and has changed since the Federal Reserve switched to a reserve-aggregate approach to monetary control in October 1979; and (6) the stock price response is essentially complete early in the subsequent trading day.

The absence of any asymmetrical or policy range effects contrasts with the results of studies on the interest rate response to money surprises. While these effects were not evident, the results nevertheless indicate that the October 1979 change in policy regimes has affected the response of stock prices to money surprises. In particular, large money surprises since October 1979 have been associated with larger changes in stock prices.

References

1. Neil G. Berkman. "On the Significance of Weekly Changes in M1." New England Economic Review (May/June 1978), 5-22.
2. Zvi Bodie. "Common Stocks as a Hedge Against Inflation." Journal of Finance 31 (May 1976), 459-70.
3. Richard V.L. Cooper. "Efficient Capital Markets and the Quantity Theory of Money." Journal of Finance 29 (June 1974), 115-46.
4. Eugene F. Fama. "Short-Term Interest Rates as Predictors of Inflation." American Economic Review 65 (June 1975), 269-82.
5. _____ and G. William Schwert. "Asset Returns and Inflation." Journal of Financial Economics 4 (November 1977), 115-46.
6. Martin Feldstein. "Inflation and the Stock Market." American Economic Review 70 (December 1980), 837-47.
7. Kenneth D. Garbade and Claudia P. Sekaran. "Opening Prices on the New York Stock Exchange." Journal of Banking and Finance 5 (September 1981), 345-56.
8. Jacob Grossman. "The 'Rationality' of Money Supply Expectations and the Short-Run Response of Interest Rates to Monetary Surprises." Journal of Money, Credit, and Banking 13 (November 1981), 409-24.
9. Michael J. Hamburger and Levis A. Kochin. "Money and Stock Prices: The Channels of Influence." Journal of Finance 27 (May 1972), 231-49.
10. Patric H. Hendershott and Sheng Cheng Hu. "Inflation and Extraordinary Returns on Owner-Occupied Housing: Some Implications for Capital Allocation and Productivity Growth." Journal of Macroeconomics 3 (Spring 1981), 177-203.

11. Kenneth E. Homa and Dwight M. Jaffee. "The Supply of Money and Common Stock Prices." Journal of Finance 26 (December 1971), 1056-66.

12. Jeffrey F. Jaffee and Gershon Mandelker. "The 'Fisher Effect' for Risky Assets: An Empirical Investigation." Journal of Finance 31 (May 1976), 447-58.

13. Morgan J. Lynge, Jr. "Money Supply Announcements and Stock Prices." Journal of Portfolio Management 8 (Fall 1981), 40-43.

14. Frederic S. Mishkin. "The Real Interest Rate: An Empirical Investigation." Carnegie-Rochester Conference Series on Public Policy 15 (Autumn 1981), 151-200.

15. Franco Modigliani and Richard A. Cohn. "Inflation, Rational Valuation and the Market." Financial Analysts Journal (March/April 1979), 24-44.

16. _____ and Robert J. Shiller. "Inflation, Rational Expectations and the Term Structure of Interest Rates." Economica 40 (February 1973), 12-43.

17. Charles R. Nelson. "Inflation and Rates of Return on Common Stocks." Journal of Finance 31 (May 1976), 471-83.

18. James E. Pesando. "The Supply of Money and Common Stock Prices: Further Observations on the Econometric Evidence." Journal of Finance 29 (June 1974), 909-21.

19. _____. "A Note on the Rationality of the Livingston Price Expectations." Journal of Political Economy 88 (August 1975), 849-58.

20. Richard J. Rogalski and Joseph D. Vinso. "Stock Returns, Money Supply and the Direction of Causality." Journal of Finance 32 (September 1977), 1017-30.

21. V. Vance Roley. "The Response of Short-Term Interest Rates to Weekly Money Announcements." Mimeo: Federal Reserve Bank of Kansas City, 1982.

22. Michael S. Rozeff. "Money and Stock Prices." Journal of Financial Economics 1 (September 1974), 245-302.

23. Beryl W. Sprinkel. Money and Stock Prices. Homewood, Ill.: Richard D. Irwin, 1964.

24. Lawrence H. Summers. "Inflation, the Stock Market and Owner-Occupied Housing." American Economic Review 71 (May 1981), 429-34.

25. _____. "Inflation and the Valuation of Corporate Equities." National Bureau of Economic Research Working Paper No. 824, December 1981.

26. Thomas Urich and Paul Wachtel. "Market Response to the Weekly Money Supply Announcements in the 1970s." Journal of Finance 36 (December 1981), 1063-72.

27. John B. Williams. The Theory of Investment Value. Cambridge, Mass.: Harvard University Press, 1938.

Footnotes

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1. Using the same survey data as those used here, Urich and Wachtel [23] 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 [8] and Roley [21] find that anticipated announced changes in money as represented by the survey data are not statistically significant over the same sample period.

2. A number of empirical studies have found a negative relationship between inflation and stock prices, including those by Bodie [2], Jaffee and Mandelker [12], Nelson [17], and Fama and Schwert [5]. 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 [27].

3. See Grossman [8] and Roley [21] for more detailed descriptions of these arguments.

4. 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.

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

6. 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 [21], 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 [21], 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. For a further discussion of the rationale for using a revised expectations measure, see the related discussion in section IV.C.

7. 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 [18]. While Grossman [8] could not reject efficiency, unbiasedness could be rejected. However, the rejection resulted from a statistically significant constant term. This measure could therefore be adjusted by adding the estimated bias to the survey measure. However, the response of stock prices estimated in this paper would be unaffected since a constant term is always included in the specifications.

8. For evidence that opening prices are as representative of equilibrium prices as subsequent intra-day transactions prices, see Garbade and Sekaran [7].

9. 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.

10. We are grateful to Morgan Lynge, Jr., for the DJIA data through 1979. The observations for 1980-82 are from Barron's.

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

12. The discount rate dummy variables are defined as follows:

D_1 = 1 when discount rate raised 1/4 point

= 0 otherwise

D_2 = 1 when discount rate raised 1/2 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—in cases where they are statistically significant—imply that an increase in the discount rate depresses stock prices, and vice versa. For example, the lowering of both the discount rate and the surcharge by 1 percentage point on October 30, 1981, is estimated to have raised the DJIA by over 11 points.

13. The equivalence of equation (2) and equation (3), under the assumption that $b' = c'$, can be seen by noting that

$$\Delta M_t^a = M_t^a - M_{t-1}^r$$

and, under the assumption that agents expect no revision in the previous week's announced level,

$$\Delta M_t^e = M_t^e - M_{t-1}^a.$$

14. The relevant F-statistics for the three periods are $F(1,97) = .97$, $F(1,11) = .17$, and $F(1,81) = .39$, with marginal significance levels of .325, .686, and .544, respectively.

15. Note that in each period the nonlinear term reduces the magnitude of the response per dollar of money surprise as the surprise becomes larger. This behavior is consistent with the notion that, due to seasonal or other

factors, large surprises are sometimes offset in subsequent weeks.

16. The F-statistic is equal to 0.643 with (2,192) degrees of freedom. As is the case for all tests across the three subsamples 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.

17. The F-statistic for the hypothesis that both linear and nonlinear coefficients are constant over time is 2.048 with (4,189) degrees of freedom, which has a marginal significance level of 0.088. The F-statistic for the hypothesis that the first and third periods had the same coefficients is 3.758 with (2,189) degrees of freedom, which has a marginal significance level of 0.025.

18. While Urich and Wachtel [26] 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.

19. For the linear model (1), the relevant F-statistics for the three subsamples are .878 (2,96), .583 (1,11), and 2.506 (2,80) with marginal significance levels of .422, .461, and .086, respectively. For the nonlinear model, the relevant F-statistics were .815 (4,93) and 1.047 (4,77) for the first and third periods with marginal significance levels of .521 and .389, respectively. The second period was too short for a meaningful test.

20. The linear model yielded identical conclusions. As in the nonlinear case,

the only significant response occurred in the third period for the ΔSP1 measure. The point estimate in this case was -.345 with a t-statistic of -3.714. This response is roughly half of the initial response and, again, disappears over the entire trading day.

21. Because only the data for the third subsample is particularly well suited to investigate this aspect of stock price behavior, the other two subsamples will not be considered further. In particular, the time interval between the market survey and the money announcement must be of sufficient length to allow two stock price observations. Since the exact time of the day that the market survey is taken is somewhat uncertain, the Thursday survey and announcement data used here for the first two periods do not lend themselves to this analysis.

22. Note that the methodology employed here is similar to that used, for example, by Fama [4] and Mishkin [14] in investigating real interest rates.

23. There are at least two possible rationales for including the observed change in the Treasury bill yield in equation (8′). First, since a Treasury bill is an alternative asset, the expected bill yield may be relevant in the determination of stock prices. If this is the case, and if the bill yield follows a random walk, then the observed change in the bill yield represents the relevant change in the expected bill yield. Second, following Fama [4], the change in the bill yield may represent a change in expected inflation.