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The Rationality and Efficiency of Stock Price Relative to Money Announcement Information

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Abstract

Recent studies find that stock price reacts only to unanticipated changes in the money supply. These studies assume a joint hypothesis of rationality and efficiency in their tests. This paper formulates a model in which stock price depends both upon anticipated and unanticipated money supply forecasts. From this model, an econometric model that separates the hypotheses of rationality and efficiency is estimated. The results show that investors rationally incorporate forecasts of the weekly current money announcement into stock price during the pre-October 6, 1979, sample period. However, efficiency with respect to money information cannot be corroborated in this period. Cross-equation restrictions implied by rationality are rejected during the post-October 6, 1979, period. In this period, efficiency again cannot be corroborated. Alternative money prediction specifications indicate the robustness of these results.

Introduction

Studies of the relationship between money and stock prices focus on the market's efficient use of money announcement information. For example, Pearce and Roley [13] confirm Cooper [5], Rozeff [17], and Rogalski and Vinso [15] in that only unanticipated money affects the stock price. Consequently, these studies seem to corroborate the efficient markets' hypothesis that current asset prices reflect all available money announcement information. If the stock price is efficient with respect to money

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information, then market participants can neither use the money announcement to predict movements in stock price, nor can the monetary authority affect the market, except by surprise.

However, as Mishkin [10, 11] points out, there are two separable issues with regard to efficiency and an asset market's use of exogenous information. The first question is whether investors' prediction of the money announcement will be rationally incorporated into the stock price. By rationality is meant that investors first predict the level of the money announcement; and then, through an optimization process and market equilibrium, incorporate their prediction into the stock price. Given that investors' predictions are *rationally* incorporated into the stock price, the second question is whether the prediction is *fully,* that is *efficiently,* incorporated into the market valuation of equity. For the stock price to be efficient with respect to money information, the stock price must first rationally contain money predictions. If the stock price sequence passes the rationality test, then this sequence is called "efficient" if only unanticipated money announcement information significantly explains stock price changes.

Studies by Rozeff [17], Rogalski and Vinso [15], Pearce and Roley [13], Sorensen [20], and Geske and Roll [8] conclude that there is no reason to reject the efficiency of stock price with respect to money stock announcements. However, each study assumes that investors' estimates of stock price reaction to money changes occur independently of the prediction rule also estimated by market participants. Thus, the cited studies maintain rationality and test for efficiency by examining the statistical significance of the reaction of the stock price to anticipated or unanticipated money. They estimate time series of anticipated and unanticipated money changes independently of the estimated relationship between money and stock price. Thus the results of these studies must rely upon the assumption that expectations about the money announcement, and therefore innovations in the money announcement process, are incorporated into the distribution of stock prices. If these predictions were found not to be rationally incorporated into the stock price, then there are no grounds either for accepting or rejecting the hypothesis of efficiency.

The purpose of this paper is to ascertain whether weekly stock price data corroborate an efficiency property with respect to the weekly money stock announcement by separately considering hypotheses of rationality and efficiency. In this paper, estimates of the reaction of stock price to anticipated and unanticipated money are made *jointly* with the prediction equation used by the market to forecast money stock announcements. This paper tests hypotheses of rationality and efficiency using the techniques of Mishkin [11] and Abel and Mishkin [1]. The advantage of their approach is that estimates are statistically efficient and consistent with those of the money prediction rule assumed to be used by market. Errors-in-variables problems reported by Small [19] and Sims [18] are then avoided.

The paper proceeds as follows: the second section develops a rational expectations model of money and stock price. It is shown that stock price depends upon both anticipated and unanticipated components of the investors' assumed money prediction rule. The third section formulates an econometric version of this model to test the rationality and efficiency of stock price with respect to weekly announcements of the money stock level. The fourth section describes the empirical test results. The final section concludes the paper.

A Model of Money and Stock Price

This section builds an expository rational expectations model of money and stock price. Current stock price, p_t, depends positively upon current expectations (formed at date t) of future (date $t + 1$) stock price, $E_t p_{t+1}$, and positively upon current money stocks, m_t ([21]):

$$p_t = aE_t p_{t+1} + bm_t, \qquad 0 < a < 1, b > 0 \tag{1}$$

where a represents a positive discount factor. Given a fixed stock of wealth, positive b implies that when the monetary authority increases the money supply, there will be an excess demand for all other assets, including stock. To clear an excess demand for stock, the market bids stock prices up. As Pearce and Roley [13] note, b depends upon the stock market's reaction to monetary authority announcements.

To characterize market participant reaction to money announcements, we suppose that participants predict current money announcements according to the moving average process (see [21] and [22]):

$$m_t = \sum_{j=0}^{\infty} A_j \epsilon_{t-j} \equiv A(L)\epsilon_t \tag{2}$$

where $A(L) \equiv \sum_{j=0}^{\infty} A_j L^j$ and $L^j X_t = X_{t-j}$, $\sum_{j=0}^{\infty} A_j^2 < \infty$.

Current m_t is the sum of an innovation, or unanticipated component, ϵ_t, plus an anticipated component, $E_t m_t = A_1\epsilon_{t-1} + A_2\epsilon_{t-2} + \ldots$. At date t, participants know past money stock figures and therefore know the innovations in the money process, $\{\epsilon_{t-1}, \epsilon_{t-2}, \ldots\}$. This scenario fits well with Federal Reserve procedures ([13]) in that during a given week (date t), the Federal Reserve reports to the market the previous week's (date $t - 1$) money stock figures. At date t, the market must predict the current money stock figure, m_t, which it does with error, ϵ_t. The information set that conditions future stock price, p_{t+1}, in equation (1) must, with respect to money information, at most include $\{\epsilon_{t-1}, \epsilon_{t-2}, \ldots\}$ or equivalently $\{m_{t-1}, m_{t-2}, \ldots\}$.

Since the goal of this model is to represent stock price in terms of money announcements, only a subset of all possible information available to investors is employed when $\{p_t\}$ sequences are determined. Following Futia [6], using the sequence of money innovations $\{\epsilon_t\}$, and given a sequence of coefficients $\{C_j\}$, p_t can be represented as the series

$$p_t = \sum_{j=0}^{\infty} C_j \epsilon_{t-j} = C(L)\epsilon_t, \tag{3}$$

where $C(L) \equiv \Sigma_{j=0}^{\infty} C_j L^j$, $\Sigma_{j=0}^{\infty} C_j^2 < \infty$.

Stock price depends both upon unanticipated money, ϵ_t, and anticipated money, $\{\epsilon_{t-1}, \epsilon_{t-2}, \ldots\}$. If investors rationally incorporate money predictions into their decisions to hold stock, then stock price sequences will depend upon the coefficients of the money prediction rule. That is, the coefficients $\{C_j\}$ will depend upon the coefficients $\{A_j\}$. Given this technical definition of rationality, the market is characterized as "efficient," relative to money stock information, if the model $p_t = C_1\epsilon_t$ is at least as informative about p_t as the model in equation (3) is.

Given a solution for $\{p_t\}$ represented by equation (3), equation (1) requires that

$$\sum_{j=0}^{\infty} C_{j+1}\epsilon_{t-j} - (1/a)\sum_{j=0}^{\infty} C_j\epsilon_{t-j} = -(b/a)\sum_{j=0}^{\infty} A_j\epsilon_{t-j}, \quad (4)$$

where $E_t p_{t+1} = E_t[C_0\epsilon_{t+1} + C_1\epsilon_t + \ldots] = C_1\epsilon_t + C_2\epsilon_{t-1} + \ldots = \Sigma_{j=0}^{\infty} C_{j+1}\epsilon_{t-j}$.

If equation (4) holds for all realizations of $\{\epsilon_t\}$, then equivalently the z-transforms of coefficients in (4) must be equal as analytic functions on the open disk $|z| < 1$ (see Futia [6] and Whiteman [22] for further details). The z-transform of the sequence $\{C_0, C_1, \ldots\}$ is $C(z)$; that of $\{A_0, A_1, \ldots\}$ is $A(z)$; and that of $\{C_1, C_2 \ldots\}$ is $z^{-1}[C(z) - C_0]$, given C_0. Thus equation (1) requires that

$$z^{-1}[C(z) - C_0] - (1/a)C(z) = -(b/a)A(z)$$

or

$$C(z) = [1 - (1/a)A(z)]^{-1}\{C_0 - (b/a)zA(z)\}. \quad (5)$$

In equation (5), $C(z)$ is not defined at $z = a$. Using methods introduced by Futia [6], C_0 can be set to ensure that $C(z)$ is analytic (that is, "defined") at $z = a$. Calculating the residue of $C(z)$ at a and setting the residue equal to zero yields

$$\lim_{z\to a}[1 - (1/a)z]C(z) = C_0 - bA(a) = 0,$$

or $C_0 = bA(a)$, so that

$$C(z) = [1 - (1/a)z]^{-1}\{bA(a) - (b/a)zA(z)\}. \quad (7)$$

Using (7), the representation for p_t, restricted by the equilibrium condition in (1), is

$$p_t = [1 - (1/a)L]^{-1}\{bA(a) - (b/a)LA(L)\}\epsilon_t. \quad (8)$$

Since

$$[1 - (1/a)L]^{-1} = 1 + (1/a)L + (1/a)^2L^2 + (1/a)^3L^3 + \dots,$$
$$A(a) = A_0 + A_1a + A_2a^2 + \dots, \text{ and}$$
$$LA(L) = A_0L + A_1L^2 + \dots,$$

then equation (8) can be written

$$p_t = C_0\epsilon_t + C_1\epsilon_{t-1} + \dots, \tag{9}$$

where cross-equation restrictions on the *rationality* of $\{p_t\}$ given the predictions of $\{m_t\}$ and using market equilibrium condition (1) imply

$$C_0 = b \sum_{j=0}^{\infty} A_j a^j < \infty, \tag{10a}$$

$$C_j = b \sum_{k=1}^{\infty} A_k a^{k-j}, \qquad \text{for all } j = 1, 2, \dots. \tag{10b}$$

C_0 is bounded in (10a) because $a < 1$.

As an example, suppose that the stock market forecasts the money supply to contract upon news of an increase in the past money supply. To provide an application of the effect of this news on stock prices, let $j = 0, 1$, so that the money prediction rule becomes

$$m_t = A_0\epsilon_t - A_1\epsilon_{t-1},$$

where ϵ_{t-1} is the innovation relative to the announcement news. In this case, $C_0 = b(A_0 - A_1a)$ is greater than zero only if $A_0 > A_1a$. Stock price will rise only if the market forecasts that unanticipated money has a diminutive role relative to anticipated money in the prediction rule. If the old news, ϵ_{t-1}, affects p_t, then C_1 cannot be zero and will be equal to $-bA_1 < 0$. Given rationality, that is the relationships in equations (10) hold, then the stock market can be called "efficient" if C_1 is econometrically insignificant. This would imply that either (or both) $b = 0$ or $A_1 = 0$ in this example. If $b = 0$, then money has no equilibrium effect on the stock price. Money, in turn, does not affect stock price when either money is the riskless asset ([11] and [21]) or if investors are risk neutral ([21]). Similarly, stock price is efficient when $A_1 = 0$, that is, when current money cannot be predicted using the history of money innovations $\{\epsilon_{t-1}\}$.

The above analysis began with two fundamental building blocks: an asset pricing model dependent upon the money supply and a forecast of the current money supply. Investor rationality implies that stock price depends upon the same elements used to forecast the money supply. What remains is the money supply prediction rule, a reduced form expression for the stock price in terms of anticipated and unanticipated money supply, and the cross-equation restrictions implied by the rationality of investor response to money supply innovations. In the next section, an empirical money supply prediction rule is specified along with a stock price reaction equation that depends upon the elements of the empirical money supply prediction rule to examine two hypotheses. First, do the cross-equation restrictions implied by rationality (such as those in equation (10)) hold? Second, if the restrictions hold, is stock price efficient with respect to money supply information?

The Empirical Model

The following prediction equation for money announcements allows us to distinguish anticipated from unanticipated money in ways similar to the simple model of equation (2):

$$DM_t = f(X_t, \alpha) + \epsilon_t, \tag{11}$$

where DM_t is the change in the money stock at date t, X_t is a vector of instruments useful in predicting money stock movements available to investors at date t, α is a vector of estimators relating the instruments to the change in money stock, $f(\cdot, \cdot)$ is a transformation of instruments and estimators that is identified with anticipated changes in money stock, and ϵ_t is a zero mean finite variance term that represents unanticipated money stock changes. Roley [16] indicates that interest rate movements just prior to money announcements provide useful information in predicting money variation, and can proxy for market beliefs about economic indicators such as inflation and income growth. Other elements in X_t might include revisions of money announcements and the history of money announcement innovations. Equation (11) is not to be construed as a money demand function but rather as the way market participants can predict money stock changes using the history of interest rates as well as past realizations of the money stock.

To examine rationality/efficiency issues, we follow Barro [4] and Sorensen [20] by investigating the reaction of stock price to changes in anticipated and unanticipated money stock movements. The theory contained in equation (9) above suggests the following statistical model:

$$DP_t = g(f(X_t, \alpha), \epsilon_t, \beta) + \eta_t, \tag{12}$$

where DP_t is the change in the stock price during a money announcement, β is a vector of estimators of the effects of anticipated and unanticipated money on stock price, and η_t is a serially uncorrelated zero mean finite variance term. Imposition of rationality implies that $\beta = \beta(\alpha)$, that is, the β estimators are constrained to be a (nonlinear) function of the money announcement process estimators.

To define the dates and periods in the empirical implementation of the variables, we suppose that the Federal Reserve announces the money stock figures at 4:15 p.m. on Thursday. Given this announcement, a period t for DP_t begins with the close of the stock market at 3:00 p.m. on Thursday and ends at the opening of the exchange at 9:00 a.m. on Friday. This measurement captures information in the stock price during the interval in which new information about the money stock occurs. At 4:15 p.m. on Thursday, the Federal Reserve announces money stock figures for the week ending Wednesday of the previous week. In this way, the Fed reports in period t, the money stock for period $t - 1$. The term DM_t refers to the difference between two successive money stock announcements. The term DR_t will refer to the change in an interest rate during period t. Using the three-month Treasury bill rate, we take the difference between the rate observed after the bill auction on Tuesday and the rate observed again just before the money stock announcement on Thursday. This measurement employs Roley's [16] observation concerning the informativeness of rates for predicting current money announcements.

The empirical work below uses weekly data over the January 1, 1978, to June 28, 1982, sample period. The sample period is further divided into Sample Period I from January 1, 1978, to October 6, 1979, and Sample Period II from October 13, 1979, to June 28, 1982, to reflect the Federal Reserve's change to reserves targeting on October 6, 1979. The data sources and definitions of the variables used in the estimation and tests follow:

DP_t = for Sample Period I, the difference between the Thursday close and the Friday opening of the Dow Jones 30 Industrials Average; and for Sample Period II, the difference between the Friday closing and the Monday opening of the Dow Jones 30 Industrials Average.

DM_{t-1} = from January 3, 1978, to January 31, 1980, the difference between the money stock announcements as of the week previous to date t, on a Thursday to Thursday basis; after January 31, 1978, the Federal Reserve announced money stock data on Friday at 4:15 EST.

DR_t = bid rate (on discount basis) for three-month Treasury bills in secondary market; difference from just after Tuesday auction to just before money stock announcement.

$DMREV_t$ = difference in money stock revisions announced at date t for money stock figures issued two weeks prior.

Observations of money stock figures are from *Barron's*, various issues; Treasury bill rates and stock prices are procured from the *Wall Street Journal*, various issues.

Several difficulties attend the estimation of the system of equations (11) and (12). First, we cannot expect that weekly observations are normally distributed. Second, residual variances between the two equations are probably not equal. Third, cross-equation restrictions implied by rationality must be imposed leading to estimation that is nonlinear in the parameters.

The first problem can be handled by employing Nonlinear Three Stage Least Squares (NL3S) procedures. This estimator assumes that residuals are iid random variables with mean zero and homoscedastic variance-covariance matrix. The most important strength of this class of estimators is their consistency regardless of whether or not the equation system is properly identified. In those cases when Nonlinear Full Information Maximum Likelihood fails, for example if residuals are nonnormal, or variance-covariance matrices are nonspherical, the NL3S estimator remains consistent ([3]). The second problem, that of heteroscedastic residual variances, can be cured by weighting the data in the prediction equation with the ratio of standard deviations of prediction equation to stock price equation residuals (see [11]). The system is reestimated until the variances are within 1 percent of one another. Finally, the imposition of cross-equation restrictions simply makes the estimation nonlinear in parameters. Use of nonlinear least squares estimators in a system of equations allows the easy application of constraints. Pagan [12] discusses several issues with regard to estimators relying upon expectational variables. Equations (11) and (12) are examples of Model 4 in Pagan's article.

Plosser and Schwert [14] demonstrate that inconsistencies in parameter estimation and loss of efficiency in parameter inference result from serially correlated residuals in time series regressions. As a precaution, all estimations of the stock price reaction function take into account whatever order of serial correlation Akaike's [2] Information Criterion (AIC) applied to residuals might indicate.

The testing of rationality and efficiency proceeds in two steps. First, the model is tested for rationality. This implies that the cross-equation restrictions cannot be rejected at a reasonable level of significance. To test this hypothesis, we employ the Sums of Squared Residuals (SSRD) test. Denoting by $\tilde{\gamma}$ the estimators without the imposition of cross-equation constraints and $\hat{\gamma}$ the vector of estimators constrained by rationality, Gallant and Jorgenson [7] show that the test statistic

$$SSRD(\tilde{\gamma}, \hat{\gamma}) = T(S(\tilde{\gamma}) - S(\hat{\gamma}))/S(\hat{\gamma}),$$

where T is the sample size, and $S(\cdot)$ is the sum of squared residuals, is asymptotically distributed as χ^2 with q degrees of freedom equal to the number of cross-equation restrictions. Given rationality, that is, the data cannot accept the null hypothesis that cross-equation restrictions do not hold, efficiency can be tested by the significance of the estimated effect of anticipated money on stock price. If anticipated money significantly affects stock price, then the data reject the hypothesis that the stock market is efficient with respect to money information. Rejections of rationality and efficiency are potentially dependent upon the specification of the prediction equation for money announcements. To examine this issue, we present two different prediction rule specifications in each subsample time period.

Empirical Results

The estimation and rationality test results are contained in Table 1 for the pre-October 6, 1979, subsample, and in Table 2 for the post-October 6, 1979, period. Based on the theory presented in the equations (2) and (3) section, we use linear combinations of estimators and instruments to specify the functional form of $f(\cdot)$ and $g(\cdot)$ in equations (11) and (12). In Table 1, two specifications of the instrument vector X_t were found significant. The Akaike [2] Information Criterion identifies an AR(2) process in the money announcement change for the pre-October 6, 1979, sample. This specification and associated stock price reaction is displayed in Panel A of Table 1. The stock price reaction significantly incorporates the cross-equation restrictions since the SSRD statistic cannot reject this hypothesis. With the corroboration of rationality, the significance of the effect of anticipated money on stock price permits an economic interpretation through the significance of the anticipated money announcement term. Using this specification of the money announcement prediction rule, and given the acceptance of the null hypothesis of rationality, the data corroborate a significant anticipated money announcement effect. However, unanticipated money announcements are insignificant. In the second specification of the money announcement prediction equation, the instrument list includes two lags of money announcements and current and lagged T-bill rate changes. With this alternative specification, rationality again is corroborated since the SSRD statistic indicates that relaxation of the cross-equation restrictions does not provide a significant in-

TABLE 1

Joint Estimation of Stock Price and Money Announcements
January 1, 1978 to October 6, 1979*

A. Money prediction using AR(2)

$$DM_t = \underset{(0.223)}{0.6841} - \underset{(0.098)}{0.2889}DM_{t-1} - \underset{(0.082)}{0.1792}DM_{t-2} + u_t,$$

$$SSE = 9471.58,\ R^2 = 0.0975,\ df = 81$$

$$DP_t = \underset{(1.984)}{-1.5744} + \underset{(0.473)}{1.0415}(DM_t - \epsilon_t) + \underset{(2.110)}{2.1096}\epsilon_t + v_t,$$

$$SSE = 8905.10,\ R^2 = 0.1114,\ df = 81$$

SSRD test of cross-equation restrictions: $\chi^2\,(3) = 1.3889$

B. Money prediction using AR(2) and current, lagged rates

$$DM_t = \underset{(0.222)}{0.6573} - \underset{(0.086)}{0.2395}DM_{t-1} - \underset{(0.076)}{0.1797}DM_{t-2} + \underset{(1.446)}{3.2062}DR_t - \underset{(1.503)}{2.9177}DR_{t-1} + u_t,$$

$$SSE = 8804.91,\ R^2 = 0.1385,\ df = 81$$

$$DP_t = \underset{(1.870)}{-1.5228} + \underset{(0.400)}{1.0343}(DM_t - \epsilon_t) + \underset{(0.808)}{2.1434}\epsilon_t + v_t,$$

$$SSE = 8458.21,\ R^2 = 0.1560,\ df = 81$$

SSRD test of cross-equation restrictions: $\chi^2\,(5) = 2.8834$

*Asymptotic standard deviations in parentheses. SSRD = sum of squared residuals. $\chi^2_{0.05}\,(3) = 12.8381$; $\chi^2_{0.05}\,(5) = 16.7496$. DM = money announcement difference; DR = Thursday–Tuesday 3-month T-bill bid rate change; DP = Friday opening-Thursday closing Dow Jones 30 Industrial Average; ϵ = unanticipated change in money; $DM - \epsilon$ = anticipated change in money.

TABLE 2

Joint Estimation of Stock Price and Money Announcements
October 13, 1979 to June 28, 1982*

A. Money prediction using ARMA(2,2)

$$\underset{}{DM_t} = \underset{(3.066)}{1.0823} - \underset{(0.066)}{0.9394}DM_{t-1} - \underset{(0.044)}{0.3091}DM_{t-1} + u_t,$$

$$u_t = \underset{(0.054)}{0.1570}u_{t-1} - \underset{(0.032)}{0.3936}u_{t-2} + \epsilon_t$$

$$SSE = 62189.83,\ R^2 = 0.3886,\ df = 131$$

$$DP_t = \underset{(9.175)}{6.5723} - \underset{(0.382)}{3.8256}(DM_t - \epsilon_t) - \underset{(0.781)}{7.2388}\epsilon_t + v_t,$$

$$v_t = \underset{(0.063)}{0.7505}v_{t-1} + \eta_t$$

$$SSE = 60367.52,\ R^2 = 0.9167,\ df = 131$$

SSRD test of cross-equation restrictions: $\chi^2(5) = 23.9351$

B. Money prediction using ARMA(2,1) and revised money

$$DM_t = \underset{(3.53)}{0.9964} - \underset{(0.058)}{0.2076}DM_{t-1} - \underset{(0.031)}{0.3319}DM_{t-2} - \underset{(0.159)}{0.3639}DMREV_t + u_t,$$

$$u_t = \underset{(0.044)}{-0.5188}u_{t-1} + \epsilon_t$$

$$SSE = 72243.64,\ R^2 = 0.3703,\ df = 131$$

$$DP_t = \underset{(0.650)}{6.2950} - \underset{(0.373)}{3.1608}(DM_t - \epsilon_t) - \underset{(0.762)}{6.7323}\epsilon_t + v_t,$$

$$v_t = \underset{(0.063)}{0.7571}v_{t-1} + \eta_t$$

$$SSE = 70125.35,\ R^2 = 0.9032,\ df = 131$$

SSRD test of cross-equation restrictions: $\chi^2(5) = 29.3226$

*Asymptotic standard deviations in parentheses. SSRD = sum of squared residuals. $\chi^2_{0.05}(5) = 16.7496$. DM = money announcement difference; $DMREV$ = change in revised money announcement for two weeks previous to revision date; DP = Monday opening-Friday closing Dow Jones 30 Industrial Average; ϵ = unanticipated change in money; $DM - \epsilon$ = anticipated change in money.

crease in the explanatory power of the model. With this alternative money prediction specification, the model detects significant anticipated and unanticipated money announcement effects on stock price around an announcement event. Insofar as two specifications of the money prediction rule are employed, the data indicate that for the pre-October 6, 1979, sample period stock price rationally incorporates money predictions and that efficiency cannot be corroborated.

The positive relation between stock price and anticipated money announcements implies that stock is overvalued relative to the announcement information. To see this, subtract the anticipated announcement effect from the *DP* term in either Panel A or B of Table 1. The arbitrage strategy in this case is to sell the stock short, creating a downward pressure on stock so that the investor would be able to buy the securities back at a lower price and realize an arbitrage profit. The explanation for this effect on stock price emanates from the interest rate targeting scheme employed by the Federal Reserve system prior to October 6, 1979. If current rates rise, the prediction equation in Panel B indicates that the Fed will increase the money stock to create an excess supply of money. This excess will drive rates down. Asset prices rise as yields decline.

In the post-October 6, 1979, sample period, the data fail to corroborate rationality using two different money prediction specifications. In Panel A of Table 2, the X_t vector lists an ARMA(2,2) process identified by Akaike's [2] Information Criterion to predict money announcement changes. As in the pre-October 6, 1979, period, an increase in past weeks' money will lead to a decrease predicted for the current change in money announcement. However, stock prices do not significantly incorporate the cross-equation restrictions imposed by rationality according to the SSRD statistic. The stock price reaction includes significant serial correlation that reflects a major structural difference from the stock price estimation during the pre-October 6, 1979, period. Similar results occur with an alternative money prediction specification that includes current week revisions of money data released two weeks before. In Panel B of Table 2, the money announcement negatively reacts to past announcements and revisions of past announcements. Again the stock price exhibits serial correlation and negative significant reactions both to anticipated and unanticipated money announcements. Again, rationality cannot be corroborated using the alternative money announcement specification. With rationality insignificant under both money prediction rules, significant stock price reaction to anticipated money announcements does not possess an economic interpretation. Thus in the second sample period, after the Federal Reserve policy change on October 6, 1979, the data reject the hypothesis that the stock market efficiently incorporates money announcement information.

Even though the data do not indicate a rational incorporation of money announcement information in stock prices, the negative relationship between stock price changes and anticipated money announcements would be explained as follows. If the Federal Reserve announces at date t that money for the week before, at date $t - 1$, has risen, then the stock market predicts that current money will decline. This will result in an excess demand for money, an excess supply in the asset markets, and in the case of stock, a decline in the stock price. These estimations also reveal that across money announcement events, stock price change is not memoryless, since the change depends upon the history of stock price innovations through serial correlation.

If a higher than target money announcement occurs, the model indicates that the stock price is undervalued relative to this information. To see this, add the anticipated announcement effect to the change in stock price in either the Panel A or B estimation in Table 2. DP_t is therefore biased downward relative to optimal forecasts of money announcement information. An investor could, conceivably, incur a liability to buy the Dow Jones 30 Industrials and thereby reap a profit without any initial investment. The positive serial correlation in the stock price change for the second sample period indicates that the Dow Jones 30 Industrials is overvalued relative to the past history of changes across money announcement events. The overvaluation and money-induced undervaluation tend to offset one another, possibly precluding successful arbitrage attempts.

Conclusions

Several conclusions can be reached from the evidence reported here. First, the stock market responds differently to money announcements in different Federal Reserve policy regimes. The stock price under interest rate targeting prior to October 6, 1979, does incorporate predictions of the money supply, so that it is meaningful to discuss stock price efficiency relative to money announcement information during this period. The data indicate that efficiency cannot be corroborated. On the other hand, the stock price under monetary aggregate targeting does not rationally react to anticipated and unanticipated money announcements. If the market had reacted rationally, there is some evidence that the reaction requires a decline in the stock price when past money rises. This would occur because the Fed followed a target path for money. If the announcement reveals a higher than target value of the money stock, the market predicted that the Fed would pull money back to the predetermined path. A tighter monetary policy reduces the money supply, causing a decline in the stock price.

Second, the size of the stock market response to money announcements seems larger in the 1979–1982 sample than in the pre-October 6, 1979, period. This result should be viewed with caution since the data reject rationality of stock price relative to money announcement information in the post-October 6, 1979, sample.

Third, the pre-October 6, 1979, to 1982 stock prices can be affected by anticipated money announcements. There is an announcement effect, that, although weaker than the unanticipated effect, indicates that the market does not fully incorporate optimal forecasts of money announcements in the stock price. On average, a high anticipated money announcement will increase the stock price.

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