Market Response to Earnings Announcements: The Effects of Firm Characteristics

Kirt C. Butler*
Michigan State University

Ki C. Han
Suffolk University

This study develops a two period model of investment in which the ratio of share price response to earnings surprise is a function of the earnings retention rate, marginal productivity, and the cost of capital. These factors are examined empirically using dividend yield, Tobin's q ratio, and beta as proxies. Empirical results indicate that each of the factors significantly impacts the return/surprise relation in the direction predicted by the theoretical model, with the exception of dividend yield for positive earnings surprise. The results prevail even after controlling for the information environment.

INTRODUCTION

Studies of the information content of earnings announcements have a long history. Early studies determined that the sign and magnitude of stock price responses are correlated positively with the sign and magnitude of unexpected earnings (e.g., Ball and Brown, 1968; Beaver, 1968). Subsequent articles document intertemporal (Collins and Kothari, 1989) and cross-sectional (Grant, 1980; Kormendi and Lipe, 1987) differences in market response to earnings announcements. Recent studies have focused on firm-specific factors associated with market response, including earnings predictability (Pincus, 1983), firm size (Atiase, 1985; Freeman, 1987), systematic risk (Easton and Zmijewski, 1989; Collins and Kothari, 1989), and earnings persistence (Kormendi and Lipe, 1987; Collins and Kothari, 1989).

Most of these studies proceed without a formal model of the transmission process whereby the effect of an earnings surprise is transmitted through firm-specific factors into share price response. This study develops a two period model of investment under uncertainty to identify firm-specific factors related to market response to earnings surprise. The model suggests that share price response to earnings surprise is a function of the earnings retention rate, marginal productivity, and the cost of capital. We use dividend yield, Tobin's q ratio, and beta as empirical proxies for these factors. The focus of the formal model and empirical analysis is the return/surprise ratio rather than the magnitude of market response.

Empirical evidence indicates that each of the factors significantly impacts the return/surprise relation in the direction predicted by the theoretical model, with the exception of dividend yield for positive earnings surprise. Our empirical findings remain quali-

* The authors would like to thank the editor, George McCabe, and two anonymous referees for valuable comments and suggestions.

0747-5535/94/1400-0003 $01.00

tatively the same even after firm size is included in the empirical analysis to control for the information environment.

INVESTMENT DECISIONS AND THE RETURN/SURPRISE RELATION

MODEL ASSUMPTIONS

We assume that there is no corporate tax. (This assumption is relaxed later.) We further assume that the firm is financed by equity only and that all market participants are equally informed regarding likely returns on investment.[1] Therefore, this study abstracts from bankruptcy and agency costs.[2]

We assume a two period investment horizon. At the end of two periods, the firm's assets are liquidated. The firm makes an investment decision at the beginning of each period. The firm is assumed to base its investment decision on the interaction of its investment opportunity schedule with its cost of capital schedule. Cost of capital is assumed to be known and fixed during both periods.[3] At the beginning of period one, the firm invests an amount such that its expected marginal return on investment equals its cost of capital. Because of uncertainty, however, the firm cannot be sure that the chosen level of investment is optimal. When investment outcomes deviate from expectations, the firm reflects this information in its investment decision for period two. The firm's periodic cash flow from operations (operating income or operating earnings), X, is a stochastic, specified function of total investment, K. Let

(1) $X_1 = E_0(G_0(K_0)) + UX_1$ and

(2) $X_2 = E_1(G_1(K_1)) + UX_2$,

where:

X_t	=	Income or earnings realized at time t;
$E_t(.)$	=	Expectation given the information available at time t;
$G_t(.)$	=	Income-generating function corresponding to K_t, which is random such that $G_t(.) = h_t[G_{t-1}(.)]$, where h_t is a positive random variable with mean 1;
K_t	=	Total investment at time t; and
UX_t	=	Unexpected income or earnings realized at time t.

[1] By assuming an unlevered firm, we presume that it does not matter whether the outside financing is via stock issues or bond issues (Modigliani and Miller, 1958). By assuming symmetric information, we do not consider the possibility that managers have an incentive to underinvest and pay a higher proportion of earnings as dividends.

[2] We assume no bankruptcy or agency costs not because these costs do not matter to a firm's investment decision, but because they are not central to the issues in this paper.

[3] This assumption is introduced here merely as an explanatory tool to establish the theoretical argument. In tests of the model, this assumption is relaxed.

The random operating income generating function G is continuous and twice differentiable and provides diminishing positive marginal returns to investment such that $G' > 0$ and $G'' < 0$. Considering depreciation, the total investment at time 1 (the beginning of period two) can be expressed as:

(3) $K_1 = (1 - b)K_0 + I_1$,

where:

b = Depreciation rate; and
I_1 = New investment at time 1.

THE ASSOCIATION BETWEEN EARNINGS SURPRISE AND STOCK RETURN

At time 0 (the beginning of period one), the firm invests K_0 expecting that the marginal return on investment will equal the marginal cost of capital, so that

(4) $E_0(G_0'(K_0)) = 1 + i$.

Actual investment K_0 may turn out to be different from the value-maximizing level of investment. If $G_0'(K_0) > 1 + i$, then the firm initially underestimated its investment opportunity or its income function. At the end of period one, the firm realizes that the marginal net return is still positive at K_0. As a result, realized earnings exceed expected earnings. Conversely, if $G_0'(K_0) < 1 + i$, then actual earnings are less than expected earnings.

By the rational expectations property of consistency, the following should hold:[4]

(5) $E_0(G_0'(K_0)) = E_0(G_1'(K_1)) = 1 + i$;

(6) $E_0(K_0) = E_0(K_1) = K_0$; and

(7) $E_0(I_1) = bK_0$.

The level of total investment initially is expected to remain constant over the two periods. Expectations are revised at the end of period one, however, so that actual K_1 may differ from $E_0(K_1)$ based on information received in UX_1.

At time 1 (the beginning of period two), the firm realizes X_1, pays dividend D_1, borrows F_1, and invests I_1, so that

(8) $X_1 + F_1 = D_1 + I_1$.

The left and right sides of equation(8) represent the firm's total cash inflows and outflows, respectively.

[4] Rational expectations are characterized by unbiasedness, efficiency, and consistency (Cuthbertson and Taylor, 1987).

Given these conditions, Appendix 1 develops the change in equity value in response to an earnings announcement:

$$(9)\ V_1 - E_0(V_1) = UX_1\left[1 + \alpha\left(\frac{E_1\left(\frac{dG_1}{dK_0}\right)}{1+i} - 1\right) + \frac{1}{1+i}\right],$$

where:

V_t = Value of original shares at time t; and
α = Earnings retention rate.

Relaxing the assumption of no corporate tax, Appendix 2 derives a similar model (equation (A.9)'). Because the model (equation (A.9)') has virtually the same implications as equation (9), we focus on equation (9) throughout the paper. To scale for cross-sectional differences in the level and variability of equity value, divide equation (9) by $E_0(V_1)$ and define V_1 and UX_1 as per share values:

$$(10)\ \frac{V_1 - E_0(V_1)}{E_0(V_1)} = \frac{UX_1}{E_0(V_1)}\left[1 + \alpha\left(\frac{E_1\left(\frac{dG_1}{dK_0}\right)}{1+i} - 1\right) + \frac{1}{1+i}\right].$$

For notational convenience, define:

R = Stock Return = $\dfrac{V_1 - E_0(V_1)}{E_0(V_1)}$;

S = Earnings Surprise = $\dfrac{UX_1}{E_0(V_1)}$; and

$$Q = \frac{E_1\left(\frac{dG_1}{dK_0}\right)}{1+i}.$$

Q represents marginal productivity, interpreted as return generated by \$1 of new investment, discounted at the cost of capital. Equation (10) can be rewritten as:

$$(11)\ R = S\left[1 + \alpha(Q - 1) + \frac{1}{1+i}\right].$$

Share price response is a function of earnings surprise and an earnings response coefficient. If there is no earnings surprise, there should be no change in share price. But if there is, share price change is determined by the earnings response coefficient, which is a nonlinear function of the earnings retention rate, marginal productivity, and the cost of capital. For an economic insight into equation (11), consider a firm for which actual earnings are greater than expected earnings. Because the unexpected earnings indicate that the firm's investment opportunities initially were underestimated, the firm will adjust its next period investment upward to capture the unrealized investment opportunities, which will result in a higher return for the next period than for the previous period. Because the market is aware of this, it will adjust the stock price upward. In this process, the marginal productivity of the firm should have an impact on the stock price adjustment. *Ceteris paribus*, the higher the marginal productivity, the higher the net return from the investment. For this reason, higher marginal productivity should lead to a larger stock price increase. Also, a higher earnings retention rate, *ceteris paribus*, should have a more favorable effect on the stock price, because shareholders will do better by investing in the firm than investing on their own. But cost of capital has an adverse effect on the share price because a discount is deeper with higher cost of capital.

COMPARATIVE STATICS OF THE THEORETICAL RELATIONSHIP

To investigate the functional form of the return/surprise relation, rewrite equation (11) as:

$$(12)\ \frac{R}{S} = 1 + \alpha(Q - 1) + \frac{1}{1+i}.$$

Although the functional form of the return/surprise relation is the same for both positive and negative surprises, the comparative statics are different. This is due to the association between the sign of the change in value and the sign of (Q - 1) and to the multiplicative form of the return/surprise relationship. For positive surprise ($S > 0$), marginal return on investment should be greater than the marginal cost of capital so that marginal productivity Q is greater than one, and $(Q - 1) > 0$. For negative surprise ($S < 0$), marginal return should be less than marginal cost, and $(Q - 1) < 0$. This results in the following predictions for positive and negative earnings surprises:

$$(13)\ S > 0:\ \frac{R}{S} = f^{+}(\overset{+}{\alpha}, \overset{+}{Q}, \overset{-}{i});\ \text{and}$$

$$(14)\ S < 0:\ \frac{R}{S} = f^{-}(\overset{-}{\alpha}, \overset{+}{Q}, \overset{-}{i}).$$

Thus, the predicted sign on α differs depending on whether the earnings surprise is positive or negative. If the earnings surprise is positive, shareholders do better when the firm retains more income because its marginal net return on investment is positive. In the case of negative earnings surprise, shareholders do better when the firm pays more dividends because of its negative marginal net return on investment.

EMPIRICAL ANALYSIS

EMPIRICAL PROXIES

In order to translate equation (12) into a testable empirical specification, we need proxies for R, S, α, Q, and i. As a proxy for R we use the average of daily returns over the three day period from day -1 to day +1 relative to the earnings announcement.[5] Return data are derived from the CRSP daily returns file.[6] A longer event period may allow non-earnings information to affect stock prices, thereby confounding empirical results.

Actual primary earnings per share before extraordinary items are taken from the Compustat quarterly file. As the market's earnings expectation, we use financial analysts' mean consensus forecasts of quarterly primary earnings per share before extraordinary items from Lynch, Jones and Ryan's I/B/E/S tapes (because earnings expectations based on time series models have been shown to be inferior to financial analysts' forecasts of earnings (e.g., Brown *et al.*, 1987a, 1987b)). Nevertheless, we admit that a substantial amount of error is involved with measurement of this earnings expectation primarily due to a timing difference between the formation of earnings expectation and the earnings announcement. Unexpected earnings (actual earnings minus consensus forecasts), scaled by share price two trading days prior to the earnings announcement date, are used as a proxy for S.

The earnings retention rate, α, alternatively can be defined as (1 - dividend payout ratio). To overcome the problem of negative or zero earnings resulting in an unreasonable range of retention rates, we use dividend yield, D_{jt} (dividends divided by stock price two trading days prior to the earnings announcement date) as a proxy for the firm's earnings retention rate.[7] Quarterly dividend payments are obtained from the Compustat quarterly file.

Tobin's q ratio is used as a proxy for Q. Tobin's q conventionally is defined as the ratio of the market value of debt and equity to the replacement cost of physical assets. Tobin (1969) shows that the q ratio is also the ratio of marginal return on investment to the marginal cost of capital. Using the Lindenberg and Ross' (1981) algorithm, the q ratio is derived from the National Bureau of Economic Research's R&D master file.

Because systematic risk is related linearly to required return according to the capital asset pricing model, we use beta, B_{jt}, as a proxy for i. We estimate betas based on the

---

[5] The authors are grateful to a referee for the suggestion of the three day window. In an earlier version of this paper, the authors used a two day window including the day before and the day of earnings announcement. The referee pointed out that earnings announcements often are made public after the close of the exchange.

[6] While we only report empirical results for raw returns, results using abnormal returns are qualitatively the same. As in Collins and Kothari (1989), the results are not sensitive to the choice of raw or abnormal returns.

[7] For instance, suppose a firm with zero earnings paid $0.20 per share for dividends. In this case, its earnings retention rate goes to negative infinity. This violates the distributional assumption of the least squares method (Schmidt, 1976). Using dividend yield not only enables the variable to be in a reasonable range in the econometric sense, but also has a scaling effect. Thus, using the direct variable, retention rate, is not appropriate for our empirical study.

180 days leading up to two days prior to the earnings announcement date with the Scholes and Williams (1977) estimator with a lead and lag of one day.[8]

Our sample consists of 1,925 firm-quarters between the fourth quarter of 1983 and the second quarter of 1986. The sample period is determined by data availability. Because equation (12) predicts asymmetric price responses to positive and negative earnings surprises, we divide the sample of 1,925 observations into two samples according to the sign of earnings surprise. We do not examine the zero surprise (105 observations) sample.

METHODOLOGICAL CONSIDERATIONS

There are several impediments to an empirical test of equation (12). First, equation (12) is a nonlinear relation that linear regression models fit poorly. Second, our empirical proxies measure the theoretical variables with error. As indicated earlier, there is likely to be a large amount of measurement error in the earnings surprise proxy.

To minimize the problems, we adopt a reverse regression (Collins and Kothari, 1989):[9]

$$(15)\ S_{jt} = b_0 + b_1R_{jt} + b_2D_{jt}R_{jt} + b_3Q_{jt}R_{jt} + b_4B_{jt}R_{jt} + u_{jt},$$

for firm $j = 1, \ldots N$ and time $t = 1, \ldots T$. Using dividend yield as a proxy for the earnings retention rate switches the sign of the predictions in equations (13) and (14). As functional relations are inverted in a reverse regression, the empirical model predictions depending on the sign of S are as follows:

$$(16)\ S > 0:\ S = g^{+}(\overset{+}{R}, \overset{+}{D^{*}R}, \overset{-}{Q^{*}R}, \overset{+}{B^{*}R});\ \text{and}$$

---

[8] Scholes and Williams (1977) show that OLS estimators of market betas using daily returns in the presence of nonsynchronous trading are biased and inconsistent.

[9] Because equation (12) is a nonlinear relation, we attempted a nonlinear least squares method. For nonlinear regression, equation (12) can be specified as

$$\frac{R_{jt}}{S_{jt}} = 1 + \partial_1 D_{jt}(\partial_2 Q_{jt} - 1) + \frac{1}{1 + \partial_3 B_{jt}}.$$

The estimates of ∂_1, ∂_2, and ∂_3 are calculated by the Gauss-Newton algorithm (Amemiya, 1985). The estimate of ∂_1 is predicted to be negative, and the estimates of ∂_2 and ∂_3 are predicted to be positive. The results below are based on the following initial values: $\partial_1 = -1.0$; $\partial_2 = \partial_3 = 1.0$.

	Parameter Estimate	Standard Error	95% Confidence Interval Lower	Upper
∂_1	-1.3447	0.2145	-0.9240	-1.7653
∂_2	0.6718	0.0932	0.4890	0.8546
∂_3	0.4921	0.0008	0.4906	0.4937

All the coefficient estimates have the predicted signs. The estimated coefficients vary, however, depending on initial values. Moreover, when the empirical proxies are not accurate measures of the variables, nonlinear regression results are not reliable. We focus on the results using the reverse regression.

$$(17)\ S < 0:\ S = g^{-}(\overset{+}{R}, \overset{-}{D^*R}, \overset{-}{Q^*R}, \overset{+}{B^*R}).$$

We examine the sign and significance of the coefficient on each variable in equation (15) with OLS regression. With errors in variables, the magnitudes of coefficient estimates in reverse regressions have little meaning, especially for regressions with more than one independent variable (Levi, 1973). We use significance tests only to judge whether the regression coefficients have the predicted sign.

EMPIRICAL RESULTS

FIRM-SPECIFIC FACTORS IN THE RETURN/SURPRISE RELATION

Summary statistics on the positive and negative earnings surprise samples are reported in Table 1. The positive and negative surprise samples differ along several dimensions. Dividend yield and q ratio show statistically significant differences between the positive and negative surprise samples at the 5 percent level based on a t-test comparison of means. The dividend yield is lower and the q ratio is higher for the positive surprise sample than they are for the negative surprise sample.

Table 1—Descriptive Statistics: Factors Associated with Share Price Response

	R_{jt}	S_{jt}	D_{jt}	Q_{jt}	B_{jt}	F_{jt}
$S_{jt} > 0$						
Number of Observations	826	826	826	826	826	826
Mean	0.0094	0.0083	0.0054	1.0824	1.2112	5.1931
Standard Deviation	0.0291	0.0195	0.0042	0.7374	0.8321	1.0005
$S_{jt} < 0$						
Number of Observations	994	994	994	994	994	994
Mean	-0.0070	-0.0209	0.0061	1.0021	1.2485	5.0996
Standard Deviation	0.0323	0.1348	0.0048	0.6298	0.8784	1.0995
Two sample t-statistic			-3.275*	2.505*	-0.924	1.881
Two tailed p-value			0.001	0.013	0.353	0.063

R_{jt} is the mean return over the three day period including the day before, the day of, and the day after an earnings announcement. S_{jt} is unexpected earnings as a percent of share price. D_{jt} is quarterly dividends divided by share price two days before the earnings announcement. Q_{jt} is the ratio of the market value of the firm to the replacement cost of assets (i.e., Tobin's q ratio). B_{jt} is Scholes-Williams' adjusted beta. F_{jt} is the natural logarithm of the market value of equity

* Significant at 5 percent level based on two tailed test

Correlation coefficients between return, earnings surprise, and the firm-specific proxies appear in Table 2. Table 2 shows that the firm-specific factors are intercorrelated.[10]

First, the following equation is estimated for positive and negative earnings surprises:

[10] Because of the statistically significant correlations between the factors in Table 2, we calculated "condition numbers" according to Belsley *et al.*'s (1980) diagnostic test of multicollinearity. Condition numbers over 20 indicate a serious collinearity problem. Maximum condition number in Tables 3-5 is 14.7.

Table 2—Correlations Between Factors Associated With Share Price Response

	R_{jt}	S_{jt}	D_{jt}	Q_{jt}	B_{jt}	F_{jt}
R_{jt}		0.095* (0.002)	-0.018 (0.619)	0.030 (0.364)	-0.015 (0.648)	0.035 [a] (0.228)
S_{jt}	0.184* (0.000)		0.100* (0.002)	0.101* (0.002)	-0.003 (0.930)	0.136* (0.000)
D_{jt}	-0.110* (0.002)	-0.126* (0.000)		-0.119* (0.000)	-0.232* (0.000)	0.285* (0.000)
Q_{jt}	0.011 (0.779)	-0.193* (0.000)	-0.185* (0.000)		0.201* (0.000)	0.383* (0.000)
B_{jt}	-0.013 (0.736)	0.022 (0.530)	-0.247* (0.000)	0.242* (0.000)		-0.024 (0.454)
F_{jt}	-0.033 (0.336)	-0.275* (0.000)	0.161* (0.000)	0.409* (0.000)	0.059[b] (0.091)	

R_{jt} is the mean return over the three day period including the day before, the day of, and the day after an earnings announcement. S_{jt} is unexpected earnings as a percent of share price. D_{jt} is quarterly dividends divided by share price two days before the earnings announcement. Q_{jt} is the ratio of the market value of the firm to the replacement cost of assets (i.e., Tobin's q ratio). B_{jt} is Scholes-Williams' adjusted beta. F_{jt} is the natural logarithm of the market value of equity. Statistically significant correlations at the 5 percent level are indicated by an asterisk (*)

[a] Upper-triangular entries are the correlation coefficients for the group of negative earnings surprises. P-values are in parentheses

[b] Lower-triangular entries are the correlation coefficients for the group of positive earnings surprises. P-values are in parentheses

(18) $S_{jt} = b_0 + b_1 R_{jt}$.

Results are reported in Table 3 for positive earnings surprise and in Table 4 for negative surprise. Estimates of b_1 are 0.1728 and 0.5571 for positive and negative surprises, respectively. As expected, these estimates are positive and statistically significant at the 1 percent level.

The results from estimating equation (15) are presented in Tables 3 and 4. Explanatory power is improved greatly when firm-specific factors are incorporated into the return/surprise relation. For both positive and negative earnings surprises, adjusted R^2s significantly increase when the three factors are added. The coefficient estimates of all independent variables except dividend yield for positive earnings surprise have the same sign as predicted in equations (16) and (17).

The coefficient on the q ratio is negative and significant at the 1 percent level for both positive and negative surprises. Because functional relations are inverted in a reverse regression, this indicates that firms with higher q ratios have larger price responses to both positive and negative earnings surprises as predicted in equations (16) and (17). The coefficient on beta is greater than zero for both positive and negative surprises with two tail p-values of 0.0364 and 0.0795, respectively. This indicates that beta is related negatively to the return/surprise relation, as predicted in equations (16) and (17). Firms with lower betas have larger price responses to both positive and negative earnings surprises.

Table 3—Market Response to Positive Unexpected Earnings
$S_{jt} = b_0 + b_1R_{jt} + b_2D_{jt}R_{jt} + b_3Q_{jt}R_{jt} + b_4B_{jt}R_{jt} + u_{jt}$ [a]

	Independent Variables				Regression Statistics		
S > 0 (N = 826)	b_1	b_2	b_3	b_4	F value P>F	R^2 Adjusted R^2	MSE
Coefficient	0.1728*				28.683*	0.0339	0.0004
(SE)	(0.0322)					0.0327	
T-statistic	5.367						
P-value	0.0001				0.0001		
Coefficient	0.4485*	-34.736*	-0.2109*	0.0752*	22.323*	0.0984	0.0003
(SE)	(0.0783)	(7.3451)	(0.0362)	(0.0313)		0.0939	
T-statistic	5.728	-4.729	-5.826	2.402			
P-value	0.0001	0.0001	0.0001	0.0364	0.0001		

R_{jt} is the mean return over the three day period including the day before, the day of, and the day after an earnings announcement. S_{jt} is unexpected earnings as a percent of share price. D_{jt} is quarterly dividends divided by share price two days before the earnings announcement. Q_{jt} is the ratio of the market value of the firm to the replacement cost of assets (i.e., Tobin's q ratio). B_{jt} is Scholes-Williams' adjusted beta

[a] The coefficient estimate on the intercept, b_0, is not reported

* Significant at 5 percent level based on two tailed test

This corroborates Easton and Zmijewski (1989) and Collins and Kothari (1989). The coefficient on dividend yield is negative and significant at the 1 percent level for both positive and negative surprises. Firms with high dividend yield have stronger responses than firms with low dividend yield. This is consistent with the prediction of equation (17) for negative surprise, but opposite that predicted by equation (16) for positive surprise. A possible explanation is that dividend yield (or retention rate) is determined not only by the firm's investment opportunities, but also its other considerations such as signaling (Bhattacharya, 1979, 1980), free cash flow (Lang and Litzenberger, 1989), and taxation (John and Williams, 1985).

CONTROLLING FOR THE INFORMATION ENVIRONMENT

Firms can differ from one another in many ways that are not included in the theoretical model. Some of these firm-specific differences involve the information environment of the firm.[11] The differential information hypothesis of Atiase (1985) and Freeman (1987) states that the availability of information relevant to security valuation is an increasing function of firm size.

To examine whether the above results prevail even after controlling for the information environment, we estimate the following equation:

$$(19)\quad S_{jt} = b_0 + b_1R_{jt} + b_2D_{jt}R_{jt} + b_3Q_{jt}R_{jt} + b_4B_{jt}R_{jt} + b_5F_{jt}R_{jt} + u_{jt},$$

where:

[11] The *information environment* is defined as the availability and accuracy of information relevant to assessing firm value including macroeconomic, industry, and firm-specific information.

Table 4—Market Response to Negative Unexpected Earnings
$S_{jt} = b_0 + b_1R_{jt} + b_2D_{jt}R_{jt} + b_3Q_{jt}R_{jt} + b_4B_{jt}R_{jt} + u_{jt}$ [a]

	Independent Variables				Regression Statistics		
S < 0 (N = 994)	b_1	b_2	b_3	b_4	F value P>F	R^2 Adjusted R^2	MSE
Coefficient	0.5571*				8.985*	0.0092	0.0180
(SE)	(0.1859)					0.0083	
T-statistic	2.997						
P-Value	0.0028				0.0028		
Coefficient	1.6165*	-91.498*	-1.1868*	0.2907	8.316*	0.0327	0.0177
(SE)	(0.4341)	(33.711)	(0.3280)	(0.1655)		0.0287	
T-Statistic	3.724	-2.714	-3.619	1.757			
P-Value	0.0002	0.0068	0.0003	0.0795	0.0001		

R_{jt} is the mean return over the three day period including the day before, the day of, and the day after an earnings announcement. S_{jt} is unexpected earnings as a percent of share price. D_{jt} is quarterly dividends divided by share price two days before the earnings announcement. Q_{jt} is the ratio of the market value of the firm to the replacement cost of assets (i.e., Tobin's q ratio). B_{jt} is Scholes-Williams' adjusted beta

[a] The coefficient estimate on the intercept, b_0, is not reported

* Significant at 5 percent level based on two tailed test

Table 5—Market Response to Unexpected Earnings: Controlling for Firm Size
$S_{jt} = b_0 + b_1R_{jt} + b_2D_{jt}R_{jt} + b_3Q_{jt}R_{jt} + b_4B_{jt}R_{jt} + b_5F_{jt}R_{jt} + u_{jt}$ [a]

	Independent Variables					Regression Statistics		
	b_1	b_2	b_3	b_4	b_5	F value P>F	R^2 Adj. R^2	MSE
S > 0 (N = 826)								
Coefficient	0.9451*	-22.443*	-0.1312*	0.0694*	-0.1318*	22.212*	0.1196	0.0003
(SE)	(0.1360)	(7.7732)	(0.0342)	(0.0312)	(0.0297)		0.1142	
T-Statistic	6.949	-2.887	-3.836	2.224	-4.438			
P-Value	0.0001	0.0004	0.0001	0.0210	0.0001	0.0001		
S < 0 (N = 994)								
Coefficient	2.0932*	-80.175*	-1.0540*	0.2772	-0.1395	6.726*	0.0331	0.0178
(SE)	(0.8772)	(38.282)	(0.3920)	(0.1673)	(0.2227)		0.0281	
T-Statistic	2.386	-2.094	-2.689	1.654	-0.626			
P-Value	0.0172	0.0365	0.0074	0.0984	0.5317	0.0001		

R_{jt} is the mean return over the three day period including the day before, the day of, and the day after an earnings announcement. S_{jt} is unexpected earnings as a percent of share price. D_{jt} is quarterly dividends divided by share price two days before the earnings announcement. Q_{jt} is the ratio of the market value of the firm to the replacement cost of assets (i.e., Tobin's q ratio). B_{jt} is Scholes-Williams' adjusted beta. F_{jt} is the natural logarithm of the market value of equity

[a] The coefficient estimate on the intercept, b_0, is not reported

* Significant at 5 percent level based on two tailed test

F_{jt} = Firm size proxied by the natural logarithm of the market value of equity.

Table 5 indicates that the inclusion of firm size has little impact on the sign and significance of the theoretically derived factors. Thus, our empirical findings remain qualitatively the same, even after the information environment is controlled.

CONCLUSION

This study develops a theoretical model to explain how the effect of an earnings surprise is transmitted through firm-specific factors into share price response. In the model, market response to earnings surprise is a function of the earnings retention rate, marginal productivity, and the cost of capital. While the empirical results are subject to the usual limitations due to our selection criteria and methodology, the theoretical model is supported in general by the sample data. The roles of marginal productivity (q ratio) and the earnings retention rate have not been previously investigated.

This study offers a new perspective on previous research in this area. Earlier studies largely have ignored the aspect of corporate investment decisions. By contrast, our theoretical model highlights the association of a firm's investment decision with earnings surprise. The model indicates that the stock price response to earnings announcements is determined within the context of investment opportunities and decisions.

The study also has an implication for future research. Although our study was conducted within a rational expectations framework, it can be extended into an option framework. A firm's investment decisions may involve various operating options (Myers, 1987) because investment projects in many cases involve flexibility, enabling the firm to make or revise decisions at some future time. The operating options give the firm time to examine the course of future events and the chance to avoid costly errors if unfavorable developments occur. As new information arrives and uncertainty about future events is resolved, the firm can exercise the operating options. While there are many sources from which the firm can obtain information needed to exercise its operating options, its own earnings performance is probably one of the most important sources. Thus, it would be fruitful to investigate the implication of unexpected earnings on investment from the perspective of operating options.

REFERENCES

1. Amemiya, T., *Advanced Econometrics* (Cambridge: Harvard University Press, 1985).

2. Atiase, R.K., "Predisclosure Information, Firm Capitalization and Security Price Behavior Around Earnings Announcements," *Journal of Accounting Research*, 23 (Spring 1985), pp. 21-36.

3. Ball, R., and P. Brown, "An Empirical Evaluation of Accounting Income Numbers," *Journal of Accounting Research*, 6 (Autumn 1968), pp. 159-178.

4. Beaver, W., "The Information Content of Annual Earnings Announcements," *Journal of Accounting Research*, 6 (Supplement 1968), pp. 67-92.

5. Belsley, D.A., E. Kuhn, and R.E. Welsch, *Regression Diagnostics* (New York: Wiley, 1980).

6. Bhattacharya, S., "Imperfect Information, Dividend Policy, and the 'Bird in the Hand' Fallacy," *Bell Journal of Economics*, 10 (Spring 1979), pp. 259-279.

7. __________, "Nondissipative Signalling Structures and Dividend Policy," *Quarterly Journal of Economics*, 95 (August 1980), pp. 1-24.

8. Brown, L.D., P. Griffin, R. Hagerman, and M. Zmijewski, "Security Analyst Superiority Relative to Univariate Time Series Models in Forecasting Quarterly Earnings," *Journal of Accounting and Economics*, 9 (April 1987a), pp. 61-87.

9. Brown, L.D., P. Griffin, R. Hagerman, and M. Zmijewski, "An Evaluation of Alternative Proxies for the Market's Assessment of Unexpected Earnings," *Journal of Accounting and Economics*, 9 (July 1987b), pp. 159-193.

10. Collins, D.W., and S.P. Kothari, "An Analysis of Intertemporal and Cross-Sectional Determinants of Earnings Response Coefficients," *Journal of Accounting and Economics*, 11 (July 1989), pp. 143-181.

11. Cuthbertson, K. and M.P. Taylor, *Macroeconomic Systems* (New York: Basil Blackwell, 1987).

12. Easton, P., and M. Zmijewski, "Cross-Sectional Variation in the Stock Market Response to Accounting Earnings Announcements," *Journal of Accounting and Economics*, 11 (July 1989), pp. 117-141.

13. Freeman, R.N., "The Association Between Accounting Earnings and Security Returns for Large and Small Firms," *Journal of Accounting and Economics*, 9 (July 1987), pp. 195-228.

14. Grant, E.B., "Market Implications of Differential Amounts of Interim Information," *Journal of Accounting Research*, 18 (Spring 1980), pp. 255-268.

15. John, K., and J. Williams, "Dividends, Dilution, and Taxes: A Signalling Equilibrium," *Journal of Finance*, 40 (September 1985), pp. 1053-1070.

16. Kormendi, R., and R. Lipe, "Earnings Innovations, Earnings Persistence and Stock Returns," *Journal of Business*, 60 (July 1987), pp. 323-345.

17. Lang, L.H.P., and R.H. Litzenberger, "Dividend Announcements: Cash Flow Signalling vs. Free Cash Flow Hypothesis?" *Journal of Financial Economics*, 24 (September 1989), pp. 181-191.

18. Levi, M., "Errors in the Variables Bias in the Presence of Correctly Measured Variables," *Econometrica*, 41 (September 1973), pp. 985-986.

19. Lindenberg, E.B., and S.A. Ross, "Tobin's Q Ratio and Industrial Organization," *Journal of Business*, 54 (January 1981), pp. 1-32.

20. Modigliani, F., and M.H. Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment," *American Economic Review*, 48 (June 1958), pp. 261-297.

21. Myers, S., "Finance Theory and Financial Strategy," *Midland Corporate Finance Journal*, 5 (Spring 1987), pp. 6-13.

22. Pincus, M., "Information Characteristics of Earnings Announcements and Stock Market Behavior," *Journal of Accounting Research*, 21 (Spring 1983), pp. 155-183.

23. Schmidt, P., *Econometrics* (New York: Marcel Dekker, 1976).

24. Scholes, M., and J. Williams, "Estimating Betas from Nonsynchronous Data," *Journal of Financial Economics*, 5 (December 1977), pp. 309-327.

25. Tobin, J., "A General Equilibrium Approach to Monetary Theory," *Journal of Money, Credit and Banking*, 1 (February 1969), pp. 15-29.

Appendix 1

At time 1 (the beginning of period two), the firm realizes X_1, pays dividend D_1, borrows F_1, and invests I_1, so that

(A.1) $X_1 + F_1 = D_1 + I_1$.

The cum-dividend value of the original shares after the earnings announcement at time 1 is:

$$(A.2)\ V_1 = D_1 - F_1 + \frac{E_1(X_2)}{1 + i} + L$$

$$= X_1 - I_1 + \frac{E_1(X_2)}{1 + i} + L,$$

where:

L = Discounted salvage value of the assets to be liquidated at the end of period two.

Recall equations (1) and (2):

(1) $X_1 = E_0(G_0(K_0)) + UX_1$, and

(2) $X_2 = E_1(G_1(K_1)) + UX_2$.

Substituting for X_1 and X_2 in (A.2) leads to:

$$(A.3)\ V_1 = [E_0(G_0(K_0)) + UX_1] - I_1 + \frac{E_1(G_1(K_1))}{1 + i} + L$$

$$= E_0(G_0(K_0)) + UX_1 - I_1 + \frac{E_1(G_1(K_1))}{1 + i} + L.$$

Equation (A.3) shows the value of the original shares immediately after the earnings announcement at time 1. Using the rational expectations property of consistency (equations (6) and (7)), the expectation (before the earnings announcement) of this post-announcement value is:

$$(A.4)\ E_0(V_1) = E_0[E_0(G_0(K_0)) + UX_1] - E_0(I_1) + \frac{E_0(G_1(K_1))}{1 + i} + L$$

$$= E_0(G_0(K_0)) - E_0(I_1) + \frac{E_0(G_1(K_1))}{1 + i} + L$$

$$= E_0(G_0(K_0)) - bK_0 + \frac{E_0(G_1(K_1))}{1 + i} + L.$$

The change in value in response to the earnings announcement is then $V_1 - E_0(V_1)$.

If $UX_1 = 0$, then $G_0'(K_0) = 1 + i$, and the firm invested exactly the right amount of capital. Because the income-generating function is a random walk, no adjustment of the investment level is necessary or desirable ($dI = 0$). The firm invested the value-maximizing amount. Consequently, equity value does not change at the time of the earnings announcement.

If UX_1 differs from 0, then the firm either under- or overinvested relative to its optimal level of investment. Equity value either should rise to reflect the unexpected investment opportunities from underinvestment ($E_1(G_1'(K_0)) > 1 + i$) or fall because income is insufficient to meet costs due to overinvestment ($E_1(G_1'(K_0)) < 1 + i$). The firm will revise its next investment I_1 so that $I_1 = bK_0 + dI$, where dI represents either net new investment ($dI > 0$) or disinvestment ($dI < 0$). The value of the equity immediately after the announcement is:

$$\text{(A.5)}\quad V_1 = E_0(G_0(K_0)) + UX_1 - bK_0 - dI + \frac{E_1(G_1(K_0 + dI))}{1 + i} + L.$$

Because $E_1(G_1(K_0 + dI)) = E_1(G_1(K_0)) + E_1((dG_1/dK_0)*dI)$ for small changes in the level of investment dI,

$$\text{(A.6)}\quad V_1 = E_0(G_0(K_0)) + UX_1 - bK_0 - dI + \frac{E_1(G_1(K_0))}{1 + i} + \frac{E_1\left(\frac{dG_1}{dK_0}*dI\right)}{1 + i} + L,$$

where:

$dG_1/dK_0 = dG_1/dK$ at the level of investment K_0.

Because $E_1(G_1(K_0)) = E_0(G_0(K_0)) + UX_1$,

$$\text{(A.7)}\quad V_1 = E_0(G_0(K_0)) + UX_1 - bK_0 - dI + \frac{E_0(G_0(K_0))}{1 + i} + \frac{UX_1}{1 + i} + \frac{E_1\left(\frac{dG_1}{dK_0}*dI\right)}{1 + i} + L.$$

The change in value at the time of an earnings announcement is equal to equation (A.7) minus equation (A.4):

$$E_1\left(\frac{dG_1}{dK_0}*dI\right) \quad UX_1$$

Assuming $dI = \alpha^*UX_1$, where α can be interpreted as the firm's earnings retention rate, leads to:

$$\text{(A.9)}\quad V_1 - E_0(V_1) = UX_1 - \alpha^*UX_1 + \frac{E_1\left(\frac{dG_1}{dK_0}\right)}{1 + i}\alpha^*UX_1 + \frac{UX_1}{1 + i}$$

$$= UX_1\left[1 + \alpha\left(\frac{E_1\left(\frac{dG_1}{dK_0}\right)}{1 + i} - 1\right) + \frac{1}{1 + i}\right].$$

Appendix 2

Allowing for corporate tax, the cash flow identity can be rewritten as:

$$(A.1)'\ X_1 + F_1 = D_1 + I_1 + T_1,$$

where T_t represents the firm's tax at time t. The left and right sides of (A.1)' indicate the firm's total cash inflows and outflows, respectively. The cum-dividend value of the original shares after the earnings announcement at time 1 is:

$$(A.2)'\ V_1 = X_1 - T_1 - I_1 + \frac{E_1(X_2 - T_2)}{1 + i} + L.$$

Using equations (1) and (2),

$$(A.3)'\ V_1 = E_0(G_0(K_0)) + UX_1 - T_1 - I_1 + \frac{E_1(G_1(K_1) - T_2)}{1 + i} + L.$$

By the rational expectations property of consistency (equations (6) and (7)), the expectation (before the earnings announcement) of this postannouncement value is:

$$(A.4)'\ E_0(V_1) = E_0(G_0(K_0) - T_1) - bK_0 + \frac{E_0(G_0(K_0) - T_1)}{1 + i} + L.$$

On the other hand, using the relation, $I_1 = bK_0 + dI$, the value of the equity immediately after the announcement can be stated as:

$$(A.5)'\ V_1 = E_0(G_0(K_0)) + UX_1 - T_1 - bK_0 - dI + \frac{E_1(G_1(K_0 + dI))}{1 + i} - \frac{E_1(T_2)}{1 + i} + L.$$

Because $E_1(G_1(K_0 + dI)) = E_1(G_1(K_0)) + E_1((dG_1/dK_0)*dI)$ for small changes in the level of investment dI,

$$(A.6)'\ V_1 = E_0(G_0(K_0)) + UX_1 - T_1 - bK_0 - dI + \frac{E_1(G_1(K_0))}{1 + i} + \frac{E_1\left(\frac{dG_1}{dK_0}*dI\right)}{1 + i} - \frac{T_1}{1 + i} + L.$$

Because $E_1(G_1(K_0)) = E_0(G_0(K_0)) + UX_1$,

$$(A.7)'\ V_1 = E_0(G_0(K_0)) + UX_1 - T_1 - bK_0 - dI + \frac{E_0(G_0(K_0))}{1 + i} + \frac{UX_1}{1 + i} + \frac{E_1\left(\frac{dG_1}{dK_0}*dI\right)}{1 + i}$$

$$- \frac{T_1}{1 + i} + L.$$

The change in value at the time of an earnings announcement is:

$$\text{(A.8)'}\ V_1 - E_0(V_1) = UX_1 - dI + \frac{UX_1}{1 + i} + \frac{E_1\left(\frac{dG_1}{dK_0}*dI\right)}{1 + i} - \left[T_1 - E_0(T_1) + \frac{T_1}{1 + i} - \frac{E_0(T_1)}{1 + i}\right]$$

Because the difference, $T_1 - E_0(T_1)$, represents the unexpected corporate tax, it must be an increasing function of the unexpected earnings. Consequently, the whole term in the brackets can be simplified as a function of UX_1:

$$T_1 - E_0(T_1) + \frac{T_1}{1 + i} - \frac{E_0(T_1)}{1 + i} = \delta^* UX_1.$$

Assuming $dI = \alpha^* UX_1$ leads to:

$$\text{(A.9)'}\ V_1 - E_0(V_1) = UX_1 \left[1 - \delta + \alpha \left(\frac{E_1\left(\frac{dG_1}{dK_0}\right)}{1 + i} - 1\right) + \frac{1}{1 + i}\right].$$

Thus, equation (A.9)' provides virtually the same implications as equation (A.9).