



Financial analysts as users of accounting information

Evidence about forecast revision activity after earnings announcements

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Abstract

Purpose – To examine whether both the value relevance of accounting information, and the quality of earnings affect financial analysts' revisions of forecast annual earnings per share soon after an earnings release.

Design/methodology/approach – For firms whose accounting earnings provide either a basis for firm valuation or new information, analysts are predicted to revise earnings forecasts in response to the magnitude of surprise in the earnings release. Using publicly available data, regression analysis explores the influence of earnings response coefficients (ERCs), unexpected earnings, and interactions between ERCs, the association between earnings and returns, and unexpected earnings on forecast revisions after earnings announcements.

Findings – Empirical tests demonstrate a positive relation between the percentage of analysts revising forecasts soon after interim earnings announcements and firm-specific ERCs, the interaction between the magnitude of earnings surprises, ERCs, and earnings-returns associations, and pre-announcement dispersion in forecasts. The results suggest that usefulness of earnings releases is related to the magnitude of new information in the release, the persistence of earnings innovations, the firm-specific mapping between earnings and returns, and prior uncertainty about earnings.

Research limitations/implications – This paper examines forecast revisions only soon after earnings announcements. Future research should examine more general determinants of analysts' forecast revision activity.

Originality/value – This paper provides evidence about determinants of forecast revision frequency, a measure of how actively financial analysts provide information, an extension of prior research that focuses on analyst following as a measure of information environments.

Keywords Forecasting, Earnings, Accounting information

Paper type Research paper

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1. Introduction

This paper explores how the value relevance of accounting earnings and the information content of earnings surprises are related to financial analysts' forecast revision activities. Interest in analyst activity after earnings announcements stems from research relating firms' reporting and disclosure policies to financial analysts' forecast characteristics (e.g. Lang and Lundholm, 1996; Dechow *et al.*, 1996; Barron *et al.*, 1999), and from research that demonstrates convergence in forecasts after earnings announcements, as long as measures are purged of stale forecasts (Brown and Han, 1992; Stickel, 1996). This literature indicates that earnings releases and the characteristics of accounting information influence analysts' activities. This paper extends that literature by providing evidence that the magnitude of analysts' forecast errors is differentially associated with revision activity in response to the earnings announcement, depending upon firm-specific earnings response coefficients (ERCs) and earnings-returns associations. It also demonstrates a positive relation between dispersion in forecasts prior to earnings announcements and the frequency of forecasts revisions following those same announcements. The results of this study suggest that analysts more actively provide information about firms with high-quality earnings, especially when the earnings release has high predictive value. These results should be of interest to managers who are concerned with the effects of financial disclosure on investor beliefs, relationships with analysts, and the extent to which forecasts of earnings per share (EPS) are current.

This study examines the relation between the frequency of financial analysts forecast revisions of annual EPS soon after an earnings release and both the firm's ERC and association between annual earnings and annual returns. Empirical tests demonstrate a positive relation between the percentage of analysts who revise annual forecasts soon after earnings announcements and firm-specific ERCs, the interaction between the magnitude of earnings surprises, ERCs, and earnings-returns associations, and dispersion in forecasts made before the announcement. These results suggest that analysts are more likely to revise forecasts in response to earnings announcements when the information content of earnings is high, and that earnings surprises are more likely to lead to revisions for firms with surprises that are perceived as persistent. Further, the magnitude of surprise influences analyst activity most strongly for firms whose earnings have high information content.

2. Related literature

Financial analysts have been separately characterized as both providers of private information (e.g. Bhushan, 1989; Brennan and Hughes, 1991; Dempsey, 1989; Shores, 1990) and information intermediaries who use accounting information in preparation of earnings forecasts and buy-sell recommendations (e.g. Lang and Lundholm, 1996). The work of Stickel (1989) and Barron and Stuerke (1998) suggest that analysts' forecast revisions both represent reactions to accounting releases and provide predisdisclosure information to the market. Stickel (1989) finds fewer forecast revisions before interim earnings announcements, and more forecast revisions after interim earnings announcements. He concludes that analysts intentionally delay revisions until after earnings are announced, implying that these revisions are likely to be based, at least in part, on the information in the accounting release. Barron and Stuerke (1998) test whether uncertainty about future earnings leads to private information

acquisition, and find that dispersion in forecasts conditional on an earnings announcement is positively associated with the number of additional forecast revisions before the next announcement by the same set of analysts[1]. Taken together, these studies suggest that analysts' forecasts reflect two different, but not mutually exclusive activities: the acquisition of predisclosure information that will eventually be reflected in earnings, and reactions to accounting releases.

However, Stickel (1989) examines only interim earnings releases and excludes the announcement of fourth-quarter earnings, and thus, his results can be interpreted as arising from analysts replacing expectations with realizations of earnings. That is, the analyst forecasts annual earnings at the beginning of the year, and as quarterly earnings are announced, revises the forecast to replace the implicit forecast for the quarter with actual earnings. Further, Stickel does not consider whether the price response to the earnings surprise is a factor in analysts' decisions to revise an existing forecast. This paper extends his work by examining revisions following both interim and annual earnings announcements, and provides evidence regarding the impact of the interaction between earnings surprises and price responses to earnings on analysts' revision activity. Additionally, Barron and Stuerke (1998) calculate dispersion as a proxy for uncertainty based on forecast revisions in the month after the earnings announcement, and find that it is positively associated with subsequent forecast revisions by the same analysts. This paper extends their work as it provides evidence about factors that lead to the forecasts made during the period in which they measure dispersion.

Prior literature investigates analyst following as a measure of informational supply (e.g. Bhushan, 1989; Brennan and Hughes, 1991), as a measure of predisclosure or private information transferred to investors (Dempsey, 1989; Shores, 1990), or a measure of the informativeness of firms' disclosure policies (Lang and Lundholm, 1996). However, the total number of analysts following a given firm includes analysts who actively update forecasts after acquiring information, analysts who update forecasts after observing the forecasts of other analysts, and analysts who rarely update their forecasts. The inclusion of all three types of analysts (active, herding, and inactive, respectively) in a measure of the level of predisclosure information acquisition and dissemination assumes either that both the proportions and activity levels of the analysts following a firm are the same for all firms and time-periods, or that firms' information environments are influenced similarly by the activities of all three types of analysts. Analyst activity levels may better capture the underlying construct of information acquisition and dissemination than analyst following. This study extends the prior literature by providing evidence about the way that value-relevance of accounting earnings and information content of earnings surprises are associated with variation in the influence of accounting information on changes in analysts' beliefs.

3. Study design

This paper examines analyst forecast revision activity in the month immediately following quarterly earnings announcements as a way to observe financial analysts' responses to earnings announcements. There are several reasons for focusing on first forecast revisions made soon after an announcement. First, financial analyst revisions made soon after earnings releases are more likely to reflect the influence of accounting information, as an analyst's first forecast revision after an earnings announcement

presumably includes the analyst's reaction to the recent release. Second, revisions made soon after the announcement are less likely to be influenced by the acquisition of information about other events not yet reflected in accounting earnings than are forecasts made later in the quarter, and are also less likely to be the result of observing other analysts' forecasts than are first forecast revisions made later in the period[2]. Thus, examining only forecasts made soon after the earnings release mitigates the influence of analyst herding and other confounding events on measures of analyst activity. Therefore, forecast revisions made in the period soon after an earnings announcement provide good conditions for examining the way that earnings announcements affect expectations of future earnings.

In this study, the period between quarterly earnings announcements is divided into three sub-periods:

- (1) the announcement period, trading days -1 to $+1$, where day 0 is the earnings announcement date,
- (2) the post-announcement period, days $+2$ to $+21$, and
- (3) the remainder, from day $+22$ to day -2 before the subsequent announcement.

Days $+2$ to $+21$ approximate the calendar month used by Barron and Stuerke (1998). Using 20 trading days instead of a calendar month removes variability in the length of the period during which revisions are accumulated. It also provides a basis for comparability with studies using the I/B/E/S summary data, which is reported by month. Returns during the announcement period are used to estimate the response to unexpected earnings by each firm. For each firm-quarter, the number of forecast revisions during the post-announcement period is accumulated to measure the level of analyst activity. There are two reasons for focusing only on the post-announcement period. First, the intent of this study is to examine analyst activity in response to earnings releases. Focusing on the period soon after the earnings announcement reduces the likelihood that activity is the result of information other than information pertaining to the earnings release. Second, analysts that revise soon after an earnings announcement are more likely to be relying on their own evaluation of the earnings release, and less likely to be relying on the forecasts of other analysts (Trueman, 1994; Barron and Stuerke, 1998).

3.1 Analyst forecast revision activity

Analysts' forecast revision frequency depends upon the extent to which new information is available to analysts, the costs of acquiring and conveying that information, and investors' expected profit from early trading on information (Holden and Stuerke, 2004). However, the information available to analysts includes both public and private information, and the costs of gathering information vary accordingly, as do the benefits from incorporating information into a forecast model. Information about past results, such as earnings announcements and the associated published financial statements, is a low-cost form of public information provided to analysts and investors at regular intervals[3]. Thus, analysts' forecast revision activity after a public release of information, such as an earnings announcement, is more likely to depend on the magnitude and nature of new information in the release.

The predictions of the model, in combination with consideration of the effects of a public release of information, suggest that forecast revision activity after an earnings

announcement is positively related to the permanence of earnings innovations and the mapping between earnings and returns, and trading profits. However, the model in Holden and Stuerke (2004) addresses the decision of a single analyst, while many firms are followed by more than one analyst, and not all analysts are equally active in their responses to the release of information. Therefore, the percentage of analysts following the firm who revise forecasts in response to an earnings announcement is used as a measure of analyst forecast revision activity.

3.2 Earnings surprises

Earnings surprises that are larger in absolute value are more likely to result in revised forecasts. Yet permanent earnings surprises (i.e. those that reflect earnings that will reoccur in future years) are more likely to result in revised expectations about future earnings than are temporary surprises, as only the permanent innovations persist into future periods. Since ERCs are related to the persistence of earnings innovations (Kormendi and Lipe, 1987), large absolute earnings surprises for firms with high ERCs are more likely to result in revisions than are equally large surprises for firms with low ERCs[4].

However, ERCs depend upon the relation between earnings surprises and stock returns as well as permanence of earnings innovations (Collins and Kothari, 1989). The association between earnings and stock returns, or earnings association coefficients (EACs), in contrast, are related only to the firm’s earnings-return relation[5]. Since an EAC measures whether earnings are related to firm value, and an ERC measures the information content of an earnings release as the associated price reaction, they provide different information about the firm-specific relation between accounting earnings and stock returns. In theory, however, they should have a common element in that both ERCs and EACs represent the relation between earnings and returns. The interaction between ERCs and EACs may be used to disentangle the influences of permanence and the earnings-return relation on analyst forecast revision activities. Figure 1 depicts the expected characteristics of the different interacted ERC/EAC conditions.

		ERCs	
		High	Low
EACs*	High	Permanent earnings innovations Earnings strongly related to returns	Temporary earnings innovations Earnings strongly related to returns
	Low	Permanent earnings innovations Earnings weakly related to returns	Temporary earnings innovations Earnings weakly related to returns

Figure 1.
Disentangling persistence and returns in ERCs

Note: *Earnings Association Coefficient

When both ERCs and EACs are high, earnings are more strongly related to returns, and earnings surprises are more permanent, so the magnitude of earnings surprises will influence revision activity positively. When ERCs are high and EACs are low, earnings are not strongly related to returns, but earnings surprises are more permanent. In this case, revision activity will still be influenced by the magnitude of earnings surprises, but less strongly. When ERCs are low and EACs are high, earnings map into returns, but earnings surprises are temporary, so the magnitude of earnings surprises will have only a small influence on revision activity. Finally, when both ERCs and EACs are low, earnings surprises are temporary and earnings are not strongly related to returns, so the magnitude of earnings surprises will have no influence on revision activity.

Since ERCs are related to both earnings persistence and the stock price response to information, ERCs may be associated with analyst revision activity for two reasons. First, if ERCs capture the price response to new information in general as well as the price response to earnings surprises, then ERCs will be positively associated with profits from trading on information and hence the value to investors of a forecast revision. Second, when ERCs are high, indicating a high-quality earnings signal (or earnings persistence), a small earnings surprise will be enough to cause analysts to revise their beliefs, as the surprise will have implications for future earnings. Further, unless all analysts' prior forecasts agree and are correct, there will be individual forecast errors arising from the earnings surprise, even when there is no error in the mean forecast. Thus, in either case, for firms with high ERCs, analysts are more likely to revise forecasts of annual EPS in response to earnings announcements.

The permanence of earnings innovations and the price-response to information are not the only influences on financial analysts' revision activity following earnings announcements. The analyst's potential benefit from revising a forecast is also related to reputation effects pertaining to forecast accuracy, as well as to informed investors' expected profits from trading based on the forecast. The model presented in Holden and Stuerke (2004) demonstrates that the magnitude of surprise at which the analyst will revise is also positively related to the variability of liquidity trading, and negatively related to the number of informed investors and the cost of information acquisition in a single-analyst setting. After an earnings announcement, the analyst's cost to revise is both very small and similar (although not equal) across both analysts and firms, as all analysts receive the same information, quarterly earnings, at the same time. However, the model suggests that control variables for the level of liquidity trading and the number of informed investors may be appropriate.

Investors' expected profit from trading on analysts' information is associated with the extent to which individual informed trades reveal the trader's information[6]. The extent to which an informed trade reveals information to other market participants depends upon the size of the trade, relative to normal trading activity for the firm, so an informed trade must be much smaller to be unnoticed by market participants for thinly traded firms. Thus, the analyst has a greater incentive to provide forecast revisions for firms whose shares are more heavily traded. Therefore, it is appropriate to control for prior trading volume in tests of analyst activity.

Analyst following is known to be related to both the speed with which information is impounded in stock price (e.g. Dempsey, 1989; Brennan *et al.*, 1993) and firm characteristics such as market value of equity, returns variance, and institutional

holdings (Bhushan, 1989; O'Brien and Bhushan, 1990; El-Gazzar, 1998)[7]. Whether analyst following is construed as investor interest or predisclosure information search, which affects surprise in the earnings announcement, it is related to both the dependent variable and the variables of interest. To control for analyst following, the dependent variable is expressed as the percentage of analysts' following the firm who revise during the post-announcement period[8].

Control variables for additional tests are suggested by Stickel (1989). First, investors, and therefore analysts, may respond differently to negative forecast errors than to positive forecast errors of the same magnitude, so the percentage of analysts who revise forecasts soon after earnings announcements may also be influenced by the sign of unexpected earnings. Second, differences in prior uncertainty about future earnings may also influence the likelihood of revision. When priors are more diffuse, earnings surprises have a greater impact on the revised belief, and therefore the likelihood of revision. Dispersion in analysts forecasts has been used in the prior literature to proxy for uncertainty (Barron and Stuerke, 1998). Therefore, the regression is also estimated including prior forecast dispersion and an indicator variable for the sign of the forecast error.

Analysts who prepare forecasts of annual earnings are able to observe interim announced earnings, and revise their annual forecasts to correct for any forecast error revealed by announced quarterly earnings, even if that error has no implications for future periods. For interim announcements, therefore, large unexpected earnings are expected to result in more forecast revisions, even when earnings surprises are not permanent. Stickel (1989) includes indicator variables for fiscal quarters in his tests and finds differences in abnormal revision activity across fiscal quarters. Barron and Stuerke (1998) observe significant differences in firm size and analyst following for firm-quarters with at least two revisions soon after the earnings announcement and partition their data by fiscal quarter. Preliminary tests for a difference of means were significant at $\alpha < 0.01$ for differences in both the number of revisions and the percentage of analysts who revise between all pairs of quarters except first and fourth quarters. Therefore, following Barron and Stuerke, the data analysis is conducted by fiscal quarter.

4. Data and variable measurement

This paper uses analyst forecast and actual earnings data from the 1976-1996 Institutional Brokers Estimate System (I/B/E/S) detail data and I/B/E/S summary data. Earnings announcement dates and EPS are from the Compustat Quarterly P-S-T and Industrial data and annual EPS is from the Compustat Annual P-S-T and Industrial data. Share prices, returns, and trading volume are from the Center for Research in Security Prices (CRSP). Data are organized by firm-quarter. To be included in the sample, a firm must have at least 20 quarters with:

- (1) analysts' forecasts of quarterly EPS available in the I/B/E/S detail data;
- (2) actual quarterly EPS in either the I/B/E/S data or the Compustat data;
- (3) returns data from CRSP for at least 50 of the 200 trading days prior to the earnings announcement and for a three-day window at the announcement; and
- (4) stock price two days prior to the earnings announcement.

To be included, firm-quarters must have at least two analysts providing a forecast of annual EPS prior to the announcement date and volume data in CRSP for the year preceding the earnings announcement, in addition to all of the preceding information. Firm-quarters missing any of the above data are eliminated from the sample. The resultant sample includes 708 firms, and 21,674 firm-quarter observations.

Firm-specific ERCs are estimated as γ_1 from the regression

$$CAR_{it} = \gamma_{0i} + \gamma_{1i} \left(\frac{UE_{it}}{P_{i(t-2)}} \right) + \varepsilon_{it} \quad (1)$$

where CAR_{it} is the cumulative abnormal return from day -1 to day $+1$ around the earnings announcement date, estimated using a market model[9], UE_{it} is unexpected earnings in the announcement, $P_{i(t-2)}$ is the closing stock price two days before the earnings announcement, γ_0 and γ_1 are firm-specific regression parameters, and ε_t is the error term[10]. Unexpected earnings is measured as the difference between forecasted EPS from I/B/E/S and actual EPS from I/B/E/S if reported in that data[11], and otherwise is primary EPS before extraordinary items from the quarterly Compustat data. Forecasted EPS is the mean of new one-quarter-ahead forecasts reported by I/B/E/S in the most recent month prior to the earnings announcement date in which at least one new forecast is reported. Descriptive statistics for estimates of the firm-specific ERCs are presented in Table I.

Firm-specific EACs are estimated as δ_1 from the regression:

$$R_{it} = \delta_{0i} + \delta_{1i} X_{it} + \varepsilon_{it}, \quad (2)$$

where R_{it} is the compound return for the firm for months -8 through $+3$ around the fiscal year end, and X_{it} is annual primary EPS before extraordinary items for the same year[12]. This specification was chosen as the coefficients are less biased than those estimated using earnings changes (Kothari and Zimmerman, 1995)[13]. Descriptive statistics for estimates of the firm-specific EACs are presented in Table I.

Average volume is calculated as average daily shares traded, from the CRSP data. The natural logarithm of average volume (Ln VOL) is used to mitigate heteroskedasticity arising from skewness of the untransformed variable. The magnitude of unexpected earnings is calculated as the absolute value of the difference between forecasted EPS and actual EPS, scaled by actual EPS, for the firm-quarter[14]. Any observation where unexpected earnings was more than four standard deviations away from mean unexpected earnings were eliminated from the sample[15]. Dispersion in analysts' forecasts (DISP) is measured as the standard deviation of forecasts in the

	Mean	Median	Standard deviation
ERC	2.933	1.576	4.476
EAC	2.3709	1.894	2.694

Notes: ERC – γ_1 from firm-specific estimation of $CAR_{it} = \gamma_{0i} + \gamma_{1i}(UE_{it}/P_{i(t-2)}) + \varepsilon_{it}$; EAC1 – δ_1 from firm-specific estimation of $R_{it} = \delta_{0i} + \delta_{1i}X_{it} + \varepsilon_{it}$, with R_{it} as compound returns and X_{it} as primary EPS before extraordinary items

Table I.
Descriptive statistics:
Panel A. Firm-specific
ERCs and EACs
($n = 708$ firms)

month before the earnings announcement, scaled by the absolute value of the mean forecast, and is taken from the I/B/E/S summary data[16]. The natural logarithm of dispersion (Ln DISP) is used to mitigate heteroskedasticity arising from skewness of the untransformed variable.

The number of revisions (#Revised) is measured by counting the revisions of existing annual forecasts in the I/B/E/S detail data where the revision date was between trading days +2 and +21 after the earnings announcement, and the date of the analyst's prior forecast preceded the earnings announcement. The number of analysts following the firm (Following) is the number of analysts who have at least one forecast of annual EPS in the I/B/E/S detail data for the firm-year prior to the earnings announcement. The dependent variable is the percentage of analysts following the firm who revise forecasts of annual EPS in the post-announcement period (%Revised), and is calculated as #Revised/Following. Descriptive statistics for these variables are found in Table II.

There are four indicator variables used in this study. The first distinguishes firms with high ERCs and high EACs and is denoted HH. It is set equal to 1 if the firm-specific ERC is greater than 1.57 and the firm-specific EAC is greater than or equal to 1[17], and 0 otherwise. The second (denoted HL) distinguishes firms with high ERCs and low EACs. It is set equal to 1 if the firm-specific ERC is greater than 1.57 and the firm-specific EAC is less than 1, and 0 otherwise. The third (denoted LH) identifies firms with low ERCs and high EACs, and is set equal to 1 if the firm-specific ERC is less than or equal to 1.57 and the firm-specific EAC is greater than or equal to 1, and 0 otherwise. These three variables are used to test three-way interactions between ERCs, EACs and the magnitude of unexpected earnings. The fourth identifies firm-quarters with positive forecast errors (denoted Sign(UE)), and is set equal to 1 if unexpected earnings are positive, and 0 otherwise[18].

5. Tests and results

5.1 Description of the regression model and tests

The following regression model is used to test the relations predicted in Section 3:

	Mean	Standard deviation	Minimum	Median	Maximum
#Revised	4.7312	4.3633	0	4	35
Follow	15.0083	10.1023	1	13	60
%Revised	0.3111	0.1969	0.0000	0.2941	1.0000
UE	0.2798	0.5437	0.0000	0.0963	5.000
Avgvol	69,896	114,465	832	33,973	2,371,521
Disp	0.1133	0.3073	0.0025	0.0465	15.6364
Size	3,453,029	7,791,301	8.831	1,088,466	119,220,000

Notes: #Revised – The number of analysts who issue a forecast revision between day +2 and day +21 after earnings announcement; Follow – The number of analysts providing at least one forecast of annual earnings during the fiscal year of the announcement; %Revised – #Revised/Follow; |UE| – The absolute value of unexpected earnings; Avgvol – The average daily trading volume over the year prior to the earnings; Disp – The dispersion in analysts forecasts, measured as the standard deviation of forecasts in the month before the earnings announcement, from the I/B/E/S summary data, divided by the mean forecast; Size – Market value of equity on day – 2 before the earnings announcement

Table II.

Descriptive statistics:
Panel B ($n = 21, 672$
firm-quarters)

$$\begin{aligned} \%Revised = & \beta_0 + \sum_{i=87}^{95} \beta_0 + \beta_1 \text{Ln ERC} + \beta_2 \text{Ln EAC} + \beta_3 |\text{UE}| + \beta_4 \text{HH}^* |\text{UE}| \\ & + \beta_5 \text{HL}^* |\text{UE}| + \beta_6 \text{LH}^* |\text{UE}| + \beta_7 \text{Ln VOL} + \varepsilon, \end{aligned} \quad (3)$$

where the variables are measured as defined in Section 4 above. An alternative regression is estimated, including the control variables of Ln DISP and Sign(UE). The data include multiple firm-quarter observations for firms. Thus, there is possible time-series correlation and dependency in the data, and the standard errors of regression coefficients are biased upward. To mitigate this problem, indicator variables for years 1987-1995 are used in the regressions.

It is expected that the percentage of financial analysts who issue revised forecasts in response to earnings announcements is associated positively with firm-specific ERCs. If that is true, the coefficient estimate on Ln ERC will be positive and significantly different from 0, or $\beta_1 > 0$. The influence of the ERC/EAC interactions with |UE| on revision activity is captured by combinations of coefficients. Since β_4 and β_5 identify the incremental contributions to the regression of $\text{HH}^*|\text{UE}|$ and $\text{HL}^*|\text{UE}|$, respectively, the influence of the interaction between high ERCs, high EACs and the magnitude of unexpected earnings is $\beta_3 + \beta_4$, and that of the interaction between high ERCs, low EACs and the magnitude of unexpected earnings is $\beta_3 + \beta_5$, and the expectation is that both $\beta_3 + \beta_4 > 0$ and $\beta_3 + \beta_5 > 0$. The expectation that the influence of the magnitude of unexpected earnings on the percentage of financial analysts who issue revised forecasts in response to earnings announcements is strongest for firms that have both high ERCs and high EACs implies three relations among the coefficients: $\beta_4 > \beta_5$, $\beta_4 > \beta_6$, and $\beta_4 > 0$ [19]. The appropriate tests of significance are the t -statistic of β_4 , the F -statistic of the summed coefficients, and the F -statistic of the comparison of the coefficients.

An additional test is the comparison of a restricted model, one that includes no interaction between ERCs, EACs, and |UE|, and the unrestricted model presented above[20]. A test of structural change, or Chow test, provides evidence about the influence of the interactions beyond the significance of the coefficients[21]. The Chow test identifies whether allowing coefficients to differ across groups is a significantly better description of underlying relations in the data[22].

5.2 Bivariate evidence

Examination of the Pearson pairwise correlations (untabulated, available upon request) reveals a positive correlation of 0.059 between Ln ERC and %Revised, suggesting that earnings forecasts are revised more frequently as ERCs increase. The correlation of 0.102 between Ln DISP and %Revised implies that prior uncertainty about earnings increases the likelihood of revisions in response to earnings announcements. The correlations between Ln DISP and the variables that interact ERC/EAC conditions with absolute unexpected earnings, $\text{HH}|\text{UE}|$, $\text{HL}|\text{UE}|$, and $\text{LH}|\text{UE}|$, are 0.090, 0.097, and 0.223, respectively, in comparison with 0.370 for |UE|, and suggest that there is less prior uncertainty about earnings for high ERC firms. The negative correlation of -0.121 between Ln DISP and Ln ERC suggests that there is also less prior uncertainty for firms with high ERCs.

5.3 Results of multivariate tests

Table III contains results of the estimation of equation (3), both with and without the additional control variables. The coefficient on Ln ERC is positive and significant at $p < 0.01$ ($p < 0.05$) for three of the four (all) quarters in the estimation without additional control variables, and at $p < 0.01$ for all quarters with additional control variables. This suggests that the percentage of analysts who revise in response to an earnings announcement is positively associated with firm-specific ERCs. In contrast, the coefficient on Ln EAC is not significant at $p < 0.01$ in any quarter, and is not consistently positive.

The estimated coefficient of |UE| is positive and significant at $p < 0.01$ only after first quarter earnings announcements, and only when Ln DISP and Sign(UE) are not included in the model. This result is consistent with no relation between the percentage of analysts who revise after earnings announcements and the magnitude of surprise for firms where earnings surprises are not persistent and earnings are not related to stock

	First quarter		Second quarter	
Intercept	0.093	0.180	0.220	0.301
Year indicators	0.054-0.107	0.053-0.109	0.005-0.068	0.005-0.071
Ln ERC	0.002 (2.22)*	0.002 (2.90)**	0.003 (3.58)**	0.003 (4.13)**
Ln EAC	-0.002 (-1.82)	-0.001 (-1.10)	0.001 (1.40)	0.002 (2.10)*
UE	0.027 (2.61)**	0.004 (0.40)	0.022 (2.24)*	-0.007 (-0.69)
HH UE	0.064 (3.77)**	0.074 (4.45)**	0.042 (2.76)**	0.058 (4.02)**
HL UE	0.048 (2.75)**	0.056 (3.25)**	0.070 (3.28)**	0.078 (3.60)**
LH UE	0.020 (1.56)	0.029 (2.35)**	0.002 (0.17)	0.014 (1.21)
Ln VOL	0.010 (4.54)**	0.009 (3.79)**	0.005 (2.07)*	0.003 (1.51)
Ln DISP	-	0.025 (8.79)**	-	0.024 (8.69)**
Sign(UE)	-	0.004 (0.77)	-	0.001 (0.10)
F-statistic for Chow test	6.19**	7.87**	6.26**	7.81**
n	5,403	5,403	5,438	5,438
Adj. r^2	0.05	0.06	0.03	0.04
	Third quarter		Fourth quarter	
Intercept	0.235	0.297	0.166	0.208
Year indicators	0.006-0.096	0.019-0.098	0.026-0.096	0.027-0.098
Ln ERC	0.003 (4.04)**	0.004 (4.71)**	0.005 (5.64)**	0.005 (6.03)**
Ln EAC	-0.001 (-1.39)	-0.001 (-0.99)	-0.0004 (-0.048)	-0.0002 (-0.27)
UE	0.019 (1.65)	-0.003 (-0.27)	0.013 (1.17)	0.003 (0.29)
HH UE	0.052 (3.40)**	0.061 (4.05)**	0.033 (2.03)*	0.035 (2.17)*
HL UE	0.040 (2.15)*	0.046 (2.50)**	0.045 (2.44)**	0.048 (2.60)**
LH UE	0.007 (0.54)	0.016 (1.28)	0.002 (0.21)	0.003 (0.21)
Ln VOL	0.004 (1.71)*	0.004 (1.65)	0.007 (3.12)**	0.007 (2.97)**
Ln DISP	-	0.18 (6.76)**	-	0.011 (3.88)**
Sign(UE)	-	-0.014 (-2.71)**	-	-0.010 (-1.75)*
F-statistic for Chow test	5.83**	6.63**	3.82**	4.26**
n	5,450	5,450	5,381	5,381
Adj. r^2	0.04	0.05	0.03	0.03

Table III. Coefficients from regression estimation of (%Revised = $\beta_0 + \sum_{i=87}^{95} \beta_i + \beta_1 \text{Ln ERC} + \beta_2 \text{Ln EAC} + \beta_3 |\text{UE}| + \beta_4 \text{HH}^* |\text{UE}| + \beta_5 \text{HL}^* |\text{UE}| + \beta_6 \text{LH}^* |\text{UE}| + \beta_7 \text{Ln VOL} + \beta_8 \text{Ln DISP} + \beta_9 \text{Sign(UE)} + \varepsilon$)

Notes: Variable definitions: See Table IV; White's (1980) t -statistics in parentheses; * significant at $0.01 < p < 0.05$; ** significant at $p < 0.01$

returns. The estimated coefficients of $HH*|UE|$ are positive and significant at $p < 0.01$ ($p < 0.05$) for interim (all) announcements in both models, and those of $HL*|UE|$ are positive and significant at $p < 0.01$ ($p < 0.05$) for three (all) quarters in the model without additional variables, and for all quarters in the model with additional variables. In contrast, the estimated coefficients of $LH*|UE|$ are significant in only one quarter. These results suggest that the percentage of forecasts revised in response to earnings announcements is incrementally different for firms with high ERCs, regardless of the firm's EAC.

For the model that includes $LnDISP$, the coefficient estimate is positively significant at $p < 0.01$ for all quarters, indicating the influence of prior uncertainty on analysts' revision activity. This result is different from that of Stickel (1989), who predicted, but did not find, a positive relation between revision activity and prior dispersion. The difference between these results and the results of Stickel likely arises from the inclusion of $LnERC$, and the ERC/EAC interactions with the magnitude of unexpected earnings, as $LnDISP$ and $LnERC$ are negatively correlated, and the correlations between $LnDISP$ and the interactions between ERCs, EACs, and the magnitude of unexpected earnings differ. The coefficient estimate of $Sign(UE)$ is significantly negative at $p < 0.01$ ($p < 0.05$) only for activity following third quarter (and annual) earnings announcements, which is consistent with Stickel's results. This finding indicates that the direction of the forecast error influences revision activity only after the last interim announcement, and marginally, after the announcement of annual earnings.

The results presented in Table IV are the summed coefficients described above. The estimates of the summed coefficients for $HH*|UE|$ are significant at $p < 0.01$ in all quarters for all models, as are the summed coefficients for $HL*|UE|$, which indicates that the magnitude of earnings surprises for firms with high ERCs is associated positively with forecast revision activity. In contrast, the estimate of the total influence of $LH*|UE|$ is significant at $p < 0.01$ ($p < 0.05$) in three (all) quarters when $LnDISP$ is excluded from the model. However, when $LnDISP$ is included, the sum of the coefficients is significant only in the first quarter. These results provide evidence that the percentage of forecast revisions in response to earnings announcements is positively associated with the magnitude of unexpected earnings for firms with high ERCs. They also suggest that, for firms where earnings surprises are temporary but earnings are related to returns, revision activity after earnings announcements is more likely to be associated with prior uncertainty than with the magnitude of earnings surprises.

The F -statistics of the differences between the coefficients are also presented in Table IV. The test of $\beta_4 > \beta_5$ indicates that the influence of the magnitude of unexpected earnings does not differ significantly between firms with high ERCs/high EACs and firms with high ERCs/low EACs. In contrast, the difference between high ERC/high EAC firms and low ERC/high EAC firms, $\beta_4 > \beta_6$, is significant at $p < 0.01$ in every quarter, and $\beta_5 > \beta_6$ is significant at $p < 0.01$ in two quarters. The t -statistic of the coefficient estimate of $HH*|UE|$ is significant at $p < 0.01$ ($p < 0.05$) in three (all) quarters, indicating that $\beta_4 > 0$. Finally, the F -statistic of the Chow test, for a difference between the restricted and unrestricted estimations, is significant at $p < 0.01$ for all estimations. This indicates that the unrestricted model better describes the underlying data. Therefore, the relation between the percentage of

Earnings announced for

	First quarter		Second quarter	
$\beta_3 + \beta_4$	0.091 (78.83)**	0.078 (57.70)**	0.064 (47.81)**	0.052 (30.14)**
$\beta_3 + \beta_5$	0.075 (27.06)**	0.060 (17.36)**	0.093 (29.60)**	0.071 (17.07)**
$\beta_3 + \beta_6$	0.047 (44.42)**	0.033 (21.08)**	0.025 (12.77)**	0.008 (1.13)
$\beta_3 + \beta_4 > \beta_3 + \beta_5$	(0.86)	(0.29)	(2.24)	(1.03)
$\beta_3 + \beta_4 > \beta_3 + \beta_6$	(13.69)**	(14.49)**	(12.69)**	(15.73)**
$\beta_3 + \beta_5 > \beta_3 + \beta_6$	(3.14)	(2.94)	(14.06)**	(12.22)**
	Third quarter		Fourth quarter	
$\beta_3 + \beta_4$	0.071 (60.61)**	0.058 (39.61)**	0.046 (27.61)**	0.039 (18.54)**
$\beta_3 + \beta_5$	0.059 (14.79)**	0.043 (7.60)**	0.059 (16.94)**	0.051 (12.73)**
$\beta_3 + \beta_6$	0.025 (15.75)**	0.013 (3.76)	0.016 (5.41)*	0.006 (0.80)
$\beta_3 + \beta_4 > \beta_3 + \beta_5$	(0.45)	(0.79)	(0.57)	(0.58)
$\beta_3 + \beta_4 > \beta_3 + \beta_6$	(17.90)**	(17.94)**	(8.21)**	(9.19)**
$\beta_3 + \beta_5 > \beta_3 + \beta_6$	(4.18)*	(3.30)	(7.58)**	(8.27)**

Table IV.

Summed coefficients for tests of significance
 $\% \text{Revised} = \beta_0 + \sum_{i=87}^{95} \beta_0 + \beta_1 \text{Ln ERC} + \beta_2 \text{Ln EAC} + \beta_3 |\text{UE}| + \beta_4 \text{HH}^* |\text{UE}| + \beta_5 \text{HL}^* |\text{UE}| + \beta_6 \text{LH}^* |\text{UE}| + \beta_7 \text{Ln VOL} + \beta_8 \text{Ln DISP} + \beta_9 \text{Sign(UE)} + \varepsilon$

Notes: *F*-statistics in brackets; * significant at $0.01 < \alpha < 0.05$; ** significant at $\alpha < 0.01$; Ln ERC – The natural log of γ_1 from firm-specific estimation of $\text{CAR}_{it} = \gamma_{0i} + \gamma_{1i}(\text{UE}_{it}/P_{i(t-2)}) + \varepsilon_{it}$; Ln EAC – The natural log of the δ_1 from firm-specific estimation of $R_{it} = \delta_{0i} + \delta_{1i}X_{it} + \varepsilon_{it}$, with R_{it} as compound returns and X_{it} as primary EPS before extraordinary items; Ln VOL – The natural log of average daily trading volume over the year prior to the earnings announcement; |UE| – The absolute value of unexpected earnings; HH|UE| – The absolute value of unexpected earnings when the firm-specific ERC and EAC are both high; HL|UE| – The absolute value of unexpected earnings when the firm-specific ERC is high and the firm-specific EAC is low; LH|UE| – The absolute value of unexpected earnings when the firm-specific ERC is low and the firm-specific EAC is high; Sign(UE) – 1 if unexpected earnings are positive, and 0 otherwise

revisions and the magnitude of unexpected earnings differs across the ERC/EAC classifications.

Taken together, the results in Tables III and IV provide evidence about determinants of forecast revision following earnings announcements. The percentage of analysts who revise forecasts after earnings announcements is associated positively with firm-specific ERCs, for both interim and annual announcements. It is also associated positively with the magnitude of unexpected earnings for firms with high ERCs. However, while influence of the magnitude of unexpected earnings does not differ between firms where ERCs and EACs are both high and firms with high ERCs and low EACs, the influence differs strongly between high ERC/high EAC firms and low ERC/high EAC firms and weakly between high ERC/low EAC firms and low ERC/high EAC firms. The frequency of forecast revisions is also positively associated with prior trading volume and prior forecast dispersion. Consistent with the results of Stickel (1989), activity in response to earnings announcements is lowest after the announcements of the prior year's and the first quarter's earnings, and increases as the year proceeds. However, unlike Stickel (1989), these results demonstrate a positive relation between prior dispersion and revision activity after earnings announcements. Finally, the sign of the forecast error is associated with revision activity only in response to third quarter earnings, when negative forecast errors are more likely to result in revisions.

6. Conclusion

This paper explores how the value relevance of accounting earnings and the information content of earnings surprises affect financial analysts' forecast revision activities. It examines the relation between the percentage of financial analysts following the firm who revise forecasts of annual EPS soon after an earnings release and earnings surprises, firm-specific ERCs and firm-specific earnings association coefficients (EACs). Empirical tests demonstrate that analysts' revision activity after earnings announcements is positively associated with:

- (1) firm-specific ERCs;
- (2) the magnitude of surprise in the earnings announcement for firms with high ERCs; and
- (3) prior dispersion in analysts forecasts, after controlling for the direction of the forecast error, and prior trading volume.

Further, the effect of magnitude of surprise is significantly larger for firms with both high ERCs and high EACs than for firms with low ERCs and high EACs.

The results of this study suggest several inferences about financial analysts forecast revision activity in response to earnings announcements. First, financial analysts are more likely to revise their forecasts of annual EPS for firms with high-quality or persistent earnings, independent of surprise in the announcement. Second, the magnitude of earnings surprises is most strongly associated with subsequent revision activity for firms whose earnings have both high information content and high value-relevance. These findings are consistent with the conclusion that ERCs capture persistence of earnings surprises (Easton and Zmijewski, 1989). The magnitude of surprise leads less strongly to revision activity for firms with value-relevant earnings. The results of this paper suggest that analysts' revision activity after earnings announcements is influenced by the interactions among surprise in earnings announcements, the permanence of earnings surprises, and the relation between earnings and returns. Further, for firms where earnings surprises are temporary, but earnings are related to returns, revision activity after earnings announcements is more likely to be associated with prior uncertainty than with the magnitude of earnings surprises.

Notes

1. Rogers and Grant (1997) report that over half of firm-specific financial and operating data cited in analysts' reports is not found in firms' annual reports, suggesting that a substantial portion of the information collected by analysts is private in nature (i.e. not publicly disclosed). In contrast, Lang and Lundholm (1996) show that analyst following increases with the perceived quality of firms' disclosure policies, and interpret this result as an indication that analysts process and disseminate firm-provided information.
2. That is, the analysts who revise earlier are less likely to be basing their interpretation of the earnings release on other analysts' response to the release. Trueman (1994) obtains the result that stronger (weaker) analysts are more (less) likely to revise without waiting to observe other analysts, where stronger and weaker refer to analyst ability to predict future earnings. The same results would obtain for analysts who have higher quality information or greater confidence in that information.

3. The forecasts of other analysts who follow the same firm are a second form of public information. In contrast, private information from diverse sources is likely to require costly effort to gather and compile into forecasts.
4. ERCs map unexpected earnings into stock price changes at earnings announcements and are known to be related to several firm and economic variables, including persistence of earnings surprises (Easton and Zmijewski, 1989) and quality of the earnings signal (Collins and Salatka, 1993), in addition to being one measure of the firm's earnings-return relation.
5. There is extensive theoretical and empirical evidence on ERCs. The term "earnings response coefficient" has been applied in studies examining either the association between the abnormal return at the earnings announcement (usually based on a two- or three-day event window) and an estimate of the unexpected earnings in the announcement, and the association between accounting earnings and returns over the earnings period (e.g. Easton and Harris, 1991). This study uses "earnings response coefficient" to refer exclusively to the first relation, and "earnings association coefficient" (EAC) to refer to the second.
6. See Holden and Subrahmanyam (1992) for additional analytic evidence.
7. Analyst following also constrains the level of analyst activity for a firm, as the maximum number of first forecast revisions after an earnings announcement is the number of analysts following the firm.
8. Alternate tests with the number of revisions as the dependent variable and analyst following included in the regression were conducted. The results from those tests are qualitatively similar to the results presented in Tables III and IV, and lead to identical inferences.
9. The market model is estimated over trading days -200 to -2 , where the announcement date is day 0, using the CRSP value-weighted index.
10. Firms with extreme values for γ_1 were investigated for influential observations and re-estimated after excluding highly influential observations. Results of tests using original estimations are not substantially different from those presented in Tables III and IV.
11. Philbrick and Ricks (1991) point out the importance of using a measure of EPS that includes and excludes the same items as the forecasts. Analysts' forecasts and actual earnings on the I/B/E/S data are stated on the same basis, and actual earnings are adjusted to reflect the items included in analysts forecasts (which may not be the same as EPS before extraordinary items). Use of this EPS number reduces measurement error in unexpected earnings.
12. Firms with extreme values for δ_1 were investigated for influential observations and re-estimated after excluding highly influential observations.
13. However, as an alternative measure, δ_1 was also estimated where R_{it} is the difference between return on the firm and return on the CRSP value-weighted index and X_{it} is the change in EPS. Results from those tests do not differ substantially from those presented in Tables III and IV.
14. Alternate tests using $P_{i(t-2)}$ as the scalar for unexpected earnings were also performed. The results of those tests are substantially identical to the results reported later in this paper.
15. These were observations where the forecast error as a percent of EPS was greater than 736 percent for positive forecast errors or less than -782 percent for negative forecast errors.
16. While dispersion measured using the summary data includes potentially stale forecasts, and therefore may be biased upward, other problems arise from use of various measures using detail data. Use of only new forecasts made in the month preceding the earnings announcement results in a substantially reduced sample, and is more likely to include the forecasts of analysts who are herding. Use of the prior forecasts of the analysts who revise after the earnings announcement may include stale forecasts, as those forecasts were not all

made in the same month, and may also mathematically induce a negative relation between dispersion and the percentage of revisions.

17. Estimated EACs less than 1 were also, without exception, not significantly different from 0, and these regression estimations had r^2 statistics considerably lower than those estimations that were greater than 1.
18. Unexpected earnings (UE) are positive for 10,446 firm-quarters.
19. These predictions can also be expressed as $\beta_3 + \beta_4 > \beta_3 + \beta_5$, $\beta_3 + \beta_4 > \beta_3 + \beta_6$, and $\beta_3 + \beta_4 > \beta_3$.
20. Estimating the regression without the interaction variables (HH*|UE|, HL*|UE|, and LH*|UE|) restricts the coefficients to be equal for all types of firms, while including the interactions is an unrestricted estimation.
21. While the Chow test is often used to test structural changes in time-series data, it is also applicable to a model with dummy variables in cross-sectional or panel data. See Collins and Salatka (1993) for an example.
22. The test statistic follows an F distribution and is calculated as $F(r, n - k) = ((SSE_R - SSE_U)/r)/(SSE_U/n - k)$, where SSE_U and SSE_R are the sum of squared errors from estimating the unrestricted and restricted regressions, respectively, r is the number of coefficients in the restricted model, k is the number of coefficients in the unrestricted model, and n is the number of observations used to estimate the coefficients (Greene, 1993).

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