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Volume, Opinion Divergence, and Returns: A Study of Post–Earnings Announcement Drift

JON A. GARFINKEL* AND JONATHAN SOKOBIN†

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ABSTRACT

This paper examines the relationship between post–earnings announcement returns and different measures of volume at the earnings date. We find that post-event returns are strictly increasing in the component of volume that is unexplained by prior trading activity. We interpret unexplained volume as an indicator of opinion divergence among investors and conclude that post-event returns are increasing in ex ante opinion divergence. Our evidence is consistent with Varian [1985], who suggests that opinion divergence may be treated as an additional risk factor affecting asset prices.

1. *Introduction*

The phenomenon of post–earnings announcement drift has challenged efficient market supporters for over 30 years. Both Ball [1992] and, more recently, Fama [1998] argue that the predictable relationship between current earnings and future returns is likely to be treated as an anomaly for the

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foreseeable future. However, recent theoretical work in finance offers the potential to explain anomalous return patterns following company events. A key element found in several of these theories is divergence among investors' opinions (see for example, Miller [1977], Varian [1985], Harris and Raviv [1993], and Hong and Stein [1999]). This paper develops an empirical proxy for investor opinion divergence at the announcement of earnings and examines its effect on post–earnings announcement returns.

Our proxy for investor opinion divergence is the quantity of volume at the earnings announcement that is unexplained by prior trading behavior. While previous work has established a negative relation between post–earnings announcement returns and *average* trading volume (Bhushan [1994]), we offer tests and results of a very different sort. Our measure of unexplained volume is specific to the earnings announcement (unlike that of Bhushan [1994]), and its effect on ex post returns is measured after controlling for average prior trading volume. This delineation is crucial to our analysis and results.

We find that unexpected trading volume at the earnings announcement positively correlates with future returns. In other words, higher opinion divergence at the earnings date is associated with more positive returns during the post–earnings announcement period. This evidence is consistent with predictions from Varian [1985], who posits that, under reasonable conditions,[1] asset prices will be lower when investors' opinions are more dispersed. Our results are robust to controls found in the extant drift literature, such as earnings surprise, firm size, systematic risk (beta), and total risk (standard deviation of stock returns).

We are careful to note that our results do not fully account for the phenomenon known as post–earnings announcement drift. Specifically, the positive relation between opinion divergence and ex post returns persists among earnings announcements of both positive and negative sign. Since drift is traditionally characterized as negative returns following negative surprises and positive returns after positive surprises, our results would seem to have more to say about the latter than the former.

We are also cognizant that our focus is on a particular proxy for opinion divergence and that others in the literature have employed different measures. We justify our use of unexplained volume as a proxy for divergent investor opinions in a few ways. Primarily, our approach is consistent with earlier studies of opinion divergence and earnings announcements. Beaver [1968], Bamber [1987], Kandel and Pearson [1995], Ajinkya et al. [2004], and many others, all link volume to opinion divergence in some fashion. We simply formalize the link by appealing to the finance literature's findings. We recognize that volume captures many reasons for trading such as liquidity needs (Benston and Hagerman [1974], Branch and Freed [1977],

[1] The conditions take the form of restrictions on utility functions: the Constant Absolute Risk Aversion (CARA) utility, quadratic utility, and Constant Relative Risk Aversion (CRRA) with a coefficient of relative risk aversion greater than one all satisfy the conditions.

and Petersen and Fialkowski [1994]), information content of news (Karpoff [1987] and Chordia and Swaminathan [2000]), and opinion divergence (Harris and Raviv [1993] and Chordia, Subrahmanyam, and Anshuman [2001]). Our measures of unexpected volume are designed to isolate the latter.

Second, we entertain an alternative proxy for opinion divergence built on analysts' forecasts. Diether, Malloy, and Scherbina [2002] argue that cross-sectional variability in these forecasts indicates similar variability in investors' opinions. Our results employing this alternative proxy mirror those of Diether, Malloy, and Scherbina [2002]. Ex post returns are *declining* in forecast variability. The interpretation of this result is that returns are decreasing in opinion divergence, which conflicts with our interpretation under the unexplained volume proxy in our main tests. We show that selection bias (in using a sample of analyst-covered firms) is a concern in these tests. We also show that analyst coverage changes the information environment in a way that alters the explanatory power of unexplained volume for post–earnings announcement returns.

Our paper is related to work by Gervais, Kaniel, and Mingelgrin [2001]. They investigate the information content of trading activity for future returns. However, they do not focus on post–earnings announcement drift, nor do they separate out unexpected volume as we do. Finally, our results may speak to work by Lewellen and Shanken [2002]. They show that parameter uncertainty in asset pricing models can lead to patterns in returns that appear to be predictable. Post–earnings announcement drift could be a form of this. Their results offer a third interpretation of return predictability as neither rational behavior nor irrational mispricing.

Taken together, our work offers contributions along several lines of inquiry. The anomaly known as post–earnings announcement drift can be partially tied to divergence in investors' opinions, particularly among positive earnings surprises. Also, we offer a more complete picture of the relationship between volume and ex post returns, recognizing that volume is made up of several components. Unexpected volume carries a very different meaning for future returns than the components of volume that we often associate with liquidity trading or response to the information content of news. Finally, we offer insights into the tripartite relationship among volume, returns, and other measures of opinion divergence, such as those based on analysts' forecasts. We show that tests using analyst data are subject to concerns with selection bias and illustrate that analysts may change the information environment in ways that influence the relation between volume and ex post returns.

The remainder of this research is organized as follows. Section 2 discusses the placement of our work in the context of research on post–earnings announcement drift and on trading activity around earnings announcements. Section 3 presents our data. Section 4 describes our methods of proxy measurement. Section 5 contains results and section 6 concludes.

2. *Prior Literature*

2.1 POST–EARNINGS ANNOUNCEMENT DRIFT

The literature on post–earnings announcement drift is extensive. Beginning with the documentation of the phenomenon by Ball [1968], numerous papers attempt to explain the basic result that positive (negative) earnings surprises are followed by significant abnormal positive (negative) returns over the following three months. Subsequent research highlights the robustness of this result after controlling for changes in risk (Bernard and Thomas [1989]), potential flaws in research design (Bernard and Thomas [1989]), and the incomplete adjustment of forecasts by analysts (Abarbanell and Bernard [1992]).

A common result documented in prior work is that drift is concentrated among smaller firms, implying potential selection bias concerns in tests that require data typically available only for larger firms. The importance of firm size to the drift phenomenon is addressed specifically by Bhushan [1994]. He shows that the concentration of drift among these firms is likely associated with the difficulty they present in trading to take advantage of the mispricing. In other words, transaction costs are higher for smaller firms and this drives the sensitivity of drift to firm size. He controls for transaction costs through share price and previous trading volume, with higher share prices and volumes indicating lower costs. The inclusion of these controls dissipates the effect of firm size on drift.

Our work also focuses on the effects of volume on drift. However, our approach and our results differ markedly from those of Bhushan [1994]. Our volume measure for divergent opinions is very different from the one employed by Bhushan [1994], both in spirit and in anticipated effect on post–earnings announcement returns. His volume is measured as the average trading activity in the stock over the fiscal year that precedes the earnings event and is designed to capture liquidity or (inverse) transaction cost levels. We measure volume at the earnings event, and we control for Bhushan's [1994] effect by removing prior trading volume from our measure. The residual is designed to measure divergence of opinion among investors. Our empirical tests confirm that the two measures of volume are capturing differing economic effects.

2.2 VOLUME AND OPINION DIVERGENCE AROUND EARNINGS ANNOUNCEMENTS

There is ample research to suggest that a component of trading volume may be attributed to opinion divergence. Kandel and Pearson [1995] predict that volume will be increasing in the diversity of investor opinions around earnings events. They first document that volume is higher around earnings events than during control periods with similar returns and no earnings news. Then they propose a theory to explain this finding, even in those cases in which earnings events elicit little to no price reaction. Their theory assumes that investors possess different likelihood functions and this causes them to interpret earnings news differently.

Harris and Raviv [1993] present a model in which traders receive common information, as in an earnings announcement, but differ in their interpretation of the information. The difference from Kandel and Pearson [1995] is that their traders have both different prior beliefs as well as different models for evaluating the news. Nevertheless, the conclusions are comparable—greater opinion divergence across investors is associated with more volume.

Kim and Verrecchia [1994] construct a model in which earnings announcements may increase information asymmetries because some market participants process the announcement into private or informed judgments. In the context of their model, the authors are able to show that greater diversity of opinions, caused by the differential processing of the information, leads to an increase in trading volume.[2] Thus, as in Kandel and Pearson [1995], earnings announcement volume relative to some prior period's volume may be a good proxy for more divergent opinions.

Holthausen and Verrecchia [1990] model how public announcements can influence traders through an informedness effect (the extent to which investors become more knowledgeable) and a consensus effect (the extent of agreement among investors). In terms of implications for trading volume, they find that both greater informedness and reduced consensus cause more trading volume. Again, it is the theoretical relation between decreased investor consensus (more divergent opinions) and increased trading volume that we appeal to. However, one of our proxies for investor consensus (see below) also attempts to control for the effect of informedness on trading volume.

Empirically, there is also support for using volume to proxy for differential opinions by traders. Studies analyzing total trading volume around earnings announcements include those of Bamber [1987], Bamber, Barron, and Stober [1997, 1999], and Ajinkya et al. [2004]. Generally, these studies find that volume is higher around earnings events that are more likely associated with more divergent investor opinions. Fleming and Remolona [1999] find that trading volume increases significantly, while price volatility and spreads remain wide, as investors in Treasury securities trade to reconcile differential interpretations of macroeconomic information releases. Brockman and Chung [2000] find that volume is increasing in the Wang

[2] Strictly speaking, the model of Kim and Verrecchia [1994] is a model of differential information. Specifically, their earnings announcement signal about anticipated liquidating value is denoted $\tilde{Y} = \tilde{u} + \tilde{\delta}$. The differential information component of the model is driven by the receipt of $\tilde{O}_i = \tilde{\delta} + \tilde{\varepsilon}_i$ by a group of information processors (indexed by i). However, differential information models can sometimes lead to no trading. Milgrom and Stokey [1982] argue that there will be no trade if initial allocations are ex ante Pareto-optimal, even when private (different) news information is offered to individual traders. Kim and Verrecchia [1994] avoid this problem by using the information asymmetry between their information processors and other participants (a market maker and liquidity traders) to affect liquidity, and therefore volume. Indeed, Kim and Verrecchia [1994, p. 55] characterize their model as one way to allow different interpretations of the earnings announcement: "This private information can be thought of as informed judgments or opinions." Formally, their proposition 2 states that ". . . trading volume at the time of an earnings announcement is . . . increasing in the diversity of opinion . . ."

[1998] model's heterogeneity parameter on information event days, after controlling for the information effects of the announcements. Finally, in the experimental literature, Smith, Suchanek, and Williams [1988] show that even when traders observe identical probabilistic dividend distributions, then trade occurs, sometimes in large volume. They conclude that there is diversity in opinions.

Taken together, the literature on volume around earnings events suggests that investor trading activity is driven by several factors. Investors may trade for liquidity reasons, suggesting a typical amount of trading that may be captured by a measure of volume resembling that of Bhushan [1994]. Trading may also be larger when the news in the earnings announcement is bigger (see Karpoff [1987]). Third, more trading may indicate more divergent opinions about the implications of the earnings news. Our volume-based proxies for opinion divergence attempt to control for the first two possible sources of volume and treat the remainder as an indicator of divergent opinions.

3. Data

Our primary sample meets the following criteria. From Compustat we identify earnings announcements between January 1985 and July 1998 by New York Stock Exchange/American Stock Exchange (NYSE/AMEX) firms with at least 10 quarters of primary earnings per share, excluding extraordinary items, adjusted for stock splits and stock dividends. We exclude NASDAQ stocks for comparability—drift papers typically focus on only NYSE/AMEX stocks. We begin our sample in January 1985 because I/B/E/S began offering quarterly forecast data during the calendar year 1984. We use I/B/E/S data in later tests.

All stock return data are from the Center for Research in Securities Prices (CRSP) at the University of Chicago. We also calculate the market capitalization decile for each firm prior to every earnings announcement. The decile ranking is based on the market value of equity of the firm at the beginning of the calendar year in which the earnings are announced. The size portfolio values range from one (for firms whose market cap measure is within the smallest decile of capitalization rankings of NYSE/AMEX firms in the previous year) to 10 (for the largest firms). We denote size portfolio rankings with the variable MV_{pf}.[3]

We collect information on the number of shares traded in the security over the two-day earnings announcement window (Compustat date and preceding day)[4] and during a 50-day control period preceding it ([t−54, t−5], where t is the Compustat earnings date). Aggregate market volume (NYSE/AMEX stocks) is also collected over these periods, as are the number of shares outstanding for the announcing firm and the market. These

[3] We consistently denote portfolio ranked variables with the subscript pf.

[4] Our results are robust to widening the earnings announcement window to [t−1, t+1].

data are used to calculate some of our volume measures, discussed more fully below. Finally, we obtain volume over the full fiscal year previous to the earnings event and shares outstanding at the end of said year to calculate a measure of the average turnover in the stock. Our primary sample consists of 45,187 earnings announcement events with sufficient data to calculate volume measures, post–earnings announcement returns, and earnings surprise proxies.

4. *Variable Construction*

In this section, we describe methods for variable construction. First, we require a measure of earnings surprise. We use the abnormal return to the earnings announcement, calculated using market model methodology. This allows us to focus on investor surprise, rather than a measure built on past earnings. We describe the measure in section 4.1. We describe calculations of volume-based proxies for opinion divergence in section 4.2. Section 4.3 describes our drift calculation approach. Section 4.4 discusses the correlation between our variables.

4.1 MEASURING EARNINGS SURPRISE

Our measure of earnings surprise is based on the abnormal stock return at the earnings announcement. The abnormal return is calculated using standard market model methodology. The estimation period for the market model parameters is $[t-200, t-21]$, where t is the Compustat earnings date. As noted above, the event window is $[t-1, t]$. We denote the abnormal return as *PE*, to reflect its construction as a prediction error. In each quarter, *PE* values are ranked into deciles. This controls for time variation in the market's reaction to earnings surprises of similar magnitude. The largest positive (negative) *PE* values are assigned a portfolio ranking of 10 (one). These rankings are denoted PE_{pf}.

4.2 MEASURES OF UNEXPECTED VOLUME—PROXIES FOR OPINION DIVERGENCE

We construct two different measures of unexpected volume as our proxies for opinion divergence. Both measures are assigned a portfolio (decile) ranking. We describe our two measures of unexpected volume separately.

4.2.1. Change in Turnover Calculation. We calculate the change in turnover associated with an earnings announcement using a several-step process. Our methodology follows those of Lee and Swaminathan [2000], Gebhardt, Lee, and Swaminathan [2001], and Ajinkya et al. [2004]. We begin by calculating daily turnover for any firm/day as the firm's volume on that day divided by its shares outstanding. In other words, we calculate the percentage of outstanding shares traded on any particular day. However, some firm/days may exhibit more trading because a macroannouncement creates significant trading in the whole market. We therefore subtract market-wide turnover calculated the same way, but across all NYSE/AMEX stocks. This creates our daily market-adjusted turnover measure.[5] We measure earnings announcement turnover as the average daily market-adjusted turnover across our earnings announcement window ($[t-1, t]$, where t is the Compustat earnings date). Equation (1) illustrates.

$$TO_{ea} = \left\{ \sum_{t=-1}^{0} \left[\left(\frac{Vol_{i,t}}{Shs_{i,t}} \right)_{firm} - \left(\frac{Vol_t}{Shs_t} \right)_{mkt} \right] \right\} \Big/ 2 \qquad (1)$$

where $Vol_{i,t}$ is the announcing firm's volume on day t ($t = 0$ is the Compustat earnings date), $Shs_{i,t}$ is firm i's shares outstanding on day t, and the subscript "ea" indicates earnings announcement.

In our next step, we recognize that stocks with relatively higher turnover at the earnings announcement may reasonably be the same stocks with relatively higher turnover overall (i.e., more liquid stocks). In other words, TO_{ea} may capture more than just volume attributable to divergent opinions; it can also include liquidity trading.

Our controls for the liquidity aspect of trading volume take two forms. First, we recognize that a typical amount of trading occurs in a stock, even without earnings news. We therefore subtract trading activity over a non–announcement period, from our above measure of earnings announcement turnover (TO_{ea}). Specifically, we adjust the earnings event turnover measure in equation (1) by subtracting market-adjusted turnover averaged over a pre-earnings announcement period $[t-54, t-5]$ (t is the earnings event date). We label the resulting change in market adjusted turnover ΔTO, and the portfolio ranked version of it as $(\Delta TO)_{pf}$. Specifically,

$$\Delta TO = \frac{\left\{ \sum_{t=-1}^{0} \left[\left(\frac{Vol_{i,t}}{Shs_{i,t}} \right)_{firm} - \left(\frac{Vol_t}{Shs_t} \right)_{mkt} \right] \right\}}{2} - \frac{\left\{ \sum_{t=-54}^{-5} \left[\left(\frac{Vol_{i,t}}{Shs_{i,t}} \right)_{firm} - \left(\frac{Vol_t}{Shs_t} \right)_{mkt} \right] \right\}}{50} \qquad (2)$$

A large market microstructure literature supports our approach by highlighting the role of volume as a determinant of liquidity. Moreover, Amihud and Mendelson [1986] show that liquidity is a key determinant of returns in general, implying a need to control for it if we wish to isolate the relationship between ex post returns and volume-based proxies for opinion divergence. Lee, Mucklow, and Ready [1993] illustrate that liquidity concerns are pronounced around earnings events. Finally, more recent work by Ahmed, Schneible, and Stevens [2003] suggests that the liquidity effects of online trading are important to the market's reaction to earnings announcements.

[5] Our results are robust to removal of the market adjustment in our turnover calculations.

Our second liquidity control is motivated by the work of Bhushan [1994], who shows that volume affects the sensitivity of post–earnings announcement returns to earnings surprise proxies. In order to illustrate that we are not simply measuring this effect, we include past annual turnover as a control variable in our primary tests. We calculate this control as total volume during the fiscal year preceding the earnings event divided by shares outstanding at the end of that fiscal year. The portfolio ranked version of past annual turnover is labeled $(TO_{yr-1})_{pf}$.

4.2.2. Standardized Unexpected Volume Calculation. As discussed above, Holthausen and Verrecchia [1990] describe an informedness effect wherein volume may be related to price moves.[6] Simply scaling by non–announcement volume, as in equation (2), assumes similar price moves during the announcement and control windows. Thus, to the extent that earnings announcements convey new information, $(\Delta TO)_{pf}$ may proxy for both an informedness effect and a consensus effect.

Our alternative measure of unexpected volume is designed to control for both the liquidity effect and informedness effect in volume.[7] Similar to Crabbe and Post [1994], we estimate the volume attributable to differences of opinion using a methodology that mirrors the market model approach to estimating abnormal returns. Specifically, we construct a measure of standardized unexpected volume (SUV), calculated as a standardized prediction error from a univariate model of trading volume on the absolute value of returns for the j^{th} earnings announcement made by firm i.

$$SUV_{i,j} = UV_{i,j}/S_{i,j} \tag{3}$$

$$UV_{i,j} = Volume_{i,j} - E[Volume_{i,j}], \tag{4}$$

$$E[Volume_{i,j}] = \hat{\alpha}_i + \hat{\beta}_1 \cdot |R_{i,j}|^+ + \hat{\beta}_2 \cdot |R_{i,j}|^- \tag{5}$$

where the plus and minus superscripts on the absolute valued returns indicate positive or negative returns. This recognizes the observed empirical regularity that volume and absolute value of return are differentially sensitive to each other when returns are positive versus negative (e.g. Karpoff [1987]). Finally, $S_{i,j}$ is the standard deviation of the residuals from the regression, calculated over the model's estimation period ([t−54, t−5], where t is the Compustat earnings date.

Announcement period returns and volume are measured over the period [t−1, t] for each earnings event, where t is the Compustat earnings date.[8] Parameter estimates $\hat{\alpha}$, $\hat{\beta}_1$, and $\hat{\beta}_2$ are generated from the regression of daily volume on the absolute value of daily returns, with separate slope coefficients for positive versus negative return days.[9]

[6] The evidence in Karpoff [1987] is broadly consistent with this.

[7] The residual is designed to capture opinion divergence.

[8] Given a two-day prediction error, our individual daily SUVs (on days t−1 and t) are summed and then scaled by the square root of 2, to construct our variable of interest.

[9] We use the natural log of volume to mitigate concerns about skewness.

If volume is *linearly* related to the absolute value of returns, the intercept from the regression captures average volume uncorrelated with price moves during the estimation window. Therefore, subtracting the $\hat{\alpha}$ term of equation (5) is isomorphic to the liquidity trading adjustment in equation (2). In addition, subtracting $\hat{\beta}_{(1\&2)} \cdot |R_{i,j}|^{(+/-)}$ in (5) controls for the informedness effect of Holthausen and Verrecchia [1990]. We interpret *SUV* in a manner consistent with the discussion above: greater than anticipated volume at the earnings announcement implies greater divergence of opinion about firm value at that time. Similar to above, we use the decile rankings of *SUV* (SUV_{pf}), constructed on a quarter-by-quarter basis, in our returns tests.

It is possible that the volume–return relation is nonlinear, even within the positive or negative announcement return groups. For example, figure 1 in Kandel and Pearson [1995], illustrating the relationship between volume and returns, might be viewed as convex. To capture this possibility, we also estimate unexpected volume using two alternative approaches: a quadratic form and a matching procedure. These approaches are described more fully below in the robustness checks.

4.3 MEASURING DRIFT

To maintain comparability with past studies, drift is calculated in a manner identical to that used by Foster, Olson, and Shevlin [1984] and Bernard and Thomas [1989]. Specifically, for each earnings event, we cumulate the firm's size-adjusted return over a 60 trading day window following the announcement. The daily size-adjusted return is calculated as the daily difference between the firm's equity return and a benchmark portfolio return based on NYSE/AMEX market capitalization deciles. In our robustness checks, we use market-adjusted returns, with a value-weighted market index return, as our dependent variable.

4.4 CORRELATIONS AMONG VARIABLES

Table 1 presents correlations between drift, earnings surprise, firm size, and opinion divergence proxies. The upper triangle presents Pearson correlations, while the lower triangle presents Spearman rank correlations. We confirm the typical significant relation between drift and earnings surprise. Also consistent with past studies, post–earnings announcement returns are declining in firm size. Finally, initial evidence on the relation between post–earnings announcement returns and opinion divergence is consistent with the work of Varian [1985]: size-adjusted returns are increasing in both measures of unexpected volume.

5. *Results*

Our results are presented as follows. The main findings are in sections 5.1 (univariate) and 5.2 (multivariate). All robustness checks and specification changes are discussed in section 5.3. Section 5.4 focuses on an alternative

TABLE 1

Correlations Between Post–Earnings Announcement Returns, Earnings Surprise, Firm Size, and Measures of Volume

The table presents correlations between portfolio rankings (indicated with *pf* subscript) of: earnings announcement abnormal return (*PE*), firm size (*MV*), prior year turnover (TO_{yr-1}), earnings announcement turnover (TO_{ea}), standardized unexpected volume (*SUV*), and the difference in market adjusted turnover (ΔTO) between the control period [t−54, t−5] and earnings date (day t). *Drift* (post–earnings announcement returns) is also correlated with these variables. The sample is 45,187 earnings announcements from January 1985 through July 1998 by NYSE/AMEX firms with sufficient data to calculate portfolio rankings of all variables. Portfolio rankings are cardinal rankings from 1 to 10 of the current quarter's variable value, based on which one of this quarter's decile rankings the value falls within. Calculations of variables: *PE* is calculated as the two-day abnormal return at the earnings announcement, using standard market model methodology. *Drift* is the cumulated size-adjusted return over the trading days window [t+1, t+60], where day t is the earnings announcement date. *MV* is the market value of equity from the end of the year preceding the earnings announcement. Prior fiscal year turnover (TO_{yr-1}) is volume over the entire prior fiscal year, divided by shares outstanding at the end of that fiscal year. Change in market-adjusted turnover (ΔTO) is the average daily market-adjusted turnover over the earnings announcement window (TO_{ea}) minus a similarly calculated measure over the window [t−54, t−5], where t is the earnings announcement date. The daily market-adjusted turnover (*TO*) is the firm volume divided by shares outstanding, minus a similarly calculated measure averaged over all NYSE/AMEX firms. Standardized unexpected volume (*SUV*) is the scaled (by estimation window standard deviation of prediction errors) two-day prediction error from a market model–style regression of volume on absolute valued returns. Upper (lower) triangle of correlation matrix presents Pearson (Spearman rank) correlations. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	ΔTO_{pf}	SUV_{pf}	$(TO_{yr-1})_{pf}$	$(TO_{ea})_{pf}$	MV_{pf}	PE_{pf}	*Drift*
ΔTO_{pf}	1	0.539***	0.053***	0.454***	−0.022***	0.064***	0.047***
SUV_{pf}	0.539***	1	0.097***	0.496***	0.061***	0.005	0.021***
$(TO_{yr-1})_{pf}$	0.053***	0.097***	1	0.615***	0.376***	0.004	−0.044***
$(TO_{ea})_{pf}$	0.453***	0.496***	0.615***	1	0.226***	0.075***	−0.007
MV_{pf}	−0.005	0.070***	0.375***	0.244***	1	−0.002	−0.073***
PE_{pf}	0.064***	0.005	0.004	0.075***	−0.00003	1	0.041***
Drift	0.050***	0.029***	−0.020***	0.015***	−0.026***	0.047***	1

proxy for opinion divergence—variability in analysts' forecasts. Section 5.5 relates the two proxies for opinion divergence, forecast variability and unexplained volume, to the quantity of accruals at the earnings announcement.

5.1 UNIVARIATE RESULTS

Table 2, panel A presents estimates of mean and median ex post returns, classified by whether the earnings event exhibits high or low unexpected volume. We define high unexpected volume events as those in which the volume portfolio ranking exceeds five; all other earnings events are considered low. Table 2 also presents results from tests (t-test and Wilcoxon) of differences in the central tendency of ex post returns, by the same classification. The top half of the panel employs ΔTO_{pf} as the unexpected volume measure, while the bottom half reports the results for SUV_{pf}.

Our results indicate that the mean of the post–earnings announcement returns following earnings surprises with low ΔTO_{pf} is −0.07% (insignificant

TABLE 2

Univariate Statistics on Post–Earnings Announcement Returns and Unexpected Volume

The table presents descriptive statistics of percent drift categorized by unexpected volume. The panel A sample is 45,187 earnings announcements from January 1985 through July 1998 by NYSE/AMEX firms with sufficient data (see table 1 legend and text for details). *Drift* is the cumulated size-adjusted return over the trading days window $[t+1, t+60]$, where day t is the earnings announcement date. Unexpected volume is high when its value exceeds the sample median, and low otherwise. Change in market-adjusted turnover (ΔTO) is the average daily market-adjusted turnover over the earnings announcement window (TO_{ea}) minus a similarly calculated measure over the window $[t-54, t-5]$, where t is the earnings announcement date. The daily market-adjusted turnover (TO) is the firm volume divided by shares outstanding, minus a similarly calculated measure averaged over all NYSE/AMEX firms. Standardized unexpected volume (SUV) is the scaled (by estimation window standard deviation of prediction errors) two-day prediction error from a market model–style regression of volume on absolute valued returns. The panel B sample is earnings announcements whose decile ranking is anywhere between three and six. For this sample, low, medium, and high unexpected volume classification is as follows: low if ΔTO_{pf} is in lowest three deciles, high if ΔTO_{pf} is in the highest three deciles, and medium otherwise. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: all earnings events

	Unexpected Volume		Significance Test for Difference between High and Low
	High	Low	
ΔTO_{pf} as unexpected volume			
Mean postannouncement return	1.386%***	−0.070%	$t = 9.49$***
Median postannouncement return	0.761%***	−0.399%***	$\chi^2 = 105.96$***
SUV_{pf} as unexpected volume			
Mean postannouncement return	0.977%***	0.339%***	$T = 4.15$***
Median postannouncement return	0.468%***	−0.154%	$\chi^2 = 31.44$***

Panel B: small absolute value announcement return

	Postannouncement returns	
Unexpected volume (ΔTO_{pf})	Mean	Median
Low	−0.220%	−0.366%**
Medium	0.264%*	−0.058%
High	1.415%***	1.015%***
High versus medium versus low (ΔTO_{pf})		
Test of differences among associated postannouncement returns	$F = 17.81^{c}$	$\chi^2 = 38.12$***

at conventional levels), while the mean is 1.39% (significant with 99% confidence) for high ΔTO_{pf} announcements. The difference in (size-adjusted) returns seems economically substantial: nearly 1.5% over three months. Viewed on a percentage basis, the difference in returns is 105% of the value for high unexpected volume. The test of whether these means are statistically different rejects the null hypothesis with 99% confidence ($t = 9.5$ under unequal variances, which is indicated by the data). The median post–earnings announcement returns for the two subsamples (−0.4% for low ΔTO_{pf} events, 0.76% for high) are also statistically different ($\chi^2 = 106$).

When proxying for unexpected volume with SUV_{pf}, we see results that are statistically and economically similar to those described above. Again, high opinion divergence (unexpected volume) announcements are associated with more positive ex post returns than low opinion divergence events. Taken together, our results are consistent with the joint hypothesis that unexpected volume at earnings events proxies for opinion divergence, and investors treat this as a risk proxy requiring ex post compensation (à la Varian [1985]).

Panel B of table 2 presents results focusing on a subsample of earnings announcements with announcement returns closer to zero. We do so because Kandel and Pearson [1995] motivate their theoretical analysis with the observation that even earnings announcements with minimal associated price changes carry significant trading activity. We therefore focus on earnings events with announcement return rankings in the middle four deciles.[10]

The results continue to indicate that post–earnings announcement returns are increasing in unexpected volume measured using ΔTO_{pf}. Given our control for price changes via sampling methodology, we eschew analysis of the effects of *SUV*. We report ex post returns for three different groupings of ΔTO_{pf}. Earnings announcements with ΔTO_{pf} in the lowest three deciles are associated with the lowest average (−0.22%) and median (−0.37%) ex post returns. Earnings announcements with ΔTO_{pf} in the next four deciles show higher mean (0.26%) and median (−0.06%) ex post returns. The set of earnings announcements in the highest three deciles of ΔTO exhibits the highest average (1.42%) and median (1.02%) ex post returns. The F and χ^2 statistics from nonparametric tests of differences across the three groups are both significant with 99% confidence. Our results appear robust to a more strict interpretation of Kandel and Pearson's [1995] model of opinion divergence.

5.2 MULTIVARIATE RESULTS

Table 3 presents results from regressions of post–earnings announcement returns on the standard controls found in the drift literature (earnings surprise and firm size) and on our unexpected volume proxies for opinion divergence. We also include two other volume measures motivated by Bhushan [1994] and Ajinkya et al. [2004]. We proxy for liquidity with stock turnover (volume divided by shares outstanding) from the fiscal year prior to the earnings event. We measure total earnings announcement trading activity as market-adjusted turnover during the earnings announcement window.

Consistent with prior work, we find that post–earnings announcement returns are increasing in earnings surprise (PE_{pf}) and decreasing in firm size (MV_{pf}). The coefficients on these variables are significantly different from zero with 99% confidence across all specifications. We also document

[10] We obtain similar results if we restrict our attention to events in the middle two decile rankings. We thank the referee for this suggestion.

TABLE 3

Relationship between Post–Earnings Announcement Returns and Unexpected Volume

The table presents regressions of percent drift on volume measures and controls. The sample is 45,187 earnings announcements from January 1985 through July 1998 by NYSE/AMEX firms with sufficient data to calculate portfolio rankings of following variables. *PE* is calculated as the two-day abnormal return at the earnings announcement, using standard market model methodology. *Drift* is the cumulated size-adjusted return over the trading days window [t+1, t+60], where day t is the earnings announcement date. *MV* is the market value of equity from the end of the year preceding the earnings announcement. Prior fiscal year turnover (TO_{yr-1}) is volume over the entire prior fiscal year, divided by shares outstanding at the end of that fiscal year. Change in market-adjusted turnover (ΔTO) is average daily market-adjusted turnover over the earnings announcement window (TO_{ea}) minus a similarly calculated measure over the window [−54, t−5], where t is the earnings announcement date. The daily market-adjusted turnover (TO) is the firm volume divided by shares outstanding, minus a similarly calculated measure averaged over all NYSE/AMEX firms. Standardized unexpected volume (SUV) is the scaled (by estimation window standard deviation of prediction errors) two-day prediction error from a market model–style regression of volume on absolute valued returns. t-statistics (in parentheses) are calculated using White's [1980] heteroskedasticity consistent standard errors. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	I	II	III	IV	V	VI
Intercept	2.30***	1.89***	0.98***	1.45***	1.27***	1.66***
	(8.22)	(6.33)	(3.41)	(4.93)	(4.31)	(5.60)
PE_{pf}	0.23***	0.23***	0.22***	0.23***	0.22***	0.23***
	(7.47)	(7.51)	(6.98)	(7.45)	(6.91)	(7.06)
MV_{pf}	−0.36***	−0.41***	−0.39***	−0.41***	−0.35***	−0.36***
	(−9.88)	(−11.77)	(−11.39)	(−11.63)	(−9.62)	(−9.88)
$(TO_{yr-1})_{pf}$	−0.11***				−0.12**	−0.17***
	(−3.78)				(−2.92)	(−4.01)
$(TO_{ea})_{pf}$		0.04			−0.02	0.07
		(1.37)			(−0.36)	(1.42)
ΔTO_{pf}			0.24***		0.26***	
			(8.52)		(7.08)	
SUV_{pf}				0.14***		0.12***
				(4.85)		(2.98)
Adjusted R^2	0.0073	0.0070	0.0088	0.0076	0.0092	0.0080
F-statistic	112.05***	107.69***	134.69***	116.48***	84.93***	74.28***

evidence consistent with Bhushan [1994]: post–earnings announcement returns are decreasing in liquidity. The coefficient on $(TO_{yr-1})_{pf}$ is significantly negative with at least 99% confidence in all specifications in which the variable is included. Finally, total earnings announcement turnover (see Ajinkya et al. [2004]) does not appear to affect ex post returns.

Turning to our analysis of the effects of opinion divergence on returns, we see that unexpected volume (both ΔTO_{pf} and SUV_{pf}) positively influences post–earnings announcement returns with 99% confidence. This contrasts with both the negative effect of past volume (liquidity) and the lack of significant effects of total volume on ex post returns. Clearly, there are differences in the effects of prior volume, total earnings announcement volume, and unexpected volume on post–earnings announcement returns.

The estimates in models III and IV indicate important economic effects as well. A change from the lowest to the highest decile of unexpected volume implies increases in ex post returns of 1.4% to 2.4%. A similar calculation using earnings surprise (PE_{pf}) implies about 2.2% to 2.3% drift differences between the highest and lowest earnings surprises. Unexpected volume and earnings surprise have reasonably comparable economic effects on post–earnings announcement returns. In sum, our multivariate results mirror the univariate results presented above. Post–earnings announcement returns are increasing in proxies for opinion divergence around earnings announcements, consistent with the work of Varian [1985].

5.2.1. Explanatory Power. The regression itself is significant, with F-statistics varying between 74 and 135. However, the adjusted R^2s are rather low, between 0.7% and 0.9%. This likely reflects several factors. First, we are explaining abnormal returns in a purely cross-sectional framework. Below, when we assess the effects of unexpected volume on returns in a framework related to Fama and French [1993], our explanatory power is much higher (on the order of 13% to 14%). In other words, the table 3 regressions seek to explain variation in excess (size-adjusted) returns, whereas our Fama–French style tests do not. Second, we are explaining *individual event* abnormal returns in table 3, as opposed to portfolio returns. A large portion of the literature studying post–earnings announcement drift focuses on portfolio returns, which enhances the signal-to-noise ratio. Finally, we note that our adjusted R^2s are in line with those found in other studies that employ regressions to study drift (e.g., Bhushan [1994]).

5.3 ALTERNATIVE SPECIFICATIONS AND ROBUSTNESS

5.3.1. Earnings Surprise Interactive Tests. Following Bhushan [1994], we also examine whether our results persist in a setting in which volume may influence the relation between post–earnings announcement returns and earnings surprise. Table 4 presents results from regressions of post–earnings announcement returns on PE_{pf} (surprise) and interactions of surprise with firm size (MV_{pf}), prior year turnover ($(TO_{yr-1})_{pf}$), and our two unexpected volume proxies (ΔTO_{pf} and SUV_{pf}). This allows us to see whether unexpected volume affects post–earnings announcement returns through their sensitivity to earnings surprise.

Consistent with prior results, post–earnings announcement returns are increasing in earnings surprise (PE_{pf}) and declining in surprise interacted with firm size ($PE_{pf} * MV_{pf}$). Moreover, the coefficient on $PE_{pf} * (TO_{yr-1})_{pf}$ is significantly negative, consistent with the work of Bhushan [1994], indicating that the sensitivity of drift to earnings surprise is larger when transactions costs are higher (or when $(TO_{yr-1})_{pf}$ is lower).

We continue to find support for the hypothesis that opinion divergence, as proxied by unexpected volume, affects post–earnings announcement returns. The coefficients on the interactions of PE_{pf} with unexpected volume

TABLE 4

Sensitivity of Post–Earnings Announcement Returns to Earnings Surprise and its Interactions

The table presents regressions of percent *Drift* (the cumulated size-adjusted percent return over the trading days window $[t+1, t+60]$, where day t is the earnings announcement date) on earnings surprise (PE_{pf}), market capitalization (MV_{pf}), volume measures, and PE_{pf} interacted with market capitalization and volume measures. The sample is 45,187 earnings announcements from January 1985 through July 1998 with sufficient information to calculate all variables. Volume measures are as follows. Prior fiscal year turnover (TO_{yr-1}) is volume over the entire prior fiscal year divided by shares outstanding at the end of that fiscal year. Change in market-adjusted turnover (ΔTO) is the average daily market-adjusted turnover over the earnings announcement window (TO_{ea}) minus a similarly calculated measure over the window $[t-54, t-5]$, where t is the earnings announcement date. The daily market-adjusted turnover (TO) is the firm volume divided by shares outstanding, minus a similarly calculated measure averaged over all NYSE/AMEX firms. Standardized unexpected volume (SUV) is the scaled (by estimation window standard deviation of prediction errors) two-day prediction error from a market model–style regression of volume on absolute valued returns. t-statistics (in parentheses) are calculated using White's (1980) heteroskedasticity consistent standard errors. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Intercept	PE_{pf}	$MV_{pf} * PE_{pf}$	$(TO_{yr-1})_{pf} * PE_{pf}$	$\Delta TO_{pf} * PE_{pf}$	$SUV_{pf} * PE_{pf}$	Adj. R^2	F-stat
−0.11	0.37***	−0.05***	−0.02***	0.05***		0.0082	94.33***
(−0.75)	(5.82)	(−7.28)	(−3.78)	(8.43)			
−0.24	0.51***	−0.06***	−0.02***		0.03***	0.0069	79.99***
(−1.60)	(8.47)	(−7.81)	(−3.49)		(4.83)		

(either ΔTO_{pf} or SUV_{pf}) are significant. Opinion divergence appears to affect post–earnings announcement returns by increasing the sensitivity of drift to surprise. In other words, when opinion divergence is high, the drift-surprise relation is stronger.

5.3.2. Other Risk Controls. We examine the robustness of our results to additional controls for firm risk. In other words, we take the view that investor opinion divergence may be a risk proxy and ask whether this risk is simply a more commonly recognized factor in different guise. To assess the incremental explanatory power of unexpected volume on returns, we include changes in either beta or the standard deviation of stock returns as controls.

We calculate changes in beta and standard deviation of stock returns as the difference between their post–earnings announcement and pre–earnings announcement values. Both calculation windows span 50 trading days. The pre–earnings announcement window is $[t-54, t-5]$, where day t is the Compustat earnings date, and the post–earnings announcement window is $[t+5, t+54]$. Beta is calculated using the standard market model methodology. Standard deviation is calculated using closing daily raw stock returns. Again, we portfolio rank these explanatory variables into deciles based on the previous quarter's distribution of variable values.

Table 5 presents the results. As in table 3, we observe significant positive coefficients on our unexpected volume measures. Moreover, the standard deviation of stock returns appears to positively affect returns. This is

TABLE 5

Post–Earnings Announcement Returns, Unexpected Volume, and Standard Risk Proxies

The table presents regressions of percent *Drift* (the cumulated size-adjusted percent return over the trading days window [t+1, t+60], where day t is the earnings announcement date) on volume and controls. Volume is either the standardized unexpected volume (*SUV*) or change in market-adjusted turnover (ΔTO). ΔTO is the average daily market-adjusted turnover over the earnings announcement window (TO_{ea}) minus a similarly calculated measure over the window [t−54, t−5], where t is the earnings announcement date. The daily market-adjusted turnover (*TO*) is the firm volume divided by shares outstanding, minus a similarly calculated measure averaged over all NYSE/AMEX firms. *SUV* is the scaled (by estimation window standard deviation of prediction errors) two-day prediction error from a market model–style regression of volume on absolute valued returns. Portfolio rankings (indicated with a *pf* subscript) are cardinal rankings from 1 to 10 of the current quarter's variable value, based on which decile of the previous quarter variable decile rankings it falls in. PE_{pf} is a portfolio ranking of *PE*. *PE* is the two-day abnormal return to the earnings announcement, calculated using standard market model methodology. $\Delta\beta_{pf}$ is the portfolio ranking of the change in beta (estimated as the difference in market model betas calculated over windows [t−54, t−5] and [t+5, t+54]). $\Delta\sigma_{pf}$ is the portfolio ranking of the change in standard deviation of returns (estimated as the difference in σ calculated over windows [t−54, t−5] and [t+5, t+54]). t-statistics (in parentheses) are calculated using White's [1980] heteroskedasticity consistent standard errors. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	I	II
Intercept	−0.22	0.10
	(−0.71)	(0.30)
PE_{pf}	0.22***	0.24***
	(7.07)	(7.51)
MV_{pf}	−0.40***	−0.41***
	(−11.45)	(−11.72)
ΔTO_{pf}	0.22***	
	(7.69)	
SUV_{pf}		0.13***
		(4.56)
$\Delta\beta_{pf}$	0.03	0.03
	(1.19)	(0.94)
$\Delta\sigma_{pf}$	0.26***	0.28***
	(6.83)	(7.24)
N	45,187	45,187
Adjusted R^2	0.0110	0.0101
F-statistic	101.33***	93.08***

consistent with Goyal and Santa-Clara [2003], who provide evidence that idiosyncratic risk matters. The basic principle applying to risk and return applies around earnings announcements. However, even controlling for these previously used risk factors, unexpected volume carries incremental explanatory power.

5.3.3. Other Robustness Checks. Our results are also robust to post–earnings announcement returns calculated using an alternative benchmark return. When we use CRSP's value-weighted index return as our benchmark, we obtain results similar to those reported in table 3.

We re-examine the relation between post–earnings announcement returns and unexpected volume for separate samples of positive and negative earnings surprises. Under Hong and Stein [1999], negative surprises should exhibit ex post returns that are declining in unexpected volume around the earnings announcement. Under Varian [1985], the prediction is reversed.[11] The results indicate that returns after negative earnings surprises are increasing in unexpected volume (with 99% confidence using our ΔTO_{pf} variable, but only 85% confidence with SUV_{pf}) in regressions mimicking models III and IV in table 3. These results suggest rather more support for Varian [1985] than for Hong and Stein [1999]. Among positive surprises, in which the predicted relation between unexpected volume and returns is positive under both models, we document evidence consistent with them. The coefficients on unexpected volume in the drift regressions are always positive and significant with 99% confidence.

We also re-run our table 3 regressions separately for subsamples categorized by firm size. We create several different subsamples. First, we categorize firms as small or large depending on their market value of equity relative to the median NYSE firm's market equity at the prior calendar year end. Both large and small firms exhibit a significantly positive relation between unexplained volume and post–earnings announcement stock returns. Second, we categorize firms as small or large depending on their market value of equity relative to the median sample firm's market equity. Again, our results persist for small and large firms. Finally, we categorize our sample firms as small, medium, or large, again based on their market equity values relative to the full sample. Our results generally persist under all three firm size subsamples.[12]

Following panel B of table 2, we also run a regression similar to model III for the subsample of earnings announcements with surprises closer to zero. The regressors are firm size and a variable that indicates whether unexpected volume is low, medium, or high. Unexpected volume is measured using the ΔTO calculation in equation (2). We do not include a regressor for earnings surprise because of our sampling approach; we use observations with earnings surprise decile rankings of four through seven.[13] The results continue to indicate that post–earnings announcement returns are increasing in unexpected volume.

Finally, we entertain two alternative measures of unexpected volume that control for the price change at the earnings announcement. First, viewing figure 1 in Kandel and Pearson [1995] as a possible indicator of a convex relationship between volume and returns, we estimate the volume–return

[11] Among positive surprises, the predicted relation between ex post returns and unexpected volume is the same for both models.

[12] The lone exception is the regression in column 6 of table 3, with SUV_{pf} as our measure of unexpected volume and both prior year turnover and earnings announcement volume included as controls. For the subsample of medium-sized firms, the coefficient on SUV_{pf} is positive, but insignificant.

[13] Our results are robust to sampling on earnings surprises with decile rankings of 5 and 6.

relation underlying equations (3) through (5) as a quadratic form. Second, we follow Kandel and Pearson [1995] more directly. We subtract volume measured over a carefully matched control period from earnings announcement volume, and the percentage difference is treated as unexpected volume. The matched control period is chosen as follows. The pre–earnings announcement window [$t-54$, $t-5$] is split into 25 two-day windows. The two-day window with the closest return is the match window. As always, we rank unexpected volume into decile portfolios on a quarter-by-quarter basis. Our results under both of the above alternatives continue to indicate that post–earnings announcement returns are increasing in unexpected volume.

5.3.4. An Alternative Framework (Fama–French). We also examine the determinants of post–earnings announcement returns using the framework of Fama and French [1993], hereafter FF. We follow the basic approach presented by Kim and Kim [2003]. Specifically, each earnings event has its own time-series regression over the 60 trading days following the earnings event. The dependent variable is the daily return, net of the daily risk-free rate. The independent variables are the usual FF factors (daily versions)—*RMRF*, the market's daily return minus the daily risk-free rate; *SMB*, the daily return difference between portfolios of small and large stocks; *HML*, the daily return difference between portfolios of high and low book-to-market (equity) stocks—and two additional variables specific to this study. These are *ES* (an earnings surprise factor) and *UV* (an unexpected volume factor). *ES* is the difference in daily return between two portfolios: earnings events with surprise in the top decile and events with surprise in the bottom decile. *UV* is the difference in daily return between two other portfolios: earnings events with high and low unexpected volume (above/below the median). Daily portfolio returns are calculated by averaging daily returns across firms that announced earnings within the previous 60 trading days. We use the above/below median classification to maintain comparability with our tests in panel A of table 2.

Our estimation of *UV* recognizes that both earnings surprise and firm size are likely to be correlated with unexpected volume. Therefore, our classification into high versus low unexpected volume groups is done after we group events first by surprise magnitude and firm size. Specifically, we form *UV* as follows. We construct five portfolios of earnings events, based on earnings surprise. We then break each of those five portfolios into five groupings based on firm size. We now have 25 portfolios. Each of the 25 portfolios is split into high or low unexpected volume. The daily *UV* factor is the average daily return across all 25 high unexpected volume portfolios minus the average daily return across all 25 low unexpected volume portfolios.

Results are presented in table 6. The effects of *ES* and *UV* on ex post returns can be seen by examining the coefficients on these two factors. To facilitate the analysis, we separately form groups of high and low unexpected volume earnings events. The average coefficient on *UV* for the high unexpected volume events is 0.48 with a *t*-statistic of 28.61. Intuitively,

TABLE 6

Fama and French [1993] Regressions of Post–Earnings Announcement Returns on Market, Size, Value, Earnings Surprise, and Unexpected Volume Factors

The table presents averages of results from individual Fama and French [1993] (hereafter, FF) firm/earnings announcement regressions; that is, one regression for each earnings announcement. Regressions are time series over 60 trading days following the earnings announcement. The dependent variable is daily stock return minus daily risk-free rate. Independent variables are: *RMRF*, the market's daily return minus the daily risk-free rate; *SMB*, the daily return difference between portfolios of small and large stocks; *HML*, the daily return difference between portfolios of high and low book-to-market (equity) stocks; *ES*, the daily return difference between portfolios of high and low earnings surprise events (portfolio 10 minus portfolio 1); and *UV*, the daily return difference between portfolios of high and low unexpected volume events (where unexpected volume is as defined in equation [3]).

Model: $(R_{it} - R_{ft}) = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_t$		
Mean intercept		0.0090 ($t = 6.88$)
Mean β_1		0.9482 ($t = 220.5$)
Mean β_2		0.4364 ($t = 80.17$)
Mean β_3		0.2331 ($t = 32.60$)
Mean adjusted R^2		13.66%

Model: $(R_{it} - R_{ft}) = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 ES + \varepsilon_t$		
	Positive Earnings Surprise	Negative Earnings Surprise
Mean intercept	0.0207 ($t = 11.97$)	−0.0071 ($t = -3.27$)
Mean β_1	0.9579 ($t = 166.8$)	0.9292 ($t = 133.5$)
Mean β_2	0.4196 ($t = 57.85$)	0.4495 ($t = 51.69$)
Mean β_3	0.2138 ($t = 23.69$)	0.2408 ($t = 19.85$)
Mean β_4	0.0194 ($t = 3.62$)	−0.0365 ($t = -5.83$)
Mean adjusted R^2	13.89%	

Model: $(R_{it} - R_{ft}) = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 ES + \beta_5 UV + \varepsilon_t$		
Coefficient	High Unexpected Volume	Low Unexpected Volume
Mean intercept	0.0079 ($t = 4.40$)	0.0081 ($t = 4.08$)
Mean β_1	0.9482 ($t = 155.1$)	0.9453 ($t = 153.9$)
Mean β_2	0.4303 ($t = 55.46$)	0.4362 ($t = 56.14$)
Mean β_3	0.2350 ($t = 24.25$)	0.2295 ($t = 20.53$)
Mean β_4	−0.0086 ($t = -1.66$)	−0.0057 ($t = -1.07$)
Mean β_5	0.4846 ($t = 28.61$)	−0.4747 ($t = -26.10$)
Mean adjusted R^2	14.12%	

when an earnings announcement has high opinion divergence (large unexpected volume), that announcement's drift is very sensitive (positively) to the constructed unexpected volume premium (*UV* factor). By comparison, the average coefficient on *ES* for positive earnings surprise events is 0.02 with a *t*-statistic of 3.62.[14] Unexpected volume has at least a comparable influence, and may have a stronger influence on drift, than earnings surprise

[14] We examine the typical coefficient on *ES* categorized by earnings surprise direction, rather than by whether unexpected volume is large or small, because we expect positive and negative earnings surprises to have differential sensitivities of drift to the *ES* factor. Recall that the *ES* factor is the difference in returns to surprise portfolios 1 and 10, and is therefore likely to

in an FF framework. Another way to see this is to examine the incremental explanatory power of *ES* and *UV* to the adjusted R^2s of the FF regressions. Including *ES* raises the adjusted R^2 by 1.68% of the original value (from 13.66% to 13.89%). *UV* increments the adjusted R^2 of the FF regression by a very similar amount: 1.66% of the previous value (from 13.89% to 14.12%).

Finally, for completeness, we report that among low unexpected volume events, the average coefficient on *UV* is −0.47, with a *t*-statistic of −26.10. Intuitively, when unexpected volume (opinion divergence) is low, the sensitivity of drift to the unexpected volume factor (*UV*) is low. More specifically, among low opinion divergence events, larger excess returns to high opinion divergence matter less.

5.4 ALTERNATIVE PROXIES FOR OPINION DIVERGENCE

We conduct ancillary tests using analysts' forecast data. These data come from I/B/E/S.[15] We face two issues with such data. First, standard I/B/E/S data contain rounding-induced errors, which are described in Diether, Malloy, and Scherbina [2002]. Briefly, I/B/E/S adjusts forecasts for splits and stock dividends to enhance comparability through time. However, these adjusted values are rounded to the nearest penny, creating the possibility of truncated data problems, especially among stocks with a large number of splits. To the extent that firms with more splits are systematically different from those with few or no splits, measures of forecast variability across the two groups will differ due to data construction. To avoid such complications, we use unadjusted forecast data provided by I/B/E/S at our request.

Second, increases in forecast volatility may be due to later forecasts that reflect either news that arrived subsequent to the earnings announcement, or even earlier analysts' forecasts (see Guttman [2005]). If the forecast changes because of either of these, forecast volatility rises, but not because analysts interpreted identical news differently. Therefore, our post–earnings announcement forecast volatility measure only uses forecasts issued within 10 calendar days after the earnings announcement.

Our two measures of analyst dispersion of opinion are as follows. Prior to the earnings announcement, we calculate the standard deviation across analysts of their forecasts for annual earnings per share, deflated by the absolute value of the across-analysts mean forecast. We label this variable *SDF* and rank each earnings announcement's *SDF* into a decile portfolio following the approach described earlier. We require that these forecasts be no more than 30 days before the earnings announcement, and there must

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be positive. We expect the coefficient on it in the FF regressions to be positive for positive earnings surprises, because positive surprises tend to be followed by positive drift. However, the coefficient on *ES* is likely to be negative among negative earnings surprises, since these are typically followed by negative drift. Similar thinking applies to our separate examination of the average coefficient on *UV* for high and low unexpected volume events.

[15] Another source for dispersion of analysts' forecasts is First Call. We note that First Call's parent, Thomson, recently purchased I/B/E/S and has combined the products.

be at least three forecasts available to be included in the sample. Finally, we ignore forecasts just prior to the fiscal year-end earnings announcement, since we are also interested in forecast variability after the event, and forecasts of annual earnings after the year-end announcement would necessarily be of next year's earnings.

Our second proxy for analyst opinion divergence is the change in analyst forecast variability for a window around the earnings event. Specifically, we subtract *SDF*, calculated as described above, from a similarly calculated measure using (at least three) forecasts post–earnings announcement, but within 10 days. The short window following the earnings announcement is designed to increase the likelihood that forecast dispersion reflects opinion divergence, rather than newly arrived information after the earnings news. This change in opinion divergence is labeled ΔSDF, and we place each estimate into ranked decile portfolios. Data constraints limit this sample to only 5,987 observations that have both analyst opinion divergence measures.[16]

The simple correlation between volume and analyst-based proxies for opinion divergence is not terribly strong. Pre–earnings announcement forecast variability (SDF_{pf}) is unrelated to both SUV_{pf} and ΔTO_{pf}. The change in forecast variability (ΔSDF_{pf}) is not significantly related to SUV_{pf} and is positively related to ΔTO_{pf}. Given that three out of four correlations are insignificant, this suggests that when both types of proxies are available, they capture different effects. We discuss this below.

Table 7 presents results from regressions of post–earnings announcement returns on the usual controls (PE_{pf} and MV_{pf}), as well as SDF_{pf} and ΔSDF_{pf}. In the latter two specifications, we also include a volume-based proxy for opinion divergence. The results indicate that analyst-based measures of opinion divergence are negatively correlated with post–earnings announcement returns. The coefficients on SDF_{pf} and ΔSDF_{pf} are uniformly negative and significant in all specifications.

The obvious interpretation of this evidence is that returns are declining in opinion divergence. This interpretation is in direct contrast to the one in which we employed volume-based measures of opinion divergence. It is also consistent with the results in Diether, Malloy, and Scherbina [2002] and the biases discussed in Scherbina [2004]. We also see that there is a nonpositive relation between post–earnings announcement returns and our unexpected volume proxies among firms with sufficient analyst following to calculate forecast dispersion. This too is in contrast to the evidence presented in table 3. Obviously, there is something different between the samples of earnings announcements with and without analyst following.

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[16] Henceforth, we will typically refer to a firm or announcement as having analyst following if *SDF* and ΔSDF are nonmissing. Our requirement of at least three analysts' forecasts (especially within 10 days following the earnings announcement) to calculate *SDF* and ΔSDF implies that some firms with little analyst following (one or two analysts) are labeled as having none. We simply wish to imply a difference between little to no analyst coverage and greater coverage within this short time window.

TABLE 7

The Relationship among Post–Earnings Announcement Returns, Unexpected Volume, and Analyst Forecast Variability

The table presents regressions of percent drift on volume measures, analyst forecast variability measures, and controls. The sample is 5,987 earnings announcements from January 1985 through July 1998 by NYSE/AMEX firms with sufficient data to calculate portfolio rankings (indicated with *pf* subscript) of the following variables. *PE* is calculated as the two-day abnormal return at the earnings announcement, using standard market model methodology. *Drift* is the cumulated size-adjusted return over the trading days window $[t+1,\ t+60]$, where day t is the earnings announcement date. *MV* is the market value of equity from the end of the year preceding the earnings announcement. Change in market-adjusted turnover (ΔTO) is the average daily market-adjusted turnover over the earnings announcement window (TO_{ea}) minus a similarly calculated measure over the window $[t-54,\ t-5]$, where t is the earnings announcement date. The daily market-adjusted turnover (TO) is the firm volume divided by shares outstanding, minus a similarly calculated measure averaged over all NYSE/AMEX firms. Standardized unexpected volume (SUV) is the scaled (by estimation window standard deviation of prediction errors) two-day prediction error from a market model–style regression of volume on absolute valued returns. *SDF* is the pre–earnings announcement dispersion (standard deviation) of analyst forecasts and ΔSDF is the change in analyst forecast dispersion from before to after the earnings event. Forecasts are of fiscal year-end earnings. Fiscal year-end earnings announcements are not included in the analysis. *t*-statistics (in parentheses) are calculated using White's [1980] heteroskedasticity consistent standard errors. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	I	II	III
Intercept	−1.34	−1.64	−1.56
	(−0.52)	(−0.64)	(−0.60)
PE_{pf}	0.14**	0.14**	0.14**
	(2.31)	(2.29)	(2.31)
MV_{pf}	0.26***	0.25	0.25
	(2.86)	(0.88)	(0.86)
SDF_{pf}	−0.20***	−0.20***	−0.20***
	(−3.17)	(−3.19)	(−3.17)
ΔSDF_{pf}	−0.19***	−0.19***	−0.19***
	(−2.85)	(−2.89)	(−2.87)
ΔTO_{pf}		0.08	
		(1.33)	
SUV_{pf}			0.07
			(1.22)
N	5,987	5,987	5,987
Adj. R^2	0.0035	0.0036	0.0035
F-statistic	6.18***	5.37***	5.25***

What could explain the declining significance of unexpected volume for drift among analyst-followed firms? First, it does not appear to be caused by analyst-based proxies usurping the explanatory power of volume-based proxies. If we include in our sample only those observations with analyst data, then volume-based proxies are insignificant determinants of drift, regardless of whether we include or exclude the forecast dispersion measures. An alternative explanation is that there is selection bias in the use of analyst data, as small firms are less likely to be followed and drift is strongest among smaller firms. Our tests below attempt to control for this by employing the

Heckman [1979] procedure. A third possibility is that volume-based proxies work well when analyst data are unavailable (e.g., among smaller firms) and work poorly at other times. If availability of analyst data implies volume carries a different meaning, then the sensitivity of drift to unexpected volume will differ for analyst-followed firms versus other firms.

To address the latter two possible explanations described above, we regress post–earnings announcement returns on PE_{pf}, MV_{pf}, and unexpected volume, as well as interactions of these variables. The interactions are created by multiplying the usual explanatory variables by the indicator *Analyst*, which takes the value of one if the earnings announcement is associated with sufficient analyst following to calculate *SDF* and ΔSDF, and zero otherwise.[17] However, we cannot run such regressions in isolation, because of potential selection bias. To control for this, we estimate the regressions using Heckman's [1979] two-step selection corrected procedure.

The first step in the two-stage Heckman is a probit of the dummy variable for significant analyst coverage on firm size, prior year turnover (both in *pf* ranked form), and one-digit industry dummies. We adopt this simplified structure to maximize the number of observations in our probit (and hence in the second-pass regression), and because Hong, Lim, and Stein [2000] show that the key determinant of analyst following is firm size.[18] The results indicate that analyst following is more likely for larger firms with greater prior year turnover. The second-step regression includes the inverse Mills ratio from the first-step probit. *t*-statistics are calculated using White's [1980] heteroskedasticity consistent standard errors.[19] The results are presented in table 8.

First, we see that the sensitivity of ex post returns to firm size (MV_{pf}) is significantly less negative when the firm is analyst followed. Second, if we loosen the restriction on the number of days between the earnings announcement and subsequent forecasts (to 15 rather than 10), we find that ex post returns are less sensitive to announcement returns (in the second model). In other words, analysts appear to help accelerate the incorporation of news into prices, leading to less underreaction at the announcement and a less positive correlation between surprise and post–earnings announcement returns. This interpretation is in line with evidence reported by Hong, Lim, and Stein [2000]. Taken together, these results suggest that analyst coverage changes the information environment, and we must be cognizant

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[17] Our restriction of at least three forecasts within 10 days following the earnings announcement has a small effect on our results here (see below). If *Analyst* equals one, this suggests sufficient coverage generating information *near* the earnings announcement.

[18] The other critical determinant of analyst coverage identified by Hong, Lim, and Stein [2000] is trading venue (NYSE versus NASDAQ), which we do not include because our sample is taken exclusively from exchange-traded firms.

[19] White's [1980] correction is acceptable, if somewhat inefficient. We use it for consistency and because Heckman's [1979] correction can, in finite samples, occasionally generate negative variance estimates.

TABLE 8

Heckman [1979] Second-Stage Ordinary Least Squares Regression Results

The table presents results from second-stage regression of the two-stage Heckman [1979] procedure. The first-stage probit explains I/B/E/S coverage as a function of firm size, prior year turnover, and industry dummies. The dependent variable is percent drift (the cumulated size-adjusted percent return over the trading days window [t+1, t+60], where day t is the earnings announcement date). The sample is 45,187 earnings announcements from January 1985 through July 1998 by NYSE/AMEX firms with sufficient data to calculate portfolio rankings (indicated with *pf* subscript) of the following variables. *PE* is calculated as the two-day abnormal return at the earnings announcement, using standard market model methodology. *MV* is the market value of equity from the end of the year preceding the earnings announcement. Change in market-adjusted turnover (ΔTO) is the average daily market-adjusted turnover over the earnings announcement window (TO_{ea}) minus a similarly calculated measure over the window [$t-54$, $t-5$], where t is the earnings announcement date. The daily market-adjusted turnover (TO) is the firm volume divided by shares outstanding, minus a similarly calculated measure averaged over all NYSE/AMEX firms. Standardized unexpected volume (SUV) is the scaled (by estimation window standard deviation of prediction errors) two-day prediction error from a market model–style regression of volume on absolute valued returns. *Analyst* is a dummy variable equal to one if the firm is followed by at least three analysts before and after the earnings event. λ is the inverse Mills ratio from the probit. *t*-statistics (in parentheses) are calculated using White's [1980] heteroskedasticity consistent standard errors. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Intercept	1.18***	1.73***
	(3.55)	(5.13)
PE_{pf}	0.23***	0.24***
	(6.52)	(7.00)
$PE_{pf} * Analyst$	−0.08	−0.10
	(−1.16)	(−1.39)
MV_{pf}	−0.51***	−0.54***
	(−9.61)	(−10.07)
$MV_{pf} * Analyst$	1.22**	1.22**
	(2.44)	(2.42)
ΔTO_{pf}	0.26***	
	(8.24)	
$\Delta TO_{pf} * Analyst$	−0.18***	
	(−2.73)	
SUV_{pf}		0.15***
		(4.45)
$SUV_{pf} * Analyst$		−0.08
		(−1.27)
Analyst	−9.42*	−9.58*
	(−1.79)	(−1.81)
λ	−2.01***	−2.20***
	(−4.21)	(−4.61)
$\lambda * Analyst$	2.71***	2.84***
	(2.80)	(2.93)
Adjusted R^2	0.0093	0.0081
F-statistic	48.11***	41.86***

of this as it could affect the sensitivity of ex post returns to unexpected volume.

We also find that selection bias is a particular concern in this sample. The coefficients on the inverse Mills ratio and its interaction with the analyst following indicator are always significant. This makes interpretations of ordinary least squares regression results based on this sample potentially unreliable. It also raises concerns with sampling strictly on analyst-followed firms in studies of anomalies that are particular to small firms.

Finally, unexpected volume may have a differential effect on post–earnings announcement returns when the firm is analyst followed, as opposed to when it is not. Specifically, ex post returns are increasing in unexpected volume when the firm has little analyst following, while the relation between unexpected volume (ΔTO_{pf}) and ex post returns is significantly smaller if the firm has greater analyst following.[20] For the low (no)-analyst following sample, this is consistent with the joint hypothesis that unexpected volume proxies for opinion divergence and investors treat this as a risk factor. For the high-analyst following sample, our results are in line with those of Hong, Lim, and Stein [2000], who show that analyst coverage changes the information environment. In this new environment, with additional sources of information (analyst coverage), volume may carry less information for post–earnings announcement returns.

6. *Conclusions*

The phenomenon of post–earnings announcement drift has been well explored by accounting and finance academics. Attempts to explain it as compensation for risk have generally been less than completely successful. However, work by Varian [1985] advocates viewing divergence of investors' opinions as a risk factor that may be priced. We explore whether opinion divergence carries explanatory power for post–earnings announcement returns.

We proxy for opinion divergence with measures of unexpected volume. We find that post–earnings announcement returns are increasing in unexpected volume, while they are decreasing in prior year turnover (a proxy for liquidity) and unrelated to total earnings announcement trading activity. In other words, unexpected volume differs from total trading activity, both in construction and in implication for ex post returns. Our results are consistent with the joint hypothesis that unexpected volume proxies for opinion divergence and is treated as an additional risk proxy requiring compensation.

We also investigate the relation between post–earnings announcement returns and an alternative proxy for opinion divergence that is based on analysts' forecasts. Greater variability in these forecasts is associated with more negative post–earnings announcement returns, contradicting the evidence from volume-based proxies for opinion divergence. We show that the results using analyst data are subject to concerns with selection bias. We also show

[20] This result does not hold when we use SUV_{pf} as our volume-based proxy for opinion divergence.

that analysts' forecasts may affect the information environment in a way that reduces the empirical content of unexplained volume for ex post returns.

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