PRICE AND TRADING VOLUME REACTIONS AROUND EARNINGS ANNOUNCEMENTS: AN ANALYTICAL AND EMPIRICAL EXAMINATION

by

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Abstract

Since Beaver (1968) used trading volume as an information indicator in his seminal paper, several studies have used trading volume in examining the information content of an announcement. However, these studies have been criticized because trading volume can increase without any price change or vice versa. Recently Kim and Verrecchia (1991, 1994) provide a rationale for using trading volume as an information indicator. They show that trading volume is positively related to price change, and that the increase in trading volume around information announcements is induced by new information contained in the announcements. However, in the absence of a direct specification of information as accounting earnings, the Kim and Verrecchia (1994) model can not completely address the impact of earnings announcements on trading volume.

To address the effect of earnings announcement on trading volume, this paper extends the the Kim and Verrecchia (1994) model in two ways: i) it specifies the source of disagreement about earnings information; specifically, investors differ in interpreting what portion of earnings surprise is permanent or transitory; ii) it explicitly incorporates the valuation role of earnings information in that investors value a firm using an information dynamics similar to Ohlson's (1991) model. Therefore, investors arrive at different firm values, even though they use the same valuation model and earnings information. I demonstrate in this setting that a larger earnings surprise and diversity of opinions among analysts may lead to a larger trading volume. Thus this paper contributes to the existing literature in the sense that it

explores the impact of earnings announcements on trading volume by integrating an earnings valuation model and rational expectation model. This formulation allows me to examine the direct relationship between earnings surprise and both price change and trading volume.

In the empirical section of the study, the above results are empirically examined using data from the CRSP, COMPUSTAT, I/B/E/S, and ISSM tapes. The results are generally consistent with the model predictions, and are also consistent with those documented in the existing empirical literature.

First, I document that trading around earnings announcements occurs more when earnings surprise is large, and when analysts disagree more about the content of earnings information. In addition, I show that trading volume is affected by earnings surprise, even after controlling for stock price changes and firm size. This implies that trading volume reflects information contained in earnings which is not reflected in price. I also find that market liquidity around earnings announcements, proxied by the bid-ask spread, decreases when earnings surprise is large and analysts disagree about the content of earnings information.

1 Introduction

This paper proposes and tests a model of trading developed by combining Ohlson's (1991) fundamental valuation model with the model proposed by Kim and Verrecchia (1994). Kim and Verrecchia (1994) analyze a model of trade where investors of different abilities diversely interpret information announcements, which leads to more trading and less liquidity around the announcements. However, their characterization of information announcements is very general. It neither reflects the characteristics of earnings information, nor specifies the source of information asymmetry to investors.

This paper extends the Kim and Verrecchia (1994) model in two ways: i) it specifies the source of disagreement about earnings information; specifically, investors differ in interpreting what portion of earnings surprise is permanent or transitory; ii) it explicitly incorporates the valuation role of earnings information in that investors value a firm using an information dynamics similar to Ohlson's (1991) model. Therefore, investors arrive at different firm values, even though they use the same valuation model and earnings information. This, in turn, induces trading among investors.

Since Beaver (1968) used trading volume as an information indicator in his seminal paper, several studies have used trading volume in examining the information content of an announcement. However, these studies have been criticized for using trading volume because trading volume can increase without any price change or vice versa.[1] Recently Kim and Verrecchia (1991, 1994) provide a rationale for using trading volume as an information indi-

[1] See Watts and Zimmerman (1986) and Lev and Ohlson (1982).

cator. They show that trading volume is positively related to price change, and that the increase in trading volume around information announcements is induced by new information contained in the announcements. However, in the absence of a direct specification of information as accounting earnings, the Kim and Verrecchia (1994) model cannot completely address the impact of earnings announcements on trading volume. In an effort to integrate accounting earnings into a general theory of valuation, Ohlson (1991, 1994) provides a fundamental valuation model using accounting earnings, where current earnings and current dividends provide information about future earnings and future dividends. However, his model lacks implications regarding trading volume.

To analyze the effects of earnings on the trading volume behavior, I use the same market structure of Kim and Verrecchia (1994), while using earnings valuation model. I also define the diversity of opinion among investors differently from Kim and Verrecchia (1994), namely, the extent to which each individual investor believes a given earnings surprise to be permanent or temporary.[2] One feature of my model is that a market maker estimates the value of a firm and sets the market clearing price in two ways: i) using the fundamental information in a manner similar to Ohlson (1991, 1994) and ii) updating beliefs through rational expectation based on available information, namely, the total order flow from investors. I characterize a

[2]Kim and Verrecchia (1994) define diversity as one minus the correlation between each investor's error of interpreting financial accounting disclosures. They assume that earnings information is contaminated by a common noise term to all investors and an idiosyncratic noise term to individual investors. However, it is difficult to interpret how these noise terms map into fundamental valuation attributes such as accounting earnings.

no-arbitrage equilibrium whereby a market maker must arrive at an identical valuation through the two different ways.

I obtain three results from my model. The first result is that trading volume around earnings announcements is positively related to both the diversity of opinion among investors in interpreting earnings information and the absolute value of earnings surprise. Also, trading volume is negatively related to the discount rate and the information processing cost of informed traders.

Second, the stock price at the time of earnings announcements is positively (negatively) related to the magnitude of earnings surprise and negatively (positively) related to the magnitude of the temporary earnings component and the discount rate, when earnings surprise is positive (negative).[3] The model also predicts that the diversity of opinion among investors in interpreting earnings as well as the noise in liquidity trading are not related to price.

Third, the market liquidity around earnings announcements is proportional to the discount rate and information processing cost of informed traders, and inversely related to the diversity of opinion among informed traders and the absolute value of earnings surprise.

In the empirical section of the study, the above results are empirically examined using data from the CRSP, COMPUSTAT, I/B/E/S, and ISSM tapes. The results are generally consistent with the model predictions. First, I document that trading around earnings announcements occurs more when

[3]See Ball and Brown (1968), Easton and Zmijewski (1989), Collins and Kothari (1989) and Ali and Zarowin (1992), among others.

earnings surprise is large, and analysts disagree more about the content of earnings information, which is consistent with findings in other volume related studies. In addition, I show that trading volume is affected by earnings surprise, even after controlling for stock price changes and firm size. This implies that trading volume reflects information contained in earnings which is not reflected in price. I also find that market liquidity around earnings announcements, proxied by the bid-ask spread, decreases when earnings surprise is large and analysts disagree about the content of earnings information.

The remainder of the paper is organized as follows. I provide a literature review in section 2 and a detailed description of my model in section 3. Section 4 describes the valuation function and the condition for existence of the market, and characterizes the equilibrium number of informed traders at the time of earnings announcements. Section 5 discusses the role of market liquidity, and expected behavior of trading volume and price at the time of earnings announcements. The empirical methodology constitutes section 6. Empirical results and implications are discussed in section 7. Finally some concluding remarks appear in section 8.

2 Literature Review

In this section I briefly review the literature on trading volume, valuation of stocks and rational expectation which are related to this study.

2.1 Trading volume as an information indicator

In his seminal paper about the information content of earnings announcements, Beaver (1968) investigates whether changes in trading volume are associated with earnings announcements. He argues that if there are any significant price changes and/or trading volume changes around earnings announcements, then earnings announcements have information content in the sense that earnings information changes investors' assessments of the probability distribution of future returns. Using weekly trading data, he shows that the average trading volume in the announcement week is much larger than in the non-announcement period.

Focusing more on when the market reacts relative to an earnings announcements rather than to the existence of information content per se, Morse (1981) finds that significant trading occurs on the day prior to, the day of, and three days following earnings announcements. He argues that trading prior to a public announcement may occur because of diverse beliefs about the probability of different information being announced, and trading following a public announcement may be due to diverse interpretations of announced information and/or investors returning to diversified positions after taking speculative positions prior to the public announcement.

Bamber (1986,1987) extends Morse (1981) by examining the association between unexpected earnings, firm size, and trading volume around earnings announcements. Similar to Beaver, Clarke, and Wright's (1979) security price results, she finds that trading volume is positively related to the magnitude of unexpected earnings. In sum, research in trading volume concludes that trading volume reflects information contained in earnings announcements which is similar to that of price-based studies. But volume studies have been criticized because of a lack of theory explaining trading volume. For example, Watts and Zimmerman (1986 p. 64) write:

> ...Conceptually, information could be conveyed to the market and prices could change by large amounts without a single transaction (trade). For example, after the close of trading on a given day, a firm could announce a major, unanticipated loss. When trading on the stock opens again, the bid and ask prices will be substantially below the last transaction price. On the other hand, there could be substantial trading (e.g. due solely to portfolio rearrangement) without any information release.

However, using dispersion in analysts' forecasts, many studies examine and confirm Beaver's (1968) intuition that abnormal trading volume reflects the degree to which individual investors in the market revise their expectations as a result of the announcement, whereas abnormal returns reflect the aggregate revision in expectations.

These studies find that dispersion in analysts' forecasts is positively related to trading volume. Comiskey et al. (1987) is the first study to show the relation between trading volume and dispersion in analysts' forecasts. They argue that the amount of information conveyed to by a news announcement is proportional to the reduction in uncertainty. The aggregate level of uncertainty reduction (information) is greater for the high dispersion firms, and there will be greater amounts of trading volume for these firms. As a proxy for the extent of investor disagreement (dispersion of expectation), they use the coefficient of variation of analysts' forecasts and find a positive relation between annual trading volume and the coefficient of variation of analysts' forecasts, after controlling for price change, market and industry volume effects, and transaction costs.

Ziebart (1990) and Ajinkya et al. (1991) add evidence that trading volume is positively associated with the dispersion of analysts' forecasts, implying that difference in beliefs or different interpretation of earnings causes trading among investors. These studies include earnings surprise (Ziebart (1990)) or the absolute value of change in the mean of analysts' forecasts (Ajinkya et al. (1991)) to control for information revealed by earnings or analysts' forecasts. They implicitly assume that trading volume is indicative of information contained in earnings or changes in analysts' forecasts but they do not provide any explicit explanation. They provide evidence that earnings announcements provide source of disagreement on the distribution of earnings which may lead to more trading volume.

However, there have been few papers that provide theoretical support for the relation between earnings and trading volume, prior to Holthausen and Verrecchia (1990), hereafter HV. HV characterize the effects of information release on investors' behavior into an informedness and a consensus effect. The informedness effect measures the degree to which agents become more knowledgeable, and the consensus effect measures the extent of agreement among agents at the time of an information release. In HV model, price changes and trading volume are influenced by both informedness and consensus, which generally occur jointly when information is disseminated.

Therefore, trading volume and price can be equally used as information indicators around earnings announcements.

Kim and Verrecchia (1994), hereafter KV, also provide a model where expected trading volume and the variance of price change move in the same direction around public disclosures. KV focus on disclosures with the following characteristics: (1) there may be no alternative source of private information, and (2) information from disclosures may lead to different interpretation of a firm's performance.[4] In KV model, some investors who are willing to bear the interpretation cost process public disclosures into private information about a firm's performance at some cost. Thus the more investors disagree on the information contained in the public disclosures, the greater is the expected trading volume at the time of public disclosures.

While HV and KV provide some rationale for trading volume as an information variable, however, their characterization of information is too broad to completely address the impact of earnings announcements on trading volume. While useful, the definition of information precision in HV and KV cannot be directly considered as earnings surprise, which have been documented to be positively associated with price change and trading volume. The positive relation between earnings surprise and trading volume is indirectly shown by revealing that trading volume and price change are positively associated around earnings announcements. Therefore, this current study analytically complements the literature by modeling the behavior of

[4]Because their characterization is sufficiently broad to include earnings announcements, management and analysts' forecasts, 10-K filings, and other summaries of detailed financial statistics, they assume these disclosures to be earnings announcements throughout the paper, without further specification.

trading volume when the information asymmetry is defined over earnings attributes and empirically examine trading volume reactions around earnings announcements along with price reactions.

2.2 Accounting earnings and the valuation of a security

Since Ball and Brown (1968) document an association between unexpected price changes and unexpected earnings, many papers have studied the link between stock prices and accounting earnings. These studies have been motivated by the view that accounting data, especially earnings, are relevant to security valuation and have been successful in finding the relation between earnings and prices (Beaver, Clarke, and Wright (1979), Kormendi and Lipe (1987) and Easton and Zmijewski (1989), among others). However, as Ohlson (1990) points out, much of its success would be confined because the hypothesis investigated in these studies usually are not related to any theoretical constructs. Therefore, several studies begin to consider formal security valuation models prior to formulating empirical hypothesis.

Beaver, Lambert and Morse (1980), hereafter BLM, is one of the first attempts to derive a theoretical relationship between prices and earnings. They assume that prices and earnings can be viewed as joint realizations from a state generating process. That is, if the two mappings reflect similar attributes of a state, a contemporaneous relationship between earnings changes and price changes should be observed. Price changes will depend upon changes in expectations regarding future earnings. Therefore, their derivation of the relation between prices and earnings takes two steps: first, a link between changes in earnings (ΔX_t) and changes in the expected value of future earnings ($\Delta E(X_{t+k})$), and second, the link between expected future earnings and security prices. As an earnings process, they use a first-order moving average process in the first difference (IMA(1,1)) of the following form:[5]

$$\tilde{x}_{t+1} = x_t - \theta a_t + \tilde{a}_{t+1}$$
$$\tilde{X}_t = \tilde{x}_t + \tilde{\epsilon}_{1t}$$

where $\tilde{x}_t$ is ungarbled earnings, X_t is accounting earnings, and $E[\tilde{a}_t] = cov(\tilde{a}_t, \tilde{a}_s) = cov(\tilde{a}_s, \tilde{\epsilon}_{1t}) = 0$ for all t and s ($t \neq s$). They assume that x_t's, but not X_t's, reflect events that affect prices. Thus, the price-relevant information set at time t is given by $z_t \equiv (x_t, x_{t-1}, \cdots)$. They postulate the following earnings valuation model.

$$P_t = \rho E[x_{t+k} \mid z_t]$$

for $\forall \;\; k > 0$, where ρ is a constant.

Using only no-arbitrage assumption, Ohlson (1989) shows that the BLM model implicitly restricts conceivable relations between the earnings and dividends at all dates, i.e., their model is a special case of the dividend discount model which has a specific payout ratio in the future. BLM's limitation derives from the fact that they do not distinguish between ungarbled earnings and dividends.

[5]They provide several reasons for using this stochastic process (p.6). First, a random walk and a mean reverting process which have been studied are members of this family, if $\theta = 0$ and $\theta = 1$, respectively. Second, this class has been studied extensively by previous research. Third, the change in expectations of future earnings ($\Delta E(X_{t+k})$) is independent of k as of a given time t.

Ohlson (1990, 1991) provides a concrete theoretical foundation to the relation between earnings and the value of a firm by distinguishing earnings from dividends, but not requiring specific dividend policy. First, he uses a no-arbitrage condition and Hicksian definition of earnings to derive a valuation function which is a function of current earnings and dividend, thus characterizing of earnings as any sequence of dividends, given initialization condition $x_0 = 0$. Then, in a reverse manner, using earnings dynamics derived in the first step, he derives the valuation function under a no-arbitrage condition and dividend dynamics which only requires that dividends not be paid without reference to earnings.

Specifically, his earnings dynamics and dividend dynamics are as follows:

$$\begin{aligned} \tilde{x}_{t+1} &= x_t + r \cdot (x_t - d_t) + \tilde{\epsilon}_{t+1} \\ \tilde{d}_{t+1} &= \gamma_1 x_t + \gamma_2 d_t + \tilde{u}_{t+1} \end{aligned}$$

where $E[\tilde{\epsilon}_{t+\tau} \mid x_t, d_t], E[\tilde{u}_{t+\tau} \mid x_t, d_t] = 0$ for all $\tau > 0$ and $\gamma_1 \neq 0$. This earnings characterization is of interest because it excludes mechanical growth due to dividend retention or higher expected returns (see Collins and Kothari (1989)). The dividend dynamics require that dividends cannot be paid without reference to earnings, but not that dividends are paid on specific payout ratios. With no-arbitrage condition, Ohlson (1991) shows that these linear earnings and dividends dynamics lead to the following valuation function:

$$\begin{aligned} v_t &= \frac{1+r}{r} x_t - d_t & (1) \\ &= \frac{1}{r} E[\tilde{x}_{t+1} \mid x_t, d_t] & (2) \end{aligned}$$

That is, the derived valuation function is a function of expected earnings which does not restrict dividend policy.

However, an implicit assumption in his analysis is that the investment opportunity set is fixed, known to the market, and generates returns of r. That is, the firm's existing investment will generate the same amount of earnings as the prior period and additional investment through residual income will generate returns of r. Alternatively, current earnings contain no information, and there will be no price movement except random change. However, many empirical studies document that current earnings do contain new information and induce price movement more than random change. This suggests that ex post unexpected earnings based on information available before earnings announcements are not zero. That is, some portion of unexpected earnings is due to change in a firm's investment opportunity set, which is predictable if investors have the information, and the other portion is due to random change. This paper incorporates this aspects in the earnings dynamics.

Ohlson (1994) generalizes his earnings valuation model by showing how earnings, book value, and dividends are related to firm value through clean surplus relation. Because clean surplus relation replace dividends with earnings and book value in the present valuation function from no-arbitrage condition, he shows that the firm value can be expressed as future expected abnormal earnings and current book value instead the sequence of dividends. He defines abnormal earnings as earnings minus the risk-free rate times the beginning of period book value. Then by assuming that abnormal earnings satisfy an autoregressive process, he shows that firm value equals to a weighted average of (i) current earnings capitalized minus current dividend and (ii) current book value.

However, his model does not provide any implication about the relation between earnings and trading volume which have been documented in many studies, because it assumes that everyone in the market interprets earnings information in the same way. This paper analyzes when market participants interpret information differently, while they use the Ohlson valuation model to estimate firm value.

2.3 Rational Expectation Model used in this study

Many studies in the economics and finance literature develop models that show how private information is reflected in market prices in pure exchange markets (Grossman and Stiglitz (1980)) and in markets with dealer (Kyle (1985), Admati and Pfleiderer (1988), and Kim and Verrecchia (1994), among others).

As the stock market has the aspect of a dealer market, I follow the approach in Kyle (1985) and Kim and Verrecchia (1994). Kyle provides the dealer market model used in this study. His market has three types of traders: an informed trader, noise liquidity traders, and market makers. There is one risky asset and riskless bonds. The informed trader is assumed to have private information about the liquidation value of the risky asset, and he trades based on his information. His information set consists of his private information about the risky asset, past prices and past quantities traded by himself. But he doesn't know current or future prices and current or future quantities traded by the liquidity traders who trade randomly. Market makers set the price which clears market, based on their information, which consists of current and past total quantities traded by the informed and liquidity traders combined together. But the market maker cannot distinguish between the individual quantities traded by the informed trader from those by the the liquidity traders.

Under this setting, Kyle shows that market liquidity is proportional to the amount of liquidity trading and inversely related to the amount of private information. Because he analyzes the economy where there exists an informed trader who is endowed with superior knowledge of the underlying performance of a firm, public disclosure will reduce information asymmetry and increase market liquidity, which has been the focus of most market liquidity literature.

However, as Kim and Verrecchia (1994) characterize, when a firm announces information which has no alternative source of private information in an economy in which (i) there exist no information asymmetry and (2) investors have different abilities to interpret information, information announcement provides opportunities for investors with superior abilities to exploit their skills and thereby increases information asymmetry around information announcements. This characterization enable us to analyze the trading aspect of the market along with the liquidity and price effects of information. Thus I follow Kim and Verrecchia (1994) approach to analyze the trading behavior around earnings announcements.

3 Model

To construct a model where trading occurs, I use a variation of the models of Kyle (1985), and Kim and Verrecchia (1994) with T periods, t=1,2,3,...,T. There are three types of risk-neutral agents: a market maker, potential information processors, and liquidity traders. There is one risky asset (the firm), and riskless bonds. One bond pays off one unit of consumption in period T.

I assume that the liquidating value of the firm is not known until the firm liquidates. Instead, investors have to estimate their own equity value of the firm by projecting future payoff attributes and transforming those attributes into a present value. Following Ohlson (1991, 1994), I assume that current earnings and dividends are sufficient to estimate future expected dividends, in this paper. Periodically, the firm publicly announces earnings, x_t, that contain information about the firm's future earnings for period t. When earnings come out, the value of the stock may change depending on the information contained in earnings.[6]

In the finance literature, the value of equity is viewed as the present value of expected future dividends (Rubinstein (1976)). Formally:

$$v_t = \sum_{\tau=1}^{\infty}(1+r)^{-\tau}E[\tilde{d}_{t+\tau}] \tag{3}$$

where v_t is the value of equity at time t, $d_{t+\tau}$ is dividend paid at $t+\tau$, r is the discount rate (assumed to be constant over time), and E is an expected

[6] Accounting earnings should provide the relevant information in assessing the amount, timing and uncertainty of future returns of the firm (SFAC No. 1 par 37). Many empirical studies provide evidence that accounting earnings are related to price change (Beaver (1968) and Beaver, Clarke, and Wright (1979)) and explains more than half of price changes over extended accounting periods (Easton, Harris and Ohlson (1992)). Therefore, it is reasonable to use accounting earnings for measuring the firm value .

value conditional on information available at time t. As in Ohlson (1991), I introduce a linear earnings and dividend dynamics assumptions to derive a fundamental valuation model which is a function of earnings. But unlike Ohlson, I allow earnings announcements to contain new information, some of which is persistent and the other is temporary.

Suppose unexpected earnings consist of permanent and temporary earnings. That is, some portion of the shock persists for a long time and the other portion disappears in the next period. Assuming that both surprises are normally distributed with mean zero and denoting the portion of temporary surprise as θ, earnings in period $t+1$ evolve as follows:[7]

$$x_{t+1} = (1+r)x_t - r \cdot d_t + a_{t+1} - \theta a_t \tag{4}$$

$$\epsilon_{t+1} = a_{t+1} - \theta a_t \tag{5}$$

It assumes that earnings grow at the rate of r from re investing current earnings minus current dividends, which can be interpreted as the risk-free rate or a book rate of return. Firm value at t can be written as (see appendix):[8]

$$\begin{aligned} v_t &= \frac{1+r}{r}x_t - d_t - \frac{\theta}{r}a_t \\ &= \frac{1}{r}E[x_{t+1} \mid x_t, d_t] \end{aligned} \tag{6}$$

When firms announce earnings information, investors interpret earnings information differently (i.e., $\tilde{\theta}$ is different among investors) and the ith

[7]This form of earnings process has been used in many other papers, except earnings growth due to re investing residual income (Beaver, Lambert, and Morse (1980), Ramakrishnan and Thomas (1991), among others). Ohlson's (1991) earnings dynamics is a special case of this earnings process when $a_t = 0$.

[8]This equation can be written using book value and abnormal earnings in Ohlson (1994). See appendix for detail.

investor observes the value of the firm ($\tilde{v}_{it}$) as follows:

$$\begin{aligned}\tilde{v}_{it} &= \frac{1+r}{r}x_t - d_t - \frac{\tilde{\theta}_{it}}{r}a_t \\ &= \frac{1}{r}E[\tilde{x}_{it+1} \mid x_t, d_t] \end{aligned} \tag{7}$$

where $E\ [\ \tilde{x}_{it+1} \mid \cdot\ ]$ is the ith investor's next period expected earnings and $\tilde{\theta}_{it}$ is derived from i.i.d. normal (θ, σ_θ^2). Let's call investors who process earnings information into private information informed traders.

While informed traders trade in order to take advantage of their private information ($\tilde{\theta}_{it}$), liquidity traders trade for liquidity reasons. I assume that l liquidity traders trade at all dates. It is assumed that each liquidity trader's net demand when he trades is a normally distributed random variable with mean zero. All random variables in this model are assumed to be mutually independent unless specified otherwise.

The market operates as follows. At dates s=1,2,...,t-1,t,...,T, information processors and liquidity traders submit their market orders for risky assets to the market maker. Denote the ith information processor's net demand by $\tilde{q}_{is}$, and the aggregate processors and liquidity demand by $\tilde{q}_s \equiv \sum_{i=1}^{N_s} \tilde{q}_{is}$, and $\tilde{l}_s$, respectively. The market maker cannot distinguish among orders from different types of agents, but makes use of the total demand order:

$$\tilde{\omega}_s = \tilde{q}_s + \tilde{l}_s \tag{8}$$

to infer the existing private information to a certain degree. He then sets the price so that his expected profit is 0 at each date.[9]

[9]Zero-profit assumption is usually used to examine the informational effect of trading.

4 Market Equilibrium

In this section I seek an equilibrium in which the market participants make conjectures about the actions of others and the conjectures turn out to be correct. I start the analysis with an exogenously given number of informed traders, N, and a given variance of liquidity trading , σ_l^2.

Denote the informed traders' trading strategy as $\hat{q}_t = Q(\tilde{v}_t)$. The market clearing price $\tilde{p}_t$ determined by the market maker can be written as $\tilde{p}_t = P(\tilde{\omega}_t)$. The profits of the ith informed trader, denoted as $\tilde{\phi}_{it}$, are given by $\tilde{\phi}_{it} = (\tilde{v}_{it} - \tilde{p}_t)\tilde{q}_{it}$. An equilibrium is defined as follows:

1. Profit maximization condition: Informed traders maximize their expected profits by choosing trading quantity over a risky asset. That is, $\tilde{q}_{it}$ is the trading strategy such that $\tilde{q}_{it}$ maximizes the profit of informed investor i. $E[\tilde{\phi}_{it}(\tilde{p}_t, \tilde{q}_{it} \mid \tilde{\theta}_{it}] \geq E[\tilde{\phi}_{it}(\tilde{p}_t, \tilde{q}'_{it} \mid \tilde{\theta}_{it}]$.

2. Market clearing condition: The market maker sets the price equal to his expectation of the firm value conditional on total order flow which clears the market. That is, the price $\tilde{p}_t$ satisfies $\tilde{p}_t(\tilde{\omega}_t) = E[\tilde{v}_{it} \mid \tilde{\omega}_t]$.

3. No arbitrage condition: There exists no arbitrage opportunities for the market maker and informed traders. That is, $\tilde{p}(\tilde{\omega}_t) = \tilde{p}_t(x_t, d_t, \theta_{mt})$ and $E[\tilde{\phi}_{it}] - C = 0$.

Assuming that market makers have some profit does not change the results in the paper qualitatively. Also, this assumption reflects the fact that market making is competitive and closely regulated. Glosten and Milgrom (1985), Kyle (1985), and Kim and Verrecchia (1994) also use the same assumption. Glosten and Milgrom (1985) analyze the setting where informed traders enter the market on by one. This setting is inappropriate for analyzing the effect of public disclosures on the market.

4. Market participants estimate firm value using earnings and dividends which follows the following linear dynamics: $x_{t+1} = (1+r)x_t - r \cdot d_t + a_{t+1} - \theta a_t$ and $\tilde{d}_{t+1} = \gamma_1 x_t + \gamma_2 d_t + \tilde{u}_{t+1}$.

5. Investors' persistence factor of earnings surprise is given by $1-\theta$ where $\tilde{\theta}_{it} \sim N(\theta, \sigma_\theta)$, $\theta \in (0,1)$.

I begin with the analysis at the time of an earnings announcement. At date t, informed traders choose their net demand orders, $\tilde{q}_{it}$'s, for risky assets and the market maker offers a price, $\tilde{p}_t$, based on their respective information. Let the linear conjecture about their action-information relations be written as:

$$\begin{aligned}
\tilde{p}_t &= \mu + \lambda \tilde{\omega}_t \\
&= \frac{1+r}{r} x_t - d_t - \frac{\tilde{\theta}_{mt}}{r} a_t \\
\tilde{q}_{it} &= \alpha + \beta \tilde{v}_{it}
\end{aligned} \tag{9}$$

Given eq. (9), the ith informed trader's problem is to:

$$\begin{aligned}
\max_{\tilde{q}_{it}} \tilde{\phi}_{it} &\equiv E[\tilde{q}_{it}(\tilde{v}_{it} - \tilde{p}_t) \mid \tilde{v}_t = \tilde{v}_{it}] \\
&= E[\tilde{q}_{it}(\tilde{v}_{it} - \mu - \lambda \tilde{\omega}_t) \mid \tilde{v}_{it}] \\
&= E[\tilde{q}_{it}(\tilde{v}_{it} - \mu - \lambda \tilde{q}_{it} - \lambda(N-1)\alpha - \lambda\beta \sum_{j \neq i}^{N} \tilde{v}_{jt}) \mid \tilde{v}_{it}] \\
&= \tilde{q}_{it}(\tilde{v}_{it} - \mu - \lambda \tilde{q}_{it} - \lambda(N-1)\alpha - \lambda\beta(N-1)\bar{v}_t)
\end{aligned} \tag{10}$$

where $\bar{v}_t = \frac{1+r}{r} x_t - d_t - \frac{\theta}{r} a_t$. From the first order condition, the optimal net demand for risky assets is obtained as:

$$\tilde{q}_{it} = \frac{1}{2\lambda}[\tilde{v}_{it} - \mu - \lambda(N-1)\alpha - \lambda\beta(N-1)\bar{v}_t]$$

Then from eq. (9), we get:

$$\beta = \frac{1}{2\lambda} \tag{11}$$

and:

$$\alpha = \frac{1}{2\lambda}[-\mu - \lambda(N-1)\alpha - \lambda\beta(N-1)\bar{v}_t]$$

α is solved as:

$$\alpha = \frac{1}{\lambda(N+1)}[-\mu - \frac{(N-1)}{2}\bar{v}_t] \tag{12}$$

Eqs. (9), (11), and (12) determine informed trader i's equilibrium demand order as a function of the value of the firm which are estimated from earnings number, given any μ and λ.

The market maker sets the price equal to his expectation of the firm value conditional on his information. That is:

$$\tilde{p}_t = \mu + \lambda\tilde{\omega}_t = E[\tilde{v}_{mt} \mid \tilde{\omega}_t] \tag{13}$$

In the appendix, the expected value of the firm conditional on total order flow is calculated and, by using the equivalence of eq. (13), μ and λ are solved as:

$$\mu = \bar{v}_t \tag{14}$$

$$\lambda = \frac{\sqrt{N}\,|a_t|\,\sigma_\theta}{2r\sigma_l} \tag{15}$$

By putting eqs. (14) and (15) into eqs. (11) and (12), we get:

$$\alpha = -\frac{r\sigma_l}{\sqrt{N}\,|a_t|\,\sigma_\theta}\bar{v}_t \tag{16}$$

$$\beta = \frac{r\sigma_l}{\sqrt{N}\,|a_t|\,\sigma_\theta} \tag{17}$$

Eqs. (14), (15), (16), and (17) provide a complete characterization of the unique market equilibrium at the time of an earnings announcement for any given number of informed traders and liquidity traders.

The market makers also use the same earnings valuation model as informed traders use and observe the firm value based on his information, total order flow. Therefore, in order to prevent arbitrage for the market maker, I require that a θ_{mt} exists such that:

$$\theta_{mt} \equiv \theta - \frac{r}{a_t}\lambda\tilde{l}_t \tag{18}$$

Also, this θ_{mt} should be between zero and one. This requires that the number of informed traders, N, should not be greater than $\frac{4\sigma_l^2\ \theta^2}{\sigma_\theta^2 l_t^2}$ or $\frac{4\sigma_l^2\ (1-\theta)^2}{\sigma_\theta^2 l_t^2}$ depending on the sign of $\frac{r}{a_t}\lambda\tilde{l}_t$. All calculations are provided in the appendix. When the number of informed traders is greater than this number, the market breaks down. In this model, the number of informed traders (N) is inversely related to the market liquidity ($\frac{1}{\lambda}$), which will be shown later.[10] Therefore, when the number of informed traders is very large, the market becomes very illiquid, and it crashes. This is consistent with another analytical paper and empirical evidence in the market crash.[11]

The number of informed traders at the time of an earnings announcement, N in eq. (15), is endogenous and can be solved for from the equilibrium

[10]The inverse relation between the number of informed traders and the market liquidity is also implied in Kim and Verrecchia (1994), even though they do not show this in detail. In their model, the market becomes very illiquid when the number of informed traders is sufficiently large. However, their model does not have any restrictions on the number of informed traders.

[11]This argument is consistent with Gennotte and Leland (1990) who show that diminished liquidity can cause a market to crash. Further, Amihud, Mendelson and Wood (1990) provide evidence that the stock market crash of October 1987 is linked to increased illiquidity.

condition:

$$E[\phi_{it}] - C = \frac{|a_t|\ \sigma_\theta\ \sigma_l}{2\sqrt{N}\ r} - C = 0 \tag{19}$$

This condition of zero overall profit for each informed trader must be satisfied in equilibrium. Assuming that N can take on any nonnegative value, the number of informed traders is solved as:

$$N = (\frac{|a_t|\sigma_\theta\ \sigma_l}{2Cr})^2 \tag{20}$$

That is, the above equation gives us unique N for any nonnegative σ_θ, σ_l, C, and r and any a_t.

5 Characteristics of Market Equilibrium

In this section I examine what properties equilibrium in the previous section has by examining how trading volume, price, and liquidity change around earnings announcements as various exogenous parameters change.

5.1 Trading Volume around earnings announcements

Volume at a non earnings announcement date t', denoted by $Q_{t'}$, is simply:

$$Q_{t'} = \frac{1}{2}\ [\sum_{j=1}^{l}\ |\tilde{l}_{jt'}|\ ]$$

The expected volume at a nonearnings announcement date t'. denoted by $E[Q_{t'}]$, is:

$$E[Q_{t'}] = \frac{1}{2}\sqrt{\frac{2}{\pi}}\ [\ l\sqrt{var(\tilde{l}_{jt'})}\ ] = \frac{l\sigma_{l_j}}{\sqrt{2\pi}}$$

Volume at the time of an earnings announcement, denoted by Q_t, is given by:

$$Q_t = \frac{1}{2} \left[\sum_{i=1}^{N} |\tilde{q}_{it}| + \sum_{j=1}^{l} |\tilde{l}_{jt}| \right]$$

The expected volume at the time of an earnings announcement (calculations are provided in the appendix), denoted by, $E[Q_t]$, is:

$$\begin{aligned} E[Q_t] &= \frac{1}{2}\sqrt{\frac{2}{\pi}} \; [\; N\sqrt{var(\tilde{q}_{it})} + l\sqrt{var(\tilde{l}_{jt})} \;] \\ &= \frac{1}{\sqrt{2\pi}}[\sqrt{N}\; \sigma_l + l\; \sigma_{l_j} \;] \\ &= \frac{1}{\sqrt{2\pi}}(\frac{|a_t|\sigma_\theta\sigma_l}{2Cr} + l\sigma_{l_j}) \end{aligned} \tag{21}$$

The following proposition is obtained from eq. (21). All proofs are provided in the appendix.

Proposition 1 *The expected trading volume at the time of an earnings announcement is increasing in the diversity of opinion among investors, and the absolute magnitude of earnings surprise, and decreasing in the discount rate and information processing cost. That is,* $\frac{d\;E[Q_t]}{d\;\sigma_\theta} > 0$, $\frac{d\;E[Q_t]}{d\;|a_t|} > 0$, $\frac{d\;E[Q_t]}{d\;r} < 0$, and $\frac{d\;E[Q_t]}{d\;C} < 0$.

The positive relation between expected trading volume and the diversity of opinions among investors about earnings announcements is consistent with Beaver's (1968) contention that volume reflects a lack of consensus about the value of a firm induced by earnings reports. Also, expected trading volume increases as the absolute magnitude of earnings surprise increases. This is consistent with the empirical evidence of Bamber (1986, 1987), who finds unexpected trading volume to be positively associated with the absolute value of unexpected earnings. This result directly supports the use of trading volume in information content studies in accounting. An increase in the discount rate reduces expected trading volume because the higher discount rate decreases expected profit for informed traders, thereby affecting the number of informed traders and trading volume. Finally increased information processing cost for informed traders decreases expected trading volume. This is quite intuitive because the larger the information processing cost, the smaller is the expected profit for informed traders, thereby reducing informed trading.[12]

5.2 Price reaction around earnings announcements

Price at the time of earnings announcements is given by $\tilde{p}_t = \frac{1+r}{r}x_t - d_t - \frac{a_t}{r}\theta_{mt}$. Because $E[\theta_{mt}] = \theta$, the expected price is given by $E[p_t] = \frac{1+r}{r}x_t - d_t - \frac{a_t}{r}\theta$. This implies the following proposition.

Proposition 2 *The expected price at the time of earnings announcements is increasing (decreasing) in the magnitude of earnings surprise and decreasing (increasing) in the magnitude of temporary earnings surprise and the discount rate when earnings surprise is positive (negative). That is,* $\frac{d\ E[p_t]}{d\ |a_t|} > (<)0$, $\frac{d\ E[p_t]}{d\ \theta} < (>)0$, and $\frac{d\ E[p_t]}{d\ r} < (>)0$, *when* $a_t > (<)0$. *Moreover, the diversity of opinion among investors in interpreting earnings and the noise in liquidity trading do not affect expected price. That is,* $\frac{d\ E[p_t]}{d\ \sigma_\theta} = \frac{d\ E[p_t]}{d\ \sigma_l} = 0$.

[12]Epps (1976) shows that trading cost is inversely related to trading volume. Kim and Verrecchia (1994) also show that information processing cost is inversely related to expected trading volume.

These relations can be easily derived from the above expected price equation. The negative relationship between expected price and the magnitude of temporary earnings surprise and the discount rate for a given earnings surprise is consistent with the earnings response coefficient literature.[13] This is intuitive, because for a given amount of earnings surprise, the larger the temporary earnings surprise, the smaller is the permanent earnings surprise and the lower expected future dividends. Therefore, there will be less price reaction. If the discount rate is high, the present value of its expected future dividends for a given earnings surprise is smaller. The positive (negative) relation between earnings surprise and price when earnings surprise is positive (negative) is intuitive and consistent with many empirical studies. Consistent with Kyle (1985), the level of liquidity traders does not affect price. That is, price change depends only on the information investors have, not on the level of liquidity traders. Finally the diversity of opinion among investors in interpreting earnings information does not affect price. This is consistent with Beaver's (1968) intuition that price reflects changes in the expectations of the market as a whole while volume reflects changes in the expectations of individual investors.

Propositions 1 and 2 imply that changes in the exogenous variables $|a_t|$ and r, move expected trading volume and price in the same direction at the time of earnings announcements. This suggests that trading volume and price change are positively associated at the time of earnings announcements. This

[13]Easton and Zmijewski (1989) and Collins and Kothari (1989) document that the systematic risk of a firm is inversely related to earnings response coefficient. Also, Easton and Zmijewski (1989) and Ali and Zarowin (1992) show that the larger portion of earnings surprise persist, the larger is the earnings response coefficient.

is consistent with results of many empirical studies, and with the theoretical papers by Kim and Verrecchia (1991, 1994).[14]

5.3 Liquidity

I use $\frac{1}{\lambda}$ as my measure of liquidity, as in Kyle (1985). The inverse of λ measures the depth of the market, the order flow necessary to induce prices to rise or fall by one dollar. A large λ implies that a trader would buy or sell small amounts of stock for a price very different from the current market price. By the same token, a small λ implies a liquid market.

The following proposition states how market liquidity changes as exogenous variables change. All proofs are provided in the appendix.

Proposition 3 *Market liquidity at the time of earnings announcements is increasing in the information processing cost of informed traders and the discount rate, and decreasing in the diversity of opinion among informed investors and the absolute magnitude of earnings surprise. That is,* $\frac{d\,\frac{1}{\lambda}}{d\,C} > 0$, $\frac{d\,\frac{1}{\lambda}}{d\,r} > 0$, $\frac{d\,\frac{1}{\lambda}}{d\,\sigma_\theta} < 0$, and $\frac{d\,\frac{1}{\lambda}}{d\,|a_t|} < 0$.

Market liquidity increases as there is more information processing cost for informed traders. As the discount rate increases, market liquidity increases. This is intuitive because, ceteris paribus, more information processing cost for informed traders and the higher discount rate will give less profit for informed traders who will trade less, thereby increasing market liquidity. The diversity of opinion among investors about earnings information induces more in-

[14]Karpoff (1987) summarizes studies regarding the relation between trading volume and price change.

formed traders to process earnings, which in turn decreases liquidity.[15] Also, the large magnitude of earnings surprise attracts more investors to process earnings and decreases liquidity. This is consistent with Patel (1991) who documents that the bid-ask spread increases after earnings announcements. At a nonearnings announcement date, $\lambda = 0$, and the market is " infinitely deep " in the Kim and Verrecchia (1994) sense.

Corollary 1 *The market is less liquid at the time of earnings announcements when there are more informed traders.*

This follows from eq. (15) ($\frac{\partial \frac{1}{\lambda}}{\partial N} = -\frac{r\sigma_l}{N^{\frac{3}{2}}|a_t|\ \sigma_\theta} < 0$) because the relation between the number of informed traders and various exogenous variables is opposite to the relation between market liquidity and those variables. That is, the number of informed traders is inversely related to information processing cost and the discount rate, and is positively related to the diversity of opinion among informed traders and the magnitude of earnings surprise. Also, this inverse relation between the number of informed traders and market liquidity is consistent with Kim and Verrecchia (1994).

Corollary 2 *Market liquidity is proportional to a ratio of the level of liquidity trading and the amount of private information the informed traders is expected to have if and only if $N = 1$.*

Proof. When $N = 1$ the market liquidity measure is given by:

$$\frac{1}{\lambda} = \frac{2r\sigma_l}{|a_t|\ \sigma_\theta}$$

[15]Kim and Verrecchia (1994) also show that the diversity among informed traders is inversely related to market liquidity, even though they define the diversity among informed traders differently from this paper.

Therefore, the market liquidity is proportional to $\frac{\sigma_l}{\sigma_\theta}$.

This is consistent with Kyle (1985) whose structure of the market consists of one informed trader. But when $N > 1$, an increase in the level of liquidity trading brings forth more informed traders, and more informed traders offset market liquidity increase due to an increase in the level of liquidity trading. Therefore, the level of liquidity trading does not affect market liquidity around the earnings announcements.

6 Empirical Test Design

In this section, test design for the propositions 1 and 3 suggested in the previous section are discussed. The second proposition gives the same prediction as results in many empirical papers: a positive relation between expected price and earnings surprise (Ball and Brown (1968) and Easton and Zmijewski (1989)) and a negative relation between expected price and both the discount rate (Collins and Kothari (1989)) and the temporary component of earnings surprise (Ali and Zarowin (1992)). No specific test is performed.

6.1 Tests of Proposition 1

To test the first proposition which predicts the relation between trading volume and various exogenous variables around earnings announcements, I calculate increased trading volume induced by earnings announcements. The expected trading volume at a non-earnings announcement date is:

$$E[\ Q_{t'}\ ] = \frac{1}{\sqrt{2\pi}} l_t \sigma_{l_j},$$

and the expected trading volume at the time of earnings announcements is:

$$E[Q_t] = \frac{1}{\sqrt{2\pi}}(\frac{|a_t|\sigma_\theta\sigma_l}{2Cr} + l_t\sigma_{l_j}).$$

Therefore, the expected trading volume at the time of earnings announcements caused by earnings information is:

$$E[\ Q_t\ ] - E[\ Q_{t'}\ ] = \frac{1}{\sqrt{2\pi}} \cdot \frac{|a_t|\sigma_\theta\sigma_l}{2Cr}.$$

Take logarithms of both sides of this equation to get:

$$\begin{aligned} log\ (E[\ Q_t\ ] - E[\ Q_{t'}\ ]) &= log\ (\frac{1}{\sqrt{2\pi}}) + log\ (\sigma_l) - log\ 2 + log\ (|a_t|) \\ &\quad + log\ (\sigma_\theta) - log\ C - log\ r. \end{aligned}$$

I use the above equation as a basis for testing the first proposition. Two volume measures are chosen for the analysis: (1) the percentage of shares traded, and (2) the market adjusted percentage of shares traded. As in Bamber (1986), Ajinkya et al. (1991) and Atiase and Bamber (1994), I use the percentage of firm i's shares traded on day t (TV_{it}), cumulated over two-day, t=[-1,0], and seven-day periods, t=[-1,5], where day 0 is the COMPUSTAT earnings announcement date. Morse (1981) and Bamber (1986, 1987) suggest that although the most trading volume reaction occurs on days -1 and 0, abnormally high trading volume persists up to five days after the announcements. I denote these two trading volume metrics for firm i as $UNADJ2_i$ and $UNADJ7_i$ for the two- and seven-day event windows, respectively.

For the second measure of trading volume, I use the market adjusted percentage of shares traded of a firm. The adjustment for the overall market level of trading is considered for the following reasons. First, if the information announcement affects the entire market (e.g., interest rate changes and money supply, etc.), the trading volume of the market is affected. Since individual firms are components of the market, trading volume of the firms is expected to be associated with the market trading volume. Second, to the extent information transfer across firms as depicted in Foster (1981) and Han, Wild, and Ramesh (1989) affects trading volume across firms, correlation among trading volume across firms should exist.

To adjust overall market level of trading, I subtract the daily percentage shares traded on the NYSE on day t (MTV_t) from firm i's percentage of shares traded on day t (TV_{it}). Daily market trading volume and total number of shares outstanding on the NYSE are calculated from the CRSP daily tapes. The percentage shares traded on the market is calculated by dividing daily market trading volume by total number of shares outstanding on the market. I denote the resulting market-adjusted trading volumes as $ADVOL2_i$ and $ADVOL7_i$ for the two- and seven-day event windows, respectively.

$$ADVOL_{it} = TV_{it} - MTV_t$$

$$ADVOL2_i = \sum_{t=-1}^{0} ADVOL_{it}$$

$$ADVOL7_i = \sum_{t=-1}^{5} ADVOL_{it}$$

The variance of liquidity traders (σ_l) is expected to be constant and will be captured in the intercept term with *log* 2. The magnitude of surprise ($|a_t|$) is proxied by analysts' forecast errors. The last analysts' forecasts before earnings announcements from the I/B/E/S consensus tape is chosen as expected earnings. As a proxy for the diversity of opinions among investors about earnings information (σ_θ), I use the coefficient of variation of analysts' forecasts. Because the coefficient of variation of analysts' forecasts is calculated by dividing standard deviation of analysts' forecasts by absolute mean forecast, observations with absolute mean forecasts less than \$ 0.2 are omitted due to the metric's sensitivity to small denominators. Atiase and Bamber (1994) and O'Brien (1988) use similar cut-off rules.

Information processing cost (C) is proxied by analyst following the firm after controlling for firm size. Analysts will follow firms of which information is easy to interpret.[16] Analyst following the firm is regressed on firm size and the residual analyst following the firm from the regression is used to proxy for the information processing cost. The discount rate (r) is proxied by the three month treasury bill rates. Treasury bills are sold in weekly auction conducted by Federal Reserve Bank of New York. Monthly average rate on the three month treasury bills at the month of earnings announcement is used in the analysis.

Therefore, the following regression is estimated:

$$\begin{aligned} log\ (Volume_{it}) &= \alpha + \beta_1 log\ (ABSSURP_{it}) + \beta_2 log\ (COVAR_{it}) + \\ &\quad \beta_3 log\ (NUMRES_{it}) + \beta_4 log\ (TBILL_{it}) + \xi_{it}, \end{aligned}$$

where:

[16] Bhushan (1989) documents that the number of analysts following the firm is positively associated with firm size and inversely related to the number of lines of business of a firm. As the number of lines of business increases, it requires more effort to get and interpret information.

$Volume_{it}$ is trading volume metric for firm i at day t,

$ABSSURP_{it}$ is the absolute value of analysts' forecasts errors,

$COVAR_{it}$ is the coefficient of variation of analysts' forecasts,

$NUMRES_{it}$ is the number of analysts following, and

$TBILL_t$ is three month treasury bill rate at the month of earnings announcement.

Because the basic relation requires the log transformation of variables, I added 1 to volume metrics, the absolute value of earnings surprise scaled by mean analysts' forecasts, coefficient of variation of analysts' forecasts and the the three month treasury bill rate to get positive numbers. For the number of analysts following the firm, I use log-transformed value when I regress the variable on size. ξ is assumed to be normally distributed with mean zero. I expect positive coefficients for β_1, β_2 and β_3 and a negative coefficient for β_4.

6.2 Tests of Proposition 3

The third proposition predicts a positive relation between market liquidity and information processing cost and the discount rate, and a negative relation between market liquidity and the diversity of opinion among informed traders, the absolute magnitude of earnings surprise, and the number of informed traders. This relation comes from eq. (42) of appendix A which shows the relation between the inverse of λ and exogenous variables in the model. Take logarithms of both sides of the equation to get:

$$log\ (\frac{1}{\lambda}) \ = \ log\ (\frac{2r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta})$$

$$= log\ 2 + log\ \sigma_l + log\ r - \frac{1}{2} log\ N - log\ |a_t| - log\ \sigma_\theta$$

As in the test of the first proposition, I use the above equation as a basis for testing the third proposition. Market liquidity ($\frac{1}{\lambda}$) is proxied by the bid-ask spread. At bid (ask) price, investors can sell (buy) securities immediately. Any increase or decrease in the bid-ask spread will be reflected in market order price. Therefore, the bid-ask spread can be used a proxy for market liquidity. Using closing bid and ask quotes, I calculated the proportional bid-ask spread, the dependent variable, as follows:

$$Proportional\ \ spread = \frac{Ask\ Price_{it} - Bid\ Price_{it}}{\frac{(Ask\ Price_{it} + Bid\ Price_{it})}{2}}$$

The number of informed traders (N) is proxied by market adjusted trading volume around earnings announcements. Beaver (1968) and Bamber (1986,1987) show that abnormal trading occurs during earnings announcements and Kim and Verrecchia (1994) provide analytic evidence that if trading volume increases during an information announcement, it is due to informed trading.

Therefore, the following regression is estimated to test proposition 1:

$$\begin{aligned} log\ (SPRD_{it}) &= \alpha + \beta_1 log\ (TBILL_t) + \beta_2 log\ (ADVOL_{it}) + \\ &\quad \beta_3 log\ (ABSSURP_{it}) + \beta_4 log\ (COVAR_{it}) + \xi_{it}, \end{aligned}$$

where:

$SPRD_{it}$ is the bid-ask spread for a firm i at day t, and all other variables are previously defined.[17]

[17] I add 1 to SPRD when I log transformed.

I expect a negative coefficient for β_1 and positive coefficients for β_2, β_3, and β_4 because the larger is the bid-ask spread, the less liquid is the market.

Substitute $\sqrt{N} = \frac{|a_t|\sigma_\theta\sigma_l}{2Cr}$ into eq. (42) in the appendix A and take the logarithms of both sides to get:

$$log\ (\frac{1}{\lambda}) = log\ 4 + 2log\ r - 2log\ |a_t| - 2log\ \sigma_\theta + log\ C.$$

Based on this equation, I also estimate the regression:

$$\begin{aligned} log\ (SPRD_{it}) &= \alpha + \beta_1 log\ (TBILL_{it}) + \beta_3 log\ (ABSSURP_{it}) + \\ &\quad \beta_4 log\ (COVAR_{it}) + \beta_5 log\ (NUMRES_{it}) + \xi_{it}. \end{aligned}$$

I expect a negative coefficient for β_1 and positive coefficients for β_3, β_4 and β_5. Further, as an empirical matter, the following regression is estimated:

$$\begin{aligned} log\ (SPRD_{it}) &= \alpha + \beta_1 log\ (TBILL_{it}) + \beta_2 log\ (ADVOL_{it}) + \\ &\quad \beta_3 log\ (ABSSURP_{it}) + \beta_4 log\ (COVAR_{it}) + \\ &\quad \beta_5 log\ (NUMRES_{it}) + \xi_{it}. \end{aligned}$$

I expect a negative coefficient for β_1 and positive coefficients for β_2, β_3, β_4 and β_5.

Many empirical studies in bid-ask spread have found that price volatility, stock price, and firm size are important explanatory variables for the bid-ask spread. Therefore, I also examine run the regression after including these other determinants of the bid-ask spread as independent variables along with the variables in the model to check whether variables in the model have the same relations along with other determinants of the bid-ask spread.

7 Empirical Results

7.1 Sample Selection

The observations in this study meet the following selection criteria:

1. The number of analysts following the firm, analysts' EPS forecast data (based on four or more individual analysts' forecasts) are available from the Institutional Brokers Estimate System (I/B/E/S) consensus tapes,

2. Annual earnings announcement dates and the number of shares outstanding at the end of the fiscal year are available from the COMPUSTAT tapes,

3. Trading volume and return data are available from the daily master CRSP tape, and

4. Closing bid-ask spread data are available from the Institute for the Study of Security Markets.

The study includes annual earnings announcements made between 1976 and 1993, inclusive. However, the analysis for the third proposition has been done for the period between 1988 and 1990, because I was only able to obtain closing bid-ask spreads of the NYSE listed firms for the 1988-90 period. Only observations with positive earnings are used, because non-positive earnings numbers have no meaning in the model and firms with negative earnings have uniquely anomalous return behavior. (Jaffe et al. (1989)).

7.2 Tests of Trading Volume

7.2.1 Descriptive Statistics

Sample selection criteria generate 8,567 firm/year observations. Table 1 shows the mean, standard deviation, median, and selected percentile values of all variables used in test of proposition 1. The table shows that the mean and standard deviation of two (seven) day trading volume are 0.7% (2.1%) and 0.9% (2.3 %), respectively. On average, the absolute value of analysts' forecast errors is 14.5%, and about fifteen analysts follow the sample firms.

7.2.2 A brief look at the correlation structure

Table 2 presents simple correlations between variables used in testing proposition 1. All correlations are significant and have the signs predicted by the model. Both the correlations between three month treasury bill rate and unadjusted two-day and seven-day trading volume measures are -0.166, which is consistent with the prediction that trading volume reaction to earnings announcement is a decreasing function of the discount rate. Also, it reveals that both the magnitude of earnings surprise and the coefficient of variation of analysts' forecasts are positively related to trading volume around earnings announcements. Further the number of analysts following the firm is positively related to trading volume around earnings announcements. However, the magnitude of earnings surprise is also positively related to the coefficient of variation and the number of analysts following. Therefore, it still remains as a question whether this relation will hold on multivariate tests.

7.2.3 Primary Analysis

The model predicts that trading volume around earnings announcements is an increasing function of the diversity of opinion among investors and the magnitude of earnings surprise, and decreasing function of the discount rate and information processing costs. Table 3 presents the results of ordinary least square regression estimation described in the previous section. To avoid the effects of extreme values, all the variables' values are truncated at 97%.[18] The results in table 3 are all significant and consistent with the prediction in the model as in the univariate analysis. In all regressions, the magnitude of earnings surprise (ABSSURP) and the coefficient of variation of analysts' forecasts (COVAR) are positively associated with trading volume around earnings announcements. This is consistent with the findings in the previous trading volume literature (Bamber(1986,1987), Ziebart (1990), and Atiase and Bamber(1994)). Table 3 also reveals a positive relation between trading volume reaction to earnings announcements and the analysts following the firm (NUMRES) and a negative relation between trading volume and the three month treasury bill rate (TBILL).

7.2.4 Additional Analysis

Additional tests are performed to check the validity of the data used in this study and assess the sensitivity of the results to (1) time period of sample, (2) inclusion of other variables in the regression associated with trading volume in other studies, (3) use of different discount horizon, and (4) alternative

[18]Atiase and Bamber (1994). Because ordinary least square minimizes squared errors, estimators are sensitive to outliers (Judge et al. (1985)).

functional forms of the relationship among the variables of interest. Each is discussed in turn.

Replication of Atiase and Bamber (1994)

To validate the data used in this study, I replicate the results of Atiase and Bamber (1994). Atiase and Bamber (1994) examined whether trading volume is associated with the dispersion in analysts' forecasts, in testing Kim and Verrecchia (1991) model which analyzes the relation between trading volume and the level of predisclosure information asymmetry. Using 5,282 annual earnings announcements made between 1980 and 1989 available on COMPUSTAT, they document that trading volume is significantly positively related to the dispersion in analysts' forecast even after controlling for the magnitude of the associated price reaction and size. (see table 3 in Atiase and Bamber (1994), p. 320.)

Table 3-1 replicates Atiase and Bamber (1994) using my sample. Consistent with their results, the absolute value of abnormal return (ABSRET), the coefficient of variation of analysts' forecast (COVAR), and market size (ASIZE) are all positively related to trading volume around earnings announcements. The magnitude of the coefficients, significance level, and the explanatory power of model are almost similar. Both the absolute abnormal return and the coefficient of variation of analysts' forecasts are significant at 1 % level. This provides the validity of the data used in this study.

Time period

To check whether the results in the primary analysis is sensitive to time period, I run the regression year by year. Table 3-14 provides the results. In general, the results are weaker but consistent with pooled regressions. The coefficient on the magnitude of earnings surprise (ABSSURP) is significantly positively related associated with trading volume more than half times. The coefficient of variation of analysts' forecasts (COVAR), the number of analysts following the firm (NUMRES), and the three month treasury bill rate (TBILL) show weaker relations than the magnitude of earnings surprise but have predicted relations in most of the regression. In sum, the results in the pool regressions are not time period specific.

Effects of adding size and the magnitude of abnormal returns as additional explanatory variables

Empirical studies in trading volume have shown that trading volume is positively associated with price changes.[19] Analytical studies also suggest that volume and price changes are positively related at the time of earnings announcements (Kim and Verrecchia (1991, 1994)).

Firm size has been documented to be positively related to trading volume (Atiase and Bamber (1994)). Atiase (1980) argues that private predisclosure information production and dissemination are an increasing function of firm size. Kim and Verrecchia (1991) provide an analysis that trading volume is an increasing function of predisclosure information asymmetry. Therefore, trading volume could be affected by firm size.

Thus, as possible omitted variables in this paper, I adopt firm size and the absolute magnitude of abnormal return. The results of re-estimating the model with firm size and absolute abnormal returns appear in tables 3-2, 3-3, and 3-4. Tables 3-2 and 3-3 report the results of the regressions by adding

[19]see Karpoff (1987) for a review.

firm size and absolute abnormal returns, respectively. Table 3-4 presents the results of the regression after including both variables as additional independent variables. In general, both size and the magnitude of abnormal returns are significantly positively related to trading volume, even though size is not significant when only size is added as an explanatory variable. This is consistent with the results previously documented in other empirical studies. More importantly, all variables of interest show the same relations as in table 3, and the explanatory power of the model (R^2) is increased about 10%.

In primary regression, the values of adjusted r-squared are 2.6% to 8.6% lower than those in Atiase and Bamber (1994), 9.3% to 11.9% . Therefore, it might be possible that all explained variance in trading volume in this paper is only a subset of that in Atiase and Bamber (1994), i.e., price changes and size explain the variance in trading volume explained by earnings surprise, the dispersion in analysts' forecasts, the number of analysts following the firm, and the three month treasury bill rate. After adding both variables, the adjusted r-squared goes up to 10.8 % to 15.6 % . This result indicates that the variables of my model attribute to most of the increasing explanatory power.

Use of long-term discount rate instead treasury bill rate

The discount horizon in this model is not necessarily short-term, but I used the three month treasury bill rate which is risk-free rate over the short-term. Depending on the term structure of interest, the long-term risk-free rate may be greater or less than the short-term rate. Thus, to check the robustness of the results to the discount horizon, I use the long-term government securities yields (TNOTE) which are available from Standard & Poor's Statistical Service - Basic Statistics. Table 3-5 provides the results of the estimation which are very similar to those reported in table 3. The long-term government securities yield (TNOTE) is significant at 1 % level and estimated coefficients of all other variables are significant with predicted signs as in table 3. Thus, the results in table 3 do not appear to be affected by changing the discount horizon.

Use of alternative specifications of the functional form

Even though the derivation of the regression equations requires log transformation of variables, the empirical proxies for the theoretical constructs might not have the same relations as described in the model. Therefore, I perform additional tests to assess the sensitivity of my results to the alternative functional form. Based on comparative statistics, I repeat the regressions using no log-transformed variables (tables 3-6, 3-7, and 3-8). Table 3-6 reports the results of the primary regressions using no-log transformed data. Tables 3-7 and 3-8 provide the results of the regression after including only absolute abnormal return and both absolute abnormal return and firm size, respectively. The results are qualitatively similar to those in log-transformed regressions. All estimated coefficients of primary explanatory variables are significant with predicted signs as in table 3 at the 1% significance level. The absolute abnormal returns are also positively associated with trading volume. But the size variable is negatively associated with trading volume, which is opposite to the relation in table 3. This might be due to some large firms having very small trading volume. When I use rank value instead of the real value of the variables, the effect of these observations might be minimized.

I also repeat the regressions using the rank values of the variables. When the relations are nonlinear but monotonic, this non-parametric test is powerful (Iman and Conover (1979), Lang and Lundholm (1993)). Tables 3-9 through 3-13 provide the results of rank regressions. Table 3-9 provides the results of rank regressions of primary relationship and tables 3-10, 3-11 and 3-12 provide the results of rank regressions after adding firm size and absolute abnormal returns to primary regressions. Table 3-13 provides the rank regressions when long-term government securities yields are used as the discount rate instead the three month treasury bill rate. All the results are almost the same as those in log-transformed regressions. The absolute value of earnings surprise, the coefficient of variation of analysts' forecasts, and the number of analysts following the firm are positively related to trading volume and the three month treasury bill rate is negatively related to trading volume. Also, the absolute abnormal return shows a strong positive relation to trading volume. Further, in rank regression, the size variable is strongly positively related to trading volume, which confirms the monotonic but nonlinear relation between size and trading volume. In sum, the statistical inferences remain the same as in table 3 in alternative functional forms.

7.3 Tests of Liquidity

7.3.1 Descriptive Statistics

Due to data availability, observations between 1988 and 1990, which generate 1,350 firm/year observations, are used in the analysis. Table 4 presents descriptive statistics of variables used in testing proposition 3. For each variable, its mean, standard deviation, median, and selected percentile values during the study period are provided. The table shows that the mean and standard deviation of two (seven) day spreads are 1.9% (6.5%) and 1.2% (4%), respectively. The two (seven) day market adjusted trading volume is 0.2% (0.5%). On average, the absolute value of analysts' forecast errors is 12.5%.

7.3.2 A brief look at the correlation structure

Table 5 presents the simple correlation matrix among the empirical proxies for the theoretical constructs of the Proposition 3. All the variables' values are truncated at 97% to mitigate the effects of extreme values. All correlations except volume metrics (ADVOL2 and ADVOL7) between dependent variables and explanatory variables are significant at the 10% level. Further, all correlations except that between spreads and the number of analysts following the firm have signs consistent with the model's predictions. The correlation between SPRD2 (SPRD7) and the three month treasury bill rate (TBILL) is -0.054 (-0.082), which is consistent with the model's prediction that the higher discount rate is positively related to the market liquidity. Also, table 5 reveals that absolute earnings surprise (ABSSURP) and the coefficient of variation of analysts' forecasts (COVAR) are positively related to the bid-ask spread around earnings announcements. The result indicates that market makers increase their bid-ask spread when there are larger earnings surprises and more diversity of opinions about earnings information. Even though univariate correlation analysis provides the evidence which supports the prediction of the model, many explanatory variables are significantly correlated with each other. Therefore, it needs to be checked whether this relation will hold on multivariate tests.

7.3.3 Primary analysis

Tables 6, 7, and 8 present the results of ordinary least square regression estimations suggested in the previous section. Table 6 provides the regression results when the bid-ask spread is regressed against the three month treasury bill rate, market adjusted trading volume, the magnitude of earnings surprise, and the coefficient of variation of analysts' forecasts. Table 7 shows the regression results when the number of analysts following the firm is used instead of market adjusted trading volume. Table 8 provides the regression results when both market adjusted trading volume and the number of analysts following the firm are used in the regression along with other three variables. The regression results support the validity of the model in general. In all six regressions, the three month treasury bill rate (TBILL) is significantly negatively related to the percentage bid-ask spread. This supports the model's prediction that for a given amount of earnings surprise, there is less profit for informed traders and thereby less information asymmetry around earnings announcements. The absolute value of analysts' forecast errors (ABSSURP) and the coefficient of variation of analysts' forecasts (COVAR) are significantly positively related to the bid-ask spread around earnings announcements. This implies that market makers deduce the extent of their adverse selection problem associated with earnings announcement through the magnitude of earnings surprise (ABSSURP) and diversity of opinions among analysts (COVAR) regarding earnings information. However, market adjusted percentage shares traded and the number of analysts following are not significantly related to the market liquidity around earnings announcements.

7.3.4 Additional Analysis

Additional tests are performed to check the robustness of the results to (1) time periods of sample, (2) the discount horizon and (3) alternative functional forms.

Time periods

To check whether the results in the primary analysis is sensitive to time period, I run the regressions year by year. The results presented in tables 6-1, 7-1, and 8-1 provide consistent, albeit slightly weaker, results with pooled regressions. The coefficients on three month treasury bill (TBILL) is significant with predicted sign 10 times out of 18 regressions at the 10% significance level. The magnitude of earnings surprise (ABSSURP) and the dispersion in analysts' forecasts (COVAR) are positively related to spreads 15 and 12 times out of 18 regressions, respectively. But market adjusted trading volume and the number of analysts following the firm is not significantly related to spreads most of the time. In sum, the results in the pooled regression are not time period specific.

Use of long-term discount rate instead treasury bill rate

As pointed out in the additional test of proposition 1, the discount horizon for informed traders is not necessarily short-term. Thus, I repeat the regressions in tables 6, 7, and 8 using long-term government securities yield

(TNOTE) instead of the three month treasury bill rate. Tables 6-2, 7-2, and 8-2 provide the results of the regressions. Unlike in the tests of trading volume, the coefficients on the discount rate is sensitive to the discount horizon. The coefficients on the long-term government securities yield (TNOTE) is not significant in all six regressions. However, the magnitude of earnings surprise (ABSSURP) and the coefficients of variation of analysts' forecasts (COVAR) are positively significant in all six regressions at the 1 % significance level as in primary analysis.

Two stage least square regression

In the model, market liquidity and the number of informed traders are endogenous variables which are determined simultaneously at the time of earnings announcements. Further, market liquidity is a function of the number of informed traders along with exogenous variables in the model. Therefore, running simple ordinary least square regression might violate the OLS assumption that the regressors and the residual are uncorrelated, yielding biased coefficient estimators. To avoid this problem, I perform two stage least square regressions for market liquidity and the number of informed traders.

In the first stage, I regress market adjusted trading volume which proxies for the number of informed traders, on all proxies for exogenous variables, i.e., the three month treasury bill rate, the magnitude of earnings surprise, the coefficient of variation of analysts' forecast and the number of analysts following the firm. In the second stage, the predicted value of market adjusted trading volume is regressed along with other proxies for exogenous variables on the bid-ask spread, which proxies for the market liquidity. Then all regressors are not correlated with residual error. Table 9 provides the results of two stage least square regressions. They are almost the same as the results in table 6. It implies the results in the ordinary least square regressions are not sufficiently biased so as to alter the relation in the two stage least square regressions.

Use of rank regressions

I also repeat the regressions in tables 6, 7, and 8 using rank values of variables. The results are presented in tables 6-3, 7-3, 8-3 and 9-1. In all regressions, the estimated coefficients on the three month treasury bill rate, the magnitude of earnings surprise, and the coefficient of variation of analysts' forecasts are significant with predicted signs as in primary regressions. Market adjusted trading volume is significantly negatively related to market liquidity.

7.3.5 Relation with other determinants of bid-ask spreads

In addition to variables described in the previous section, there are many other variables which have been found as determinants of bid-ask spread in empirical market micro-structure studies (Benston and Hagerman (1974), McInish and Wood (1992), and Chung et al. (1995), among others). The results of these studies have been fairly consistent. I include these variables in the next regression test and check whether variables of interest in the paper still explain the bid-ask spread behavior around earnings announcements. These other determinants of the bid-ask spreads can be summarized into the following categories: market activity, inventory holding risk, information asymmetry, the extent of competition and other variables. Each is discussed in turn.

Market activity variables

Literature in the market micro-structure area suggests that greater trading activity can lead to lower spreads due to economies of scale in trading costs. Using trading cost arguments, many researchers show that a number of activity variables are significant determinants of bid-ask spreads including (1) average number of shares traded (Tinic (1972)), (2) volume (Tinic and West (1972), Branch and Freed(1977), Stoll (1978)) and (3) the number of transactions (Benston and Hagerman (1974)). They document negative relationships between the bid-ask spread and market activity variables. However, none of these studies have been done around public announcements. In this study, percentage of trading volume used. So no other market activity variable is added.

Inventory holding risk

Because market makers always have to have some inventory to provide immediate change of stocks, inventory carrying costs are a positive function of bid-ask spread. Benston and Hagerman (1974) argue inventory carrying costs are primarily due to the risks incurred in holding the inventory. Thus, a positive relationship between bid-ask spreads and the level of risk of stocks is expected. This risk has been proxied by the volatility of stock price (Stoll (1978), Chiang and Venkatesh (1986), McInish and Wood (1992) and Chung et al. (1995)), systematic risk and unsystematic risk (Benston and Hagerman (1974)). These studies document fairly consistent positive relations between bid-ask spread and risk measures.[20] Price volatility measure is included in the regression. Following Chiang and Venkatesh (1986), I use the return variance of the average bid-ask spreads over 30 days before earnings announcements as price volatility measure in this study. The positive relation between bid-ask spreads and risk variable is expected.

Information asymmetry

In general, market makers face an adverse selection problem, since a customer agreeing to trade at the market makers' ask or bid price may be trading because he knows something that market makers do not. In effect, then, market makers must compensate for the losses suffered in trades with informed traders by making gains in trades with liquidity traders. These gains are achieved by setting a spread. This information asymmetry problem has been addressed by Copeland and Galai (1983) and Glosten and Milgrom (1985). They show that generally, bid-ask spreads increase if informed traders have better information, or there are more informed traders relative to liquidity traders.

In empirical bid-ask spread literature, firm size has been used as a proxy for information asymmetry because large firms, on average, release more information than small firms. Brown and Kim (1993) argue that outsiders such as analysts and the press are more likely to produce and disseminate information for large firms. Chiang and Venkatesh (1988) argue that because a small firm often has a smaller number of insiders and hence retains more inside information than a large firm, this poses a greater adverse-selection

[20]Benston and Hagerman (1974) document that systematic risk is not significantly related to spreads.

problem to the dealer and leads to higher spreads. Chung et al. (1995) argue that large firms also more intensively followed by security analysts and thus are subject to closer scrutiny by the investment community than small firms. This suggests that the stock prices of large firms are relatively more informative and, as a result, the extent of information asymmetry is likely to be lower for larger firms. Firm size is included in the regression and is expected to be negatively related to the bid-ask spreads.

In this paper, this information asymmetry problem is also reflected in earnings surprise and the diversity of opinions about earnings. The larger the earnings surprise, the more likely is that information asymmetry exists. So as predicted in the model, I expect a positive relation between earnings surprise and spreads based on adverse selection argument.

The extent of competition

Benston and Hagerman (1974) argue that a large number of dealers should keep the spread down to the competitive level. In the New York Stock Exchange, market making is generally competitive and only firms listed in the NYSE are used in the analysis. Therefore, this factor has not been considered in this paper. But several studies document that if stocks are listed on the other exchange as well as NYSE, the bid-ask spreads tend to decrease.

Other variables

Stock price is positively associated with the size of the bid-ask spread (Benston and Hagerman (1974)) but negatively associated with the proportional bid-ask spread (Stoll (1978) and Chung et al. (1995)). Stoll (1978) suggests that the minimum allowable spread of 1/8 dollar can cause low priced stocks to have artificially high spreads. The proportional bid-ask spread is used in this study. Therefore, I expect a negative relation between the bid-ask spread and price of the firm.

Regression results

Based on the variables discussed above, the following regressions are estimated:

$$\begin{aligned} log\ (BA_{it}) &= \alpha + \beta_1 log\ (TBILL_{it}) + \beta_2 log\ (ADVOL_{it}) + \\ &\quad \beta_3 log\ (ABSSURP_{it}) + \beta_4 log\ (COVAR_{it}) + \\ &\quad \beta_5 log\ (NUMRES_{it}) + \beta_6 log(VOLATIL_{it}) + \\ &\quad \beta_7 log(Price_{it}) + \beta_8 log(MARKET_{it}) + \xi_{it}. \end{aligned}$$

where:

$VOLATIL_{it}$ is price variance of a firm before earnings announcements,

$Price_{it}$ is share price,

$MARKET_{it}$ is market value of a firm and all other variables are previously defined.

Table 10 presents the results of the regressions. All explanatory variables except the coefficient of variation of analysts' forecasts are significantly related to bid-ask spreads. All added bid-ask spread determinants have the predicted signs: price volatility is positively and price and firm size are negatively associated with the bid-ask spreads around earnings announcements. More importantly, all variables of interest in the model still show the same relations with spreads. The other bid-ask spread determinants only increase the adjusted r-squared of the regression equation up to 72.2% while not affecting the significance of explanatory variables of interests.

8 Concluding remarks

The key feature of the model in this paper is that earnings announcements lead to information asymmetry among investors through the disagreement in interpreting how much portion of earnings surprise will be permanent or transitory. While they may use the same fundamental valuation model, such information asymmetry leads to different valuation and creates incentive to trade. Changes in price around earnings announcements are well documented in empirical literature. As long as new information is released in earnings announcements, there is no doubt about price changes around earnings announcements. However, the announcement of earnings may not result in any trading if all traders interpret earnings the same way and there are no liquidity traders. In our model and that of Kim and Verrecchia (1994), increases in trading volume around earnings announcements result from different interpretations of earnings announcements. While investors use the same valuation model and earnings information, they arrive at different firm values due to different interpretations of the persistence of earnings surprise.

The results in the empirical tests also support the model predictions in general. First of all, it provides another finding in the literature that trading volume is positively associated with earnings surprise and the dispersion among analysts' forecasts. It also documents that trading volume around earnings announcements is negatively related with the discount rate.

Moreover, it shows that these relations hold even after controlling for absolute abnormal returns and firm size which are found to be associated with trading volume, but not included in the model. In sum, the results indicate that trading volume does capture some information contained in earnings announcements that is not reflected in price changes. Therefore, this paper sheds some light on the informational role of trading volume at the time of earnings announcements. Also, it provides evidence that market liquidity around earnings is affected by earnings announcements. The magnitude of earnings surprise and the dispersion in analysts' forecasts are negatively related to market liquidity.

This paper as a theoretical exercise contributes to the existing literature in the sense that it exploits the impact of earnings announcements on trading volume by integrating an earnings valuation model and rational expectation model. This formulation allows us to reveal the direct relation between earnings surprise and both price changes and trading volume, which has been documented in the empirical literature. However, as in Kim and Verrecchia (1994), the private information gathering of differential quality is not incorporated in this model. An interesting extension to this paper to allow the existence of preannouncement information asymmetry.

Appendix A

Proof of eq. (6)

Given eq. (3), earnings dynamics (eqs. (4) and (5)), and dividend dynamics in Ohlson (1991), we can obtain eq. (6). Suppose the value of a firm at t can be written as:

$$v_t = \beta_1 x_t + \beta_2 d_t + \beta_3 a_t, \tag{22}$$

where β_1, β_2, and β_3 possibly depend on γ_1, γ_2, and r. Multiply both sides of eq. (22) by $(1+r)$ then:

$$v_t(1+r) = (1+r)\beta_1 x_t + (1+r)\beta_2 d_t + (1+r)\beta_3 a_t. \tag{23}$$

By eq. (3), the L.H.S. of eq. (23) is equal to:

$$v_t(1+r) = E[v_{t+1} \mid x_t, d_t] + E[d_{t+1} \mid x_t, d_t]. \tag{24}$$

Substitute eq.(22) into eq. (24):

$$v_t(1+r) = \beta_1 E[x_{t+1} \mid x_t, d_t] + (\beta_2 + 1)E[d_{t+1} \mid x_t, d_t] + \beta_3 E[a_{t+1} \mid x_t, d_t].$$

Then from earnings dynamics eq. (4):

$$\begin{aligned} v_t(1+r) &= \beta_1[(1+r)x_t - r \cdot d_t - \theta a_t] + (\beta_2+1)(\gamma_1 x_t + \gamma_2 d_t), \\ &= [\beta_1(1+r) + (\beta_2+1)\gamma_1]x_t + [-\beta_1 r + (\beta_2+1))\gamma_2]d_t, \\ &\quad -\beta_1\theta a_t. \end{aligned} \tag{25}$$

Then, from eq. (23):

$$(1+r)\beta_1 = \beta_1(1+r) + (\beta_2+1)\gamma_1 \tag{26}$$

$$(1+r)\beta_2 = -\beta_1 r + (\beta_2+1)\gamma_2 \tag{27}$$

$$(1+r)\beta_3 = -\beta_1\theta \tag{28}$$

Given that $\gamma_1 \neq 0$, it follows from (26) that $\beta_2 = -1$. From eq. (27), it follows that $\beta_1 = \frac{1+r}{r}$. From (28), $\beta_3 = -\frac{\theta}{r}$. Thus:

$$\begin{aligned} v_t &= \frac{1+r}{r}x_t - d_t - \frac{\theta}{r}a_t \\ &= \frac{1}{r}[(1+r)x_t - r \cdot d_t - \theta a_t] \\ &= \frac{1}{r}E[x_{t+1} \mid x_t, d_t]. \end{aligned}$$

Relation of valuation function, eq. (6), to Ohlson (1994)

As an extension of earnings valuation model, eq (2), Ohlson(1994) develops a model of a firm's value based on earnings, book value, and dividends. Using the implication of owner's equity accounting constructs that : (a) the clean surplus relation applies, and (b) dividends reduce current book value but they do not affect current earnings, he drives valuation expression that the market value equals the book value adjusted for the current profitability as measured by abnormal earnings. That is:

$$P_t = y_t + \alpha_1 x_t^a + \alpha_2 \nu_t$$

where

$$\alpha_1 = \frac{\omega}{R_f - \omega}$$

$$\alpha_2 = \frac{R_f}{(R_f - \omega)(R_f - \gamma)}$$

and

$$x_t^a = x_t - (R_f - 1) \cdot y_{t-1}$$

This valuation equation can be related to eq (6) in this paper as follows. In Ohlson (1994), expected next period earnings are written as (assuming ν to be zero):

$$E_t[x_{t+1}] = R_f x_t - (R_f - 1) \cdot d_t - x_t^a + \omega x_t^a$$

In this paper, expected next-period earnings are:

$$\begin{aligned} E_t[x_{t+1}] &= (1+r)x_t - r \cdot d_t - \theta a_t \\ &= R_f x_t - (R_f - 1)d_t - \theta a_t \end{aligned}$$

Therefore,

$$(\omega - 1)x_t^a = -\theta a_t$$

and

$$x_t^a = \frac{\theta}{1-\omega} a_t \quad or \quad a_t = \frac{1-\omega}{\theta} x_t^a$$

That is, eq. (6) in this paper can be written as:

$$\begin{aligned} v_t &= y_t + \frac{\omega}{R_f - 1} x_t^a \\ &= y_t + \frac{\omega\,\theta}{(R_f - 1)(1-\omega)} a_t \end{aligned}$$

This relation assumes that abnormal earnings follow the following time series behavior:

$$\tilde{x}_{t+\tau}^a = \omega x_t^a + \tilde{\varepsilon}_{1t+\tau}, \quad \forall \tau \geq 1.$$

<u>Calculation of $E[\tilde{v}_{mt} \mid \tilde{\omega}_t], \mu$, and λ</u>

$$\begin{aligned} \tilde{\omega}_t &= \sum_{i=1}^{N} (\alpha + \beta \tilde{v}_{it}) + \tilde{l}_t \\ &= N\alpha + \sum_{i=1}^{N} \beta \tilde{v}_{it} + \tilde{l}_t \\ &= N\alpha + \beta \tilde{v}_{1t} + \beta \tilde{v}_{2t} + \cdots + \beta \tilde{v}_{Nt} + \tilde{l}_t. \end{aligned}$$

Therefore, the variance of $\tilde{\omega}_t$ is:

$$\sigma_\omega^2 = N\beta^2(\frac{a_t}{r})^2\sigma_\theta^2 + \sigma_l^2.$$

and the covariance between the value of the firm and total order is:

$$\sigma_{v\omega} = N\beta(\frac{a_t}{r})^2\sigma_\theta^2.$$

The unconditional expectation of $\tilde{\omega}_t$ is:

$$\begin{aligned} E[\tilde{\omega}_t] &= E\ [\ \sum_{i=1}^{N}(\alpha + \beta\tilde{v}_{it})\ ] \\ &= N\alpha + \beta E[\sum_{i=1}^{N}\tilde{v}_{it}] \\ &= N\alpha + \beta N\bar{v}_t. \end{aligned}$$

By using the standard formula of condition expectation, the conditional expectation of the firm value can be written as:

$$\begin{aligned} E[\tilde{v}_t \mid \tilde{\omega}_t] &= \bar{v}_t + \frac{N\beta(\frac{a_t}{r})^2\sigma_\theta^2}{N\beta^2(\frac{a_t}{r})^2\sigma_\theta^2 + \sigma_l^2}(\tilde{\omega}_t - E[\tilde{\omega}_t]) \\ &= \frac{N\beta(\frac{a_t}{r})^2\sigma_\theta^2}{N\beta^2(\frac{a_t}{r})^2\sigma_\theta^2 + \sigma_l^2}\tilde{\omega}_t + (1 - \frac{N\beta(\frac{a_t}{r})^2\sigma_\theta^2}{N\beta^2(\frac{a_t}{r})^2\sigma_\theta^2 + \sigma_l^2}N\beta)\bar{v}_t \\ &\quad - \frac{N\beta(\frac{a_t}{r})^2\sigma_\theta^2}{N\beta^2(\frac{a_t}{r})^2\sigma_\theta^2 + \sigma_l^2}N\alpha. \end{aligned}$$

From eq. (9):

$$\lambda = \frac{N\beta(\frac{a_t}{r})^2\sigma_\theta^2}{N\beta^2(\frac{a_t}{r})^2\sigma_\theta^2 + \sigma_l^2} \tag{29}$$

$$\begin{aligned} \mu &= (1 - \lambda N\beta)\bar{v}_t - \lambda N\alpha \\ &= (1 - \lambda N\frac{1}{2\lambda})\bar{v}_t - \lambda N\alpha \\ &= (1 - \frac{N}{2})\bar{v}_t - \lambda N\alpha. \end{aligned} \tag{30}$$

Substituting eq. (11) into eq. (29):

$$\lambda = \frac{\frac{N}{2\lambda}(\frac{a_t}{r})^2\sigma_\theta^2}{\frac{1}{4\lambda^2}N(\frac{a_t}{r})^2\sigma_\theta^2 + \sigma_l^2}, \tag{31}$$

$$\frac{1}{4\lambda}N(\frac{a_t}{r})^2\sigma_\theta^2 + \lambda\sigma_l^2 = \frac{N}{2\lambda}(\frac{a_t}{r})^2\sigma_\theta^2,$$

$$N(\frac{a_t}{r})^2\sigma_\theta^2 + 4\lambda^2\sigma_l^2 = 2N(\frac{a_t}{r})^2\sigma_\theta^2.$$

From the second order condition $\lambda > 0$:

$$\begin{aligned} \lambda &= \sqrt{\frac{N(\frac{a_t}{r})^2\sigma_\theta^2}{4\sigma_l^2}} \\ &= \frac{\sqrt{N}\ |a_t|\sigma_\theta}{2r\sigma_l}. \end{aligned} \tag{32}$$

And:

$$\beta = \frac{1}{2\lambda} = \frac{r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta}. \tag{33}$$

Also by inserting eq. (30) into eq. (12):

$$\begin{aligned} \alpha &= \frac{1}{\lambda(N+1)}[-\mu - \frac{(N-1)}{2}\bar{v}_t] \\ &= \frac{1}{\lambda(N+1)}[-(1-\frac{N}{2})\bar{v}_t + \lambda N\alpha - \frac{(N-1)}{2}\bar{v}_t] \\ \alpha\lambda(N+1) &= -\frac{1}{2}\bar{v}_t + \lambda N\alpha \\ \alpha\lambda &= -\frac{\bar{v}_t}{2} \\ \alpha &= -\frac{\bar{v}_t}{2\lambda} \qquad (34) \\ &= -\frac{\bar{v}_t}{2}\cdot\frac{2r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta} \\ &= -\frac{r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta}\cdot\bar{v}_t. \qquad (35) \end{aligned}$$

By putting eq. (34) into eq. (30):

$$\begin{aligned}\mu &= (1-\frac{N}{2})\bar{v}_t - \lambda\ N\alpha \\ &= (1-\frac{N}{2})\bar{v}_t + \lambda\ N\frac{\bar{v}_t}{2\lambda} \\ &= \bar{v}_t. \end{aligned} \tag{36}$$

<u>Calculation of θ_{mt}</u>

Substituting eqs. (14) and (15) into eq. (13):

$$\begin{aligned}p_t &= \mu + \lambda\tilde{\omega}_t \\ &= \bar{v}_t + \frac{\sqrt{N}\ |a_t|\sigma_\theta}{2r\sigma_l}\ \tilde{\omega}_t. \end{aligned}$$

And by inserting eqs. (8) and (9):

$$\begin{aligned}p_t &= \bar{v}_t + \frac{\sqrt{N}\ |a_t|\sigma_\theta}{2r\sigma_l}\ (\sum_{i=1}^{N}\ \tilde{q}_{it} + \tilde{l}_t\ ) \\ &= \bar{v}_t + \frac{\sqrt{N}\ |a_t|\sigma_\theta}{2r\sigma_l}\ [\sum_{i=1}^{N}(\alpha + \beta\tilde{v}_{it}) + \tilde{l}_t\ ]. \end{aligned}$$

From eqs. (16) and (17):

$$\begin{aligned}p_t &= \bar{v}_t + \frac{\sqrt{N}\ |a_t|\sigma_\theta}{2r\sigma_l}\ [\sum_{i=1}^{N}(-\frac{r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta}\bar{v}_t + \frac{r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta}\tilde{v}_{it}) + \tilde{l}_t] \\ &= \bar{v}_t + \frac{\sqrt{N}\ |a_t|\sigma_\theta}{2r\sigma_l}\ [\frac{r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta}\ \sum_{i=1}^{N}(\tilde{v}_{it} - \bar{v}_t) + \tilde{l}_t\ ]. \end{aligned}$$

From $\bar{v}_t = \frac{1+r}{r}x_t - d_t - \frac{a_t}{r}\theta$ and $\tilde{v}_{it} = \frac{1+r}{r}x_t - d_t - \frac{a_t}{r}\tilde{\theta}_{it}$, the above equation can be written as:

$$p_t = \frac{1+r}{r}x_t - d_t - \frac{a_t}{r}\theta + \frac{\sqrt{N}\ |a_t|\sigma_\theta}{2r\sigma_l}\ [\frac{r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta}\ \sum_{i=1}^{N}(-\frac{a_t}{r}\tilde{\theta}_{it} + \frac{a_t}{r}\theta) + \tilde{l}_t\ ]$$

$$= \frac{1+r}{r}x_t - d_t - \frac{a_t}{r}\theta - \frac{a_t}{r}\left[\frac{1}{2}\sum_{i=1}^{N}(\tilde{\theta}_i - \theta)\right] + \frac{\sqrt{N}\,|a_t|\sigma_\theta}{2r\sigma_l}\,\tilde{l}_t$$

$$= \frac{1+r}{r}x_t - d_t - \frac{a_t}{r}\left[\theta + \frac{1}{2}\sum_{i=1}^{N}(\tilde{\theta}_{it} - \theta) - \frac{r}{a_t}\lambda\,\tilde{l}_t\right].$$

From eq. (9):

$$\theta_{mt} \equiv \theta + \frac{1}{2}\sum_{i=1}^{N}(\tilde{\theta}_{it} - \theta) - \frac{r}{a_t}\lambda\,\tilde{l}_t.$$

The middle term in the above equation is $\frac{1}{2}\sum_{i=1}^{N}(\tilde{\theta}_{it} - \theta) \simeq 0$. Therefore:

$$\theta_{mt} \equiv \theta - \frac{r}{a_t}\lambda\,\tilde{l}_t.$$

Condition for market existence

Because $\theta_{mt} \in (0,1)$, the following condition should be satisfied to have equilbrium:

$$0 < \theta_{mt} \equiv \theta - \frac{r}{a_t}\lambda\tilde{l}_t < 1. \tag{37}$$

From eq. (15), $\lambda = \frac{\sqrt{N}\,|a_t|\,\sigma_\theta}{2r\sigma_l}$:

$$0 < \theta - \frac{r}{a_t}\,\frac{\sqrt{N}\,|a_t|\,\sigma_\theta}{2r\sigma_l}\tilde{l}_t < 1. \tag{38}$$

The sign of $\frac{r}{a_t}\,\frac{\sqrt{N}\,|a_t|\,\sigma_\theta}{2r\sigma_l}\tilde{l}_t$ depends on a_t and $\tilde{l}_t$ because λ and r are always positive.

Case 1. $a_t > 0$ *and* $\tilde{l}_t > 0$.

The R.H.S of the above equation is always true because the sign of $\frac{r}{a_t}\,\frac{\sqrt{N}\,|a_t|\,\sigma_\theta}{2r\sigma l}\tilde{l}_t$ is positive and $\theta \in (0,1)$. That is, only the L.H.S of the equation needs to be checked:

$$\begin{aligned}0 &< \theta - \frac{\sqrt{N}\ \sigma_\theta}{2\sigma_l}\tilde{l}_t,\\ \theta &> \frac{\sqrt{N}\ \sigma_\theta}{2r\sigma_l}\tilde{l}_t,\\ N &< \frac{4\sigma_l^2\ \theta^2}{\sigma_\theta^2 l_t^2}.\end{aligned}$$

Case 2. $a_t > 0$ *and* $\tilde{l}_t < 0$.

The L.H.S of the above equation is always true because the sign of $\frac{r}{a_t}\ \frac{\sqrt{N}\ |a_t|\ \sigma_\theta}{2r\sigma l}\tilde{l}_t$ is negative and $\theta \in (0,1)$. That is, only the R.H.S of the equation needs to be checked:

$$\begin{aligned}1 &> \theta + \frac{\sqrt{N}\ \sigma_\theta}{2\sigma_l}\tilde{l}_t,\\ 1-\theta &> \frac{\sqrt{N}\ \sigma_\theta}{2r\sigma_l}\tilde{l}_t,\\ N &< \frac{4\sigma_l^2\ (1-\theta)^2}{\sigma_\theta^2 l_t^2}.\end{aligned}$$

Case 3. $a_t < 0$ *and* $\tilde{l}_t > 0$.

same as Case 2.

Case 4. $a_t < 0$ *and* $\tilde{l}_t < 0$.

same as Case 1.

Calculation of expected profit for the informed traders

The expected profit of the ith informed trader is given by:

$$E[\tilde{\phi}_{it}] = E[(\tilde{v}_{it} - \tilde{p}_t)\tilde{q}_{it}]. \tag{39}$$

From eqs. (9), (16), and (17):

$$\begin{aligned}\tilde{q}_{it} &= \alpha + \beta\tilde{v}_{it} = \beta(-\bar{v}_t + \tilde{v}_{it}),\\ \tilde{v}_{it} &= \frac{1}{\beta}\tilde{q}_{it} + \bar{v}_t. \end{aligned} \tag{40}$$

Substituting eqs. (9) and (40) into eq. (39):

$$E[\tilde{\phi}_{it}] = E[(\frac{1}{\beta}\tilde{q}_{it} + \bar{v}_t - \mu - \lambda\tilde{\omega}_t)\tilde{q}_{it}].$$

And from $\mu = \bar{v}_t$, $E[(\tilde{q}_{it} \cdot \tilde{q}_{jt})] = 0, \forall\ i \neq j$, and $E[(\tilde{l}_t \cdot \tilde{q}_{it})] = 0$:

$$\begin{aligned}E[\tilde{\phi}_{it}] &= E[\frac{1}{\beta}\tilde{q}_{it}^2 - \lambda\tilde{q}_{it}^2]\\ &= E[2\lambda\tilde{q}_{it}^2 - \lambda\tilde{q}_{it}^2]\\ &= E[\lambda\tilde{q}_{it}^2]\\ &= \lambda\ var(\tilde{q}_{it})\\ &= \lambda\beta^2(\frac{a_t}{r})^2\sigma_\theta^2\\ &= \lambda\ \frac{1}{4\lambda^2}(\frac{a_t}{r})^2\sigma_\theta^2\\ &= \frac{1}{4\lambda}(\frac{a_t}{r})^2\sigma_\theta^2\\ &= \frac{1}{4}\frac{2r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta}(\frac{a_t}{r})^2\sigma_\theta^2\\ &= \frac{|a_t|\sigma_\theta\sigma_l}{2\sqrt{N}\ r}. \end{aligned} \tag{41}$$

<u>Calculation of expected trading volume</u>

From eq. (9):

$$E[|\tilde{q}_{it}|] = E[\ |\alpha + \beta\ \tilde{v}_{it}|\ ].$$

From eq. (16), $\alpha = -\beta \bar{v}_t$:

$$E[|\tilde{q}_{it}|] = E[\ \beta\ |\tilde{v}_{it} - \bar{v}_t|\ ]$$
$$= \beta\ E[\ |\tilde{v}_{it} - \bar{v}_t|\ ].$$

From $\tilde{v}_{it} = \frac{1+r}{r} x_t - d_t - \frac{a_t}{r} \tilde{\theta}_{it}$, and $\bar{v}_t = \frac{1+r}{r} x_t - d_t - \frac{a_t}{r} \theta$:

$$E[|\tilde{q}_{it}|] = \beta E[\ | - \frac{a_t}{r} \tilde{\theta}_{it} + \frac{a_t}{r} \theta\ |\ ]$$
$$= \beta E[\ | - \frac{a_t}{r} (\tilde{\theta}_{it} - \theta) |\ ].$$

Let $\tilde{z}_{it} = -\frac{a_t}{r}(\tilde{\theta}_{it} - \theta)$. Then $\tilde{z}_{it}$ is a normal random variable with mean zero and variance $(\frac{a_t}{r})^2 \sigma_\theta^2$. Then the expected absolute value of a random variable, $\tilde{z}_{it}$, is calculated as follows:

$$E\ [\ |\tilde{z}_{it}|\ ] = \frac{1}{\sqrt{2\pi\ var(\tilde{z}_{it})}} \int_{-\infty}^{\infty} |\tilde{z}_{it}|\ e^{-\frac{\tilde{z}_{it}^2}{2\ var(\tilde{z}_{it})}}\ dz_{it}.$$

Since the normal distribution is symmetric about the origin, the above equation becomes:

$$E\ [\ |\tilde{z}_{it}|\ ] = \frac{2}{\sqrt{2\pi\ var(\tilde{z}_{it})}} \int_{0}^{\infty} \tilde{z}_{it}\ e^{-\frac{\tilde{z}_{it}^2}{2\ var(\tilde{z}_{it})}}\ d\ z_{it}.$$

Let:

$$\tilde{Z}_{it} = \frac{\tilde{z}_{it}}{\sqrt{var(\tilde{z}_{it})}}.$$

Then:

$$E\ [\ |\tilde{z}_{it}|\ ] = \frac{2\sqrt{var(\tilde{z}_{it})}}{\sqrt{2\pi\ var(\tilde{z}_{it})}} \int_{0}^{\infty} \tilde{Z}_{it}\ e^{-\frac{\tilde{Z}_{it}^2}{2}} \sqrt{var(\tilde{z}_{it})}\ d\ Z_{it}$$

$$
\begin{aligned}
&= \sqrt{\frac{2\ var(\tilde{z}_{it})}{\pi}} \int_0^{\infty} \tilde{Z}_{it}\ e^{-\frac{\tilde{z}_{it}^2}{2}}\ d\ Z_{it} \\
&= \sqrt{\frac{2\ var(\tilde{z}_{it})}{\pi}} \{ -e^{-\frac{\tilde{z}_{it}^2}{2}} \ |_0^{\infty} \} \\
&= \sqrt{\frac{2\ var(\tilde{z}_{it})}{\pi}} (0 - (-1)) \\
&= \sqrt{\frac{2\ var(\tilde{z}_{it})}{\pi}} \\
&= \sqrt{\frac{2}{\pi}} (\frac{a_t}{r}) \sigma_\theta .
\end{aligned}
$$

Therefore:

$$
\begin{aligned}
E[\ |\tilde{q}_{it}|\ ] &= \beta \sqrt{\frac{2}{\pi}}\ (\frac{a_t}{r})\ \sigma_\theta \\
&= \frac{r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta} \sqrt{\frac{2}{\pi}}\ (\frac{a_t}{r}) \sigma_\theta \\
&= \sqrt{\frac{2}{\pi}} \cdot \frac{\sigma_l}{\sqrt{N}} .
\end{aligned}
$$

The total expected trading volume of informed traders is:

$$
\begin{aligned}
E[Q_t] &= \frac{1}{2} \sum_{i=1}^{N} E[\ |\tilde{q}_{it}|\ ] + \frac{1}{2} \sum_{j=1}^{l} E[\ |l_{jt}|\ ] \\
&= \frac{1}{2} \cdot\ N \sqrt{\frac{2}{\pi}} \cdot \frac{\sigma_l}{\sqrt{N}} + \frac{1}{2} \cdot\ l \cdot \sqrt{\frac{2}{\pi}}\ \sigma_{l_j} \\
&= \frac{1}{\sqrt{2\pi}} (\sqrt{N}\ \sigma_l + l\sigma_{l_j}) .
\end{aligned}
$$

<u>Proof of Proposition 1</u>

The expected trading volume is given by:

$$
\begin{aligned}
E[Q_t] &= \frac{1}{\sqrt{2\pi}} \{ \sqrt{N}\ \sigma_l + l\sigma_{l_j} \} \\
&= \frac{1}{\sqrt{2\pi}} \{ \frac{|a_t|\sigma_\theta \sigma_l^2}{2Cr} + l\sigma_{l_j} \} .
\end{aligned}
$$

Therefore:

$$\begin{aligned}
\frac{d\ E[Q_t]}{d\ \sigma_\theta} &= \frac{1}{\sqrt{2\pi}} \cdot \frac{|a_t|\sigma_l^2}{2Cr} > 0, \\
\frac{d\ E[Q_t]}{d\ |a_t|} &= \frac{1}{\sqrt{2\pi}} \cdot \frac{\sigma_\theta\sigma_l^2}{2Cr} > 0, \\
\frac{d\ E[Q_t]}{d\ r} &= -\frac{1}{\sqrt{2\pi}} \cdot \frac{|a_t|\sigma_\theta\sigma_l^2}{2Cr^2} < 0, \\
\frac{d\ E[Q_t]}{d\ C} &= \frac{1}{\sqrt{2\pi}} \cdot \frac{|a_t|\sigma_\theta\sigma_l^2}{2C^2r} < 0.
\end{aligned}$$

Proof of Proposition 3

The market depth measure is given by:

$$\frac{1}{\lambda} = \frac{2r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta}. \tag{42}$$

Therefore:

$$\begin{aligned}
\frac{d\ \frac{1}{\lambda}}{d\ r} &= \frac{2\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta} > 0, \\
\frac{d\ \frac{1}{\lambda}}{d\ \sigma_\theta} &= -\frac{2r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta^2} < 0, \\
\frac{d\ \frac{1}{\lambda}}{d\ |a_t|} &= -\frac{2r\sigma_l}{\sqrt{N}\ |a_t|^2\sigma_\theta} < 0.
\end{aligned}$$

Also, substitute eq. (20) into eq. (42):

$$\frac{1}{\lambda} = \frac{2r\sigma_l}{|a_t|\sigma_\theta}\ \frac{2Cr}{|a_t|\sigma_\theta\sigma_l} = \frac{4Cr^2}{|a_t|^2\sigma_\theta^2}.$$

Therefore:

$$\frac{d\ \frac{1}{\lambda}}{d\ C} = \frac{4r^2}{|a_t|^2\sigma_\theta^2} > 0.$$

Appendix B

This section confirms the signs of derivatives in the propositions in the paper using implicit functions in the paper. The equations used in this paper are as follows:

$$\bar{v}_t - \frac{1+r}{r}x_t + d_t + \frac{a_t}{r}\theta = 0$$

$$\mu - \bar{v}_t(\theta) = 0$$

$$\alpha + \beta\bar{v}_t(\theta) = 0$$

$$\beta - \frac{r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta} = 0$$

$$\frac{1}{\lambda} - \frac{\sigma_l^2}{NC} = 0$$

$$\frac{1}{\lambda} - \frac{2r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta} = 0$$

$$\theta_{mt} - \theta + \frac{r}{a_t}\lambda\tilde{l}_t = 0$$

Then the Jacobian determinant of the above equations is:

$$|J| = \begin{vmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 1 & 0 & 0 & 0 & 0 & 0 \\ \beta & 0 & 1 & \bar{v}_t & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & \frac{r\sigma_l}{2N^{\frac{3}{2}}|a_t|\sigma_\theta} & 0 & 0 \\ 0 & 0 & 0 & 0 & \frac{\sigma_l^2}{N^2C} & 1 & 0 \\ 0 & 0 & 0 & 0 & \frac{r\sigma_l}{N^{\frac{3}{2}}|a_t|\sigma_\theta} & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & -(\frac{r}{a_t})(\frac{1}{\lambda})^{-2}l_t & 1 \end{vmatrix}$$

$$\begin{aligned} |J| &= \frac{\sigma_l^2}{N^2C} - \frac{r\sigma_l}{N^{\frac{3}{2}}|a_t|\sigma_\theta} \\ &= \frac{\sigma_l^2|a_t|\sigma_\theta - \sqrt{N}\ r\sigma_l C}{N^2C|a_t|\sigma_\theta} \end{aligned}$$

$$= \frac{\sigma_l^2}{2N^2C} > 0$$

Proposition 1

The partial derivatives of the equations with respect to information processing cost for informed traders are given by a vector $(0,0,0,0,\frac{\sigma_l^2}{NC^2},0,0)$. Then, by the implicit function theorem and Cramer's rule:

$$\frac{d\,\frac{1}{\lambda}}{d\,C} = \frac{|J_i|}{|J|}$$

$$\text{where} \quad |J_i| = \begin{vmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 1 & 0 & 0 & 0 & 0 & 0 \\ \beta & 0 & 1 & \bar{v}_t & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & \frac{r\sigma_l}{2N^{\frac{3}{2}}|a_t|\sigma_\theta} & 0 & 0 \\ 0 & 0 & 0 & 0 & \frac{\sigma_l^2}{N^2C} & -\frac{\sigma_l}{NC^2} & 0 \\ 0 & 0 & 0 & 0 & \frac{r\sigma_l}{N^{\frac{3}{2}}|a_t|\sigma_\theta} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{vmatrix}$$

$$= 0 - \left(-\frac{\sigma_l^2}{NC^2}\right)\left(\frac{r\sigma_l}{N^{\frac{3}{2}}\ |a_t|\ \sigma_\theta}\right) = \frac{r\sigma_l^3}{N^{\frac{3}{2}}|a_t|\ \sigma_\theta\ C^2} > 0$$

Therefore, $\frac{d\,\frac{1}{\lambda}}{d\,C} > 0$.

The partial derivatives of the equations with respect to the required rate of return (r) are given by a vector $(\frac{1}{r^2}x_t - \frac{a_t}{r^2}\theta, 0, 0, -\frac{\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta}, 0, -\frac{2\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta}, \frac{\lambda\ l_t}{a_t})$. Then, by the implicit function theorem and Cramer's rule:

$$\frac{d\,\frac{1}{\lambda}}{d\,r} = \frac{|J_i|}{|J|}$$

$$\text{where}\quad |J_i| = \begin{vmatrix} 1 & 0 & 0 & 0 & 0 & -\frac{1}{r^2}x_t + \frac{a_t}{r^2}\theta & 0 \\ -1 & 1 & 0 & 0 & 0 & 0 & 0 \\ \beta & 0 & 1 & \bar{v}_t & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & \frac{r\sigma_l}{2N^{\frac{3}{2}}|a_t|\sigma_\theta} & \frac{\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta} & 0 \\ 0 & 0 & 0 & 0 & \frac{\sigma_l^2}{N^2C} & 0 & 0 \\ 0 & 0 & 0 & 0 & \frac{r\sigma_l}{N^{\frac{3}{2}}|a_t|\sigma_\theta} & \frac{2\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta} & 0 \\ 0 & 0 & 0 & 0 & 0 & -\frac{\lambda\ l_t}{a_t} & 1 \end{vmatrix}$$

$$= \frac{\sigma_l^2}{N^2C} \times \frac{2\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta} = \frac{2\sigma_l^3}{N^{\frac{5}{2}}|a_t|\sigma_\theta C} > 0$$

Therefore, $\frac{d\ \frac{1}{\lambda}}{d\ r} > 0$.

The partial derivatives of the equations with respect to the diversity of opinion about earnings announcements (σ_θ) are given by a vector $(0, 0, 0, \frac{r\sigma_l}{\sqrt{N}\ |a_t|\ \sigma_\theta^2}, 0, \frac{2r\sigma_l}{\sqrt{N}\ |a_t|\ \sigma_\theta^2}, 0)$. Then, by the implicit function theorem and Cramer's rule:

$$\frac{d\ \frac{1}{\lambda}}{d\ \sigma_\theta} = \frac{|J_i|}{|J|}$$

$$\text{where}\quad |J_i| = \begin{vmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 1 & 0 & 0 & 0 & 0 & 0 \\ \beta & 0 & 1 & \bar{v}_t & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & \frac{r\sigma_l}{2N^{\frac{3}{2}}|a_t|\sigma_\theta} & -\frac{r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta^2} & 0 \\ 0 & 0 & 0 & 0 & \frac{\sigma_l^2}{N^2C} & 0 & 0 \\ 0 & 0 & 0 & 0 & \frac{r\sigma_l}{N^{\frac{3}{2}}|a_t|\sigma_\theta} & -\frac{2r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta^2} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{vmatrix}$$

$$= \frac{\sigma_l^2}{N^2C} \times \left(-\frac{2r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta^2}\right) = -\frac{2r\sigma_l^3}{N^{\frac{5}{2}}C|a_t|\sigma_\theta^2} < 0$$

Therefore, $\frac{d\ \frac{1}{\lambda}}{d\ \sigma_\theta} < 0$.

The partial derivatives of the equations with respect to the absolute magnitude of earnings surprise ($|a_t|$) are given by a vector ($\frac{\theta}{r}, 0, 0, \frac{r\sigma_l}{\sqrt{N}\ |a_t|^2\ \sigma_\theta}, 0, \frac{2r\sigma_l}{\sqrt{N}\ |a_t|^2\ \sigma_\theta}, -\frac{r}{|a_t|^2}\ \lambda l_t$), when $a_t > 0$. Then, by the implicit function theorem and Cramer's rule:

$$\frac{d\ \frac{1}{\lambda}}{d\ |a_t|} = \frac{|J_i|}{|J|}$$

$$\text{where}\quad |J_i| = \begin{vmatrix} 1 & 0 & 0 & 0 & 0 & -\frac{\theta}{r} & 0 \\ -1 & 1 & 0 & 0 & 0 & 0 & 0 \\ \beta & 0 & 1 & \bar{v}_t & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & \frac{r\sigma_l}{2N^{\frac{3}{2}}|a_t|\sigma_\theta} & -\frac{r\sigma_l}{\sqrt{N}\ |a_t|^2\sigma_\theta} & 0 \\ 0 & 0 & 0 & 0 & \frac{\sigma_l^2}{N^2C} & 0 & 0 \\ 0 & 0 & 0 & 0 & \frac{r\sigma_l}{N^{\frac{3}{2}}|a_t|\sigma_\theta} & -\frac{2r\sigma_l}{\sqrt{N}\ |a_t|^2\sigma_\theta} & 0 \\ 0 & 0 & 0 & 0 & 0 & -\frac{r}{|a_t|^2}\lambda\ l_t & 1 \end{vmatrix}$$

$$= \frac{\sigma_l^2}{N^2C} \times \left(-\frac{2r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta}\right) = -\frac{2r\sigma_l^3}{N^{\frac{5}{2}}C|a_t|^2\sigma_\theta} < 0$$

Therefore $\frac{d\ \frac{1}{\lambda}}{d\ |a_t|} < 0$. When $a_t < 0$, the determinant of $|J_i|$ is the same as when $a_t > 0$, while the partial derivatives of the equation with respect to absolute magnitude of earnings surprise are given by a vector ($-\frac{\theta}{r}, 0, 0, \frac{r\sigma_l}{\sqrt{N}\ |a_t|^2\ \sigma_\theta}, 0, \frac{2r\sigma_l}{\sqrt{N}\ |a_t|^2\ \sigma_\theta}, \frac{r}{|a_t|^2}\ \lambda l_t$). That is, $\frac{d\ \frac{1}{\lambda}}{d\ |a_t|} < 0$, when $a_t < 0$.

Proposition 2

The partial derivative of trading volume with respect to the number of informed traders is given by

$$\frac{\partial E[Q_t]}{\partial N} = \frac{\sigma_l}{2\sqrt{2\pi N}} > 0$$

And $\frac{\partial\ E[Q_t]}{\partial\ \sigma_\theta} = \frac{\partial\ E[Q_t]}{\partial\ |a_t|} = \frac{\partial\ E[Q_t]}{\partial\ r} = \frac{\partial\ E[Q_t]}{\partial\ C} = 0$. Therefore, we just need to check how the number of informed traders changes when exogenous variables change to confirm the relations between trading volume and exogenous variables.

The partial derivatives of the equations with respect to the diversity of opinion among informed traders in interpreting earnings information (σ_θ) are given by a vector $(0, 0, 0, \frac{r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta^2}, 0, \frac{2r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta^2}, 0)$. Then, by the implicit function theorem and Cramer's rule:

$$\frac{d\ N}{d\ \sigma_\theta} = \frac{|J_i|}{|J|}$$

$$\text{where}\quad |J_i| = \begin{vmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 1 & 0 & 0 & 0 & 0 & 0 \\ \beta & 0 & 1 & \bar{v}_t & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & -\frac{r\sigma_l}{\sqrt{N}|a_t|\sigma_\theta^2} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & -\frac{2r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta^2} & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & -\frac{r}{a_t^2}(\frac{1}{\lambda})^{-2}l_t & 1 \end{vmatrix}$$

$$= -(-\frac{2r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta^2}) = \frac{2r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta^2} > 0$$

Therefore, $\frac{d\ N}{d\ \sigma_\theta} > 0$ and $\frac{d\ E[Q_t]}{d\ \sigma_\theta} > 0$.

The partial derivatives of the equations with respect to the absolute magnitude of earnings surprise ($|a_t|$) are given by a vector $(\frac{\theta}{r}, 0, 0, \frac{r\sigma_l}{\sqrt{N}\ |a_t|^2\sigma_\theta}, 0, \frac{2r\sigma_l}{\sqrt{N}\ |a_t|^2\sigma_\theta}, -\frac{r}{|a_t|^2}\lambda l_t)$, when $a_t > 0$. Then, by the implicit function theorem and Cramer's rule:

$$\frac{d\ N}{d\ |a_t|} = \frac{|J_i|}{|J|}$$

where $|J_i| = \begin{vmatrix} 1 & 0 & 0 & 0 & -\frac{\theta}{r} & 0 & 0 \\ -1 & 1 & 0 & 0 & 0 & 0 & 0 \\ \beta & 0 & 1 & \bar{v}_t & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & -\frac{r\sigma_l}{\sqrt{N}|a_t|^2\sigma_\theta} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & -\frac{2r\sigma_l}{\sqrt{N}\ |a_t|^2\sigma_\theta} & 1 & 0 \\ 0 & 0 & 0 & 0 & \frac{r}{|a_t|^2}\lambda\ l_t & -\frac{r}{a_t^2}(\frac{1}{\lambda})^{-2} l_t & 1 \end{vmatrix}$

$$= -(-\frac{2r\sigma_l}{\sqrt{N}\ |a_t|^2\sigma_\theta}) = \frac{2r\sigma_l}{\sqrt{N}\ |a_t|^2\sigma_\theta} > 0$$

Therefore, $\frac{d\ N}{d\ |a_t|} > 0$ and $\frac{d\ E[Q_t]}{d\ |a_t|} > 0$. When $a_t < 0$, the determinant of $|J_i|$ is the same as when $a_t > 0$, while the partial derivatives of the equation with respect to absolute magnitude of earnings surprise are given by a vector $(-\frac{\theta}{r}, 0, 0, \frac{r\sigma_l}{\sqrt{N}\ |a_t|^2\ \sigma_\theta}, 0, \frac{2r\sigma_l}{\sqrt{N}\ |a_t|^2\ \sigma_\theta}, \frac{r}{|a_t|^2}\ \lambda l_t)$. That is, $\frac{d\ E[Q_t]}{d\ |a_t|} > 0$.

The partial derivatives of the equations with respect to the required rate of return (r) are given by a vector $(\frac{1}{r^2}x_t - \frac{a_t}{r^2}\theta, 0, 0, -\frac{\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta}, 0, -\frac{2\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta}, -\frac{\lambda l_t}{a_t})$. Then, by the implicit function theorem and Cramer's rule:

$$\frac{d\ N}{d\ r} = \frac{|J_i|}{|J|}$$

$$\text{where} \quad |J_i| = \begin{vmatrix} 1 & 0 & 0 & 0 & -\frac{1}{r^2}x_t + \frac{a_t}{r^2}\theta & 0 & 0 \\ -1 & 1 & 0 & 0 & 0 & 0 & 0 \\ \beta & 0 & 1 & \bar{v}_t & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & \frac{\sigma_l}{\sqrt{N}|a_t|\sigma_\theta} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & \frac{2\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta} & 1 & 0 \\ 0 & 0 & 0 & 0 & -\frac{\lambda\ l_t}{a_t} & -\frac{r}{a_t^2}(\frac{1}{\lambda})^{-2}l_t & 1 \end{vmatrix}$$

$$= -\frac{r\sigma_l}{\sqrt{N}\ |a_t|\sigma_\theta} < 0$$

Therefore, $\frac{d\ N}{d\ r} < 0$ and $\frac{d\ E[Q_t]}{d\ r} < 0$.

The partial derivatives of the equations with respect to information processing cost for informed traders (C) are given by a vector $(0, 0, 0, 0, \frac{\sigma_l^2}{NC^2}, 0, 0)$. Then, by the implicit function theorem and Cramer's rule:

$$\frac{d\ N}{d\ C} = \frac{|J_i|}{|J|}$$

$$\text{where} \quad |J_i| = \begin{vmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 1 & 0 & 0 & 0 & 0 & 0 \\ \beta & 0 & 1 & \bar{v}_t & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -\frac{\sigma_l}{NC^2} & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & -\frac{r}{a_t^2}(\frac{1}{\lambda})^{-2}l_t & 1 \end{vmatrix}$$

$$= -\frac{\sigma_l^2}{NC^2} < 0$$

Therefore, $\frac{d\ N}{d\ C} < 0$ and $\frac{d\ E[Q_t]}{d\ C} < 0$.

Table 1. Summary statistics of variables used in test of Proposition 1

Variable	Mean	Std. dev	Q3	Median	Q1
UNADJ2	0.0070	0.0090	0.0081	0.0043	0.0022
UNADJ7	0.021	0.023	0.027	0.016	0.009
ADVOL2	0.002	0.009	0.003	-0.0005	-0.0023
ADVOL7	0.0045	0.0224	0.0086	-0.0015	-0.0073
TBILL	7.469	3.062	8.48	7.59	5.59
ABSSURP	0.1453	0.4013	0.14	0.05	0.02
COVAR	0.070	0.1295	0.6727	0.0377	0.0208
NUM	14.786	8.375	20	13	8

1. The number of observations is 8,576.
2. UNADJ2 and UNADJ7 are based on the firm's percentage of shares traded cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.
3. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date, respectively.
4. TBILL is the three month treasury bill rate.
5. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.
6. COVAR is the coefficient of variation of analysts' EPS forecasts.
7. NUM is the number of analysts following.

Table 2. Correlation matrix of variables used in test of Proposition 1

Variable	UNADJ7	ADVOL2	ADVOL7	ABSSURP	COVAR	NUMRES	TBILL
UNADJ2	0.851	0.988	0.836	0.058	0.043	0.084	-0.166
UNADJ7	-	0.835	0.982	0.069	0.056	0.117	-0.166
ADVOL2	-	-	0.847	0.058	0.038	0.065	-0.082
ADVOL7	-	-	-	0.067	0.049	0.091	-0.071
ABSSURP	-	-	-	-	0.194	0.015*	0.014*
COVAR	-	-	-	-	-	0.005*	0.027
NUMRES	-	-	-	-	-	-	-0.051

1. All correlations are significant at 1% level except correlations marked *
2. UNADJ2 and UNADJ7 are based on the firm's percentage of shares traded cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.
3. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date, respectively.
4. TBILL is the three month treasury bill rate.
5. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.
6. COVAR is the coefficient of variation of analysts' EPS forecasts.
7. NUMRES is the residual number of analysts following after regressing against size.

Table 3. Regression of trading volume on the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, the number of analysts following and three month treasury bill rate during 76-93. All variables are log-transformed. 97% observations are used.

$$Volume = \alpha_0 + \beta_1 ABSSURP + \beta_2 COVAR + \beta_3 NUMRES + \beta_4 TBILL + \epsilon$$

	Dependent Variables			
Var	UNADJ2	ADVOL2	UNADJ7	ADVOL7
INTERCEP	0.0087	0.0019	0.0276	0.0036
	(46.808)	(10.185)	(55.253)	(7.506)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
ABSSURP	4.0220	3.9434	11.7864	11.5428
	(5.818)	(5.818)	(6.391)	(6.445)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
COVAR	3.8001	3.4465	13.0642	11.4297
	(3.057)	(2.828)	(3.919)	(3.531)
	(0.0022)	(0.0047)	(0.0001)	(0.0004)
NUMRES	0.0020	0.0017	0.0067	0.0056
	(10.478)	(9.131)	(13.204)	(11.413)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
TBILL	-0.0004	-0.0002	-0.0012	-0.0004
	(-18.867)	(-7.159)	(-21.544)	(-6.366)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
F Value	132.521	52.658	181.323	68.725
Adj R-sq	0.0638	0.0261	0.0855	0.0339

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. UNADJ2 and UNADJ7 are based on the unadjusted percentage of shares traded. ADVOL2 and ADVOL7 are based on the firm's percentage of shares

traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated over the following periods, relative to the earnings announcement date: UNADJ2, ADVOL2 - from day -1 to day 0 and UNADJ7, ADVOL7 - from day -1 to day 5.

4. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

5. COVAR is the coefficient of variation of analysts' EPS forecasts.

6. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

7. TBILL is the three month treasury bill rate.

Table 3-1. Replication of Atiase and Bamber (1994) during 76-93.
$Volume = \alpha_0 + \beta_1 ABSRET + \beta_2 COVAR + \beta_3 ASIZE + \epsilon$

Dep Var	INTERCEP	ABSRET	COVAR	ASIZE	Adj. R^2
UNADJ2	0.0037	99.8793	4.1722	0.0478	0.1190
	(34.150)	(31.442)	(6.971)	(2.417)	
	(0.0001)	(0.0001)	(0.0001)	(0.0157)	
ADVOL2	- 0.0011	95.1187	3.4752	0.0151	0.1139
	(-9.963)	(30.884)	(5.989)	(0.789)	
	(0.0001)	(0.0001)	(0.0001)	(0.4301)	
UNADJ7	0.0137	143.1292	15.7646	0.1389	0.0959
	(44.220)	(27.013)	(9.497)	(2.536)	
	(0.0001)	(0.0001)	(0.0001)	(0.0112)	
ADVOL7	-0.0031	137.4121	12.8545	0.0206	0.0925
	(-10.406)	(26.882)	(8.027)	(0.390)	
	(0.0001)	(0.0001)	(0.0001)	(0.6967)	

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations is 8,056 for two-day periods and 8,107 for seven-day periods.

3. UNADJ2 and UNADJ7 are based on the unadjusted percentage of shares traded. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated over the following periods, relative to the earnings announcement date: UNADJ2, ADVOL2 - from day -1 to day 0 and UNADJ7, ADVOL7 - from day -1 to day 5.

4. ABSRETs (absolute abnormal return metrics) are the absolute values of the cumulated beta excess returns over the two- or seven day periods, as in 3.

5. COVAR is the coefficient of variation of analysts' EPS forecasts.

6. ASIZE is the market value of the firm's common shares outstanding minus the median market value of the sample firms' common shares outstanding in that year.

Table 3-2. Regression of trading volume on the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, the number of analysts following, three month treasury bill rate, and size during 76-93. All variables are log-transformed. 97% observations are used.

$$Volume = \alpha_0 + \beta_1 ABSSURP + \beta_2 COVAR + \beta_3 NUMRES + \beta_4 TBILL + \beta_5 ASIZE + \epsilon$$

	Dependent Variables			
Var	UNADJ2	ADVOL2	UNADJ7	ADVOL7
INTERCEP	0.0087	0.0019	0.0275	0.0037
	(46.42)	(10.158)	(54.785)	(7.487)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
ABSSURP	4.0616	3.9219	11.9357	11.5000
	(5.852)	(5.764)	(6.447)	(6.395)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
COVAR	3.9005	3.3920	13.4334	11.3240
	(3.113)	(2.762)	(4.001)	(3.472)
	(0.0019)	(0.0058)	(0.0001)	(0.0005)
NUMRES	0.0020	0.0017	0.0067	0.0056
	(10.41)	(9.134)	(13.116)	(11.406)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
TBILL	-0.0004	-0.0002	-0.0012	-0.0004
	(-18.846)	(-7.166)	(-21.516)	(-6.37)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
ASIZE	0.0000	-0.0000	0.0001	-0.0000
	(0.648)	(-0.359)	(0.911)	(-0.268)
	(0.5173)	(0.7198)	(0.3626)	(0.7885)
F Value	106.092	42.147	145.221	54.988
Adj R-sq	0.0637	0.026	0.0855	0.0338

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. UNADJ2 and UNADJ7 are based on the unadjusted percentage of shares traded. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated over the following periods, relative to the earnings announcement date: UNADJ2, ADVOL2 - from day -1 to day 0 and UNADJ7, ADVOL7 - from day -1 to day 5.

4. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

5. COVAR is the coefficient of variation of analysts' EPS forecasts.

6. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

7. TBILL is three month treasury bill rate.

8. ASIZE is the market value of a firm's common shares outstanding minus the median market value of the sample firms' common shares outstanding in that year.

Table 3-3. Regression of trading volume on the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, the number of analysts following, three month treasury bill rate, and absolute excess return during 76-93. All variables are log transformed.

$$\begin{aligned} Volume &= \alpha_0 + \beta_1 ABSSURP + \beta_2 COVAR + \beta_3 NUMRES + \\ &\quad \beta_4 TBILL + \beta_5 ABSRET + \epsilon \end{aligned}$$

		Dependent Variables		
Var	UNADJ2	ADVOL2	UNADJ7	ADVOL7
INTERCEP	0.0064	-0.0004	0.0221	-0.0017
	(33.323)	(-1.938)	(41.894)	(-3.316)
	(0.0001)	(0.0527)	(0.0001)	(0.0009)
ABSSURP	3.0397	2.9604	9.4909	9.1355
	(4.633)	(4.609)	(5.272)	(5.231)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
COVAR	1.9688	1.6414	8.2866	6.8172
	(1.672)	(1.424)	(2.576)	(2.185)
	(0.0945)	(0.1545)	(0.01)	(0.0289)
NUMRES	0.0020	0.0017	0.0067	0.0056
	(10.926)	(9.536)	(13.589)	(11.726)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
TBILL	-0.0004	-0.0001	-0.0012	-0.0003
	(-17.593)	(-5.295)	(-20.71)	(-5.01)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
ABSRET	91.0375	88.7411	132.9458	129.8607
	(28.189)	(28.07)	(25.102)	(25.278)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
F Value	272.35	200.785	275.94	182.602
Adj R-sq	0.1528	0.1172	0.1545	0.1077

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. UNADJ2 and UNADJ7 are based on the unadjusted percentage of shares traded. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated over the following periods, relative to the earnings announcement date: UNADJ2, ADVOL2 - from day -1 to day 0 and UNADJ7, ADVOL7 - from day -1 to day 5.

4. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

5. COVAR is the coefficient of variation of analysts' EPS forecasts.

6. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

7. TBILL is three month treasury bill rate.

8. ABSRETs (absolute abnormal return metrics) are the absolute value of the cumulative beta excess returns over the two- or seven day periods, as in 3.

Table 3-4. Regression of trading volume on the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, the number of analysts following, three month treasury bill rate, absolute excess return, and size during 76-93. All variables are log-transformed.

$$Volume = \alpha_0 + \beta_1 ABSSURP + \beta_2 COVAR + \beta_3 NUMRES + \beta_4 TBILL + \beta_5 ABSRET + \beta_6 ASIZE + \epsilon$$

	Dependent Variables			
Var	UNADJ2	ADVOL2	UNADJ7	ADVOL7
INTERCEP	0.0063	-0.0004	0.0219	-0.0019
	(32.47)	(-2.311)	(40.895)	(-3.64)
	(0.0001)	(0.0209)	(0.0001)	(0.0003)
ABSSURP	3.2407	3.1057	9.9640	9.4489
	(4.926)	(4.821)	(5.522)	(5.397)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
COVAR	2.4896	2.0181	9.6461	7.7179
	(2.101)	(1.739)	(2.978)	(2.456)
	(0.0357)	(0.0821)	(0.0029)	(0.0141)
NUMRES	0.0019	0.0016	0.0066	0.0055
	(10.665)	(9.337)	(13.324)	(11.535)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
TBILL	-0.0004	-0.0001	-0.0012	-0.0003
	(-17.476)	(-5.204)	(-20.588)	(-4.924)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
ABSRET2	92.078	89.494	134.965	131.198
	(28.425)	(28.211)	(25.347)	(25.391)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
ASIZE	0.0002	0.0001	0.0005	0.0003
	(3.675)	(2.715)	(3.449)	(2.355)
	(0.0002)	(0.0066)	(0.0006)	(0.0186)
F Value	229.586	168.691	232.266	153.184
Adj R-sq	0.1542	0.118	0.1558	0.1083

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. UNADJ2 and UNADJ7 are based on the unadjusted percentage of shares traded. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated over the following periods, relative to the earnings announcement date: UNADJ2, ADVOL2 - from day -1 to day 0 and UNADJ7, ADVOL7 - from day -1 to day 5.

4. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

5. COVAR is the coefficient of variation of analysts' EPS forecasts.

6. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

7. TBILL is three month treasury bill rate.

8. ABSRETs (absolute abnormal return metrics) are the absolute value of the cumulative beta excess returns over the two- or seven day periods, as in 3.

9. ASIZE is the market value of the firm's common shares outstanding minus the median market market value of the sample firms' common shares outstanding in that year.

Table 3-5. Regression of trading volume on the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, the number of analysts following and long-term government securities yield during 76-93. All variables are log-transformed. 97% observations are used.
$Volume = \alpha_0 + \beta_1 ABSSURP + \beta_2 COVAR + \beta_3 NUMRES + \beta_4 TNOTE + \epsilon$

	Dependent Variables			
Var	UNADJ2	ADVOL2	UNADJ7	ADVOL7
INTERCEP	0.0108	0.0027	0.0341	0.0060
	(35.069)	(9.142)	(41.469)	(7.589)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
ABSSURP	3.9070	3.9094	11.450	11.4817
	(5.634)	(5.769)	(6.19)	(6.414)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
COVAR	3.9963	3.5034	13.5180	11.4823
	(3.205)	(2.875)	(4.043)	(3.548)
	(0.0014)	(0.0041)	(0.0001)	(0.0004)
NUMRES	0.0020	0.0017	0.0068	0.0057
	(10.522)	(9.187)	(13.272)	(11.497)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
TNOTE	-0.0005	-0.0002	-0.0017	-0.0005
	(-17.434)	(-7.059)	(-20.248)	(-6.7)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
F Value	119.228	52.295	167.343	69.848
Adj R-sq	0.0577	0.0259	0.0794	0.0345

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. UNADJ2 and UNADJ7 are based on the unadjusted percentage of shares traded. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading

volume metrics are cumulated over the following periods, relative to the earnings announcement date: UNADJ2, ADVOL2 - from day -1 to day 0 and UNADJ7, ADVOL7 - from day -1 to day 5.

4. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

5. COVAR is the coefficient of variation of analysts' EPS forecasts.

6. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

7. TNOTE is long-term government securities yield.

Table 3-6. Regression of trading volume on the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, the number of analysts following and three month treasury bill rate during 76-93.
$Volume = \alpha_0 + \beta_1 ABSSURP + \beta_2 COVAR + \beta_3 NUMRES + \beta_4 TBILL + \epsilon$

	Dependent Variables			
Var	UNADJ2	ADVOL2	UNADJ7	ADVOL7
INTERCEP	0.0084	0.0017	0.0266	0.0031
	(44.756)	(8.948)	(52.818)	(6.149)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
ABSSURP	0.0046	0.0045	0.0136	0.0133
	(6.671)	(6.525)	(7.354)	(7.263)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
COVAR	4.9255	4.4337	16.3594	14.2428
	(3.935)	(3.584)	(4.893)	(4.309)
	(0.0001)	(0.0003)	(0.0001)	(0.0001)
NUMRES	0.00019	0.0001	0.0003	0.0003
	(9.553)	(7.376)	(11.987)	(9.183)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
TBILL	-0.0004	-0.0001	-0.0011	-0.0003
	(-17.445)	(-6.072)	(-19.633)	(-4.93)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
F Value	128.511	47.357	172.223	58.806
Adj R-sq	0.062	0.0235	0.0816	0.0291

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. UNADJ2 and UNADJ7 are based on the unadjusted percentage of shares traded. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated over the following periods, relative to the

earnings announcement date: UNADJ2, ADVOL2 - from day -1 to day 0 and UNADJ7, ADVOL7 - from day -1 to day 5.

4. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

5. COVAR is the coefficient of variation of analysts' EPS forecasts.

6. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

7. TBILL is three month treasury bill rate.

Table 3-7. Regression of trading volume on the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, the number of analysts following, three month treasury bill rate, and absolute excess return during 76-93.

$$Volume = \alpha_0 + \beta_1 ABSSURP + \beta_2 COVAR + \beta_3 NUMRES + \beta_4 TBILL + \beta_5 ABSRET + \epsilon$$

	Dependent Variables			
Var	UNADJ2	ADVOL2	UNADJ7	ADVOL7
INTERCEP	0.0063	-0.0004	0.0216	-0.0019
	(33.092)	(-2.121)	(41.418)	(-3.573)
	(0.0001)	(0.0339)	(0.0001)	(0.0004)
ABSSURP	0.0018	0.0017	0.0049	0.0046
	(4.635)	(4.362)	(4.586)	(4.335)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
COVAR	1.8832	1.5975	8.5419	7.1707
	(2.596)	(2.227)	(4.291)	(3.635)
	(0.0095)	(0.026)	(0.0001)	(0.0003)
NUMRES	0.0001	0.0001	0.0004	0.0003
	(12.084)	(9.981)	(14.838)	(12.063)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
TBILL	-0.0003	-0.0001	-0.0011	-0.0002
	(-16.618)	(-4.705)	(-18.914)	(-3.817)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
ABSRET2	95.969	93.975	140.924	139.528
	(30.884)	(30.589)	(27.628)	(27.61)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
F Value	316.918	233.984	304.804	201.932
Adj R-sq	0.1648	0.127	0.1592	0.1113

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. UNADJ2 and UNADJ7 are based on the unadjusted percentage of shares traded. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated over the following periods, relative to the earnings announcement date: UNADJ2, ADVOL2 - from day -1 to day 0 and UNADJ7, ADVOL7 - from day -1 to day 5.

4. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

5. COVAR is the coefficient of variation of analysts' EPS forecasts.

6. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

7. TBILL is three month treasury bill rate.

8. ABSRETs (absolute abnormal return metrics) are the absolute value of the cumulative beta excess returns over the two- or seven day periods, as in 3.

Table 3-8. Regression of trading volume on the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, the number of analysts following, three month treasury bill rate, absolute excess return, and size during 76-93.

$$
\begin{aligned}
Volume &= \alpha_0 + \beta_1 ABSSURP + \beta_2 COVAR + \beta_3 NUMRES + \\
&\quad \beta_4 TBILL + \beta_5 ABSRET + \beta_6 ASIZE + \epsilon
\end{aligned}
$$

	Dependent Variables			
Var	UNADJ2	ADVOL2	UNADJ7	ADVOL7
INTERCEP	0.0062	-0.0005	0.0214	-0.0021
	(31.13)	(-2.687)	(39.202)	(-3.915)
	(0.0001)	(0.0072)	(0.0001)	(0.0001)
ABSSURP	0.0036	0.0034	0.0113	0.0108
	(5.426)	(5.255)	(6.249)	(6.095)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
COVAR	2.6171	2.1602	10.4102	8.3376
	(2.213)	(1.849)	(3.224)	(2.615)
	(0.027)	(0.0645)	(0.0013)	(0.0089)
NUMRES	0.0001	0.0001	0.0004	0.0003
	(12.375)	(10.17)	(14.89)	(12.199)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
TBILL	-0.0003	-0.0001	-0.0011	-0.0002
	(-16.283)	(-4.302)	(-18.82)	(-3.643)
	(0.0001)	(0.0001)	(0.0001)	(0.0003)
ABSRET2	94.726	92.715	136.898	135.446
	(29.197)	(28.934)	(25.666)	(25.718)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
ASIZE	-0.0648	-0.0615	-0.2167	-0.2180
	(-3.948)	(-3.793)	(-4.732)	(-4.82)
	(0.0001)	(0.0002)	(0.0001)	(0.0001)
F Value	240.59	177.301	233.648	154.558
Adj R-sq	0.1605	0.1233	0.1564	0.109

1. Each cell reports the estimated coefficient, and t-statistics and p-value in

parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. UNADJ2 and UNADJ7 are based on the unadjusted percentage of shares traded. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated over the following periods, relative to the earnings announcement date: UNADJ2, ADVOL2 - from day -1 to day 0 and UNADJ7, ADVOL7 - from day -1 to day 5.

4. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

5. COVAR is the coefficient of variation of analysts' EPS forecasts.

6. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

7. TBILL is three month treasury bill rate.

8. ABSRETs (absolute abnormal return metrics) are the absolute value of the cumulative beta excess returns over the two- or seven day periods, as in 3.

9. ASIZE is the market value of the firm's common shares outstanding minus the median market market value of the sample firms' common shares outstanding in that year.

Table 3-9. Rank regression of trading volume on the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, the number of analysts following and three month treasury bill rate during 76-93.
$Volume = \alpha_0 + \beta_1 RABSSURP + \beta_2 RCOVAR + \beta_3 RNUMRES + \beta_4 RTBILL + \epsilon$

	Dependent Variables			
Var	UNADJ2	ADVOL2	UNADJ7	ADVOL7
INTERCEP	4.4338	3.5253	4.3059	3.2881
	(50.943)	(39.223)	(50.041)	(36.845)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RABSSURP	0.0305	0.0459	0.0324	0.0472
	(2.457)	(3.581)	(2.638)	(3.708)
	(0.014)	(0.0003)	(0.0083)	(0.0002)
RCOVAR	0.0668	0.0596	0.0775	0.0705
	(5.324)	(4.598)	(6.247)	(5.48)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RNUMRES	0.1813	0.1488	0.2124	0.1818
	(17.406)	(13.835)	(20.626)	(17.021)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RTBILL	-0.2494	-0.0385	-0.2642	-0.0323
	(-23.654)	(-3.536)	(-25.351)	(-2.984)
	(0.0001)	(0.0004)	(0.0001)	(0.0029)
F Value	220.838	73.808	275.381	105.425
Adj R-sq	0.0931	0.0329	0.1136	0.0465

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. UNADJ2 and UNADJ7 are based on the unadjusted percentage of shares traded. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading

volume metrics are cumulated over the following periods, relative to the earnings announcement date: UNADJ2, ADVOL2 - from day -1 to day 0 and UNADJ7, ADVOL7 - from day -1 to day 5.

4. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

5. COVAR is the coefficient of variation of analysts' EPS forecasts.

6. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

7. TBILL is three month treasury bill rate.

Table 3-10. Rank regression of trading volume on the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, the number of analysts following, three month treasury bill rate, and size during 76-93.

$$
\begin{aligned}
Volume &= \alpha_0 + \beta_1 RABSSURP + \beta_2 RCOVAR + \beta_3 RNUMRES + \\
&\quad \beta_4 RTBILL + \beta_5 RASIZE + \epsilon
\end{aligned}
$$

	Dependent Variables			
Var	UNADJ2	ADVOL2	UNADJ7	ADVOL7
INTERCEP	4.0141	3.2143	3.9605	3.0573
	(39.116)	(30.281)	(38.995)	(28.985)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RABSSURP	0.0422	0.0546	0.0420	0.0537
	(3.385)	(4.232)	(3.405)	(4.185)
	(0.0007)	(0.0001)	(0.0007)	(0.0001)
RCOVAR	0.0755	0.0660	0.0847	0.0753
	(6.013)	(5.084)	(6.813)	(5.833)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RNUMRES	0.1719	0.1419	0.2047	0.1767
	(16.446)	(13.12)	(19.784)	(16.439)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RTBILL	-0.2481	-0.0375	-0.2632	-0.0315
	(-23.607)	(-3.453)	(-25.303)	(-2.92)
	(0.0001)	(0.0006)	(0.0001)	(0.0035)
RSIZE	0.0811	0.0601	0.0668	0.0446
	(7.655)	(5.484)	(6.365)	(4.095)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
F Value	189.578	65.262	229.425	87.849
Adj R-sq	0.0992	0.0362	0.1176	0.0482

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. UNADJ2 and UNADJ7 are based on the unadjusted percentage of shares traded. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated over the following periods, relative to the earnings announcement date: UNADJ2, ADVOL2 - from day -1 to day 0 and UNADJ7, ADVOL7 - from day -1 to day 5.

4. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

5. COVAR is the coefficient of variation of analysts' EPS forecasts.

6. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

7. TBILL is three month treasury bill rate.

8. ASIZE is the market value of the firm's common shares outstanding minus the median market value of the sample firms' common shares outstanding in that year.

Table 3-11. Regression of trading volume on the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, the number of analysts following, three month treasury bill rate, and absolute excess return during 76-93. All variables are log transformed.

$$Volume = \alpha_0 + \beta_1 RABSSURP + \beta_2 RCOVAR + \beta_3 RNUMRES + \beta_4 RTBILL + \beta_5 RABSRET + \epsilon$$

	Dependent Variables			
Var	UNADJ2	ADVOL2	UNADJ7	ADVOL7
INTERCEP	3.1982	2.3175	3.4370	2.3843
	(34.286)	(23.936)	(36.256)	(24.254)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RABSSURP	0.0079	0.0239	0.0166	0.0308
	(0.667)	(1.934)	(1.383)	(2.471)
	(0.5051)	(0.0531)	(0.1667)	(0.0135)
RCOVAR	0.0565	0.0495	0.0720	0.0648
	(4.717)	(3.981)	(5.936)	(5.151)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RNUMRES	0.1768	0.1444	0.2103	0.1796
	(17.782)	(13.993)	(20.888)	(17.203)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RTBILL	-0.2266	-0.0163	-0.2483	-0.0156
	(-22.463)	(-1.552)	(-24.286)	(-1.476)
	(0.0001)	(0.1206)	(0.0001)	(0.14)
RABSRET2	0.2878	0.2813	0.1993	0.2073
	(29.075)	(27.381)	(19.887)	(19.948)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
F Value	363.161	214.156	309.551	167.835
Adj R-sq	0.1745	0.1107	0.1526	0.0887

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. UNADJ2 and UNADJ7 are based on the unadjusted percentage of shares traded. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated over the following periods, relative to the earnings announcement date: UNADJ2, ADVOL2 - from day -1 to day 0 and UNADJ7, ADVOL7 - from day -1 to day 5.

4. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

5. COVAR is the coefficient of variation of analysts' EPS forecasts.

6. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

7. TBILL is three month treasury bill rate.

8. ABSRETs (absolute abnormal return metrics) are the absolute value of the cumulative beta excess returns over the two- or seven day periods, as in 3.

Table 3-12. Rank regression of trading volume on the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, the number of analysts following, three month treasury bill rate, absolute excess return, and size during 76-93.

$$Volume = \alpha_0 + \beta_1 RABSSURP + \beta_2 RCOVAR + \beta_3 RNUMRES + \beta_4 RTBILL + \beta_5 RABSRET + \beta_6 RASIZE + \epsilon$$

	Dependent Variables			
Var	RUNADJ2	RADVOL2	RUNADJ7	RADVOL7
INTERCEP	2.6042	1.8438	2.9218	1.9907
	(24.05)	(16.361)	(26.346)	(17.273)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RABSSURP	0.0227	0.0356	0.0290	0.0403
	(1.91)	(2.881)	(2.404)	(3.213)
	(0.0562)	(0.004)	(0.0162)	(0.0013)
RCOVAR	0.0677	0.0584	0.0815	0.0721
	(5.666)	(4.699)	(6.724)	(5.719)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RNUMRES	0.1642	0.1344	0.1997	0.1715
	(16.508)	(12.979)	(19.779)	(16.347)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RTBILL	-0.2242	-0.0143	-0.2460	-0.0139
	(-22.36)	(-1.372)	(-24.165)	(-1.315)
	(0.0001)	(0.1701)	(0.0001)	(0.1884)
RABSRET2	0.2968	0.2885	0.2094	0.2150
	(30.068)	(28.083)	(20.85)	(20.604)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RASIZE	0.1073	0.0855	0.0911	0.0696
	(10.608)	(8.128)	(8.845)	(6.503)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
F Value	325.333	190.831	273.327	147.586
Adj R-sq	0.1851	0.1174	0.1602	0.0931

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. UNADJ2 and UNADJ7 are based on the unadjusted percentage of shares traded. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated over the following periods, relative to the earnings announcement date: UNADJ2, ADVOL2 - from day -1 to day 0 and UNADJ7, ADVOL7 - from day -1 to day 5.

4. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

5. COVAR is the coefficient of variation of analysts' EPS forecasts.

6. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

7. TBILL is three month treasury bill rate.

8. ABSRETs (absolute abnormal return metrics) are the absolute value of the cumulative beta excess returns over the two- or seven day periods, as in 3.

9. ASIZE is the market value of the firm's common shares outstanding minus the median market market value of the sample firms' common shares outstanding in that year.

Table 3-13. Rank regression of trading volume on the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, the number of analysts following and long-term government securities yield during 76-93.
$Volume = \alpha_0+\beta_1 RABSSURP+\beta_2 RCOVAR+\beta_3 RNUMRES+\beta_4 RTNOTE+\epsilon$

	Dependent Variables			
Var	UNADJ2	ADVOL2	UNADJ7	ADVOL7
INTERCEP	4.4174	3.5729	4.3001	3.3421
	(49.55)	(39.015)	(48.785)	(36.755)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RABSSURP	0.0279	0.0459	0.0297	0.0473
	(2.235)	(3.58)	(2.407)	(3.716)
	(0.0254)	(0.0003)	(0.0161)	(0.0002)
RCOVAR	0.0699	0.0600	0.0807	0.0708
	(5.544)	(4.63)	(6.479)	(5.506)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RNUMRES	0.1793	0.1496	0.2105	0.1827
	(17.125)	(13.911)	(20.338)	(17.115)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
RTNOTE	-0.2425	-0.0490	-0.2596	-0.0443
	(-21.672)	(-4.259)	(-23.467)	(-3.878)
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
F Value	197.578	75.263	251.244	107.034
Adj R-sq	0.0841	0.0335	0.1046	0.0472

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. UNADJ2 and UNADJ7 are based on the unadjusted percentage of shares traded. ADVOL2 and ADVOL7 are based on the firm's percentage of shares

traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated over the following periods, relative to the earnings announcement date: UNADJ2, ADVOL2 - from day -1 to day 0 and UNADJ7, ADVOL7 - from day -1 to day 5.

4. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

5. COVAR is the coefficient of variation of analysts' EPS forecasts.

6. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

7. TNOTE is long-term government securities yield.

Table 3-14. Yearly regression of trading volume on the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, the number of analysts following and three month treasury bill rate during 76-93. All variables are log-transformed. 97% observations are used.
$Volume = \alpha_0 + \beta_1 ABSSURP + \beta_2 COVAR + \beta_3 NUMRES + \beta_4 TBILL + \epsilon$

Panel A. UNADJ2

Year	INTERCEP	ABSSURP	COVAR	NUMRES	TBILL	Adj. R^2
76	-0.0181	-0.0006	9.8498	0.0005	0.0044	0.0606
	(-1.597)	(-0.163)	(1.392)	(0.546)	(1.803)	
	(0.117)	(0.871)	(0.171)	(0.588)	(0.078)	
77	0.0103	0.0021	2.8243	0.0008	-0.0014	0.1393
	(3.419)	(0.795)	(0.412)	(1.791)	(-2.858)	
	(0.001)	(0.430)	(0.682)	(0.079)	(0.006)	
78	0.0118	0.0068	-0.2240	0.0008	-0.0011	0.1637
	(3.305)	(2.951)	(-0.058)	(1.655)	(-2.910)	
	(0.001)	(0.004)	(0.954)	(0.102)	(0.005)	
79	0.0029	0.0020	13.9292	-0.0000	-0.0000	0.0081
	(0.828)	(0.383)	(1.676)	(-0.026)	(-0.111)	
	(0.410)	(0.703)	(0.097)	(0.980)	(0.912)	
80	0.0087	0.0018	8.7918	0.0010	-0.0004	0.0303
	(4.458)	(0.873)	(1.947)	(1.674)	(-2.822)	
	(0.000)	(0.383)	(0.052)	(0.095)	(0.005)	
81	0.0055	0.0014	6.1035	0.0020	-0.0002	0.0362
	(2.737)	(1.075)	(1.973)	(4.132)	(-1.287)	
	(0.006)	(0.283)	(0.049)	(0.000)	(0.199)	
82	-0.0009	0.0037	6.0426	0.0022	0.0007	0.0298
	(-0.248)	(1.885)	(1.476)	(3.331)	(1.542)	
	(0.804)	(0.060)	(0.140)	(0.001)	(0.124)	
83	-0.0128	0.0043	2.4703	0.0011	0.0019	0.0208
	(-1.748)	(1.936)	(0.552)	(1.688)	(2.411)	
	(0.081)	(0.054)	(0.581)	(0.092)	(0.016)	

84	0.0059	0.0043	7.3259	0.0015	0.0000	0.0223
	(2.250)	(2.053)	(1.678)	(2.153)	(0.059)	
	(0.025)	(0.041)	(0.094)	(0.032)	(0.953)	
85	0.0242	0.0075	4.1892	0.0018	-0.0026	0.0457
	(3.728)	(3.220)	(0.913)	(2.341)	(-2.779)	
	(0.000)	(0.001)	(0.362)	(0.020)	(0.006)	
86	0.0180	0.0075	2.2587	0.0025	-0.0020	0.0366
	(1.215)	(3.010)	(0.510)	(3.015)	(-0.729)	
	(0.225)	(0.003)	(0.610)	(0.003)	(0.466)	
87	-0.0132	0.0043	6.1102	0.0011	0.0031	0.0434
	(-2.456)	(2.580)	(1.636)	(1.911)	(3.420)	
	(0.014)	(0.010)	(0.103)	(0.057)	(0.001)	
88	0.0148	0.0063	5.0516	0.0013	-0.0011	0.0333
	(3.081)	(3.463)	(1.294)	(1.850)	(-1.873)	
	(0.002)	(0.001)	(0.196)	(0.065)	(0.062)	
89	-0.0370	0.0017	2.6239	0.0023	0.0055	0.0229
	(-1.846)	(0.978)	(0.690)	(3.444)	(2.132)	
	(0.065)	(0.329)	(0.490)	(0.001)	(0.033)	
90	0.0149	0.0063	-6.3044	0.0036	-0.0014	0.0579
	(4.752)	(3.109)	(-1.611)	(4.931)	(-2.748)	
	(0.000)	(0.002)	(0.108)	(0.000)	(0.006)	
91	0.0075	0.0034	0.4056	0.0023	-0.0001	0.0113
	(3.508)	(1.274)	(0.096)	(2.910)	(-0.265)	
	(0.001)	(0.203)	(0.924)	(0.004)	(0.791)	
92	0.0114	0.0053	3.8074	0.0022	-0.0013	0.0138
	(1.155)	(2.005)	(0.824)	(2.604)	(-0.401)	
	(0.249)	(0.045)	(0.410)	(0.009)	(0.689)	
93	0.0588	0.0060	12.6798	0.0019	-0.0167	0.0039
	(1.240)	(0.619)	(0.898)	(0.906)	(-1.077)	
	(0.218)	(0.537)	(0.371)	(0.367)	(0.284)	

Panel B. ADVOL2

Year	INTERCEP	ABSSURP	COVAR	NUMRES	TBILL	Adj. R^2
76	-0.0252	-0.0002	10.3022	0.0008	0.0055	0.1125
	(-2.231)	(-0.055)	(1.461)	(0.866)	(2.246)	
	(0.031)	(0.956)	(0.151)	(0.391)	(0.030)	
77	0.0061	0.0011	4.0334	0.0007	-0.0010	0.0766
	(2.084)	(0.407)	(0.603)	(1.635)	(-2.111)	
	(0.042)	(0.686)	(0.549)	(0.108)	(0.039)	
78	0.0080	0.0065	0.4199	0.0005	-0.0010	0.1259
	(2.246)	(2.820)	(0.108)	(1.199)	(-2.489)	
	(0.027)	(0.006)	(0.915)	(0.234)	(0.015)	
79	-0.0009	0.0016	13.8645	-0.0000	-0.0000	0.0042
	(-0.239)	(0.308)	(1.642)	(-0.030)	(-0.114)	
	(0.812)	(0.759)	(0.104)	(0.976)	(0.910)	
80	0.0039	0.0015	9.0079	0.0010	-0.0003	0.0211
	(2.077)	(0.744)	(2.046)	(1.740)	(-1.928)	
	(0.038)	(0.457)	(0.041)	(0.083)	(0.055)	
81	0.0015	0.0012	6.3109	0.0020	-0.0001	0.0359
	(0.729)	(0.911)	(2.069)	(4.200)	(-0.780)	
	(0.466)	(0.363)	(0.039)	(0.000)	(0.436)	
82	-0.0091	0.0033	5.9980	0.0022	0.0011	0.0370
	(-2.638)	(1.711)	(1.480)	(3.432)	(2.569)	
	(0.009)	(0.088)	(0.139)	(0.001)	(0.011)	
83	-0.0230	0.0042	3.3055	0.0012	0.0026	0.0313
	(-3.183)	(1.928)	(0.746)	(1.776)	(3.212)	
	(0.002)	(0.055)	(0.456)	(0.076)	(0.001)	
84	-0.0040	0.0039	9.8875	0.0015	0.0005	0.0306
	(-1.532)	(1.886)	(2.311)	(2.219)	(1.646)	
	(0.126)	(0.060)	(0.021)	(0.027)	(0.100)	
85	0.0158	0.0074	3.0931	0.0019	-0.0022	0.0421
	(2.455)	(3.208)	(0.679)	(2.506)	(-2.427)	
	(0.014)	(0.001)	(0.497)	(0.013)	(0.016)	

86	0.0057	0.0069	2.3138	0.0025	-0.0010	0.0335
	(0.385)	(2.775)	(0.527)	(3.057)	(-0.365)	
	(0.700)	(0.006)	(0.598)	(0.002)	(0.715)	
87	-0.0111	0.0041	6.3078	0.0010	0.0018	0.0301
	(-2.074)	(2.507)	(1.702)	(1.648)	(1.996)	
	(0.039)	(0.013)	(0.089)	(0.100)	(0.046)	
88	0.0128	0.0063	5.5726	0.0011	-0.0015	0.0382
	(2.696)	(3.508)	(1.450)	(1.607)	(-2.547)	
	(0.007)	(0.001)	(0.148)	(0.109)	(0.011)	
89	-0.0586	0.0015	2.7988	0.0023	0.0077	0.0286
	(-2.948)	(0.859)	(0.743)	(3.429)	(2.998)	
	(0.003)	(0.391)	(0.458)	(0.001)	(0.003)	
90	0.0051	0.0054	-5.7904	0.0035	-0.0006	0.0461
	(1.675)	(2.739)	(-1.515)	(5.014)	(-1.280)	
	(0.094)	(0.006)	(0.130)	(0.000)	(0.201)	
91	-0.0007	0.0031	0.7896	0.0024	0.0006	0.0145
	(-0.337)	(1.158)	(0.188)	(3.019)	(1.138)	
	(0.737)	(0.247)	(0.851)	(0.003)	(0.256)	
92	-0.0084	0.0049	4.1181	0.0019	0.0034	0.0125
	(-0.861)	(1.857)	(0.900)	(2.289)	(1.053)	
	(0.390)	(0.064)	(0.369)	(0.022)	(0.293)	
93	0.0590	0.0060	12.8114	0.0017	-0.0185	0.0053
	(1.249)	(0.619)	(0.911)	(0.848)	(-1.199)	
	(0.214)	(0.537)	(0.364)	(0.398)	(0.233)	

Panel C. UNADJ7

Year	INTERCEP	ABSSURP	COVAR	NUMRES	TBILL	Adj. R^2
76	-0.0036	-0.0124	37.8450	0.0011	0.0025	0.1070
	(-0.164)	(-1.658)	(2.746)	(0.555)	(0.524)	
	(0.871)	(0.104)	(0.009)	(0.582)	(0.603)	
77	0.0304	0.0110	6.4388	0.0034	-0.0039	0.2778
	(4.147)	(1.735)	(0.388)	(3.056)	(-3.357)	
	(0.000)	(0.088)	(0.700)	(0.004)	(0.001)	
78	0.0618	0.0001	8.5124	0.0064	-0.0057	0.0538
	(2.258)	(0.005)	(0.342)	(2.109)	(-1.947)	
	(0.027)	(0.996)	(0.733)	(0.038)	(0.055)	
79	0.0032	0.0055	37.3951	-0.0004	0.0004	0.0118
	(0.342)	(0.397)	(1.693)	(-0.128)	(0.592)	
	(0.733)	(0.692)	(0.094)	(0.898)	(0.556)	
80	0.0214	0.0037	30.1625	0.0017	-0.0007	0.0287
	(4.411)	(0.728)	(2.684)	(1.077)	(-2.212)	
	(0.000)	(0.467)	(0.008)	(0.282)	(0.028)	
81	0.0143	0.0072	16.8255	0.0033	-0.0004	0.0279
	(2.765)	(2.161)	(2.040)	(2.737)	(-0.923)	
	(0.006)	(0.031)	(0.042)	(0.006)	(0.357)	
82	-0.0102	0.0020	38.4732	0.0087	0.0031	0.0675
	(-1.024)	(0.368)	(3.399)	(4.772)	(2.504)	
	(0.306)	(0.713)	(0.001)	(0.000)	(0.013)	
83	-0.0116	0.0020	27.4914	0.0056	0.0030	0.0356
	(-0.616)	(0.354)	(2.384)	(3.264)	(1.433)	
	(0.539)	(0.724)	(0.018)	(0.001)	(0.153)	
84	0.0195	0.0218	14.4210	0.0067	-0.0001	0.0635
	(2.758)	(3.966)	(1.245)	(3.618)	(-0.114)	
	(0.006)	(0.000)	(0.214)	(0.000)	(0.909)	
85	0.0610	0.0207	22.3303	0.0040	-0.0060	0.0541
	(3.726)	(3.481)	(1.937)	(2.088)	(-2.565)	
	(0.000)	(0.001)	(0.053)	(0.037)	(0.011)	

86	0.0331	0.0272	16.5104	0.0098	-0.0021	0.0842
	(0.842)	(4.124)	(1.402)	(4.414)	(-0.297)	
	(0.400)	(0.000)	(0.162)	(0.000)	(0.766)	
87	-0.0365	0.0113	4.8068	0.0044	0.0094	0.0408
	(-2.436)	(2.442)	(0.458)	(2.605)	(3.700)	
	(0.015)	(0.015)	(0.647)	(0.009)	(0.000)	
88	0.0250	0.0167	5.3517	0.0041	-0.0007	0.0272
	(2.037)	(3.569)	(0.543)	(2.208)	(-0.482)	
	(0.042)	(0.000)	(0.587)	(0.028)	(0.630)	
89	-0.0473	0.0051	10.8822	0.0079	0.0084	0.0352
	(-0.912)	(1.175)	(1.109)	(4.456)	(1.256)	
	(0.362)	(0.241)	(0.268)	(0.000)	(0.210)	
90	0.0544	0.0122	-11.0774	0.0111	-0.0052	0.0694
	(6.288)	(2.165)	(-1.021)	(5.534)	(-3.821)	
	(0.000)	(0.031)	(0.308)	(0.000)	(0.000)	
91	0.0243	0.0161	-4.4864	0.0100	-0.0006	0.0377
	(4.291)	(2.263)	(-0.399)	(4.694)	(-0.433)	
	(0.000)	(0.024)	(0.690)	(0.000)	(0.665)	
92	0.0439	0.0119	14.6838	0.0071	-0.0067	0.0201
	(1.686)	(1.709)	(1.215)	(3.243)	(-0.783)	
	(0.092)	(0.088)	(0.225)	(0.001)	(0.434)	
93	0.2932	0.0212	25.6203	0.0064	-0.0875	0.0269
	(2.272)	(0.802)	(0.667)	(1.136)	(-2.077)	
	(0.025)	(0.424)	(0.506)	(0.258)	(0.040)	

Panel D. ADVOL7

Year	INTERCEP	ABSSURP	COVAR	NUMRES	TBILL	Adj. R^2
76	-0.0292	-0.0102	38.9628	0.0019	0.0064	0.1677
	(-1.334)	(-1.375)	(2.848)	(1.016)	(1.355)	
	(0.189)	(0.176)	(0.007)	(0.315)	(0.182)	
77	0.0196	0.0088	7.8959	0.0032	-0.0032	0.2520
	(2.903)	(1.502)	(0.515)	(3.095)	(-2.960)	
	(0.005)	(0.139)	(0.609)	(0.003)	(0.005)	
78	0.0463	-0.0019	10.1270	0.0057	-0.0049	0.0347
	(1.727)	(-0.130)	(0.415)	(1.922)	(-1.704)	
	(0.088)	(0.897)	(0.679)	(0.058)	(0.092)	
79	-0.0094	0.0036	39.0315	-0.0008	0.0004	0.0096
	(-0.992)	(0.257)	(1.762)	(-0.271)	(0.547)	
	(0.324)	(0.798)	(0.081)	(0.787)	(0.586)	
80	0.0052	0.0035	29.2204	0.0018	-0.0003	0.0197
	(1.107)	(0.723)	(2.674)	(1.194)	(-1.014)	
	(0.269)	(0.470)	(0.008)	(0.233)	(0.311)	
81	0.0015	0.0068	16.9602	0.0033	-0.0002	0.0266
	(0.293)	(2.063)	(2.079)	(2.734)	(-0.521)	
	(0.770)	(0.040)	(0.038)	(0.006)	(0.603)	
82	-0.0365	0.0021	36.7316	0.0086	0.0042	0.0780
	(-3.734)	(0.399)	(3.318)	(4.850)	(3.537)	
	(0.000)	(0.690)	(0.001)	(0.000)	(0.000)	
83	-0.0504	0.0016	29.5434	0.0053	0.0055	0.0453
	(-2.716)	(0.288)	(2.594)	(3.122)	(2.684)	
	(0.007)	(0.773)	(0.010)	(0.002)	(0.008)	
84	-0.0154	0.0193	19.7695	0.0071	0.0017	0.0684
	(-2.216)	(3.585)	(1.739)	(3.906)	(2.090)	
	(0.027)	(0.000)	(0.083)	(0.000)	(0.037)	
85	0.0332	0.0191	20.2755	0.0046	-0.0051	0.0490
	(2.067)	(3.276)	(1.792)	(2.406)	(-2.210)	
	(0.039)	(0.001)	(0.074)	(0.017)	(0.028)	

86	-0.0144	0.0257	17.3740	0.0090	0.0021	0.0809
	(-0.377)	(4.016)	(1.523)	(4.212)	(0.307)	
	(0.706)	(0.000)	(0.128)	(0.000)	(0.759)	
87	-0.0298	0.0109	7.4719	0.0037	0.0049	0.0247
	(-2.064)	(2.441)	(0.739)	(2.293)	(1.999)	
	(0.040)	(0.015)	(0.460)	(0.022)	(0.046)	
88	0.0184	0.0157	7.1301	0.0033	-0.0021	0.0265
	(1.527)	(3.429)	(0.738)	(1.810)	(-1.415)	
	(0.127)	(0.001)	(0.461)	(0.071)	(0.158)	
89	-0.1087	0.0040	12.2202	0.0079	0.0143	0.0402
	(-2.135)	(0.935)	(1.270)	(4.549)	(2.162)	
	(0.033)	(0.350)	(0.205)	(0.000)	(0.031)	
90	0.0216	0.0088	-8.9067	0.0108	-0.0029	0.0508
	(2.556)	(1.599)	(-0.842)	(5.515)	(-2.159)	
	(0.011)	(0.110)	(0.400)	(0.000)	(0.031)	
91	-0.0031	0.0144	-3.5863	0.0097	0.0017	0.0389
	(-0.550)	(2.051)	(-0.324)	(4.666)	(1.225)	
	(0.582)	(0.041)	(0.746)	(0.000)	(0.221)	
92	-0.0205	0.0105	14.3628	0.0063	0.0081	0.0169
	(-0.799)	(1.538)	(1.207)	(2.915)	(0.960)	
	(0.425)	(0.125)	(0.228)	(0.004)	(0.337)	
93	0.2762	0.0233	25.3991	0.0063	-0.0881	0.0303
	(2.170)	(0.892)	(0.670)	(1.137)	(-2.118)	
	(0.032)	(0.375)	(0.504)	(0.258)	(0.036)	

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. UNADJ2 and UNADJ7 are based on the unadjusted percentage of shares traded. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading

volume metrics are cumulated over the following periods, relative to the earnings announcement date: UNADJ2, ADVOL2 - from day -1 to day 0 and UNADJ7, ADVOL7 - from day -1 to day 5.

4. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

5. COVAR is the coefficient of variation of analysts' EPS forecasts.

6. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

7. TBILL is three month treasury bill rate.

Table 4. Summary statistics of variables used in test of Proposition 3

Variable	Mean	Std. dev	Q3	Median	Q1
SPRD2	0.019	0.012	0.023	0.015	0.011
SPRD7	0.065	0.040	0.079	0.055	0.038
TBILL	7.917	0.446	8.29	7.59	7.64
ADVOL2	0.002	0.006	0.004	-0.000	-0.002
ADVOL7	0.005	0.017	0.010	-0.001	-0.005
ABSSURP	0.1245	0.248	0.105	0.039	0.014
COVAR	0.083	0.128	0.082	0.041	0.022
NUM	15.786	8.684	23	14	8

1. The number of observations is 1,350.

2. SPRD2 and SPRD7 are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

3. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date, respectively.

4. TBILL is the three month treasury bill rate.

5. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

6. COVAR is the coefficient of variation of analysts' EPS forecasts.

7. NUM is the number of analysts following.

Table 5. Correlation matrix of variables used in test of Proposition 3

Variable	SPRD7	TBILL	ADVOL2	ADVOL7	ABSSURP	COVAR	NUMRES
SPRD2	0.922	-0.054	0.005*	-0.042*	0.199	0.266	-0.407
SPRD7	-	-0.082	0.006*	-0.040*	0.220	0.275	-0.431
TBILL	-	-	0.011	0.030	0.058	0.037*	0.021
ADVOL2	-	-	-	0.809	0.059	0.083	0.102
ADVOL7	-	-	-	-	0.080	0.109	0.125
ABSSURP	-	-	-	-	-	0.590	-0.051
COVAR	-	-	-	-	-	-	-0.049

1. All correlations are significant at 10% level except correlations marked by *.

2. UNADJ2 and UNADJ7 are based on the firm's percentage of shares traded cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

3. ADVOL2 and ADVOL7 are based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date, respectively.

4. TBILL is the three month treasury bill rate.

5. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

6. COVAR is the coefficient of variation of analysts' EPS forecasts.

7. NUMRES is the residual number of analysts following after regressing against size.

Table 6. Regression of bid-ask spread on three month treasure bill rate, trading volume, the absolute value of earnings surprise, and the coefficient of variation of analysts' EPS forecasts during 88-90. All variables are log-transformed. 97 % observations are used.

$$SPRD = \alpha_0 + \beta_1 TBILL + \beta_2 ADVOL + \beta_3 ABSSURP + \beta_4 COVAR + \epsilon$$

Dep. Var	INTERCEP	TBILL	ADVOL	ABSSURP	COVAR	Adj. R^2
SPRD2	0.0314	-0.0021	-0.0553	0.0106	0.0378	0.0888
	(6.335)	(-3.404)	(-0.713)	(3.554)	(7.282)	
	(0.0001)	(0.0007)	(0.4759)	(0.0004)	(0.0001)	
SPRD7	0.0952	-0.0057	-0.8554	0.0350	0.1093	0.0881
	(6.365)	(-2.993)	(-2.620)	(3.818)	(6.854)	
	(0.0001)	(0.0028)	(0.0089)	(0.0001)	(0.0001)	

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. SPRD2 and SPRD7 are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

4. TBILL is the three month treasury bill rate.

5. ADVOL is based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date for SPRD2 and SPRD7, respectively.

6. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

7. COVAR is the coefficient of variation of analysts' EPS forecasts.

Table 6-1. Yearly regressions of bid-ask spread on three month treasure bill rate, trading volume, the absolute value of earnings surprise, and the coefficient of variation of analysts' EPS forecasts during 88-90. All variables are log-transformed. 97 % observations are used.

$SPRD = \alpha_0 + \beta_1 TBILL + \beta_2 ADVOL + \beta_3 ABSSURP + \beta_4 COVAR + \epsilon$

Panel A. 1988

Dep Var	INTERCEP	TBILL	ADVOL	ABSSURP	COVAR	Adj. R^2
SPRD2	0.0285	-0.0018	-0.1366	0.0017	0.0539	0.1155
	(3.828)	(-1.942)	(-2.138)	(0.433)	(7.562)	
	(0.0001)	(0.0526)	(0.0329)	(0.6650)	(0.0001)	
SPRD7	0.0777	-0.0034	-0.2193	0.0242	0.1325	0.1155
	(3.519)	(-1.266)	(-3.243)	(2.036)	(6.196)	
	(0.0005)	(0.2059)	(0.0012)	(0.0422)	(0.0001)	

Panel B. 1989

SPRD2	-0.0134	0.0036	0.0256	0.0186	0.0238	0.0823
	(-0.383)	(0.792)	(0.384)	(4.374)	(3.127)	
	(0.7018)	(0.4284)	(0.7013)	(0.0001)	(0.0018)	
SPRD7	-0.1107	0.0207	-0.1221	0.0465	0.0955	0.0868
	(-1.033)	(1.492)	(-1.642)	(3.459)	(4.100)	
	(0.3022)	(0.1363)	(0.1010)	(0.0006)	(0.0001)	

Panel C. 1990

SPRD2	0.0997	-0.0111	-0.1380	0.0752	-0.0435	0.1591
	(2.819)	(-2.274)	(-0.615)	(3.162)	(-1.311)	
	(0.0059)	(0.0252)	(0.5403)	(0.0021)	(0.1930)	
SPRD7	0.3509	-0.0392	-0.3330	0.1490	-0.0270	0.1006
	(3.240)	(-2.624)	(-1.333)	(1.857)	(-0.272)	
	(0.0017)	(0.0102)	(0.1857)	(0.0666)	(0.7862)	

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The numbers of observations for 1988-1990 are 596, 640, and 99, respectively. Across the dependent variables, the number of observations used differs slightly due to a few missing data points for seven-day periods.

3. SPRD2 and SPRD7 are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

4. TBILL is the three month treasury bill rate.

5. ADVOL is based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date for SPRD2 and SPRD7, respectively.

6. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

7. COVAR is the coefficient of variation of analysts' EPS forecasts.

Table 6-2. Regression of bid-ask spread on long-term government security market yield, trading volume, the absolute value of earnings surprise, and the coefficient of variation of analysts' EPS forecasts during 88-90. All variables are log-transformed. 97 % observations are used.

$$SPRD = \alpha_0 + \beta_1 TNOTE + \beta_2 ADVOL + \beta_3 ABSSURP + \beta_4 COVAR + \epsilon$$

Dep Var	INTERCEP	TNOTE	ADVOL	ABSSURP	COVAR	Adj. R^2
SPRD2	0.0163	-0.0002	-0.0555	0.0105	0.0373	0.0818
	(2.341)	(-0.252)	(-1.207)	(3.533)	(7.133)	
	(0.0194)	(0.8010)	(0.2277)	(0.0004)	(0.0001)	
SPRD7	0.0423	0.0010	-0.1870	0.0335	0.1088	0.0868
	(1.995)	(0.412)	(-3.742)	(3.697)	(6.883)	
	(0.0463)	(0.6803)	(0.0002)	(0.0002)	(0.0001)	

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. SPRD2 and SPRD7 are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

4. TNOTE is long term government market yield.

5. ADVOL is based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date for SPRD2 and SPRD7, respectively.

6. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

7. COVAR is the coefficient of variation of analysts' EPS forecasts.

Table 6-3. Rank regression of bid-ask spread on three month treasure bill rate, trading volume, the absolute value of earnings surprise, and the coefficient of variation of analysts' EPS forecasts during 88-90.

$$RSPRD = \alpha_0 + \beta_1 RTBILL + \beta_2 RADVOL + \beta_3 RABSSURP + \beta_4 RCOVAR + \epsilon$$

Dep. Var	INTERCEP	RTBILL	RADVOL	RABSSURP	RCOVAR	Adj. R^2
RSPRD2	4.1103	-0.0982	-0.1642	0.1619	0.1906	0.1143
	(20.108)	(-3.779)	(-6.626)	(5.459)	(6.424)	
	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	
RSPRD7	4.3424	-0.1169	-0.1838	0.1618	0.1822	0.1175
	(21.406)	(-4.507)	(-7.465)	(5.482)	(6.162)	
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. SPRD2 and SPRD7 are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

4. TBILL is the three month treasury bill rate.

5. ADVOL is based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date for SPRD2 and SPRD7, respectively.

6. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

7. COVAR is the coefficient of variation of analysts' EPS forecasts.

Table 7. Regression of bid-ask spread on three month treasure bill rate, number of analysts following, the absolute value of earnings surprise, and the coefficient of variation of analysts' EPS forecasts during 88-90. All variables are log-transformed. 97 % observations are used.

$$SPRD = \alpha_0 + \beta_1 TBILL + \beta_2 NUMRES + \beta_3 ABSSURP + \beta_4 COVAR + \epsilon$$

Dep. Var	INTERCEP	TBILL	NUMRES	ABSSURP	COVAR	Adj. R^2
SPRD2	0.0296	-0.0019	-0.0010	0.0100	0.0385	0.0862
	(6.014)	(-3.069)	(-1.292)	(3.362)	(7.288)	
	(0.0001)	(0.0022)	(0.1966)	(0.0008)	(0.0001)	
SPRD7	0.0975	-0.0059	-0.0037	0.0325	0.1127	0.0822
	(6.470)	(-3.121)	(-1.499)	(3.507)	(6.884)	
	(0.0001)	(0.0018)	(0.1340)	(0.0005)	(0.0001)	

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. SPRD2 and SPRD7 are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

4. TBILL is the three month treasury bill rate.

5. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

6. COVAR is the coefficient of variation of analysts' EPS forecasts.

7. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

Table 7-1. Yearly regressions of bid-ask spread on three month treasure bill rate, the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, and number of analysts following during 88-90. All variables are log-transformed. 97 % observations are used.

$$SPRD = \alpha_0 + \beta_1 TBILL + \beta_2 ABSSURP + \beta_3 COVAR + \beta_4 NUMRES + \epsilon$$

Panel A. 1988

Dep Var	INTERCEP	TBILL	ABSSURP	COVAR	NUMRES	Adj. R^2
SPRD2	0.0266	-0.0015	0.0006	0.0549	-0.0006	0.1091
	(3.588)	(-1.710)	(0.158)	(7.521)	(-0.554)	
	(0.0004)	(0.0879)	(0.8745)	(0.0001)	(0.5797)	
SPRD7	0.0831	-0.0042	0.0199	0.1423	-0.0055	0.1035
	(3.693)	(-1.528)	(1.631)	(6.303)	(-1.598)	
	(0.0002)	(0.1271)	(0.1034)	(0.0001)	(0.1106)	

Panel B. 1989

Dep Var	INTERCEP	TBILL	ABSSURP	COVAR	NUMRES	Adj. R^2
SPRD2	-0.0145	0.0038	0.0186	0.0234	-0.0012	0.0773
	(-0.412)	(0.824)	(4.285)	(3.011)	(-0.986)	
	(0.6807)	(0.4104)	(0.0001)	(0.0027)	(0.3245)	
SPRD7	-0.0928	0.0184	0.0447	0.0938	-0.0026	0.0768
	(-0.851)	(1.305)	(3.235)	(3.903)	(-0.717)	
	(0.3949)	(0.1924)	(0.0013)	(0.0001)	(0.4737)	

Panel C. 1990

Dep Var	INTERCEP	TBILL	ABSSURP	COVAR	NUMRES	Adj. R^2
SPRD2	0.1029	-0.0116	0.0656	-0.0327	-0.0033	0.1629
	(2.948)	(-2.414)	(2.845)	(-1.023)	(-0.946)	
	(0.0040)	(0.0177)	(0.0055)	(0.3087)	(0.3465)	
SPRD7	0.3487	-0.0390	0.1556	-0.0373	-0.0005	0.0762
	(3.144)	(-2.547)	(1.881)	(-0.371)	(-0.046)	
	(0.0022)	(0.0126)	(0.0632)	(0.7117)	(0.9637)	

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The numbers of observations for 1988-1990 are 603, 638, 98, respectively. Across the dependent variables, the number of observations used

differs slightly due to a few missing data points for seven-day periods.

3. SPRD2 and SPRD7 are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

4. TBILL is the three month treasury bill rate.

5. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

6. COVAR is the coefficient of variation of analysts' EPS forecasts.

7. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

Table 7-2. Regression of bid-ask spread on long-term government securities yield, the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, and number of analysts following during 88-90. All variables are log-transformed. 97 % observations are used.

$$SPRD = \alpha_0 + \beta_1 TNOTE + \beta_2 ABSSURP + \beta_3 COVAR + \beta_4 NUMRES + \epsilon$$

Dep Var	INTERCEP	TNOTE	ABSSURP	COVAR	NUMRES	Adj. R^2
SPRD2	0.0160	-0.0002	-0.0010	0.0094	0.0384	0.0798
	(2.309)	(-0.219)	(-1.224)	(3.172)	(7.246)	
	(0.0211)	(0.8265)	(0.2211)	(0.0016)	(0.0001)	
SPRD7	0.0431	0.0009	-0.0035	0.0301	0.1119	0.0755
	(2.001)	(0.351)	(-1.405)	(3.245)	(6.812)	
	(0.0456)	(0.7254)	(0.1603)	(0.0012)	(0.0001)	

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. SPRD2 and SPRD7 are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

4. TNOTE is long-term government securities yield.

5. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

6. COVAR is the coefficient of variation of analysts' EPS forecasts.

7. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

Table 7-3. Rank regression of bid-ask spread on three month treasure bill rate, number of analysts following, the absolute value of earnings surprise, and the coefficient of variation of analysts' EPS forecasts during 88-90.

$$RSPRD = \alpha_0 + \beta_1 RTBILL + \beta_2 RNUMRES + \beta_3 RABSSURP + \beta_4 RCOVAR + \epsilon$$

Dep. Var	INTERCEP	RTBILL	RNUMRES	RABSSURP	RCOVAR	Adj. R^2
RSPRD2	3.6657	-0.1033	-0.0483	0.1565	0.1832	0.0901
	(17.510)	(-3.925)	(-1.928)	(5.203)	(6.064)	
	(0.0001)	(0.0001)	(0.0540)	(0.0001)	(0.0001)	
RSPRD7	3.8213	-0.1213	-0.0451	0.1545	0.1704	0.0857
	(18.215)	(-4.593)	(-1.797)	(5.144)	(5.642)	
	(0.0001)	(0.0001)	(0.0725)	(0.0001)	(0.0001)	

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. SPRD2 and SPRD7 are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

4. TBILL is the three month treasury bill rate.

5. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

6. COVAR is the coefficient of variation of analysts' EPS forecasts.

7. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

Table 8. Regression of bid-ask spread on three month treasury bill rate, trading volume, the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, and the number of analysts following during 88-90. All variables are log-transformed. 97 % observations are used.

$$SPRD = \alpha_0 + \beta_1 TBILL + \beta_2 ADVOL + \beta_3 ABSSURP + \beta_4 COVAR + \beta_5 NUMRES + \epsilon$$

	Dependent Variables	
Var	SPRD2	SPRD7
INTERCEP	0.0304	0.0965
	(6.087)	(6.386)
	(0.0001)	(0.0001)
TBILL	-0.0020	-0.0059
	(-3.214)	(-3.067)
	(0.0013)	(0.0022)
ADVOL2	-0.0390	-0.8192
	(-0.494)	(-2.415)
	(0.6216)	(0.0159)
ABSSURP	0.0110	0.0362
	(3.629)	(3.86)
	(0.0003)	(0.0001)
COVAR	0.0381	0.1092
	(7.154)	(6.649)
	(0.0001)	(0.0001)
NUMRES	-0.0007	-0.0014
	(-0.903)	(-0.559)
	(0.3665)	(0.5765)
F Value	26.33	25.746
Adj R-sq	0.0888	0.0877

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. SPRD2 and SPRD7 are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

4. TBILL is the three month treasury bill rate.

5. ADVOL is based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date, respectively.

6. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

7. COVAR is the coefficient of variation of analysts' EPS forecasts.

8. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

Table 8-1. Yearly regressions of bid-ask spread on three month treasury bill rate, trading volume, the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, and the number of analysts following during 88-90. All variables are log-transformed. 97 % observations are used.

$$SPRD = \alpha_0 + \beta_1 TBILL + \beta_2 ADVOL + \beta_3 ABSSURP + \beta_4 COVAR + \beta_5 NUMRES + \epsilon$$

Panel A. 1988

	Dependent Variables	
Var	SPRD2	SPRD7
INTERCEP	0.0286	0.0806
	(3.761)	(3.595)
	(0.0002)	(0.0004)
TBILL	-0.0018	-0.0038
	(-1.935)	(-1.405)
	(0.0535)	(0.1606)
ADVOL2	-0.1429	-0.2274
	(-2.135)	(-3.259)
	(0.0332)	(0.0012)
ABSSURP	0.0023	0.0242
	(0.549)	(1.999)
	(0.5832)	(0.046)
COVAR	0.0554	0.1397
	(7.441)	(6.23)
	(0.0001)	(0.0001)
NUMRES	-0.0001	-0.0030
	(-0.082)	(-0.873)
	(0.9348)	(0.383)
F Value	16.164	16.673
Adj R-sq	0.1158	0.1198

Panel B. 1989

INTERCEP	-0.0215	-0.1492
	(-0.609)	(-1.388)
	(0.5425)	(0.1656)
TBILL	0.0046	0.0257
	(1.014)	(1.846)
	(0.3109)	(0.0654)
ADVOL2	0.0466	-0.1141
	(0.678)	(-1.485)
	(0.4983)	(0.1381)
ABSSURP	0.0197	0.0489
	(4.532)	(3.562)
	(0.0001)	(0.0004)
COVAR	0.0219	0.0874
	(2.83)	(3.704)
	(0.0048)	(0.0002)
NUMRES	-0.0009	0.0015
	(-0.774)	(0.42)
	(0.4394)	(0.6746)
F Value	12.173	12.325
Adj R-sq	0.0823	0.0847

Panel C. 1990

INTERCEP	0.1044	0.3455
	(2.94)	(3.048)
	(0.0042)	(0.003)
TBILL	-0.0118	-0.0385
	(-2.413)	(-2.461)
	(0.0179)	(0.0158)
ADVOL2	0.0281	-0.3753
	(0.115)	(-1.295)
	(0.9091)	(0.1988)
ABSSURP	0.0675	0.1549
	(2.867)	(1.873)
	(0.0052)	(0.0643)

COVAR	-0.0352	-0.0279
	(-1.083)	(-0.276)
	(0.2817)	(0.7829)
NUMRES	-0.0042	0.0048
	(-1.059)	(0.399)
	(0.2926)	(0.6909)
F Value	4.689	2.779
Adj R-sq	0.1626	0.0864

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The numbers of observations for 1988-1990 are 580, 624, 96, respectively. Across the dependent variables, the number of observations used differs slightly due to a few missing data points for seven-day periods.

3. SPRD2 and SPRD7 are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

4. TBILL is the three month treasury bill rate.

5. ADVOL is based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volumemetrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date, respectively.

6. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

7. COVAR is the coefficient of variation of analysts' EPS forecasts.

8. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

Table 8-2. Regression of bid-ask spread on long-term government securities yield, trading volume, the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, and the number of analysts following during 88-90. All variables are log-transformed. 97 % observations are used.

$$SPRD = \alpha_0 + \beta_1 TNOTE + \beta_2 ADVOL + \beta_3 ABSSURP + \beta_4 COVAR + \beta_5 NUMRES + \epsilon$$

	Dependent Variables	
Var	SPRD2	SPRD7
INTERCEP	0.0157	0.0395
	(2.228)	(1.843)
	(0.026)	(0.0655)
TNOTE	-0.0001	0.0013
	(-0.178)	(0.525)
	(0.8588)	(0.5999)
ADVOL2	-0.0433	-0.1872
	(-0.906)	(-3.611)
	(0.365)	(0.0003)
ABSSURP	0.0109	0.0345
	(3.614)	(3.719)
	(0.0003)	(0.0002)
COVAR	0.0375	0.1080
	(7.002)	(6.64)
	(0.0001)	(0.0001)
NUMRES	-0.0006	-0.0001
	(-0.756)	(-0.059)
	(0.4497)	(0.9529)
F Value	24.277	25.107
Adj R-sq	0.0822	0.0858

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. SPRD2 and SPRD7 are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

4. TNOTE is long-term government securities yield.

5. ADVOL is based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date, respectively.

6. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

7. COVAR is the coefficient of variation of analysts' EPS forecasts.

8. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

Table 8-3 Rank regression of bid-ask spread on three month treasury bill rate, trading volume, the absolute value of earnings surprise, the coefficient of variation of analysts' EPS forecasts, and the number of analysts following during 88-90.

$$RSPRD = \alpha_0 + \beta_1 RTBILL + \beta_2 RADVOL + \beta_3 RABSSURP + \beta_4 RCOVAR + \beta_5 RNUMRES + \epsilon$$

	Dependent	Variables
Var	RSPRD2	RSPRD7
INTERCEP	4.1742	4.3756
	(18.85)	(19.898)
	(0.0001)	(0.0001)
RTBILL	-0.0986	-0.1171
	(-3.793)	(-4.512)
	(0.0002)	(0.0001)
RADVOL2	-0.1607	-0.1819
	(-6.374)	(-7.246)
	(0.0001)	(0.0001)
RABSSURP	0.1610	0.1613
	(5.425)	(5.461)
	(0.0001)	(0.0001)
RCOVAR	0.1930	0.1834
	(6.466)	(6.167)
	(0.0001)	(0.0001)
RNUMRES	-0.0189	-0.0098
	(-0.751)	(-0.391)
	(0.453)	(0.6957)
F Value	38.873	39.698
Adj R-sq	0.1141	0.1169

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. SPRD2 and SPRD7 are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

4. TBILL is the three month treasury bill rate.

5. ADVOL is based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date, respectively.

6. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

7. COVAR is the coefficient of variation of analysts' EPS forecasts.

8. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

Table 9. Two stage least square regression of bid-ask spread on three month treasure bill rate, trading volume, the absolute value of earnings surprise, and the coefficient of variation of analysts' EPS forecasts during 88-90. All variables are log-transformed. 97 % observations are used.

$$SPRD = \alpha_0 + \beta_1 TBILL + \beta_2 ADVOL + \beta_3 ABSSURP + \beta_4 COVAR + \epsilon$$
$$ADVOL = \alpha_0 + \beta_1 TBILL + \beta_2 ABSSURP + \beta_3 COVAR + \beta_4 NUMRES + \epsilon$$

Dep. Var	INTERCEP	TBILL	ADVOL	ABSSURP	COVAR	Adj. R^2
SPRD2	0.0301	-0.0020	-0.3045	0.0120	0.0388	0.0892
	(6.036)	(-3.109)	(-0.936)	(3.951)	(6.732)	
	(0.0001)	(0.0019)	(0.3494)	(0.0001)	(0.0001)	
SPRD7	0.0940	-0.0055	-0.2272	0.0372	0.1091	0.0836
	(6.175)	(-2.817)	(-0.671)	(3.950)	(6.321)	
	(0.0001)	(0.0049)	(0.5026)	(0.0001)	(0.0001)	

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. SPRD2 and SPRD7 are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

4. TBILL is the three month treasury bill rate.

5. ADVOL is based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date for SPRD2 and SPRD7, respectively.

6. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

7. COVAR is the coefficient of variation of analysts' EPS forecasts.

8. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

Table 9-1. 2 stage least square rank regression of bid-ask spread on three month treasure bill rate, trading volume, the absolute value of earnings surprise, and the coefficient of variation of analysts' EPS forecasts during 88-90.

$$
\begin{aligned}
RSPRD &= \alpha_0 + \beta_1 RTBILL + \beta_2 RADVOL + \beta_3 RABSSURP + \\
&\quad \beta_4 RCOVAR + \epsilon \\
RADVOL &= \alpha_0 + \beta_1 RTBILL + \beta_2 RABSSURP + \beta_3 RCOVAR + \\
&\quad \beta_4 RNUMRES + \epsilon
\end{aligned}
$$

Dep. Var	INTERCEP	RTBILL	RADVOL	RABSSURP	RCOVAR	Adj. R^2
RSPRD2	3.5807	-0.0958	-0.0620	0.1634	0.2010	0.0908
	(18.902)	(-3.615)	(-2.196)	(5.425)	(6.274)	
	(0.0001)	(0.0003)	(0.0282)	(0.0001)	(0.0001)	
RSPRD7	3.7398	-0.1157	-0.0577	0.1624	0.1875	0.0863
	(19.712)	(-4.366)	(-2.017)	(5.384)	(5.825)	
	(0.0001)	(0.0001)	(0.0439)	(0.0001)	(0.0001)	

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The number of observations differs slightly across the models due to a few missing data points for seven-day periods.

3. SPRD2 and SPRD7 are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announcement date, respectively.

4. TBILL is the three month treasury bill rate.

5. ADVOL is based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date for SPRD2 and SPRD7, respectively.

6. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

7. COVAR is the coefficient of variation of analysts' EPS forecasts.

8. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

Table 10. Regression of bid-ask spread on the variables specified in the model along with other determinants of bid-ask spreads. All variables are log-transformed.

$$SPRD = \alpha_0 + \beta_1 TBILL + \beta_2 ADVOL + \beta_3 ABSSURP + \beta_4 COVAR + \beta_5 NUMRES + \beta_6 VOLATIL + \beta_7 PRICE + \beta_8 MARKET + \epsilon$$

Panel A. Two-day window

Variable	Regressions		
INTERCEP	0.0146	0.0830	0.0772
	(1.456)	(11.205)	(10.361)
	(0.1456)	(0.0001)	(0.0001)
TBILL	-0.0014	-0.0098	-0.0083
	(-0.29)	(-2.843)	(-2.417)
	(0.7720)	(0.0045)	(0.0158)
ADVOL2	-0.2516	-0.1129	-0.1221
	(-5.439)	(-3.402)	(-3.707)
	(0.0001)	(0.0007)	(0.0002)
ABSSURP	0.0117	0.0044	0.0043
	(4.012)	(2.107)	(2.058)
	(0.0001)	(0.0353)	(0.0398)
COVAR	0.0235	0.0045	0.0046
	(4.608)	(1.215)	(1.268)
	(0.0001)	(0.2247)	(0.2052)
NUMRES	-0.0006	-0.0018	-0.0021
	(-0.811)	(-3.578)	(-4.055)
	(0.4175)	(0.0004)	(0.0001)
VOLATIL	12.372	3.4537	3.6935
	(12.497)	(4.586)	(4.936)
	(0.0001)	(0.0001)	(0.0001)
PRICE		-0.0140	-0.0130
		(-33.529)	(-28.101)
		(0.0001)	(0.0001)
MARKET			-2.09E-7
			(-4.651)
			(0.0001)
F Value	46.129	238.656	215.267
Adj R-sq	0.1894	0.5894	0.5966

Panel B. Seven-day window

INTERCEP	0.0515	0.2907	0.2721
	(1.770)	(15.832)	(14.843)
	(0.0769)	(0.0001)	(0.0001)
TBILL	-0.0049	-0.0382	-0.0336
	(-0.346)	(-4.502)	(-3.997)
	(0.7291)	(0.0001)	(0.0001)
ADVOL7	-0.3384	-0.1651	-0.1743
	(-6.953)	(-5.573)	(-5.966)
	(0.0001)	(0.0001)	(0.0001)
ABSSURP	0.0371	0.0141	0.0136
	(4.34)	(2.718)	(2.654)
	(0.0001)	(0.0067)	(0.0081)
COVAR	0.0590	-0.0047	-0.0040
	(3.899)	(-0.51)	(-0.445)
	(0.0001)	(0.6105)	(0.6566)
NUMRES	0.0010	-0.0038	-0.0046
	(0.472)	(-2.953)	(-3.603)
	(0.6368)	(0.0032)	(0.0003)
VOLATIL	39.8059	9.7525	10.546
	(13.554)	(5.145)	(5.637)
	(0.0001)	(0.0001)	(0.0001)
PRICE		-0.0463	-0.0432
		(-44.783)	(-37.837)
		(0.0001)	(0.0001)
MARKET			-6.67E-7
			(-6.109)
			(0.0001)
F Value	51.397	407.41	372.427
Adj R-sq	0.2075	0.7112	0.7201

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The dependent variables are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announce-

ment date for panel A and panel B, respectively.

3. TBILL is the three month treasury bill rate.

4. ADVOL is based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date, respectively.

5. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

6. COVAR is the coefficient of variation of analysts' EPS forecasts.

7. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

8. VOLATIL is the variance of the 30 day bid-ask average before earnings announcements.

9. Price is stock price.

10. Market is the market value of the firm at the end of the fiscal year.

Table 10-1. Rank regression of bid-ask spread on the variables specified in the model along with other determinants of bid-ask spreads.

$$SPRD = \alpha_0 + \beta_1 RTBILL + \beta_2 RADVOL + \beta_3 RABSSURP + \beta_4 RCOVAR + \beta_5 RNUMRES + \beta_6 RVOLATIL + \beta_7 RPRICE + \beta_8 RMARKET + \epsilon$$

Panel A. Two-day window

Variable	Regressions		
INTERCEP	2.6357	8.2380	9.8923
	(11.148)	(39.864)	(46.593)
	(0.0001)	(0.0001)	(0.0001)
RTBILL	0.0196	-0.0702	-0.0664
	(0.747)	(-3.983)	(-4.137)
	(0.4550)	(0.0001)	(0.0001)
RADVOL2	-0.2748	-0.1077	-0.1018
	(-10.852)	(-6.222)	(-6.453)
	(0.0001)	(0.0001)	(0.0001)
RABSSURP	0.1654	0.0682	0.0384
	(5.813)	(3.578)	(2.2)
	(0.0001)	(0.0004)	(0.0280)
RCOVAR	0.1212	0.0078	0.0127
	(4.209)	(0.402)	(0.718)
	(0.0001)	(0.6879)	(0.4730)
RNUMRES	0.0158	-0.0371	0.0075
	(0.652)	(-2.293)	(0.499)
	(0.5146)	(0.0220)	(0.6177)
RVOLATIL	0.4078	0.0718	0.0630
	(14.355)	(3.494)	(3.364)
	(0.0001)	(0.0005)	(0.0008)
RPRICE		-0.7586	-0.5391
		(-41.808)	(-25.626)
		(0.0001)	(0.0001)
RMARKET			-0.4339
			(-16.868)
			(0.0001)
F Value	68.944	383.175	439.377
Adj R-sq	0.2263	0.6574	0.7156

Panel B. Seven-day window

INTERCEP	2.6465	8.8448	10.5897
	(11.311)	(51.424)	(64.208)
	(0.0001)	(0.0001)	(0.0001)
RTBILL	0.0132	-0.0870	-0.0826
	(0.508)	(-5.956)	(-6.647)
	(0.6115)	(0.0001)	(0.0001)
RADVOL7	-0.2871	-0.1075	-0.1115
	(-11.569)	(-7.567)	(-9.224)
	(0.0001)	(0.0001)	(0.0001)
RABSSURP	0.1684	0.0621	0.0319
	(6.008)	(3.943)	(2.371)
	(0.0001)	(0.0001)	(0.0179)
RCOVAR	0.1041	-0.0211	-0.0152
	(3.664)	(-1.317)	(-1.119)
	(0.0003)	(0.1881)	(0.2634)
RNUMRES	0.0259	-0.0386	0.0094
	(1.079)	(-2.876)	(0.807)
	(0.2808)	(0.0041)	(0.4197)
RVOLATIL	0.4344	0.0681	0.0623
	(15.589)	(4.03)	(4.338)
	(0.0001)	(0.0001)	(0.0001)
RPRICE		-0.8312	-0.5984
		(-55.29)	(-36.649)
		(0.0001)	(0.0001)
RMARKET			-0.4556
			(-22.939)
			(0.0001)
F Value	75.816	645.811	846.385
Adj R-sq	0.2449	0.7653	0.8301

1. Each cell reports the estimated coefficient, and t-statistics and p-value in parenthesis.

2. The dependent variables are based on the bid-ask spread cumulated from day -1 to day 0 and from day -1 to day 5 relative to the earnings announce-

ment date for panel A and panel B, respectively.

3. TBILL is the three month treasury bill rate.

4. ADVOL is based on the firm's percentage of shares traded minus the percentage of NYSE firms' shares traded. The trading volume metrics are cumulated from day -1 to day 0, from day -1 to day 5, relative to the earnings announcement date, respectively.

5. ABSSURP (absolute earnings surprise) are the absolute value of analysts' forecast errors.

6. COVAR is the coefficient of variation of analysts' EPS forecasts.

7. NUMRES is the residual number of analysts following after regressing the number of analysts following on market value of the firm.

8. VOLATIL is the variance of the 30 day bid-ask average before earnings announcements.

9. Price is stock price.

10. Market is the market value of the firm at the end of the fiscal year.

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