The Sensitivity of Observed Trading Volume Reactions to the Choice of Trading Volume Reaction Metric

Young Sam Kim  
Department of Accountancy

David A. Ziebart  
Department of Accountancy

Bureau of Economic and Business Research  
College of Commerce and Business Administration  
University of Illinois at Urbana-Champaign
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Young Sam Kim

and

David A. Ziebart*

Department of Accountancy

*Associate Professor of Accountancy, Office of Accounting Research Fellow, University of Illinois at Urbana-Champaign.

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THE SENSITIVITY
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Synopsis

The purpose of this investigation is to examine the sensitivity of trading volume event studies to alternative trading volume metrics. Many previous trading volume event studies have used different trading volume metrics and the sensitivity of the observed trading reactions to these alternative trading volume metrics has not been fully assessed. This objective is accomplished in this study by assessing the degree to which the results of a simple information content study regarding the trading volume reaction to earnings announcements are sensitive to the choice of trading volume metric employed.

We conduct our analysis of the similarity of results using six alternative trading volume metrics. We assess the consistency of observed correlations between the observed volume reactions to an earnings announcement (based on the alternative trading volume metrics) and the magnitude of the surprise in the earnings announcement. Our analysis suggests that results and inferences may vary across alternative trading volume metrics for the same study. In fact, the sign of the rank-order correlation between unexpected earnings and the observed trading volume reaction varies across the alternative trading volume metrics.

**KEYWORDS:** stock reaction; trading volume; volume reaction; alternative trading volume reaction metrics
THE SENSITIVITY OF OBSERVED TRADING VOLUME REACTIONS TO THE CHOICE OF TRADING VOLUME REACTION METRIC

1. INTRODUCTION

The purpose of this investigation is to examine the sensitivity of trading volume event studies to alternative trading volume metrics. This topic is important since many previous trading volume event studies have used different trading volume metrics and the sensitivity of the observed trading reactions to these alternative trading volume metrics has not been assessed. It is important to determine if the results of trading volume event studies and the accompanying inferences are robust across alternative trading volume reaction metrics. This objective is accomplished in this study by assessing the degree to which the results of a simple information content study regarding the trading volume reaction to earnings announcements are sensitive to the choice of trading volume metric employed.¹

Stock market trading reactions to informative events have been analyzed since the late 1950s in the finance and accounting literatures.² The primary motivation for studying trading volume is that trading volume reactions to an informative event may convey a different meaning than the observed price reaction to the same informative event (Beaver [1968]). Numerous studies have documented an observed trading volume reaction to an informative event (Bamber [1986], Bamber [1987], Beaver [1968], Morse [1981], and others). However, various trading

¹ We do not examine the generalizability of our results, which are based on a simple information content analysis, to other trading volume reaction studies so as to determine the extent to which the inferences from these other studies may have been impacted by the choice of trading volume metric analyzed. Instead, we demonstrate that, for the event we have chosen to study, the observed results and the associated inferences are affected by the choice of trading volume metric. We believe that this evidence draws attention to the potential problem in empirical research focusing on trading volume reactions and that the onus is placed on the researcher to assess the degree to which her/his results may be driven by the choice of trading volume metric.

² See Karpoff [1987] for a recent survey of research in finance using trading volume.
volume metrics have been employed in these studies and we do not know the extent to which
the inferences are robust across the alternative trading volume metrics.

It is difficult to compare trading volume reaction results across studies since researchers
have employed different trading volume reaction metrics. For instance, for two trading volume
reaction studies on the same topic, it is difficult to know whether the results and inferences in
one study, using a particular volume metric, are comparable to the results of the second study,
which uses a different volume reaction metric. This lack of comparability across studies and our
lack of knowledge regarding the robustness of inferences using alternative volume reaction
metrics motivates this study. By documenting the sensitivity of trading volume reaction results,
using alternative trading volume metrics which have appeared in the literature, we hope to
provide researchers with useful information concerning whether choice of trading volume metric
is an issue in trading volume reaction research.

Although almost all researchers agree that trading volume conveys a different meaning
than abnormal returns or price changes, there has been little consensus as to what constitutes
the normal trading volume of a firm and, accordingly, abnormal trading volume. There is no
consensus on to operationalize either normal or abnormal trading volume.\(^3\)

Previous analytical research by Verrechia [1981], Hakansson, Kunkel and Ohlson [1982,
1984], Pfleiderer [1984], Varian [1986], Karpoff [1986], Grundy and McNichols [1989], Jang and
Ro [1989], Lang and Litzenberger [1989], Holthausen and Verrechia [1990], and others has
attempted to identify various factors that generate trading activity. Generally, the following
factors have been identified as potential justifications for observed trading activity:

(1) Differences in endowments;

(2) Differences in prior beliefs;

(3) Release and acquisition of both public and private information;

\(^3\) In stock returns studies, the CAPM has played a role in operationalizing the normal return of a firm. See
Brown and Warner [1980] for the documentation of the sensitivity of alternative abnormal return measures in event
studies.
(4) Differences in interpretation of information;
(5) Differences in risk preferences of traders;
(6) Tax purposes;
(7) Portfolio rebalancing purposes; and
(8) Transaction costs.

Unfortunately, none of the analytical work provides the insights needed to determine appropriate measures of normal trading activity and, consequently, the appropriate measure of abnormal trading volume. As a result, previous trading volume studies have employed different methods to operationalize normal trading volume and have based their analysis on alternative abnormal trading volume metrics. Some of the approaches used to measure a trading volume reaction in the previous literature include:

(1) the market model (e.g., Beaver [1968]);
(2) standardization of prediction errors from the market model (e.g., Morse [1980, 1981], Bamber [1986]);
(3) the market model with log transformed variables (e.g., Bamber [1987]);
(4) standardization of prediction errors from the market model with log transformed variables (e.g., Bamber [1987]);
(5) percentage of trading without adjustment (e.g., Beaver [1968], Foster [1973], Nichols, Tsay, and Larkin [1979], Bamber [1986]);
(6) mean-adjusted trading volume (e.g., Peterson and Wohlgemuth [1989]);
(7) median-adjusted trading volume (e.g., Bamber [1986, 1987], Ou, Sepe, and Ushman [1988]); and
(8) other methods (e.g., Kiger [1972], Ro [1981]).

The extent to which results and inferences may vary across alternative volume metrics has not been assessed and no in-depth analysis has been conducted to substantiate that trading volume research results can be generalized across alternative trading volume metrics.
We conduct our analysis of the similarity of results using alternative trading volume metrics within a simple information content of earnings announcements context. The major focus is on the degree of consistency across alternative volume reaction metrics which we assess by measuring the consistency of observed correlations between the observed volume reactions (based on the alternative trading volume metrics) to an earnings announcement and the magnitude of the surprise in the earnings announcement. We document the Spearman rank-order correlations and Pearson product-moment correlations for the alternative volume reaction metrics measured during the earnings announcement week. We also document the Spearman rank-order correlations between the alternative trading volume metrics for a three week event window surrounding the earnings announcement and the magnitude of the earnings surprise in the announcement.4

Our analysis suggests that results and inferences may vary across alternative trading volume metrics for the same study. In fact, the sign of the rank-order correlation between unexpected earnings and the observed trading volume reaction varies across the alternative trading volume metrics.

The next section describes the research design, variables, and sample of this study. The third section reports the descriptive characteristics of the sample while section four reports the results of our analyses. The last section summarizes our results and discusses our conclusions and recommendations.

2. RESEARCH DESIGN, VARIABLES, AND SAMPLE

In order to evaluate the sensitivity of trading volume reaction results across alternative trading volume metrics, we analyze the trading volume reactions to earnings announcements, a

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4 We choose to focus our analysis primarily on the rank-order correlations so as to avoid the common problems found when the product-moment correlation is used (i.e., outliers).
straight-forward and traditional application. This allows us to compare the results of alternative trading volume metrics in a readily accepted research context.

We conduct our analyses using two different event windows for the earnings announcement event. A three week event window consisting of the week prior to the week of the earnings announcement, the week of the announcement, and the subsequent week for each earnings announcement is used and an average weekly volume reaction measure is employed. This three week event window is used to examine the consistency of the computed volume reaction across the alternative trading volume metrics. A similarly defined seven week event period is used to analyze the weeks individually and to examine the consistency of the alternative volume metrics for each of the seven weeks in that event window.

We employ a random walk model for modeling the market's expectations of earnings prior to the earnings announcement.\(^5\) Unexpected earnings (UE) is defined as the absolute value of the difference between the current period's (either the annual or the quarterly) earnings per share before extraordinary items (EPSBEI\(_t\)) and the previous period's (either the annual or the quarterly) earnings per share before extraordinary items (EPSBEI\(_{t-1}\)) deflated by either the prior period's stock price (P\(_{t-1}\)) or the prior period's earnings per share (EPSBEI\(_{t-1}\)). These two measures can be expressed as:

\[
\text{AUEP} = \frac{|\text{EPSBEI}_t - \text{EPSBEI}_{t-1}|}{\text{P}_{t-1}} \\
\text{AUEE} = \frac{|\text{EPSBEI}_t - \text{EPSBEI}_{t-1}|}{|\text{EPSBEI}_{t-1}|} \tag{2}
\]

Unlike most previous studies which examined the information content of either annual or quarterly earnings information, this study examines both annual and quarterly announcements. This allows us to assess the consistency of our results across the different types of earnings announcement events.

\(^5\) Fried and Givoly [1982] and Bamber [1986] report that the random walk earnings expectation model performs better than an expectation model based on financial analysts' forecasts. model. We do not examine this contention since our aim is to examine sensitivity across alternative volume reaction metrics. We employ the same surrogate for expectations across all our analyses in order to facilitate our comparison. A topic for future study could examine the interaction between alternative earnings expectation models and the alternative trading volume reaction metrics.
For our analysis we choose six alternative trading volume metrics from the trading volume reaction methods employed in previous trading volume research. One of the alternative volume metrics, labeled VI, does not attempt to control for any normal level of trading. However, the other five volume metrics attempt to control for a normal level of trading. Three of the alternative abnormal volume metrics we use (V2, V3, and V4) control for market-wide trading with two of the metrics (V2 and V3) utilizing a "market model" approach. The other metric that controls for market-wide trading (V4) assumes that the trading sensitivity between the individual security and the market is equal and simply subtracts the percentage of market-wide trading from the firm's percentage trading volume. The remaining two abnormal volume metrics, V5 and V6, control for the normal level of trading by adjusting for the normal (average) trading of the firm observed during a defined time period. Except for VI and V4, which do not need estimation periods, the other volume metrics use the calendar year in which the earnings announcement is made for the estimation period.\(^6\) The six alternative trading volume methods are defined as the following.

**VI: Weekly Percentage of Shares Traded**

VI, the percentage of shares traded for firm i in week t (PT\(_{it}\)), is calculated as the number of shares traded for firm i in week t divided by the number of shares outstanding for firm i in week t:

\[
PT_{it} = \frac{\text{number of shares traded for firm } i \text{ in week } t}{\text{number of shares outstanding for firm } i \text{ in week } t}
\]

This trading volume metric is the raw percentage of shares traded without any adjustment for either market-wide or firms-specific levels of normal trading.

\(^6\) The use of the calendar year in which the earnings announcement occurs for estimating the market model parameters or computing the mean and median trading activity for an individual firm differs somewhat from the techniques employed in most previous studies. In the previous studies, an estimation period which does not include the event window has been typically employed. Our approach would be somewhat biased against observing a reaction but this should have no systematic bias in our comparisons across the different volume reaction metrics.
V2: Log Transformed Regression Prediction Errors

V2 employs a market model regression approach with a log transformation.

\[ \ln(PT_{it}) = a_i + b_i \ln(PM_t) + \epsilon_{it} \]  

where:  
- \( PT_{it} \) = percentage of shares traded for firm i in week t,  
- \( PM_t \) = percentage of shares traded for NYSE firms in week t,  
- \( a_i, b_i \) = regression constant and coefficient for firm i,  
- \( \epsilon_{it} \) = an error term for firm i in week t.

For each firm, the regression parameters are estimated for the 52 weeks of the year in which the earnings announcement occurred. V2 is the observed residual:

\[ V2_{it} = \ln(PT_{it}) - [a_i + b_i \ln(PM_t)] \]  

V3: Standardized Prediction Errors

V3 attempts to control for the degree of variability in the regression residuals across firms. Standardized prediction errors (\( \Delta_{it} \)) are obtained by dividing the prediction errors by the standard deviations of the distribution of the errors during the year.

\[ V3 = \Delta_{it} = [PT_{it} - (\alpha_i + \beta_i PM_t)]/\sigma[PT_{it} - (\alpha_i + \beta_i PM_t)] \]  

V4: Market-Adjusted Weekly Percentage of Shares Traded

V4 is calculated by subtracting the percentage of shares traded for the NYSE firms in week t (\( PM_t \)) from the percentage of shares traded for firm i in week t (\( PT_{it} \)):

\[ V4 = PT_{it} - PM_t \]  

This trading volume metric adjusts for market-wide effects and implicitly assumes that the normal level of trading for the individual security is the same as the percentage of shares traded in the market. Obviously, the major
weakness of this trading volume metric is that it ignores each firm's unique factors which may constitute the normal trading level of the firm.

**V5: Mean-Adjusted Weekly Percentage of Shares Traded**

V5 is calculated by subtracting the average percentage of shares traded for firm i for each year (Mean[PT\textsubscript{it}]) from the firm's weekly percentage of shares traded (PT\textsubscript{it}):

\[
V5 = MPT_{it} = PT_{it} - \text{Mean}[P_{ti}] ,
\]

(7)

**V6: Median-Adjusted Weekly Percentage of Shares Traded**

V6 is calculated by subtracting the median percentage of shares traded for firm i for each year from each firm's weekly percentage of shares traded (PT\textsubscript{it}):

\[
V6 = DPT_{it} = PT_{it} - \text{Med}[P_{ti}] .
\]

(8)

Each of these trading volume metrics has been employed in previous trading volume reaction research.

Our sample of observations consists of 566 earnings announcements for 74 NYSE firms with calendar year-ends which satisfy the following criteria:

1. weekly trading volume data are available in *ISL Daily Stock Record* for the year in which the earnings announcement is made;
2. the firm announced annual earnings and/or quarterly earnings during the 1979 through the 1982 period, and the announcement is listed in *The Wall Street Journal Index*;
3. the firm's EPS figures are available in the *COMPSTAT* Annual and/or Quarterly Industrial Tape for the sample period; and
4. there were no major confounding events such as stock splits, mergers, divestitures, dividends, litigation, and strikes during the three weeks surrounding the week of the earnings announcements.
The weekly trading volume data as well as the number of shares outstanding are collected from the *ISL Daily Stock Record.*

3. CHARACTERISTICS OF SAMPLE FIRMS

Table 1 reports descriptive statistics regarding the distribution of the earnings announcements across years and quarters. In addition, the correlations for the earnings surprise surrogates based on the two alternative deflators are provided. Panel A indicates that the observations are distributed relatively even across the three years. In addition, the number of observations is fairly consistent across the quarters.

**INSERT TABLE 1**

Panel B reports the correlations for the earnings surprise measures based on the two different deflators. As expected, the rank order correlation exceeds the product-moment correlation since it ignores magnitudes. This also suggests that the observed product-moment correlation is not due to a few extreme observations.

4. RESULTS

The Spearman rank-order correlations and Pearson product-moment correlations across the alternative trading volume metrics for the observed trading volume reactions in the week of the earnings announcement, based on the complete sample, are provided in Table 2. It is apparent that the six alternative trading volume metrics can be dichotomized by the magnitude of the correlation coefficients (an indicator of consistency) among the alternative trading volume reaction metrics. The volume reaction metrics attempting to adjust for market-wide effects

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7 The data used in this study is a subsample of the data used in Ziebart’s [1990] study of the association between dispersion of beliefs and trading volume. See Ziebart [1990] for a more thorough description of the data.

8 The Spearman rank-order correlation coefficients using the seven week event period \((t = -3, -2, -1, 0, +1, +2, \text{ and } +3)\) are not different from those in the announcement week although the results are not reported here. For the seven week event period, small differences in the Spearman rank correlation coefficients between the volume metrics are found among different announcements (annual and quarterly).
(the log transformed regression prediction errors \(V2\), the standardized regression prediction errors \(V3\), and the market-adjusted abnormal volume metric \(V4\)) are closely related to each other. In addition, these three volume reaction metrics \((V2, V3, \text{and } V4)\) are also more closely associated with the unadjusted weekly percentage of trading volume \((VI)\) than are the other two volume metrics \((V5 \text{ and } V6)\). As expected, the mean-adjusted abnormal trading volume metric \((V5)\) is more closely correlated with the median-adjusted abnormal volume metric \((V6)\) than any of the other volume metrics attempting to adjust for market-wide factors. These results suggest that the five alternative volume metrics which attempt to control for normal trading can be aggregated in two groups (group 1: \(V2, V3, \text{and } V4\); and group 2: \(V5 \text{ and } V6\)). In addition, these results suggest that unadjusted trading activity \((VI)\) is highly correlated with all of the other alternative metrics.

**INSERT TABLE 2**

Tables 3a and 3b provide the Spearman rank-order correlations between the average trading volume reactions, across the alternative trading volume metrics, and the absolute value of the unexpected earnings deflated by stock price (AUEP) or the absolute value of the unexpected earnings deflated by the absolute value of earnings (AUEE) for the three week event window. Overall, the inferences from Tables 3a and 3b are similar. For metrics \(VI, V2, V3, \text{ and } V4\), the correlation coefficients for the group of first quarter announcements, the group of all quarterly announcements, and the total sample of all announcements (both annual and quarterly) reject the null hypotheses that the correlation coefficients between the trading volume reaction and the magnitude of the surprise in the earnings announcement are equal to zero. This is not surprising since these four trading volume metrics are highly correlated with each other.

The two abnormal trading volume metrics that use the firm's average trading volume level to control for the normal level of trading activity, \(V5 \text{ and } V6\), only reject the null hypothesis of no relationship in one instance (for the total sample using \(V5\) when stock price is the deflator
for unexpected earnings). For the alternative volume metrics \( V_1, V_2, V_3, \) and \( V_4 \), the correlation coefficients are the largest for the first quarter earnings announcements. The third quarter announcements are the second largest in magnitude; followed by the second quarter and annual (fourth quarter) announcements. Although the results reported in Table 3a and Table 3b are similar, the magnitude of the correlation between the trading volume reaction metric and the surprise in earnings is mixed across quarters and measures.\(^9\)

INSERT TABLES 3a and 3b

It is distressing to note the discrepancy in the association between the earnings surprise and the observed trading volume reaction across the alternative trading volume reaction metrics. The observed negative correlations between the observed trading volume reactions and the absolute value of the surprise in earnings are of particular concern.

Table 4a indicates that the correlation coefficients between the absolute value of the surprise in the earnings announcements and the trading volume reactions are significant (\( \alpha < .05 \) level) for \( V_3 \) and \( V_4 \) for all seven weeks surrounding the earnings announcements when price is used as the unexpected earnings deflator. The correlations for \( V_2 \) are significant for weeks \( t-3, t-2, t=0, t=1, t=2, \) and \( t+3 \). The correlation between the earning surprise and the observed trading reaction is significant for weeks \( t-3, t-2, t=0, t=2, \) and \( t=3 \) for \( V_1 \). Most of the correlation coefficients for volume metrics \( V_5 \) and \( V_6 \) are negative but not statistically significant (\( \alpha > .05 \)). However, the correlation is significantly negative for volume metric \( V_5 \) for weeks \( t-1 \) and \( t+1 \). Similar to the results reported in Table 3a, the observation of either insignificant and/or negative rank-order correlations between the observed volume reaction and the absolute value of the earnings surprise is of concern.

INSERT TABLES 4a AND 4b

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\(^9\) These results are contrary to those reported by Bamber [1987, Table 3, p. 520]. She finds the correlation between the trading volume reaction and the absolute value of the earnings surprise to be the smallest for the first quarter earnings announcements.
Table 4b provides the rank-order correlations between the observed trading reaction and the absolute value of the earnings surprise when earnings per share is used as the deflator. The correlation coefficients based on VI are statistically significant in the week of the earnings announcement and the three subsequent weeks. The other three volume metrics which control for market-wide trading (V2, V3, and V4) have a significantly positive association in weeks t-3, and weeks t=0 through t+3. The correlation coefficients for measures V5 and V6 are not significant with the exception of week t-3 for V5, which is negative.

The results reported in the Tables 4a and 4b imply that the observed announcement impact (market reaction), measured using the alternative trading volume reaction metrics, although not identical across the six alternative metrics, continues up to three weeks after the week of the announcement. This result appears to support, in part, the observation made by Morse [1981] and Karpoff [1986] that the volume reaction usually lasts longer than the price reaction.

Using the observed trading volume reaction for the week of the earnings announcement our results suggest that the alternative trading volume metrics which attempt to control for market-wide effects (V2, V3, and V4) are more powerful than the unadjusted measure (VI). This is expected since controlling for market-wide effects on the individual firm's trading volume reduces noise. The two trading volume metrics which use the firm's own average level of trading (mean or median), V5 and V6, have results of the opposite sign which are statistically insignificant.

5. SUMMARY AND CONCLUSIONS

This study analyzes the sensitivity of results from employing alternative trading volume reaction metrics. Our analysis is accomplished using a simple information content setting. Our results can be summarized as follows.
(a) The Spearman rank-order correlation coefficients and the Pearson product-moment correlation coefficients between the alternative volume reaction metrics seem to dichotomize the volume metrics into two groups: group I - $V_1$ (the weekly percentage of shares traded), $V_2$ (the log transformed regression prediction errors), $V_3$ (the standardized prediction errors), and $V_4$ (market-adjusted weekly percentage of shares traded); group II - $V_5$ (mean-adjusted weekly percentage of shares traded) and $V_6$ (median-adjusted weekly percentage of shares traded).

(b) The correlations between the measures of the earnings announcement surprise, AUEP (absolute value of unexpected earnings deflated by prices) or AUEE (absolute value of unexpected earnings deflated by earnings), and each of the alternative volume reactions metrics also dichotomize the volume metrics: group I - $V_1$, $V_2$, $V_3$, and $V_4$; group II - $V_5$ and $V_6$.

(c) Using different deflators for the unexpected earnings, AUEP (price) and AUEE (earnings), produces slightly different results: especially, in weeks before the earnings announcement.

These findings imply that the alternative trading volume reaction metrics attempting to adjust for market-wide effects (e.g., $V_2$, $V_3$, and $V_4$) produce different results from those attempting to adjust for firm-specific normal levels of trading (e.g., $V_5$ and $V_6$). The trading volume reaction based on the weekly percentage of shares traded without any adjustment ($V_1$) appears to be more closely related to $V_2$, $V_3$, and $V_4$ than to volume metrics $V_5$ and $V_6$.

The results of this study suggest that the reported results and inferences from previous market reaction studies which focused on trading volume reactions may have been a function of the particular trading volume market reaction metric employed. However, our findings can not be used to prescribe that a specific trading volume metric should be employed since no plausible theoretical explanation of a normal level of trading is readily available in the literature. Instead,
our results strongly suggest that researchers assess the extent to which their results and inferences are sensitive to the choice of trading volume reaction metric employed. However, if we can presume that there is information content in the earnings announcements studied, then our results suggest that the two volume metrics that control for the average level of trading for that security using either the mean or median trading level are not very powerful and made lead to inappropriate inferences.
REFERENCES


Table 1
Descriptive Statistics

Panel A: Number and Distribution of Earnings Announcements

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual</th>
<th>1st Quarter</th>
<th>2nd Quarter</th>
<th>3rd Quarter</th>
<th>1st-3rd Quarter Total</th>
<th>Total for all</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>39</td>
<td>33</td>
<td>34</td>
<td>38</td>
<td>105</td>
<td>144</td>
</tr>
<tr>
<td>1981</td>
<td>52</td>
<td>53</td>
<td>51</td>
<td>56</td>
<td>160</td>
<td>212</td>
</tr>
<tr>
<td>1982</td>
<td>56</td>
<td>51</td>
<td>50</td>
<td>53</td>
<td>154</td>
<td>210</td>
</tr>
<tr>
<td>Total</td>
<td>147</td>
<td>137</td>
<td>135</td>
<td>147</td>
<td>419</td>
<td>566</td>
</tr>
</tbody>
</table>

Panel B: Spearman Rank-Order Correlations and Pearson Product-Moment Correlations between Absolute Value of Unexpected Earnings Deflated by Stock Price (AUEP) and Absolute Value of Unexpected Earnings Deflated by Absolute Earnings (AUEE)

<table>
<thead>
<tr>
<th></th>
<th>Annual (n = 147)</th>
<th>1st Quarter (n = 137)</th>
<th>2nd Quarter (n = 135)</th>
<th>3rd Quarter (n = 147)</th>
<th>Total (n = 566)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spearman Rank-Order</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correlations *</td>
<td>0.9278 (.0001)</td>
<td>0.9039 (.0001)</td>
<td>0.9408 (.0001)</td>
<td>0.9433 (.0001)</td>
<td>0.8396 (.0001)</td>
</tr>
<tr>
<td>Pearson Product-Moment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correlations *</td>
<td>0.1633 (.0480)</td>
<td>0.1902 (.0260)</td>
<td>0.2757 (.0012)</td>
<td>0.3666 (.0001)</td>
<td>0.1150 (.0062)</td>
</tr>
</tbody>
</table>

* The numbers in parentheses indicate approximate two-tailed significance levels.
Table 2

Spearman Rank-Order Correlations and Pearson Product-Moment Correlations between Alternative Volume Metrics at the Earnings Announcement Week *

<table>
<thead>
<tr>
<th></th>
<th>( V1 )</th>
<th>( V2 )</th>
<th>( V3 )</th>
<th>( V4 )</th>
<th>( V5 )</th>
<th>( V6 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V1 )</td>
<td>1.0000</td>
<td>0.9343</td>
<td>0.8866</td>
<td>0.9075</td>
<td>0.6015</td>
<td>0.6802</td>
</tr>
<tr>
<td>( V2 )</td>
<td>0.7875</td>
<td>1.0000</td>
<td>0.9796</td>
<td>0.9855</td>
<td>0.4933</td>
<td>0.5759</td>
</tr>
<tr>
<td>( V3 )</td>
<td>0.9590</td>
<td>0.8162</td>
<td>1.0000</td>
<td>0.9947</td>
<td>0.4668</td>
<td>0.5447</td>
</tr>
<tr>
<td>( V4 )</td>
<td>0.9646</td>
<td>0.8238</td>
<td>0.9948</td>
<td>1.0000</td>
<td>0.4976</td>
<td>0.5775</td>
</tr>
<tr>
<td>( V5 )</td>
<td>0.7994</td>
<td>0.5227</td>
<td>0.7360</td>
<td>0.7451</td>
<td>1.0000</td>
<td>0.9665</td>
</tr>
<tr>
<td>( V6 )</td>
<td>0.8832</td>
<td>0.5987</td>
<td>0.8244</td>
<td>0.8322</td>
<td>0.9637</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

\( V1 \) is the unadjusted weekly percentage of shares traded; 
\( V2 \) is the log transformed market model regression prediction errors; 
\( V3 \) is the standardized market model regression prediction errors; 
\( V4 \) is the market-adjusted weekly percentage of shares traded; 
\( V5 \) is the mean-adjusted weekly percentage of shares traded; 
\( V6 \) is the median-adjusted weekly percentage of shares traded.

* The amounts in the upper right diagonal are Spearman rank-order correlation coefficients while the amounts in the lower left diagonal are Pearson product-moment correlation coefficients. All coefficients are statistically significant at the .001 level for a two-tailed test.
Table 3a

Spearman Rank-Order Correlation Between Abnormal Trading Activity Surrounding the Earnings Announcement and the Absolute Value of Unexpected Earnings Deflated by Stock Price (AUEP)

<table>
<thead>
<tr>
<th>Trading Volume Metrics</th>
<th>Annual (n=147)</th>
<th>1st Quarter (n=137)</th>
<th>2nd Quarter (n=135)</th>
<th>3rd Quarter (147)</th>
<th>All Quarters (n=419)</th>
<th>Total (n=566)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V1 )</td>
<td>0.0607 (.465)*</td>
<td>0.2067 (.015)</td>
<td>0.1014 (.242)</td>
<td>0.1207 (.145)</td>
<td>0.1351 (.006)</td>
<td>0.0926 (.028)</td>
</tr>
<tr>
<td>( V2 )</td>
<td>0.0602 (.469)</td>
<td>0.2029 (.017)</td>
<td>0.1090 (.208)</td>
<td>0.1118 (.178)</td>
<td>0.1365 (.005)</td>
<td>0.1184 (.005)</td>
</tr>
<tr>
<td>( V3 )</td>
<td>0.0548 (.510)</td>
<td>0.1981 (.020)</td>
<td>0.1076 (.214)</td>
<td>0.1494 (.071)</td>
<td>0.1567 (.001)</td>
<td>0.1402 (.001)</td>
</tr>
<tr>
<td>( V4 )</td>
<td>0.0401 (.630)</td>
<td>0.1853 (.030)</td>
<td>0.1120 (.196)</td>
<td>0.1376 (.096)</td>
<td>0.1461 (.003)</td>
<td>0.1254 (.003)</td>
</tr>
<tr>
<td>( V5 )</td>
<td>-0.1507 (.069)</td>
<td>-0.0737 (.392)</td>
<td>-0.0716 (.409)</td>
<td>0.0437 (.599)</td>
<td>-0.0398 (.416)</td>
<td>-0.0827 (.49)</td>
</tr>
<tr>
<td>( V6 )</td>
<td>-0.1400 (.090)</td>
<td>0.0337 (.696)</td>
<td>-0.0094 (.914)</td>
<td>0.0857 (.302)</td>
<td>0.0317 (.517)</td>
<td>-0.0313 (.458)</td>
</tr>
</tbody>
</table>

\( V1 \) is the unadjusted weekly percentage of shares traded; \( V2 \) is the log transformed market model regression prediction errors; \( V3 \) is the standardized market model regression prediction errors; \( V4 \) is the market-adjusted weekly percentage of shares traded; \( V5 \) is the mean-adjusted weekly percentage of shares traded; \( V6 \) is the median-adjusted weekly percentage of shares traded.

* The number in parenthesis indicates the two-tailed level of statistical significance.
Table 3b

Spearman Rank-Order Correlation Between Abnormal Trading Activity Surrounding the Earnings Announcement and the Absolute Value of Unexpected Earnings Deflated by Unexpected Earnings (AUEE)

<table>
<thead>
<tr>
<th>Trading Volume Metrics</th>
<th>Annual (n=147)</th>
<th>1st Quarter (n=137)</th>
<th>2nd Quarter (n=135)</th>
<th>3rd Quarter (n=147)</th>
<th>All Quarters (n=419)</th>
<th>Total (n=566)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V1 )</td>
<td>0.0590 (.478)*</td>
<td>0.2141 (.012)</td>
<td>0.0496 (.568)</td>
<td>0.1620 (.050)</td>
<td>0.1302 (.008)</td>
<td>0.1149 (.006)</td>
</tr>
<tr>
<td>( V2 )</td>
<td>0.0632 (.447)</td>
<td>0.1962 (.022)</td>
<td>0.0580 (.504)</td>
<td>0.1424 (.085)</td>
<td>0.1226 (.012)</td>
<td>0.1026 (.015)</td>
</tr>
<tr>
<td>( V3 )</td>
<td>0.0489 (.556)</td>
<td>0.1906 (.026)</td>
<td>0.0602 (.488)</td>
<td>0.1758 (.033)</td>
<td>0.1457 (.003)</td>
<td>0.1199 (.004)</td>
</tr>
<tr>
<td>( V4 )</td>
<td>0.0417 (.616)</td>
<td>0.1769 (.039)</td>
<td>0.0654 (.451)</td>
<td>0.1674 (.043)</td>
<td>0.1365 (.005)</td>
<td>0.1112 (.008)</td>
</tr>
<tr>
<td>( V5 )</td>
<td>-0.1155 (.164)</td>
<td>-0.0520 (.546)</td>
<td>-0.1177 (.174)</td>
<td>0.0609 (.464)</td>
<td>-0.0377 (.441)</td>
<td>-0.0473 (.261)</td>
</tr>
<tr>
<td>( V6 )</td>
<td>-0.1061 (.201)</td>
<td>0.0571 (.508)</td>
<td>-0.0682 (.432)</td>
<td>0.1100 (.185)</td>
<td>0.0307 (.531)</td>
<td>0.0058 (.890)</td>
</tr>
</tbody>
</table>

\( V1 \) is the unadjusted weekly percentage of shares traded; 
\( V2 \) is the log transformed market model regression prediction errors; 
\( V3 \) is the standardized market model regression prediction errors; 
\( V4 \) is the market-adjusted weekly percentage of shares traded; 
\( V5 \) is the mean-adjusted weekly percentage of shares traded; 
\( V6 \) is the median-adjusted weekly percentage of shares traded.

* The number in parenthesis indicates the two-tailed level of statistical significance.
Table 4a

Spearman Rank-Order Correlation across Weeks between
Abnormal Trading Activity Surrounding the Earnings Announcement
and the Absolute Value of Unexpected Earnings Deflated by Stock Price (AUEP)

<table>
<thead>
<tr>
<th>Trading Volume Metrics</th>
<th>Week Relative to Announcement Week</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-3</td>
<td>-2</td>
<td>-1</td>
<td>0</td>
<td>+1</td>
<td>+2</td>
<td>+3</td>
</tr>
<tr>
<td>$V_1$</td>
<td>0.1266 (.003)</td>
<td>0.1064 (.011)</td>
<td>0.0525 (.212)</td>
<td>0.0959 (.023)</td>
<td>0.0785 (.062)</td>
<td>0.1086 (.010)</td>
<td>0.1343 (.001)</td>
</tr>
<tr>
<td>$V_2$</td>
<td>0.1350 (.001)</td>
<td>0.1012 (.016)</td>
<td>0.0824 (.050)</td>
<td>0.1323 (.002)</td>
<td>0.0950 (.024)</td>
<td>0.1184 (.005)</td>
<td>0.1470 (.001)</td>
</tr>
<tr>
<td>$V_3$</td>
<td>0.1342 (.001)</td>
<td>0.0922 (.028)</td>
<td>0.1007 (.017)</td>
<td>0.1459 (.001)</td>
<td>0.1102 (.009)</td>
<td>0.1180 (.005)</td>
<td>0.1536 (.001)</td>
</tr>
<tr>
<td>$V_4$</td>
<td>0.1255 (.003)</td>
<td>0.0882 (.036)</td>
<td>0.0888 (.035)</td>
<td>0.1345 (.001)</td>
<td>0.1006 (.017)</td>
<td>0.1113 (.008)</td>
<td>0.1438 (.001)</td>
</tr>
<tr>
<td>$V_5$</td>
<td>-0.0384 (.361)</td>
<td>-0.0424 (.314)</td>
<td>-0.0812 (.054)</td>
<td>-0.4830 (.251)</td>
<td>-0.0936 (.026)</td>
<td>-0.0551 (.190)</td>
<td>0.0112 (.790)</td>
</tr>
<tr>
<td>$V_6$</td>
<td>0.0119 (.777)</td>
<td>0.0064 (.879)</td>
<td>-0.0472 (.262)</td>
<td>-0.0116 (.783)</td>
<td>-0.0354 (.401)</td>
<td>-0.0131 (.756)</td>
<td>0.0604 (.152)</td>
</tr>
</tbody>
</table>

$V_1$ is the unadjusted weekly percentage of shares traded;
$V_2$ is the log transformed market model regression prediction errors;
$V_3$ is the standardized market model regression prediction errors;
$V_4$ is the market-adjusted weekly percentage of shares traded;
$V_5$ is the mean-adjusted weekly percentage of shares traded;
$V_6$ is the median-adjusted weekly percentage of shares traded.

* The number in parenthesis indicates the two-tailed level of statistical significance.
Spearman Rank-Order Correlation across Weeks between Abnormal Trading Activity Surrounding the Earnings Announcement and the Absolute Value of Unexpected Earnings Deflated by Earnings (AUEE)

<table>
<thead>
<tr>
<th>Trading Volume Metrics</th>
<th>Week Relative to Announcement Week</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-3</td>
</tr>
<tr>
<td>( V1 )</td>
<td>0.0350 (0.406)</td>
</tr>
<tr>
<td>( V2 )</td>
<td>0.0997 (0.018)</td>
</tr>
<tr>
<td>( V3 )</td>
<td>0.1274 (0.002)</td>
</tr>
<tr>
<td>( V4 )</td>
<td>0.1044 (0.013)</td>
</tr>
<tr>
<td>( V5 )</td>
<td>-0.1064 (0.111)</td>
</tr>
<tr>
<td>( V6 )</td>
<td>-0.0663 (0.115)</td>
</tr>
</tbody>
</table>

\( V1 \) is the unadjusted weekly percentage of shares traded; \\
\( V2 \) is the log transformed market model regression prediction errors; \\
\( V3 \) is the standardized market model regression prediction errors; \\
\( V4 \) is the market-adjusted weekly percentage of shares traded; \\
\( V5 \) is the mean-adjusted weekly percentage of shares traded; \\
\( V6 \) is the median-adjusted weekly percentage of shares traded.

* The number in parenthesis indicates the two-tailed level of statistical significance.