The Firm Size Effect on Trading Volume Reactions to Earnings Announcements: A Re-examination and Extension

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ABSTRACT: We argue that technological advances, changes in financial regulation, and changes in investor composition over the past 30 years have increased the available financial information of small firms and the investor diversity of large firms. This leads us to hypothesize and test for a positive shift in the relation between trading volume reactions to earnings announcements and firm size. Consistent with our hypothesis, we document a positive shift in the trading volume reaction/firm size relation between the time of Bamber’s (1986, 1987) seminal research (1977-1980) and a modern time period (2003-2006). Surprisingly, this positive shift has caused the trading volume reaction/firm size relation to turn positive, thereby reversing Bamber’s previously documented negative relation. We also provide evidence that this positive shift is driven by relative increases in differential precision of pre-announcement information in large firms.

Keywords: Firm size; Earnings announcements; Trading volume reactions; Pre-announcement precision of information

Data Availability: Data used in this study are available from public sources.
I. INTRODUCTION

In seminal research, Bamber (1986, 1987) found a positive relation between unexpected earnings and trading volume reactions to earning announcements and a negative relation between firm size and trading volume. This later result settled the question of whether a firm size effect existed for trading volume reactions to earnings and the direction of that effect. Consequently, Bamber’s papers are heavily cited with each paper having over 150 citations in published work\(^1\) and the documented firm size effect has motivated the inclusion of firm size in most subsequent trading volume models. If, however, the factors which motivate trade around earnings announcement are significantly different in alternative samples, then Bamber’s seminal firm size result may not generalize and question may not be settled and consequent interpretation of the coefficient on firm size may be misguided.

We argue that technological advances, changes in financial regulation, and changes in investor composition over the past 30 years have increased the available financial information of small firms relative to large and the investor diversity of large firms relative to small. These changes lead us to hypothesize and test for a positive shift in the relation between trading volume reactions to earnings announcements and firm size. Thus, we re-examine and extend Bamber’s (1986, 1987) seminal research of the volume reaction/firm size relation. We re-examine Bamber’s firm size results in her time period by using earnings announcements from a wider sample of firm sizes and using alternative models and measures of trading volume reaction. We confirm that her result holds within the time period of the original sample and, then, extend Bamber’s firm size

\(^1\) Approximately half of the citations refer to the firm size result.
results by hypothesizing and documenting a fundamental shift in the volume reaction/firm size relation in more recent time periods.

We identify four motivations for this study. First, researchers have long argued that testing the robustness of prior results advances our knowledge by demonstrating the generalizability of those results and guarding against the dissemination of “false knowledge” (Kane 1984).² For example, researchers in accounting have demonstrated the usefulness of this kind of robustness research by re-examining Beaver’s (1968) seminal study. Bamber, Christensen, and Gaver (2000) document that Beaver’s abnormally high price and volume reactions around earnings announcements were driven primarily by research design choices that resulted in a sample of relatively smaller firms, and that most of the individual Fortune 200 earnings announcements during Beaver’s sample period did not generate unusual market reactions.³ Landsman and Maydew (2002) document that Beaver’s two measures of market reaction to earnings announcements, abnormal trading volume and return volatility, do not decrease around quarterly earnings announcements over the time period 1972-1998 despite intuition that earnings announcements may have lost some of their value relevance. In particular, Landsman and Maydew find evidence that price and volume reactions to earnings announcements increase over this time period, and that the increase is driven primarily by large firms. While several researchers have attempted to explain Landsman and Maydew’s price reaction results (Francis,

² Kane (1984, 3) begins his article by quoting an age-old prayer: “Lord, protect us from what we only think we know.” Kane argues that few economists would find fault with the sentiment embodied in this prayer, but laments the lack of safeguards erected against the accumulation and dissemination of false knowledge. Bamber, Christensen, and Gaver (2000) make similar arguments regarding the potential for false knowledge in accounting research to motivate their re-examination of Beaver (1968).

³ The design choices that Beaver (1968) made that reduced the firm size in his sample included limiting the analysis to non-12/31 firms (to avoid event clustering) and firms that had a limit of 20 news items in the WSJ (to obtain a cleaner non-announcement period).
Schipper, and Vincent 2002; Collins, Li, and Xie 2009), no study that we are aware of has attempted to explain their volume reaction results.

A second motivation for this study is the special design choices in Bamber’s (1986, 1987) studies. Because of the need to gather earnings forecasts for one of her unexpected earnings measures, Bamber’s samples included relatively large firms from the Value Line Investment Survey over the time period 1977–1980. At the time of Bamber’s studies, the Value Line Investment Survey typically included firms with the following characteristics: (1) capitalization in excess of $50 million, (2) at least 2 million shares held by outside investors, and (3) over 100,000 shares traded per month.4 We find that these data requirements limit Bamber’s sample to relatively large firms. Thus, it is an empirical question whether her firm size result generalizes to a wider sample of firm sizes in her sample period. There have also been significant advances in modeling and measuring trading volume reactions in the literature (Bamber, Barron, and Stevens 2011), and these advances have not been applied to Bamber’s original time period.

The third motivation for this study, and the foundation for our directional hypothesis, is the significant differences in technology, financial regulation, and investor composition in recent time periods versus Bamber’s (1986, 1987) time period. As Bamber et al. (2000) point out, there is a tendency to over generalize seminal results outside of the original sample. The last 30 years have witnessed significant advances in technology and increases in financial regulation (Regulation Fair Disclosure, the redesign of the 8-K, Sarbanes-Oxley, etc.). These technological advances and increases in regulation have likely led to fewer differences in the provision of information between large and small firms. Investor diversity in large firms has also likely increased due to the

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4 These sample characteristics were clearly noted by Bamber in a footnote (Bamber 1987, 514, Footnote 9).
increase in both large (institutions and hedge funds) and small (retail) investors who are both attracted to large firms (Ahmed, Schneible, and Stevens 2003, Atiase 1985, Barber and Odean 2008). Thus, it is an empirical question whether Bamber’s firm size result generalizes to more recent time periods.

A fourth motivation for this study is that firm size continues to be an *ex ante* observable variable that is of interest to investors, regulators, and researchers. As mentioned above, both large and small investors are attracted to large firms. Large investors and hedge funds are attracted to large firms because the increased liquidity hides informed trade (Atiase 1985), and small investors are attracted to large firms because of the frequent coverage of such firms in the financial press (Grant 1980; Thompson, Olsen, and Dietrich 1987; Barber and Odean 2008). Many funds have investment restrictions based on firm size, and analysts appear to make the decision to follow a firm based on its size (Bhushan 1989). Policy makers have used firm size to differentiate the requirements of various financial regulations (Bamber 1986, 1987; Atiase, Bamber, and Freeman 1988). Finally, our citation analysis and a recent review of trading volume reaction studies by Bamber et al. (2011) suggest that researchers continue to use firm size as a proxy measure of information environment in empirical studies of trading volume. Thus, evidence that the effect of firm size on trading volume reactions has changed should be of interest to investors, regulators, and researchers.

Based on our argument that technology advances, changes in financial regulation and changes in investor composition over the past 30 years have relatively increased the available financial information of small firms and the investor diversity of large firms, we hypothesize that the trading volume reaction/firm size relation is more positive in recent
time periods than in the time period documented by Bamber (1986, 1987). To test this hypothesis, we examine the trading volume reaction/firm size relation using quarterly earnings announcements from NYSE firms for the time period 1977–2008. Given the increased availability of machine readable data, and our less stringent data requirements, we are able to include a wider array of firm sizes. This allows us to offer more rigorous evidence of the trading volume reaction/firm size relation in Bamber’s original time period and in more recent time periods. With our enhanced data set and modern regression models, we replicate Bamber’s negative relation between trading volume reaction and firm size in her original time period (1977-1980) confirming that her original result maintains within the original time period. Consistent with our hypothesis, however, we document a positive shift in the trading volume reaction/firm size relation between this time period and a more recent period (2003-2008). Surprisingly, this positive shift has caused the trading volume reaction/firm size relation to turn positive, thereby reversing Bamber’s previously documented negative relation. During the financial crisis of 2007 and after, we document that this positive relation recedes briefly and then returns.

To help explain our results, we apply intuition from recent empirical and theoretical studies of trading volume reactions. We note that prior empirical research has found price change to be an important explanatory variable of trading volume reactions. Further, theoretical models of trading volume suggest that the coefficient on price change in a trading volume regression reflects differential precision of pre-announcement information (Kim and Verrecchia 1997; Verrecchia 2001; Bamber et al. 2011) and prior

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5 In sensitivity analysis, we separately and individually include NASDAQ firms, use annual announcements, and exclude the smallest and largest of firms. Our results are robust to these.
empirical studies (Ahmed et al. 2003; Hope et al. 2009) have used this coefficient to examine changes in firms’ predislosure information environments. Therefore, we examine the variation in the coefficient on price change across firm size and time. We demonstrate that the relation between abnormal trading volume and absolute price change is increasing in firm size and in time. This suggests that our firm size results are driven primarily by increases in differential pre-announcement precision of information in large firms over time. This evidence helps explain not only our results but also Landsman and Maydew’s (2002) trading volume reaction results.

Our results emphasize the role of share liquidity in motivating investors to gather private information prior to an earnings announcement. The intuition that share liquidity hides informed trade and thereby increases the profitability of private information acquisition was used by Atiase (1980, 1985) to predict a firm size effect on price reactions to earnings announcements. Given the strong belief in market efficiency at the time, Atiase assumed that the private information gathered for large firms would be quickly and efficiently impounded into price prior to the earnings announcements. This led Atiase (1980, 1985) to predict that earnings announcements would represent a smaller portion of available information for large firms relative to small firms, leading to a smaller price reaction to such announcements for large firms. Our results suggest that a greater portion of the private information gathered by investors for large firms remains private and is reflected in a larger volume reaction to earnings announcements.

In the following section we provide a literature review and develop the main hypothesis we test in this study. In section three, we describe the research design and empirical measures that we use to test our hypothesis, and present descriptive statistics.
In section four we present the results of our hypothesis tests, and in section five we present our sensitivity analysis. In section six we present our summary and conclusions.

II. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Banz’s (1981) finding of a negative association between the logarithm of a firm’s market value of equity and future stock returns set off a flurry of research in the finance literature. Finance researchers generally agreed that this anomalous result was caused by the misspecification of the capital asset pricing model, but researchers were unsuccessful at identifying the “missing factor” for which size was a proxy (Schwert, 1983). Fama and French (1992, 427) identified this size anomaly as the most prominent contradiction of asset pricing theory. After modeling the relation between the log of market value and future stock returns, Berk (1995) concluded that there is no single factor that market value proxies for. He asserted that market value is inversely correlated with unmeasured risk, and the type of risk it proxies for is entirely determined by the asset pricing model used. Berk’s model and related empirical evidence, however, provided a justification for including firm size measures to increase the power of empirical tests of stock returns.

Atiase (1985) documented a similar firm size effect on the stock price reaction to quarterly earnings announcements. In particular, Atiase found that market value of equity was inversely related to the stock price revaluation around a firm’s quarterly earnings announcement. In contrast to the response of finance researchers to the firm size effect on future stock returns, however, most accounting researchers did not view the firm size effect on price reactions as anomalous.6 Instead, accounting researchers generally

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6 A notable exception can be found in Ball and Kothari (1991). After finding a similar firm size effect on price reactions to earnings announcements, Ball and Kothari (1991, 736) concluded: “There are no credible
accepted Atiase’s (1980) theoretical explanation that the expected payoff of gathering private information is greater for large firms, and thus firm size is a proxy for pre-announcement private information production and dissemination. Atiase’s theoretical explanation and empirical evidence provided a justification for including firm size measures to increase the power of empirical tests of price reactions to earnings announcements.

In contrast to stock price reactions, there was considerable disagreement among accounting researchers regarding a firm size effect for trading volume reactions to earnings announcements. The debate between Freeman (1981) and Ro (1981) represents the two sides of the argument. To argue in support of a firm size effect for trading volume, Freeman (1981) repeated theoretical arguments in Atiase (1980) that the expected payoff of private information is an increasing function of firm size. Because earnings announcements represent a smaller proportion of the total information available for large firms relative to small firms, Freeman concluded that this implied a smaller trading volume reaction to the earnings announcements for large firms. To argue against a firm size effect for trading volume reactions, Ro (1981) pointed out the lack of theoretical and empirical support for such a firm size effect. Ro (1981, 182) concluded, “it is not clear whether one can say that volume is inversely related to firm size based on evidence found in returns.”

Prior to Bamber’s (1986, 1987) seminal research, therefore, there was considerable disagreement among accounting researchers as to whether a firm size effect existed for trading volume reactions to earnings announcements. While Bamber’s studies
provided little theoretical support for such a firm size effect, they did provide rigorous empirical evidence that previously had been lacking. Using a sample of relatively large firms followed on the Value Line Investment Survey from 1977-1980, Bamber examined the relation trading volume and firm size\(^7\). Bamber (1986) found that market value of equity was inversely related to the magnitude of trading volume reactions to annual earnings announcements and Bamber (1987) found that market value of equity was inversely related to the magnitude and duration of trading volume reactions to quarterly earnings announcements. Similar to Freeman’s (1981) arguments, Bamber (1987, 529) interpreted her trading volume results as further evidence that investors find large firms’ earnings announcements less informative than those of small firms. Using arguments in Beaver (1968), however, Bamber was careful to point out that stock price and trading volume capture fundamentally different aspects of investors’ reactions to earnings announcements.

The empirical evidence in Bamber (1986, 1987) settled the argument among accounting researchers whether a firm size effect existed for trading volume reactions to earnings. Bamber’s papers are heavily cited with each of paper having over 150 citations in published work. Approximately half of these citations rely on the firm size result in developing and interpreting the results of their trading volume models.

Some papers (i.e. Collins et al. 2009) continue to find a negative relation between trading volume and firm size while other papers (i.e. Hope et al. 2009, Miller 2010) find a positive relation. Thus, findings in the literature post Bamber (1986, 1987) are

\(^7\) In both papers, Bamber examined two questions: the effect of firm size and the effect of unexpected earnings on trading volume. Our paper focuses exclusively on the question of the firm size effect, but, as discussed below, we control for the news contained in unexpected earnings and other news in the announcement period.
inconsistent. This inconsistency provides an initial indication that the trading volume firm size result may have limits to its generalizability. As we discuss later, sample selection decisions which affect the period the observations are drawn from or the average size of the firm in the sample impact the direction of this basic relation.

Bamber’s (1986, 1987) initial interpretation of her firm size result reflects the lack of trading volume theory at the time of her seminal study. Since her study, however, researchers in accounting, finance, and economics have developed a rich body of theory suggesting that trading volume reactions to earnings announcements reflect primarily differential belief revisions, which can be caused by either differential precision of pre-announcement information or differential interpretation (Kim and Verrecchia 1997; Verrecchia 2001; Bamber et al. 2011). This body of trading volume theory provides an economics-based explanation for Bamber’s results. In particular, it suggests that the larger firms in her sample were characterized by less differential belief revision around earnings announcements, either due to less differential precision of pre-announcement information or less differential interpretation. Further, this body of trading volume theory suggests that any change in the firm size effect on trading volume reactions over time will occur due to changes in the cross-sectional variation in differential belief revision by firm size.

To motivate the main hypothesis of this study, we identify changes in the information environment over the past 30 years that may have changed the cross-sectional variation in differential belief revision by firm size. While it would be impossible to identify every significant change to the information environment over the
last 30 years, we identify three general changes that are likely to have altered the trading volume reaction/firm size relation.

The first general change we identify is the rapid advance in technology over the past 30 years. This technological advance has reduced the cost of accessing firm information and trading on that information. In particular, the internet is now a common source of information dissemination and the advent of online trading in the mid-1990s has greatly reduced the average cost of executing trades (Ahmed et al. 2003). The outcome of this change is twofold. First, the information gap between small firms and large firms has likely narrowed in the past 30 years. While differences still exist, the ability of small firms to provide timely information to investors has likely increased more than large firms. Second, the ease and affordability of executing trades has likely increased the diversity of investors during this time period. Both large and small investors are attracted to large firms (Ahmed et al. 2003). Thus, the net effect of this rapid advance in technology is likely to be an increase in the differential precision of pre-announcement information for large firms.

The second general change we identify is the increase in financial regulation over the past 30 years. The purpose of financial regulation is generally to improve the quality of financial information across all firms and to level the information playing field across investors (Levitt 1999). The largest increase in information quality due to these regulatory changes, however, is likely to have occurred in small firms that have historically had lower quality information environments on average (Atiase 1985; Bamber 1987). This suggests, again, that there is now less information difference between large and small firms than there was 30 years ago. On the other hand, attempts to
level the playing field by blocking differential disclosure of private information (e.g., Regulation FD) may have increased the incentive for sophisticated investors to acquire private information about firms where it is most profitable—for large firms. Thus, these increases in financial regulation may also have increased the differential precision of pre-announcement information for large firms.

The third change we identify is a demographic change in investors, generally, and on investors in large firms, specifically. Due in part to a shift toward defined contribution retirement plans and in part to lower barriers to entry (transaction costs, access to information, etc.), non-professional investors have entered the market in unprecedented numbers (ICI&SIA 2005). These non-professional investors, however, are trading in the market against a rising tide of professional, institutional investors. Institutions now account for more than 50% of equity ownership (Bennett, Sias, and Starks 2003). In addition, hedge funds, which were almost nonexistent 30 years ago, now control almost a trillion dollars of equities (Hennessee Group LLC, 2006). The result of these demographic shifts is increased differences in the ability of investors to gather and use financial information (Hirshleifer and Teoh 2003). Both large and small investors are drawn to large firms (Ahmed et al. 2003). Large investors prefer large firms due to higher liquidity while small investors prefer large firms due to more news and, thus, decreased search costs (Barber and Odean 2008). Thus, this increase in investor diversity is likely to increase the differential precision of pre-announcement information for large firms.

Based on these arguments, we hypothesize that the trading volume reaction/firm size relation is significantly more positive in modern time periods than it was in the time period studied by Bamber (1986, 1987).
III. VARIABLE DEFINITIONS AND DESCRIPTIVE STATISTICS

In this section we describe the research design and empirical measures that we use to test our hypothesis. First, we present the sample selection criteria. Next, we describe the empirical measures used for our dependent and independent variables. We conclude this section by presenting descriptive statistics suggesting a shift in the trading volume/firm size relation.

Sample Data

Our full sample includes quarterly earnings announcements of NYSE firms over the period 1977–2008 inclusive that meet the following criteria:

- Quarterly earnings announcement dates are available on Compustat
- Price, trading volume, and return data are available on CRSP

These sample criteria ensure data availability and yet allow for the widest possible range of firm size.

Since we hypothesize a shift in the information environment between the period studied by Bamber and the current time period, we focus our study on two subsamples of the data: one from the time period studied by Bamber (1977-1980) and a modern time period (2003-2008). In figures, however, we present quarterly trading volume data across the entire 31 year time period from 1977-2008.

Dependent Variable: Abnormal Trading Volume

Choosing an empirical measure of abnormal trading volume is problematic because all measures of normal trade are ad hoc (see Bamber et al. 2011 for a
 Consequently, we examine a wide variety of trading volume measures found in the literature. For conciseness and because we are extending Bamber’s original research (1986, 1987), however, we present figures and tabled results based on the additive measure of abnormal trading volume similar to the measure used in Bamber (1986, 1987) and many other papers. This additive measure of abnormal trading volume is the cumulative three-day share turnover around the earnings announcement date (shares traded as a percentage of shares outstanding at the time of the announcement) less the median cumulative three-day share turnover of consecutive three-day periods in the non-announcement period (B1VOL). It has become the most common measure of abnormal trading volume used in trading volume studies (e.g., Atiase and Bamber 1994; Kross, Ha, and Heflin 1994; Bamber et al. 1997, Ahmed et al. 2003; and Chen and Sami 2008). The other abnormal volume measures are used for robustness checks. In all cases, results are quantitatively similar and inferences remain unchanged.

**Independent Variables: Firm Size and Control Variables**

Our key independent variable of interest is firm size. Similar to Bamber (1986, 1987), our measure of firm size, $SIZE$, is the market value of common shares outstanding two days prior to the earnings announcement. We use a decile measure of market value of equity, $DSIZE$, in our tabulated results. $DSIZE$ takes on values 1 to 10 depending on the market capitalization of the firm relative to other firms in the same sample quarter.\(^8\) This is consistent with Bamber (1987), who uses a quartile measure of market value of equity.

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\(^8\) We use $SIZE$ and the natural log of $SIZE$ in our sensitivity analysis and find that our results are robust to both continuous measures of firm size.
Using firm size quartiles rather than firm size deciles does not alter the results of our analysis.

We also include a number of control variables in our analysis that have been shown in prior empirical studies to affect abnormal trading volume around earnings announcements. We include \(ABSRET\), the absolute value of the cumulative three-day return around the quarterly earnings announcement, to control for the value-relevant public information contained in the earnings announcement. The second key result in Bamber (1986, 1987) is that trading volume is related to the unexpected component of earnings indicating that the new information brought to the market by the earnings announcement led investors to differentially revise their beliefs. We use \(ABSRET\) in our main model to capture the degree of new information reaching the market rather than unexpected earnings for two reasons. First, the amount and type of information released on an earnings announcement day has changed significantly over our sample period and using only an unexpected earnings measure would fail to control for this. Second, using the most common unexpected earnings measure requires the use of analysts’ forecasts which creates a large firm bias in the sample.

We also include \(MKVOL\), the mean share turnover of all the firms in the sample for the same three-day announcement period window, to control for contemporaneous market-wide trading volume. We include \(LPRICE\), the log of ending market price two days before the earnings announcement, as a proxy for transaction costs. In sensitivity tests, we use additional control variables suggested by Chordia, Roll, and Subrahmanyam (2001).

**Descriptive Statistics**
Table 1 presents descriptive statistics for our two sub-samples of quarterly earnings announcements from NYSE firms. Panel A presents the descriptive statistics of the Bamber period sample (1977-1980). SIZE ranges from $5.4 million to $4.2 billion with a mean and median of $356 million and $157 million, respectively. Our abnormal volume measure, B1VOL, ranges from –0.7% to 3.6% with a mean and median of 0.2% and 0.1%, respectively. In Bamber (1987), by comparison, the median abnormal volume around quarterly earnings announcements (her measure resembling B1VOL) was 0.025%.

Panel B of Table 2 shows the descriptive statistics for our modern sample (2003-2008). SIZE ranges from $16.8 million to $38.1 billion with a mean and median of $3.68 billion and $1.63 billion, respectively. This demonstrates a tenfold increase in firm size from the period studied by Bamber. B1VOL ranges from –1.0 % to 13.1% with a mean and median of 1.3% and 0.9%, respectively. This increase in trading volume provides preliminary evidence that the information environment has fundamentally changed over the past 30 years.

[Insert Table 1 about here]

Table 2 displays the bivariate correlations for our two sub-samples of interest: 1977-1980 and 2003-2008. Panel A of Table 3 displays the bivariate correlations for the Bamber time (1977-1980) period. In the Bamber time period, trading volume is negatively related to both measures of firm size in the Spearman and Pearson correlations. Panel B of Table 3 displays the bivariate correlations for the current time

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9 We winsorize the variables at the one percent level (1% and 99%) to mitigate any potential effects of outliers.
period sample. Trading volume is positively related to both measures of firm size in the Pearson and Spearman correlations. The shift from negative to positive correlations between the two periods supports our main hypothesis. Interestingly, absolute price changes remains negatively related to firm size in both periods as in Ataise (1985), though the magnitude of the correlation is much smaller. While a reexamination of Ataise (1985) is not the focus of this study, the decrease is consistent with the over time changes which we expect to decrease the differences in information provided by large and small firms.

[Insert Table 2 about here]

Our prediction is that the cumulative effect of changes between Bamber’s time period and the modern time period have resulted in a more positive relation between trading volume reactions and firm size. We do not predict any particular pattern of change. Nonetheless, to provide information on the timing of the change, we present the relation between trading volume and firm size for each quarter across the entire 31 year period from 1977-2008 in Figure 1. The coefficient of the trading volume reaction on firm size is negative in the period studied by Bamber. It is less negative or insignificantly positive by the mid 1990’s and significantly positive and remains so in almost all quarters from the late 1990’s forward\textsuperscript{10}.

[Insert Figure 1 about here]

\textsuperscript{10} As is clear from the figure, the volume-size relation becomes negative again for several quarters during the recent financial crisis. We believe this provides additional evidence for the need to not over generalize results from one time period to the next.
To provide further insight regarding this change in the trading volume reaction/firm size relation, we present the trading volume reactions of the largest and smallest quintiles across the entire 31-year period from 1977-2008 in Figure 2. It is clear from these figures that trading volume around earnings announcements is increasing for all firms but that this increase is greater for large firms consistent with Landsman and Maydew (2002).

[Insert Figure 2 about here]

IV. RESULTS OF TESTS

To provide formal evidence of the shift in the trading volume reaction/firm size effect, we estimate a regression model of trading volume reactions on our decile measure of firm size and control variables suggested by the prior literature. We include a dummy variable, RECENT, and interact it with each of our independent variables to examine changes across time. Table 3 presents the results of the following regression model:

\[
B1VOL_{it} = \alpha_0 + \alpha_1 DSIZE_{it} + \alpha_2 MKVOL_t + \alpha_3 LPRICE_{it} + \alpha_4 ABSRET_{it} + \alpha_5 \text{RECENT} + \alpha_6 \text{RECENT} \times DSIZE_{it} + \alpha_7 \text{RECENT} \times MKVOL_t + \alpha_8 \text{RECENT} \times LPRICE_{it} + \alpha_9 \text{RECENT} \times ABSRET_{it} + \varepsilon_{it} \tag{1}
\]

where

\[B1VOL = \text{The cumulative three-day share turnover around the earnings announcement date (shares traded as a percentage of shares outstanding at the time of the announcement) less the median cumulative three-day share turnover of consecutive three-day periods in the non-announcement period}\]

\[DSIZE = \text{Size decile measured 1 to 10 depending on the market capitalization of the firm relative to other firms in the same sample quarter}\]
\[ MKVOL = \text{Mean share turnover of the firms in the sample for the same time as the announcement period (three days around the earnings announcement).} \]

\[ LPRICE = \text{Natural log of ending price two days before the announcement.} \]

\[ ABSRET = \text{Absolute value of the cumulative three-day return around the earnings announcement.} \]

\[ RECENT = 1 \text{ if the year is greater than or equal to 2003, 0 otherwise.} \]

The coefficient on the variable \( DSIZE (\alpha_1) \) captures the average change in abnormal trading volume as firms increase one firm size decile in the sample during the Bamber period. The coefficient on \( \text{RECENT} \times DSIZE_{it} (\alpha_6) \) captures the change in that coefficient between the Bamber period and the modern time period.

The results are presented in three columns. Column I & II present an estimate of equation (1) during Bamber’s time period (1977–1980) and a modern time period (2003–2008). Column I presents the coefficients from Bamber’s time period and Column II presents the coefficients for the interaction terms indicating the change between periods. The coefficient on the variable \( DSIZE (\alpha_1) \) is significantly negative in the Bamber period and the difference between periods (\( \alpha_6 \)) is significantly positive. Column III presents an estimate of a pooled regression of modern time period (2003–2008) only. This estimate is presented to demonstrate that the coefficient on \( DSIZE \) is significantly positive in the modern period. The estimation of these two regressions provides evidence consistent with our prediction that the trading volume/firm size relation is significantly more positive in recent time periods than it was in the time period studied by Bamber (1987).

Not only is the relation more positive in the modern period, but the relation has, in fact,
turned positive. As we discuss in section five, this change in the firm size effect is robust to alternative models and alternative measures of abnormal volume and firm size.

[Insert Table 3 about here]

Prior research (Kendal and Pearson 1995; Kim and Verrecchia 1997; Verrecchia 2001; Ahmed et al. 2003; Hope et al. 2009) has demonstrated that the association between abnormal volume and absolute price change is a useful proxy for the differential precision of pre-announcement information (see the discussion in Bamber et al. 2011). Consequently, we extend our examination of the change in the trading volume firm size relation by examining how the trading volume-return relation varies across firm size and time.

We estimate the following regression model of abnormal trading volume around earnings announcements across our subperiods:

\[
VOL_{it} = \beta_0 + \beta_1 DSIZE_{it} + \beta_2 ABSRET_{it} + \beta_3 ABSRET_{it} \times DSIZE_{it} \\
+ \beta_4 MKVOL_t + \beta_5 LPRICE_{it} + \beta_6 RECENT + \beta_7 RECENT \times DSIZE_{it} \\
+ \text{RECENT} \times \beta_8 ABSRET_{it} + \beta_9 \text{RECENT} \times ABSRET_{it} \times DSIZE_{it} \\
+ \beta_{10} \text{RECENT} \times MKVOL_t + \beta_{11} \text{RECENT} \times LPRICE_{it} + \epsilon_{it} \tag{2},
\]

where all variables are measured as before.

The results are presented in three columns. Column I&II in Table 4 presents an estimate of equation (2) during Bamber’s time period (1977–1980) and a modern time period (2003–2008). Column I presents the coefficients from Bamber’s time period and Column II presents the coefficients for the interaction terms indicating the change between periods. Column III presents an estimate of a pooled regression of modern time period
(2003–2008) only. Our independent variable of interest is the interaction term \( ABSRET \times DSIZE \). The coefficient \( \beta_3 \) captures the average change in the relation between abnormal volume and absolute price change as firms increase one firm size decile during the Bamber period. This coefficient, therefore, tests the relation between firm size and abnormal volume associated with absolute price change during the Bamber period. This coefficient is slightly significantly positive in the Bamber period. The coefficient \( \beta_9 \) captures the change in that coefficient between the Bamber period and the modern time period. This coefficient is significantly positive. Column III shows that the coefficient on the interaction of returns and firm size is significantly positive in the modern period. Thus, in the modern time period larger firms appear to be experiencing higher levels of differential prior precision than smaller firms. These results suggest that as share liquidity increases over time and firm size, investors are motivated to acquire more pre-announcement private information resulting in greater differences in the precision of information across investors (differential prior precision).

[Insert Table 4 about here]

It is also notable that the coefficient on \( DSIZE \) (\( \beta_1 \) and \( \beta_1 + \beta_7 \)) in Bamber’s time and the modern time period is negative. Thus, abnormal trading volume independent of absolute price change decreases with firm size in all time periods. Trading volume theory suggests that abnormal trading volume unrelated to price change captures differential interpretation of the announcement. Intuitively, investors more uniformly interpret the information contained in the announcement of large firms. This firm size effect on
differential interpretation appears to swamp the firm size effect on differential prior precision during Bamber’s period, thereby generating her negative relation between overall abnormal trading volume and firm size.

V. SENSITIVITY ANALYSIS

In this section we test the sensitivity of our results to (1) the definition of our variables, (2) the composition of our sample, (3) the specification of our model, and (4) other concerns.

Variable Definitions

As discussed in Bamber et al. (2011), there are many difficulties in choosing an appropriate measure of abnormal trading volume since all of the measures of normal trade are necessarily ad hoc. Consequently, we test multiple measures of abnormal trading volume found in the literature.

A potential complication with using any abnormal trading volume is that not all non-announcement period trading is uninformed (Bamber 1987; Bamber et al. 1997; Bamber et al. 2011). Thus, we use unadjusted share turnover as suggested by Bamber et al. (2011). Some trading volume studies in the literature have used a multiplicative abnormal trading volume measure that scales the announcement period trading volume by the non-announcement period trading volume (e.g., Bamber and Cheon 1995, Utama and Cready 1997, Barron et al 2005). Thus, we use a measure of scaled abnormal trading volume (the natural log of the ratio of announcement period turnover over non-announcement period turnover) based on a recent empirical study in Barron, Harris, and Stanford (2005). We use another abnormal trading volume measure found in Bamber
(1987) in which normal trading is predicted based on the relation between a firm’s non-announcement period trade and market wide trade (conceptually similar to a market model beta). We also test two measures of abnormal trading volume suggested by Garfinkel (2009): one is an additive measure of abnormal trading volume that controls for both firm level and market trading volume and the other predicts abnormal trading volume as a function of price change. Results and inferences for all of these measures are similar to our tabled results. Further, our results persist when we rank order all of the variables in our regression models to control for non-normality effects as suggested by Cheng, Hopwood, and McKeown (1992). We conclude that our results are not attributable to our choice of trading volume measure.

We also examine the robustness of our results across alternative measures of the independent variable, firm size. Our reported results use a market value of equity decile measure. We achieve substantially the same results with a continuous measure of the market value of equity and the natural log of the market value of equity. We conclude that our results are not attributable to our choice of firm size measure.

**Sample Composition**

The sample selection screens used in this study were minimal to ensure the widest possible range of firm size in the sample. In particular, we included quarterly data from all NYSE firms with available data on CRSP and COMPUTSTAT and winsorized outliers at the 1% level. Thus, we examine the robustness of our results across alternative sample composition choices. Our results are essentially unchanged when we use stricter definitions of outliers and when deleting extreme observations.
To further test the robustness of our results across alternative sample composition choices, we include NASDAQ firms and control for double-counting as suggested by Atkins and Dyl (1997). Again, our inferences are substantially the same. To counter any concerns that our results are driven by some change in the standard deviation of firm size over time, we scale our data to common 1967 dollars. Our results persist.

**Model Specification**

To further test the robustness of our results we add additional control variables found by prior empirical studies to affect turnover. From Chordia et al (2001), we include market wide variables such as the daily first difference in the Federal Funds Rate, a dummy variable equal to one if the concurrent CRSP daily index return is positive and zero otherwise, a dummy variable equal to one if the concurrent CRSP daily index return is negative and zero otherwise, a dummy variable equal to one if the past five trading-day CRSP daily index return is positive and zero otherwise, a dummy variable equal to one if the past five trading-day CRSP daily index return is negative and zero otherwise, and the past five trading-day average of CRSP daily absolute index returns. Based on Garfinkel (2009), we include a dummy which equals one if the return to the firm during the announcement period is positive and zero otherwise. Including all of these control variables has no quantitative or qualitative effect on the results and inferences remain unchanged.

Based on the seminal research of Bamber (1986, 1987) modern research has included firm size as a control variable in nearly every trading volume regression. Some of these papers, even with modern samples, continue to find negative coefficients on firm size. Such findings initially appear inconsistent with our findings and warrant further
investigation. Our report ordinary least squares model imposes a linearity constraint on the coefficient on our DSIZE measure. We relax this constraint by including a dummy variable for each decile in the regression thus allowing the coefficients on each decile to vary independently and examine each year of our sample independently. For parsimony, the results of this analysis are summarized in a heatmap presented in Figure 3. These results make it clear that while our main results holds with the trading volume / firm size relation being more positive in the recent periods the maximum trading volume is not always in the largest firms. In fact, the results represented in Figure 3 allow us to predict an insignificant or negative coefficient on firm size if a research designs biases toward large firms when the maximum trading volume is in the eighth or ninth decile. An obvious example of a research design where this can arise is the need for analysts’ forecasts. Analyst following is highly correlated with firm size and requiring forecasts (especially multiple forecasts) will lead to a negative coefficient on firm size in almost any period. The time period of the sample selected will also have an effect since this change is relatively recent research designs spanning long time periods might average negative coefficients on firm size.

The results presented in Figure 3, also, allow us to predict when authors will find a positive coefficient on firm size. Recent studies that use exclusively modern time periods and do not bias too much toward large firms should find positive coefficients. Two example of this are Hope et al. (2009) and Miller et al. (2010). Ultimately, the inconsistent findings in the literature and explanation offered by the results in Figure 3 reinforce the danger in over-generalizing results outside of a particular sample and
confirm the value added by reexamining seminal results such as the trading volume firm size relation.

[Insert Figure 3 about here]

Other Concerns

Our primary analysis uses Rogers (1993) corrected standard errors to control for the fact that our firm quarter observations are not independent. Peterson (2006) finds that this procedure is an effective way to adjust the standard errors for cross-sectional dependence and heteroskedasticity. Peterson also finds, however, that a firm level fixed effects model generates results that are as accurate as the Rogers procedure in most cases. Thus, we repeat our analysis using a firm fixed effects model, and our results are substantially the same.

VI. SUMMARY AND CONCLUSIONS

We argue that technology advances, changes in financial regulation, and changes in investor composition over the past 30 years have increased the available financial information of small firms and the investor diversity of large firms. This leads us to hypothesize and test for a positive shift in the trading volume reaction/firm size relation. Using multiple measures and models of trading volume reactions to quarterly earnings announcements, we document a positive shift in the trading volume reaction/firm size relation between the time period of Bamber’s (1987) seminal study (1977-1980) and a modern time period (2003-2006). Surprisingly, this positive shift has caused the trading volume reaction/firm size relation to turn positive, thereby reversing Bamber’s previously
documented negative relation. We also provide evidence that this positive shift is driven by increases in differential pre-announcement precision of information in large firms.

The evidence reported here may be helpful in explaining previous results in the literature that appear anomalous, such as Landsman and Maydew’s (2002) result that trading volume reactions have increased primarily for large firms and recent research studies that have reported inconsistent signs on firm size in trading volume regressions. The evidence reported here also suggests that empirical researchers should be careful about using firm size as a control variable in trading volume studies. In particular, researchers should be aware that using firm size in a regression model of trading volume may filter out some of the effect of interest in studies of investor heterogeneity or differential prior precision around earnings announcements. Finally, this study highlights the importance of utilizing extant trading volume theory when designing and interpreting empirical trading volume studies. By utilizing extant trading volume theory, we were able to document a shift in the trading volume reaction/firm size relation that has potential relevance for investors, regulators, and researchers.

Our evidence challenges previously held beliefs about firm size and investor heterogeneity and emphasizes the importance of interpreting trading volume reactions differently from price reactions. Based in part on empirical studies documenting a similar negative relation between firm size and both price reactions (Ataise 1985) and trading volume reactions (Bamber 1987), researchers have assumed that the pre-announcement information environment of large firms is characterized by both increased average precision and decreased differential precision of information. Our results suggest that this characterization may be incorrect. In particular, our evidence suggests that the pre-
announcement information environment of large firms is now characterized by increased average precision and increased differential precision. Further, our evidence supports Bamber’s (1986, 40) assertion that trading volume reactions are fundamentally different than price reactions, and that we should not expect trading volume and price studies to yield the same results when more refined hypotheses are tested.
REFERENCES


TABLE 1
Descriptive statistics for the two sub-periods of NYSE firm quarters.


<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
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<td>B1VOL</td>
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<td>0.001</td>
<td>0.004</td>
<td>-0.007</td>
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<td>0.174</td>
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</table>


<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
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</thead>
<tbody>
<tr>
<td>B1VOL</td>
<td>0.013</td>
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<td>0.031</td>
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<td>0.000</td>
<td>0.302</td>
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</table>

Variable Definitions:

B1VOL = Abnormal volume measured as the cumulative three-day share turnover (shares traded as a percentage of shares outstanding at the time of the announcement) around the period t earnings announcement less the median cumulative three-day share turnover of the non-announcement period.

SIZE = Market value of equity.

LSIZE = Natural log of the market value of equity

DSIZE = Decile measure of the market value of equity.

ABSRET = Absolute value of the cumulative three-day return around the earnings announcement.

MKVOL = Mean share turnover of the firms in the sample for the same time as the announcement period (three days around the earnings announcement).
TABLE 2
Bivariate correlations


<table>
<thead>
<tr>
<th></th>
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<th>DSIZE</th>
<th>ABSRET</th>
</tr>
</thead>
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<tr>
<td>B1VOL</td>
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<td>-0.077***</td>
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</table>

***, **, * indicate significance at the .01, .05, and .10 levels respectively (2-tailed test)

Variables are defined in the footnotes to Table 2


<table>
<thead>
<tr>
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<th>B1VOL</th>
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<th>DSIZE</th>
<th>ABSRET</th>
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</tr>
<tr>
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<td>0.395***</td>
<td>-0.051***</td>
<td>-0.056***</td>
<td>1.000</td>
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</tbody>
</table>
Column I & II present an estimate of equation (1) which is a pooled regression of abnormal trading volume (B1VOL) around quarterly earnings announcements on firm size and controls during Bamber’s time period (1977–1980) and a modern time period (2003–2008). A dummy variable, RECENT, is used to indicate the modern period and interacted with all of the independent variables. Coefficients and significances tests on uninteracted terms appear in column I and coefficients and significances tests on interacted terms indicating the change between periods appear in column II. Column III presents an estimate of a pooled regression of abnormal trading volume of abnormal trading volume (B1VOL) around quarterly earnings announcements on firm size and controls during a modern time period (2003–2008) only. Rogers (1993) corrected t-statistics appear in parentheses.

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<td>-0.0081***</td>
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<td>(1.91)</td>
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<td>(20.28)</td>
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<td>(7.91)</td>
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<td>33,779</td>
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Notes: All variables are as defined previously in Table 2. ***,**,* indicate significance at the .01, .05, and .10 levels respectively.
Column I & II present an estimate of equation (2) which is a pooled regression of abnormal trading volume (B1VOL) around quarterly earnings announcements on absolute returns, size and the interaction of absolute returns and size during Bamber’s time period (1977–1980) and a modern time period (2003–2008). A dummy variable, RECENT, is used to indicate the modern period and interacted with all of the independent variables. Coefficients and significances tests on uninteracted terms appear in column I and coefficients and significances tests on interacted terms indicating the change between periods appear in column II. Column III presents an estimate of a pooled regression of abnormal trading volume of abnormal trading volume (B1VOL) around quarterly earnings announcements on absolute returns, size and the interaction of absolute returns and size during a modern time period (2003–2008) only. Rogers (1993) corrected t-statistics appear in parentheses.

<table>
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<td>-0.0002***</td>
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<td>33,779</td>
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</table>

**Notes:** All variables are as defined previously in Table 2. 
***, **, * indicate significance at the .01, .05, and .10 levels respectively.
FIGURE 1
Coefficient on firm size, $\alpha_1$, from a simple regression of abnormal trading volume on firm size by quarter.

$$BIVOL_{it} = \alpha_0 + \alpha_1 DSIZE_{it} + \epsilon_{it}$$

Notes: The dotted line represents the quarterly regression coefficient and the solid line represents the moving four quarter average.
All variables are as defined previously in Table 2.
FIGURE 2
Abnormal trading over time for the largest and smallest firm size quintiles of B1VOL

Notes: All variables are as defined previously in Table 2.
FIGURE 3
Heat Map of Abnormal Trading Volume by Decile over Time

This heat map shows that, while trading volume is not perfectly uniformly negative across firm size in the Bamber period nor perfectly uniformly positive in the recent period, there is indeed a shift toward a more positive relation. It, also, shows that within certain subsamples (such as very large firms in recent periods) the previously documented negative relation might be maintained.

<table>
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</tbody>
</table>

Notes: Lighter areas indicate more trading volume. Darker areas indicate less trading volume.