Cross-market Information Transfer and Voluntary Corporate Disclosure: Evidence from Stock Options Trading

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Abstract

Motivated by the close relation between stock options and the underlying stock and the informed trading taking place in the options market, we examine the effect of options trading on voluntary corporate disclosure. We find that options trading is negatively and significantly related to the likelihood and frequency of management earnings forecasts, suggesting that firms with active options trading on their stock make fewer voluntary disclosures. This finding suggests that information spillover from the options market to the stock market can increase stock price informativeness, in turn reducing the need for firms to engage in voluntary disclosure to guide investor expectations. We further document that the negative relation between options trading and management forecasts is more pronounced for firms with a poorer information environment, a finding that highlights that information transfer from other markets, especially those with informed trading, is more important for more opaque firms. Consistent with information transfer reducing the need for voluntary disclosure, we also find that the negative relation is more pronounced for firms with stock market conditions that facilitate more price discovery. Lastly, we find that options trading reduces firm information asymmetry. It also reduces the specificity and informativeness of management forecasts. Our paper offers new insight into how cross-market information transfer can affect voluntary disclosure.

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1. Introduction

In this study, we examine how exchange-traded options on a firm's stock affect the firm's voluntary disclosure behavior. According to the Options Clearing Corporation, the total equity options volume has increased dramatically, from 673 million contracts in 2000 to over 3,689 million in 2017.[1] Stock options' low cost and high leverage make them an ideal security for informed investors, who can use them to profit from trading on private information (Black 1975). Options also alleviate short sale constraints by enabling investors to synthetically short a stock by purchasing puts and writing calls. Research finds that options trading increases the participation rate of informed traders (Chakravarty et al. 2004; Hu 2018) and the informational efficiency of stock prices (Pan and Poteshman 2006; Cremers and Weinbaum 2010). For example, research shows that options trading reduces the cost of equity capital (Naiker et al. 2013), the stock price response to earnings announcements (Truong and Corrado 2014), and the probability of informed trading (Hu 2018). The literature on options trading focuses exclusively on its effect on stock market conditions. However, little is known about whether options trading also affects corporate decisions.[2] We help fill this gap in the literature by investigating how options trading shapes managers' voluntary disclosure behavior.

In this paper, we examine whether an active options trading market on a firm's stock affects the firm's likelihood and frequency of management earnings forecasts. Ex-ante, options trading could increase or decrease voluntary disclosure. When informed investors trade in the options market, information could be transferred from that market to the stock market and price discovery in the stock market could occur (Cremers and Weinbaum 2010; Jin et al. 2012; Johnson and So

[1] https://www.theocc.com/webapps/historical-volume-query.
[2] Two papers examine the effect of options trading on corporate decisions. Gao (2010) finds that CEOs in firms with active options trading (i.e., lower hedging costs) have higher incentive pay. Blanco and Wehrheim (2017) document that options trading enhances corporate innovation.

2012). To the extent that stock price becomes more informative and price discovery reduces information asymmetry between firm insiders and outside investors, there will be less need for managers to guide investor expectations via management forecasts. More informative stock prices and reduced information asymmetry can also result in capital market benefits such as a lower cost of capital and improved stock liquidity, which in turn minimize a firm's need to rely on disclosure to achieve these benefits. To the extent that information transfer from the options market to the stock market improves stock market conditions, we expect managers to provide less voluntary disclosure when options trading on the firms' stock is active.

However, options trading may increase voluntary disclosure. Informed investors go to great lengths to acquire new and private information and then trade on it (Mayhew et al. 1995; Anthony 1988). To the extent that the outcomes of these trades (e.g., spikes in option prices and trading and possible stock market spillover effects, such as stock price crashes) result in the perception or revelation that managers have been hiding information, especially information that should have been disclosed earlier, the managers might suffer from litigation, reputation loss, or adverse career effects. Hence, when confronted with the likelihood that options trading will reveal hidden information, managers' ability to withhold information from investors becomes more constrained. From this perspective, we expect managers to be more willing to issue earnings forecasts when there is active options trading on their firm's stock.

In sum, there is tension in the hypothesis linking options trading to voluntary disclosure. Cross-market information transfer, with its effect on reducing expectation misalignment and providing firms with capital market benefits, predicts that options trading will have a negative effect on voluntary disclosure. In contrast, if options trading constrains information withholding, the predication would be a positive association between such trading and voluntary disclosure.

Hence, the effect of stock options trading on managers' voluntary disclosure is an empirical question, the answer to which can shed light on cross-market information dynamics.[3]

Using a large sample of U.S. public firms with exchange-traded options on their stocks for the 1996-2016 period, we find that options trading volume is negatively and significantly associated with the likelihood and frequency of management earnings forecasts, indicating that options trading reduces voluntary disclosure by management. We conduct several robustness tests to confirm our baseline results. The baseline results remain consistent when we examine different types of management forecasts and when we use alternative measures of options trading volume, alternative samples, alternative specifications such as a logit regression and a change analysis.

An important concern in our analysis is the endogeneity problem. It is possible that both options trading and management earnings forecasts are correlated with omitted variables that cause the apparent relation between them. It is also likely that options trading is endogenously determined by management earnings forecasts. We use two methods to mitigate the potential endogeneity problem. First, following prior literature we use moneyness and open interest as instrumental variables of options trading volume (Roll et al. 2009). Our results hold in the two-stage least squares (2SLS) regressions with these two variables as the instrument. Second, we conduct a difference-in-differences (DID) test based on options listings. Options listing decisions are made by exchanges, so options listings are less likely to be affected by endogenous firm decisions and are somewhat exogenous to firm characteristics. There are some criteria for options listing, such as the trading volume and market capitalization of the underlying stock (Mayhew and

[3] It is also possible that options trading has no effect on voluntary disclosure. A few papers indicate that options trading does not reveal new information to the stock market. Stephan and Whaley (1990) find that stock trading leads options trading, and Muravyev et al. (2013) show that the option price does not incorporate valuable information about future stock prices. We note, however, that the preponderance of the literature suggests that information transfer does occur from the options market to the stock market.

Mihov 2004). We use these criteria to define eligible non-options-listing stocks. For each options listing firm, we find a matched firm that has the closest propensity score but no options listing in the same month. Using the matched sample, we find that after an options listing, firms tend not to issue management earnings forecasts, or they issue them less frequently than eligible non-listing firms. Overall, the results of the instrumental variables and DID test based on options listings confirm the causal effect of options trading on management earnings forecasts.

To shed more light on the relation between options trading and voluntary disclosure, we conduct a series of cross-sectional tests. We focus on how firms' information environment and price discovery facilitation affect the association between options trading and managers' voluntary disclosures. First, options trading reduces the information asymmetry between managers and outside investors, and an important motivation for managers in issuing voluntary disclosure is to reduce information asymmetry. The reduction in information asymmetry caused by options trading is likely to be larger for firms with a poorer information environment, thus leading to a larger reduction in voluntary disclosure. We use financial reporting quality and readability of 10-K reports to gauge a firm's information environment. We find that the negative relation between options trading and management earnings forecasts is more pronounced for firms with higher abnormal accruals (i.e., poorer financial reporting quality) and less readable 10-K reports. Second, price discovery in the stock market due to options trading is also larger for firms with stock market conditions that facilitate information transfer from the options market to the stock market. The larger the price discovery in the stock market, the greater the reduction in the need for voluntary disclosure. We use stock liquidity and transient institutional ownership to capture price discovery facilitation and find that the negative relation between options trading and management earnings

forecasts is more pronounced for firms with higher stock liquidity and larger transient institutional ownership.

In additional tests, we first examine the effect of options trading on firm information asymmetry and find evidence that high options trading is associated with less information asymmetry. Next, we show that firms are more likely to issue more general rather than more specific forecasts when there is an active options market for their stock, which indicates that managers devote less energy to predicting future earnings as the need for management forecasts is reduced. We also find that the stock price reaction to an earnings surprise in a management earnings forecast is lower for firms with active options trading. Because options trading can help incorporate information into future stock price expectations, the price discovery arising from options trading reduces the informativeness of management earnings forecasts. Further, we separately examine the effect of options trading on good news and bad news forecasts. We find that options trading reduces both types of forecasts, indicating a reduction in the overall level of voluntary disclosure. Last, we examine whether options trading also affects other forms of voluntary disclosure and find that high options trading is related to a reduced likelihood and frequency of non-GAAP earnings disclosures.

This study makes two contributions. First, we add to the growing literature on the effect of options trading from a new perspective, voluntary corporate disclosure. The vast majority of studies on options trading focus on the effect of options trading on stock market conditions (Easley et al. 1998; Kumar et al. 1998; Chakravarty et al. 2004; Johnson and So 2012). As a result, evidence of how managers respond to the options market in making corporate decisions is limited. There are two notable exceptions. Gao (2010) finds that CEOs in firms with active options trading (i.e., lower hedging costs) tend to have higher pay-for-performance sensitivity and higher sensitivity of

CEO wealth to stock return volatility. Blanco and Wehrheim (2017) document that options trading enhances corporate innovation through increased informational efficiency and increased monitoring. In this paper, we extend the literature on the real effects of options trading by studying whether management earnings forecasts are affected by it. A study of this relation is important because management forecasts serve as a timely voluntary disclosure conduit that has a significant effect on price informativeness (Beyer et al. 2010).[4] In addition, the literature highlights that options trading and management forecasts can lead to similar equity outcomes, such as increasing price efficiency and reducing the cost of equity capital.

Second, this paper contributes to the voluntary disclosure literature by showing that price discovery originating from the capital markets reduces the need for voluntary disclosure. The literature documents that characteristics related to CEOs, outside directors, institutional investors, analysts, product market competition, and employees are important determinants of management disclosure behavior (Bamber et al. 2010; Ajinkya et al. 2005; Boone and White 2015; Anantharaman and Zhang 2011; Huang et al. 2017; Bova et al. 2015). There is emerging literature on how developments in capital markets can generate informational (or feedback) effects that can affect managerial disclosure choices (e.g., Zuo 2016; Kim et al. 2018; Sethuraman 2019). Motivated by the presence of sophisticated traders in options markets and the findings of cross-market information transfer between the options and stock markets (e.g., Merton 1976; Klemkosky and Resnick 1979; Finucane 1991; Cremers and Weinbaum 2010), we extend this literature by studying how trades in equity derivatives, specifically stock options, influence voluntary disclosure.

[4] Beyer et al. (2010) estimate that earnings guidance explains the total stock return variance far more than do mandatory earnings reports and SEC filings.

The rest of this paper is organized as follows. Section 2 develops the hypotheses. Section 3 describes the data, sample, and variables. Section 4 presents the baseline regression results and the results of robustness checks and endogeneity tests. Section 5 reports the results of cross-section tests, and Section 6 shows the results of additional analyses. Section 7 concludes the paper.

2. Hypothesis Development

Black and Scholes (1973) argue that under the assumption of a perfect market, options are redundant assets and their payoffs can be replicated by taking positions in stocks and bonds. Hull (2003) similarly contends that the price of stock options is just a function of the underlying stock's price. In contrast, Ross (1976) and Figlewski (1989) note that options are not redundant because in the absence of a perfect market, it is impossible to perfectly replicate them. Because of their low cost and high leverage, options are ideal securities for informed investors who have private information (Black 1975). There is evidence that options traders make an extensive effort to acquire firm-specific information and trade on it to profit from uninformed investors (Mayhew et al. 1995; Anthony 1988; Cremers and Weinbaum 2010; Jin et al. 2012; Johnson and So 2012). Trading by options traders reveals private information to the stock market, which facilitates that market's price discovery and enhances the informational efficiency of stock prices (Pan and Poteshman 2006; Chakravarty et al. 2004; Ge et al. 2016). The literature (Avellaneda and Lipkin 2003; Ni et al. 2005; Golez and Jackwerth 2012) has examined the phenomenon of stock pinning, which refers to the tendency of an underlying security's market price to close at or very near to the strike price of heavily traded options (in the same security) as the expiration time nears. Options trading can also serve to correct stock overvaluations and enhance the price discovery process by

alleviating short sale constraints on the underlying stock (Diamond and Verrecchia 1987; Figlewski and Webb 1993)

The price discovery arising from options trading reduces information asymmetry between firm insiders and outside investors, resulting in market consequences that are favorable to firms. For example, Kumar et al. (1998) suggest that options listings have a beneficial effect on the quality of the market for the underlying stock in terms of higher liquidity, lower information asymmetry, and greater pricing efficiency. Roll et al. (2009) show that options trading improves the market valuation of the underlying stock, and Naiker et al. (2013) document that firms with exchange-traded options have a lower implied cost of capital compared to firms without options. Blanco and Wehrheim (2017) find that options trading enhances corporate innovation through improving the efficiency of corporate resource allocation.

Similar to options trading, management forecasts also have an informational role. Management earnings forecasts allow managers to voluntarily communicate their expectations about future firm earnings. Such forecasts are an effective means by which managers can disclose private information to capital market participants (Trueman 1986), thereby aligning investor expectations with management beliefs about future earnings (Ajinkya and Gift 1984; Matsumoto 2002; Cotter et al. 2006). There is evidence that managers use earnings forecasts to reduce information asymmetry between firm insiders and outside investors (Coller and Yohn 1997; Verrecchia 2001; Healy and Palepu 2001; Beyer et al. 2010), resulting in higher stock liquidity (Diamond and Verrecchia 1991; Kim and Verrecchia 1994; Schoenfeld 2017) and a lower cost of capital (Cao et al. 2017).

Nevertheless, there are costs associated with voluntary disclosure. For example, disclosing forward-looking information may attract lawsuits (Johnson et al. 2001). Voluntary disclosure may

also increase proprietary costs, which damage firms' competitive positions (Verrecchia 1983; Huang et al. 2017). Therefore, there is a tradeoff to voluntarily disclosing more information.

Because options trading facilitates information transfer from options traders to the stock market, it enhances price discovery in the stock market and hence improves the informational efficiency of stock prices. With reduced information asymmetry between firm insiders and outside investors, there is less need for managers to issue earnings forecasts to align investor expectations with management beliefs about future earnings. More informative stock prices and reduced information asymmetry can also result in capital market benefits, such as lower cost of capital and improved stock liquidity. This reduces the need for the firm to rely on disclosure to achieve these benefits. Consistent with this argument, Sethuraman (2019) shows that managers issue fewer earnings forecasts when their firms' bond ratings are more credible, suggesting a substitution between voluntary disclosure and the credibility of bond rating information. As a result, managers may reduce earnings forecasts due to less need for them. From this perspective, we expect managers to be less willing to issue earnings forecasts when there is active options trading on their firm's stock.

Nevertheless, it is likely that options trading increases firms' voluntary disclosure. Options traders make extensive efforts to discover new information about firms to trade against uninformed investors. Options trading also alleviates short sale constraints, making it easier to trade on negative information. If managers do not disclose important information (especially negative information) in a timely manner, options traders are likely to detect such information and trade on it, which may result in negative consequences to managers, such as litigation, reputation loss, or adverse career effects. Skinner (1994) suggests that managers issue earnings forecasts to preemptively disclose bad news to reduce litigation risk. As such, managers might be more willing

to issue earnings forecasts when options trading is high. Overall, there is a tension about how options trading affects management earnings forecasts. However, we predict that on balance, the negative effect of options trading on management earnings forecasts dominates. Therefore, we formulate the first hypothesis as follows.

H1: The likelihood that and the frequency with which managers issue earnings forecasts are lower when there is an active options trading market for their firm's stock.

Based on our previous discussion, options trading reduces the information asymmetry between firm insiders and outside investors by facilitating price discovery and enhancing the informational efficiency of stock prices. However, the effect of options trading may vary among firms, depending on their information environment. Healy and Wahlen (1999) note that managers engage in earnings management to mislead other stakeholders about the firm's performance or to influence contractual outcomes linked to reported accounting numbers. Because earnings management distorts the information in financial reports, it renders firm financial disclosure opaque, giving rise to information risk to outside investors. Therefore, firms with high earnings management have lower quality financial reporting and hence a poorer information environment. In addition, the market may have delayed responses to information contained in complex financial reports because it is more difficult to process such information (Bloomfield 2002). Biddle et al. (2009) argue that less readable financial reports make it harder for investors to infer the future cash flow implications of accounting information. Therefore, less readable financial reports indicate a poorer firm information environment.

When firms have a poor information environment, as indicated by high earnings management or less readable financial reports, there is more private information for options traders to discover, which could result in options trading playing a more significant role. As such, options

trading may have a greater substitution effect on management earnings forecasts. Therefore, we formulate the second hypothesis as follows.

H2: The negative relation between options trading and management earnings forecasts is more pronounced for firms with a worse information environment (i.e., higher earnings management or less readable financial reports).

We argue that options trading reduces firm information asymmetry by transferring information from options traders to the stock market. To incorporate information from options traders more efficiently, firms need stock market conditions that facilitate stronger price discovery. Prior literature (e.g., Holmström and Tirole 1993; Edmans 2009) suggests that the marginal value of information acquisition increases with stock liquidity because high liquidity enables informed traders to make profits by trading against liquidity traders. As such, high liquidity encourages trading by informed traders, which facilitates greater information transfer from the options market to the stock market. Furthermore, transient institutional investors are characterized as having high portfolio turnover, highly diversified portfolio holdings, and a strong interest in short-term trading profits (Bushee 1998, 2001). Bushee (2001) and Bushee and Goodman (2007) suggest that transient institutional investors have strong incentives to acquire private information and trade on it. Trading by these investors accelerates the incorporation of firm-specific information into stock prices (Piotroski and Roulstone 2004; Ke and Ramalingegowda 2005; Sias et al. 2006). Firms with more transient institutional investors are expected to have more information transfer from the options market, which helps price discovery in the stock market.

With strong price discovery facilitation, such as higher stock liquidity or greater transient institutional ownership, more information is transferred from the options market and is incorporated into stock prices. This makes options trading more effective in reducing the

information symmetry between firm insiders and outside investors. As such, managers' need to engage in voluntary disclosure is further reduced, which results in options trading having a greater effect on management earnings forecasts. Therefore, we formulate the third hypothesis as follows.

H3: The negative relation between options trading and management earnings forecasts is more pronounced for firms with stock market conditions that facilitate more price discovery (i.e., higher stock liquidity or greater transient institutional ownership).

3. Data and Variables

3.1. Sample

We obtain data on management earnings forecasts from I/B/E/S, which covers earnings forecasts made by managers prior to the official release of reported earnings. The management forecast data start from 1992 and include detailed information about management forecasts with regard to earnings per share and other data items, such as cash flow per share and revenue. Our options trading data come from OptionMetrics and contain information about all of the exchange-traded options of U.S. listed stocks since 1996. The dataset contains information about each individual put and call option on a daily basis, such as the number of contracts traded, the closing bid and ask prices, and implied volatility. We collect firm financial information from Compustat and stock information from CRSP. Analyst coverage, equity issuance, and institutional ownership data are from I/B/E/S, Thomson One, and Thomson Reuters Institutional Holdings (13f) databases, respectively. We obtain institutional investor classification data from Brian Bushee's website.[5] Since the OptionMetrics data start in 1996, we restrict our sample period to 1996-2016.

[5] http://acct.wharton.upenn.edu/faculty/bushee/IIclass.html.

Our initial sample consists of all firms in the Compustat database. We drop firms with missing total assets. We further drop firms with no options trading because such firms have different fundamentals than firms with options trading (Mayhew and Mihov 2004). In addition, Roll et al. (2009) suggest that the informational efficiency associated with options trading depends on the volume of options traded rather than the options trading itself. Last, we drop observations with missing values for any of the control variables. We winsorize all of the continuous variables at the 1st and 99th percentiles to mitigate the effect of outliers. Our final sample consists of 38,493 firm-year observations for 5,022 unique firms during the 1996-2016 period.

Table 1 provides the industry and year distributions of our sample. Panel A shows the distribution of observations among the industries in the Fama-French 12 industry classification and the number and percentage of observations with an earnings forecast. The panel shows that the business equipment industry has the largest number of observations (7,148) in our sample, while the telephone and television transmission industry has the smallest (899). It further shows that the utilities industry has the highest percentage of observations with earnings forecasts (67.89%), and the oil, gas, and coal extraction and products industry has the lowest (16.01%).

Panel B presents the year distribution of the observations and the annual number and percentage of observations with an earnings forecast. The panel shows that the number of observations increases gradually, from 990 in 1996 to 2,461 in 2016. The percentage of observations with earnings forecasts increases from 24.34% in 1996 to 45.23% in 1999. It jumps to 64.66% in 2000, likely due to the passage of Regulation Fair Disclosure (Reg FD) that year. After that, the percentage increases slightly before decreasing gradually to 34.62% in 2016.

[Insert Table 1 about here]

3.2. Variable Construction

We measure voluntary disclosure using management earnings forecasts that include both annual and quarterly forecasts. Forecast likelihood (*DumMF*) is a dummy variable that equals one if the firm issues any earnings forecasts during a fiscal year and zero otherwise. Forecast frequency (*FreqMF*) is the natural logarithm of one plus the number of earnings forecasts issued by the firm in a fiscal year. We measure options trading using the dollar options trading volume (*LnOptvol*). Options trading volume measures how rich the information environment is and the ease with which informed trading can be facilitated (Roll et al. 2009). Easley et al. (1998) suggest that informed traders are motivated to trade in the options market when liquidity is high. Following Roll et al. (2009), we aggregate the dollar trading volume of all options contracts for each firm during each fiscal year. Specifically, we multiply the daily trading volume with the midpoint of the end-of-day bid-ask spread for each options contract on a stock. Then, we aggregate all listed options contracts on a stock across all trading days during a fiscal year. Last, we take the natural logarithm of one plus the aggregate dollar trading volume (in millions of U.S. dollars).

Following the literature (Kim et al. 2018; Bourveau et al. 2018), we include the following variables as controls in the regression. Firm size (*Size*) is the natural logarithm of the market value of equity at the fiscal year-end. Larger firms usually have a higher analyst rating for corporate disclosure (Lang and Lundholm 1993). Kasznik and Lev (1995) also suggest that the likelihood of disclosure is positively associated with firm size. Firm leverage (*Lev*) is total liabilities divided by total assets at fiscal year-end. The book-to-market ratio (*BM*) is the ratio of the book value of equity to its market value at fiscal year-end. Miller (2002) suggests that firm performance positively affects firm disclosure practices. Return on assets (*ROA*) is income before extraordinary items divided by total assets. Operating loss (*Loss*) is a dummy variable equal to one if income before extraordinary items for a fiscal year is negative and zero otherwise. Stock return (*Ret*) is the

buy-and-hold size-adjusted return for a fiscal year. Earnings volatility (*EarnVol*) is the standard deviation of the annual return on assets over the past 10 years with at least five non-missing observations. Firms with less volatile earnings tend to issue earnings forecasts more frequently (Waymire 1985). Institutional ownership (*IO*) is the percentage of shares held by institutional investors in a fiscal year. Bird and Karolyi (2016) suggest that institutional investors demand public information. As a result, managers disclose more and better quality information when institutional ownership is high. Analyst following (*Analyst*) is the natural logarithm of one plus the number of analysts covering the firm in a fiscal year. Anantharaman and Zhang (2011) show that managers tend to disclose more information to attract analysts. Litigation risk (*Litigation*) is the ex-ante class action litigation risk, calculated using the coefficients in Kim and Skinner (2012). Altman Z-score (*Mid_Zscore*) is a dummy variable that equals one if the firm's Altman Z-score falls within the middle quintile of the sample distribution in a given year and zero otherwise. Equity issuance (*Issue*) is a dummy variable that equals one if the firm issues equity during the fiscal year and zero otherwise. Firms are more likely to make an earnings forecast if they need access to the capital market (Frankel et al. 1995). Detailed variable definitions are available in Appendix A.

3.3 Descriptive Statistics

Table 2 provides the summary statistics of the main variables in the analysis. The table shows that the mean value of *DumMF* is 0.463, indicating that 46.3% of firm-year observations in our sample have at least one earnings forecast. *FreqMF* has a mean value of 0.803, which reflects that firms issue an average of 1.232 earnings forecasts during a year. The mean value of *LnOptvol* is 2.34 and its median value is 1.862. Further, the mean values of *Size*, *Lev,* and *BM* are 7.367, 0.223, and 0.562, respectively. The mean values of *ROA* and *Loss* are 0.013 and 0.227, respectively, indicating that most firms in our sample are profitable. The sample firms also have a mean *IO* of

0.657, suggesting that 65.7% of shares are held by institutional investors. The mean value of *Analyst* is 2.037, which suggests that an average of 6.667 analysts follow a firm. The mean values of *Ret*, *EarnVol*, *Litigation*, and *Mid_Zscore* are 0.028, 0.111, 0.172, and 0.2, respectively. The mean value of *Issue* is 0.137, which suggests that 13.7% of observations have an equity issuance.

[Insert Table 2 about here]

4. Empirical Results

4.1. Options Trading and Management Earnings Forecasts

To investigate the effect of options trading on management earnings forecasts, we perform the following regression:

$$
\begin{aligned}
DumMF_{i,t+1}/FreqMF_{i,t+1} &= \alpha_0 + \alpha_1 LnOptvol_{i,t} + \alpha_2 Size_{i,t} + \alpha_3 Lev_{i,t} + \alpha_4 BM_{i,t} + \alpha_5 ROA_{i,t} \\
&+ \alpha_6 Loss_{i,t} + \alpha_7 IO_{i,t} + \alpha_8 Analyst_{i,t} + \alpha_9 Ret_{i,t} + \alpha_{10} EarnVol_{i,t} \\
&+ \alpha_{11} Litigation_{i,t} + \alpha_{12} Mid\_Zscore_{i,t} + \alpha_{13} Issue_{i,t} + Firm\ FE + Year\ FE \\
&+ \varepsilon
\end{aligned}
\tag{1}
$$

in which *i* denotes the firm, *t* denotes the year, and ε is the error term. The dependent variables are forecast likelihood (*DumMF*) and forecast frequency (*FreqMF*). The independent variable of interest is options trading volume (*LnOptvol*). We also include a firm fixed effect to control for time-invariant firm-specific characteristics and a year fixed effect to control for the time trend of management earnings forecasts. We use an ordinary least squares (OLS) model for both forecast

likelihood and frequency.[6] We also adjust the standard errors for heteroscedasticity and clustering at the firm level.

The regression results are presented in Table 3. Column (1) presents the results for forecast likelihood and shows that the coefficient on options trading volume (*LnOptvol*) is negative and statistically significant, suggesting that a larger options trading volume is associated with a lower likelihood of a management forecast. In terms of economic significance, increasing the options trading volume by one standard deviation (1.986) reduces the probability of an earnings forecast by $1.986 \times 0.016 = 0.032$. Given that the mean probability is 0.463, this constitutes a 6.91% reduction compared to the mean. Therefore, the effect of options trading on the forecast likelihood is not only statistically but also economically significant.

Column (2) presents the results for forecast frequency. The coefficient on options trading volume (*LnOptvol*) is negative and statistically significant, which indicates that options trading volume also reduces the frequency of management earnings forecasts. In terms of economic significance, increasing the options trading volume by one standard deviation (1.986) reduces the forecast frequency by $1.986 \times 0.036 = 0.071$. This magnitude is comparable to other key determinants. For example, a one-standard-deviation increase in the return on assets (*ROA*) is associated with an increase in the forecast frequency of 0.033 ($0.141 \times 0.231 = 0.033$). Therefore, the effect of options trading on the frequency of earnings forecasts is also economically significant.

[Insert Table 3 about here]

[6] We use an OLS regression for *DumMF* in the main regression because of the inclusion of firm fixed effects. When the number of fixed effects is large, a logit regression is inconsistent and suffers from quasi-separation issues (Albert and Anderson 1984). Also, the inclusion of firm fixed effects in a logit model typically results in a significant drop in the number of observations. Nevertheless, our results hold when we use a logit regression in one of the robustness checks in Section 4.2.

The coefficients on the control variables are generally consistent with the literature. The coefficient on *Size* is positive and significant, indicating that larger firms are more likely to issue earnings forecasts (Kasznik and Lev 1995; Lang and Lundholm 1993). The coefficient on *ROA* is positive and significant, while the coefficient on *Loss* is negative and significant. This is consistent with Miller's (2002) evidence that profitable firms are more likely to issue earnings forecasts. In addition, the coefficient on *Analyst* is positive and significant. Graham et al. (2005) document that financial analysts use information disclosed by managers in predicting earnings, which results in a greater demand for management forecasts when analyst following is high. The coefficient on *Ret* is negative and significant, suggesting that firms with high stock returns are less likely to make earnings forecasts. The coefficients on the other control variables are mainly insignificant.

Collectively, the results in Table 3 document that high options trading volume is associated with a lower likelihood and frequency of management earnings forecasts. This is consistent with Hypothesis 1 that options trading improves informational efficiency and price discovery in the stock market, which reduces information asymmetry between firm insiders and outside investors. With reduced capital market benefits, managers' incentives to issue earnings forecasts are lower, resulting in a negative relation between options trading and management earnings forecasts.

4.2. Robustness Tests

In this section, we perform a series of robustness tests to validate the findings in our main test. We report the results of the robustness tests in Table 4. For brevity, we only report the coefficient on the variable of interest, options trading volume. In Panel A of Table 4, we examine different types of management forecasts. In the main analysis, we use both annual and quarterly earnings forecasts in measuring the likelihood and frequency of management forecasts. As a robustness check, we examine the annual and quarterly earnings forecasts separately. The results

are reported in columns (1)-(4), which show that the coefficient on *LnOptvol* remains negative and statistically significant for both annual and quarterly earnings forecasts. In addition, we consider non-earnings management forecasts. Forecasts of other items, such as sales and capital expenditure, can also provide useful information to investors and hence reduce information asymmetry. In columns (5) and (6), the coefficient on *LnOptvol* is insignificant for forecast likelihood but negative and statistically significant for forecast frequency. The results are consistent with our main findings in general.

[Insert Table 4 about here]

Panel B reports the results using the alternative measures for options trading volume. First, we examine whether the trading volumes of call (*LnCallOptvol*) and put (*LnPutOptvol*) options have differing effects on management earnings forecasts. The results in columns (1) and (2) show that the coefficients on both *LnCallOptvol* and *LnPutOptvol* are negative and statistically significant, suggesting that the effects of the two types of options on management forecasts are similar. Second, we aggregate the number of options contracts for each firm during each fiscal year and use the natural logarithm of one plus the total number of contracts (*Lnsoptvol*) as the measure of options trading volume. Third, we follow Roll et al. (2010) and define the option-to-stock ratio (*LnO/S*) as the natural logarithm of the ratio of the annual dollar options trading volume to the dollar trading volume of the underlying stock.[7] Columns (3)-(6) show that the coefficients on both alternative measures of options trading volume are negative and statistically significant, consistent with our baseline results.

In Panel C, we present the results using alternative samples. In the main analysis, we exclude firms with no exchange-traded options. As a robustness check, we include these firms and set their

[7] Our results hold when we define *LnO/S* as the natural logarithm of the ratio of the annual options trading volume in shares to the stock trading volume in shares.

options trading volume to zero following Roll et al. (2009). Next, we exclude the dot-com bubble (i.e., 2000-2001) and financial crisis (i.e., 2007-2008) periods. Because the health of financial institutions deteriorated during these periods, managers' incentive to issue earnings forecasts to seek capital may have seen a decline (Lo 2014). Last, we limit our analysis to the post Reg FD period (i.e., 2000 onward). Because Reg FD prohibits public firms from disclosing information to certain parties privately, management forecast behavior may have changed after its implementation (Bailey et al. 2003; Heflin et al. 2003; Heflin et al. 2016). The panel shows that the coefficient on *LnOptvol* remains negative and statistically significant, suggesting that our findings are not driven by a particular sample.

Panel D reports the results using alternative regression specifications. In the main analysis, we use OLS in the regression for forecast likelihood. As a robustness check, we use the logit model in the regression and report the results in column (1). Even if the sample size is reduced significantly, the coefficient on *LnOptvol* is still negative and statistically significant. Next, we use a change analysis to mitigate the possibility that time-invariant firm-specific characteristics may drive our main findings. The results are presented in columns (2) and (3), which show that the coefficient on the change in options trading volume (Δ*LnOptvol*) is negatively associated with the changes in forecast likelihood (Δ*DumMF*) and forecast frequency (Δ*FreqMF*). The results confirm the robustness of our findings to alternative regression specifications.

Last, we perform tests that control for CDS trading and report the results in Panel E. Kim et al. (2018) find that CDS trading is positively related to the likelihood and frequency of management earnings forecasts. They argue that CDS trading weakens lenders' incentives to monitor firms, which raises shareholders' demand for management disclosure. While it is unclear whether the monitoring incentives of lenders affect information transfer from the options market

to the stock market, we add CDS trading as an additional control variable. Following Kim et al. (2018), we define *PostCDS* as a dummy variable that equals one for years after CDS initiation and zero otherwise, and *CDSTraded* as a dummy variable that equals one if the firm ever has CDS trading during our sample period and zero otherwise. Due to the availability of CDS trading data, our sample period for this test is from 1997 to 2015. We do not include a firm fixed effect because *CDSTraded* does not have any within-firm variation and will be subsumed if a firm fixed effect is included. We find that the coefficient on *LnOptvol* is still negative and statistically significant when controlling for CDS trading.[8]

4.3. Endogeneity

A concern about our analysis is that options trading and management earnings forecasts could be endogenously determined. They may both be correlated with variables omitted from the regression, which would result in an apparent relation between them. It is also likely that the causality extends from management earnings forecasts to options trading. For example, firms that constantly issue earnings forecasts may have less private information for options traders to trade on, resulting in a low options trading volume. We use two methods to mitigate the potential endogeneity problems.

In the first method, we follow Roll et al. (2009) and use option moneyness and open interest as instrumental variables of options trading. Option moneyness (*Moneyness*) is the annual average absolute difference between a stock's market price and an option's strike price. Informed traders are attracted by out-of-the-money (OTM) options because they offer the greatest leverage, while uninformed traders are interested in in-the-money (ITM) options to avoid risky positions (Pan and

[8] Our result for *PostCDS* is different from Kim et al. (2018), mainly because we use a different sample and different regression specifications. When we follow their methods exactly, we obtain results similar to theirs (i.e., a negative and statistically significant coefficient on *PostCDS*).

Poteshman 2006). In addition, volatility traders are likely to dodge deep ITM or OTM options because their vega is close to zero (Roll et al. 2009). Therefore, option moneyness is closely related to options trading volume. Option open interest (*OpenInterest*) is the annual average number of outstanding options contracts that have not been settled across all options on a stock. Because open interest indicates unsettled options contracts, it is closely related to options trading volume. However, there is no economic intuition that option moneyness and open interest are related to management earnings forecasts. As a result, these two instruments meet the exclusion restrictions (Larcker and Rusticus 2010).

[Insert Table 5 about here]

We follow the standard two-stage least squares (2SLS) estimation using option moneyness and open interest as the instrumental variables. In the first stage, we regress options trading volume against option moneyness, open interest, and the set of control variables in Equation (1). In the second stage, we regress forecast likelihood and frequency against the predicted value of options trading volume from the first-stage regression and the same set of control variables. Table 5 presents the results of the 2SLS regression. Column (1) shows that the coefficients on option moneyness and open interest are both positive and statistically significant, consistent with our expectation. In columns (2) and (3), the coefficient on predicted options trading volume remains negative and statistically significant in both regressions. Overall, the results of the 2SLS regression are consistent with the baseline results, which helps mitigate the endogeneity concerns.

In the second method, we perform a DID analysis based on options listing events (i.e., the first time the firm has exchange-traded options). Because options listing decisions are made by stock exchanges, they are largely exogenous to firm policies, especially firm disclosure practices. We identify options listing events using the OptionMetrics database, and we define the options

listing date as the first day the firm appears in the database.[9] In total, there are 1,198 eligible options listing events in our sample.

For each options listing firm during the month prior to the options listing date, we find a matched non-listing firm from a pool of firms that meet the selection criterion in Mayhew and Mihov (2004) and Hu (2018). The criteria are as follows: (1) the stock should be listed on the NYSE, Amex, or Nasdaq; (2) the stock should issue at least seven million publicly held shares; (3) the stock should reach the minimum price;[10] and (4) the stock should have no options trading history and been traded for at least 252 trading days in the CRSP database. The matched non-listing firm should have the closest propensity score (i.e., the probability of an options listing), calculated based on firm size, trading volume, stock return volatility, and bid-ask spread (Mayhew and Mihov 2004; Hu 2018). The regression results in calculating the propensity score are shown in Panel A of Appendix B. Further, Panel B of Appendix B shows that there is almost no significant difference between options listing firms and matched non-listing firms, which suggests that our matching is successful.

We adopt the DID approach and examine whether options listing firms experience a reduction in management earnings forecasts after options listing compared to matched non-listing firms. The regression specification is as follows:

$$
\begin{aligned}
DumMF_{i,t+1}/FreqMF_{i,t+1} &= \alpha_0 + \alpha_1 Post_{i,t} + \alpha_2 Size_{i,t} + \alpha_3 Lev_{i,t} + \alpha_4 BM_{i,t} + \alpha_5 ROA_{i,t} + \alpha_6 Loss_{i,t} \\
&+ \alpha_7 IO_{i,t} + \alpha_8 Analyst_{i,t} + \alpha_9 Ret_{i,t} + \alpha_{10} EarnVol_{i,t} + \alpha_{11} Litigation_{i,t} \\
&+ \alpha_{12} Mid\_Zscore_{i,t} + \alpha_{13} Issue_{i,t} + Firm\ FE + Year\ FE + \varepsilon
\end{aligned}
$$

[9] OptionMetrics coverage starts in 1996, and we are unable to identify the options listing year for firms that have options trading information in OptionMetrics in 1996. Therefore, we drop firms that first appear in the OptionMetrics database in 1996.

[10] The minimum price is $7.5 before 2002 and $3 after 2002.

(2)

in which *i* denotes the firm, *t* denotes the year, and ε denotes the error term. We require firms to have at least one firm-year observation before and after the options listing. For options listing firms, *Post* equals one for years after the options listing and zero for years before it. For matched non-listing firms, *Post* equals zero both before and after the options listing.

[Insert Table 6 about here]

The results of the DID analysis are presented in Table 6. Columns (1) and (2) report the results for one year before and after the options listing, and columns (3) and (4) report the results for the three years before and after the options listing. In all of the columns, the coefficient on *Post* is negative and statistically significant, suggesting that compared to matched non-listing firms, options listing firms are less likely to issue earnings forecasts after an options listing, confirming the negative relation between options trading and management earnings forecasts. Overall, the results are consistent with the baseline results, indicating that endogeneity is unlikely to drive our findings.

5. Cross-Sectional Tests

5.1 The Effect of Information Environment

After establishing the negative relation between options trading and management earnings forecasts, we examine the effect of a firm's information environment on the relation. As illustrated in Hypothesis 2, if options trading leads to a reduced need for managers' voluntary disclosure by mitigating the information asymmetry between firm insiders and outside investors, we would expect the effect of options trading to be more prominent for firms with a poorer information environment.

We use two types of measures to capture a firm's information environment. The first is based on abnormal accruals and is estimated following Dechow and Dichev (2002) and McNichols (2002). A higher value for abnormal accruals indicates more earnings management and hence lower quality financial reporting. We define accruals (*Accruals*) as a dummy variable that equals one if abnormal accruals are above the sample median and zero otherwise. The second is the readability of the firm's 10-K reports. We use the modified readability measures proposed by Kim et al. (2019). Specifically, we define modified fog (*Modfog*) as a dummy variable that equals one if the modified fog score is above the sample median and zero otherwise. We also define modified flesch (*Modflesch*) as a dummy variable that equals one if the modified Flesch score is above the sample median and zero otherwise, and modified kincaid (*Modkincaid*) as a dummy variable that equals one if the modified Kincaid score is above the sample median and zero otherwise. Higher *Modfog*, *Modflesch*, and *Modkincaid* indicate less readable financial reports. We interact the four variables with options trading volume (*LnOptvol*) and include the interaction term in the regression specification in Equation (1). The results are reported in Table 7.

[Insert Table 7 about here]

Columns (1) and (2) show that the coefficient on *LnOptvol*×*Accruals* is negative and statistically significant in both regressions, suggesting that the effect of options trading on management forecasts is more pronounced for firms with higher abnormal accruals (i.e., lower quality financial reporting). In columns (3) to (8), the coefficients on *LnOptvol*×*Modfog*, *LnOptvol*×*Modflesch*, and *LnOptvol*×*Modkincaid* are all negative and statistically significant, indicating that the effect of options trading on management forecasts is more pronounced for firms whose annual reports are less readable. Overall, the results show that when a firm's information environment is poor, options trading is more effective in reducing information asymmetry, which

results in a larger reduction in the demand for voluntary firm disclosure. The findings provide supporting evidence to our Hypothesis 2.

5.2. The Effect of Price Discovery Facilitation

In this section, we further examine whether the relation between options trading and management earnings forecasts is stronger for firms with stock market conditions that facilitate more price discovery. Hypothesis 3 states that if the stock market facilitates more price discovery, there will be greater information transfer from the options market to the stock market. As such, options trading will be more effective in curtailing information asymmetry between firm insiders and outside investors, which results in even less need for voluntary disclosure.

We measure price discovery facilitation using stock liquidity and transient institutional ownership. With high stock liquidity, it is easier for informed traders to trade in the stock market, which facilitates more information transfer from the options market and hence greater price discovery in the stock market. We follow Amihud (2002) and calculate Amihud stock illiquidity as the average ratio of the daily absolute return to the dollar trading volume across the year. Because higher values indicate greater illiquidity of the underlying stock, we define stock liquidity (*Liquidity*) as a dummy variable that equals one if the Amihud stock illiquidity measure is below the sample median and zero otherwise. Further, Bushee (1998, 2001) classifies institutional investors into transient, quasi-index, and dedicated institutions. Transient institutional investors are characterized as having high portfolio turnover and highly diversified portfolio holdings as well as focusing on short-term trading profits. Transient institutional investors have strong incentives to acquire private information. Their trading facilitates more information transfer from the options market, which helps price discovery in the stock market. We define transient institutional ownership (*TraIO*) as a dummy variable that equals one if the proportion of the firm's

shares held by transient institutional investors is above the sample median and zero otherwise. We also control for quasi-index (*QixIO*) and dedicated (*DedIO*) institutional ownership, defined as a dummy variable that equals one if the proportion of the firm's shares held by quasi-index or dedicated institutional investors is above the sample median and zero otherwise. We interact stock liquidity (*Liquidity*) and institutional investor variables (*TraIO*, *QixIO*, and *DedIO*) with options trading volume (*LnOptvol*) and include the interaction terms in the regression specification in Equation (1). The results are reported in Table 8.

[Insert Table 8 about here]

Columns (1) and (2) show that the coefficient on *LnOptvol*×*Liquidity* is negative and statistically significant in both regressions, indicating that the effect of options trading on management forecasts is greater for firms with high stock liquidity. In columns (3) and (4), the coefficient on *LnOptvol*×*TraIO* is negative and statistically significant, which indicates that the effect of options trading on management forecasts is more pronounced for firms with high transient institutional ownership. The coefficients on *LnOptvol*×*QixIO* and *LnOptvol*×*DedIO* are both insignificant. Collectively, the results lend support to Hypothesis 3 by showing that options trading is more effective in reducing information asymmetry when stock market conditions facilitate greater information transfer from the options market. This results in greater price discovery in the stock market and hence a larger reduction in voluntary disclosure.

6. Additional Analyses

6.1 The Effect of Options Trading on Information Asymmetry

According to our story, options trading improves informational efficiency and price discovery in the stock market, which reduces information asymmetry between firm insiders and

outside investors. This results in less need for managers to guide investor expectations via management forecasts. In this section, we try to validate our story by examining whether options trading reduces firm information asymmetry. We adopt two information asymmetry measures. Bid-ask spread (*BASPREAD*) is defined as 100 times the annual average daily difference between the ask price and the bid price divided by the midpoint of the ask and bid prices. A higher bid-ask spread value indicates greater information risk (Glosten and Milgrom 1985). Probability of informed trading (*PIN*) measures the probability that trades are conducted by informed investors and hence captures the information asymmetry among investors in the stock market (Easley and Ohara 1987; Brown and Hillegeist 2007). We obtain the probability of informed trading data from Brown and Hillegeist (2007).[11]

[Insert Table 9 about here]

We regress bid-ask spread and probability of informed trading against options trading (*LnOptvol*) and the same set of control variables in Equation (1). The results are reported in Table 9. In column (1), the coefficient on *LnOptvol* is negative and statistically significant, suggesting that options trading reduces the bid-ask spread of the underlying stock. In column (2), the coefficient on *LnOptvol* is also negative and statistically significant, indicating that options trading also reduces the probability of informed trading. Overall, our results suggest that options trading does reduce the information asymmetry of the underlying stock, which provides further support for our argument.

6.2 Management Forecast Characteristics

In this section, we extend our analysis to management forecast characteristics. It is likely that options trading affects not only the likelihood and frequency of management earnings forecasts

[11] Because the probability of informed trading data is only available for the period 1993-2010, we restrict our sample in this test to the period 1996-2010.

but also their characteristics. We document in the main analysis that options trading reduces firm information asymmetry and hence the need for managers to issue earnings forecasts. If this is the case, managers who issue earnings forecasts for various other reasons (e.g., maintaining the tradition of making earnings forecasts) may devote less energy to preparing them due to their decreasing value. We test this prediction by investigating whether high options trading is associated with more general management earnings forecasts.

Forecast width (*Width*) is calculated as the difference between the upper and lower end estimates, divided by stock price. We assign a width of zero for point estimates and take the average value of the forecast width among the forecasts if the firm makes multiple forecasts during the year. For ease of interpretation, we multiply the forecast width by -100. Forecast range (*Range*) is defined as an ordinal variable equal to one for forecasts with an open range estimate, two for forecasts with a closed range estimate, and three for forecasts with a point estimate. Following Bova et al. (2015), we take the natural logarithm of the sum of the values across all forecasts if the firm makes multiple forecasts during the year. For both measures, a higher value indicates that the forecasts are more general. We restrict the analysis to the sample of firms that make at least one forecast during the year in the test. We regress forecast width and range against options trading (*LnOptvol*) and the same set of control variables in Equation (1). The results are reported in Table 10.

[Insert Table 10 about here]

Column (1) shows that the coefficient on *LnOptvol* is negative and statistically significant when forecast width is the dependent variable, suggesting that managers tend to issue more general forecasts when options trading is high. The results in column (2) are similar: they show that the coefficient on *LnOptvol* is still negative and statistically significant when forecast range is the

dependent variable. In sum, our results suggest that there is less need for managers to issue specific earnings forecasts when options trading is high. The findings are consistent with our argument that with active options trading on their firm's stock, managers who issue earnings forecasts devote less energy to preparing those forecasts due to the decrease in their value.

6.3. Stock Market Reaction to Management Earnings Forecasts

The literature (Truong and Corrado 2014) demonstrates that the stock price response to earnings announcements is reduced when there is active options trading on the firm's stock because some of the private information is partially revealed to the public by options traders prior to earnings announcements. There is also evidence that the prices of non-optioned stocks take significantly longer to adjust to earnings announcements (Jennings and Starks 1986), takeover announcements (Cao et al. 2005), and stock-split announcements (Chern et al. 2008). If options trading enables information transfer from the options market, which facilitates more price discovery in the stock market, some of the information in management earnings forecasts may be revealed by options trading before the forecasts' release. Therefore, we expect the market response to management forecast information to be lower for firms with high options trading. To test this prediction, we perform the following regression.

$$\begin{aligned} CAR_{i,t+1} = {} & \alpha_0 + \alpha_1 MFSurp_{i,t+1} + \alpha_2 MFSurp_{i,t+1} \\ & \times HighOpt_{i,t} + \alpha_3 MFSurp_{i,t+1} \times Size_{i,t+1} + \alpha_4 MFSurp_{i,t+1} \times BM_{i,t+1} \\ & + \alpha_5 MFSurp_{i,t+1} \times Loss_{i,t+1} + \alpha_6 MFSurp_{i,t+1} \times Analyst_{i,t+1} \\ & + \alpha_7 HighOpt_{i,t} + \alpha_8 Size_{i,t+1} + \alpha_9 BM_{i,t+1} + \alpha_{10} Loss_{i,t+1} + \alpha_{11} Analyst_{i,t+1} \\ & + Firm\ FE + Year\ FE + \varepsilon \end{aligned} \quad (3)$$

in which *i* denotes the firm, *t* denotes the year, and ε is the error term. We restrict the analysis to the sample of firms that make at least one earnings forecast during a year. If there are multiple earnings forecasts during a year, we use the last annual earnings forecast (Ajinkya et al. 2005). Market reaction to a forecast (*CAR*) is the three-day value-weighted market-adjusted cumulative abnormal returns around the release of the forecast. Management forecast surprise (*MFSurp)* is calculated as the difference between the management forecast and the consensus analyst forecast divided by stock price. High options trading (*HighOpt*) is a dummy variable that equals one if options trading (*LnOptvol*) is above the sample median and zero otherwise. The results are presented in Table 11.

[Insert Table 11 about here]

Column (1) presents the results of the original model without the interaction term between *MFSurp* and *HighOpt*. The columns show that the coefficient on *MFSurp* is positive and statistically significant, suggesting that the market has a stronger reaction to management earnings forecasts when forecast surprises are higher. In column (2), we include in the model an interaction term between *MFSurp* and *HighOpt*. The coefficient on *MFSurp*×*HighOpt* is negative and statistically significant, which indicates that the market reaction to forecast surprises is mitigated for firms with active options trading on their stock.

Overall, our results indicate that options trading can help incorporate information about future earnings into stock prices earlier, which reduces the informativeness of management earnings forecasts. The findings lend further support to our argument that options trading reduces the need for managers to make earnings forecasts because options trading reveals some earnings information.

6.4 Good News versus Bad News Forecasts

We show in the main analysis that options trading reduces the likelihood and frequency of management earnings forecasts. Nevertheless, it is likely that options trading affects good news and bad news forecasts differently. Our competing hypothesis suggests that options trading could encourage voluntary disclosures because managers are subject to negative consequences such as litigation, reputation loss, and adverse career effects if undisclosed information is detected and revealed by options traders. Because such effects would be more severe for bad news (Skinner 1994), managers may issue more forecasts that preemptively disclose bad news when the firm has active options trading on its stock.

To test this possibility, we classify management earnings forecasts into good news and bad news forecasts based on management forecast surprise (*MFSurp*) and the market reaction to a forecast (*CAR*), respectively. We define good news forecasts as those with positive *MFSurp* or *CAR* and bad news forecasts as those with negative *MFSurp* or *CAR*. Then we define good news forecast likelihood (*DumGN*) as a dummy variable that equals one if the firm issues any good news earnings forecasts during a fiscal year and zero otherwise, and bad news forecast likelihood (*DumBN*) as a dummy variable that equals one if the firm issues any bad news earnings forecasts during a fiscal year and zero otherwise. We define good news forecast frequency (*FreqGN*) as the natural logarithm of one plus the number of good news earnings forecasts issued by the firm in a fiscal year, and bad news forecast frequency (*FreqBN*) as the natural logarithm of one plus the number of bad news earnings forecasts issued by the firm in a fiscal year.

[Insert Table 12 about here]

We re-estimate the baseline regression in Equation (1) with good and bad forecast variables as the dependent variables. The results are reported in Table 12. Panel A presents the results for defining good and bad news forecasts by forecast surprise. The panel shows that the coefficient on

options trading volume (*LnOptvol*) is negative and statistically significant for the likelihood and frequency of both good and bad news forecasts. Panel B presents the results for defining good and bad news forecasts by market reaction, with similar findings. Overall, the results suggest that options trading lowers the likelihood and frequency of both good and bad news forecasts, consistent with options trading reducing information asymmetry and hence the need for managers to issue earnings forecasts.

6.4 The Effect of Options Trading on Non-GAAP Earnings

Non-GAAP earnings, earnings excluding components that managers deem to be less representative of core operations, are one of the most important performance metrics that managers voluntarily disclose to investors (Graham et al. 2005). Prior research finds that investors perceive non-GAAP earnings to be more informative than GAAP earnings to forecast future performance (e.g., Bradshaw and Sloan 2002; Bhattacharya et al. 2003; Bradshaw et al. 2018). As options trading enhances informational efficiency and price discovery in the stock market, we expect that options trading reduces the need for non-GAAP earnings to provide more informative earnings information. We obtain the non-GAAP earnings data from Bentley et al. (2018).[12] Non-GAAP disclosure likelihood (*DumNonGAAP*) is defined as a dummy variable that equals one if the firm makes any non-GAAP earnings disclosure during a fiscal year and zero otherwise. The non-GAAP disclosure frequency (*FreqNonGAAP*) is the natural logarithm of one plus the number of non-GAAP earnings disclosure made by the firm in a fiscal year.

[Insert Table 13 about here]

We regress the non-GAAP disclosure likelihood and frequency against options trading (*LnOptvol*) and the same set of control variables in Equation (1). The results are reported in Table

[12] Because the non-GAAP disclosure data are only available for the period 2003-2016, we restrict our sample in this test to the same period.

13. Column (1) shows that the coefficient of *LnOptvol* is negative and statistically significant, suggesting that options trading reduces the likelihood of non-GAAP disclosure. The findings in column (2) are similar and show that the frequency of non-GAAP disclosure also decreases when options trading is high. Overall, the results in this section suggest that with the decrease in information asymmetry associated with options trading, firms not only reduce the issuance of earnings forecast but also reduce other forms of voluntary disclosure such as non-GAAP earnings disclosure.

7. Conclusion

This study examines the effect of options trading on voluntary disclosure. Options traders are informed investors who have private information about a firm. These traders' trading disseminates their private information into options prices, and the resulting information transfer from the options market to the stock market can increase informational efficiency and price discovery in the latter. Due to the reduced information asymmetry and capital market benefits that options trading provides, there is less need for managers to issue earnings forecasts, which results in a negative relation between options trading and earnings forecasts. Nevertheless, it is also likely that when confronted with the likelihood of options trading revealing hidden information, managers' ability to withhold information from investors becomes more constrained. As a result, managers are more willing to issue earnings forecasts when there is active options trading on the firm's stock.

Using a large sample of U.S. public firms with exchange-traded options on their stocks, we find that options trading volume is significantly and negatively associated with the likelihood and frequency of management earnings forecasts. Our findings are robust to a battery of robustness

tests. We use instrumental variables and DID tests based on options listings to alleviate potential endogeneity problems. In the cross-sectional tests, we find that the negative relation between options trading and management earnings forecasts is more pronounced for firms with a poorer information environment and for those with stronger price discovery facilitation. Further, we show that options trading is associated with a decrease in firm information asymmetry. We also find that firms are more likely to issue a more general earnings forecast when there is active options trading on its stock. Additionally, options trading reduces the informativeness of management earnings forecasts because such trading helps incorporate information into stock prices. We also separately examine the effect options trading has on good and bad news forecasts and find that it reduces the likelihood and frequency of both types of forecasts. Last, we find that options trading also reduces the likelihood and frequency of non-GAAP earnings disclosure.

Our study contributes to the growing literature on the effect of options trading from the perspective of voluntary disclosure. The vast majority of studies in options trading concentrate on its effect on stock market conditions. We extend the literature on the real effects of options trading by studying whether management earnings forecasts are affected by it. Our study also contributes to the voluntary disclosure literature by showing that price discovery originating from the capital markets reduces the need for voluntary disclosure. In this sense, our paper is in line with the emerging literature on how capital market developments can generate informational (or feedback) effects that can affect managerial disclosure choices.

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Appendix A: Variable Definitions

Variable	Definition
Variables in the Baseline Analysis	
DumMF	Dummy variable that equals one if the firm issues at least one earnings forecast during the fiscal year, zero otherwise.
FreqMF	Natural logarithm of one plus the number of earnings forecasts issued by the firm in a fiscal year.
LnOptvol	Natural logarithm of one plus the total annual dollar options volume (in millions of U.S. dollars) in a fiscal year.
Size	Natural logarithm of the market value of equity at the fiscal year-end.
Lev	Total debt divided by total assets at the fiscal year-end.
BM	Book value of equity divided by the market value of equity at the fiscal year-end.
ROA	Income before extraordinary items divided by total assets.
Loss	Dummy variable equal to one if income before extraordinary items at the fiscal year-end is negative, zero otherwise.
IO	Percentage of total shares outstanding held by institutional investors at the fiscal year-end.
Analyst	Natural logarithm of one plus the number of analysts covering the firm in a fiscal year.
Ret	Buy-and-hold size-adjusted return in a fiscal year.
EarnVol	Standard deviation of the annual return on assets over the past 10 years with, at minimum, five non-missing observations.
Litigation	Ex-ante class action litigation risk, calculated using the coefficients from Model (3) in Kim and Skinner (2012).
Mid_Zscore	Dummy variable that takes a value of one if the firms' Altman Z-score falls within the middle quintile of the sample distribution at the fiscal year-end, zero otherwise. Z-score = 1.2 × (current assets minus current liabilities/total assets) + 1.4 × (retained earnings/total assets) + 3.3 × (earnings before interest and taxes/total assets) + 0.6 × (market value of equity/total debt) + 0.999 × (sales/total assets).
Issue	Dummy variable that takes a value of one if the firm issues equity during the fiscal year, zero otherwise.
Additional Variables in Table 4	
LnCallOptvol	Natural logarithm of one plus the total annual dollar call options volume (in millions of U.S. dollars) in a fiscal year.
LnPutOptvol	Natural logarithm of one plus the total annual dollar put options volume (in millions of U.S. dollars) in a fiscal year.
Lnsoptvol	Natural logarithm of one plus the total annual number of options contracts in a fiscal year.
LnO/S	Natural logarithm of the ratio of dollar options volume over dollar stock volume.
Additional Variables in Table 5	
Moneyness	Annual average absolute difference between a stock's market price and the option's strike price.
OpenInterest	Average open interest across all options on a stock throughout the fiscal year.
Additional Variables in Table 6	
Post	Dummy variable that equals one for options listing firms after the options listing year and zero for options listing firms before the options listing year and for matched control firms throughout all years.
Additional Variables in Table 7	

Accruals	Dummy variable that equals one if abnormal accruals are greater than the sample median, zero otherwise. Abnormal accruals are calculated following Dechow and Dichev (2002) and McNichols (2002).
Modfog	Dummy variable that equals one if the modified fog score is greater than the sample median, zero otherwise. To capture readability in the financial context, Kim et al. (2019) identify a list of words that exceed three syllables but are not difficult to understand in the financial context and classify them as simple words. The modified fog index is calculated as (words per sentence + percentage of complex words) × 0.4. A higher modified fog score indicates a less readable report.
Modflesch	Dummy variable that equals one if the modified Flesch score is greater than the sample median, zero otherwise. Using words classified as simple in the financial context by Kim et al. (2019), the modified Flesch score is calculated as 206.835 – (1.015 × words per sentence) – (84.6 × syllables per word). A higher modified Flesch score indicates a more readable report. For ease of interpretation, we multiply the index by -1 so that higher values indicate a less readable report.
Modkincaid	Dummy variable that equals one if the modified Kincaid score is greater than the sample median, zero otherwise. Using the words classified as simple in the financial context by Kim et al. (2019), the modified Kincaid score is calculated as (11.8 × syllables per word) + (0.39 × words per sentence) – 15.59. A higher modified Kincaid score indicates a less readable report.
Additional Variables in Table 8	
Liquidity	Dummy variable that equals one if Amihud stock illiquidity is less than the sample median, zero otherwise. Amihud stock illiquidity is calculated following Amihud (2002).
TraIO	Dummy variable that equals one if transient institutional ownership is greater than the sample median, zero otherwise. Transient institutional ownership is the percentage of total shares outstanding held by transient institutional investors for a fiscal year.
QixIO	Dummy variable that equals one if quasi-indexer institutional ownership is greater than the sample median, zero otherwise. Quasi-indexer institutional ownership is the percentage of total shares outstanding held by quasi-indexer institutional investors for a fiscal year.
DedIO	Dummy variable that equals one if dedicated institutional ownership is greater than the sample median, zero otherwise. Dedicated institutional ownership is the percentage of total shares outstanding held by dedicated institutional investors for a fiscal year.
Additional Variables in Table 9	
BASPREAD	100 times the average daily difference between the ask and bid prices divided by the midpoint of the bid price and ask price in a fiscal year.
PIN	Probability of informed trading measured following Brown and Hillegeist (2007).
Additional Variables in Table 10	
Width	-100 times the average difference between the upper and lower end estimates, divided by price. Point estimates are assigned a value of zero.
Range	Natural logarithm of one plus the forecast range. We assign a value of one to a forecast with an open range estimate, a value of two to a forecast with a closed range estimate, and a value of three to a forecast with a point estimate. We sum the values across all of a firm's earnings forecasts in a fiscal year.
Additional Variables in Table 11	
CAR	Three-day value-weighted market-adjusted cumulative abnormal returns around the release of management earnings forecasts.

HighOpt	Dummy variable that equals one if the options volume (*LnOptvol*) is greater than the sample median, zero otherwise.
MFSurp	Difference between a management forecast and the consensus analyst forecast, divided by stock price.
Additional Variables in Table 12	
DumGN	Dummy variable that equals one if the firm issues at least one good news forecast in a fiscal year, zero otherwise. Good news forecasts are those with a positive *MFSurp* or *CAR*.
DumBN	Dummy variable that equals one if the firm issues at least one bad news forecast in a fiscal year, zero otherwise. Bad news forecasts are those with a negative *MFSurp* or *CAR*.
FreqGN	Natural logarithm of one plus the number of good news forecasts issued by the firm in a fiscal year. Good news forecasts are those with a positive *MFSurp* or *CAR*.
FreqBN	Natural logarithm of one plus the number of bad news forecasts issued by the firm in a fiscal year. Bad news forecasts are those with negative *MFSurp* or *CAR*.
Additional Variables in Table 13	
DumNonGAAP	Dummy variable that equals one if the firm reports at least one quarterly non-GAAP earnings disclosure in a fiscal year, zero otherwise.
FreqNonGAAP	Natural logarithm of one plus the number of quarterly non-GAAP earnings disclosures by the firm in a fiscal year.

Appendix B: Options Listing

Panel A of this table shows the logit regression of the probability of an options listing. Following the selection criterion in Mayhew and Mihov (2004) and Hu (2018), we define stocks as eligible for an options listing in the next month if they meet the following requirements: (1) they are listed on the NYSE, Amex, or Nasdaq; (2) they issue at least seven million publicly held shares; (3) they reach the minimum price ($7.5 before 2002 and $3 after 2002); and (4) they have no options trading history and have stock trading history for at least 252 trading days. Options listing (*Optlist*) is a dummy variable that equals one for firm-months when the options of a stock are first traded, zero otherwise. The control variables include the natural logarithm of the market value at the end of last month ($Size_{t-1}$); the natural logarithm of the average daily volume in the past 12 months ($Volume_{t-1,t-12}$), in the last month ($Volume_{t-1}$), and in month t-12 ($Volume_{t-12}$); the natural logarithm of the standard deviation of daily returns in the past year ($STD_{t-1,t-12}$), in the last month (STD_{t-1}), and in month t-12 (STD_{t-12}); the average daily percentage bid-ask spread at market close in the past year ($Spread_{t-1,t-12}$), in the last month ($Spread_{t-1}$), and in month t-12 ($Spread_{t-12}$); and industry fixed effects based on the two-digit SIC code and year fixed effects. The z-statistics in parentheses are adjusted for heteroscedasticity and clustered by firm. Panel B of this table shows a comparison of the independent variables in Panel A between the options listing firms and control firms. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Logit Regression of the Probability of an Options Listing

	$Optlist_t$
Variables	(1)
$Size_{t-1}$	-0.1832***
	(-6.11)
$Volume_{t-1,t-12}$	-0.8116***
	(-12.48)
$Volume_{t-1}$	1.1563***
	(28.59)
$Volume_{t-12}$	-0.4942***
	(-11.90)
$STD_{t-1,t-12}$	0.4563***
	(4.81)
STD_{t-1}	0.2649***
	(5.80)
STD_{t-12}	0.5648***
	(10.23)
$Spread_{t-1,t-12}$	-0.3840***
	(-5.80)
$Spread_{t-1}$	-0.6002***
	(-9.30)
$Spread_{t-12}$	-0.0446
	(-1.16)
Constant	6.7793***
	(14.55)
Industry FE	Yes
Year FE	Yes
N	320,684
Pseudo R^2	0.149

Panel B: Difference in Pre-Listing Firm Characteristics

Variables	Options Listing Firms	Control Firms	Difference
$Size_{t-1}$	12.900	12.930	0.028
$Volume_{t-1,t-12}$	11.690	11.710	0.017
$Volume_{t-1}$	12.070	12.060	-0.001
$Volume_{t-12}$	11.170	11.210	0.039
$STD_{t-1,t-12}$	-3.571	-3.558	0.013
STD_{t-1}	-3.599	-3.586	0.013
STD_{t-12}	-3.710	-3.687	0.023
$Spread_{t-1,t-12}$	0.956	0.961	0.006
$Spread_{t-1}$	0.681	0.720	0.040**
$Spread_{t-12}$	1.198	1.181	-0.017

Table 1: Sample Distribution

This table shows the industry and year distribution of the observations. The industry distribution is based on the Fama-French 12 industry classification.

Panel A: Industry Distribution

Industry	Total no.	No. with forecast	% with forecast
Consumer Non-Durables	1,854	1,188	64.08%
Consumer Durables	954	485	50.84%
Manufacturing	3,904	2,058	52.72%
Oil, Gas, and Coal Extraction and Products	1,980	317	16.01%
Chemicals and Allied Products	1,042	627	60.17%
Business Equipment	7,148	4,403	61.60%
Telephone and Television Transmission	899	203	22.58%
Utilities	1,445	981	67.89%
Wholesale, Retail, and Some Services	3,784	2,412	63.74%
Healthcare, Medical Equipment, and Drugs	4,214	1,821	43.21%
Finance	6,541	1,428	21.83%
Other	4,728	1,898	40.14%
Total	38,493	17,821	46.30%

Panel B: Year Distribution

Year	Total no.	No. with forecast	% with forecast
1996	990	241	24.34%
1997	1,178	411	34.89%
1998	1,341	482	35.94%
1999	1,406	636	45.23%
2000	1,344	869	64.66%
2001	1,296	842	64.97%
2002	1,433	927	64.69%
2003	1,535	1,003	65.34%
2004	1,666	1,006	60.38%
2005	1,765	1,034	58.58%
2006	1,867	1,030	55.17%
2007	1,909	966	50.60%
2008	1,977	867	43.85%
2009	2,090	906	43.35%
2010	2,168	942	43.45%
2011	2,222	950	42.75%
2012	2,418	1,007	41.65%
2013	2,456	982	39.98%
2014	2,483	941	37.90%
2015	2,488	927	37.26%
2016	2,461	852	34.62%
Total	38,493	17,821	46.30%

Table 2: Summary Statistics

This table presents the summary statistics of the variables in the analysis. Variable definitions are presented in Appendix A.

Variable	N	Mean	S.D.	Median	P5	P25	P75	P95
$DumMF_{t+1}$	38,493	0.463	0.499	0.000	0.000	0.000	1.000	1.000
$FreqMF_{t+1}$	38,493	0.803	0.955	0.000	0.000	0.000	1.609	2.485
$LnOptvol_t$	38,493	2.340	1.986	1.862	0.053	0.627	3.668	6.238
$Size_t$	38,493	7.367	1.678	7.295	4.705	6.198	8.450	10.331
Lev_t	38,493	0.223	0.192	0.198	0.000	0.046	0.350	0.585
BM_t	38,493	0.562	0.437	0.459	0.107	0.276	0.714	1.350
ROA_t	38,493	0.013	0.141	0.035	-0.241	0.005	0.075	0.158
$Loss_t$	38,493	0.227	0.419	0.000	0.000	0.000	0.000	1.000
IO_t	38,493	0.657	0.264	0.713	0.082	0.504	0.864	1.000
$Analyst_t$	38,493	2.037	0.820	2.079	0.693	1.609	2.639	3.219
Ret_t	38,493	0.028	0.452	-0.019	-0.595	-0.238	0.211	0.822
$EarnVol_t$	38,493	0.111	0.208	0.049	0.005	0.022	0.108	0.396
$Litigation_t$	38,493	0.172	0.138	0.145	0.002	0.041	0.303	0.395
Mid_Zscore_t	38,493	0.200	0.400	0.000	0.000	0.000	0.000	1.000
$Issue_t$	38,493	0.137	0.344	0.000	0.000	0.000	0.000	1.000

Table 3: Options Trading and Management Earnings Forecasts

This table presents the effect of options trading on the likelihood and frequency of management earnings forecasts. The regressions are performed using OLS. The *t*-statistics in parentheses are adjusted for heteroscedasticity and clustered by firm. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are presented in Appendix A.

	(1)	(2)
Variables	$DumMF_{t+1}$	$FreqMF_{t+1}$
$LnOptvol_t$	-0.016***	-0.036***
	(-4.915)	(-5.565)
$Size_t$	0.063***	0.141***
	(8.309)	(9.285)
Lev_t	0.053*	0.096
	(1.770)	(1.632)
BM_t	0.015	0.030
	(1.368)	(1.516)
ROA_t	0.145***	0.231***
	(4.876)	(4.256)
$Loss_t$	-0.045***	-0.106***
	(-5.861)	(-7.826)
IO_t	0.009	0.002
	(0.429)	(0.053)
$Analyst_t$	0.055***	0.094***
	(7.622)	(6.866)
Ret_t	-0.018***	-0.031***
	(-3.654)	(-3.598)
$EarnVol_t$	-0.048	-0.046
	(-1.333)	(-0.623)
$Litigation_t$	0.013	0.041
	(0.801)	(1.372)
Mid_Zscore_t	0.011*	0.021*
	(1.759)	(1.715)
$Issue_t$	-0.004	-0.018*
	(-0.720)	(-1.694)
Firm FE	Yes	Yes
Year FE	Yes	Yes
N	38,493	38,493
Adjusted R^2	0.595	0.669

Table 4: Robustness Tests

This table shows the results of the robustness tests. For brevity, all of the control variables are included but not reported. The regressions are performed using OLS. The *t/z*-statistics in parentheses are adjusted for heteroscedasticity and clustered by firm. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are presented in Appendix A.

Panel A: Different Types of Management Forecasts

	Annual earnings forecasts		Quarterly earnings forecasts		Non-earnings forecasts	
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	$DumMF_{t+1}$	$FreqMF_{t+1}$	$DumMF_{t+1}$	$FreqMF_{t+1}$	$DumMF_{t+1}$	$FreqMF_{t+1}$
$LnOptvol_t$	-0.018***	-0.025***	-0.011***	-0.025***	0.001	-0.016**
	(-5.745)	(-4.651)	(-3.219)	(-4.987)	(0.364)	(-2.505)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	38,493	38,493	38,493	38,493	38,493	38,493
Adjusted R^2	0.593	0.655	0.504	0.595	0.663	0.729

Panel B: Alternative Options Trading Measures

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	$DumMF_{t+1}$	$FreqMF_{t+1}$	$DumMF_{t+1}$	$FreqMF_{t+1}$	$DumMF_{t+1}$	$FreqMF_{t+1}$
$LnCallOptvol_t$	-0.010**	-0.027***				
	(-2.201)	(-3.046)				
$LnPutOptvol_t$	-0.010**	-0.016*				
	(-2.017)	(-1.794)				
$Lnsoptvol_t$			-0.010***	-0.020***		
			(-4.524)	(-5.168)		
LnO/S_t					-0.010***	-0.022***
					(-4.320)	(-4.880)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	75,086	75,086	38,493	38,493	38,306	38,306
Adjusted R^2	0.569	0.649	0.595	0.669	0.595	0.669

Panel C: Alternative Samples

	Including firms without options trading		Excluding the dot-com bubble and financial crisis periods		Post Reg FD period	
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	$DumMF_{t+1}$	$FreqMF_{t+1}$	$DumMF_{t+1}$	$FreqMF_{t+1}$	$DumMF_{t+1}$	$FreqMF_{t+1}$
$LnOptvol_t$	-0.010***	-0.010**	-0.016***	-0.031***	-0.016***	-0.039***
	(-4.162)	(-2.164)	(-4.235)	(-4.268)	(-5.109)	(-6.180)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	75,086	75,086	31,967	31,967	32,234	32,234
Adjusted R^2	0.569	0.649	0.600	0.678	0.680	0.738

Panel D: Alternative Regression Specifications

	Logit regression	Change analysis	
	(1)	(2)	(3)
Variables	$DumMF_{t+1}$	$\Delta DumMF_{t+1}$	$\Delta FreqMF_{t+1}$
$LnOptvol_t$	-0.143***		
	(-4.694)		
$\Delta LnOptvol_t$		-0.009***	-0.021***
		(-2.775)	(-4.450)
Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	22,240	32,619	32,619
Pseudo/Adjusted R^2	0.098	0.022	0.046

Panel E: Controlling for CDS Trading

	(1)	(2)
Variables	$DumMF_{t+1}$	$FreqMF_{t+1}$
$LnOptvol_t$	-0.016***	-0.029***
	(-4.137)	(-3.631)
$PostCDS_t$	0.005	0.036
	(0.284)	(0.893)
$CDSTraded_t$	0.064***	0.103**
	(3.215)	(2.543)
Controls	Yes	Yes
Year FE	Yes	Yes
N	35,042	35,042
Adjusted R^2	0.170	0.195

Table 5: Instrumental Variable Approach

This table shows the results of a two-stage least squares (2SLS) regression with moneyness and option interest as the instrumental variables. The *t*-statistics in parentheses are adjusted for heteroscedasticity and clustered by firm. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are presented in Appendix A.

	First stage	Second stage	
	(1)	(2)	(3)
Variables	$LnOptvol_t$	$DumMF_{t+1}$	$FreqMF_{t+1}$
$LnOptvol_t$		-0.056***	-0.106***
		(-5.359)	(-4.966)
$Size_t$	0.892***	0.099***	0.204***
	(38.452)	(8.590)	(8.794)
Lev_t	0.466***	0.075**	0.135**
	(5.809)	(2.470)	(2.256)
BM_t	0.184***	0.027**	0.052**
	(5.854)	(2.461)	(2.553)
ROA_t	0.337***	0.151***	0.243***
	(3.628)	(5.094)	(4.500)
$Loss_t$	0.171***	-0.036***	-0.090***
	(8.782)	(-4.532)	(-6.451)
IO_t	0.263***	0.015	0.013
	(4.154)	(0.733)	(0.340)
$Analyst_t$	0.145***	0.060***	0.104***
	(7.364)	(8.215)	(7.418)
Ret_t	-0.239***	-0.027***	-0.048***
	(-17.681)	(-5.051)	(-4.915)
$EarnVol_t$	0.284***	-0.033	-0.019
	(2.947)	(-0.912)	(-0.259)
$Litigation_t$	0.457***	0.030*	0.070**
	(10.352)	(1.760)	(2.271)
Mid_Zscore_t	-0.038**	0.009	0.017
	(-2.217)	(1.373)	(1.364)
$Issue_t$	0.110***	0.001	-0.009
	(6.861)	(0.085)	(-0.858)
$Moneyness_t$	0.818***		
	(11.425)		
$OpenInterest_t$	0.001***		
	(17.266)		
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	37,919	37,919	37,919
Adjusted R^2	0.855	0.591	0.667

Table 6: Difference-in-Differences Analysis Based on Options Listing

This table shows the results of the DID analysis based on options listing. The regressions are performed using OLS. The *t*-statistics in parentheses are adjusted for heteroscedasticity and clustered by firm. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are presented in Appendix A.

	One year before and after		Three years before and after	
	(1)	(2)	(3)	(4)
Variables	$DumMF_{t+1}$	$FreqMF_{t+1}$	$DumMF_{t+1}$	$FreqMF_{t+1}$
$Post_t$	-0.035**	-0.053**	-0.029**	-0.043*
	(-2.281)	(-2.238)	(-2.059)	(-1.787)
$Size_t$	0.034*	0.051*	0.038***	0.065***
	(1.896)	(1.745)	(3.341)	(3.458)
Lev_t	0.167**	0.101	0.139***	0.133
	(2.056)	(0.674)	(2.807)	(1.537)
BM_t	-0.010	-0.014	0.010	0.021
	(-0.416)	(-0.402)	(0.772)	(1.100)
ROA_t	0.201***	0.387***	0.147***	0.262***
	(2.784)	(2.830)	(3.487)	(3.487)
$Loss_t$	-0.058**	-0.085**	-0.050***	-0.091***
	(-2.542)	(-2.491)	(-4.107)	(-4.536)
IO_t	0.056	0.078	0.069*	0.135*
	(1.093)	(0.930)	(1.808)	(1.779)
$Analyst_t$	0.063***	0.099***	0.063***	0.095***
	(3.710)	(3.604)	(6.293)	(5.938)
Ret_t	-0.009	-0.001	-0.004	0.009
	(-0.687)	(-0.052)	(-0.499)	(0.820)
$EarnVol_t$	-0.021	-0.035	-0.038	-0.024
	(-0.293)	(-0.297)	(-1.045)	(-0.385)
$Litigation_t$	0.044	0.070	0.045	0.069
	(0.831)	(0.835)	(1.472)	(1.270)
Mid_Zscore_t	0.027	0.043	0.014	0.025
	(1.385)	(1.316)	(1.187)	(1.269)
$Issue_t$	0.004	0.003	-0.004	-0.008
	(0.234)	(0.107)	(-0.372)	(-0.502)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	5,236	5,236	13,332	13,332
Adjusted R^2	0.600	0.686	0.600	0.679

Table 7: The Effect of the Firm Information Environment

This table presents the effect of the firm information environment on the relation between options trading and management earnings forecasts. The regressions are performed using OLS. The *t*-statistics in parentheses are adjusted for heteroscedasticity and clustered by firm. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are presented in Appendix A.

Variables	(1) $DumMF_{t+1}$	(2) $FreqMF_{t+1}$	(3) $DumMF_{t+1}$	(4) $FreqMF_{t+1}$	(5) $DumMF_{t+1}$	(6) $FreqMF_{t+1}$	(7) $DumMF_{t+1}$	(8) $FreqMF_{t+1}$
$LnOptvol_t \times Accruals_t$	-0.004**	-0.006*						
	(-2.012)	(-1.742)						
$Accruals_t$	0.013**	0.021*						
	(1.992)	(1.828)						
$LnOptvol_t \times Modfog_t$			-0.006**	-0.009*				
			(-2.101)	(-1.733)				
$Modfog_t$			0.007	0.005				
			(0.792)	(0.292)				
$LnOptvol_t \times Modflesch_t$					-0.008**	-0.013**		
					(-2.498)	(-2.202)		
$Modflesch_t$					0.022**	0.033*		
					(2.269)	(1.916)		
$LnOptvol_t \times Modkincaid_t$							-0.007**	-0.011*
							(-2.528)	(-1.950)
$Modkincaid_t$							0.010	0.011
							(1.178)	(0.714)
$LnOptvol_t$	-0.012***	-0.033***	-0.016***	-0.040***	-0.015***	-0.038***	-0.015***	-0.039***
	(-3.001)	(-4.340)	(-4.075)	(-5.246)	(-3.711)	(-4.835)	(-3.896)	(-5.091)
$Size_t$	0.061***	0.152***	0.077***	0.177***	0.077***	0.177***	0.077***	0.177***
	(7.216)	(8.747)	(8.534)	(9.767)	(8.539)	(9.776)	(8.551)	(9.781)
Lev_t	0.013	0.059	0.050	0.080	0.051	0.081	0.050	0.080
	(0.416)	(0.900)	(1.453)	(1.166)	(1.477)	(1.185)	(1.459)	(1.167)
BM_t	0.020	0.040*	0.015	0.025	0.015	0.025	0.015	0.025
	(1.611)	(1.755)	(1.156)	(1.074)	(1.149)	(1.068)	(1.155)	(1.069)
ROA_t	0.120***	0.174***	0.158***	0.256***	0.158***	0.255***	0.158***	0.255***
	(3.787)	(2.962)	(4.689)	(4.202)	(4.667)	(4.176)	(4.678)	(4.189)
$Loss_t$	-0.042***	-0.107***	-0.047***	-0.116***	-0.048***	-0.117***	-0.047***	-0.116***
	(-4.826)	(-6.873)	(-5.241)	(-7.412)	(-5.290)	(-7.467)	(-5.251)	(-7.429)
IO_t	0.017	-0.002	-0.003	-0.031	-0.004	-0.032	-0.004	-0.032

	(0.771)	(-0.042)	(-0.135)	(-0.727)	(-0.152)	(-0.739)	(-0.161)	(-0.748)
$Analyst_t$	0.062***	0.113***	0.052***	0.089***	0.052***	0.089***	0.052***	0.089***
	(7.292)	(6.794)	(6.132)	(5.630)	(6.148)	(5.647)	(6.129)	(5.630)
Ret_t	-0.017***	-0.034***	-0.025***	-0.050***	-0.025***	-0.050***	-0.025***	-0.051***
	(-3.097)	(-3.422)	(-4.558)	(-5.066)	(-4.546)	(-5.055)	(-4.560)	(-5.069)
$EarnVol_t$	-0.033	-0.031	-0.030	-0.006	-0.029	-0.005	-0.030	-0.007
	(-0.849)	(-0.379)	(-0.755)	(-0.076)	(-0.742)	(-0.059)	(-0.759)	(-0.080)
$Litigation_t$	0.028	0.072**	0.014	0.047	0.014	0.047	0.014	0.048
	(1.492)	(2.139)	(0.780)	(1.442)	(0.775)	(1.439)	(0.807)	(1.464)
Mid_Zscore_t	0.012*	0.019	0.022***	0.038***	0.022***	0.038***	0.022***	0.038***
	(1.706)	(1.441)	(3.058)	(2.682)	(3.057)	(2.682)	(3.053)	(2.678)
$Issue_t$	-0.004	-0.020	-0.007	-0.018	-0.007	-0.018	-0.007	-0.018
	(-0.620)	(-1.505)	(-0.984)	(-1.458)	(-0.962)	(-1.436)	(-0.979)	(-1.452)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	29,225	29,225	30,521	30,521	30,521	30,521	30,521	30,521
Adjusted R^2	0.607	0.684	0.579	0.663	0.579	0.663	0.579	0.663

Table 8: The Effect of Information Transfer Facilitation

This table presents the effect of information transfer facilitation on the relation between options trading and management earnings forecasts. The regressions are performed using OLS. The *t*-statistics in parentheses are adjusted for heteroscedasticity and clustered by firm. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are presented in Appendix A.

Variables	(1) $DumMF_{t+1}$	(2) $FreqMF_{t+1}$	(3) $DumMF_{t+1}$	(4) $FreqMF_{t+1}$
$LnOptvol_t \times Liquidity_t$	-0.012**	-0.017*		
	(-2.507)	(-1.920)		
$Liquidity_t$	0.058***	0.115***		
	(4.186)	(4.370)		
$LnOptvol_t \times TraIO_t$			-0.008***	-0.010*
			(-2.603)	(-1.873)
$TraIO_t$			0.014	0.024
			(1.525)	(1.466)
$LnOptvol_t \times QixIO_t$			-0.005	-0.007
			(-1.361)	(-0.981)
$QixIO_t$			0.025**	0.047**
			(2.018)	(2.115)
$LnOptvol_t \times DedIO_t$			0.001	0.005
			(0.410)	(0.830)
$DedIO_t$			-0.023**	-0.049***
			(-2.516)	(-2.861)
$LnOptvol_t$	-0.021***	-0.045***	-0.009**	-0.028***
	(-5.588)	(-5.831)	(-2.249)	(-3.479)
$Size_t$	0.057***	0.127***	0.062***	0.138***
	(7.419)	(8.217)	(8.148)	(9.135)
Lev_t	0.053*	0.094	0.054*	0.098*
	(1.746)	(1.611)	(1.782)	(1.663)
BM_t	0.014	0.027	0.014	0.029
	(1.293)	(1.403)	(1.320)	(1.483)
ROA_t	0.146***	0.235***	0.144***	0.230***
	(4.915)	(4.313)	(4.847)	(4.220)
$Loss_t$	-0.045***	-0.104***	-0.045***	-0.104***
	(-5.793)	(-7.730)	(-5.796)	(-7.727)
IO_t	0.000	-0.014		
	(0.017)	(-0.372)		
$Analyst_t$	0.053***	0.091***	0.054***	0.091***
	(7.319)	(6.600)	(7.528)	(6.687)
Ret_t	-0.016***	-0.026***	-0.017***	-0.030***
	(-3.219)	(-2.940)	(-3.511)	(-3.435)
$EarnVol_t$	-0.049	-0.047	-0.049	-0.047
	(-1.355)	(-0.636)	(-1.353)	(-0.639)
$Litigation_t$	0.016	0.046	0.014	0.042
	(0.955)	(1.553)	(0.871)	(1.412)
Mid_Zscore_t	0.011*	0.022*	0.011*	0.022*
	(1.790)	(1.753)	(1.800)	(1.753)
$Issue_t$	-0.005	-0.018*	-0.004	-0.018*
	(-0.752)	(-1.698)	(-0.696)	(-1.655)
Firm FE	Yes	Yes	Yes	Yes

Year FE	Yes	Yes	Yes	Yes
N	38,493	38,493	38,493	38,493
Adjusted R^2	0.595	0.670	0.595	0.670

Table 9 The Effect of Options Trading on Information Asymmetry

This table shows the effect of options trading on information asymmetry. The regressions are performed using OLS. The *t*-statistics in parentheses are adjusted for heteroscedasticity and clustered by firm. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are presented in Appendix A.

	(1)	(2)
Variables	$BASPREAD_t$	PIN_t
$LnOptvol_t$	-0.023***	-0.009***
	(-5.820)	(-24.593)
$Size_t$	-0.135***	-0.017***
	(-13.207)	(-18.607)
Lev_t	0.187***	0.008**
	(4.959)	(2.486)
BM_t	0.121***	0.002
	(7.466)	(1.586)
ROA_t	-0.239***	0.001
	(-5.861)	(0.172)
$Loss_t$	-0.015*	-0.001
	(-1.725)	(-0.874)
IO_t	-0.303***	-0.026***
	(-11.868)	(-7.828)
$Analyst_t$	-0.046***	-0.006***
	(-5.290)	(-7.001)
Ret_t	0.056***	0.008***
	(9.106)	(14.597)
$EarnVol_t$	-0.074*	-0.014***
	(-1.942)	(-3.338)
$Litigation_t$	0.043**	0.010***
	(2.296)	(5.380)
Mid_Zscore_t	-0.012	-0.001
	(-1.605)	(-0.954)
$Issue_t$	-0.026***	-0.001
	(-4.171)	(-1.195)
Firm FE	Yes	Yes
Year FE	Yes	Yes
N	38,465	23,067
Adjusted R^2	0.789	0.712

Table 10: Forecast Characteristics

This table shows the effect of options trading on the characteristics of management earnings forecasts. The regressions are performed using OLS. The *t*-statistics in parentheses are adjusted for heteroscedasticity and clustered by firm. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are presented in Appendix A.

	(1)	(2)
Variables	$Width_{t+1}$	$Range_{t+1}$
$LnOptvol_t$	-0.021***	-0.032***
	(-4.107)	(-4.426)
$Size_t$	0.119***	0.129***
	(7.906)	(7.297)
Lev_t	-0.127***	0.076
	(-2.996)	(1.074)
BM_t	-0.260***	-0.062*
	(-8.274)	(-1.921)
ROA_t	0.273***	0.154*
	(2.731)	(1.754)
$Loss_t$	-0.073***	-0.094***
	(-4.061)	(-4.949)
IO_t	0.077**	0.037
	(2.139)	(0.820)
$Analyst_t$	0.005	0.024
	(0.393)	(1.436)
Ret_t	0.026***	-0.014
	(2.867)	(-1.090)
$EarnVol_t$	0.036	0.024
	(0.665)	(0.318)
$Litigation_t$	-0.000	0.034
	(-0.002)	(0.846)
Mid_Zscore_t	0.010	0.026*
	(1.083)	(1.824)
$Issue_t$	0.002	0.004
	(0.167)	(0.268)
Firm FE	Yes	Yes
Year FE	Yes	Yes
N	17,147	17,821
Adjusted R^2	0.668	0.494

Table 11: Stock Market Reactions to Management Earnings Forecasts

The table shows the results of the effect of options trading on stock market reactions to management earnings forecasts. The regressions are performed using OLS. The *t*-statistics in parentheses are adjusted for heteroscedasticity and clustered by firm. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are presented in Appendix A.

	(1)	(2)
Variables	CAR_{t+1}	CAR_{t+1}
$MFSurp_{t+1}$	4.012**	3.381**
	(2.500)	(2.034)
$MFSurp_{t+1} \times HighOpt_t$		-0.918**
		(-2.154)
$MFSurp_{t+1} \times Size_{t+1}$	-0.253	-0.176
	(-1.220)	(-0.829)
$MFSurp_{t+1} \times BM_{t+1}$	-0.471	-0.398
	(-1.117)	(-0.943)
$MFSurp_{t+1} \times Loss_{t+1}$	-1.233***	-1.103***
	(-2.945)	(-2.626)
$MFSurp_{t+1} \times Analyst_{t+1}$	0.521	0.771**
	(1.590)	(2.147)
$HighOpt_t$		-0.012***
		(-3.509)
$Size_{t+1}$	0.014***	0.016***
	(4.034)	(4.380)
BM_{t+1}	-0.020**	-0.018**
	(-2.488)	(-2.314)
$Loss_{t+1}$	-0.002	-0.001
	(-0.424)	(-0.255)
$Analyst_{t+1}$	-0.017***	-0.015***
	(-4.412)	(-3.976)
Firm FE	Yes	Yes
Year FE	Yes	Yes
N	9,921	9,921
Adjusted R^2	0207	0.210

Table 12: Good News versus Bad News Forecasts

This table shows the effect of options trading on the occurrence and frequency of good news and bad news disclosures. In Panel A, we measure good (bad) news based on management forecast surprise. Good (bad) news forecasts are those with a positive (negative) forecast surprise. In Panel B, we measure good (bad) news based on the three-day value-weighted market-adjusted cumulative abnormal returns around the release of a management forecast. Good (bad) news forecasts are those with a positive (negative) three-day value-weighted market-adjusted cumulative abnormal returns. The regressions are performed using OLS. The *t*-statistics in parentheses are adjusted for heteroscedasticity and clustered by firm. The symbols ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are presented in Appendix A.

Panel A: Good and Bad News Forecasts Defined by Forecast Surprise

	(1)	(2)	(3)	(4)
Variables	$DumGN_{t+1}$	$DumBN_{t+1}$	$FreqGN_{t+1}$	$FreqBN_{t+1}$
$LnOptvol_t$	-0.019***	-0.013***	-0.023***	-0.018***
	(-5.878)	(-3.932)	(-5.794)	(-3.840)
$Size_t$	0.021***	0.082***	0.020**	0.142***
	(2.837)	(10.632)	(2.048)	(12.817)
Lev_t	0.037	0.075**	0.029	0.126***
	(1.257)	(2.529)	(0.750)	(3.066)
BM_t	0.002	0.026***	-0.006	0.048***
	(0.177)	(2.638)	(-0.520)	(3.532)
ROA_t	0.051**	0.134***	0.048	0.161***
	(1.976)	(4.662)	(1.607)	(4.309)
$Loss_t$	-0.045***	-0.048***	-0.050***	-0.074***
	(-6.002)	(-6.431)	(-5.466)	(-7.565)
IO_t	0.005	-0.018	0.007	-0.017
	(0.262)	(-0.902)	(0.290)	(-0.616)
$Analyst_t$	0.034***	0.039***	0.035***	0.050***
	(5.192)	(5.576)	(4.273)	(5.082)
Ret_t	0.015***	-0.035***	0.022***	-0.058***
	(3.024)	(-6.686)	(3.718)	(-8.478)
$EarnVol_t$	-0.019	-0.014	-0.030	-0.022
	(-0.588)	(-0.432)	(-0.698)	(-0.454)
$Litigation_t$	0.008	0.013	0.020	0.018
	(0.444)	(0.762)	(0.975)	(0.798)
Mid_Zscore_t	0.010	0.007	0.019**	0.007
	(1.556)	(1.102)	(2.256)	(0.701)
$Issue_t$	-0.016**	0.000	-0.021***	-0.007
	(-2.520)	(0.018)	(-2.870)	(-0.900)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	38,493	38,493	38,493	38,493
Adjusted R^2	0.435	0.495	0.434	0.522

Panel B: Good and Bad News Forecasts Defined by Market Reaction

Variables	(1) $DumGN_{t+1}$	(2) $DumBN_{t+1}$	(3) $FreqGN_{t+1}$	(4) $FreqBN_{t+1}$
$LnOptvol_t$	-0.018***	-0.011***	-0.031***	-0.016***
	(-5.472)	(-3.409)	(-6.143)	(-3.302)
$Size_t$	0.036***	0.081***	0.054***	0.143***
	(4.707)	(10.732)	(4.664)	(12.374)
Lev_t	0.020	0.057*	0.027	0.095**
	(0.641)	(1.922)	(0.585)	(2.096)
BM_t	0.002	0.014	0.002	0.039***
	(0.223)	(1.395)	(0.116)	(2.657)
ROA_t	0.097***	0.119***	0.107***	0.167***
	(3.548)	(4.060)	(2.840)	(3.801)
$Loss_t$	-0.042***	-0.045***	-0.067***	-0.076***
	(-5.643)	(-5.866)	(-6.275)	(-7.001)
IO_t	0.027	-0.003	0.023	-0.017
	(1.362)	(-0.152)	(0.777)	(-0.585)
$Analyst_t$	0.045***	0.041***	0.061***	0.064***
	(6.375)	(5.876)	(5.780)	(6.168)
Ret_t	-0.003	-0.024***	-0.000	-0.035***
	(-0.580)	(-4.530)	(-0.019)	(-4.684)
$EarnVol_t$	-0.019	-0.037	0.004	-0.048
	(-0.561)	(-1.034)	(0.064)	(-0.920)
$Litigation_t$	0.027*	0.012	0.049**	0.005
	(1.666)	(0.690)	(2.015)	(0.182)
Mid_Zscore_t	0.017***	0.000	0.023**	0.000
	(2.650)	(0.011)	(2.247)	(0.017)
$Issue_t$	-0.006	-0.005	-0.017*	-0.012
	(-1.027)	(-0.756)	(-1.855)	(-1.299)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	38,493	38,493	38,493	38,493
Adjusted R^2	0.547	0.517	0.568	0.527

Table 13: The Effect of Options Trading on Non-GAAP Earnings Disclosures

The table shows the results of the effect of options trading on the likelihood and frequency of non-GAAP earnings disclosures. The regressions are performed using OLS. The *t*-statistics in parentheses are adjusted for heteroscedasticity and clustered by firm. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are presented in Appendix A.

	(1)	(2)
Variables	$DumNonGAAP_{t+1}$	$FreqNonGAAP_{t+1}$
$LnOptvol_t$	-0.008**	-0.009**
	(-2.236)	(-2.006)
$Size_t$	0.036***	0.053***
	(3.845)	(4.579)
Lev_t	0.177***	0.216***
	(4.681)	(4.734)
BM_t	0.050***	0.075***
	(3.924)	(4.977)
ROA_t	0.000	-0.010
	(0.009)	(-0.258)
$Loss_t$	-0.012	-0.019*
	(-1.238)	(-1.670)
IO_t	0.009	-0.000
	(0.354)	(-0.006)
$Analyst_t$	0.040***	0.041***
	(4.871)	(4.076)
Ret_t	-0.006	-0.010
	(-0.921)	(-1.355)
$EarnVol_t$	0.007	0.036
	(0.229)	(0.995)
$Litigation_t$	-0.027	-0.034
	(-1.312)	(-1.412)
Mid_Zscore_t	0.002	0.008
	(0.201)	(0.746)
$Issue_t$	0.006	0.007
	(0.723)	(0.815)
Firm FE	Yes	Yes
Year FE	Yes	Yes
N	27,984	27,984
Adjusted R^2	0.466	0.540