Measuring the usefulness of earnings announcement for uninformed traders-evidence from implied volatility in option market

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Abstract: In this research study, we develop a new measure based on the option market to address the information role of earnings announcement on uninformed traders. Enlightened by previous theoretical work by Kim and Verrecchia (1991, 1994) and empirical findings in Patell and Wolfson (1979, 1981), our measure might capture two advantages that informed traders have overall naïve investors. We apply three sets of validity tests and the evidence shows that firms with high disclosure score made by us experience improved market liquidity, less informed trading in stock and option market, less profitability earned by insiders, and more strongly response by analysts. These results indicate our measure does capture the disclosure quality from perspective of uninformed traders. Overall, we construct a financial information measure that could by widely applied and shows that the ability to reduce uncertainty through financial reports plays a significant role in market trading.

Key words: Financial reporting quality, uncertainty reduction, market reaction, information asymmetry

1. Introduction

In this paper, we develop a new measure enlightened from option market to investigate the information role of earnings announcement on uninformed traders. Motivated by previous theoretical work, information advantage arises for informed traders around earnings announcement either due to pre-event endowment or acquisition of private information (Glosten and Milgrom, 1985; Kim and Verrecchia,1991), and/or due to superior ability to interpret public disclosures (Kim and Verrecchia,1994). We are going to identify in which situation in general, that informed traders have least information advantage, either due to reduced pre-release of private information, or easy-to-interpret information contents in financial reports by taking advantage of the extended parameters in option market, the implied volatility, and validate our measure by three sets of tests.

Our measure is conceptually different from previous disclosure quality measures. Previous measures usually examine one specific accounting attributes, such as financial statement comparability, earnings persistence for a company. Instead, our focus is to measure the quality of earnings announcement from the perspective of uninformed investors, who usually do not have neither private access to information before earnings announcements or do not have superior ability interpret complex reports. As different kinds of informed trading around earnings announcement are widely documented by tremendous literature (e.g., Jin et al, 2012; Cohen et al, 2012) in the past, the focus specifically on naïve investors instead of informed traders could help liquidity traders better identify which firms have better information environment for them in the future investments. Further, this measure could be widely applied to firms as long as the company has options.

Specifically, we use deflated changes in implied volatilities (calculated using Black-Schole model of option market) around earnings announcement to indicate the resolved uncertainty about the firm's performance from publication of firms' financial reports. Implied volatility is used as measure ex ante market uncertainty (Rogers et al., 2009) and past studies found increased uncertainty before earnings announcement and decreased uncertainty after earnings announcement (Patell and Wolfson, 1979). Since our measure by construction compares the disagreement in pre-earnings announcement period with how financial reports help investors to reach consensus, it is likely to captures two parts of information advantage that informed traders have: when there are less private information pre-released (either due to a company's strict information policy or other reasons), informed traders, like naïve traders, have more doubts about the firm's real business operations and the information could not be incorporated in price immediately, therefore the market disagreement might increases and the demand for earnings disclosure increases; on the other hand, after financial reports are released, if company prepare financial information in a way that is easy to understand, investors might reach to consensus more quickly, resulting in quick reduction of uncertainty proxied by implied volatility. Therefore, when there is high pre-announcement disagreement and sharp decrease in post-announcement disagreement, we treat these firm-quarter earnings announcements as those most favorable to uninformed traders.

We validate whether our measure really captures the information advantage for uninformed traders in several ways. We start to look at the company-level and intertemporal determinants of our measure, and find in general, companies with more transparent environments (proxied by firm size, analyst following, and institutional ownership), higher profitability (proxied by ROA), and less complex information (proxied by negative standard deviation of return), and those

quarters with less earnings surprise (proxied by absolute earnings surprise), and annual reports instead of quarterly reports, are more likely to have higher score based on our measure. Then, we conduct three sets of validation tests including (1) whether earnings announcement with high disclosure quality score based on our measure could enjoy more improvement in market conditions; (2) whether there are less informed trading in option and stock market, and informed trading from insiders documented by previous literature in the firm-quarter earnings announcement with high disclosure quality; (3) whether analysts update their information more quickly and accurately after those quarters with high disclosure scores. Among these validation tests, we think the second set of informed trading is most relevant to the construction of our measure. If our measure indeed captures the relative two sources of information advantages that informed traders have, we should observe decrease informed trading around earnings announcement in general.

One interesting finding for our measure is that when we examine the time-series pattern, we find the absolute value of our measure increases gradually from the beginning to the end of our sample period. Specifically, we find this measure arise sharply around year 2000-2005, which is in the same period those major regulation changes related to financial reporting (e.g., Regulation FD, SOX) happen. And during period of financial crisis, our measure decreases and remain in a relative low level for a while, which might suggest the decreased trust in financial reports. And in recent year, it increases again.

After we finish all our validation tests, we conduct several robustness tests. These tests include: scale our measure by several earnings surprise and uncertainty proxies to measure for each unit amount of new information, how this quarter's earnings announcement help to solve the doubts in the market. Recalculate our measure based on different expiration dates of options, weight our

measure by open interest, change the window around earnings announcements in our main tests. Overall, the results are similar.

Our paper contributes to both accounting and finance literatures. First, we develop a new measure to quantify the ability of financial reporting to reduce overall market uncertainty based on ex ante measure derived from derivative market. Our measure specifically captures when naïve investors have most information advantages. This construction makes our measure conceptually different than previous disclosure qualities. And the validity tests in general support our argument. Besides, the new measure is based on option market and is both widely applicable and easy to interpret, which might be used in the future research. Second, we apply our new measure to retest varying market conditions to earnings announcement and shows that financial information quality increases could help to reduce information asymmetry, increase market liquidity, decrease trading predictability and profits of several kinds of informed traders.

The following of the paper is structured as follows. Section 2 reviews the related literature and motivate our measure of disclosure quality. Section 3 describes construction of this new measure. Section 4 presents descriptive statistics. Section 5 presents validation tests robustness checks and section 6 conduct robustness check. Section 7 concludes the paper.

2. What does AQ capture?

2.1 Previous literature and theoretical model

Disclosure quality is an important topic in accounting and countless literatures in accounting have developed different kinds of quality measures (Dechow et al.2010; Ball and Brown,1968; Beaver, 1968; Amin and Lee,1997; Ni et al., 2008; Xing et al., 2009; Billings and Jennings,2011).

The very initial papers have studied the market reaction on earnings announcement date to prove the general usefulness of financial. Later researches investigate several different dimensions of reporting quality based on financial reporting conceptual framework, including earnings persistence, smoothness, comparability, timely loss recognition, earnings management, financial statement comparability, financial statement complexity, fair value accounting, and so on. Existing literature find tremendous consequences of one specific reporting quality on either stock market, credit market, auditors, and other stakeholders.

How about the importance of financial reporting on uninformed and liquidity traders? Could we identify out a straight-forward measure that could capture when the relative advantages of informed traders over uninformed traders are least significant?

Since uninformed traders are important market participants who provide liquidity to overall market and informed trading is widely documented in existing literature (e.g., Jin et al., 2012; Cohen et al., 2012), it is meaningful if we could construct a simple measure for when and what kind of companies in general provide uninformed traders most protections.

To identify when uninformed traders have relatively more information advantage, we borrow the theoretical work from Kim and Verrecchia (1991, 1994). In the first paper, they find that one important source of information advantage that sophisticated investors have is their ability to get private information before announcement date. And in the second paper, they show another source of information advantage comes from superior ability to interpret complex information disclosed. Therefore, if a measure could capture the uncertainty for sophisticated investors in pre-announcement period due to less access to private information, and the ability that a clear financial report to resolve overall doubts in the market, it by construction might capture both information advantages that informed traders have.

We choose information metrics in option market as a candidate to construct our disclosure quality measure. Empirically, option market has been studied for a long time in finance literature. In general, option traders are more likely to be sophisticated traders and option market information could help to predict earnings and market information (Amin and Lee,1997; Patell and Wolfson, 1979; Cremers and Weinbaum, 2010; Jin et al., 2012; Cao and Han, 2013; Johnson and So, 2012). And introduction of option market on price discovery process and liquidity (Skinner,1990; Chakravarty et al., 2004). The popularity in studying option market in finance is not only because that it is a new market, but also option market has some attractive new features.

Among these features, implied volatility is most interesting and related to our paper. Implied volatility is widely used as a measure for ex ante uncertainty of the stock market. And papers specifically motivate our study are Patell and Wolfson(1979, 1981), which find the phenomenon that implied volatility gradually increases before earnings announcement and decrease right after earnings announcement date, which is consistent with the demand for information is highest just before financial reporting date and the supply of clear information could help to offset the demand.

Combined the theoretical work of Kim and Verrecchia (1991, 1994) with the empirical finding from Patell and Wolfson(1979, 1981), it is possible that we could construct a measure that captures both information advantage that informed traders have at the same time. Intuitively, if informed traders could not have enough access to private information beforehand, their demand for earnings announcement increases and the implied volatility might increase more right before earnings announcement date. On the other hand, if earnings announcement is clear and help uninformed traders to better understand the business nature, this proxy for uncertainty should drop sharply. Therefore, when a company has high pre-announcement implied volatility and

sharp drop in this figure, we might predict that this earnings announcement is most favorable to uninformed traders.

2.2 Predictions made based on our AQ measures

Based on our above argument, we develop three hypotheses as our validation tests afterwards.

2.2.1 Role of uncertainty reduction on general market conditions

If earnings announcement is more informative and could help overall market to reduce more uncertainty over the company, a natural prediction is that the market for such company after disclosure date should be more active. Specifically, with information disclosed with more certain information, market makers are likely not to protect themselves as much as in a world they think that other investor get more information than them. Besides, the price impact of large orders in the market should seem not contain much information if earnings announcements have already conveyed enough information the investors need. And the probability of informed trading should decrease since the likelihood of private information decreases.

Based on above argument, our second hypothesis is:

H1: Ceteris paribus, earnings announcement that help to reduce more uncertainty in the market will improve market condition by increasing market liquidity and depth, and decreasing probability of informed trading.

2.2.2 Role of uncertainty reduction on informed trading

The disclosure of new information will change relative information advantage between different participants in the market. Specifically, we have several different kind of traders: the inside trader-those mostly likely to have private information advantage before earnings announcement,

the sophisticated traders in other market(such as option traders)-those generally considered to have more access to private information and have better information processing power(Kim and Verrechia, 1991), the sophisticated traders in stock market (big traders)-still may have more private information and processing ability, and the uninformed small investors.

The relative information advantages between insiders and outside traders, and that between outside sophisticated traders and naïve traders, should all change after earnings announcement with higher ability to reduce uncertainty in the market.

The prediction for the first relation should be relatively straightforward. We examine the uncertainty reduction role of earnings announcement on trading behavior of insiders and outside traders both before and after the disclosure date. Specifically, (1) the more uncertainty that earnings announcement help to reduce (usefulness of earnings announcement), the more likely that the private information is observed by sophisticated traders (otherwise they will arbitrage immediately before earnings announcement date), the less likely the trading pattern of sophisticated investors could help to predict information on earnings announcement date; (2) the more uncertainty is resolved for market outside traders during earnings announcement, the more likely that inside traders will trade profitably after earnings announcement date (we do not consider trading behavior of insider trading before earnings announcement date because of "black window" regulation).

Based on above argument, our next hypothesis is:

H2a: Ceteris paribus, the predictability of informed trading before earnings announcement will be lower for firm-quarters with more uncertainty reduction.

H2b: Ceteris paribus, the profits of informed trading immediately after earnings announcement will be lower for firm-quarters with more uncertainty reduction.

2.2.3 Role of uncertainty reduction on information intermediary

The last thing we are going to examine is that whether firms with good accounting quality could affect the behavior of market information intermediary. Specifically, we argue that when facing financial reports that could reduce more uncertainty, analysts may use less time to analyze the information therefore could issue analyst forecast more quickly. The effect of the quality of uncertainty reduction on the number of analyst forecasts is ambiguous since it may reduce information need from market participants (demand) and information processing costs for analysts' reports (supply) at the same time. Besides, total number of forecasts depends on analyst coverage, which is relatively stable in a short time. Since the ability of uncertainty reduction of financial statements may vary from quarter to quarter, we do not expect it could affect analyst coverage (therefore total number of reports) to a large extent.

Based on above argument, we develop following hypothesis:

H3a: Ceteris paribus, firms with high ability to solve uncertainty concerns speed up analysts' forecast and analyst forecast revisions.

H3b: Ceteris paribus, firms with high ability to solve uncertainty concerns improve accuracy in analysts' forecast.

3. Construction of our disclosure quality measure

3.1 Basic AQ measure

Our new measure of disclosure quality is based on decile ranking of scaled change in average implied volatility around earnings announcement date. Options with short time to expire (indicator in OptionMetrics: days to expiration equals to 30) are chosen since these securities are more sensitive to arrival of current new information (Rogers et al., 2009). We do not consider whether the option is in-the-money/at-the-money/out-of-money since the database has already removed those in/out of the money. We calculate as follows the mean implied volatility for the pair of call and put option to get average daily figure one day before (denoted as $\overline{IV}_{i,t,d-1}$) and one day after (denoted as $\overline{IV}_{i,t,d+1}$) reporting date and figure out the scaled change hereafter denoted as $CHIV_{i,t}$.

$$\text{chiv}_{i,t} = \overline{IV}_{i,t,d+1} - \overline{IV}_{i,t,d-1} \overline{IV}_{i,t,d-1}$$

Intuitively, the more uncertainty has been resolved, the more valuable information is provided on earnings announcement; we hypothesize that more decrease in $CHIV_{i,t}$ should indicates higher disclosure quality. Therefore, we take negative value of $CHIV_{i,t}$ and assign 1 to 10 based on the new decile data to construct our main accounting quality measure (hereafter denoted as $AQ_{i,t}$).

$$\text{Nchiv}_{i,t} = -\text{chiv}_{i,t} \qquad \text{AQ}_{i,t} = \text{Decile rank of Nchiv}_{i,t}$$

Based on our prior argument, the higher disagreement before public disclosure indicates the necessity for confirming information to be released (demand for new information, either due to business nature of the company or reduced private access to pre-released information), and the rapid decrease of uncertainty during earnings announcement reveals the usefulness of financial

information to public investors (supply of confirmed information). Since our construction of $nchiv_{i,t}$ and $AQ_{i,t}$ themselves capture both pre-disclosure disagreement and the relative change in uncertainty, it might be helpful to measure the overall importance and usefulness of a company's financial reporting to investors.

3.2 Additional AQ measures scaled by available information

Our construction of disclosure quality follows the theoretical model (Kim and Verrecchia., 1991,1994) and defines the overall usefulness of earnings announcements to investors as both the ex ante importance and the ex post relative informativeness of announcement contents. However, the informativeness of a specific earnings announcement depends both on the quantity and quality of information disclosed. To rule out the effect of the amount of information and keep only the quality part, we try to scale our $nchiv_{i,t}$ measure by several "information quantity" measures. Our first candidate for scaling is absolute analyst-adjusted earnings surprise (denoted as $ABSSUE3_{i,t}$) and analysts' expectations is measured as the median of latest individual analysts forecasts issued within the 90 days prior to the earnings announcement date. We denote the scaled measure as $Nchiv\_scale1_{i,t}$ and we take year-quarter based decile ranking of $Nchiv\_scale1_{i,t}$ as $AQ\_scale1_{i,t}$ as follows to reduce noise in the estimates and to mitigate potential nonlinearity.

$$Nchiv\_scale1_{i,t} = Nchiv_{i,t}/ABSSUE3_{i,t} \qquad AQ\_scale1_{i,t} = \text{Decile rank of } Nchiv\_scale1_{i,t}$$

By construction, we assume $Nchiv\_scale1_{i,t}$ captures for each unit of new information provided in earnings announcement, how much disagreement reduced.

We also use pre-announcement forecast dispersion (denoted as $dispersion_{i,t}$) and pre-announcement call-put parity (denoted as $spread\_pre_{i,t}$) as the second and third scaling variables as follows.

$$\text{Nchiv\_scale2}_{i,t} = \text{Nchiv}_{i,t}/Dispersion_{i,t} \qquad \text{AQ\_scale2}_{i,t} = \text{Decile rank of Nchiv\_scale2}_{i,t}$$

$$\text{Nchiv\_scale3}_{i,t} = \text{Nchiv}_{i,t}/\text{Spread\_pre}_{i,t} \qquad \text{AQ\_scale3}_{i,t} = \text{Decile rank of Nchiv\_scale3}_{i,t}$$

$Nchiv\_scale2_{i,t}$ captures for each unit of forecast dispersion that analysts have before earnings announcement, how much disagreement is reduced after releasing of information. $Nchiv\_scale3_{i,t}$ measures for each unit of potential private information that option traders have (Jin et al., 2012), how earnings announcement help to realize.

3.3 Using real option price database for robustness check

Previous literature shows open interest might be an indicator for the importance of one specific option within a company (Xing et al., 2010). Standardized option database does not provide open interest information. For robustness check, we construct the above four sets of Nchiv and AQ measures again based on open interests-weighted implied volatility in option daily price database in OptionMetrics. Specifically, we select at-the-money call and put options pairs with absolute delta value among 0.4 to 0.6. We calculate the average implied volatility for each available call-put option pair for a certain day as open interest-weighted implied volatility. For those firm-days with more than one at-the-money call-put option pairs, we then weight them by total open interest of the call-put option pairs.

4. Sample and descriptive statistics

4.1 Sample and Databases

We start to construct sample from Compustat firms with available announcement date of quarterly reports (item rdq in Compustat quarterly file) and match them with OptionMetrics standard options section dataset. Standardized options are constructed to be of constant maturity and at-the-money, which reduces measurement error that arises from using options that vary in duration and in the extent to which they are in the money (Dumas et al., 1998; Hentschel., 2003; Rogers et al., 2009). The total number of firm-quarter observations with available option data is 201,000 from year 1996 to 2015. We start in 1995 as 1995 is the first available year that OptionMetrics provide data for options. We then collect stock price and volume data from CRSP, company quarterly financial data from COMPUSTAT, analyst EPS forecasts from I/B/E/S, insider trading information from Thomas Reuters, and intraday trading data from TAQ. Since we have multiple empirical tests with different data requirements, the final sample size varies depending on our specific empirical setting and we describe each sample in the respective tables.

4.2 The nature of our disclosure quality measure

Our main descriptive statistics are documented in table 1 to table 3. Table 1 shows the time-series trend of our four disclosure quality measures over years as follows.

[Insert Table 1 about here]

From table 1 we could observe that all of the four nchiv measures increases gradually over the last two decades and the percent of increase is very large. For example, at the beginning year of our sample, nchiv is about 0.01, and in the last available sample year, this number increased to tenfold of original nchiv and reaches to around 0.1. This increase in nchiv might indicate that the relative ability to resolve disagreement by earnings announcement improves. This finding is

consistent with evidence from Beaver et al. (2018), who use a nonparametric approach to investigate information content of EAD from 1971-2011, and find there is a dramatic increase in information content at earnings dates from 2001 onward. Further, if we closely examine the trends, we could observe some interesting patterns coinciding with some financial regulation and events. For example, the improvement in nchiv starts to increase around 2001 and reaches to 0.06 quickly from 2001 to 2005, which is the period coinciding with regulation FD and SOX. However, such increasing trend reverses after 2007 and stays around 0.07 for several years from 2007 to 2011, which is the period for financial crisis. And in recent years, the nchiv increases again. We don't want to draw any inferences from the consistency among our measure and those specific periods, however, the consistency might in some way validate the usefulness of our measure.

Table 2 presents descriptive statistics of main dependent variables used from 1996 to 2015. The dispersion for our nchiv is 3 standard deviation, which is wide to explain our other variables.

[Insert Table 2 about here]

Correlation metrics of our main variables is presented in table 3. Our disclosure quality measure is correlated with most of variables interested in the univariate analysis. For example, The negative correlation between nchiv and lncham (log change in Amihud illiquidity measure) indicates improved market liquidity after disclosing high quality financial reporting. The measure uv (unexpected volume) and car (cumulative abnormal return) are both positively related to nchiv, indicating more market reaction to firms with high nchiv. Absolute earnings surprise decreases the ability for earnings announcement to resolve disagreement. Insiders are less likely to purchase shares after earnings announcement with high nchiv measure and if they

trade, the trading profitability is smaller. Analyst react more to firm-quarter with high nchiv as well (from WRf, Afa, and Reaction).

4.3 Determinants of our measure

We use regression analysis to examine the determinants of our measure in table 4. Several firm fundamentals and interporal variables are included as control variables and we include two-digits sic dummy and quarter dummy for industry and quarter fixed effect.

[Insert Table 4 about here]

The results show that both firm-specific characteristics and information in quarterly announcement are related to our measure. Implied volatility in pre-earnings announcement period (pre_iv) positively affect our measure by construction. Absolute earnings surprise (abssue3) and loss indicator for current quarter negatively affect the ability for earnings announcement to resolve disagreements among investors, which is consistent with the notion that more doubts arise with unanticipated information and thus reduce the reliability of financial statement. Annual announcement (qtr4 indicator) shows higher disclosure quality. Companies with larger market cap(lnmv), more external monitoring by institutions(io) and analysts(ac), and higher profitability(roa) have higher disclosure quality in general. If the stock price is more volatile(stdret) and there are larger analyst dispersion(dispersion) before earnings announcement date, the decrease in uncertainty around earnings announcement is more significant.

5. Validation tests

We conduct three sets of validation tests. Firstly, we investigate whether our measure could predict improved market liquidity and decreased informed trading based prior general and popular market-based measures (e.g, change in Amihud illiquidity measure, change in stock price idiosyncratic risk, and probability of informed trading). Next, motivated by the overall improvement in market conditions documented in the first set of tests, we examine the informed trading specifically in option market and stock market, as well as insiders' trading around earnings announcement date and check whether our measure could help to reduce informed trading that previously documented. Last, we relate our disclosure quality measure with market intermediaries, analysts, and try to see whether analysts could update their information more quickly and revise their prediction for future earnings more accordingly to earnings surprise of current quarter. In these validation tests, firm fundamentals and quarterly information are included as controls. We also include sic two-digits and quarters fixed effect and cluster standard errors by firms.

5.1 Does market improve with higher disclosure quality we defined?

We first examine the effect of our disclosure quality measure on market conditions. More disclosure quality should help to improve market liquidity and reduce probably informed trading in market. The following regression model is used to answer our question:

$$Change\ in\ liquidity\ or\ informed\ trading\ measures_{i,t} = a + B_1 pre\_iv_{i,t} + B_2 AQ_{i,t} + \Sigma fundamentals_{i,t} + \Sigma quarterly\ results_{i,t} + \Sigma ind\_FE_{i,t} + \Sigma quarter\_FE_{i,t} + \varepsilon_{i,t}$$

where (1)change in liquidity measures include log one plus change in average Amihud illiquidity measured from [-5,-2] to [2,5] trading days around earnings announcement date and log one plus change in bid-ask spread measured from [-5,-2] to [2,5] trading days around earnings announcement date; and (2)informed trading measure include change in sigma around earnings

announcement date, change in idiosyncratic risk around earnings announcement date, and probability of informed trading for current quarter. Sigma is logistic transformed (1-R2) from Fama-French four factors model is measure based on [-32,2] to [2,32] trading days around earnings announcement date, and Idiosyncratic risk is root-mean-square deviation of error from the same Fama-French four factors model. Detailed variable definitions are provided in appendix.

This test could help us to further distinguish whether our measure captures the disclosure quality or just absolute disclosure quantity. If our measure is more associated with the operating complexity and therefore captures the amount of disclosure, we might observe reduced liquidity since the large amount of complex disclosures might require market to digest the new information gradually, therefore temporarily increase the self-protection of uninformed traders who usually do not have superior information processing ability (Kim and Verrecchia, 1994). On the other hand, if our measure captures whether overall market could quickly understand the meaning of financial announcements, we should observe increased liquidity.

The results of this test are presented in table 5. The sample spans from 1996 to 2015 and include about 108,968 firm-quarter level of observations. We control for firm-fundamentals and information for quarterly earnings, sic two digits industry fixed effect and quarter fixed effect, and clustering standard errors on firm-level.

Table 5 Panel A presents the results for the effect whether our measure is associated with improved liquidity. We could observe announcements of companies with high disclosure quality score significantly experience decrease in market illiquidity proxied by Amihud and bid-ask spread, indicating the improved market liquidity conditions. Panel B replace dependent variables for proxies for informed trading and private information. As we could observe, the overall effects show probability of informed trading is lower in quarter with higher disclosure quality score, and

the private information in stock price decreases more quickly for firm-quarter that has high disclosure quality score. The results are consistent with our disclosure quality measure capturing more about the quality instead of quantity part of earnings announcement.

[Insert Table 5 about here]

The estimated coefficients of -0.008 (-0.009) in table 5 Panel A suggest one standard deviation of AQ of 2.87 is associated with 0.019 (0.025) decrease in Amihud illiquidity(bid-ask spread), representing about 3% (6%) standard deviation of Amihud illiquidity(bid-ask spread).The coefficients of -0.001(-0.011) in table 5 Panel B suggest one standard deviation of AQ of 2.87 is associated with 0.029 (0.032) decrease in sigma(idiosyncratic risk), representing about 39% (8%) standard deviation of sigma(idiosyncratic risk).

5.2 Behavior of informed trading

Our second sets of tests examine whether our measure could help to predict reduced informed trading by different kinds of sophisticated investors documented in prior literatures (e.g., Jin et al., 2012; Cohen et al., 2012). If our measure could capture two sources of advantages, namely, access to private information and superior information processing ability (Kim and Verrecchia, 1991, 1994), that sophisticated investors have over uninformed investors, we should observe reduced information gathering before earnings announcement and also reduced information advantage that sophisticated investors have over uninformed traders after earnings announcement. Specifically, we examine (1) whether option market lead stock market (according to Jin et al., 2012) less significantly if our disclosure score indicates less private information gathered before; (2) whether insiders' information advantage decreases more significantly if our disclosure score

indicates it's easy to interpret financial information in this firm-quarter; and (3) whether predictive power of big and small stock trading to earnings surprise is less significant. We expect our measure could have an attenuating effect on those informed trading.

5.2.1 Informed trading from option traders

Theoretical work from Kim and Verrecchia(1991) identifies that one important source of information advantage that sophisticated investors have is their ability to get private information. Jin et al (2012) empirically test whether option price leads stock price because of the ability of private information gathering from option traders under the setting of earnings announcements. They find indeed option market has predictive power to stock market before scheduled quarterly announcements but not in unscheduled events, suggesting option traders do intentionally get private information before earnings announcement.

When our disclosure score is high, the underlying construction suggests that before earnings announcement, markets have high level of disagreement and doubts about current quarter's financial reports (since only those quarters with high pre_iv could potentially have high AQ), which indicates that such firm might have the ability to retain most of their information and to disclose most of their results in earnings announcement laterwards immediately. So our measure by construction exclude the information advantage of private information gathering by sophisticated traders. If our measure does capture this reduced information advantage, we should observe reduced predictive power of option market to stock market prior to earnings announcement.

We follow research design of Jin et al (2012) and add our AQ measure as the interaction with all of their independent variables. Specifically, Jin et al (2012) use two popular measure for

information embedded in option market, call-put parity and volatility skew, to see whether they have predictive power to information in earnings announcement date. Specifically, they construct $spread\_base_{i,t}$ ($skew\_base_{i,t}$) as weighted average of the difference in implied volatilities between matched call and put option pairs (difference in the implied volatility between OTM put options and ATM call options) within [-50,-11] days before earnings announcement, $spread\_pre_{i,t}$ ($skew\_pre_{i,t}$) as weighted average of the difference in implied volatilities (difference in the implied volatility between OTM put options and ATM call options) within [-10,-2] days before earnings announcement, and SUE3 as analyst-adjusted earnings surprise and predict that information in call-put parity (skewness) in option market before earnings announcement date should positively (negatively) predict CAR around earnings announcement date.

We estimate the following regression with our AQ measure interacted with measures constructed by Jin et al (2012) as follows:

$$CAR_{i,t} = a + B_1 SUE3_{i,t} + B_2 spread\_pre_{i,t} + B_3 spread\_base_{i,t} + B_4 SUE3_{i,t} * AQ_{i,t} + B_5 spread\_pre_{i,t} * AQ_{i,t} + B_6 spread\_base_{i,t} * AQ_{i,t} + \Sigma ind\_FE_{i,t} + \Sigma quarter\_FE_{i,t} + e_{i,t}$$

$$CAR_{i,t} = a + B_1 SUE3_{i,t} + B_2 skew\_pre_{i,t} + B_3 skew\_base_{i,t} + B_4 SUE3_{i,t} * AQ_{i,t} + B_5 skew\_pre_{i,t} * AQ_{i,t} + B_6 skew\_base_{i,t} * AQ_{i,t} + \Sigma ind\_FE_{i,t} + \Sigma quarter\_FE_{i,t} + e_{i,t}$$

Findings documented in Jin et al (2012) suggest that spread (skew) in option market positively (negatively) predict return in earnings announcement. If our measure could capture the decreased information access advantage for sophisticated option traders before earnings announcement date, we should observe in the first (second) regression model, B_4 and B_5 should be significantly negative (positive), indicating the reduced predicting power in option market. In addition, we

expect the sign for B_6 should be positive in both models if our disclosure quality captures the information quality in earnings announcement (similar as ERC).

The sample for this test consists a maximum of 113,465 firm-quarter observations from 1996 to 2016. Table 6 shows the results for option traders' informed trading. Consistent with Jin et al (2012)'s finding, earnings surprise and option spread positively predict car, while spread negatively predict car. With interaction of our variable to earnings surprise, skew, and spread, we could find firm-quarter announcement with higher disclosure quality could help to significantly attenuate predictiveness of option market to stock market, while at the same time enhance earnings response coefficient to earnings surprise.

[Insert Table 6 about here]

5.2.2 Informed trading from insiders

Kim and Verrecchia(1994) suggests that the second source of information advantage is that sophisticated investors have superior processing ability. If an earnings announcement could help investors to quickly understand the business operations and let them to reach consensus, we should observe the overall information advantage for public investors increases. Insiders, as those who have more private information and at the same time are more familiar with the business operations of their companies, should lose more information advantage and are less likely to engage in opportunistic trade after those informative announcements proxied by our measure.

Previous literatures suggest that insiders take a trade either due to liquidating their shares granted or due to opportunistic profits from their superior information. In general, insider purchase is

more likely to be opportunistic trade and Cohen et al (2012) develop a well-known classification for opportunistic trade and routine trade. We follow their classification method and classify all insider trade happened right after earnings announcement date into opportunistic purchase, opportunistic sale, routine purchase, and routine sale. We use logit model to test the incidence of opportunistic insider trading after earnings announcement as follow:

$$Dummy\ if\ insider\ take\ a\ trade\ [3,12]_{i,t} = a + B_1 pre\_iv_{i,t} + B_2 AQ_{i,t} + \Sigma fundamentals_{i,t} + \Sigma quarterly\ results_{i,t} + \Sigma ind\_FE_{i,t} + \Sigma quarter\_FE_{i,t} + \varepsilon_{i,t}$$

Besides, insiders usually trade with abnormal profits ((e.g., Frankel and Li, 2004; Huddart and Ke, 2007; Jagolinzer et al., 2011; Gao et al., 2014). Following Gao et al (2014), we estimate trading profits using the 180-days following transaction-specific regression of daily returns on Fama-French four common factors model and get insider trading's alpha. We measure transaction-level trading profit as percentage of potential gains following purchases and potential losses avoided following sales, that is, it is equal to 100*α for purchases and -100*α for sales. Then, we aggregate the value-weighted average alpha for those trades taken by insiders within [3,12] days after earnings announcement date.

We use OLS regression to test the effect on insider trading's profits as follows:

$$Weighted\ average\ of\ insiders'\ alpha_{i,t} = a + B_1 pre\_iv_{i,t} + B_2 AQ_{i,t} + \Sigma fundamentals_{i,t} + \Sigma quarterly\ results_{i,t} + \Sigma ind\_FE_{i,t} + \Sigma quarter\_FE_{i,t} + \varepsilon_{i,t}$$

Control variables include those frequently used in prior literature for both models. We consider various controls of information asymmetry including R&D (Aboody and Lev, 2000), loss dummy (Huddart and Ke, 2007; Brochet, 2010), stock return volatility (Ravina and Sapienza, 2010), analyst coverage (Frankel and Li, 2004). We also include contrarian trading tendencies (e.g., Lakonishok et al., 1994; Rozeff and Zaman, 1998) proxied by the book-to-market ratio

and stock return momentum. In addition, we include several general control variables such as firm size, leverage, institutional ownership, earnings surprise, and indicator for the fourth quarter. We include industry and quarter fixed effect and cluster standard errors by firm-level.

Table 7 presents the results for insider trading's probability and profitability after earnings announcement date. The sample for this test consists a maximum about 116,397 firm-quarter observations. Panel A shows that our measure only has significant positive influence on probability of opportunistic insider purchase taken within [3,12] days after earnings announcement date, which is consistent with insiders might notice their relative advantage to firms are smaller therefore they opportunistically reduce their trading for this period. The coefficient is economic significant too, with one standard deviation of AQ decreases insider trading's opportunistic purchase by 13.5%. Panel B shows that on average, insider trading taken in this period experience a negative abnormal return, which suggests again our measure captures the relative ability that earnings announcement to reduce uncertainty to overall market related to informed traders.

[Insert Table 7 about here]

5.2.3 Informed trading from big vs small equity trades

The last test for informed trading takes a glimpse at the behavior of stock traders around earnings announcement. Previous literature find that stock market could predict earnings surprises and buy-and-sale imbalance is a common measure for information that traders in the stock market have. Intuitively, if there is more buying pressure than selling pressure, it is more likely that stock market anticipates good earnings news, and vice versa.

We analyze big traders' behavior from intraday TAQ data. The measure for big/small trades is based on the daily buy-and-sell imbalance among investors before and after earnings announcement. Different from PIN measure, which uses maximum likelihood to estimate quarterly information asymmetry, this measure examines specifically how high-quality earnings announcement changes the behavior of different market participants on daily basis. Specifically, buy-and-sale imbalance of big (small) trades equals to total value of buy (follow Algorithm in Lee and Ready, 1991 to define big and small trades) minus total value of buy, scaled by average buy and sale value for a specific day.

The empirical testing is as follows,

$$\mathrm{IMB}_{\mathrm{big},[-2,-1,0,1,2]} = a + B_1 SUE3_{i,t} + B_2 AQ_{i,t} + B_3 SUE3_{i,t} * AQ_{i,t} + \Sigma fundamentals_{i,t} + \Sigma quarterly\ results_{i,t} + \Sigma firm\_FE_{i,t} + \varepsilon_{i,t}$$

$$\mathrm{IMB}_{\mathrm{smal},[-2,-1,0,1,2]} = a + B_1 SUE3_{i,t} + B_2 AQ_{i,t} + B_3 SUE3_{i,t} * AQ_{i,t} + \Sigma fundamentals_{i,t} + \Sigma quarterly\ results_{i,t} + \Sigma firm\_FE_{i,t} + \varepsilon_{i,t}$$

where dependent variable is imbalance of big/small traders[1] 2 days before, 1 day before, the same day, 1 day after, 2 days after the earnings announcement. B_3 in both models indicate the how these two groups of trades are affected by information contained in earnings announcement. Control variables include firm size, earnings surprise, standard deviation of return, book-to-market ratio, book leverage, loss indicator, analyst coverage and institutional ownership.

[1] We define a trade as big trade if trading value is more than 50000 per trade, and a trade as small trade is trading value is less than 5000 per trade.

The results are presented in table 8. Panel A and Panel B shows the effect on big and small trades, respectively. It shows that generally, predictability of small trades and big trades before disclosure date are significantly lower (the negative coefficient for interaction of our quality measure and earnings surprise) for earnings announcement that reduce more uncertainty in the market, which support again that the information leakage is less severe for high disclosure quality for firm-quarter observation proxied by our measure. And after disclosure date, big investors seem respond to information quickly than small traders-the coefficient for interaction of our quality measure and earnings surprise after earnings announcement date for big traders is insignificant, while this coefficient for small traders is negative.

[Insert Table 8 about here]

We argue the both significant influences observed in the settings of big and small trades are not surprising, as informed investors often split their trades into smaller part to hide informed trading (Angel et al., 2010). The small trades also contain informed trading. And if our measure captures the decreased advantage of access to private information, we should also observe the decreased informed trading before earnings announcement dates.

5.3 Impact on information intermediary

Our last set of tests turns to examine the effect of our measure on the well-known information intermediary, analysts, that produce second-hand information about a company. If our measure captures how disclosure could help market participants to understand the business, instead of overall amount of information content, information intermediary should benefit as well. Specifically, for analysts that regularly trace information of certain firms, if they could get information that is clearer, it could cost them less time to prepare the reports to update such

information (timeliness). And if they believe more in the new information provided, they should adjust their forecasts for further periods accordingly (response). It is also possible that their forecast is more accurate (analyst forecast revision) and there might be more forecast provided (number of forecasts).

I use an inverse-weighting scheme that assigns higher weights to more timely forecast after earnings announcement. The measure for analyst response timeliness is WRF (weighted ratio of forecasts). It is calculated as time-weighted number of forecast for next quarter divided by total number forecast within date [reporting date+2, next reporting date). The numerator is weighted by distance between forecast announcement date and financial statement announcement date plus 1 (t+1). Such weights could assign more value to forecasts right after earnings announcement than forecasts issued long time after. The denominator is total number of forecasts to control the different level of forecasts for different firms (scaling). In total, the more quickly analysts respond after earnings announcement, the higher the WRF.

$$\text{WRF} = \frac{\sum_{t=0}^{nrdq-rdq} [\frac{N_{rdq+t}}{t+1}]}{\sum_{t=0}^{nrdq-rdq} N_{rdq+t}}$$

For dependent variable, we also include (1)weighted number of forecasts (non-scaling version for WRf) to calculate the number of forecasts issued after earnings announcement date; (2) analyst forecast accuracy measured as zero minus time-weighted absolute forecast error scaled by total number of forecasts, for all forecasts issued within [2,40] days after earnings announcement date; and (3) analyst forecast response measured as zero minus absolute difference between ratio of forecast update for annual reports and the ratio of earnings surprise to

current quarter, with closer ratio of annual update to quarterly earnings surprise indicating more strongly reaction to earnings surprise for the current quarter.

Based on above four kinds of measures, we set up our regression models as follows:

$$WRf_{i,j},\ WNf_{i,j},\ Afa_{i,j},\ \text{reaction} = a + B_1 pre\_iv_{i,t} + B_2 AQ_{i,t} + \Sigma fundamentals_{i,t} + \Sigma quarterly\ results_{i,t} + \Sigma ind\_FE_{i,t} + \Sigma quarter\_FE_{i,t} + \varepsilon_{i,t}$$

The control variables are generally used firm-level variable in previous literature, including analyst forecast accuracy 10days before earnings announcement date (Afa101m), earnings surprise (sue3), loss indicator (loss), institutional ownership (io), analyst coverage (ac), firm size, etc. The definitions for these variables could be referred in appendix. We include two digits sic code and quarter-fixed effect, and cluster standard error on firm-basis. We predict b_2 to be positive in all four regression models.

[Insert Table 9 about here]

Table 9 presents the result of our measure on analyst forecasts. Predictions for forecast timeliness (WRf) shows that analyst reports for the next quarter is more likely to happen right after earnings announcement date, with higher WRf meaning more reports prepared in the early days of the quarter. The effect of our AQ measure on these respond speed measure is significantly positive, which indicates the quick response of analyst to new earnings announcement information and support our hypothesis that information intermediary also benefits from earnings announcement date that help to reduce more uncertainty. Besides, there are more total number of forecasts issued, and improved accuracy after earnings announcement, and more strongly reactions by analysts according to the table, suggesting our measure captures

those firm-quarter announcements with information not only easy to interpret (therefore increase the forecasts timeliness), but also help analysts to have more accurate estimate for future earnings.

6. Sensitivity analysis and robustness check

We include bunches of sensitivity analyses and robustness check to see whether our measure really capture the relative information advantage bought by certain earnings announcements to uninformed investors. As we indicate in section 3, we scale our raw nchiv measure again by earnings surprise, pre-announcement option spread, and pre-announcement forecast dispersion to see for each unit of new information/uncertainty, how much disagreement that this firm-quarter's earnings announcement helps to resolve. We reexamine all our tests in section 5, and find robust significant results with same direction as well. Besides, we construct our AQ measure again by using open-interest weighted implied volatility in daily file in OptionMetrics and see similar results. We examine the relationship for our measure compared with options with longer-time to expire (e.g., instead of 30 days, we investigate 60 days, 90 days etc). And we replace the dependent variable examined in section 5 with randomly selected longer time horizon. For example, we calculate the change in Amihud and bid-ask spread based on 40-days window around earnings announcement, and change the window to calculate insider trading and forecast variables from 2 days on to from 0 days on. The results are similar, suggesting our measure is overall robust in these tests.

7. Conclusion

This paper develops a new measure based on the option market to address the information role of earnings announcement to uninformed traders. Our measure is different from previously disclosure quality measures as we follow theoretical work from Kim and Verrecchia (1991,1994) and construct a measure specifically captures the situation when there is likely to be less private information gathering due to less pre-release of information (proxied by pre_iv) and when subsequently earnings announcement reduces more disagreement among traders (proxied by absolute decrease in implied volatility). By construction, our measure captures the two most important sources of information advantage that sophisticated traders have (private information gathering and processing ability) and identifies out the firm-quarter announcement that could help uninformed traders most.

We construct our measure by relative change in implied volatility around earnings announcement date. A higher pre-announcement disagreement and sharper decrease in disagreement indicate higher disclosure quality in general, with the pre-announcement disagreement proxying for the importance of (demand for) information in earnings announcement, either due to business nature or due to less private information obtained before, and the post-announcement disagreement "slope" proxying for how clearly the earnings announcement explain to overall market. To rule out the effect of total amount of information and include only the quality for the information, we further scale our variable by different measures such as earnings surprise.

We examine the validity of our measure by showing that (1) for firms that experience more decrease in uncertainty during earnings announcement date, overall market conditions for the firm improve; (2) such firms enjoy decreased information asymmetry and informed trading both before and after earnings announcement in stock and option market; (3) this measure is positively related to firms' information environment. Taken all results together, we could find

our measure do capture the quality of earnings announcement from the perspective of uninformed traders, as overall market protection decreases, previously-documented pattern of informed trading attenuates, and analyst produce forecast more timely and precisely.

This research could help to identify a new measure of earnings announcement quality from a different perspective-the benefits to uninformed traders. This measure is different than previous disclosure quality measure since it focusses specifically on benefits of earnings announcement on naïve investors. Furthermore, this is measure that can be easily constructed for the universe of companies with option data in recent two decades. We show such quality in earnings announcement is informative and could help to track where informed trading is more likely to happen.

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Figure1: Trend of implied volatilities around earnings announcement date
call, put, and average iv with expiration days 30

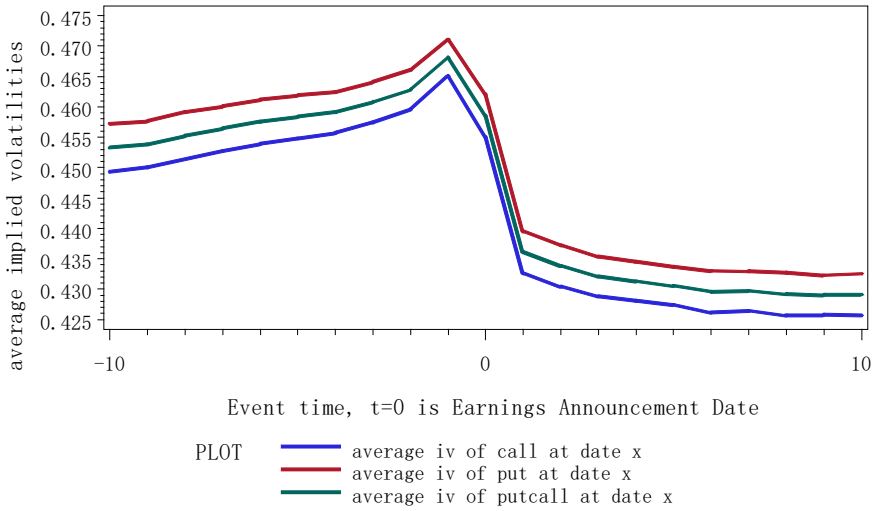

Figure2: Trend of implied volatilities around earnings announcement date
average iv with different expiration date

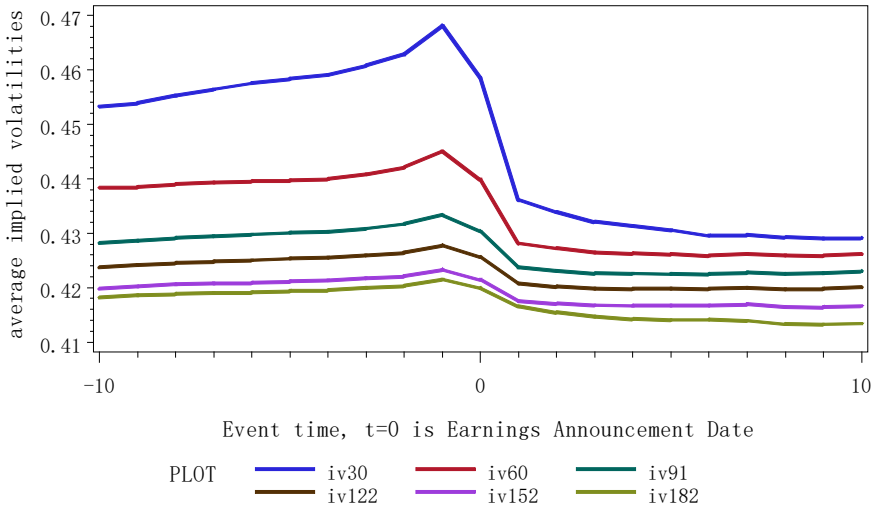

Table 1: Time-series statistic for nchiv

	Nchiv		Nchiv_scale1(by abssue)		Nchiv_scale2(by dispersion)		Nchiv_scale3(by volatility spread)	
year	Median	N	Median	N	Median	N	Median	N
1995	0.02	1,363	0.51	1,020	0.34	1,182	6.52	887
1996	0.01	7,071	0.38	5,264	0.33	5,980	8.43	4,471
1997	0.01	8,413	0.34	7,097	0.36	7,073	8.61	4,998
1998	0.01	9,479	0.30	7,922	0.33	7,912	8.11	5,132
1999	0.01	9,539	0.24	8,142	0.29	7,951	6.33	5,167
2000	0.01	8,658	0.23	7,861	0.27	7,121	8.29	4,377
2001	0.02	8,140	0.47	7,100	0.43	6,865	10.97	4,343
2002	0.02	8,176	0.55	6,962	0.57	7,055	10.59	4,637
2003	0.03	7,909	1.81	6,969	1.35	6,919	22.14	4,779
2004	0.04	8,725	2.83	7,795	1.61	7,718	31.83	5,302
2005	0.06	9,354	3.92	8,400	2.11	8,315	43.90	5,632
2006	0.09	10,004	6.23	9,181	2.72	8,909	67.58	5,865
2007	0.08	10,688	4.37	9,941	2.14	9,543	52.42	6,084
2008	0.07	10,505	2.24	9,711	1.44	9,444	29.75	6,257
2009	0.08	10,634	3.34	9,880	1.68	9,562	27.23	6,543
2010	0.07	11,263	3.17	10,307	1.67	10,035	33.80	6,605
2011	0.07	11,930	2.64	10,342	1.70	10,518	38.17	6,601
2012	0.09	12,105	4.41	9,905	2.25	10,444	56.61	6,501
2013	0.11	12,951	5.99	10,971	3.00	11,254	86.54	6,542
2014	0.11	13,454	4.27	11,622	2.75	11,725	87.04	6,529
2015	0.10	10,269	3.81	8,865	2.25	9,011	74.06	5,092
Total	0.05	201,000	1.98	175,000	1.41	175,000	31.69	112,000

Table2: Descriptive statistics

Panel A: Main dependent variables

variable	mean	p50	p25	p75	sd	N
nchiv	0.06	0.05	(0.01)	0.13	0.14	200,630
nchiv scale1	14.48	1.98	(0.11)	10.09	49.59	175,257
nchiv scale2	3.19	1.41	(0.13)	5.47	9.54	174,536
nchiv scale3	107.80	31.69	(0.15)	133.60	286.90	112,344
aq	5.50	6.00	3.00	8.00	2.87	200,630
lncham	(0.17)	(0.16)	(0.62)	0.28	0.70	200,499
lnchbas	0.05	0.04	(0.21)	0.30	0.40	200,560
pin	0.13	0.12	0.09	0.16	0.06	135,395
chsigma	0.00	0.00	(0.05)	0.05	0.07	200,536
chidrisk	0.05	(0.03)	(0.24)	0.24	0.42	200,431
uv	0.78	0.34	(0.12)	1.10	1.51	200,505
car	0.00	0.00	(0.04)	0.04	0.08	200,581
abssue3	0.00	0.00	0.00	0.00	0.01	127,222
Purchased	0.07	0.00	0.00	0.00	0.25	200,630
Saled	0.22	0.00	0.00	0.00	0.42	200,630
Wavg_profits	0.00	(0.00)	(0.10)	0.10	0.25	57,143
Big_imb	0.05	0.05	(0.02)	0.12	0.14	172,064
Small_imb	0.04	0.02	(0.01)	0.07	0.08	171,885
WRf	0.32	0.30	0.18	0.45	0.19	176,509
WNf	3.59	2.50	1.02	5.07	3.50	179,609
Afa	(0.02)	(0.01)	(0.01)	(0.00)	0.06	143,483
reaction	(41.23)	(8.94)	(25.81)	(3.10)	112.20	116,674

Table 2 provides the summary statistics for the key variables in my primary tests. The sample period spans from 1996 to 2015 and contains about a maximum of 200,630 firm-quarter observations. All variables are defined in Appendix.

Table 3: Correlation matrix

	nchiv	lncham	uv	car	abssue	purchased	saled	wavg profits	big_imb	small_imb	WRf	Afa	Rea
nchiv	1												
lncham	**-0.045**	1											
uv	**0.083**	**-0.089**	1										
car	**0.206**	**-0.133**	**-0.024**	1									
abssue	**-0.043**	**0**	**0.027**	-0.001	1								
purchased	**-0.041**	**-0.007**	**0.018**	**-0.089**	**0.035**	1							
saled	**0.133**	**-0.06**	**0.031**	**0.118**	**-0.1**	**-0.012**	1						
Wavg_profits	**-0.014**	**0.008**	0	**-0.03**	**0.038**	**0.061**	**-0.069**	1					
big_imb	**-0.026**	**-0.016**	**-0.012**	**0.019**	**-0.04**	**-0.009**	**0.004**	-0.005	1				
small_imb	**-0.046**	**-0.035**	**-0.009**	**0.038**	**-0.075**	**-0.014**	**-0.01**	-0.007	**0.215**	1			
WRf	**0.173**	**-0.034**	**0.186**	**0.009**	**-0.019**	**-0.006**	**0.102**	**-0.01**	**-0.041**	**-0.122**	1		
Afa	**0.032**	**-0.017**	**0.028**	**0.044**	**-0.288**	**0.011**	**0.075**	**-0.011**	**0.025**	**0.037**	**0.053**	1	
Reaction	**0.039**	-0.004	-0.003	**0.018**	**-0.429**	**-0.018**	**0.062**	**-0.024**	**0.018**	**0.032**	**0.013**	**0.135**	1

Table 2 provides the Pearson correlation for the key variables in my primary sample. Figures in bold indicates that two variables are significantly correlated at least at 0.1 level. All variables are defined in Appendix.

Table 4: The determinants of nchiv

	(1) nchiv	(2) nchiv_scale1	(3) nchiv_scale2	(4) nchiv_scale3
pre_iv	0.297***	31.112***	16.969***	334.487***
	(52.56)	(18.96)	(40.43)	(29.81)
abssue3	-0.994***	-113.756***	-51.000***	-6619.371***
	(-8.64)	(-3.29)	(-8.07)	(-26.93)
loss	-0.017***	-2.346***	-0.928***	-4.906
	(-11.39)	(-3.95)	(-8.87)	(-1.53)
qtr4	0.004***	0.347	0.115*	13.998***
	(4.39)	(0.78)	(1.71)	(5.98)
roa	0.222***	39.322***	14.739***	447.363***
	(10.83)	(4.78)	(8.95)	(7.02)
lnmv	0.013***	3.838***	0.826***	35.971***
	(20.38)	(16.27)	(16.20)	(20.00)
BLev	-0.002	-1.199	-1.403***	-17.081
	(-0.50)	(-0.79)	(-4.51)	(-1.64)
btm	-0.001	-0.158	-0.003	-3.263***
	(-1.45)	(-1.46)	(-0.12)	(-4.48)
io	0.032***	5.455***	1.156***	43.834***
	(9.59)	(4.82)	(4.65)	(5.63)
ac	0.002***	0.630***	0.026***	2.559***
	(13.76)	(13.73)	(2.67)	(7.73)
mom	0.017***	0.732	0.753***	2.233
	(9.11)	(1.00)	(5.35)	(0.53)
stdret	-2.537***	-376.169***	-139.128***	-2410.714***
	(-35.75)	(-18.01)	(-28.05)	(-17.88)
rd	-0.045	30.453**	2.348	-230.160**
	(-1.00)	(1.98)	(0.71)	(-2.18)
dispersion	0.015*	-2.773	-19.682***	-70.936***
	(1.73)	(-0.83)	(-28.31)	(-3.51)
constant	-0.163***	-42.608***	-8.797***	-346.977***
	(-11.13)	(-8.68)	(-8.48)	(-15.87)
Industry fixed	Yes	Yes	Yes	Yes
Quarter fixed	Yes	Yes	Yes	Yes
N	105989	96026	104442	93375
adj.r-squared	0.229	0.080	0.158	0.160

Table 4 presents the effect of the determinants of firm and quarter-specific variables on four NCHIV measure. The sample spans the period 1996 to 2015 and contains about a maximum of 105,989firm-quarter observations. The dependent variable is negative change in implied volatility (nchiv in colume (1)), nchiv scaled by absolute earnings surprice (nchiv_scale2 in colume (2)), nchiv scaled by analyst forecast dispersion (nchiv_scale3 in colume (3)), nchiv scaled by volatility spread before (nchiv_scale3 in colume (4)) , respectively. All control variables are defined in Appendix. Statistical significance (two-sided) at the 10%, 5%, and 1% level is denoted by *, **, and ***, respectively. All continuous variables are winsorized at the 1 percent and 99 percent levels. t-statistics are in parentheses, and are based on standard errors clustered on the firm level.

Table 5: The effect of our measure on market conditions
Panel A: Does AQ help to improve market liquidity?

	(1) lncham	(2) lnchbas
pre_iv	0.068***	-0.007
	(3.27)	(-0.56)
aq	**-0.008*** **	**-0.009*** **
	(-9.47)	**(-20.31)**
lnmv	0.028***	-0.018***
	(12.33)	(-14.31)
rd	-0.220	0.112
	(-1.24)	(1.19)
BLev	0.025*	0.012
	(1.79)	(1.52)
btm	0.000	-0.001
	(0.21)	(-0.86)
io	-0.050***	-0.005
	(-4.32)	(-0.71)
ac	0.000	0.000
	(0.51)	(1.20)
abssue3	-3.328***	2.280***
	(-6.66)	(7.98)
loss	0.056***	0.017***
	(7.85)	(4.43)
qtr4	0.001	0.007**
	(0.12)	(2.25)
mom	0.014	0.059***
	(1.27)	(9.49)
roa	-0.739***	0.080
	(-8.91)	(1.63)
stdret	0.013	-2.917***
	(0.04)	(-16.50)
constant	-0.295***	0.260***
	(-6.07)	(10.08)
Industry fixed	Yes	Yes
Quarter fixed	Yes	Yes
N	108968	108988
adj.r-squared	0.024	0.068

Table 5 Panel A presents the effect of our measure on market liquidity improvement. The sample spans the period 1996 to 2015. The dependent variable is log (1 plus relative change in average Amihud illiquidity measure) from [-5, -2] to [2, 5] days around earnings announcement date (lncham in colume (1)), log (1 plus relative change in average bid-ask spread) from [-5, -2] to [2, 5] days around earnings announcement date (lnchbas in colume (2)). All control variables are defined in Appendix. Statistical significance (two-sided) at the 10%, 5%, and 1% level is denoted by *, **, and ***, respectively. All continuous variables are winsorized at the 1 percent and 99 percent levels. t-statistics are in parentheses, and are based on standard errors clustered on the firm level.

Panel B: Does AQ help to reduce information asymmetry?

	(1) pin	(2) chsigma	(3) chidrisk
pre_iv	-0.018***	0.003	0.413***
	(-8.35)	(1.61)	(30.92)
aq	**-0.000*** **	**-0.001*** **	**-0.011*** **
	(-4.91)	**(-6.29)**	**(-24.10)**
lnmv	-0.018***	-0.000	-0.011***
	(-45.77)	(-0.81)	(-8.09)
rd	-0.130***	-0.007	0.388***
	(-5.32)	(-0.42)	(3.67)
BLev	0.011***	0.001	0.010
	(5.05)	(0.63)	(1.18)
btm	0.001***	0.000	0.004***
	(2.92)	(0.00)	(4.39)
io	-0.028***	-0.000	-0.019***
	(-14.47)	(-0.04)	(-2.75)
ac	-0.001***	-0.000***	0.000
	(-11.56)	(-2.92)	(0.12)
abssue3	0.528***	0.216***	3.530***
	(9.54)	(4.35)	(10.82)
loss	0.002**	-0.002***	0.032***
	(2.30)	(-3.32)	(7.55)
qtr4	0.001***	-0.005***	-0.012***
	(2.65)	(-8.24)	(-4.15)
mom	0.009***	-0.014***	0.012**
	(11.18)	(-12.08)	(1.98)
roa	-0.014	0.000	-0.032
	(-1.37)	(0.05)	(-0.63)
stdret	-0.604***	-0.060**	-12.125***
	(-22.86)	(-2.00)	(-63.84)
constant	0.362***	0.021***	0.361***
	(46.23)	(5.56)	(12.67)
Industry fixed	Yes	Yes	Yes
Quarter fixed	Yes	Yes	Yes
N	77959	108980	108958
adj.r-squared	0.464	0.104	0.109

Table 5 Panel B presents the effect of our measure on change in informed trading around earnings announcement date. The sample spans the period 1996 to 2015 and contains about a maximum of 108,988 firm-quarter observations. The dependent variable is probability of informed trading in current quarter (pin in colume (1)), relative change in logistic transformed (1-R2) from Fama-French four factors model around earnings announcement date (chsigma in colume (2)), relative change in root-mean-square deviation of error from Fama-French four factor model around earnings announcement date (chidrisk in colume (3)), respectively. All control variables are defined in Appendix. Statistical significance (two-sided) at the 10%, 5%, and 1% level is denoted by *, **, and ***, respectively. All continuous variables are winsorized at the 1 percent and 99 percent levels. t-statistics are in parentheses, and are based on standard errors clustered on the firm level.

Table 6: Is there reduced informed trading before earnings announcement date? (option traders)

	(1)	(2)		(3)	(4)
Model1	carskew_nofix	carskew	Model2	carspread_nofix	carspread
sue3	1.923***	1.935***	sue3	2.186***	2.212***
	(12.06)	(12.17)		(17.34)	(17.57)
skew_pre	-0.247***	-0.249***	spread_pre	0.049***	0.053***
	(-17.52)	(-17.51)		(4.05)	(4.40)
skew_base	-0.302***	-0.307***	spread_base	0.185***	0.185***
	(-16.79)	(-16.97)		(11.83)	(11.81)
sue3*aq	0.170***	0.173***	sue3*aq	0.110***	0.108***
	(6.37)	(6.46)		(5.05)	(4.93)
skew_pre*aq	**0.039*** **	**0.040*** **	**spread_pre*aq**	**-0.004** **	**-0.004** **
	(17.96)	**(18.07)**		**(-2.12)**	**(-2.17)**
skew_base*aq	**0.059*** **	**0.059*** **	**spread_base*aq**	**-0.041*** **	**-0.040*** **
	(20.82)	**(20.76)**		**(-15.41)**	**(-15.19)**
constant	0.001***	0.002	constant	0.002***	-0.000
	(3.06)	(0.27)		(8.68)	(-0.03)
Industry fixed	No	Yes	Industry fixed	No	Yes
Quarter fixed	No	Yes	Quarter fixed	No	Yes
N	89866	89866	*N*	113465	113465
adj.r-squared	0.079	0.085	adj.r-squared	0.054	0.059

Table 6 presents the effect of our measure on informed trading in option market before earnings announcement date. The sample spans the period 1996 to 2015 and contains about a maximum of 113,465 firm-quarter observations. The dependent variable cumulative abnormal return one day around earnings announcement date. Skew_pre, skew_base, spread_pre, spread_base follows Jin et al (2012). Statistical significance (two-sided) at the 10%, 5%, and 1% level is denoted by *, **, and ***, respectively. All continuous variables are winsorized at the 1 percent and 99 percent levels. t-statistics are in parentheses, and are based on standard errors clustered on the firm level.

Table 7: Is there reduced informed trading after earnings announcement date? (insider trading)
Panel A: The probability of insider trading happened right after earnings announcement date-further partition

	(1) opp_purchased	(2) opp_saled	(3) routine_purchased	(4) routine_saled
pre_iv	0.120	-0.632***	0.319	-0.403**
	(0.60)	(-5.07)	(1.01)	(-2.02)
aq	**-0.047*** **	**0.062*** **	**-0.020**	**0.068*** **
	(-4.62)	**(12.45)**	**(-1.22)**	**(8.72)**
lnmv	-0.014	0.150***	-0.008	0.140***
	(-0.43)	(7.03)	(-0.14)	(4.00)
rd	0.524	5.001***	-0.839	13.723***
	(0.24)	(3.69)	(-0.22)	(7.59)
BLev	0.756***	-0.471***	0.836**	-0.656**
	(3.83)	(-3.71)	(2.00)	(-2.47)
btm	-0.003	-0.162***	-0.043*	-0.288***
	(-0.23)	(-5.65)	(-1.66)	(-5.44)
io	-0.024	1.004***	-0.545*	1.095***
	(-0.13)	(8.83)	(-1.73)	(5.47)
ac	0.006	0.015***	-0.001	0.031***
	(1.09)	(4.24)	(-0.08)	(5.10)
sue3	-6.440	16.246***	-19.646***	0.231
	(-1.57)	(5.31)	(-2.92)	(0.05)
loss	0.127	-0.543***	0.126	-0.434***
	(1.47)	(-10.21)	(0.86)	(-4.81)
qtr4	0.277***	0.227***	0.405***	0.185***
	(4.50)	(8.61)	(4.15)	(5.30)
mom	-1.858***	1.446***	-0.987***	0.970***
	(-10.72)	(25.48)	(-3.63)	(12.27)
constant	-4.294***	-4.512***	-5.263***	-4.693***
	(-6.46)	(-10.24)	(-4.73)	(-10.40)
Industry fixed	Yes	Yes	Yes	Yes
Quarter fixed	Yes	Yes	Yes	Yes
N	116012	116397	112011	116397
Pseudo R2	0.048	0.086	0.051	0.118

Table 7 Panel A presents the logit regression of our measure on probability of insider trading partitioned into opportunistic trades and routine trades within [3,13] days after earnings announcement date. The sample spans the period 1996 to 2015 and contains about a maximum of 116,397 firm-quarter observations. The dependent variable is opportunistic purchase dummy indicator(opp_purchased in colume (1)), opportunistic sales dummy indicator (opp_saled in colume (2)), routine purchase dummy indicator(routine_purchased in colume (3)), routine sales dummy indicator (routine_saled in colume (4)), respectively. All control variables are defined in Appendix. Statistical significance (two-sided) at the 10%, 5%, and 1% level is denoted by *, **, and ***, respectively. All continuous variables are winsorized at the 1 percent and 99 percent levels. t-statistics are in parentheses, and are based on standard errors clustered on the firm level.

Panel B: Insider trading's profits after earnings announcement date

	(1) wavg_profits	(2) wavg_profits	(3) wavg_profits	(4) wavg_profits
pre_iv	-0.012	-0.019*	-0.016	-0.008
	(-1.12)	(-1.68)	(-1.41)	(-0.70)
aq	**-0.001***			
	(-1.85)			
aq_scale1		**-0.001****		
		(-2.14)		
aq_scale2			**-0.000**	
			(-0.92)	
aq_scale3				**-0.001*****
				(-2.69)
lnmv	-0.004***	-0.004***	-0.004***	-0.004***
	(-3.11)	(-2.73)	(-3.23)	(-3.14)
rd	-0.443***	-0.427***	-0.460***	-0.445***
	(-3.81)	(-3.58)	(-3.89)	(-3.69)
BLev	0.012	0.010	0.010	0.014*
	(1.44)	(1.19)	(1.28)	(1.69)
btm	0.001**	0.001	0.001*	0.001*
	(2.01)	(1.00)	(1.88)	(1.76)
io	0.004	0.006	-0.000	0.000
	(0.53)	(0.80)	(-0.01)	(0.02)
ac	0.000	0.000	0.000	0.000**
	(1.59)	(1.13)	(1.36)	(2.11)
sue3	-0.412	-0.411	-0.434	-0.469
	(-1.35)	(-1.29)	(-1.40)	(-1.54)
loss	0.015***	0.016***	0.015***	0.013***
	(3.66)	(3.54)	(3.49)	(3.00)
qtr4	-0.002	-0.003	-0.002	-0.002
	(-1.04)	(-1.45)	(-0.92)	(-0.93)
mom	-0.049***	-0.050***	-0.049***	-0.044***
	(-6.31)	(-6.23)	(-6.34)	(-5.35)
constant	0.048*	0.053*	0.051*	0.045*
	(1.81)	(1.86)	(1.87)	(1.65)
Industry fixed	Yes	Yes	Yes	Yes
Quarter fixed	Yes	Yes	Yes	Yes
N	39143	35872	37919	34657
adj.r-squared	0.016	0.017	0.017	0.017

Table 7 Panel B presents the OLS regression of our measure on value-weighted average insider trading's profits for all trades taken within [3,13] days after earnings announcement date. The sample spans the period 1996 to 2015 and contains about a maximum of 39,143 firm-quarter observations. All control variables are defined in Appendix. Statistical significance (two-sided) at the 10%, 5%, and 1% level is denoted by *, **, and ***, respectively. All continuous variables are winsorized at the 1 percent and 99 percent levels. t-statistics are in parentheses, and are based on standard errors clustered on the firm level.

Table 8: Behavior of big/small trades in stock market around EAD with higher AQ
Panel A: Big trades

	(1) big_imb_day2m	(2) big_imb_day1m	(3) big_imb_day0	(4) big_imb_day1	(5) big_imb_day2
sue3	0.376**	0.044	0.189	0.168	0.190
	(2.16)	(0.27)	(1.39)	(1.22)	(1.20)
aq	-0.000	-0.001***	0.001***	0.001***	-0.000
	(-1.50)	(-3.47)	(5.46)	(5.10)	(-1.43)
sue3*aq	**-0.076*** **	**-0.016**	**-0.049** **	**-0.030**	**-0.031**
	(-2.60)	**(-0.58)**	**(-2.13)**	**(-1.31)**	**(-1.17)**
stdret	0.564***	0.443***	0.446***	0.470***	0.529***
	(12.75)	(10.79)	(12.83)	(13.33)	(13.16)
btm	-0.005***	-0.005***	-0.005***	-0.005***	-0.005***
	(-12.21)	(-12.42)	(-14.50)	(-12.61)	(-11.74)
BLev	0.011**	0.008	0.008*	0.021***	0.004
	(2.11)	(1.63)	(1.90)	(4.99)	(0.86)
loss	0.001	0.001	0.001	0.001	0.001
	(0.35)	(0.97)	(0.79)	(0.93)	(0.94)
lnmv	-0.006***	-0.006***	-0.007***	-0.005***	-0.005***
	(-5.09)	(-6.09)	(-8.10)	(-5.13)	(-4.51)
ac	-0.001***	-0.001***	-0.001***	-0.001***	-0.000***
	(-6.01)	(-4.73)	(-5.76)	(-6.98)	(-3.53)
io	-0.055***	-0.056***	-0.061***	-0.047***	-0.057***
	(-13.91)	(-15.28)	(-19.89)	(-15.03)	(-15.97)
constant	0.142***	0.156***	0.152***	0.118***	0.125***
	(16.22)	(19.25)	(22.09)	(16.92)	(15.70)
Firm FE	Yes	Yes	Yes	Yes	Yes
N	104278	104292	104332	104336	104316
adj.r-squared	0.009	0.009	0.013	0.010	0.009

Table 8 Panel A presents the OLS regression of our measure on big buy-and-sale imbalance from two trading days before earnings announcement to two trading days after earnings announcement (colume (1) to (5)), respectively. Big trade is defined as those with more than $50,000 for each trade. The sample spans the period 1996 to 2015 and contains about a maximum of 104,336 firm-quarter observations. All variables are defined in Appendix. Statistical significance (two-sided) at the 10%, 5%, and 1% level is denoted by *, **, and ***, respectively. All continuous variables are winsorized at the 1 percent and 99 percent levels. t-statistics are in parentheses.

Panel B: Small trades

	(1) small_imb_day2m	(2) small_imb_day1m	(3) small_imb_day0	(4) small_imb_day1	(5) small_imb_day2
sue3	0.129	0.250***	0.218**	0.078	0.129
	(1.38)	(2.73)	(2.52)	(0.88)	(1.43)
aq	-0.000***	-0.000	0.001***	0.001***	-0.000***
	(-3.23)	(-0.89)	(11.03)	(5.28)	(-4.89)
sue3*aq	**-0.021**	**-0.044*** **	**-0.050*** **	**-0.041*** **	**-0.050*** **
	(-1.32)	**(-2.89)**	**(-3.42)**	**(-2.77)**	**(-3.33)**
stdret	0.647***	0.580***	0.541***	0.778***	0.593***
	(26.93)	(24.74)	(24.43)	(34.37)	(25.78)
btm	-0.005***	-0.006***	-0.006***	-0.007***	-0.005***
	(-21.84)	(-24.53)	(-26.00)	(-32.04)	(-22.06)
BLev	0.003	0.002	0.001	0.006**	0.001
	(1.19)	(0.66)	(0.35)	(2.13)	(0.41)
loss	-0.002*	-0.001*	-0.002***	-0.002**	-0.002**
	(-1.90)	(-1.70)	(-2.93)	(-2.30)	(-2.36)
lnmv	-0.007***	-0.007***	-0.007***	-0.009***	-0.006***
	(-11.50)	(-12.06)	(-12.42)	(-14.82)	(-9.39)
ac	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(-10.24)	(-11.00)	(-12.43)	(-15.46)	(-13.43)
io	-0.054***	-0.058***	-0.069***	-0.080***	-0.063***
	(-25.41)	(-27.73)	(-35.19)	(-39.60)	(-30.92)
mom	-0.003**				
	(-2.49)				
constant	0.128***	0.139***	0.147***	0.170***	0.130***
	(27.24)	(30.02)	(33.54)	(37.97)	(28.65)
N	103811	103988	103980	103952	103945
r2	0.031	0.033	0.042	0.061	0.037

Table 8 Panel B presents the OLS regression of our measure on small buy-and-sale imbalance from two trading days before earnings announcement to two trading days after earnings announcement (colume (1) to (5)), respectively. Big trade is defined as those with less than $5,000 for each trade. The sample spans the period 1996 to 2015 and contains about a maximum of 103,988firm-quarter observations. All variables are defined in Appendix. Statistical significance (two-sided) at the 10%, 5%, and 1% level is denoted by *, **, and ***, respectively. All continuous variables are winsorized at the 1 percent and 99 percent levels. t-statistics are in parentheses.

Table 9: Does analysts update their information more strongly and more accurately under high AQ?

	(1) WRf	(2) WNf	(3) Afa240	(4) reaction
pre_iv	-0.050***	-0.188	-0.002	-24.518***
	(-6.79)	(-1.62)	(-1.18)	(-4.41)
aq	**0.005*** **	**0.053*** **	**0.000** **	**0.473** **
	(14.73)	**(10.53)**	**(2.37)**	**(2.18)**
lnmv	-0.007***	0.153***	-0.000	4.835***
	(-5.13)	(6.24)	(-0.05)	(7.17)
rd	0.256**	5.547***	0.030	3.539
	(2.33)	(3.19)	(1.60)	(0.05)
BLev	0.016*	0.404**	0.001	-4.864
	(1.69)	(2.21)	(1.18)	(-1.04)
btm	-0.004***	-0.042**	-0.001***	-1.350***
	(-4.79)	(-2.56)	(-3.40)	(-2.88)
io	0.032***	0.595***	0.001	7.426**
	(4.24)	(4.74)	(0.73)	(2.04)
ac	0.001***	0.368***	0.000***	0.298**
	(4.32)	(69.11)	(2.74)	(2.13)
sue3	-0.185	4.838**	0.209***	597.557**
	(-1.29)	(2.27)	(3.15)	(2.17)
loss	0.003	-0.045	-0.001	-54.590***
	(1.31)	(-1.00)	(-1.12)	(-17.62)
qtr4	0.006***	-0.073**	0.002***	-27.526
	(3.72)	(-2.47)	(5.10)	(-1.33)
mom	-0.002	-0.143**	0.000	1.790
	(-0.60)	(-2.54)	(0.52)	(0.48)
Afa101m	0.079***	-1.467***	0.469***	89.189***
	(5.69)	(-4.76)	(19.33)	(3.69)
dispersion	-0.167***	-0.584*	-0.028***	-112.198***
	(-9.77)	(-1.70)	(-4.18)	(-6.29)
constant	0.202***	-3.350***	0.004	-73.568
	(6.80)	(-8.78)	(1.11)	(-1.57)
Ind FE	Yes	Yes	Yes	Yes
Qtr FE	Yes	Yes	Yes	Yes
N	44430	44524	40049	28886
adj.r-squared	0.367	0.732	0.632	0.135

t statistics in parentheses
* p<0.100, ** p<0.050, *** p<0.010

Appendix: Variable definitions

Main explanatory variables	
nchiv	zero minus change of average implied volatility from one trading day before earnings announcement date to one trading day after earnings announcement date scaled by implied voliatility one day before. The average implied volatility for a certain day is calculated as average of implied volatility in one call-put pair, then weighted by total open interest by pairs of call-put options. It measures how quickly that uncertainty resolved during earnings announcement period.
nchiv_scale1	Nchiv scaled by call-put spread_pre. It measures for each unit of information that option traders know, how much uncertainty that this quarter's earnings announcement could help to resolve.
nchiv_scale2	Nchiv scaled by analyst dispersion within 90 days before earnings announcement date. It measures for each unit of disagreement among analysts ex ante, how much uncertainty that this quarter's earnings announcement could help to resolve.
nchiv_scale3	Nchiv scaled by analyst-based earnings surprise. It measures for each unit of surprise, how much uncertainty that this quarter's earnings announcement could help to resolve.
aq, aq_scale1, aq_scale2, aq_scale3	Decile rank of nchiv,nchiv_scale2, nchiv_scale3, nchiv_scale4, for each year-quarter.

Main dependent variables	
lncham	Log one plus change in amihud liquidity measure around earnings announcement date scaled by pre-announcement amihud measure. Amihud equals 1000000*abs(ret)/abs(vol*prc)
lnchbas	Log one plus change in bid-ask spread around earnings announcement date scaled by pre-announcement bid-ask spread. bid-ask spread equals to (askhi-bidlo)/bidlo
PIN	probability of informed trading for current quarter. Data obtained from professor Stephen Brown's website
chidrisk	Change in idiosyncratic risk around earnings announcement date. Idiosyncratic risk is root-mean-square deviation of error from Fama-French four factor model.
chsigma	Change in sigma around earnings announcement date. Sigma is logistic transformed (1-R2) from Fama-French four factor model.
spread_base spread_pre	weighted average of the difference in implied volatilities between matched call and put option pairs. Use open interest to weight. And select only options with 10 to 60 days to expire and with non-zero open interest. Follows Jin et al (2012).
skew_base skew_pre	Average of difference in the implied volatility between OTM put options (delta in the range of [–0.45, –0.15], and choose the one closest to –0.3) and ATM call options (delta in the range of [0.4, 0.7] and closets to 0.5). Select only options with 10 to 60 days to expire. Follows Jin et al (2012).
opp_purchased	Indicator variable equals one if there is any purchase by oppotunistic traders after earnings announcement date. Definition of opportunistic trader follows Cohen et al (2012).

opp_saled	Indicator variable equals one if there is any sale by oppotunistic traders after earnings announcement date. Definition of opportunistic trader follows Cohen et al (2012).
routine_purchased	Indicator variable equals one if there is any purchase by routine traders after earnings announcement date. Definition of routine trader follows Cohen et al (2012).
routine_saled	Indicator variable equals one if there is any sale by routine traders after earnings announcement date. Definition of routine trader follows Cohen et al (2012).
wavg_profits	Weighted average alpha for insider trading taken during [3,12] days following earnings announcement date. Weighted by daily trading value. Alpha is intercept from Fama-French four factor model following [0,180] days for the insider trading multiplies 100. If there is net sale in one specific day, multiply alpha by -1.
imb_big	buy-and-sale imbalance for big trader(defined as those with more than 50000 trading value). Imb_big equals to (big_buy-big_sell)/((big_buy+big_sell)).
imb_small	buy-and-sale imbalance for small trader(defined as those with less than 5000 trading value). Imb_small equals to (small_buy-small_sell)/((small_buy+small_sell)).
WNf	Weighted #forecast within [2,40] days after earnings announcement. The forcast is weighted by the distance between forecast announcement date and earnings announcement date.
WRf	Weighted ratio of forecast scaled by total forecasts within [2,40] days after earnings announcement. The forcast is weighted by the distance between forecast announcement date and earnings announcement date.
Afa	analyst forecast accuracy after earnings announcement date. Equals to sum(0-abs(actual-value)/(lenghth to earnings announcement date+1))/total number of forecasts.
reaction	The relative update of analyst annual forecasts according to current quarters' earnings surprise.

Control variable	
lnmv	log marekt value.
blev	Book leverage. Calculated as (dlttq+dlcq)/atq.
btm	Total assets devided by market value. Calculated as atq/(prccq*cshoq).
io	institutional ownership.
ac	#analysts following the firm for current period.
sue3	Analyst-adjusted earnings surprise.
loss	Indicator variable equals 1 if net income for current quarter is smaller than 0.
qtr4	Indicator variable for fourth fiscal quarter.
mom	Momentum, measured as buy-and-hold raw return [-90,-2] calendar days before earnings announcement date.
rd	R&D expense scaled by average total assets. Calculated as xrdq/((atq+lag_atq)/2). For missing R&D, set it as 0.
stdret	Standard deviation of return before earnings announcement date.
roa	Return on assets. Calculated as oibdpq/lag_atq.
dispersion	Standard deviation of quarterly analyst forecast within 90 days before earnings announcement date.

avevol	Average dolloar trading volume before earnings announcement date.