Sophisticated Investors, Disclosure and the Information Environment of the Firm

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ABSTRACT

In this paper, I examine variation in inefficient call option exercise activity as a proxy for variation in the sophistication of the firm's investors. Using this new measure, I find that sophisticated information processors (investors) concentrate their trading activity in firms with increased levels of information asymmetry and decreased liquidity in firm shares. Furthermore, I find results consistent with the idea that disclosure activities that vary in the time and attention required to process attract investors with varying levels of sophistication. Thus, the potential demand for disclosure is partially driven by an investor's ability to utilize disclosed information. Specifically, I find that sophisticated information processors concentrate their trading activity in firms that issue earnings guidance on a regular basis, whereas less sophisticated investors are more prevalent in firms with increased levels of press dissemination and superior investor relations activities (e.g., better access to information on the corporate website).

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1. Introduction

The economic consequences of disclosure and information asymmetry are of primary interest in the accounting and finance literature.[1] Despite much research on this topic, we still know little about how the firm's information environment affects the investment decisions of investors with varying levels of sophistication, and varying abilities to generate private information. Understanding the behavior of investors with varying levels of sophistication is important because variation in the sophistication of firms' investor bases has implications for the liquidity of firms' shares and the ability of disclosure to reduce information asymmetry.

In this paper, I utilize variation in investor behavior in the options market to characterize the level of investor sophistication and how variation in firms' disclosure activities and information environments relate to where (less) sophisticated information processors concentrate their investments. I use the term "sophisticated" to describe investors who devote more time and attention to their investments and are more proficient in analyzing investment-related information. Differences in sophistication can arise from heterogeneity in investors' opportunity cost of time or their ability to analyze information, which in turn affects an investor's ability to extract value-relevant information from public sources. Given their advantage, sophisticated information processors are apt to learn more from public information and thus likely to become informed investors (Indjejikian [1991], Bushman et al. [1996], Fischer and Verrecchia [1999]).[2]

I examine the investment behavior of investors with varying levels of sophistication in two steps. First, I examine how the level of information asymmetry in the firm affects the asset choices of (less) sophisticated investors. Sophisticated investors prefer to trade in firms with more opaque information environments and also more uninformed (less sophisticated) trading to

[1] See, for example, Welker [1995]; Easley et al. [1996], [1997], [1998]; Leuz and Verrecchia [2000]; Frankel and Li [2004]; Brown et al. [2004], [2007]; Taylor [2009]; Lambert and Verrecchia [2010].
[2] Throughout the paper, I use the term 'sophisticated investors' to mean 'sophisticated information processors'.

increase the value of their information production. However, less sophisticated investors prefer to trade in firms with less opaque information environments and less informed trading to lower their trading costs.[3] Admati and Pfleiderer [1988] and Bhushan [1991] derive the equilibrium trading behavior when *both* types of investors behave strategically, deciding when and where to trade. I test the prediction that arises from their models: that (less) sophisticated investors concentrate their trading activity in firms with higher (lower) levels of information asymmetry and decreased (increased) liquidity in firm shares.

Second, I examine how disclosure activities with different processing requirements relate to where (less) sophisticated investors invest. Economic theory predicts that in markets with imperfect competition, publicly disclosed information has the ability to reduce information asymmetry and improve inherent liquidity (reduce adverse selection) in firm shares. However, for disclosure to be effective, less sophisticated investors must be able to process and digest the disclosed information. Otherwise, the information will serve as a complement to the sophisticated investors' current information set (Kim and Verrecchia [1994]) and will not reduce their information advantage. Therefore, I predict that disclosure activities that make information more accessible appeal to less sophisticated investors who have higher information processing costs. Conversely, I predict that disclosure that requires more time, attention, or ability to process and digest caters to more sophisticated investors. As a result, these disclosure activities may fail to reduce information gaps. To test this prediction, I examine the relation between the sophistication of the firm's investors and disclosure activities that vary in the time, attention, and ability required to utilize them: press-dissemination, management forecast activity, and superior

[3] Less sophisticated investors are not necessarily naïve and are sophisticated enough to strategically choose where to trade. If less sophisticated investors are such because they devote less time and attention to their investments, then they can behave strategically with respect to their disadvantage: choosing to invest in larger, less volatile firms, where information is more accessible.

investor relations (IR) performance. To my knowledge, this paper is the first to attempt to relate the sophistication of investors to different types of disclosure activities.

To examine these relations, I develop a new proxy to measure the presence of sophisticated investors in the firm's options. The proxy is based on inefficient call option exercise activity that results in forgone profit. Specifically, I focus on instances in which investors fail to exercise an American call option on the last cum day, when the dividend amount exceeds the expected time value of the option. The proxy equals the percent of call option contracts that remain open going into an ex-dividend day, when exercise on the last cum day is optimal, for a given firm-dividend event.[4] The measure compares the relative presence of sophisticated investors across firms, and lower values imply a higher percent of sophisticated investors (invested dollars) in the firm's options.

Focusing on investor activity in the options market has several advantages. First, this approach enables researchers to observe investor activity in a way that is more likely to be directly related to the sophistication of the firm's investors. The logic is as follows: sophisticated investors devote more time and attention to their investments and are more capable of analyzing investment-related information. Therefore, they are less likely to forgo any profit that results from early exercise, thus exercising their options efficiently. Hence, variation in this measure is directly related to disparities in sophistication among options investors. Second, if investors trade call options and individual stocks for similar reasons, then the same economic forces that affect investor behavior in the equity market (with respect to potential information asymmetries) affect investors in the options market. Therefore, examining investor behavior in the options market helps us understand the information and trading environments (less) sophisticated investors

[4] I discuss the measure, its assumptions, and the potential advantages and disadvantages of focusing on investor activity in the options market in greater detail in Sections 2 and 3 and in a technical appendix (A2).

prefer. Third, it is easier to infer how disclosure affects investor behavior within the options market, to the extent that investor activity in the options market does not directly motivate managers' decisions. Managers' disclosure activities are not likely to specifically target investors in the options market because managers consider many factors when choosing their disclosure policy and exchange-traded options are not issued by the firm. Therefore, any observed relations are more likely to arise from investors reacting to the firm's disclosures activities.

As predicted, I find that the concentration of sophisticated investors is larger in firms with higher levels of information asymmetry, as measured by higher levels of PIN,[5] lower market capitalization, and higher return volatility and market-to-book ratios. I also find a higher concentration of less sophisticated investors in firms with increased liquidity in firm shares, as measured by higher share turnover and inclusion in the Dow Jones Industrial Index, where information is more widely disseminated and more uninformed trading occurs.[6]

I find additional evidence to support the idea that sophisticated investors prefer to trade in firms with higher levels of information asymmetry and decreased liquidity, by examining the relation between the option-based proxy and different types of institutional ownership, as defined by Bushee [2001]. Transient institutions prefer to trade in firms with lower levels of adverse selection and increased liquidity, to minimize their trading costs (Bushee and Noe [2000]). Conversely, Quasi-Index institutional investors are less likely to be concerned with the trading costs associated with decreased liquidity and adverse selection because they hold a diversified portfolio of firms and trade infrequently (Amihud and Mendelson [1986], Anginer [2010]).

[5] I discuss why the option-based proxy is more effective than PIN (the probability of informed trade) in detecting the presence of sophisticated investors in Section 2.

[6] The level of bid-ask spreads is another popular proxy for the level of adverse selection in the firm. However, since spreads are also correlated with the cross-sectional variation in profit from early exercise, the relation between spreads and the option-based proxy is harder to interpret. I discuss spreads in more detail in Section 3 and Appendix A2.

Consistent with these arguments, I find sophisticated investors are more prevalent in firms in which Quasi-Index institutional investors invest more. On the other hand, less sophisticated investors concentrate their activity in firms where Transient institutional ownership is higher. Taken together, these results (1) help establish that the option-based proxy detects the presence of sophisticated investors and (2) provide new evidence on the relation between information asymmetry and the trading behavior of (less) sophisticated investors.

When examining the relation between investor sophistication and disclosure activities that vary in their processing requirements, I predict disclosure activities that reduce information processing costs and increase the accessibility of information, attract less sophisticated investors. Press dissemination is hypothesized to reduce information processing costs (Soltes [2009]) and information asymmetry (Bushee et al. [2010]). Consistent with this idea, I find the concentration of less sophisticated investors is higher in firms with increased levels of press dissemination. Moving from the 25th to the 75th percentile in news dissemination increases the option-based proxy by 5% of the average value. IR activities are also designed to reduce information processing costs (Brennan and Tamarowski [2000]) and make information more accessible to investors. As such, I find that firms with superior IR performance, as measured by the overall (Grand-Prix) IR score issued by IR Magazine, also have a higher concentration of less sophisticated investors. The average value of the option-based proxy in firms ranked in the top 10 (20) by IR Magazine in a given year is higher by approximately 15% (10%) of the average value, compared to other firms in the sample.

Conversely, management forecasts provide investors with information which requires more time and attention to process and therefore may cater to more sophisticated investors. I find the concentration of sophisticated investors is higher in firms that issue earnings guidance on a

regular basis. The average value of the option-based proxy for issuing firms is lower by 6.1% of the average value in the sample, compared to non-issuing firms. I also find that among issuing firms, the concentration of sophisticated investors is higher in firms that issue more accurate forecasts. This evidence further suggests earnings guidance is geared toward more sophisticated investors and that they prefer to trade where forecasts are more valuable to them. Taken together, these results demonstrate how disclosure activities that vary in the time and resources required to process and digest appeal to investors with varying levels of sophistication.

This paper contributes to the literature in several ways. First, I develop a new empirical approach to measure variation in the sophistication of the firm's investors based on observable investment activity in the options market. Second, I provide empirical evidence on the relation between the firm's information and trading environment and the investment decisions of (less) sophisticated investors. To my knowledge, this is the first paper to provide direct empirical evidence on the theoretical link between the firm's information environment and the investment behavior of relatively more and less informed investors. Third, the matching between investors and disclosure activities these results demonstrate, suggests that the demand for information varies across investor bases and disclosure activities and is partially driven by an investor's ability to utilize disclosed information. Finally, prior research on the relation between disclosure and the firm's investor base has mainly focused on the link between disclosure and variations in institutional holdings across firms (Bushee and Noe [2000], Bushee, Matsumoto, and Miller [2003], Jung [2010]). Although understanding the behavior of institutional investors is important, investor sophistication is not limited to institutions, and institutional ownership is not a direct proxy for investor sophistication.[7] This study augments this line of research by examining the

[7] Institutional investors face additional considerations that affect their trading behavior (e.g., fiduciary responsibilities and liquidity needs), which are unrelated to their level of sophistication (Bushee and Noe [2000],

relation between the sophistication of investors and the disclosure activities of the firm, using a new approach that is more likely to detect variation in sophistication across investors, as well as variation in sophistication among institutional and retail investors.[8]

The setting I examine in this paper is not without limitations. First, the analysis is limited to firms that pay dividends and have exchange-traded call options, which limits the empirical tests to a subset of larger firms. This likely further limits the variation in information environments. Thus, the results may understate the effect of disclosure and the firm's information environment on investment behavior. Second, the analysis focuses on investment behavior in the options market, and the ability to generalize the results to the behavior of equity investors depends on how representative option investors are. Prior research in finance presents evidence which shows that the investments made in these two markets are linked (e.g., Ang et al. [2010]), but some systematic differences between option and equity investors may still exist. Third, as the key constructs of interest are not likely to change significantly from period to period, the empirical predictions and resulting tests are primarily cross-sectional. Thus, there is the concern that unobserved or omitted factors drive the relation between the sophistication of the investor base and the firm's disclosure activities. However, I find that the associations between the option-based proxy and the specific disclosure activities differ in sign, despite the fact that the disclosure activities are positively correlated (e.g., firms with increased press dissemination are more likely to issue guidance). This result alleviates this concern to some degree.

Bushee [2004], Bushee and Goodman [2007]). Furthermore, institutional investors vary in their level of sophistication and prior research has shown that retail investors vary in their level of sophistication as well (Grinblatt and Keloharju [2000], Coval et al. [2005], Grinblatt et al. [2009]).

[8] Consequently, I find similar disclosure-related results (untabulated) if I control for the different types of institutional ownership as opposed to the overall level of institutional ownership in the firm.

The paper proceeds as follows: Section 2 defines the option-based proxy and discusses the hypothesis development and research design. Section 3 discusses identification issues related to the option-based analysis. Section 4 presents the sample and results. Section 5 concludes.

2. Hypothesis Development and Research Design

2.1. Measuring the presence of sophisticated information processors

Exercising an American call option prior to maturity is optimal when the option is in the money, the underlying stock pays a dividend, and the expected time value of the option on the last cum day is less than the expected drop in stock price, which equals the dividend per share (Hao et al. [2009], Pool et al. [2008]).[9] Exercising the option on the last cum date is optimal in this case because the cost of early exercise (the forgone time value) is lower than the benefit of early exercise (receiving the dividend). When a buyer fails to exercise an option in this scenario, he forfeits a profit equal to the difference between the dividend amount and time value of the option, to the writer (seller) of the option.

Sophisticated information processors (sophisticated investors) spend more resources (e.g., time and attention) following their investments and are more capable of analyzing investment-related information. Therefore, they are more likely to determine if early exercise is optimal and exercise their options efficiently, in order to retain the profit. Conversely, less sophisticated information processors (investors) devote less time and attention to their investments and are less proficient in analyzing investment-related information. Hence they face higher information processing costs and are less likely to make efficient exercise decisions, forgoing the profit. However, their behavior is not irrational. It results from information processing frictions (Bloomfield [2002], Hirshleifer et al. [2003]). Less sophisticated investors

[9] The expected drop in stock price equals the tax adjusted value of the dividend as perceived by the marginal investor. However in practice it is common to estimate this amount via the actual dividend amount per share (see the discussion in the appendix and Hao et al. [2009] and Pool et al. [2008]).

find tracking their investments in detail too costly due to their time constraints or limited ability to analyze information. Furthermore, these frictions do not inhibit them from rationally taking their disadvantage into account.

I develop a new proxy to measure the relative presence of sophisticated investors in the firm's options based on inefficient exercise activity. Ceteris paribus, the lower the percent of unexercised contracts, the higher the proportion of sophisticated investors (invested dollars) in the firm's options. Following this logic, the proposed measure equals the average percent of contracts that remain open across all option series in which exercise is optimal, for a given firm-dividend event (weighted by the prior level of open interest):

$$(\%)\ Open\ Interest_j = \frac{\sum_i \text{open interest going into the ex day}_{ij}}{\sum_i \text{open interest going into the last cum day}_{ij}} \quad \text{for all relevant}$$

option series *i* in each firm-dividend event *j*. Lower values of the measure imply a higher concentration of sophisticated investors. I discuss the measure construction and profit computation in further detail in Appendix A2.

2.2 The trading behavior of sophisticated information processors and less sophisticated uninformed investors

Admati and Pfleiderer [1988] describe the equilibrium trading behavior of informed and uniformed traders when *both* types of investors trade strategically. They introduce the concept of discretionary liquidity traders, who do not have private information but strategically choose when to trade. They conclude that these investors concentrate their trading activity during specific periods, in an effort to lower their trading costs. Such trading costs result from trading with more informed investors. Bhushan [1991] extends this logic to a multi-asset setting to

describe the types of information environments (assets) strategic liquidity traders prefer. In his model, strategic liquidity traders migrate to assets with lower levels of information asymmetry, where informed investors have less of an advantage and trading costs are minimized.[10]

Informed traders may either be endowed with private information (e.g., as an insider/owner) or actively engage in information production, choosing to become informed in certain assets. Ceteris paribus, informed investors prefer to trade in firms with more opaque information environments and more uninformed trading, to increase the value of their information production. Because uninformed investors prefer to trade in firms with less opaque information environments, where informed investors have less of an advantage, informed traders face an inherent trade-off when attempting to trade in firms with more uninformed traders. They must trade-off the marginal benefit of trading in firms where there are more uninformed investors, with the marginal cost of becoming informed in firms where the value of their information production is lower, and their information advantage is reduced. In the face of this friction, informed traders will not increase their trading activity proportionally to the trading of uninformed traders. Therefore, the concentration of uninformed traders will be higher in firms that have lower levels of information asymmetry.[11]

Sophisticated investors are more likely to become informed because they have superior information processing abilities and thus learn more from public information (Indjejikian [1991], Bushman et al. [1996]), Fischer and Verrecchia [1999]). Therefore, sophisticated investors are predicted to behave like informed investors, while less sophisticated investors are predicted to behave like uninformed investors.

[10] O'Hara [2003] describes a similar setting with similar outcomes.
[11] Although not discussed specifically here, this concentration could also arise if informed investors are strategic about where they choose to become informed, whereas uninformed investors are essentially noise traders distributed evenly across firms. However, this scenario would change the prediction with respect to trading volume I discuss later.

Hence my first prediction is

H1: Sophisticated investors are relatively more prevalent in firm shares with higher levels of information asymmetry and adverse selection (less liquid trading environments).

In imperfect markets, the level of information asymmetry affects the trading environment of firm shares, which in turn affects liquidity levels. In equilibrium, the concentration of sophisticated investors will be higher in less liquid firms with increased levels of information asymmetry. This test is a joint hypothesis test that establishes whether the option-based proxy detects the presence of sophisticated investors, and whether the trading of (less) sophisticated investors varies with the firm's information environment.

To test H1, I begin by examining the relation between the option-based proxy and the probability of informed trade (PIN). Because PIN is positively correlated with the level of information asymmetry in the firm, I predict the presence of sophisticated investors to be higher in firms where PIN is higher.[12] Recent literature highlights various issues related to estimating PIN and its underlying construct validity, including Spiegel and Wang [2005], who suggest PIN captures a stock's liquidity characteristics (see Mohanram and Rajgopal [2009] for a brief discussion). [13] I examine the relation between the proxy and PIN, because PIN captures characteristics related to the firm's information and trading environment. However, this discussion highlights why PIN does not proxy for the presence of sophisticated investors directly and is less effective in detecting the presence of sophisticated investors.

[12] I use the PIN measures based on the sample used in Brown et al. [2007]. I am grateful to Professor Stephen Brown for providing me access to this data.

[13] Furthermore, PIN measures the presence of informed trading by estimating the daily buy and sell order imbalance. Thus, PIN may detect forms of informed trading that are unrelated to the presence of sophisticated information processors, such as insider trading driven by private information generated within the firm (e.g., around an M&A event).

Next, I examine the relation between the sophistication of the firm's investors and two sets of variables that proxy for the level of information asymmetry in the firm. The first set includes firm-level characteristics past research has found to be associated with the level of information asymmetry in the firm, including firm size, analyst following, analyst forecast dispersion, and the ratio of the market value of assets to the book value of assets (Frankel and Li [2004], Roulstone [2003], Brown et al [2007]). Brown et al. [2007] also find that leverage is negatively associated with PIN. They attribute this relation to the increased use of debt financing by firms with more certain asset values, consistent with the pecking-order hypothesis. Thus, I include leverage as an additional variable in alternative specifications.

The second set of variables relates to the trading environment of the firm, which is associated with the level of information asymmetry in the firm. These variables include share turnover, inclusion in the Dow Jones Industrial Index, the percent of shares not held by insiders (free-float), share-price volatility, and bid-ask spreads. Prior research argues that firms with reduced levels of information asymmetry have higher share turnover, lower share-price volatility, higher levels of free float, and lower bid-ask spreads (Lang and Lundholm [1993], Leuz and Verrecchia [2000]). However, because high spread levels may result in incremental transaction costs associated with early exercise, the cross-sectional variation in spreads may also be correlated with the cross-sectional variation in profit from early exercise. Thus, interpreting the relation between the option-based proxy and spreads with respect to the level of information asymmetry in the firm is difficult.[14] Information about firms included in the Dow Jones

[14] A sophisticated investor needs to pay half of the spread in the stock when exercising an option. In cases in which the spread is relatively high on the last cum date, an investor may expect spreads to be lower at the option expiry date, and perceive the spread as an incremental cost even though he will have to pay the spread at expiry. Therefore, he may be willing to wait to exercise his option at expiry, when spreads could go down. In this case, higher spreads will result in higher incremental transaction costs and will result in a positive association between spreads and the option-based proxy (see Appendix A2 for further discussion). Under this scenario, the spread serves as an additional control variable for the cross-sectional variation in profit from early exercise

Industrial Index is more widely disseminated, and these firms experience increased levels of uninformed trading (e.g., as a result of portfolio rebalancing by index funds). Therefore, I expect the proportion of unsophisticated investors to be higher in these firms' shares.

As a final step, I examine the relation between the sophistication of the firm's investors and the percent of institutional ownership across the three categories defined by Bushee [2001] and Bushee and Noe [2000]. Bushee and Noe find that Transient institutions trade frequently and prefer to trade in firms in which the price impact of their trades is lower (e.g., firms with higher share turnover). Therefore, Transient institutional investors likely invest in firms with increased liquidity (reduced adverse selection). As a result, I expect to find a negative association between their holdings and the proportion of sophisticated investors in the firm. Conversely, Quasi-Index institutional investors hold a diversified portfolio of firms and trade infrequently. Thus they are less likely to be concerned with adverse selection-related trading costs (Amihud and Mendelson [1986], Anginer [2010]). As a result, they may hold more assets in firms in which sophisticated investors trade, resulting in a positive association between the percent of shares these institutions hold and the proportion of sophisticated investors in the firm. However, if Quasi-Index institutional investors are equally diversified across assets then there will be no relation between their holdings and the sophistication of the firm's investors.[15]

To test H1, I estimate the following linear model:

$$(1)\quad \ln(1+\%(Open\ Interest))_{it} = \alpha + \beta * Ia_{it} + \delta * Liq_{it} + \phi * Controls_{it} + Year / Ind\ effects_{t} + \varepsilon_{it}.$$

$\%(Open\ Iterest)_{it}$ is the option-based proxy defined in section 2.1. *Ia* is the vector of variables that proxy for the level of information asymmetry in the firm. *Liq* represents the variables that proxy for the trading environment and the percent of institutional ownership as

[15] I have no explicit predictions with respect to the proportion of dedicated institutions, which hold large stakes in a small number of underperforming firms.

defined by Bushee [2001]. C*ontrols* relate to the proxy and include the dividend amount, which controls for the cross-sectional variation in (gross) profit from early exercise (see Appendix A2 for further discussion). Finally, I include year and industry effects.[16] All variables are defined in detail in Appendix A1.

2.2 Disclosure and the sophistication of the firm's investors

Prior research argues that improved disclosure reduces the level of information asymmetry between informed and uninformed investors. However, the effectiveness of disclosure in achieving this goal will depend on the underlying reason some investors are more informed. Fischer and Verrecchia [1999] analyze a model where sophisticated investors learn more from public information because of their superior processing capabilities. Bushman et al. [1996] describe a similar setting in which sophisticated investors learn more from financial reports, due to lower information processing costs.[17] Finally, Kim and Verrecchia [1994] highlight how public information can serve as a complement to a sophisticated investor's private information, thus increasing the information gap between informed and uninformed investors. They discuss a setting in which the increase in information asymmetry is temporary, until the new information is impounded into prices. However, the economic idea that some investors learn more from certain disclosure activities could apply more generally, especially when the information gap between investors results from processing frictions and disclosure activities differ in the resources required to process them (Bloomfield [2002], Hirshleifer et al. [2003]).[18]

[16] I define an industry using the Fama-French 12 industry definition. I do not use the Fama-French 49 industry definition in my primary analysis because I have a limited number of observations in many of the industries defined using this approach. The Fama-French 12 industry definition is also more likely to be associated with the "type" of industry categories investors consider when choosing in which assets to invest.

[17] Indjejikian [1991] also models a setting in which investors vary in their levels of sophistication and hence in their abilities to extract information from firm disclosures.

[18] Bloomfield [2002] argues that less sophisticated investors are likely to overlook data that are harder to interpret and require more resources (e.g., time and attention) to assimilate, due to the cognitive difficulty of extracting

Managers engage in various disclosure activities in an effort to communicate information to investors. Because different disclosure activities vary in the time, attention or ability required to extract value-relevant information, I predict that they cater to different investor types. I predict that disclosure activities that make information more accessible and easier to process benefit less sophisticated investors relatively more. On the other hand, disclosure activities that require more time, attention or ability to utilize should appeal to more sophisticated information processors. To test this hypothesis, I explore the relation between the sophistication of the firm's investors and three separate disclosure activities that likely vary in the time and attention required to extract value-relevant information: press-dissemination, earnings guidance, and IR activities.

For each disclosure activity, I estimate the following linear model:

$$(2)\ \ln(1+\%(Open\ Interest))_{it} = \alpha + \beta * Disclosure_{it} + \gamma * Firm\ characteristics_{it} + \delta * Firm\ performace_{it} + \phi * Controls_{it} + Year / Ind\ effects_{t} + \varepsilon_{it}.$$

$Disclosure_{it}$ is the proxy for the disclosure activity I analyze. I include control variables for firm characteristics associated with the relevant level of disclosure and for cross-sectional differences in firm performance. Finally, I include the measure-related control variables discussed in Appendix A2. All of the variables are defined in detail in Appendix A1.

2.2.1 Press Dissemination

One of the press's roles is to disseminate or rebroadcast firm-specific information so more investors are able to assimilate it (Huberman and Regev [2001], Bushee et al [2010], and Soltes [2009]). The press is likely to provide investors with information in a concise and synthesized manner that is relatively easy to assimilate. Therefore, increased levels of

information from such data. Hirshleifer et al. [2003] argue that if time and attention is costly to allocate, investors will be inattentive to certain disclosures.

dissemination should appeal to less sophisticated investors. Prior literature finds several results consistent with this notion. Soltes [2009] hypothesizes that increased dissemination reduces information processing costs and finds that dissemination increases the liquidity of a firm's shares. Bushee et al. [2010] find that press coverage lowers information asymmetry around earnings releases, predominantly due to the dissemination role of the press.

I am interested in examining the relation between different disclosure activities and the investor base of the firm. Therefore, I focus on the dissemination role the press serves, because I view the dissemination of firm-initiated news as an activity managers have the ability to influence (e.g., via IR-related activities [Bushee and Miller [2007], Solomon [2009]).

I test the following hypothesis:

H2: A positive association exists between the level of news dissemination and the relative proportion of less sophisticated investors trading in the firm.

In this model, the disclosure proxy is the newswire-based dissemination measure used in Soltes [2009];[19] which equals the average number of newswire articles released following a firm-initiated news release, measured over a given year. Since the Newswire dissemination proxy is a yearly measure, I assign each firm-dividend observation in my sample a value as of the year of the observation, where available. Firms with multiple observations in a given year receive the same value throughout the year. I obtain data for 2,741 observations during 2001–2006, which is approximately 50% of my sample during the same period. In untabulated results, I find the distribution of variables in this sub-sample is similar to the distribution of the overall sample. The main difference is that the firms in this specification are smaller due to the size restriction Soltes's [2009] imposes on his data. A value of $\beta > 0$ is consistent with H2.

[19] Soltes's sample is available for a sub-set of firms for the period 2001–2006, due to the industry and size restrictions he imposes, as well as the need to identify FACTIVA codes and contact identifiers. I am extremely grateful to Eugene Soltes for providing me with the relevant data to test this hypothesis.

2.2.2 Management forecast activity

Forecasts provide value-relevant information to equity investors (Anilowski et al. [2007], Miller [2009], Milian [2010], Beyer et al. [2010]).[20] If earnings forecasts provide value-relevant information to all investors, they should reduce the information advantage of sophisticated investors and cater to less sophisticated investors (Coller and Yohn [1997], Rogers [2008]). However, management forecasts require relatively more time, attention and ability to process, and hence may be more valuable to sophisticated investors. For example, an EPS forecast provides information about a firm's current performance when compared to prior expectations, and information about the firm's future performance and value when incorporated into a valuation model. Hence, sophisticated investors may be more proficient in utilizing the information provided via a forecast. Consistent with this idea, Malmendier and Shanthikumar [2009] find that small (less sophisticated) traders react to analyst recommendation updates but not to forecast updates, whereas large (more sophisticated) traders react to both.[21] Finally, forecasts differ in their precision due to their accuracy, which is another dimension investors need to consider.[22] Therefore, management forecasts may serve as a complement to a sophisticated investor's current information set (Kim and Verrecchia [1994]) and it is possible that sophisticated investors find management forecasts most beneficial. To test this idea, I propose the following unsigned hypothesis:

[20] Furthermore, forecasts can be issued for a variety of additional reasons including (1) aligning the market's expectation with that of the manager (Ajinkya and Gift [1984], King, Pownall and Waymire [1990]); 2) informing analysts (Hutton [2005], Cotter et al. [2006]); 3) reducing expected litigation costs by providing forthcoming disclosure about negative performance (Skinner [1994]); and 4) affecting insider trading profits (Rogers and Stocken [2005], Rogers [2008]).

[21] Mikhail, Walther and Willis [2007] find similar evidence related to the differential responses of small and large investors to analyst recommendations and forecast revisions.

[22] Consistent with this notion, Rogers et al. [2009] find that forecasting firms experience increased uncertainty in the short run following forecast issuance, although this effect is more pronounced for bad news and sporadic forecast issuance. Botosan and Plumlee [2002] find that the cost of capital increases with more timely disclosures.

H3a1: If earnings guidance caters to less sophisticated investors then, on average, the proportion of sophisticated investors will be lower in firms that issue guidance.

H3a2: If earnings guidance caters to sophisticated investors then, on average, the proportion of sophisticated investors will be higher in firms that issue guidance.

Forecast accuracy can affect the precision of the signal a forecast provides (Hirst et al. [1999], King, Pownall, and Waymire [1990], Ng, Tuna and Verdi [2008]). The predicted relation between forecast accuracy and investor sophistication depends on who forecasts cater to. If management forecasts cater to more sophisticated investors, they will concentrate their trading activity in firms that issue more accurate forecasts, whereas less sophisticated investors fail to distinguish between issuing firms. However, if management forecasts cater to less sophisticated investors then sophisticated investors have an advantage in firms that issue less accurate forecasts. In this case, less sophisticated investors would prefer firms that issue more accurate forecasts. To test this idea, I propose the following hypothesis in the null form:

H3b: No association will exist between the accuracy of management forecasts and the proportion of sophisticated investors in the firm.

When testing H3a, the disclosure proxy equals $forcasting\ \ firm_{it}$, which is an indicator variable that equals one if the firm issues at least four annual or quarterly, point or range, EPS forecasts in the year prior to the date of the observation (the last cum date), and zero otherwise. I require the firm to issue at least four forecasts because I want the forecasting activity to be an ongoing disclosure activity in the firm.[23] A coefficient of $\beta < 0$ ($\beta > 0$) implies that, on average, more (less) sophisticated investors are in firms that issue regular guidance.

[23] This definition is similar to the one used in Rogers et al. [2009] who define a forecast as a "regular" forecast if the firm issues at least three forecasts in the four quarters prior to the forecast in question being issued. My control variables are based on Brown et al. [2005] and the results in Skinner [1994] and Kothari et al. [2009].

To test H3b, I use a similar linear model in which the disclosure proxy is defined as $forecast\ accuracy_{it}$, which equals -1 times the median (average) forecast error for each firm-dividend event for all of the forecasts issued over the year prior to the last cum date. Following Ng (2008), I compute each forecast error as $FE = |forecast - actual\_value| / |forecast|$ and, to avoid scaling by extremely low values, exclude observations in which the absolute value of the forecasted EPS is less than $0.10. I multiply the median (average) forecast error by -1 so that larger values imply more accurate forecasts. I estimate this model for all observations in which at least four forecasts were issued during the prior year. A coefficient of $\beta < 0$ ($\beta > 0$) implies that, on average, more (less) sophisticated investors invest in firms that issue more accurate forecasts.

2.2.3 Investor relations activity

Prior to Regulation Fair Disclosure (Reg-FD), one of the primary roles of an IR department was to provide analysts with timely and accurate information to reduce their information processing costs (Brennan and Tamarowski [2000]).[24] However, the implementation of Reg-FD, combined with the technological advances in communication channels, now provides IR activities with the ability to lower information processing costs for a wider range of investors (Deller et al. [1999]). Another potential role of IR activities is to target certain investor types in an effort to diversify the investor base. Although targeting is mainly concentrated on long-term institutional investors, the firm also makes efforts to attract individual investors by increasing firm visibility and providing investors with value-relevant information (Byrd et al. [1993], Bushee and Miller [2007]).

[24] Hong and Huang [2005] describe a similar benefit, which arises from the manager's desire to increase the liquidity of the firm's block shares.

A common theme across these two roles is that effective IR activities are designed to make information more accessible, in order to lower information processing costs. Therefore, effective IR activities are likely to cater to less sophisticated investors in the firm.

Therefore, I propose the following hypothesis:

H4: A positive association exists between the level of IR activities and the proportion of less sophisticated investors in the firm.

To test this hypothesis, I examine the relation between the sophistication of the firm's investors and the overall IR score published by IR Magazine during 2002–2007.[25] The overall IR score is a composite score IR Magazine assigns to a firm, based on annual surveys issued to both buy-side and sell-side investment professionals. The composite score is based on nominations in categories such as use of technology, conferencing, and the annual report. The benefit of the composite score is that it has the potential to measure the overall accessibility and clarity of the information the firm provides. For example, some of the top-rated firms in 2002 received the following feedback:

(1) *"Coach's earnings results are always presented in a well organized clear format and the company strives to always best explain the drivers behind past results."*

(2) *"Yum is the most user-friendly of any company I have dealt with.…when they don't have the answer, they look for it and if they can't find it, they help you build a reasonable estimate."*

When testing H4, the disclosure proxy equals IR rank, which is estimated using two approaches. First, I create an indicator variable, top 10 (top 20), which equals 1 if the firm has an IR department rated among the top 10 (20) departments during the year, and zero otherwise. To incorporate the fact that IR Magazine distinguishes between firms of different sizes, and that larger firms tend to score higher than smaller firms, I adjust the scores reported by IR magazine

[25] I am extremely grateful to Karl Lins for providing me access to this data set.

by subtracting the average score within each of the four size groups defined by IR Magazine, in a given year. I then use the size adjusted scores to rank the firms in my sample. I further assume that if IR magazine does not rate a firm, then that firm would not have been rated among the top 10 (20). Therefore, I assign non-rated firm years a value of zero. The advantage of this approach is that it allows me to use all of the firm-dividend events present in my sample, during 2002–2007, thus maximizing my potential sample size.[26] Second, I create an indicator variable top 10 group (top 20 group) that takes the value of one if the firm's IR department is ranked among the top 10 (20) IR departments in any of the four size groups reported by IR magazine.

3. Identification of Sophistication in the Options Market

My research design, which focuses on the options market, has several advantages and disadvantages. First, the option-based proxy allows a researcher to observe investor behavior in a way that is more likely to be directly related to the sophistication of the firm's investors. Thus, if variation exists in the level of sophistication among non-institutional and institutional investors, this measure has the potential to identify the variation *within* each group as well.[27] Second, the options market offers an attractive setting in which to examine how different disclosure activities relate to investor sophistication. If investors trade options and individual stocks for similar reasons, then potential information asymmetries in the firm also affect call option investors. However, firms' disclosure activities most likely do not specifically target investors in the options market, because managers consider many factors when choosing their disclosure policy and firms do not issue exchange-traded options. Furthermore, firms' disclosure activities (or

[26] In untabulated results, I define the top 10 (20) variable using the raw (unadjusted) scores reported by IR Magazine. I reach the same inferences using this alternative definition, and the resulting coefficients and t-stats are very similar to those reported in Table 6.

[27] For example, sophisticated hedge funds that have derivative desks are likely to exercise their options optimally and will be identified as sophisticated information processors (investors) in this setting. However, less sophisticated pension funds that use options as stock replacement instruments are less likely to exercise their options optimally due to their lack of sophistication.

differences therein) are not relevant for investors' exercise activities as they do not provide inputs for the exercise decision that could not be easily obtained elsewhere. Both of these observations make it more likely that a relation between the option-based proxy and firms' disclosure policies arise from investors reacting to firms' disclosures activities, thus alleviating concerns about reverse causality.

However, the approach I use in this paper also has several disadvantages. First, the measure can identify only investors in firms that pay dividends and have exchange-traded call options that require early exercise on the last cum day. This limitation restricts the empirical tests to a subset of larger firms, which further restricts the variation in information environments (opaqueness). Therefore, the sample selection likely biases against finding disclosure-(information-) related results and the potential findings are likely to be understated compared to the general population of firms.

Second, the cross-sectional nature of the empirical tests raises the potential concern that the relation between the proportion of contracts left unexercised and the disclosure activities of the firm results from an alternative reason. Because the underlying construct is unlikely to change significantly from period to period, and the disclosure activities I examine are relatively stable throughout the period, my ability to address this concern, for example with firm fixed-effects regressions, is limited. As a result, any analysis focused on changes would have to focus on exogenous shifts in the information environment or disclosure policy of the firm, which are difficult to identify. That said, I find several results which help alleviate this concern. First, I find that the associations between the option-based proxy and the specific disclosure activities differ in sign, despite the fact that the disclosure activities are positively correlated (e.g., firms with increased newswire dissemination are also more likely to issue earnings guidance). Second, I

examine the effect of disclosure on the investment decisions of investors with varying levels of sophistication in sub-samples where disclosure activities that benefit less sophisticated investors are predicted to have a larger impact (untabulated). I find that the disclosure activities that are predicted to benefit less sophisticated investors relatively more, have a stronger (positive) relation with the option-based proxy in firms that that have higher MTB ratios, where a larger portion of the firm's value is attributed to intangible assets and growth opportunities. I also find a stronger (positive) relation in firms with higher earnings volatility levels, which are likely experiencing significant changes in their economic activity and operating performance. [28] Taken together, these results make it less likely that a single omitted factor that is related to both investor sophistication and the firm's disclosure activities is responsible for the documented relations.

A separate concern is that investors in call options are all fairly sophisticated resulting in limited variation in the sophistication of investors present in the sample. A recent paper by Lakonishok et al. [2007] documents the types of investors that hold call options during 1990–2001, using a proprietary database. Table 1 of their paper shows that the options market attracts different types of investors. Investors in call options include customers who trade through full-service brokers (e.g., Merrill Lynch and Morgan Stanley), financial institutions that trade on their own account (e.g., investment banks' proprietary trading), and investors trading through discount brokers (e.g., E-trade), which prior research has assumed to be retail trading.[29] This evidence highlights that meaningful variation in sophistication is likely to exist within the options market.

[28] See section 4.4 for further discussion.
[29] This group represents ~ 80% of institutional proprietary holdings. Further anecdotal evidence provided by an interview with an academic consultant for derivative markets suggests the presence of retail investors in the options market has likely increased since this period due to the increase in online brokerage activity.

Finally, some investors may be sophisticated equity investors but less sophisticated derivative investors. For example, in an institutional setting, this scenario can occur if a sophisticated institution lacks a derivative desk (derivative knowledge) but still engages in options activity. Based on my conversations with broker-dealers, this situation is unlikely to occur in large investment banks and most hedge funds. However, some investment houses will lack an active derivative desk even though they occasionally trade options, and may be sophisticated equity investors who are less sophisticated options investors. In a retail setting, this situation could arise if individual investors trade options without learning about ex-dividend events, even though they devote significant time and resources to follow other market-related activity. In these cases, the measure will not identify the sophistication of the investor base with respect to the other elements of the firm's information (disclosure) environment correctly; likely making it harder to detect the link between investor sophistication and the firm's information environment.

4. Sample Selection and Results

4.1 Sample selection

To create my sample, I begin by collecting information for all of the cash dividend payments made by firms listed in the U.S. (common share code 10, 11 on CRSP) between 1996 and 2007. This collection results in a sample of approximately 2,500 firms and 66,000 dividend events. I begin my sample in 1996 because the Option Metrics database, which I use to obtain the option-related data, begins its coverage in 1996. I then gather information on all of the outstanding call options available in the Option Metrics database for each dividend payment. Data on traded call options is available for approximately half of the dividend events (firms) in the sample. From this set of options, I retain all of the options that are in the money, have

positive open interest at the open of the last cum date, and experience a decline in open interest during the last cum date. I require at least some investors to unwind their positions during the last cum date so my identification of options where exercise is optimal is more likely to be aligned with that of the market. These requirements further reduce my sample to approximately 1,100 firms and 16,500 dividend events. Finally, I compute the profit from early exercise and retain all of the options in which at least 50 contracts are open on the last cum date, and the profit from early exercise is at least $5.00 per contract. My final sample includes 22,712 options that allow me to compute the option-based measure for 7,860 firm-dividend events across 756 firms (Table 1). The final sample represents investments of approximately $133 billion in underlying equity (notional amounts) over the period.

The overall reduction in sample size highlighted by Panel A is unavoidable due to the data requirements related to the computation of the option-based proxy. A majority of the reduction in sample size arises from two sources: (1) the requirement that the firm have exchange-traded call options and (2) the fact that only some outstanding call options are in the money, have positive open interest on the last cum date, and require early exercise. Panel B further highlights that the number of observations increases over time due to the general increase in option market activity over the same period. As a result, I include year effects to control for a potential time trend in the data. Panel C presents the characteristics of the options included in the final sample. Options in which early exercise is optimal are characterized by the fact that they are deep in the money and have a relatively short remaining horizon. The mean (median) profit from early exercise in the final sample is $24.50 ($17.20) per contract. In the empirical analysis, I use a log transformation of the measure equal to $\ln(1+\%(Open\ Interest_j))$. The transformed measure has a mean (median) value of 0.28 (0.25), where lower values represent a higher

concentration of sophisticated investors. I discuss the details on the profit computation and measure construction in Appendix A2.

Table 2 (Panel A) reports descriptive statistics for all of the variables, including the measure. As expected, focusing on firms that pay dividends and have exchange-traded call options skews the sample toward larger firms with less opaque information environments. For example, the mean (median) market capitalization of the firms in my sample is $25.4bn ($9.9bn), the mean (median) number of analysts is 14.7 (15.0), and the mean level of Newswire dissemination equals 2.7, compared to the mean value of 1.0 reported by Soltes [2009]. Correlation matrices for the primary disclosure measures are presented in Panels B and C. As expected, the disclosure activities are not independent and a positive correlation exsits across the disclosure activities. However, the partial correlations reported in Panel C reveal that a portion of the relation between disclosure activities can be attributed to firm characteristics associated with the firm's disclosure policy. For example, after controlling for firm size the relation between Newswire dissemination and IR activities (Top 10) is reduced from 16.8% to 4.5%. Most of the partial correlations between disclosure activities range from 4% - 8%, indicating there is sufficient independent variation in each disclosure activity to examine them separately.

4.2 The trading behavior of sophisticated and less sophisticated investors

Table 3 presents results related to the test of H1. Specification (1) shows that the relation between the option-based proxy and PIN is negative and significant, consistent with the idea that sophisticated investors concentrate their trading activity in firms with higher levels of information asymmetry. Specifications (2), (4), and (5) examine the relation between the option-based proxy and the set of variables used to estimate the level of information asymmetry in the firm. These results show that the measure is positively related to firm size and negatively related

to market-to-book levels, which further supports H1. In specification (5), I also find a positive association between the measure and the use of debt in the firm. This finding is consistent with the finding in Brown et al. [2007], who find a negative association between PIN and firm leverage. I also find a positive association between the option-based proxy and the number of analysts when I exclude size and inclusion in the Dow Jones Industrial Index (index) from the full-specification regressions (4) and (5) (untabulated). This finding is likely a result of the high level of correlation between these variables.[30] Furthermore, the sample selection process biases the sample toward firms with increased analyst following, thus reducing the measured effect of analyst coverage.

Specifications (3), (4), and (5) examine the relation between the option-based proxy and elements of the trading environment that past research has found to be associated with levels of information asymmetry in the firm. The results show that less sophisticated investors concentrate their trading activity in firms with higher share turnover and lower levels of return volatility, which are characterized as having lower levels of information asymmetry. Less sophisticated investors also concentrate their trading activity in firms that are included in the index, where information is more widely disseminated and more uninformed trading occurs. One result that is perhaps surprising is that less sophisticated investors appear to concentrate their trading activity in firms with higher levels of bid-ask spreads. However, because high spread levels may result in incremental transaction costs associated with early exercise, the cross-sectional variation in spreads may also be negatively correlated with the cross-sectional variation in profit from early exercise. Thus, it is difficult to interpret the relation between the option-based proxy and spreads with respect to the level of information asymmetry in the firm (see Appendix A2 for further

[30] These two variables are the most highly correlated with the number of analysts following the firm. In untabulated results, I find the correlation between analyst following, firm size, and inclusion in the index is 0.59 and 0.23, respectively.

discussion).[31] To address this concern, I estimate the same regression (untabulated) using a sample in which the profit from early exercise is between zero and five dollars per contract. In this setting, the cross-sectional variation in the (gross) profit from early exercise is significantly reduced. Therefore, variations in profit and incremental transaction costs resulting from temporarily high spreads are less likely to affect the variation in exercise behavior. In these regressions, the relation between the option-based proxy and the bid-ask spread is negative across all specifications (significant in the full specification), as would be expected when spreads proxy for the level of information asymmetry in the firm. These results suggest the positive relation in Table 3 arises from the relation between spreads and the cross-sectional variation in profit from early exercise, and that sophisticated investors perceive relatively high spreads as incremental transaction costs.

The results in Table 3 also show that less sophisticated investors concentrate their activity in firms where Transient institutional investors invest more, consistent with the idea that less sophisticated investors prefer firms with increased liquidity and decreased levels of adverse selection in firm shares. Alternatively, sophisticated investors are more prevalent in firms where Quasi-Index institutional investors invest more, indicating these institutional investors are less concerned with the trading costs associated with reduced liquidity in firm shares, because they trade less frequently. Finally, the relation between the option-based proxy and the dividend amount is negative and significant in all of the regressions, revealing that sophisticated investors are more likely to exercise their options efficiently when the profit from doing so is higher.

[31] As far as the magnitudes of the spreads are concerned, the 75th percentile for spreads in the sample equals approximately 20 cents / share (based on the closing spreads reported by CRSP). Therefore, spreads in the top quartile of the distribution are sufficiently large to affect an investor's decision, because a standard option contract is for 100 shares and the average profit from early exercise is therefore approximately $0.24 per share.

Taken together, these results are consistent with the hypothesis that sophisticated investors concentrate their trading activity in firms with higher levels of information asymmetry and decreased liquidity in firm shares, as predicted by the economic theory that relates the investment behavior of (less) sophisticated investors to the level of information asymmetry in the firm. Furthermore, these results help establish that inefficient exercise behavior is systematic across assets and a function of investor sophistication.

4.3 Disclosure and the sophistication of the firm's investors

The disclosure-related results are presented in tables 4 through 6. The coefficients for the level of Newswire dissemination presented in Table 4 are positive and statistically significant (*t-stat of 2.13 and 2.01*). The positive coefficients imply that the concentration of less sophisticated investors is higher in firms with better news dissemination. This result is consistent with hypothesis H2: increased dissemination reduces information processing costs for investors and thus appeals to less sophisticated investors. To attribute economic significance to the magnitude of the coefficients, I compare the implied change in the option-based proxy to the average value of the measure in the sample. Moving from the 25^{th} to the 75^{th} percentile in Newswire dissemination increases the option-based proxy by 5%–5.4% of the average value.

Most of the results related to the control variables presented in Table 4 are directionally consistent with the results presented in Table 3. However, since the sample is different, the coefficients vary in magnitude. One notable difference is that the relation between firm size and the option-based proxy is reduced. The results in Table 4 reveal this difference is partially due to the stronger relation between the option-based proxy and inclusion in the index, present in this sub-sample. The inclusion of the proxy for news dissemination also reduces the relation between the proxy and firm size. When Newswire dissemination is removed from regression (1)

(untabulated), the relation between the proxy and firm size doubles to 0.011 (*t-stat of 1.94*). This result supports the idea that differences in firm size also proxy for variations in firms' information environments.

The management forecast results (H3 a and b) are presented in Table 5. In Panel A, the coefficient for *forecasting firm* is negative and statistically significant in both specifications (*t-stats of 2.9 and 2.7*). The average coefficient of -1.7%, implies that the option-based proxy is lower in issuing firms by approximately 6% of the average value. These results suggest earnings guidance is a disclosure activity that is geared toward more sophisticated investors.[32]

To further test this hypothesis, I examine whether sophisticated investors distinguish between forecasts of varying quality (information content), and concentrate their trading activity in firms in which the information is more valuable to them. These results are presented in panels B and C. In Panel B, the coefficient for *forecast accuracy* is negative and significant in all the specifications (*t-stats ranging from -1.98 to -3.27*). These results indicate that among firms that issue forecasts on a regular basis, the concentration of sophisticated investors is higher in firms that issue more accurate forecasts.[33] Panel C presents results that show this relation is higher in firms with more volatile forecasting environments, where accurate forecasts are more valuable. The low (high) earnings volatility sub-samples include all observations below (above) the median level of earnings volatility in the sample. The negative relation is substantially larger in firms with higher earnings volatility. The coefficient based on the mean accuracy is approximately three times higher in firms with high earnings volatility, and the coefficient based

[32] As a robustness test I re-define *forecasting firm* as ln(1+ the number of forecasts issued over the prior year). The coefficients for this variable are also negative and significant with similar magnitudes.

[33] As a robustness test, I re-define *forecast accuracy* by scaling each forecast by the price prevailing at the end of the month prior to the forecasts date. The coefficients are negative and significant when using the median forecasts error and negative when using the average forecast error. However, these results are also driven by differences in PE ratios across firms and are less likely to capture the construct in question.

on the median accuracy is approximately 30% higher in these same firms. However, the difference is not statistically significant because the standard errors for each of the coefficients are quite large. Overall, the results in Table 5 suggest that management forecasts require more time, attention and ability to process, and hence cater to more sophisticated investors. Furthermore, because forecasting activity is positively correlated with the level of newswire dissemination and investor relations activities in the firm, this result makes it less likely that a single omitted factor that is related to both investor sophistication and the firms' disclosure activities is driving the documented relations.

Table 6 presents results for the relation between the sophistication of the firm's investors and IR activities (H4). These results in Panel A show a higher concentration of less sophisticated investors in firms ranked in the top 10 (*t-stats of 2.3 and 2.5*). The value of the option-based proxy is higher in firms ranked in the top 10 in a given year, by approximately 4.5%, or 16% of the average value. As expected, the relation is weaker when measuring IR performance based on the rankings across any of the four size groups, because the proportion of firms included in this group doubles. [34] However, the relation is still positive and statistically significant (*t-stats of 1.99 and 1.81*). This result alleviates the concern that the relation between the option-based proxy and the IR ranking is driven solely by the largest firms in the sample.

Panel B presents similar results. The coefficients for the top 20 ranking are positive and statistically significant. The coefficients and related t-stats are lower, however, as more firms are included in the top ranking (*t-stats of 2.16 and 1.89*). The coefficients in these specifications show that the value of the option-based proxy is higher in firms ranked in the top 20 in a given year, by approximately 3.0%, or 10% of the average value. Finally, I find no relation between the

[34] Since not all of the firms that are ranked across these four groups are present in my sample, the number of observations does not increase four times. Furthermore, the sample is biased toward larger firms, so the number of observations ranked in the top 10 is not distributed homogenously across the four size groups.

sophistication of the firm's investors and firms ranked in the top 20 in any of the four size groups. I hypothesize that this result occurs because approximately 10% of the observations in the sample are included in this group, reducing the relative significance of the ranking to investors. The results presented in Table 6 support H4: superior IR activities increase the accessibility and clarity of information provided to investors, thus reducing information processing costs and catering to less sophisticated investors.

The disclosure-related results are consistent with the prediction that disclosure activities that vary in the time and resources required to process and digest cater to investors with varying sophistication levels. The matching between investors and disclosure activities these results suggest, supports the idea that the demand for information is not necessarily homogeneous across investors and disclosure activities, and is partially driven by an investor's ability to utilize disclosed information.

4.4 Cross-Sectional Variation in the Effect of Disclosure

To address the concern that a potential correlated omitted variable is responsible for the observed relations between the option-based proxy and the various disclosure activities I examine, I analyze the relation between the option-based proxy and different disclosure activities in sub-samples where disclosure activities that benefit less sophisticated investors are likely to be more valuable to them.[35] Brown et al. (2007) find that the marginal impact of disclosure on information asymmetry is larger (has a more negative relation) in firms that have higher MTB ratios, where a larger portion of the firm's value is attributed to intangible assets and growth opportunities. Therefore, I predict disclosure activities that benefit less sophisticated investors, to have a stronger effect in firms with higher MTB ratios. Firms with higher earnings volatility

[35] I use the base models presented in tables 4 through 6 in these analyses. I use the less restrictive models to increase the power of my tests.

levels experience more significant changes in their operating performance and economic activity. Thus, I predict disclosure to have a larger impact on the investment behavior of less sophisticated investors in these firms as well.

In untabulated results, I find that the coefficients for Newswire dissemination and IR Rank are indeed larger in the sub-samples that include all observations above the median level of MTB or earnings volatility levels in the sample, by at least 45 percent. Furthermore, while the coefficients are statistically significant in the sub-samples with higher MTB or earnings volatility levels, they are not statistically different from zero in the sub-samples where MTB or earnings volatility levels are below the median level in the sample. However, the differences in coefficients across the two samples are only statistically different in some cases.[36] Overall, these results also help alleviate the concern that the observed relations between the option-based proxy and the various disclosure proxies result from a correlated omitted variable.

4.5 Sensitivity analysis

4.5.1 Alternative measure computations

To examine the sensitivity of the disclosure-related results to the assumptions used to construct the option-based proxy, I re-run my primary disclosure tests using alternative approaches to compute the measure.[37] First, I relax the minimum profit restriction of $5.00 per contract for each option series included in the aggregate measure and compute the measure using alternative cutoffs ranging from $1.00 to $4.00 per contract. Second, I vary the minimum open interest level used to decide if a particular series is included in the measure. In this case, I re-

[36] With respect to the forecasting activity in the firm, I find much smaller differences in the coefficients across the sub-samples (with no statistical differences). This may be the case because while forecasts should be more valuable to sophisticated investors when the level of uncertainty is high and the relative value of information is greater, these may also be settings where the forecasts themselves are less informative and harder for sophisticated investors to utilize.

[37] I focus on forecast accuracy measured using the median forecast error and the IR Rank top 10 (20) score for brevity.

compute the measure using alternative minimum open interest cutoffs ranging from zero to 75 contracts. Third, instead of using the average percentage across multiple series, I use only the most liquid option, with the highest level of open interest on the last cum date. The results for these analyses are presented in Table 7. Panel A reveals that the coefficients for the various disclosure proxies are similar across the four profit specifications. The signs and magnitudes of the coefficients are comparable to the results presented in tables 4 through 6, and most of the coefficients are significant at conventional levels. Furthermore, the results generally get stronger as the profit cutoff increases, where the identification of options that require early exercise is more likely to be accurate. Panel B presents results using various open interest restrictions. Once again, the signs and magnitudes of the coefficients are comparable to the main results and most of the coefficients are significant at conventional levels. Panel C (1) shows I obtain similar results using the most liquid option to estimate the measure.

One potential concern related to the measure construction is that sophisticated investors exercise their options prior to the last cum date, because the options are deep in the money and have relatively little time value remaining. This exercise behavior would bias the measure computed using the open interest on the last cum date, and overestimate the relative presence of less sophisticated investors in an option series. To address this concern, I re-compute the measure using two alternative denominators. First, I use the average level of open interest over the five days prior to the ex-date. Second, I use the open interest in each series seven days prior to the ex-date. The results are presented in specifications (2) and (3) in Panel C. The alternative measure definitions do not materially change the results, and the signs and magnitudes of the coefficients are comparable with the main results in these specifications as well.

4.5.2 Multiple disclosure proxies

In my primary analysis, I analyze the affect of each disclosure activity on the behavior of (less) sophisticated investors separately. I use this approach in an effort to identify the impact of different disclosure activities on the behavior of investors with varying levels of sophistication. However, Table 2 reveals the disclosure activities are not independent. As a robustness test, I re-estimate the disclosure regression using two different disclosure proxies simultaneously.[38] The results are presented in Table 8. The inclusion of multiple proxies leads to similar inferences. The coefficient for *forecasting firm* is negative and significant in all of the specifications. The coefficient for Newswire dissemination remains positive and significant in all of the specifications; however, the inclusion of the IR proxies attenuates the effect of news dissemination. Finally, the coefficient for IR rank is positive with similar magnitudes to those found in the main speciation. However, the coefficients are not significant when Newswire dissemination is included in the regression, likely because the number of observations declines by half.

5. Conclusion

In this paper, I use a new empirical measure, based on inefficient exercise activity in the options market, to examine the relation between the sophistication of the firm's investors, disclosure, and the information environment of the firm. I define sophistication as the time and attention investors devote to their investments and how proficient investors are in analyzing investment-related information. Thus, ceteris paribus, sophisticated investors are more likely to generate private signals and become informed investors as a result.

[38] I only include two as opposed to three proxies simultaneously, in an attempt to maximize the sample size in each regression.

Understanding the behavior of investors with varying levels of sophistication is important because variation in the sophistication of firms' investor bases has implications for the liquidity of firms' shares and the ability of disclosure to reduce information asymmetry. In addition, the composition of firms' investor bases has potential implications for a range of corporate finance-based decisions. For example, the effectiveness of common stock (equity) as a source of payment in a merger depends on the frequency with which target investors update their information set and trade (Baker et al. [2007]). Thus, the sophistication of the investor base affects the optimal payment method in a merger. Before we investigate the various consequences of variations in the sophistication of the investor base further, it is important to understand the potential factors that give rise to these differences in the first place.

I provide new direct evidence related to the trading behavior of sophisticated (informed) and less sophisticated (uninformed) investors that is consistent with the underlying economic theory that describes how disclosure and information asymmetry affects investment decisions. Using a host of variables past research has found to be associated with the level of information asymmetry in the firm, and the related trading environment, I find that sophisticated (informed) investors concentrate their trading activity in firms with increased levels of information asymmetry and decreased liquidity in firm shares.

When examining the behavior of investors with respect to disclosure, I find that disclosure activities that vary in the time and resources required to process and digest cater to investors with varying levels of sophistication. This apparent match between investors and disclosure activities supports the idea that the potential demand for disclosure is partially driven by an investor's ability to utilize disclosed information.

Specifically, I find that the concentration of sophisticated investors is higher in firms that issue earnings guidance on a regular basis. Furthermore, among issuing firms, sophisticated investors concentrate their trading activity in firms that issue more accurate forecasts, where the information is more valuable to them. These findings are consistent with the premise that management forecasts require relatively more time, attention and ability to process, and hence may be more valuable to sophisticated investors. Conversely, less sophisticated investors concentrate their trading activity in firms with increased levels of news dissemination and superior IR activities. These results support the hypothesis that these disclosure activities are designed to reduce information gaps between investors, which result from processing frictions.

The setting I examine in this paper is not without limitations. The empirical tests focus on a subset of larger firms that pay dividends and have exchange-traded options, which limits the variation in information environments. Thus, the observed effect of disclosure and the firm's information environment on investment behavior may be understated. Moreover, the analysis focuses on investment behavior in the options market, and the ability to generalize the results to the behavior of equity investors depends on how representative option investors are. Prior research in finance presents evidence which shows the investments made in these two markets are linked, but some systematic differences between option and equity investors may still exist.

Overall, the disclosure-related results highlight that more disclosure does not always benefit less sophisticated "ordinary" investors, due to their limited ability to process and digest the information a firm releases. Therefore, regulation that aims to increase disclosure in an effort to make capital markets more attractive to "ordinary" investors needs to consider investors' abilities to process and digest the information.

APPENDIX

A1. Variable Definitions

Variable	*Variable Name*	*Description*
Information Asymmetry Proxies		
Probability of Informed Trade	PIN	• The PIN measures based on the sample used in Brown et al. [2007]; available through 2006. • PIN is estimated quarterly and each observation is assigned a value for the same quarter and year of the last cum date, where available.
Firm Size	Size	• Natural log of the market cap of the firm measured at the end of the month prior to the last cum date, as reported by CRSP.
Number of Analysts Following the Firm	Number of Analysts	• Natural log of (1 + the number of annual earnings estimates (for the next fiscal period) present in the IBES summary file, within 60 days of the last cum day. • If no data are present on IBES, I assume the firm does not have any analysts following it.
Forecast Dispersion	Forecast Dispersion	• The standard deviation of analyst forecasts as reported by IBES in the summary file within 60 days of the last cum day (Cheong and Thomas [2010]).
Market to Book Ratio	Market to Book (assets)	• (market value of equity + book value of debt) / book value of assets at the end of the quarter prior to the last cum date. • The relevant variables are collected from Compustat.
Financial Leverage	Leverage	• Ratio of (debt in current liabilities + long term debt) / (total assets), as reported by Compustat at the end of the quarter prior to the last cum date.
Trading Environment (Adverse Selection) Proxies		
Share Turnover	Share Turnover	• Natural log of the median daily turnover (trading volume in shares / shares outstanding) over the 90 days prior to the last cum date, as reported by CRSP. • For firms that trade on NASDAQ, trading volume is divided by 2 to avoid double counting of trades by NASDAQ dealers (Verdi [2005]).
Inclusion in the Dow Jones Industrial Index	Dow Index	• A variable equal to 1, if the firm is included in the Dow Jones Industrial Index during the last cum date. • The relevant data are from the index constituents file on Compustat.
Percent of Shares Not Held by Insiders	Free Float	• Percent of shares not held by insiders or block holders (share holders that hold more than 5% in the firm) measured during the year of the last cum date. • The data are taken from Worldscope where available and supplemented by data from Corporate Library (CL) for cases in which data are missing in Worldscope and available in CL.

Share Price Volatility	Return Volatility	• Annualized standard deviation of the daily returns over the 60 days prior to the last cum day (from Option-Metrics).
Percent of Shares Held by Transient Institutional Investors	Transient IO	• The (%) of outstanding shares held by Transient institutional investors, based on quarter-end 13-F filings, prior to the last cum date in question. • Manager-level holdings are reported by WRDS. To compute the percent of shares held by transient institutions, I then use the manager-level classifications provided by Professor Bushee.
Percent of Shares Held by Quasi-Index Institutional Investors	Quasi-Index IO	• The (%) of outstanding shares held by Quasi-Index institutional investors, based on quarter-end 13-F filings, prior to the last cum date in question. • Manager-level holdings are reported by WRDS. To compute the percent of shares held by Quasi-Index institutions, I then use the manager-level classifications provided by Professor Bushee.
Percent of Shares Held by Dedicated Institutional Investors	Dedicated IO	• The (%) of outstanding shares held by Dedicated institutional investors, based on quarter-end 13-F filings, prior to the last cum date in question. • Manager level holdings are reported by WRDS. To compute the percent of shares held by Dedicated institutions, I then use the manager-level classifications provided by Professor Bushee.
Disclosure Measures		
Management Forecast Activity	Forecasting Firm	• A variable equal to 1 if the firm issued at least four, point or range forecasts in the year prior to the last cum date. • I include all point and range estimates for annual and quarterly earnings available on First Call during the year prior to the last cum date. • In cases where there is no data available, I assume no forecasts were issued and I assign a value of zero.
Forecast Accuracy	Forecast Accuracy	• Accuracy = -1*[absolute value (estimate – actual earnings) / absolute value (estimate)]. Actual earnings are from First Call. • Accuracy is computed for all observations where forecasting firm equals 1. If a range is given, I use the mid-point of the range as the estimate. I exclude estimates whose absolute value is lower then $0.10 to avoid scaling by low values. • Forecast Accuracy = the median (average) value of the accuracy measure across all available observations.
Press Dissemination	Newswire Dissemination	• The average number of articles issued per firm-initiated news release, measured over one year (Soltes [2009]). • Each observation is assigned a value as of the year of the firm-dividend event, where available.

IR Activities	Top 10 (20)	• An indicator variable equal to 1 if the firm's IR department was ranked in the top 10 (20) by IR Magazine in a given year, based on a size adjusted score, using the size groups as defined by IR magazine. • I assign each firm a ranking as of the year of the firm-dividend event. • I assume firms not ranked by IR Magazine are not in the top 10 (20), and they receive a value of zero.
IR Activities	Top 10 (20) Group	• A variable equal to 1 if the firm's IR department was ranked in the top 10 (20) by IR Magazine in any size group in a given year, and zero otherwise. • I assign each firm a ranking as of the year of the firm-dividend event. • I assume firms not ranked by IR Magazine are not in the top 10 (20) in any size group and they receive a value of zero.
Other Firm Characteristics and Performance Measures		
Percent of Shares Held by Institutional Investors	Institutional Ownership	• The (%) of outstanding shares held by institutions based on quarter-end 13-F filings, prior to the last cum date in question. The variable is constructed by WRDS in their s34 database. • In cases where the (%) reported exceeds 100%, I redefine the variable to equal 100%.
Volatility of Annual Earnings	Earnings Volatility	• Standard deviation of annual earnings before extra-ordinary items scaled by total assets, over the five years prior to the last cum date. • I require at least five years of data available on Compustat to compute this variable.
Prior Returns	Total Returns	• Total returns over the three months prior to the last cum date, as reported by CRSP in the monthly file.
Measure Control Variables		
Bid-Ask Spread (%)	Bid-Ask Spread	• Median daily bid-ask spread over the 90 days prior to the ex-day, as reported by CRSP. • The bid-ask spread is the difference between the closing ask and bid scaled by the mid-point of the closing bid and ask, as reported by CRSP.
Dividend Amount to which Investors Are Entitled on the Last Cum Date	Dividend Amount	• The dividend amount (pre-share) to which investors are entitled on the last cum date, for a particular firm-dividend event, as reported by CRSP.

*I winsorize all of the explanatory variables (except the institutional ownership variables, indicator variables, and the dividend amount) at the 1% level.

A2 Measuring the presence of sophisticated investors via inefficient exercise activity in the options market

A2.1 Exercise activity around ex-dividend events

Exercising an American call option prior to maturity is optimal when the option is in the money, the underlying stock pays a dividend, and the expected time value of the option on the last cum day is less than the expected drop in stock price. The expected drop in stock price equals the tax-adjusted value of the dividend amount to be paid, as perceived by the marginal investor. For the buyer, exercising the option is optimal in this case because the cost of early exercise (the forgone time value) is lower than the benefit of early exercise (receiving the dividend). See Hao et al. [2009] and Pool et al. [2008] for a formal discussion.

If we define the following:

- S_c = the cum stock price, including the dividend payment
- $E(S_e)$ = the expected stock price on the ex-dividend day
- D = the dividend per share (the tax-adjusted value perceived by the marginal investor)
- $C_e(X)$ = the expected price of a call option with strike price X on the ex-day, which can be computed with an option pricing model and expected inputs (e.g., expected volatility)

Then:

- $E(S_e) = S_c - D$
- And the expected time value of the option on the ex-day can be defined as $\pi_e = C_e(X) - \max(0, E(S_e) - X)$

If $D > \pi_e$ then exercising the option on the last cum day is optimal since the expected time value of the option is less than the expected drop in the stock price. This condition is equivalent to when the benefit from early exercise exceeds the cost of early exercise. When an investor fails to exercise an option in this scenario, he will forfeit a profit = $D - \pi_e$ to the writer (seller) of the option.[39]

[39] Options in which early exercise is optimal are characterized by the fact that they are deep in the money and have a relatively short remaining horizon. For example, the median (mean) option in my sample is ~ \$8 (\$12) in the money

Past research has documented that a significant portion of American call options remain unexercised even when exercising them is optimal (Kalay et al. [1984], Hao et al. [2009], Pool et al. [2008]). Hao et al. [2009] conclude that approximately 40% of the call options that should have been exercised from 1996–2006 remain unexercised, and that this investor behavior has persisted throughout the period. Pool et al. [2008] further demonstrate that option investors have left approximately $491 million in profit on the table over the same period.

Given that profit opportunities exist around ex-dividend days, assuming some arbitragers will attempt to capture these profits is reasonable. Indeed, both papers document a significant increase in option volume on the last cum day, resulting from market makers' attempt to capture a portion of this potential profit. However, although the arbitragers attempt to capture some of the profit, they do not affect the total profit left on the table or the level of open interest observed at the open and close of the last cum day. These levels are a function of pre-existing investors' failure to exercise their options efficiently.

A2.2 Measuring the relative presence of sophisticated investors; implementation

The potential occurrence of forgone profit opportunities that result from suboptimal exercise behavior can be measured for all firms that pay a cash dividend and have equity call options with positive open interest going into the last cum day. For this set of firms, some call options series will be characterized by the fact that they are in the money, and their expected time value is less than the expected drop in stock price. As a result, all of the options in these series should be exercised on the last cum day, and their open interest should decline to zero

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and has 16 (30) calendar days to maturity on the last cum date. Therefore, most of these options will need to be exercised soon in any case and the *incremental cost* associated with early exercise will be insignificant. Furthermore, sophisticated institutional investors face limited transaction costs. Within the retail sector, customers who work with full-service brokers on a fee base do not pay commissions per transaction and would have no additional costs associated with this decision.

going into the ex-dividend day (by the close of the last cum day).[40] In cases in which the open interest does not decline to zero, the holders of options that have not been exercised forgo a profit of $D - \pi_e$, per option/share, to the seller of the option.[41]

For a particular firm-dividend event (underlying equity security), multiple option series will be traded with open interest going into the last cum day, some of which need to be exercised. To measure the proportion of sophisticated dollars invested in the firm's options at that point in time, one can aggregate the percent of contracts that remain open on the close of the last cum day, in a particular series in which exercise is optimal, across all such series. For example, assume a firm has two option series in which exercise is optimal on the last cum day. Further assume the first series has 100 open contracts going into the last cum day in which exercise is optimal, and 40 contracts remain open on the close of the last cum day, whereas the second series has 300 contracts going into the last cum day, and 150 contracts remain open at the close of the last cum day. Then, holders of 40% of the contracts in the first series and 50% of the contracts in the second series forgo some profit. These percentages can be aggregated across the two series, and the final value of the measure for this firm-dividend event would equal $\frac{40+150}{100+300} = 47.5\%$, which is the average percentage of open interest across the two series, weighted by the prior level of open interest.

[40] One potential concern is that a sophisticated investor chooses not to exercise his option to maintain his portfolio allocation, for example, because he is capital constrained. Then the measure would not identify the sophistication of the investor base correctly. However, this constraint is less likely to affect the decision of a sophisticated investor for several reasons: (1) Options in which early exercise is optimal are characterized by having a relatively short remaining horizon, which would imply that an investor needs to rebalance his portfolio soon in any case. (2) Sophisticated investors have alternative instruments, such as equity swaps, which allow them to exercise their options without taking delivery of their shares, while still remaining exposed to the underlying movements in the stock. (3) If more sophisticated investors are wealthier and have more capital, these investors are less likely to be constrained by these frictions.

[41] Since standard option contracts are based on 100 underlying shares, the profit per contract is 100 times the profit computed above.

To compute the measure for a given firm-dividend event, I estimate the expected time value for all of the call options with positive open interest on the open of the last cum day. I then identify all options in which the dividend amount to be paid is greater than the expected time value, and the potential profit is positive. Following Hao et al. [2009] and Pool et al. [2008] I use the actual dividend amount as an estimate of the tax-adjusted value perceived by the marginal investor. To accurately estimate the expected time value of the option on the ex-dividend day (π_e), an investor needs to use an option pricing model during the last cum day. An investor further needs to estimate the expected stock price on the ex-dividend day ($E(S_e)$) and the expected volatility on the ex-dividend day (σ_e), which serve as inputs for the model. The remaining required variables (time to maturity, strike price, and the interest rate) are deterministic and would not need to be estimated.

Following this logic and the methodology presented in Hao et al. [2009] and Pool et al. [2008], I measure the expected time value of the option as follows:

1. $E(S_e)$, the expected stock price on the ex-dividend day equals the closing price on the last cum day minus the upcoming dividend amount.
2. $C_e(X)$, the expected price of the call option with strike price X on the ex-dividend day is computed using the Black-Scholes-Merton Model, with the following inputs:
    a. $E(S_e)$: the expected stock price from above.
    b. σ_e: the expected volatility of the underlying security on the ex-dividend day equal to the annualized standard deviation of the logarithmic daily returns over the prior 60 days.[42]

[42] Pool et al. [2008] use historical volatility in their valuation, whereas Hao et al. [2009] use implied volatility where available and an estimated implied volatility parameter for the remaining cases. My approach follows Pool et al. because implied volatilities are likely to be less reliable when measured around the ex-dividend day, due to the dividend arbitrage activity documented in both papers.

c. The deterministic variables are based on values reported in the Option Metrics database: T – time to maturity, measured in years between the ex-dividend day and the expiry day; R – the zero coupon rate; and X – the exercise price.

3. Finally, the expected time value, $\pi_e = C_e - \max(E(S_e) - X, 0)$.

In practice, investors may use alternative pricing models to compute the time value of the option. To alleviate the concern that differences in pricing models may drive my identification of options in which early exercise is optimal, I require the open interest at the close of the last cum day (going into the ex-day) to be lower than the open interest at the open of the last cum day (close of the prior day) for an option series to be included in the measure. In other words, to classify an option as having potential profits from early exercise, I require at least some investors to unwind their positions so that my identification is more likely to be aligned with that of the market. Furthermore, to eliminate the effect of observations with few outstanding contracts, I also require a minimum open interest level of at least 50 contracts on the last cum day for a particular series to be included in the aggregate measure. Finally, I impose a minimum profit restriction of $0.05 for each option series that is included in the aggregate measure, which implies that an investor forgoes at least $5.00 (per contract) if he fails to optimally exercise an option contract in the series. Although this cutoff is admittedly arbitrary, I impose it to increase the likelihood that exercise is optimal in cases in which I mistakenly overestimate the profit from early exercise using my model. The final sample is presented in Table 1.

A.2.3. Additional control variables and assumptions:

In practice, the amount of potential profit gained from early exercise may also drive a sophisticated investor's exercise decision.

In other words, $((\%)\ Open\ Interest_j) = f$ (*investor base, profit from early exercise*). Therefore, I include two additional control variables in my regressions to capture the cross-sectional variation in open interest that is related to the cross-sectional variation in profit from early exercise.

(1) The dividend amount, which is the primary driver of the cross-sectional variation in the gain from early exercise, or the gross profit. In untabulated results, I find the correlation between the dividend amount and the average profit from early exercise across all of the options included in the measure to be 0.93.

(2) The bid-ask spread, at the stock level, which is the variable cost component associated with early exercise. In theory, only the incremental cost associated with early exercise should matter to a sophisticated investor and since she would pay half of the spread when exercising the option at expiry, the bid-ask spread in the stock does not necessarily result in any incremental costs. However, when the spread is relatively high on the last cum date, an investor may be more concerned with the level of the spread and willing to wait to exercise her option at expiry, when spreads could go down. In this case, higher spreads will result in higher incremental costs (expected/perceived costs) associated with early exercise, which offset the potential gain from early exercise.

Consistent with this idea, in untabulated results I find that for the entire sample, the mean (median) spread is not lower (drops by \$0.01) between the last cum day and expiry. However, for observations in which spreads are in the top quartile, the mean (median) spread is lower by \$0.04 (\$0.03) between the last cum day and expiry (both significant). These findings support the idea that investors may perceive incremental transaction costs associated with early exercise when spreads are relatively high during the last cum day. As far as the magnitudes of the spreads are concerned, the 75^{th} percentile for spreads in the sample equals approximately 20 cents / share

(based on the closing spreads reported by CRSP). Therefore, spreads in the top quartile of the distribution are sufficiently large to affect an investor's decision, because a standard option contract is for 100 shares and the average profit from early exercise per share is therefore approximately $0.24.

Finally, to aggregate the information present in all of the option series for a given firm-dividend event, I need to make the following assumption: an investor either exercises all or none of his options on a particular ex-day. This assumption is reasonable because a significant portion of the relevant processing costs are at the firm level and have a fixed nature. Therefore, it is reasonable to assume that an investor would exercise all of her contracts during a particular firm-dividend event if she invested the resources to determine whether early exercise was optimal.

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Table 1. Sample Composition

Panel A describes the sample composition process. The sample is determined by the information required to compute the option-based proxy, which measures the sophistication of the firm's investors in the options market. To create the sample, I begin by collecting information on all the cash dividend payments available on CRSP, made by firms listed in the U.S. (common share code 10, 11), over the period from 1996–2007. I then proceed to gather information on all the outstanding call options available in the Option Metrics database for each dividend payment. From this set of options, I retain all the options that are in the money, have positive open interest at the open of the last cum date, and experience a decline in open interest during the last cum date. Finally, I compute the profit from early exercise for the remaining options and retain all the options where there are at least 50 contracts open on the last cum date, and the profit from early exercise is at least $0.05/share. Panel B presents the number of observations included in the final sample, broken down by year. Panel C reports the characteristics of the options included in the final sample.

Panel A **Sample Composition Process**	Number of Options (Payments)	Number of Dividend Events	Number of Firms
Dividend payments (events)	66,279	66,279	2,528
Outstanding equity call options linked to dividend payments	757,699	28,356	1,269
Call options that are in the money, have positive open interest going into the last cum day and experience a reduction in open interest during the last cum date	77,700	16,502	1,130
Options where exercise on the last cum day is optimal	43,351	10,443	1,033
Options where exercise is optimal, the profit is at least $0.05 per share, and the open interest going into the last cum day is at least 50 contracts	22,712	7860	756
Final number of option series included in the aggregate measure of investor sophistication	22,712	7860	756

Panel B
Distribution of Observations by Year

Year	Dividend Events	Firms
1996	239	118
1997	321	153
1998	241	134
1999	260	145
2000	294	163
2001	408	205
2002	604	271
2003	1019	392
2004	1150	455
2005	1105	463
2006	1108	458
2007	1111	471
Total	7860	756

Panel C
Option Characteristics for Options Where Exercise is Optimal (n=22,712)

	Mean	Q1	Median	Q3	σ
Profit per option contract ($)	24.5	10.2	17.2	27.5	37.4
Open Interest (last cum date)	1,445	116	285	929	4,946
Days to maturity	30.6	8.0	16.0	38.0	49.4
Depth in the money (S-X) in ($)	11.9	4.8	8.8	15.1	11.2

Table 2. Descriptive Statistics

This table presents descriptive statistics for the option-based proxy and all the explanatory variables used in the analyses presented in tables 3 through 8. All the variables are described in detail in Appendix A1. The option-based proxy is described in detail in Section 2 and Appendix A2. I winsorize all the explanatory variables (except the institutional ownership variables, indicator variables, and the dividend amount) at the 1% level. For all of the explanatory variables I report distributions for the raw variable values, even though some of the explanatory variables appear in log form in the analyses presented in tables 3 through 8. Panel A includes descriptive statistics. Panel B presents a correlation matrix for the primary disclosure measures. Spearman correlations are reported below the diagonal and Pearson correlations are reported above the diagonal. Panel C presents a partial correlation matrix for the primary disclosure measures, after controlling for firm size. Spearman correlations are reported below the diagonal and Pearson correlations are reported above the diagonal.

Panel A
Descriptive Statistics

	Mean	Q1	Median	Q3	Standard Deviation	N
Option-Based proxy						
Ln (1+% Open Interest)	0.28	0.09	0.25	0.45	0.21	7860
Information Asymmetry						
PIN	0.09	0.06	0.09	0.11	0.06	6464
Firm size (marketcap) ($MM)	25,387	3,696	9,932	23,324	44,212	7860
Number of analysts	14.7	9.0	15.0	20.0	7.5	7860
Forecast dispersion	0.09	0.02	0.04	0.09	0.13	7661
Market to Book ratio (assets)	1.83	1.12	1.42	2.08	1.06	7805
Leverage	0.28	0.16	0.26	0.37	0.17	7788
Trading Environment						
Share turnover (%)	0.52	0.28	0.41	0.62	0.40	7860
Dow Index	0.10					7860
Free float	0.88	0.82	0.95	0.99	0.15	7593
Bid-Ask spread (%)	0.33	0.04	0.07	0.45	0.52	7782
Return volatility	0.26	0.18	0.23	0.32	0.12	7860
Transient IO	0.13	0.06	0.10	0.17	0.08	7860
Quasi-Index IO	0.44	0.30	0.44	0.57	0.18	7860
Dedicated IO	0.07	0.01	0.05	0.10	0.07	7860
Disclosure Measures						
Forecasting firm	0.40					7860
Forecast accuracy (Average)	-0.12	-0.16	-0.07	-0.03	0.15	3146
Forecast accuracy (Median)	-0.10	-0.11	-0.05	-0.02	0.14	3146
Newswire dissemination	2.7	1.9	2.6	3.4	1.2	2741
IR rank Top 10	0.023					6097
IR rank Top 10 group	0.044					6097
IR rank Top 20	0.040					6097
IR rank Top 20 group	0.096					6097
Other Firm Characteristics						
Institutional ownership	0.65	0.54	0.66	0.78	0.19	7860
Earnings volatility	0.022	0.006	0.015	0.028	0.024	7678
Total Returns	0.06	-0.02	0.06	0.13	0.13	7755
Dividend amount ($)	0.28	0.15	0.24	0.35	0.23	7860

Panel B
Correlation Matrix for the Primary Disclosure Measures

Variable	Forecasting firm	Newswire dissemination	IR rank Top 10	IR rank Top 10 group	IR rank Top 20	IR rank Top 20 group
Forecasting firm		0.052	0.038	0.077	0.048	0.076
Newswire dissemination	0.043*		0.168	0.097	0.183	0.099
IR rank Top 10	0.038	0.123		0.717	0.758	0.474
IR rank Top 10 group	0.077	0.063	0.717		0.673	0.660
IR rank Top 20	0.048	0.143	0.758	0.673		0.625
IR rank Top 20 group	0.076	0.087	0.474	0.660	0.625	

*Significant at the 5% level. All remaining correlations are significant at the 1% level

Panel C
Partial Correlation Matrix for the Primary Disclosure Measures (controlling for firm size)

Variable	Forecasting firm	Newswire dissemination	IR rank Top 10	IR rank Top 10 group	IR rank Top 20	IR rank Top 20 group
Forecasting firm		**0.047**	**0.029**	**0.071**	**0.037**	**0.068**
Newswire dissemination	**0.049**		**0.045**	0.005	**0.053**	-0.031
IR rank Top 10	**0.031**	**0.043**		**0.698**	**0.733**	**0.418**
IR rank Top 10 group	**0.072**	0.001	**0.705**		**0.650**	**0.635**
IR rank Top 20	**0.039**	**0.053**	**0.742**	**0.658**		**0.575**
IR rank Top 20 group	**0.069**	-0.022	**0.436**	**0.644**	**0.589**	

*All correlations highlighted in bold are significant at the 5% level

Table 3. The Relation between Investor Sophistication and the Firm's Information Environment

This table analyzes the relation between the sophistication of the firm's investors, measured via the option-based proxy, and various information asymmetry and liquidity (adverse selection) proxies. All the independent variables (proxies) are described in detail in Appendix A1. Specifications (1)–(5) are estimated using Panel (OLS) regressions which include year and industry dummies. Specification (1) includes all available observations for the period 1996–2006. Specifications (2)–(5) include all available observations for the period 1996–2007, and the coefficients for the intercepts are untabulated. Industry effects are based on the Fama French 12 industry definitions as detailed on Ken French's website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.htm).

t-statistics, based on robust standard errors clustered at the firm level, are presented below the coefficient estimates.

Dependent Variable: *Ln*[1+(%) Open Interest]						
Variable / Predicted Sign		(1)	(2)	(3)	(4)	(5)
Information Asymmetry						
PIN	(-)	-0.204***				
		[-3.08]				
Size (ln)	(+)		0.00775**		0.0141***	0.0128***
			[2.11]		[3.70]	[3.33]
# of Analysts (ln)	(+)		-0.00474		-0.0126	-0.0115
			[-0.56]		[-1.51]	[-1.38]
Forecast dispersion	(-)		0.0309		-0.0222	-0.0253
			[1.34]		[-0.93]	[-1.04]
Market to Book (assets)	(-)		-0.00692**		-0.00607*	-0.00458
			[-2.22]		[-1.92]	[-1.38]
Leverage	(+)					0.0458**
						[2.51]
Trading Environment						
Share turnover (ln)	(+)			0.0357***	0.0420***	0.0400***
				[4.87]	[5.46]	[5.16]
Dow Index	(+)			0.0414***	0.0192	0.0220*
				[3.44]	[1.62]	[1.87]
Return volatility	(-)			-0.0806***	-0.0705**	-0.0690**
				[-2.69]	[-2.30]	[-2.22]
Dedicated IO	(?)			0.0112	-0.0139	-0.0329
				[0.29]	[-0.36]	[-0.83]
Quasi-Index IO	(-)			-0.0357*	-0.0411*	-0.0407*
				[-1.70]	[-1.89]	[-1.90]
Transient IO	(+)			0.121***	0.127***	0.120**
				[2.61]	[2.65]	[2.51]
Free-float	(+)			-0.0185	-0.0379	-0.0369
				[-0.83]	[-1.63]	[-1.61]
Measure Controls						
Dividend amount	(-)	-0.0524***	-0.0444***	-0.0393***	-0.0453***	-0.0440***
		[-3.31]	[-3.08]	[-2.96]	[-3.17]	[-3.16]
Bid-Ask spread	(?)	1.540*	1.522*	1.584*	2.058**	2.121**
		[1.89]	[1.78]	[1.86]	[2.29]	[2.36]
Observations		6442	7565	7515	7308	7287
R-Squared		0.067	0.074	0.080	0.084	0.085

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4. The Relation between Investor Sophistication and Press Dissemination

This table analyzes the relation between the sophistication of the firm's investors, measured by the option-based proxy, and the level of press dissemination in the firm. Newswire dissemination equals the average number or newswire articles released per firm-initiated disclosure in a given year. All the additional variables are described in detail in Appendix A1. Specifications (1) and (2) are estimated using a Panel (OLS) regression which includes year and industry dummies. The regression includes all available observations for the period 2001–2006 and the coefficient for the intercept is untabulated. Industry effects are based on the Fama French 12 industry definitions as detailed on Ken French's website.
(http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.htm)
t-statistics, based on robust standard errors clustered at the firm level, are presented below the coefficient estimates.

Dependent Variable: *Ln*[1+(%) Open Interest]			
Variable / Predicted Sign		(1)	(2)
Disclosure Proxy			
Newswire dissemination	(+)	0.00962**	0.00890**
		[2.13]	[2.01]
Firm Characteristics			
(associated with dissemination)			
Size (ln)	(+)	0.00592	0.000974
		[1.00]	[0.16]
Share turnover (ln)	(+)	0.0427***	0.0414***
		[3.58]	[3.45]
Leverage	(+)	0.117***	0.115***
		[3.29]	[3.25]
Market to Book (assets)	(-)	0.00669	0.00851
		[1.29]	[1.59]
Dow Index	(+)		0.0415**
			[2.47]
# of Analysts (ln)	(+)	-0.00106	0.00187
		[-0.09]	[0.15]
Institutional ownership	(?)	-0.0652*	-0.0582
		[-1.69]	[-1.50]
Firm Performance			
Total returns	(?)	-0.0353	-0.0327
		[-1.18]	[-1.09]
Return volatility	(-)	-0.0577	-0.0657
		[-1.18]	[-1.34]
Measure Controls			
Dividend amount	(-)	-0.0434**	-0.0424**
		[-2.18]	[-2.11]
Bid-Ask spread	(?)	1.777	1.704
		[1.25]	[1.21]
Observations		2701	2701
R-squared		0.099	0.101

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5. The Relation between Investor Sophistication and Management Forecast Activity

This table analyzes the relation between the sophistication of the firm's investors, measured by the option-based proxy, and management forecast activity. Panel A describes the relation between the sophistication of the investor base and whether the firm issues forecasts on a regular basis. Forecasting firm is an indicator variable that equals one if the firm issued at least four forecasts (point or range) during the year prior to the firm-dividend event. Panel B describes the relation between the sophistication of the investor base and the accuracy of the firm's forecasts. Forecast accuracy equals the median (mean) forecast error over the prior year, computed for all firms where Forecasting firm = 1. Each forecast error = (-1)*[absolute value (estimate – actual earnings) / absolute value (estimate)]. Panel C compares the coefficients for Forecast accuracy across two sub-samples with high and low earnings volatility, using a chow test. The High (Low) sub-sample includes all observations with earnings volatility above (below) the median level in the sample. All the variables are described in detail in Appendix A1. In Panel B, specifications (1) and (2) report results using the median forecast error while specifications (3) and (4) report results using the mean forecast error. All specifications are estimated using Panel (OLS) regressions and include year and industry dummies. The regressions include all available observations for the period 1996–2007 and the coefficients for the intercepts are untabulated. Industry effects are based on the Fama French 12 industry definitions as detailed on Ken French's website. *t-statistics*, based on robust standard errors clustered at the firm level, are presented below the coefficient estimates.

Panel A

Dependent Variable: *Ln*[1+(%) Open Interest]

Variable / Predicted Sign		(1)	(2)
Disclosure Proxy			
Forecasting firm	(+/-)	-0.0175***	-0.0165***
		[-2.87]	[-2.69]
Firm Characteristics (Forecasting Environment)			
Size (ln)	(+)	0.0133***	0.0134***
		[3.55]	[3.48]
Share turnover (ln)	(+)	0.0502***	0.0472***
		[6.89]	[6.36]
Leverage	(+)	0.0399**	0.0442**
		[2.15]	[2.23]
Market to Book (assets)	(-)	-0.00455	-0.00648*
		[-1.37]	[-1.84]
# of Analysts (ln)	(+)	-0.0147*	-0.0117
		[-1.73]	[-1.36]
Forecast dispersion	(-)	-0.0320	-0.0324
		[-1.35]	[-1.35]
Institutional ownership	(?)	-0.0228	-0.0181
		[-1.25]	[-0.97]
Earnings volatility	(?)		0.277**
			[1.99]
Firm Performance			
Total return	(?)	-0.0426**	-0.0450**
		[-2.31]	[-2.45]
Return volatility	(-)	-0.0834***	-0.0889***
		[-2.74]	[-2.92]
Measure Controls			
Dividend amount	(-)	-0.0454***	-0.0480***
		[-3.14]	[-3.20]
Bid-Ask spread	(?)	2.440***	2.141**
		[2.81]	[2.42]
Observations		7445	7304
R-squared		0.087	0.088

* significant at 10%; ** significant at 5%; *** significant at 1%

Panel B
Dependent Variable: *Ln*[1+(%) Open Interest]

Variable / Predicted Sign		(1)	(2)	(3)	(4)
Disclosure Proxy					
Forecast accuracy (median)	+/-	-0.0982***	-0.0938***		
		[-3.27]	[-3.10]		
Forecast accuracy (average)	+/-			-0.0668**	-0.0606**
				[-2.20]	[-1.98]
Firm Characteristics (Forecasting Environment)					
Size (ln)	(+)	0.0116**	0.0115**	0.0118**	0.0117**
		[2.23]	[2.20]	[2.28]	[2.25]
Share turnover (ln)	(+)	0.0313**	0.0293**	0.0320**	0.0301**
		[2.41]	[2.23]	[2.46]	[2.28]
Leverage	(+)	0.0745**	0.0762***	0.0750**	0.0768***
		[2.54]	[2.61]	[2.56]	[2.63]
Market to Book (assets)	(-)	0.000242	-0.00209	-0.000107	-0.00249
		[0.05]	[-0.37]	[-0.02]	[-0.44]
# of Analysts (ln)	(+)	0.000919	0.00258	0.000482	0.00217
		[0.08]	[0.21]	[0.04]	[0.18]
Forecast dispersion	(-)	0.0141	0.00944	0.0108	0.00750
		[0.26]	[0.17]	[0.19]	[0.13]
Institutional ownership	(?)	-0.0285	-0.0329	-0.0263	-0.0304
		[-0.79]	[-0.90]	[-0.72]	[-0.83]
Earnings volatility	(?)		0.267		0.274
			[1.23]		[1.27]
Firm Performance					
Total return	(?)	-0.0477	-0.0490	-0.0461	-0.0474
		[-1.56]	[-1.61]	[-1.51]	[-1.56]
Return volatility	(-)	-0.0967**	-0.0996**	-0.0902*	-0.0928**
		[-2.08]	[-2.20]	[-1.93]	[-2.03]
Measure Controls					
Dividend amount	(-)	-0.0944***	-0.0961***	-0.0967***	-0.0986***
		[-3.88]	[-3.84]	[-3.94]	[-3.92]
Bid-Ask spread	(?)	2.997*	2.727*	3.047*	2.762*
		[1.91]	[1.72]	[1.94]	[1.74]
Observations		3026	3006	3026	3006
R-squared		0.104	0.105	0.103	0.103

* significant at 10%; ** significant at 5%; *** significant at 1%

Panel C	(1)	(2)	(3)	(4)
	Low earnings volatility	High earnings volatility	Low earnings volatility	High earnings volatility
Forecast accuracy (median / average)	-0.0751*	-0.0962**	-0.0225	-0.0695*
	[-1.73]	[-2.30]	[-0.47]	[-1.73]
All Controls	Yes	Yes	Yes	Yes
P-value for difference	[0.73]		[0.45]	
Observations	1449	1557	1449	1557
R-squared	0.107	0.121	0.105	0.120

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6. The Relation between Investor Sophistication and Investor Relations (IR) activities

This table analyzes the relation between the sophistication of the firm's investors, as measured by the option-based proxy, and the level of IR activities in the firm. The level of IR activities is based on the IR composite score each firm received from IR Magazine, during the period 2002–2007. In Panel A, the variable Top 10 is a variable equal to one if the firm was ranked in the top 10 in a given year, based on a size adjusted score, using the size groups as defined by IR magazine.
The variable Top 10 group is a variable equal to one if the firm was ranked among the top 10 in any one of the four size groups reported by IR Magazine in a given year, and zero otherwise. The explanatory variables in Panel B are defined in an equivalent manner; expect that the relevant indicator variables receive a value of one if the firm was ranked among the top 20 in a given specification, and zero otherwise (as opposed to among the top 10). Specifications (1)–(4) are estimated using Panel (OLS) regressions and include year and industry dummies. The regressions include all available observations for the period 2002–2007 and the coefficients for the intercepts are untabulated. Industry effects are based on the Fama French 12 industry definitions as detailed on Ken French's website. *t-statistics*, based on robust standard errors clustered at the firm level, are presented below the coefficient estimates.

Panel A
Dependent Variable: *Ln*[1+(%) Open Interest]

Variable / Predicted Sign		(1)	(2)	(3)	(4)
		Top 10	Top 10	Top 10 Group	Top 10 Group
Disclosure Proxy					
IR Rank	(+)	0.0471***	0.0431**	0.0282**	0.0261*
		[2.74]	[2.33]	[1.99]	[1.81]
Firm Characteristics					
Size (ln)	(+)	0.00828**	0.00432	0.00898**	0.00482
		[2.05]	[1.04]	[2.19]	[1.14]
Share turnover (ln)	(+)	0.0399***	0.0385***	0.0396***	0.0382***
		[4.89]	[4.70]	[4.87]	[4.68]
Leverage	(+)	0.0595***	0.0631***	0.0599***	0.0636***
		[2.86]	[3.06]	[2.87]	[3.09]
Market to Book (assets)	(-)	-0.00449	-0.00383	-0.00456	-0.00387
		[-1.16]	[-0.99]	[-1.18]	[-1.00]
Dow Index	(+)		0.0292**		0.0301**
			[2.19]		[2.24]
# of Analysts (ln)	(+)	-0.00700	-0.00374	-0.00822	-0.00476
		[-0.74]	[-0.40]	[-0.86]	[-0.51]
Forecast dispersion	(-)	-0.0134	-0.0133	-0.0139	-0.0137
		[-0.49]	[-0.49]	[-0.51]	[-0.51]
Institutional ownership	(?)	-0.0192	-0.0109	-0.0210	-0.0123
		[-0.90]	[-0.49]	[-0.98]	[-0.55]
Earnings volatility	(?)	0.268*	0.282*	0.271*	0.286*
		[1.70]	[1.80]	[1.72]	[1.82]
Firm Performance					
Total return	(?)	-0.0208	-0.0191	-0.0208	-0.0191
		[-0.94]	[-0.87]	[-0.94]	[-0.87]
Return volatility	(-)	-0.0890***	-0.0915***	-0.0882***	-0.0909***
		[-2.66]	[-2.74]	[-2.63]	[-2.72]
Measure Controls					
Dividend amount	(-)	-0.0339***	-0.0328**	-0.0343***	-0.0331**
		[-2.62]	[-2.53]	[-2.64]	[-2.55]
Bid-Ask spread	(?)	1.799	1.792	1.715	1.714
		[0.95]	[0.95]	[0.90]	[0.91]
Observations		5691	5691	5691	5691
R-squared		0.072	0.073	0.072	0.073

* significant at 10%; ** significant at 5%; *** significant at 1%

Panel B
Dependent Variable: *Ln*[1+(%) Open Interest]

Variable / Predicted Sign		(1)	(2)	(3)	(4)
		Top 20	Top 20	Top 20 Group	Top 20 Group
Disclosure Proxy					
IR Rank	(+)	0.0319**	0.0285*	0.0104	0.00840
		[2.16]	[1.89]	[0.98]	[0.79]
Firm Characteristics					
Size (ln)	(+)	0.00815*	0.00419	0.00924**	0.00508
		[1.96]	[0.98]	[2.19]	[1.18]
Share turnover (ln)	(+)	0.0398***	0.0384***	0.0392***	0.0378***
		[4.88]	[4.69]	[4.81]	[4.63]
Leverage	(+)	0.0607***	0.0643***	0.0600***	0.0637***
		[2.92]	[3.13]	[2.88]	[3.09]
Market to Book (assets)	(-)	-0.00446	-0.00380	-0.00477	-0.00404
		[-1.15]	[-0.98]	[-1.22]	[-1.03]
Dow Index	(+)		0.0295**		0.0306**
			[2.20]		[2.25]
# of Analysts (ln)	(+)	-0.00713	-0.00385	-0.00815	-0.00462
		[-0.75]	[-0.41]	[-0.85]	[-0.49]
Forecast dispersion	(-)	-0.0132	-0.0132	-0.0139	-0.0139
		[-0.49]	[-0.49]	[-0.51]	[-0.52]
Institutional ownership	(?)	-0.0189	-0.0106	-0.0208	-0.0119
		[-0.88]	[-0.48]	[-0.97]	[-0.53]
Earnings volatility	(?)	0.268*	0.283*	0.279*	0.294*
		[1.70]	[1.80]	[1.76]	[1.86]
Firm Performance					
Total return	(?)	-0.0204	-0.0188	-0.0211	-0.0194
		[-0.92]	[-0.85]	[-0.96]	[-0.88]
Return volatility	(-)	-0.0893***	-0.0917***	-0.0868**	-0.0896***
		[-2.67]	[-2.74]	[-2.58]	[-2.67]
Measure Controls					
Dividend amount	(-)	-0.0343***	-0.0332**	-0.0348***	-0.0336**
		[-2.63]	[-2.54]	[-2.65]	[-2.56]
Bid-Ask spread	(?)	1.762	1.758	1.730	1.732
		[0.93]	[0.93]	[0.91]	[0.92]
Observations		5691	5691	5691	5691
R-squared		0.072	0.073	0.071	0.073

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7. Alternative Measure Computations

This table summarizes the results of a variety of robustness tests, related to computation of the option-based proxy. Each coefficient and related t-stat represent a separate regression, based on the regression used to analyze the relevant disclosure activity, presented in tables 4 through 6. Panel A presents the coefficients and t-stats for the disclosure-related analysis where the left hand side variable equals the option-based proxy computed with alternative profit cutoff levels used to determine if an option series is included in the measure. Panel B presents similar results where the option-based proxy is computed using different minimum open interest levels (at the open of the last cum day) used to determine if an option series is included in the measure. Panel C presents results where the measure is computed using alternative computations. In specification (1), the measure is computed using the option series with the highest level of open interest going into the last cum day. In specification (2), the denominator of the measure is based on the average level of open interest in an option series measured over the five days prior to the ex-date. In specification (3), the denominator of the measure is computed using the open interest level in the option seven days prior to the ex- date.

All specifications are estimated using Panel (OLS) regressions and include year and industry dummies. The regressions include all the control variables used in the primary analysis presented in tables 4 though 6.

t-statistics, based on robust standard errors clustered at the firm level, are presented below the coefficient estimates.

Panel A

Dependent Variable: *Ln*[1+(%) Open Interest]

	Alternative Profit Cutoffs			
Disclosure Proxies	1 dollar/contract	2 dollars/contract	3 dollars/contract	4 dollars/contract
Newswire dissemination	0.00733*	0.00779*	0.00861**	0.0103**
	[1.71]	[1.85]	[2.01]	[2.35]
Forecasting firm	-0.0170***	-0.0139**	-0.0134**	-0.0155**
	[-2.88]	[-2.32]	[-2.24]	[-2.54]
Forecast accuracy (median)	-0.0989***	-0.0995***	-0.112***	-0.101***
	[-3.95]	[-3.92]	[-4.33]	[-3.65]
IR Rank Top 10	0.0323*	0.0376**	0.0356*	0.0418**
	[1.83]	[1.97]	[1.93]	[2.25]
IR Rank Top 20	0.0206	0.0232	0.0234	0.0303**
	[1.49]	[1.58]	[1.59]	[2.04]

* significant at 10%; ** significant at 5%; *** significant at 1%

Panel B

Dependent Variable: *Ln*[1+(%) Open Interest]

	Alternative Open Interest Cutoffs			
Disclosure Proxies	None	20	25	75
Newswire dissemination	0.00901**	0.00858**	0.00863**	0.00703
	[2.17]	[2.00]	[2.00]	[1.58]
Forecasting firm	-0.00691	-0.0114*	-0.0133**	-0.0166***
	[-1.20]	[-1.94]	[-2.25]	[-2.60]
Forecast accuracy (median)	-0.0806***	-0.0728**	-0.0806***	-0.0856***
	[-3.02]	[-2.51]	[-2.77])	[-2.743]
IR Rank Top 10	0.0353*	0.0402**	0.0425**	0.0435**
	[1.93]	[2.11]	[2.25]	[2.42]
IR Rank Top 20	0.0292**	0.0301**	0.0317**	0.0270*
	[2.18]	[2.21]	[2.24]	[1.76]

* significant at 10%; ** significant at 5%; *** significant at 1%

Panel C
Dependent Variable: *Ln*[1+(%) Open Interest]

	Alternative Computations		
	(1)	(2)	(3)
Disclosure Proxies	Measure computed using the option with the highest level of open interest going into the last cum date	Denominator equal to the average open interest over the 5 days prior to the ex-date	Denominator equal to the open interest seven days prior to the ex-date
Newswire dissemination	0.00809* [1.71]	0.00883** [2.02]	0.00681 [1.62]
Forecasting firm	-0.0164** [-2.45]	-0.0173*** [-2.84]	-0.0138** [-2.22]
Forecast accuracy (median)	-0.112*** [-3.09]	-0.100*** [-3.44]	-0.0931*** [-3.12]
IR Rank Top 10	0.0461** [2.48]	0.0484** [2.48]	0.0476** [2.26]
IR Rank Top 20	0.0345** [2.16]	0.0300* [1.96]	0.0319** [2.03]

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 8. Multiple Disclosure Proxies

This table presents results using multiple disclosure activities simultaneously. The disclosure proxies are defined in tables 4 through 6. In each specification, I include the most comprehensive set of control variables, based on the union of the set of control variables used when analyzing the relation between the option-based proxy and each respective disclosure proxy. All the specifications are estimated using Panel (OLS) regressions and include year and industry dummies. *t-statistics,* based on robust standard errors clustered at the firm level, are presented below the coefficient estimates.

Dependent Variable: *Ln*[1+(%) Open Interest]					
Disclosure Proxies	(1)	(2)	(3)	(4)	(5)
Forecasting firm	-0.0166*	-0.0133**	-0.0136**		
	[-1.74]	[-2.01]	[-2.04]		
Newswire dissemination	0.00864*			0.00772*	0.00763*
	[1.96]			[1.70]	[1.68]
IR Rank Top 10		0.0442**		0.0323	
		[2.38]		[0.90]	
IR Rank Top 20			0.0302**		0.0380
			[2.00]		[1.15]
All Controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Observations	2661	5691	5691	2466	2504
R-squared	0.103	0.074	0.074	0.090	0.090

* significant at 10%; ** significant at 5%; *** significant at 1%