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AN EMPIRICAL EXAMINATION OF DISCLOSURE HORIZON: EVIDENCE FROM THE TERM STRUCTURE OF IMPLIED EQUITY VOLATILITIES

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DEDICATION

To my wife (Janet), my parents (Ernesto and Zoe), and my sisters (Nailim, Zoe, and Gloria).

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ABSTRACT

I develop and test a measure of the *horizon* of managers' corporate disclosures. This measure exploits information in the term structure of implied equity volatilities to gauge the relative extent to which the information underlying securities prices reflects long-term versus short-term uncertainty. The measure allows me to characterize managers' disclosures in terms of whether they provide information about long-term business strategies or are more oriented towards short-term operating results. In the cross-section, I find that the horizon measure is associated with variables that are likely to capture the extent to which firms' business models result in differing degrees of uncertainty about the long-term versus the short-term. For example, I find that firms with relatively greater long-term uncertainty have greater R&D intensity and more growth opportunities, consistent with them engaging in projects that are longer-term in nature. I then examine changes in the term structure of implied equity volatilities around earnings announcements to assess firms' disclosure horizons. I find that earnings announcements containing management forecasts have shorter disclosure horizons than earnings announcements not containing management forecasts. The relatively short-term nature of the information in bundled earnings announcements is consistent with the view that issuing earnings guidance is associated with a short-term focus by managers. The measure potentially expands researchers' ability to evaluate the nature of various types of corporate disclosures.

CHAPTER 1

INTRODUCTION

In this paper, I develop and test a measure of the *horizon* of managers' corporate disclosures. This measure exploits information in the term structure of implied equity volatilities to gauge the relative extent to which the information underlying securities prices reflects long-term versus short-term uncertainty about firm value. The uncertainty about firm value reflected in the term structure of implied volatilities captures the precision of investor information over various horizons.[1] I expect the precision of investor information over various horizons to vary as a function of firm characteristics and changes in it to reflect the nature of information releases. Thus, examining the term structure of implied volatilities potentially allows me to characterize managers' disclosures in terms of whether they provide information about long-term business strategies or are more oriented towards short-term operating results.

Bushee and Noe (2000) suggest that managers, through their disclosures, can affect their firm's investor base (i.e., the composition of short-term and long-term investors that trade their firm's stock). Managers care about their firm's investor base because short-term investors increase volatility (Bushee and Noe, 2000; Bushee, 2004). This increase in volatility increases the chances of large stock price declines. Poor stock price performance can hurt the manager's reputation and increase the probability that the manager gets terminated (e.g., Warner, Watts, and Wruck, 1988). Increased volatility can also increase the perceived riskiness of the firm and

[1] The focus of this paper is on how uncertainty varies with horizon (i.e., a short-horizon compared to a longer horizon). The term structure of implied equity volatility also captures seasonal uncertainty which adds noise given my focus.

result in an increased cost of capital (Froot, Perold, and Stein, 1992). To the extent that relatively long-term disclosures repel short-term investors and attract long-term investors, managers can reduce the capital market pressure for short-term results, thus increasing managers' ability to take on long-term value maximizing projects (Bushee, 1998, 2001, and 2004).

Measuring the horizon of a manager's disclosures is complicated by the fact that the horizon over which investors' expectations change is unobservable. Many papers examine the informativeness of various corporate disclosures, typically measured as the stock market reaction to the disclosure.[2] However, the stock market reaction aggregates long-term and short-term changes in investors' expectations and so is not useful in distinguishing between the short-term and the long-term. On the other hand, investors' uncertainty about firm value is affected by corporate disclosures and measurable over multiple horizons. Therefore, I examine the horizon of corporate disclosures by utilizing the duration of different implied volatilities from exchange-traded option prices to measure uncertainty about firm value over multiple horizons.[3] In other words, I exploit the observability of standardized implied equity volatilities of different durations to estimate the relative amount of short-term versus long-term information, or the *horizon* of a firm's disclosure.

My horizon measure captures the extent to which a firm faces relatively short-term versus long-term uncertainty. To calculate this measure, I first compute forward implied volatilities

[2] Some representative papers are as follows: Ball and Brown (1968), Ball and Shivakumar (2008), Foster (1973), Patell (1976), Penman (1980), Ajinkya and Gift (1984), Waymire (1984), Baginski, Conrad, and Hassell (1993), Skinner (1994), Miller (2002), Hutton, Miller, and Skinner (2003), Milian (2010), Griffin (2003), Li and Ramesh (2009), Lerman and Livnat (2009), Bryan (1997), and Brown and Tucker (2011).

[3] Implied volatility is the market's expectation of the average stock return volatility over the duration of the option contract and is equal to the volatility implied by the option's price and an option pricing model such as the Black-Scholes model or the Cox-Ross-Rubinstein binomial tree model.

over each of the next four 91-day periods over a broader 365-day horizon.[4] I then measure the proportion of the 365-day (the longer-term period) implied volatility expected to occur within each of the four 91-day periods (the interim periods) and use these proportions to weight the horizon of the corresponding 91-day period to arrive at a volatility-weighted duration, or horizon. For example, if the forward volatilities are constant over the interim periods, then the volatility-weighted duration or *Horizon* equals 180 days (approximately equal to 365 days * 0.5). If the earlier interim periods have larger (smaller) implied volatilities than the later interim periods, then *Horizon* is less (greater) than 180 days. That is, smaller values of *Horizon* indicate relatively more short-term uncertainty, while larger values of *Horizon* indicate relatively more long-term uncertainty. Thus, *Horizon* measures how total uncertainty is distributed through time and will capture whether firm information reflects relatively more long-term or short-term uncertainty.[5]

To validate the horizon measure, I regress *Horizon* on variables that are likely to capture the extent to which firms' business models result in differing degrees of uncertainty about the long-term versus the short-term. In the cross-section, I find that firms with relatively greater long-term uncertainty have greater R&D intensity and more growth opportunities, consistent with them engaging in projects that are longer-term in nature. In addition, firms in industries with longer product development cycles (e.g., aircraft) have relatively more long-term uncertainty than firms in industries with shorter product development cycles (e.g., steel). In contrast, firms reporting accounting losses face relatively more short-term uncertainty. At the macroeconomic level, I find that firms face relatively more short-term uncertainty at the time of

[4] Implied volatility refers to the expected volatility over the life of the option contract, while, forward implied volatility refers to the expected volatility over some sub-period of the option contract.
[5] Throughout the paper, I refer to the "short-term" and the "long-term". I use these terms in the context of the 365-day periods that I examine.

large, negative market-wide shocks (e.g., during the financial crisis of 2008).[6] The relatively greater short-term uncertainty for loss firms and at the time of large, negative market-wide shocks is consistent with distress and liquidity issues being relatively short-term concerns. Also, investors view large firms and stable firms (firms with low volatility over the past year) as having relatively less short-term uncertainty. Further validating *Horizon,* I find that it is positively associated with the dispersion in analysts' earnings forecasts for next fiscal year relative to the dispersion in analysts' earnings forecasts for the current fiscal year (a measure of the term structure of the dispersion in analysts' earnings forecasts). My analysis suggests that the term structure of implied equity volatility can be used to extract information about an interesting firm characteristic, which is the relative amount of long-term versus short-term uncertainty that firms face and that investors are subject to.

Firms' business models and disclosure policies result in differing degrees of uncertainty about the short-term versus the long-term. To the extent that a firm's business model is relatively constant over time and controlling for the macro economy, it is a firm's disclosure policy (i.e., the relative amounts of short-term and long-term information disclosed) that affects the horizon of uncertainty. Theoretical models (e.g., Stein, 1989a) along with experimental results (Bhojraj and Libby, 2005) and survey evidence (Graham, Harvey, and Rajgopal, 2005) suggest that a focus on the short-term at the expense of long-run firm value is an important issue. Concerns about managerial myopia pertain not only to managers' investment decisions, but also to how their disclosure practices both reflect and influence their investment decisions. Gigler et al. (2009) present a model where frequent short-term disclosures result in a short-term focus due

[6] In a related and concurrent paper, Callen and Lyle (2010) find a similar result. In that paper, they use the term structure of implied volatilities to estimate the term structure of implied costs of equity capital. They find that implied firm-level costs of equity capital are not constant over time. Specifically, they find that the term structure of implied costs of equity capital is typically upward sloping, but that it was downward sloping during 2008.

to information imperfections in the market between managers and investors. Consistent with the motivation of that model, conclusions drawn from surveys of corporate managers and statements by influential market participants advise managers to shift from short-term earnings forecasts to disclosures of long-term information (e.g., Krehmeyer, Orsagh, and Schacht, 2006).[7] Fuller and Jensen (2002), Krehmeyer, Orsagh, and Schacht (2006), Hsieh, Keller, and Rajan (2006), and U.S. Chamber of Commerce (2007) postulate that a focus on quarterly earnings and short-term earnings forecasts reduces long-run firm value.

To assess a firms' disclosure horizon, I next examine the changes in implied volatilities of various durations around corporate disclosures.[8] A firm's *Disclosure Horizon* captures the relative proportions of short-term and long-term information conveyed by the firm's disclosures. Using this measure, I address the popular debate about whether earnings guidance is associated with a short-term focus. Given that a large proportion of earnings guidance occurs at earnings announcements, I examine whether bundled earnings announcements (earnings announcements containing management forecasts or earnings guidance) are relatively more short-term or long-term information events than non-bundled earnings announcements (earnings announcements not containing management forecasts or earnings guidance). The regression analysis suggests that, on average, bundled earnings announcements are associated with shorter disclosure horizons than non-bundled earnings announcements. In addition, there is relatively greater open interest in short-term options prior to bundled earnings announcements. This is consistent with bundled earnings announcements containing a larger proportion of short-term information than non-

[7] For a discussion on the costs and benefits of earnings guidance by practitioners see Krehmeyer, Orsagh, and Schacht (2006), Hsieh, Keller, and Rajan (2006), and U.S. Chamber of Commerce (2007). For a discussion by academics see Fuller and Jensen (2002), Chen, Matsumoto, and Rajgopal (2011), Miller (2009), and Houston, Lev, and Tucker (2010).

[8] Implied volatilities are available on a daily basis which makes them useful for studying information releases.

bundled earnings announcements, and supports the view that issuing earnings guidance is associated with a short-term focus by managers. I also find that firms facing relatively more long-term uncertainty have more short-term information in their earnings announcements, which is consistent with earnings being a poor measure of performance for firms with high growth opportunities.

This paper makes several contributions. First, this is the first examination of the term structure of implied equity volatilities on a large scale at the firm level. Second, the *Horizon* measure allows future research to distinguish between firms facing relatively short-term uncertainty and firms facing relatively long-term uncertainty. Third, the *Disclosure Horizon* measure allows researchers to determine the relative amounts of short-term and long-term information in a disclosure. This will potentially further our understanding of the nature of the information in various disclosures and how this attribute of disclosure differs across manager and/or firm characteristics. Fourth, I introduce the use of the relative amount of open interest in short-term options as a proxy for the amount of transient investors in a stock. Fifth, I provide empirical evidence that the provision of earnings guidance tends to be associated with a short-term focus by managers, which is relevant to the debate on the costs and benefits of earnings guidance.

Because of data availability constraints, I measure uncertainty about firm value over a relatively short period of time (i.e., 365 days). Ideally, I would measure uncertainty about firm value over a longer period of time to ensure a clearer distinction between the short-term and the long-term. Detecting differences in firms' disclosure horizons becomes increasingly difficult to the extent that one year represents the short-term for firms. However, there is reason to believe that variation in firms' term structures within a year carries over beyond one year. For example,

I provide evidence that a firm's term structure of implied volatility is positively associated with its term structure of analysts' uncertainty using estimates that have horizons greater than one year. Another limitation of my measure is that it can be calculated only for firms that have exchange traded long-term options. These firms tend to be large and/or volatile firms of interest to option investors. On the other hand, these are an interesting and important set of firms because they represent a very large proportion of the United States equity market's total market capitalization.

CHAPTER 2

PRIOR RESEARCH

2.1 Disclosure and uncertainty

Prior research on the relation between disclosure and uncertainty focuses on how disclosure affects the magnitude of uncertainty. Patell and Wolfson (1979, 1981) and Isakov and Perignon (2001) find that implied volatility (a proxy for uncertainty) increases before a firm's earnings announcement and decreases following the announcement. Subramanyam, Marquardt, and Zhang (2005) present a model where large earnings surprises (both positive and negative) increase uncertainty. Clement, Frankel, and Miller (2003) find that confirming management forecasts do not affect the mean of the consensus analyst forecast but do reduce the dispersion of the analyst estimates. Ng, Verrecchia, and Weber (2009) present a model and empirical evidence in which firms that report poor performance tend to experience increases in future earnings volatility. Rogers, Skinner, and Van Buskirk (2009) examine how management forecasts affect uncertainty over various option durations. They find that management forecasts, on average, increase uncertainty over various option durations (i.e., implied volatility increases in the days around the forecasts). Kim, Pandit, and Wasley (2010) find that there is a decrease in management forecasts during periods of high uncertainty. In contrast to these papers on the relation between disclosure and the magnitude of uncertainty, my paper abstracts away from the magnitude of uncertainty and focuses on how the relative duration or horizon of uncertainty is affected by disclosure. By analyzing changes in a firm's term structure of implied volatility, my

goal is to infer the relative amounts of short-term and long-term information in a firm's disclosure.[1]

2.2 Managerial myopia and the investor base

The importance of the distinction between long-term and short-term information is most relevant to the literature on managerial myopia and the investor base. There is evidence that a short-term focus can result in suboptimal investment policies and that short-term disclosures attract short-term investors that can destabilize the firm's stock price. Stein (1989a) shows that managers can behave myopically even in an efficient capital market. He shows that shorter management horizons lead to increasingly myopic behavior by managers. In a survey of managers, Graham, Harvey, and Rajgopal (2005) find that a surprisingly large number of managers admit to being willing to sacrifice long-run value to meet short-term earnings targets. Bhojraj and Libby (2005), in an experimental setting, find that managerial myopia is increasing in capital market pressure. They conclude that more frequent disclosure could cause greater myopia in the presence of significant stock market pressure. Consistent with the results of this experiment, Gigler et al. (2009) present a model where frequent short-term disclosures result in managerial myopia due to information imperfections in the market between managers and investors. They show that frequent reporting or forecasting of results increases the premature evaluation of projects with values that are only determined in the long-term, which causes managers to avoid these projects in favor of ones that generate short-term results. Bushee and Noe (2000) find that disclosures that attract short-term investors increase volatility. Managers care about their firm's investor base because short-term investors increase volatility which can

[1] The term structure is one dimension of the implied volatility surface. Van Buskirk (2009) examines the other dimension of the implied volatility surface, the volatility skew. He finds that high volatility skew predicts negative price jumps at earnings announcements, but not around management earnings forecasts or dividend declarations. See also Xing, Zhang, and Zhao (2010) and Jin, Livnat, and Zhang (2011).

increase the firm's cost of capital, increase pressure for short-term results, and reduce the manager's job security. Managers, therefore, aim to build a dedicated investor base.

Concerns over managerial myopia and short-term disclosures are not limited to academics. In his 2000 letter to shareholders, Warren Buffett stressed the importance of long-term strategy and not quarterly earnings. At the time Google went public, the founders established a disclosure policy of not providing earnings guidance due to the company's long-term focus. In 2005, former U.S. Securities and Exchange Commission Chairman William Donaldson referred to "short-termism" as a major issue. Also in 2005, a panel of the CFA Centre for Financial Market Integrity and the Business Roundtable Institute for Corporate Ethics recommended the abolition of quarterly guidance and a transition to "higher quality, long term, fundamental guidance practices" (Krehmeyer, Orsagh, and Schacht, 2006). Similarly, the U.S. Chamber of Commerce (2007) recommends that public companies stop issuing guidance. In addition, a focus on short-term earnings is the second most important cost of providing guidance according to a 2006 McKinsey survey of CFOs, CEOs, and board members of publicly held companies (Hsieh, Keller, and Rajan, 2006).[2]

In sum, distinguishing between short-term focused and long-term focused disclosures is central to the debate about firms' disclosure practices (e.g., mandatory quarterly reporting; voluntary earnings forecasts), managerial myopia, and firms' investor base.

2.3 The term structure of implied equity volatilities

To gauge the relative extent to which the information underlying securities prices reflects long-term versus short-term uncertainty and to assess the relative amounts of long-term and

[2] The survey finds the most important cost to be managements' time.

short-term information in corporate disclosures, I use the term structure of implied equity volatilities. Relatively little is known about how expected volatility varies with the forecast horizon (i.e., the term structure of expected volatility). Expected volatility forecasts of different horizons can be estimated using time-series models such as the ARCH model of Engle (1982), the GARCH model of Bollerslev (1986), or the EGARCH model of Nelson (1991). Each of these time-series models imposes a fixed structure on the term structure of expected volatilities, making an analysis of the term structure of expected volatilities based on these models uninteresting. In other words, the term structure of expected volatilities is solely a function of past stock returns in these models. Alternatively, one can infer the market's expectations of future volatility, also known as implied volatility, over various horizons from the prices of options with the same strike price but of different maturities (i.e., by using the term structure).[3] There is substantial evidence that implied volatility is superior to historical volatility and time-series models. See Poon and Granger (2003) for a review of that literature. This is not surprising because the series of past stock returns is only a small subset of investors' information sets.

Vanden (2008) presents a model in which the slope of an option's term structure is directly related to information quality (and information acquisition costs). He shows that in an economy with only long-lived information an upward sloping term structure is impossible; however, in an economy with short-lived information an upward sloping term structure is possible. The term structure slopes upward if information expires persistently faster than it is acquired. For example, if the term structure slopes upward (short-term implied volatility is less than long-term implied volatility) there is some information with a limited life that is keeping short-term uncertainty low, so that when that information expires uncertainty will increase. On

[3] This is analogous to calculating forward interest rates from the prices of bonds of different maturities.

the other hand, if the term structure slopes downward (meaning that short-term implied volatility is greater than long-term implied volatility) there is some long lasting information that is keeping long-term uncertainty relatively low.

Empirical work in finance examines the term structure of implied volatility at the index level. Prior work has not used the term structure of implied volatilities at the individual firm level as a way to distinguish between firms facing short-term and long-term uncertainty or as a way to determine the relative amounts of short-term and long-term information in firms' disclosures. The main interest in finance studies has been on the rationality of expected future volatility inherent in the term structure of implied volatility.

Stein (1989b) studies the term structure of implied volatility for S&P 100 index options. He models volatility as an AR(1) process and finds that given the change in short-term implied volatility, long-term implied volatility moves by more than expected by his AR(1) model. He concludes that this is evidence of overreaction in the options market because investors are overweighting new information and underweighting the typical relation between short-term and long-term volatility.[4] Heynen, Kemna, and Vorst (1994) do not find evidence of overreaction in the options market if the EGARCH model is used to model volatility rather than the mean-reverting stochastic volatility model used by Stein (1989b). Diz and Finucane (1993) critique Stein (1989b) for assuming that longer maturity implied volatility contains *no information* about expected future volatility that is *not already* captured by short-term implied volatility.[5]

[4] Vanden (2008) shows how changes in information quality can create movements in short-term and long-term implied volatilities that are consistent with those in Stein (1989b). He concludes that both overreaction and changes in information quality can impact the term structure of implied volatility. If option investors overreact differently to different types of firms, it is possible for behavioral biases to affect my *Horizon* and *Disclosure Horizon* measures (i.e., my measures may reflect investors' behavioral biases in addition to firms' economic fundamentals).

[5] A fundamental assumption of my paper is that there is additional information in long-term implied volatility that is not captured by short-term implied volatility.

CHAPTER 3

MEASURING *HORIZON* AND *DISCLOSURE HORIZON*

In this chapter, I provide details about the calculations of the *Horizon* and *Disclosure Horizon* measures.

3.1 Horizon

To analyze the information in the term structure of implied equity volatility, I create a measure that quantifies the slope of the term structure. My horizon measure captures the extent to which a firm faces relatively short-term versus long-term uncertainty. *Horizon* is a volatility-weighted average duration. It is similar in spirit to the intraperiod timeliness (IPT) measure used in accounting studies to capture the speed of price discovery over a period of time (e.g., Alford, Leftwich, and Zmijewski, 1993; Brown, Taylor, and Walter, 1999; Beekes and Brown, 2006; Butler, Kraft, and Weiss, 2007; Bushman, Smith, and Wittenberg-Moerman, 2010). *Horizon* measures the average timing of uncertainty. My approach assumes unbiased implied volatilities and efficiency in the options market. However, several papers document that option measures such as volatility skews, volatility spreads, and option trading imbalances predict future stock returns (e.g., Bates, 1991; Cao, Chen, and Griffin, 2005; Cremers and Weinbaum, 2010; Xing, Zhang, and Zhao 2010; Jin, Livnat, and Zhang 2011). It is unclear what, if any, impact these potential inefficiencies have on my measures.

Poon and Granger (2003) review evidence on the superior accuracy of implied volatilities relative to time-series models. There is limited evidence on who trades in the options markets.

However, it is not the case that option trading is dominated by small traders using discount brokers. Lakonishok, Lee, Pearson, and Poteshman (2007) provide evidence that a large majority of non-market maker activity is by full-service customers (which includes most hedge funds).

The first step in computing *Horizon* is to compute forward implied volatilities over a set of interim periods within a longer period. In this paper, the set of interim periods are four 91-day periods and the longer period is the 365-day period that contains the four 91-day periods.[1] Equation (1) generally defines the relation between the implied volatility of a first interim period ($\sigma^2_{t_0,t_1}$) that starts at t_0 and ends at t_1, the forward implied volatility of a second interim period ($\sigma^2_{t_1,t_2}$) that starts at t_1 and ends at t_2, and the implied volatility over the longer period ($\sigma^2_{t_0,t_2}$), that is made up of the two interim periods (i.e., it starts at t_0 and ends at t_2).[2] For example, if the implied volatility (σ) from day 0 (t_0) to day 30 (t_1) is 0.21 and the implied volatility from day 0 to day 60 (t_2) is 0.20, then the implied volatility from day 30 to day 60 is 0.19.

$$\sigma^2_{t_0,t_2} = \frac{1}{t_2 - t_0}((t_1 - t_0)\sigma^2_{t_0,t_1} + (t_2 - t_1)\sigma^2_{t_1,t_2}) \quad (1)$$

Using Equation (1) adapted to four sub-periods, I calculate forward implied volatilities for the second, third, and fourth 91-day periods. (It is not necessary to calculate the forward implied volatility for the first 91-day period because the implied volatility for the first 91-day period only captures the expected volatility over that 91-day period.) The second step is to measure the proportion of the total longer period volatility within each of the interim periods –

[1] I am limited to a 365-day horizon due to data constraints. Data is currently available on standardized options with durations as long as 730 days, but the data seems to be of lower quality and is limited in terms of the number firms and the length of the sample period. The usefulness of my approach increases as the liquidity in long-term options improves, as option exchanges expand the number of firms with LEAPS, and with the potential of even longer-term options than currently available being introduced in the future.

[2] Equation (1) assumes that returns are independent over time and is in terms of variances (σ^2) because variances are additive while standard deviations (σ) are not additive.

the proportion of the 365-day volatility occurring during each of the four 91-day periods. Because implied volatilities (and therefore the calculated forward implied volatilities) are quoted on an annualized basis, I multiply the daily variances for the 91-day periods (365-day period) by 91 (365). Equation (2) expresses the sum of these proportions, which sums to one by construction because all of the 365-day period volatility must occur during the four 91-day periods.

$$\frac{\sigma^2_{t_0,t_{91}}(91)}{\sigma^2_{t_0,t_{365}}(365)}+\frac{\sigma^2_{t_{92},t_{182}}(91)}{\sigma^2_{t_0,t_{365}}(365)}+\frac{\sigma^2_{t_{183},t_{273}}(91)}{\sigma^2_{t_0,t_{365}}(365)}+\frac{\sigma^2_{t_{274},t_{365}}(92)}{\sigma^2_{t_0,t_{365}}(365)}=1 \qquad (2)$$

The third and final step is to use these proportions to weight the duration of the corresponding interim period. The midpoints of the first, second, third, and fourth 91-day periods are 45, 135, 225, and 315 days, respectively. I use these midpoints as the durations of the four 91-day periods. Equation (3) is the formula for calculating *Horizon*.

$$Horizon=\frac{\sigma^2_{t_0,t_{91}}(91)}{\sigma^2_{t_0,t_{365}}(365)}(45)+\frac{\sigma^2_{t_{92},t_{182}}(91)}{\sigma^2_{t_0,t_{365}}(365)}(135)+\frac{\sigma^2_{t_{183},t_{273}}(91)}{\sigma^2_{t_0,t_{365}}(365)}(225)+\frac{\sigma^2_{t_{274},t_{365}}(92)}{\sigma^2_{t_0,t_{365}}(365)}(315) \qquad (3)$$

Horizon is measured in days. If the longer period is 365 days in length and forward volatilities are constant over the interim periods, then the volatility-weighted average duration or *Horizon* equals 180 days. Larger (smaller) values of *Horizon* indicate relatively more long-term (short-term) uncertainty. *Horizon* captures the distribution of uncertainty over time, and thereby whether firm information reflects relatively more long-term or short-term uncertainty.[3]

3.2 Disclosure Horizon

A firm's *Disclosure Horizon* captures the relative proportions of short-term and long-term information in a firm's disclosure by examining how disclosure affects the implied

[3] To the extent that there is seasonality within the year for some firms, error is introduced into *Horizon* for these seasonal firms.

volatilities of various durations. For example, if a disclosure results in a large change in the short-term implied volatilities, but results in little change in the long-term implied volatilities, then I conclude that the disclosure is short-term in nature. Whereas, if the disclosure affects long-term implied volatilities to a greater extent than short-term implied volatilities, then I conclude that the disclosure is long-term in nature.

The calculation of *Disclosure Horizon* is very similar to that of *Horizon* except for the following differences. I exclude the implied volatility over the first 30 days of the one year period from all implied volatilities when calculating *Disclosure Horizon*.[4] I do this in order to remove the uncertainty due to the disclosure event itself from both the pre-announcement and post-announcement implied volatilities. This is important because the pre-release implied volatilities impound the anticipated impact of scheduled announcements (e.g., Patell and Wolfson, 1979, 1981; Ederington and Lee, 1996; Rogers, Skinner, and Van Buskirk, 2009; Billings and Jennings, 2010).

To calculate *Disclosure Horizon*, I first compute the absolute value of log changes in forward volatilities around a disclosure for each of the four 91-day periods. For example, Equation (4) measures the absolute value of the percentage change in the variance during the first 91-day period (excluding the first 30 days) at a disclosure.

$$|\ln(\sigma^2_{t_{31},t_{91}post} / \sigma^2_{t_{31},t_{91}pre})| \quad (4)$$

I then measure the proportion of the sum of the absolute value of log changes in volatility over the 365-day period that pertains to each of the four 91-day periods and use these proportions to weight the duration of the corresponding 91-day period. Equation (5) is the formula for calculating *Disclosure Horizon*.

[4] Standardized options data is not available for durations less than 30 days.

$$\textit{Disclosure Horizon} = \frac{|\ln(\sigma^2_{t_{31},t_{91}post}/\sigma^2_{t_{31},t_{91}pre})|(45)+|\ln(\sigma^2_{t_{92},t_{182}post}/\sigma^2_{t_{92},t_{182}pre})|(135)+|\ln(\sigma^2_{t_{183},t_{273}post}/\sigma^2_{t_{183},t_{273}pre})|(225)+|\ln(\sigma^2_{t_{274},t_{365}post}/\sigma^2_{t_{274},t_{365}pre})|(315)}{|\ln(\sigma^2_{t_{31},t_{91}post}/\sigma^2_{t_{31},t_{91}pre})|+|\ln(\sigma^2_{t_{92},t_{182}post}/\sigma^2_{t_{92},t_{182}pre})|+|\ln(\sigma^2_{t_{183},t_{273}post}/\sigma^2_{t_{183},t_{273}pre})|+|\ln(\sigma^2_{t_{274},t_{365}post}/\sigma^2_{t_{274},t_{365}pre})|} \quad (5)$$

I use the absolute value of forward implied volatility changes to calculate *Disclosure Horizon* rather than signed differences because disclosure can cause uncertainty to increase or decrease. Clearly, disclosures regarding changes in firm risk can potentially increase or decrease uncertainty about firm value (e.g., Hughes and Pae, 2004). However, disclosures can increase or decrease uncertainty absent any explicit statements about firm risk. For example, uncertainty decreases as investors learn more about the parameters of the firm's earnings distribution through firm disclosures (e.g., Pastor and Veronesi, 2003). Alternatively, the unexpected nature of news can increase information asymmetry and volatility (e.g., Kim and Verrecchia, 1994). Similarly, management forecasts of negative news and management forecasts that are made by firms that do not typically forecast increase uncertainty about firm value (Rogers, Skinner, and Van Buskirk, 2009).

Because disclosure can increase or decrease uncertainty, examining signed differences in uncertainty does not allow one to draw a clear inference about whether the information in the disclosure was relatively short-term or long-term in nature. For example, if *Horizon* increases, this could be due to an increase in long-term uncertainty (holding short-term uncertainty fixed) or due to a decrease in short-term uncertainty (holding long-term uncertainty fixed). Hence, the signed change in *Horizon* at disclosures is not informative about whether the disclosure contained relatively more short-term or long-term information.

Disclosure Horizon and *Horizon* are of similar magnitudes due to the way these two variables are scaled. However, their interpretations are quite different. A low value of *Horizon* indicates that a large proportion of the 365-day uncertainty about firm value is concentrated early in the 365-day period. On the other hand, a low value of *Disclosure Horizon* indicates that over a three-day period uncertainty about firm value regarding the early part of the 365-day period has changed (either increased or decreased) to a greater extent than the uncertainty about firm value regarding the later part of the 365-day period.

CHAPTER 4

EMPIRICAL PREDICTIONS

4.1 Validating Horizon

In this section, I develop predictions used to test the validity of *Horizon* as a measure that distinguishes between firms facing relatively more short-term or long-term uncertainty.

4.1.1 Growth opportunities

Myers (1977) presents the value of a firm as the sum of the value of assets already in place and the present value of future growth opportunities. The present value of these future growth opportunities depends on future discretionary investment by the firm. Smith and Watts (1992) document that firms with more growth options have lower leverage, lower dividend yields, higher executive compensation, and greater stock-option compensation. These relations are not surprising given that firms with high growth opportunities are valued to a greater extent on long-term potential than firms with low growth opportunities. The resolution of uncertainty regarding long-term potential takes time and is therefore more likely to occur later in the future. Therefore, I predict growth opportunities to be positively related to the relative amount of long-term uncertainty faced by a firm.

Firms invest in research and development because they have potential for growth. Kothari, Laguerre, and Leone (2002) document a positive relation between current R&D expenditures and the standard deviation of the next five annual earnings realizations. This

suggests that R&D activities are positively related to uncertainty. My interest is not in the magnitude of uncertainty, but in the timing of uncertainty. I expect a firm's R&D expenditures to be positively related with the extent to which the firm engages in long-term projects whose uncertainty takes longer to resolve. Therefore, I predict a firm's R&D expense to be positively related to the relative amount of long-term uncertainty faced by the firm. I also predict R&D expense to have a stronger, positive relation to the relative amount of long-term uncertainty than capital expenditures because capital expenditures are less likely to be long-term projects whose uncertainty takes a long time to resolve.

4.1.2 Negative shocks

Ng, Verrecchia, and Weber (2009) find that poor earnings performance is associated with increases in firm risk. Ertimur (2004) finds that firms reporting losses are associated with greater information asymmetry than firms reporting profits. However, it is not clear whether the increased risk and greater informational asymmetry experienced by loss firms is due to short-term or long-term concerns. Accounting losses are indicative of negative shock to a firm (poor performance). To the extent that a firm must overcome this negative shock to survive, I expect accounting losses to be positively related to the relative amount of short-term uncertainty faced by a firm.

The leverage and "volatility feedback" effects predict equity volatility to increase after bad news (e.g., Black, 1976; Christie, 1982; French et al., 1987; Campbell and Hentschel, 1992). Negative market returns are indicative of negative shocks (bad news) to the economy. At the macroeconomic level, I expect short-term uncertainty to increase relative to long-term uncertainty at the time of negative market-wide shocks. For example, during the height of the

financial crisis of 2008, the market was pricing the potential collapse of the United States financial system. I expect investors to become relatively more concerned about the short-term during times of crisis because it is not clear whether there will even be a long-term.

Larger firms are typically more diversified, which makes large firms more stable and more likely to survive a temporary negative shock than small firms. Therefore, I expect firm size and firm stability to be negatively related to the relative amount of short-term uncertainty.

4.1.3 Product development cycles

Industries vary in the length of their product development cycles. Bushman, Indjejikian, and Smith (1996) find that CEOs are more likely to be evaluated subjectively rather than with objective accounting measures when their firms have longer product development cycles. I expect long-term (short-term) uncertainty to be relatively greater for firms in industries with long (short) product development cycles.

4.2 Predictions about Disclosure Horizon at earnings announcements

In this section, I develop predictions about the disclosure horizon of the information at earnings announcements.

Collins, Kothari, Shanken, and Sloan (1994) show that a lack of earnings timeliness helps explain the low contemporaneous return-earnings association. This lack of timeliness is due to the fact that many economic events will not be captured in earnings until future periods. This lack of timeliness increases with the amount of growth opportunities. For similar reasons other researchers find that accounting earnings are a relatively poor measure of performance for firms facing long-term uncertainty (e.g., Bushman, Indjejikian, and Smith, 1996; Amir and Lev, 1996;

Aboody and Lev, 1998; Lev and Sougiannis, 1996; Tasker, 1998; Lev and Zarowin, 1999). Therefore, I expect the relative amount of long-term information in a firm's earnings announcements to be negatively related to the relative amount of long-term uncertainty faced by the firm.[1]

I also examine whether firms that issue earnings guidance with their earnings announcements provide relatively more short-term information than firms that do not issue earnings guidance with their earnings announcements. Critics of earnings guidance claim that earnings guidance either causes or is indicative of a short-term focus that is harmful to a firms' long-run value (e.g., Fuller and Jensen, 2002; Krehmeyer et al., 2006; Hsieh et al., 2006; U.S. Chamber of Commerce, 2007). However, there is little empirical evidence to support this claim, and this claim is not obviously true. For example, given that earnings guidance is a forward looking disclosure and that it is potentially positively correlated with other forward looking statements, it is conceivable that firms that issue earnings guidance provide relatively more long-term information than firms that do not issue earnings guidance. Therefore, I do not make a prediction regarding this empirical question.

[1] I have no reason to believe that firms facing relatively high long-term uncertainty release information about their long-term projects with their earnings announcements to any large degree. For example, information regarding an FDA drug approval is more likely to be disclosed immediately rather than held until the firm's earnings announcement.

CHAPTER 5

SAMPLE AND DATA

I obtain implied volatilities from the OptionMetrics Standardized Options dataset.[1] I require firms to have implied volatilities on standardized options from OptionMetrics for the following durations: 30, 91, 182, 273, and 365 days.[2] I collect management forecasts from First Call, financial statement data from Compustat, stock market data from CRSP, and analyst forecast data from IBES. My sample period is from January 2001 through October 2010. I start in January 2001 to ensure a consistent regulatory regime (Regulation Fair Disclosure was enacted towards the end of 2000) and because there are a relatively small number of firms prior to 2001.[3] Table 1 presents the number of sample firms, the percentage of these firms in the S&P 500 index, and the number of firm-quarters by year.

The number of firms increases over the sample period up until 2009 due to the increasing popularity of Long-term Equity AnticiPation Securities (LEAPS).[4] The reason for the large drop in the number of firms in 2009 and 2010 is unclear to me, but likely related to the financial crisis.[5] LEAPS are the same as regular equity options except that these contracts are of a longer duration (i.e., durations greater than nine months). A firm must have LEAPS in order for there

[1] See http://wrds.wharton.upenn.edu/ds/optionm/manuals/IvyDBReference.pdf for more information about OptionMetrics and their method for creating standardized options and calculating implied volatilities.
[2] Durations of 547 and 730 are also available on OptionMetrics. I do not use these durations because the data appear incomplete.
[3] Data is available from OptionMetrics as far back as 1996.
[4] The CBOE launched LEAPS in 1990.
[5] The large drop in the number of firms in 2009 is not unique to the OptionMetrics database. A secondary source also shows a large decrease in the number of firms with LEAPS in 2009. For a current list of securities with exchange-traded LEAPS, see The Options Industry Council web-site.

to be implied volatility data on standardized options with durations greater than 182 days. 54% of sample firm-years are in the S&P 500 index.

Table 2 presents descriptive statistics for the firm-quarters in my sample and for the S&P 500 index option (SPX). *Horizon* is equal to a firm's volatility-weighted duration. When calculating *Horizon*, I average the implied volatilities of the previous five trading days to remove noise and to ensure that the firms' options trade regularly. Because I am interested in the relation between *Horizon*, which can be measured daily, and financial statement data, which is available quarterly, I select one day during the quarter to measure *Horizon*. Specifically, I measure *Horizon* 45 days after the firm's earnings announcement. I select 45 days because implied equity volatility exhibits a predictable pattern in the days around earnings announcements (e.g., Patell and Wolfson, 1979, 1981; Rogers, Skinner, and Van Buskirk, 2009). The mean and median of *Horizon* indicate that it is typical for firms to face slightly relatively more short-term uncertainty; the mean and median are both slightly less than 180 days, at 178 and 179 days, respectively. $Horizon_{SPX}$ is equal to the volatility-weighted duration for the S&P 500 index option (SPX), measured on the same days as the firm-level *Horizon*. In contrast to the individual firms, the mean and median of $Horizon_{SPX}$ are both greater than 180 days, at 185 and 186 days, respectively. The mean and median of $Horizon_{SPX}$ are greater than the mean and median of *Horizon*, which indicates that firms face relatively more short-term uncertainty than the market.

To get an idea of how $Horizon_{SPX}$ varies over time, Figure 1 presents a graph of $Horizon_{SPX}$, measured each day of the sample. The graph shows that it is typical for there to be relatively more long-term uncertainty at the market level (i.e., $Horizon_{SPX}$ is usually greater than 180 days). However, at the time of negative market returns there appears to be relatively more

short-term uncertainty (e.g., late 2002 and late 2008). This is consistent with my prediction about the relation between negative shocks and the horizon of uncertainty.

Figures 2, 3, and 4 show how *Horizon* varies over time for three individual firms. The firms are Analog Devices Inc. (ADI), Intuit Inc. (INTU), and Wal-Mart Stores Inc. (WMT). These firms are from the set of firms with data for each day of the sample period (2,471 trading days). From this set of firms, ADI has the smallest mean *Horizon* (174.93 days), INTU has the mean *Horizon* closest to 180 days (180.30 days), and WMT has the largest mean *Horizon* (186.55 days). In untabulated results, the Pearson and Spearman rank correlations between these firms' horizons range from 0.31 (Spearman rank correlation between ADI and WMT) and 0.54 (Pearson correlation between ADI and INTU). WMT is the most strongly correlated of these three firms with SPX (Pearson correlation of 0.59), while ADI is the least correlated with SPX (Pearson correlation of 0.51).

To investigate the relation between *Horizon* and variables designed to measure differences in the relative amounts of short-term and long-term uncertainty, I measure size as *Ln(Assets)*, volatility (the opposite of stability) as σ_{365}, growth opportunities as *Ln(MB)*, *R&D*, *R&D Indicator*, and *CapEx*, negative shocks as *Loss*, market-level horizon as $Horizon_{SPX}$, and product development cycles as PDC_{Short} and PDC_{Long}.

Ln(Assets) is equal to the natural logarithm of the firm's most recent quarter's total assets. The average firm in my sample has more than $5 billion in assets, which is relatively large compared to the universe of publicly traded firms during my sample period. σ_{365} is the standard deviation of the firm's daily returns over the previous 365 calendar days.

Ln(MB) is equal to the natural logarithm of the firm's market-to-book ratio, which is the firm's current (45 days after the earnings announcement) market value divided by the firm's most recent quarter's book value of shareholder's equity. *R&D* is equal to the sum of the firm's R&D expense for the prior four quarters divided by the most recent quarter's total assets. *R&D Ind* is equal to one if *R&D* is greater than zero, and zero otherwise. *CapEx* is equal to the sum of the firm's capital expenditures for the prior four quarters divided by the most recent quarter's total assets.

Loss is equal to one if the firm's most recent quarter's income before extraordinary items is less than zero, and zero otherwise. Firms report losses in 20% of the firm quarters in my sample, which is a relatively low percentage.[6] This relatively low percentage reflects the profitable nature of firms with long-term exchange traded options and supports my use of accounting losses as a measure of a negative firm-specific shock.

PDC_{Short} (PDC_{Long}) is equal to one if the firm's industry is classified as having a short (long) product development cycle in Bushman, Indjejikian, and Smith (1996), and zero otherwise. The classification in Bushman, Indjejikian, and Smith (1996) is adapted from a classification by the National Academy of Engineering. Because the classification is not exhaustive, some industries are classified has having neither a short nor a long product development cycle.

[6] For example, Givoly and Hayn (2000) find that 34% of firm-years from 1991-1998 are loss years.

CHAPTER 6

EMPIRICAL RESULTS

6.1 Horizon, firm characteristics, and market conditions

In this section, I test my predictions about the validity of *Horizon* as a measure that distinguishes between firms facing relatively more long-term or short-term uncertainty. Table 3 presents Pearson and Spearman rank correlations for all of the variables of interest. Not surprisingly, *Horizon* is strongly associated with $Horizon_{SPX}$. This suggests that economic conditions similarly affect the relative timing of uncertainty for both firms and the market. As predicted, *Horizon* is positively related to *Ln(Assets)* and *Ln(MB)* and negatively correlated with *Loss*, σ_{365}, and PDC_{Short}.

In order to test my predictions, I estimate variations of the following regression (firm and time subscripts suppressed):

$$\begin{aligned} Horizon = {} & \beta_1 Ln(Assets) + \beta_2 Ln(MB) + \beta_3 R\&D \text{ (or } R\&D\ Ind) + \beta_4 CapEx + \beta_5 Loss + \beta_6 Horizon_{SPX} \\ & + \beta_7 PDC_{Short} + \beta_8 PDC_{Long} + \beta_9 Ln(OpInt) + \beta_{10} Ln(Vol) + \beta_{11} StOpInt + \beta_{12} StVol + \\ & \beta_{13}\sigma_{365} + \text{Year-quarter fixed effects} + \varepsilon \end{aligned} \quad (6)$$

Table 4 presents the results.[1] *R&D* and *R&D Ind* are both positively related to *Horizon*. The coefficient on *R&D Ind* suggests that, on average, firms that invest in research and development have a *Horizon* that is 1.27 days longer than firms that do not invest in research and development. This means that more of the uncertainty about firm value for firms that invest in

[1]All regression t-statistics in this paper are calculated based on two-way (by 2-digit SIC code and year-quarter) cluster-robust standard errors (e.g., Petersen, 2009; Gow et al., 2010) to correct for cross-sectional and time-series dependence.

research and development occurs later relative to firms that do not invest in research and development. While 1.27 days may not appear to be of large economic significance, it is a relatively large proportion (about 10%) of the interquartile range and the standard deviation of *Horizon* (about 11 days). The variation in *Horizon* is naturally small given that its range is bounded between 45 and 315 and that all firms are going to have at least some uncertainty in each of the four interim periods. In addition, bear in mind that I am measuring the timing of uncertainty only within a 365-day period. Detecting differences in the timing of uncertainty using such an approach is decreasing in the extent to which one year does not represent the long-term for a firm. For example, if information regarding uncertainty about all of a firm's projects takes longer than one year to arrive, this approach would not conclude that such a firm faces relatively more long-term uncertainty.

Consistent with my prediction, I find that the coefficient on *R&D* is significantly greater than the coefficient on *CapEx*. This suggests that the uncertainty regarding research and development takes longer to resolve than uncertainty regarding capital expenditures. Also consistent with a positive relation between growth opportunities and long-term projects, I find that *Ln(MB)* is positively related to *Horizon*.

Consistent with negative shocks shifting relative uncertainty towards the present, I find that losses are negatively related to *Horizon*. The coefficient on *Loss* suggests that, on average, firms that report an accounting loss for the previous quarter face a *Horizon* that is between 1.16 and 1.53 days shorter than firms that report profits. The coefficient on *Loss* in the fourth regression is insignificant due to its correlation with σ_{365}. This is not surprising because firms with a loss this quarter are likely to have higher volatility during the past year than profitable firms. Also consistent with negative shocks shifting relative uncertainty towards the present, in

untabulated results, I find that the coefficients on the year-quarter fixed effects tend to be greater during times of market strength (e.g., 2003 and 2004) and tend to be smaller during times of market weakness (e.g., 2008). For example, on average, firms' *Horizons* were more than 10 days shorter during the fourth quarter of 2008, which was a period of extreme market weakness, than they were during the first quarter of 2001.

As I expected, I find that firm size, measured as *Ln(Assets)*, is positively related to *Horizon*. I also find that σ_{365} is negatively related to *Horizon*. These two results are consistent with larger firms and stable firms being more likely to be able to withstand a temporary negative shock.

I find that firms with short product development cycles have shorter horizons than average (i.e., firms classified as having neither short nor long product development cycles), in the first and second regressions. In the first regression, I find that the coefficient on PDC_{Short} is significantly less (at the 10% level) than the coefficient on PDC_{Long}, which suggests that firms in short product development industries have shorter horizons than firms in long product development industries. This result is significant at the 5% level if *Ln(MB)* and *R&D Ind* are excluded from the regression (untabulated). However, there is not a significant difference between the coefficients on PDC_{Short} and PDC_{Long} in the second, third, or fourth regressions.

$Horizon_{SPX}$ and the year-quarter fixed effects explain the large majority of the variation in *Horizon*. In untabulated results, a regression of *Horizon* on solely these variables yields an Adj. R^2 of 16.99%, while the regressions in Table 4 have Adj. R^2 that range from 20.53% to 25.70%. This suggests that market-wide economic conditions play the most important role regarding the timing of uncertainty about firm value within a period of one year.

In the third and fourth regressions, I include controls for option liquidity and option investor interest. *Ln(OpInt)* is equal to the natural logarithm of the total open interest of all exchange traded options for that firm. *Ln(Vol)* is equal to the natural logarithm of the total volume of all exchange traded options for that firm. *StOpInt* is equal to the proportion of the total open interest in exchange traded options with less than nine months to expiration. *StVol* is equal to the proportion of the total volume in exchange traded options with less than nine months to expiration. I measure *Ln(OpInt)*, *Ln(Vol)*, *StOpInt*, and *StVol* on the same day as *Horizon*. Sample firms must have non-zero open interest and volume in their exchange traded options. To the extent that investor interest in short-term options drives up their implied volatilities, I expect *StOpInt* and *StVol* to be negatively related to *Horizon*.

I find that *Ln(OpInt)* and *Ln(Vol)* are negatively related to *Horizon*. This suggests that option investors prefer to trade options on firms with relatively higher short-term uncertainty. As expected the coefficients on *StOpInt* and *StVol* are significantly negative. This is consistent with greater trading in a firm's short-term options driving up the short-term implied volatilities relative to long-term implied volatilities which results in a smaller *Horizon*. The liquidity and investor interest control variables are important because they show that the results regarding firm characteristics and market conditions are not due to differing amounts of liquidity and investor interest.[2]

An alternative explanation to some of these results regarding the term structure of implied volatilities and firm characteristics is that due to some behavioral or institutional bias option investors trade differently based on the firm characteristics that I've identified. For

[2] The results in Table 4 are robust to using a non-continuous horizon measure. Specifically, I create a variable that is equal to one for the top 20% of the *Horizon* measure by year-quarter, equal to zero for the middle 60%, and equal to negative one for the bottom 20%. This robustness test suggests that the results are not driven by outliers.

example, it could be the case that investors overpay for long-term options on firms with high R&D and underpay for long-term options on firms with low R&D. I leave it to future research to create and test a profitable option trading strategy that takes advantage of these potential biases.

6.2 Horizon and the term structure of the dispersion in analysts' earnings forecasts

To provide further evidence that *Horizon* is capturing differences in investor uncertainty over different horizons, I test for an association between *Horizon* and the term structure of the dispersion in analysts' earnings forecasts. Since analysts' uncertainty about earnings over various horizons is measurable through the dispersion in analyst estimates for these various horizons, a term structure of analyst uncertainty can be created which I call *AnalystTermSt*. *AnalystTermSt* is equal to the standard deviation of analyst estimates for the firm's next fiscal year's earnings scaled by the median estimate for the next fiscal year divided by the standard deviation of analyst estimates for the firm's current fiscal year's earnings scaled by the median estimate for the current fiscal year.[3] It captures the amount of uncertainty over next year's earnings relative to the amount of uncertainty over this year's earnings.[4] The descriptive statistics in Table 3 show that analysts are, on average, nearly twice as uncertain about next year's earnings as they are about this year's earnings (mean of *AnalystTermSt* is 1.93).

Note, however, that *Horizon* captures uncertainty about firm value, while the term structure of the dispersion in analysts' earnings forecasts captures uncertainty about earnings. These are two distinct constructs, but should be positively related. To test this I estimate the following two regressions (firm and time subscripts suppressed):

[3] Firms with a median earnings estimate less than $0.10 per share for the current fiscal year or the next fiscal year are excluded to avoid problems with a small denominator.
[4] I focus on this year's and next year's earnings because the number of analysts making forecasts declines as one goes further out into the future.

$$AnalystTermSt = \beta_1 Ln(Assets) + \beta_2 Ln(MB) + \beta_3 R\&D + \beta_4 CapEx + \beta_5 Loss + \beta_6 Horizon_{SPX} + \beta_7 PDC_{Short} + \beta_8 PDC_{Long} + \beta_9 Ln(OpInt) + \beta_{10} Ln(Vol) + \beta_{11} StOpInt + \beta_{12} StVol + \beta_{13}\sigma_{365} + \text{Year-quarter fixed effects} + \varepsilon \quad (7)$$

$$Horizon = \beta_1 Horizon_{SPX} + \beta_2 AnalystTermSt + \beta_3 \#Analyst_{St} + \beta_4 \#Analsyt_{Lt} + \beta_5 Ln(OpInt) + \beta_6 Ln(Vol) + \beta_7 StOpInt + \beta_8 StVol + \text{Year-quarter fixed effects} + \varepsilon \quad (8)$$

Table 5 presents the results. The first regression in Table 5 is the same as the fourth regression from Table 4 except that the dependent variable is *AnalystTermSt* rather than *Horizon*. The purpose of this regression is to determine whether the independent variables load on *AnalystTermSt* in a similar fashion as they do on *Horizon*. *R&D*, PDC_{Short}, and σ_{365} have significant coefficients of the same sign as in Table 4. This suggests that, like option investors, analysts view firms with more R&D as having more uncertainty about the long-term and view firms from short product develop cycle industries and firms with greater past volatility as having more uncertainty about the short-term. The other variables in the regression do not have significant coefficients.

The second regression tests whether there is a positive relationship between *AnalystTermSt* and *Horizon*. I control for the number of analysts giving forecasts for the current year and next year. $\#Analyst_{St}$ is equal to the number of analyst forecasts made during the current quarter for the firm's current fiscal year earnings. $\#Analyst_{Lt}$ is equal to the number of analyst forecasts made during the current quarter for the firm's next fiscal year earnings. I also control for $Horizon_{SPX}$ and for option liquidity. I find that there is a significantly positive relationship between *AnalystTermSt* and *Horizon*. The advantage of *Horizon* over the term structure of analyst uncertainty is that it can be calculated on a daily basis, whereas analysts do not update their forecasts that frequently. Another advantage of *Horizon* is that uncertainty about stock price incorporates uncertainty about earnings and that market-based sources of information are generally superior to other sources of information.

6.3 Disclosure Horizon and earnings guidance at earning announcements

Table 6 presents descriptive statistics for the *Disclosure Horizon* measure and other variables for bundled earnings announcements, non-bundled earnings announcements, and all earnings announcements. *Disclosure Horizon* measures whether changes in implied volatilities at earnings announcements occur primarily in a firm's short-term options or in a firm's long-term options. I exclude earnings announcements whose denominator in the *Disclosure Horizon* formula (i.e., the total percentage change in implied volatilities across the four interim periods) is less than the median denominator value of 0.35.[5] I do this to avoid the problem of a small denominator and because small changes in total uncertainty are more likely to result in noisy changes within the four interim periods than are large changes in total uncertainty. $Horizon_{pre}$ is the firm's volatility-weighted duration two days prior to the earnings announcement. The implied volatility for the first 30 days is excluded from the calculations of *Disclosure Horizon,* $Disclosure\ Horizon_{SPX}$, $Horizon_{pre}$, and $Horizon_{pre,SPX}$ to remove any effect due the announcement itself from the variables.

The financial statement data are calculated in the same way as before except that I use the information in the current earnings announcement and the market value, used in calculating *Ln(MB)*, is measured just prior to the earnings announcement. $Horizon_{pre,SPX}$ is the SPX's volatility-weighted duration two days prior to the earnings announcement. $Disclosure\ Horizon_{SPX}$ is equal to the volatility-weighted duration change for the S&P 500 index option (SPX), over the same three-day earnings announcement windows as the firms. *AnnRet* is equal to the firm's compounded three-day stock return during the earnings announcement window. $AnnRet^2$ is equal to *AnnRet* squared. Unlike in the previous tables, *Ln(OpInt)* and *StOpInt* are from the day prior to the three-day earnings announcement window. In untabulated results, I

[5] The results in Tables 8 and 9 are robust to including all observations.

find that on average, *Disclosure Horizon* is lower at earnings announcements. This suggests that on average earnings announcements contain relatively more short-term information because earnings announcements affect short-term options (even after excluding the first 30 days) to a greater extent than the long-term options. Also note that the mean of $Horizon_{pre}$ for the full sample is 176 days which is less than the mean *Horizon* from Table 2 of 178 days. This suggests that *Horizon* decreases prior to an earnings announcement (even after excluding the first 30 days' implied volatility from the calculation of $Horizon_{pre}$).[6]

The mean of *Disclosure* $Horizon_{SPX}$ (155 days) is much less than the mean of *Disclosure Horizon* (189 days) at firms' earnings announcements. In untabulated results, I find that this holds outside of firms' earnings announcements as well. It is not clear why this is the case. This suggests that day to day information is more short-term in nature for the S&P 500 than it is for the average firm.

Consistent with Anilowski, Feng, and Skinner (2007) and Rogers and Van Buskirk (2009), a large percentage, 41%, of the earnings announcements in my sample contain earnings guidance. The means for *Disclosure* $Horizon_{SPX}$, $Horizon_{pre}$, *StOpInt*, and $AnnRet^2$ significantly differ across the bundled and non-bundled samples.

To get an idea for the relations between the variables of interest, Table 7 presents Pearson and Spearman rank correlations for all of the variables of interest at earnings announcements. The strongest relation is the negative correlation between *Disclosure Horizon* and $Horizon_{pre}$. This suggests that the relative amount of short-term information increases as the relative amount of long-term uncertainty increases. *Disclosure Horizon* is uncorrelated with *Disclosure* $Horizon_{SPX}$ which suggests that the horizon of information in a firm's earnings announcement is

[6] If the implied volatility for the first 30 days were to be included in the calculation, the mean of $Horizon_{pre}$ would be 173 days.

uncorrelated with the horizon of market information during the firm's earnings announcement window.

In order to test my predictions from section 4.2 about the disclosure horizon of the information at earnings announcements, I estimate the following regression (firm and time subscripts are suppressed):

$$\begin{aligned} \textit{Disclosure Horizon} = {} & \beta_1 \textit{Horizon}_{pre} + \beta_2 \textit{Bundled} + \beta_3 \textit{Horizon}_{pre,SPX} + \beta_4 \textit{Disclosure Horizon}_{SPX} + \\ & \beta_5 \textit{AnnRet} + \beta_6 \textit{AnnRet}^2 + \text{Year-quarter fixed effects} + \varepsilon \end{aligned} \quad (9)$$

Table 8 presents the results of this regression. The significantly negative coefficient on $\textit{Horizon}_{pre}$ indicates that firms with relatively more long-term uncertainty have earnings announcements with relatively more short-term information (i.e., the information in their earnings announcements affects short-term uncertainty relatively more than long-term uncertainty). This is consistent with accounting earnings not being as good a measure of performance for firms facing long-term uncertainty (e.g., firms with large investments in R&D and/or many growth opportunities).

The significantly negative coefficient on *Bundled* indicates that firms that bundle earnings guidance with their earnings announcements, on average, have a *Disclosure Horizon* that is nearly three days shorter than firms that do not bundle. This means that bundled earnings announcements affect short-term implied volatilities to a relatively greater extent than they affect long-term implied volatilities, which suggests that there is relatively more short-term information in bundled earnings announcements than in non-bundled earnings announcements. This result is consistent with a positive association between the issuance of earnings guidance and a short-term focus. This result is also consistent with Rogers, Skinner, and Van Buskirk (2009) who find that stand-alone management forecasts affect short-term implied volatility to a greater extent than long-term implied volatility.

The significantly positive coefficient on *AnnRet* indicates that the information at good news earnings announcements affects long duration options relatively more than the information in bad news earnings announcements. This suggests that good news at earnings announcements is longer-term in nature than bad news and consistent with bad news being more transitory than good news (see Basu, 1997; Hayn, 1995). Another explanation is that bad news inherently increases uncertainty more than good news. Recall (e.g., Figure 1) that periods of bad news and high volatility have more uncertainty in the short-term than the long-term.

The significantly negative coefficient on $AnnRet^2$ is consistent with extreme earnings news being less persistent because the short-term implied volatilities are affected to a greater extent than the long-term implied volatilities. If a piece of information is persistent (i.e. has long-term implications) it should affect the long-term volatilities just as much as the short-term volatilities, which is not the case with extreme news at earnings announcements. This result is consistent with Freeman and Tse (1992) which document that the stock market's response to earnings news is nonlinear (i.e., the stock market responds less per unit of extreme news).

6.4 Open interest in short-term options at bundled announcements

In the previous section, I show that bundled earnings announcements are associated with relatively greater amounts of short-term information than non-bundled earnings announcements. Bushee and Noe (2001) find that transient institutions are drawn to firms with short-term information events. In this section, I examine whether there is more open interest in the short-term options prior to bundled earnings announcements. While all options trading is short-term to a certain extent, a trader in a 30-day contract is likely speculating or hedging in a way that differs greatly from a trader in a 365-day contract. To the extent that bundling earnings guidance with earnings announcements is persistent and/or predictable and indicative of a firm's overall

disclosure strategy, I expect "transient option investors", like the transient institutions in Bushee and Noe (2001), to be attracted to these firms' short-term options and trade more heavily in them than in the options of firms that do not bundle. To test this prediction, I estimate the following regression:

$$StOpInt = \beta_1 Horizon_{pre} + \beta_2 Bundled + \beta_3 Horizon_{pre,SPX} + \beta_4 Ln(OpInt) + \text{Year-quarter fixed effects} + \varepsilon \quad (10)$$

Table 9 presents the results of this regression. The significant coefficient of 0.014 on *Bundled* indicates that firms that bundle their earnings announcement with earnings guidance have 1.4% more open interest in options with less than nine months to expiration than firms that do not bundle. This is consistent with more short-term trading in firms that bundle their earnings forecasts. This suggests that using open interest in short-term options prior to information events is a potentially useful proxy for detecting short-term trading activity and also potentially useful in evaluating the nature of a firm's disclosures. Future research should analyze the similarities and benefit of this approach compared to the Bushee (1998 and 2001) classification.

CHAPTER 7

CONCLUSION

Using the term structure of implied equity volatilities, I develop a measure, *Horizon,* to capture whether a firm is subject to relatively more short-term or long-term uncertainty. I validate my measure by showing that it is positively related to R&D expenditures and growth opportunities. I also find that *Horizon* is positively related to firm size as well as firm stability and negatively related to accounting losses and negative market-wide shocks.

Using a similar approach, I develop a measure, *Disclosure Horizon*, which determines whether a firm's disclosure contains relatively more short-term or long-term information. I find that firms facing relatively more long-term uncertainty have earnings announcements that contain relatively more short-term information. This suggests that accounting earnings are less useful in conveying long-term information for firms with high amounts of long-term uncertainty. I also find that bundled earnings announcements are associated with relatively more short-term information than non-bundled earnings announcements. This finding is consistent with earnings guidance being associated with a short-term focus by managers. There is also greater trading in short-term options prior to bundled earnings announcements compared to non-bundled earnings announcements. This suggests that the short-term focus by managers exhibited in earnings guidance attracts short-term investors.

My *Horizon* measure is a market-based measure of a firm's duration which expands our understanding of the firm and its risks. For example, investors can use *Horizon* to anticipate the timing of major events and to determine whether a change in volatility is temporary or expected

to persist. The relation between *Horizon* and future investment should be examined in future research, as well as, *Horizon*'s usefulness as a measure of market sentiment and the relation between *Horizon* and future returns (or cost of capital).

My *Disclosure Horizon* measure potentially broadens researchers' ability to evaluate the nature of various types of corporate disclosures. For example, one interesting corporate disclosure to examine in the future may be conference presentations (Bushee, Jung, and Miller, 2010). In these conference presentations, managers usually disclose information about the long-run strategy of the business to build a loyal "dedicated" investor base. *Disclosure Horizon* would measure the relative amount of long-run information provided during these presentations, which is an interesting dimension of disclosure that has been largely unexplored by prior research.

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APPENDIX: FIGURES AND TABLES

Figure 1: Horizon of the S&P 500 (SPX)

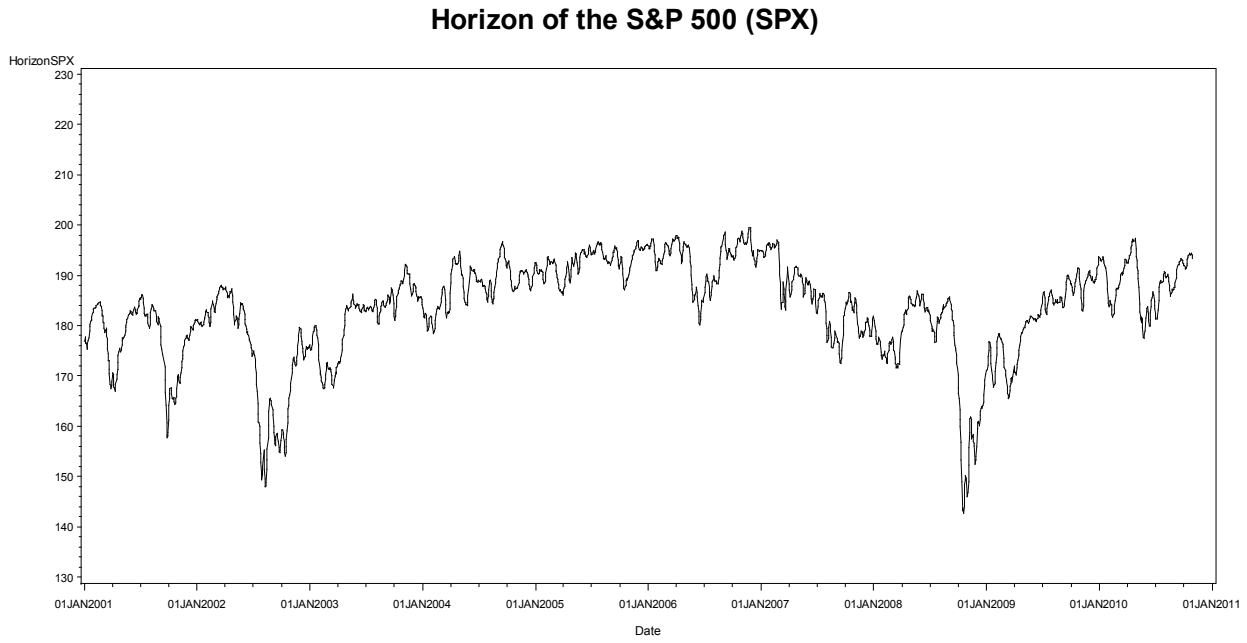

Figure 2: Horizon of Analog Devices Inc. (ADI)

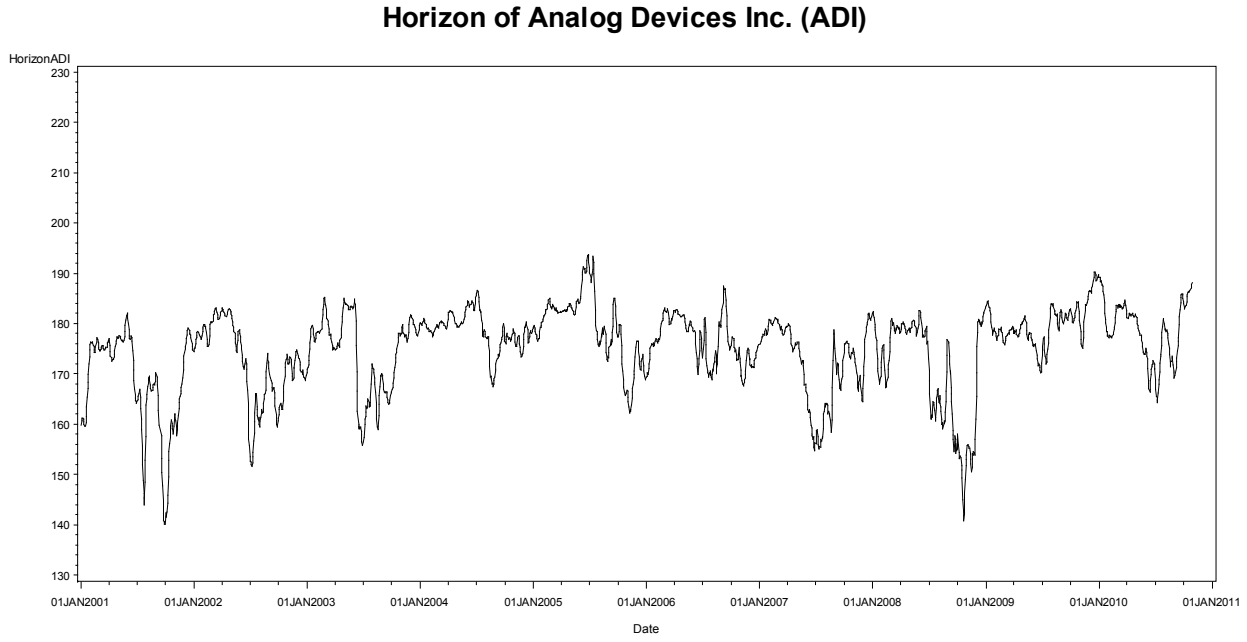

Figure 3: Horizon of Intuit Inc. (INTU)

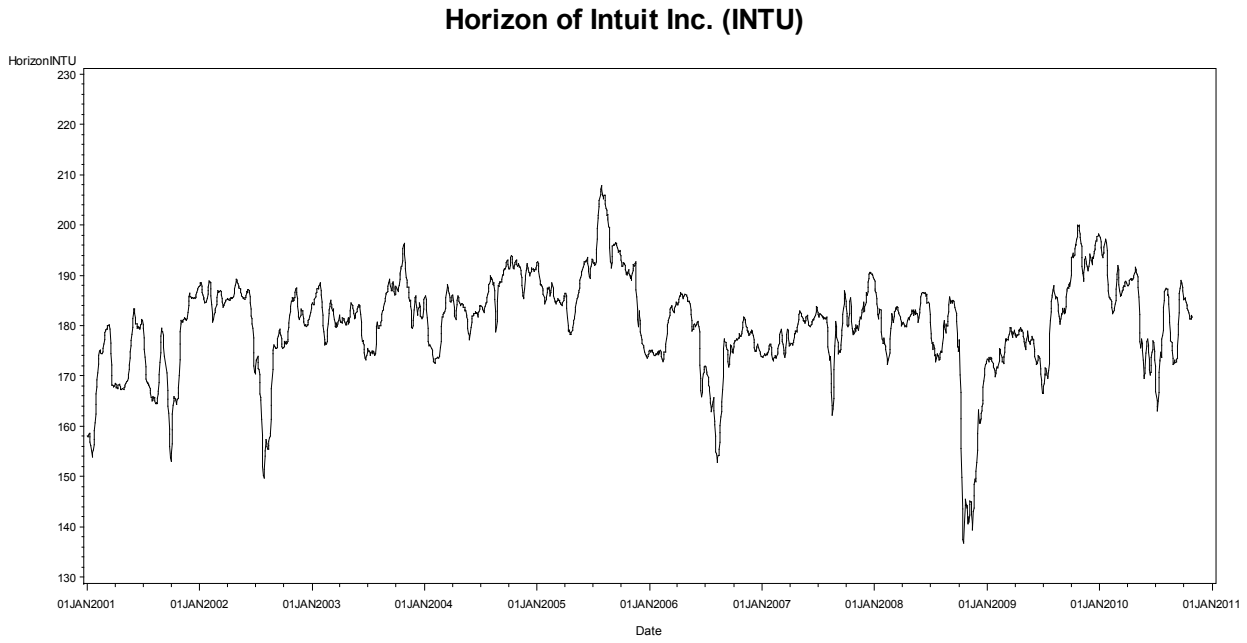

Figure 4: Horizon of Wal-Mart Stores Inc. (WMT)

Table 1
Sample Description

Year	Number of firm-years	In S&P 500 index	Number of firm-quarters
2001	288	70%	929
2002	335	71%	1,127
2003	450	68%	1,508
2004	538	62%	1,875
2005	647	54%	2,151
2006	771	47%	2,599
2007	933	41%	3,031
2008	941	41%	3,166
2009	579	59%	2,025
2010	545	63%	1,562
Total	6,027	54%	19,973

This table presents the number of firms, the percentage of these firms in the S&P 500 index, and the number of firm-quarters in my sample by year. Firms must have implied volatilities on standardized options from OptionMetrics for all of the following durations: 30, 91, 182, 273, and 365 days. Firms must also have stock market data on CRSP and financial statement data on Compustat. The sample period is from January 2001 through October 2010. There are 1,297 unique firms in this sample.

Table 2
Descriptive Statistics

Variable	N	Mean	Std. Dev.	25th	Median	75th
Horizon	19,973	178.10	11.49	172.19	179.17	185.12
Ln(Assets)	19,973	8.66	1.84	7.48	8.62	9.90
Ln(MB)	19,973	1.00	0.85	0.48	0.96	1.47
R&D	19,973	0.043	0.083	0	0	0.06
R&D Ind	19,973	0.49	0.50	0	0	1
CapEx	19,973	0.013	0.019	0.003	0.008	0.016
Loss	19,973	0.19	0.39	0	0	0
$Horizon_{SPX}$	19,973	184.61	8.84	180.65	185.72	191.54
PDC_{Short}	19,973	0.37	0.48	0	0	1
PDC_{Long}	19,973	0.25	0.43	0	0	0
σ_{365}	19,973	0.44	0.25	0.27	0.37	0.53
Ln(OpInt)	19,973	11.03	1.45	10.10	11.03	11.97
Ln(Vol)	19,973	6.81	2.15	5.44	6.97	8.33
StOpInt	19,973	0.79	0.17	0.71	0.84	0.92
StVol	19,973	0.91	0.17	0.90	0.98	1.00
$\#Analyst_{St}$	12,871	21.81	15.58	11.00	18.00	28.00
$\#Analyst_{Lt}$	12,871	19.64	14.00	10.00	16.00	25.00
AnalystTermStr	12,871	1.93	1.74	0.98	1.48	2.32

This table presents descriptive statistics for the firm-quarters in my sample and for the S&P 500 index option (SPX). *Horizon* is equal to a firm's volatility-weighted duration. I measure *Horizon* 45 days after an earnings announcement. *Ln(Assets)* is equal to the natural logarithm of the firm's most recent quarter's total assets. *Ln(MB)* is equal to the natural logarithm of the firm's market-to-book ratio, which is the firm's current (45 days after the earnings announcement) market value divided by the firm's most recent quarter's book value of shareholder's equity. *R&D* is equal to the sum of the firm's R&D expense for the prior four quarters divided by the most recent quarter's total assets. *R&D Ind* is equal to one if R&D is greater than zero, and zero otherwise. *CapEx* is equal to the sum of the firm's capital expenditures for the prior four quarters divided by the most recent quarter's total assets. *Loss* is equal to one if the firm's most recent quarter's income before extraordinary items is less than zero, and zero otherwise. $Horizon_{SPX}$ is equal to the volatility-weighted duration for the S&P 500 index option (SPX), measured on the same days as *Horizon*. PDC_{Short} (PDC_{Long}) is equal to one if the firm's industry is classified as having a short (long) product development cycle in Bushman, Indjejikian, and Smith (1996), and zero otherwise. σ_{365} is the standard deviation of the firm's daily returns over the previous 365 calendar days. *Ln(OpInt)* is equal to the natural logarithm of the total open interest of all exchange traded options for that firm. *Ln(Vol)* is equal to the natural logarithm of the total volume of all exchange traded options for that firm. *StOpInt* is equal to the proportion of the total open interest in exchange traded options with less than nine months to expiration. *StVol* is equal to the proportion of the total volume in exchange traded options with less than nine months to expiration. I measure *Ln(OpInt)*, *Ln(Vol)*, *StOpInt*, and *StVol* on the same day as *Horizon*. $\#Analyst_{St}$ is equal to the number of analyst forecasts made during the current quarter for the firm's current fiscal year earnings. $\#Analyst_{Lt}$ is equal to the number of analyst forecasts made during the current quarter for the firm's next fiscal year earnings. *AnalystTermStr* is equal to the standard deviation of analyst estimates for the firm's next fiscal year's earnings scaled by the median estimate for the next fiscal year divided by the standard deviation of analyst estimates for the firm's current fiscal year's earnings scaled by the median estimate for the current fiscal year.

Table 3

Pearson and Spearman Correlation Coefficients

Variable	*Horizon*	*Ln (Assets)*	*Ln (MB)*	*R&D*	*R&D Ind*	*Cap Ex*	*Loss*	*Horizon SPX*	*PDC Short*	*PDC Long*	σ_{365}	*Ln (OpInt)*	*Ln (Vol)*	*St OpInt*	*St Vol*	*#Analyst St*	*#Analyst Lt*	*Analyst Term Str*
Horizon	1.00	0.18	0.08	-0.02	0.01[c]	-0.08	-0.10	0.30	-0.08	-0.00[c]	-0.26	-0.01[b]	-0.05	-0.13	-0.08	-0.06	-0.06	0.03
Ln(Assets)	0.21	1.00	-0.23	-0.43	-0.30	-0.11	-0.22	0.00[c]	-0.18	-0.02	-0.26	0.53	0.42	-0.10	-0.01[c]	0.28	0.28	-0.03
Ln(MB)	0.07	-0.21	1.00	0.26	0.25	0.05	-0.15	0.13	0.01[c]	0.05	-0.23	0.04	0.09	0.05	0.05	-0.03	-0.00[c]	0.07
R&D	-0.02	-0.38	0.31	1.00	0.53	-0.09	0.30	-0.02[a]	0.05	0.19	0.17	-0.02	-0.02[a]	0.03	-0.03	-0.05	-0.03	0.09
R&D Ind	0.01[c]	-0.29	0.29	0.93	1.00	-0.11	0.10	-0.02	0.12	0.10	0.07	0.05	0.05	0.01[c]	-0.01[c]	-0.07	-0.04	0.01[b]
CapEx	-0.07	-0.13	0.16	-0.07	-0.03	1.00	-0.01[a]	-0.05	-0.00[c]	0.21	0.05	0.01[c]	0.05	0.00[c]	0.01[a]	0.21	0.20	0.00[c]
Loss	-0.10	-0.20	-0.16	0.17	0.10	-0.07	1.00	-0.07	-0.01[b]	0.11	0.40	-0.02[a]	-0.05	-0.07	-0.08	-0.08	-0.10	0.01[c]
$Horizon_{SPX}$	0.27	0.00[c]	0.11	-0.02	-0.02	-0.04	-0.08	1.00	-0.01[c]	-0.01[c]	-0.32	-0.01[c]	-0.02	0.01[c]	-0.01[b]	-0.02	-0.05	-0.03
PDC_{Short}	-0.09	-0.21	0.02	0.15	0.12	0.06	-0.01[b]	-0.01[c]	1.00	-0.44	0.12	0.04	0.06	0.04	0.02	0.11	0.09	-0.08
PDC_{Long}	0.00[c]	0.02[a]	0.05	0.12	0.10	0.21	0.11	-0.01[c]	-0.44	1.00	-0.00[c]	0.06	0.06	-0.03	-0.01[a]	0.11	0.11	0.06
σ_{365}	-0.32	-0.39	-0.17	0.18	0.12	0.02	0.37	-0.35	0.18	0.00[c]	1.00	0.06	0.09	0.06	0.01[c]	0.05	0.03	-0.02
Ln(OpInt)	-0.01[b]	0.52	0.07	0.03	0.04	0.03	-0.01[c]	-0.00[c]	0.03	0.07	0.04	1.00	0.81	-0.06	-0.01[c]	0.43	0.44	-0.03
Ln(Vol)	-0.05	0.41	0.12	0.04	0.05	0.06	-0.05	-0.02	0.05	0.06	0.07	0.81	1.00	0.03	0.07	0.43	0.44	-0.03
StOpInt	-0.14	-0.14	0.03	0.00[c]	-0.01[c]	-0.02	-0.05	-0.01[c]	0.04	-0.03	0.09	-0.08	-0.01[a]	1.00	0.33	0.03	0.04	0.05
StVol	-0.09	-0.19	-0.01[c]	-0.02	-0.03	-0.02	-0.04	-0.02[a]	0.02	-0.04	0.01[c]	-0.31	-0.23	0.38	1.00	0.05	0.06	-0.01[c]
$\#Analyst_{St}$	-0.05	0.32	-0.01[c]	-0.02	-0.04	0.13	-0.10	-0.01[c]	0.11	0.09	0.05	0.48	0.47	0.00[c]	-0.11	1.00	0.94	-0.12
$\#Analayst_{Lt}$	-0.05	0.32	0.03	-0.01[c]	-0.02	0.13	-0.12	-0.03	0.09	0.08	0.03	0.48	0.48	0.02[b]	-0.11	0.92	1.00	-0.06
Analyst TermStr	0.03	0.01[c]	0.10	-0.01[c]	-0.02[a]	0.03	-0.06	-0.01[c]	-0.07	0.08	-0.06	-0.01[c]	-0.01[c]	0.07	0.01[c]	-0.09	-0.02	1.00

[a] Correlation coefficient is significant at the 5% level; [b] Correlation coefficient is significant at the 10% level; [c] Correlation coefficient is not significant at the 10% level

This table presents Pearson (Spearman) correlation coefficients above (below) the diagonal. *Horizon* is equal to a firm's volatility-weighted duration. I measure *Horizon* 45 days after an earnings announcement. *Ln(Assets)* is equal to the natural logarithm of the firm's most recent quarter's total assets. *Ln(MB)* is equal to the natural logarithm of the firm's market-to-book ratio, which is the firm's current (45 days after the earnings announcement) market value divided by the firm's most recent quarter's book value of shareholder's equity. *R&D* is equal to the sum of the firm's R&D expense for the prior four quarters divided by the most recent quarter's total assets. *R&D Ind* is equal to one if R&D is greater than zero, and zero otherwise. *CapEx* is equal to the sum of the firm's capital expenditures for the prior four quarters divided by the most recent quarter's total assets. *Loss* is equal to one if the firm's most recent quarter's income before extraordinary items is less than zero, and zero otherwise. $Horizon_{SPX}$ is equal to the volatility-weighted duration for the S&P 500 index option (SPX), measured on the same days as *Horizon*. PDC_{Short} (PDC_{Long}) is equal to one if the firm's industry is classified as having a short (long) product development cycle in Bushman, Indjejikian, and Smith (1996), and zero otherwise. σ_{365} is the standard deviation of the firm's daily returns over the previous 365 calendar days. *Ln(OpInt)* is equal to the natural logarithm of the total open interest of all exchange traded options for that firm. *Ln(Vol)* is equal to the natural logarithm of the total volume of all exchange traded options for that firm. *StOpInt* is equal to the proportion of the total open interest in exchange traded options with less than nine months to expiration. *StVol* is equal to the proportion of the total volume in exchange traded options with less than nine months to expiration. I measure *Ln(OpInt)*, *Ln(Vol)*, *StOpInt*, and *StVol* on the same day as *Horizon*. $\#Analyst_{St}$ is equal to the number of analyst forecasts made during the current quarter for the firm's current fiscal year earnings. $\#Analyst_{Lt}$ is equal to the number of analyst forecasts made during the current quarter for the firm's next fiscal year earnings. *AnalystTermStr* is equal to the standard deviation of analyst estimates for the firm's next fiscal year's earnings scaled by the median estimate for the next fiscal year divided by the standard deviation of analyst estimates for the firm's current fiscal year's earnings scaled by the median estimate for the current fiscal year. All correlation coefficients are significant at the 1% level, unless noted otherwise.

Table 4
Regression Analysis of *Horizon*

Variable	Predicted Sign	(1)	(2)	(3)	(4)
Ln(Assets)	+	0.96	1.02	1.89	1.32
		(7.08)	*(6.42)*	*(9.96)*	*(6.17)*
Ln(MB)	+	0.76	0.71	1.40	0.75
		(3.26)	*(2.89)*	*(6.40)*	*(3.24)*
R&D Ind	+	1.27			
		(3.09)			
R&D	+		9.49	15.13	14.96
			(3.86)	*(8.44)*	*(8.83)*
CapEx		-18.64	-17.43	-4.13	-3.24
		(-2.39)	*(-1.90)*	*(-0.48)*	*(-0.40)*
Loss	-	-1.16	-1.53	-1.48	-0.35
		(-2.41)	*(-4.11)*	*(-4.67)*	*(-0.90)*
$Horizon_{SPX}$	+	0.37	0.37	0.38	0.38
		(4.66)	*(4.72)*	*(5.90)*	*(5.86)*
PDC_{Short}	-	-1.73	-1.67	-0.57	-0.62
		(-2.78)	*(-2.71)*	*(-1.05)*	*(-1.36)*
PDC_{Long}	+	-0.77	-0.90	-0.46	-0.71
		(-1.16)	*(-1.26)*	*(-0.85)*	*(-1.54)*
Ln(OpInt)				-0.93	-0.62
				(-5.18)	*(-3.87)*
Ln(Vol)				-0.54	-0.45
				(-5.71)	*(-4.40)*
StOpInt	-			-7.30	-7.29
				(-4.58)	*(-4.63)*
StVol	-			-2.82	-2.85
				(-4.81)	*(-5.02)*
σ_{365}	-				-8.81
					(-4.04)
Year-quarter fixed effects		Yes	Yes	Yes	Yes
Adj. R^2		.2053	.2060	.2422	0.2570
N		19,973	19,973	19,973	19,973
t-tests:					
R&D = CapEx			*(3.28)*	*(2.27)*	*(2.35)*
$PDC_{Long} = PDC_{Short}$		*(1.84)*	*(1.26)*	*(0.20)*	*(-0.19)*

The dependent variable, *Horizon*, is equal to a firm's volatility-weighted duration measured 45 days after an earnings announcement. *Ln(Assets)* is equal to the natural logarithm of the firm's most recent quarter's total assets. *Ln(MB)* is equal to the natural logarithm of the firm's market-to-book ratio, which is the firm's current (45 days after the earnings announcement) market value divided by the firm's most recent quarter's book value of shareholder's equity. *R&D* is equal to the sum of the firm's R&D expense for the prior four quarters divided by the most recent quarter's total assets. *R&D Ind* is equal to one if R&D is greater than zero, and zero otherwise. *CapEx* is equal to the sum of the firm's capital expenditures for the prior four quarters divided by the most recent quarter's total assets. *Loss* is equal to one if the firm's most recent quarter's income before extraordinary items is less than zero, and zero otherwise. $Horizon_{SPX}$ is equal to the volatility-weighted duration for the S&P 500 index option (SPX), measured on the same days as *Horizon*. PDC_{Short} (PDC_{Long}) is equal to one if the firm's industry is classified as having a short (long) product development cycle in Bushman, Indjejikian, and Smith (1996), and zero otherwise. σ_{365} is the standard deviation of the firm's daily returns over the previous 365 calendar days. *Ln(OpInt)* is equal to the natural logarithm of the total open interest of all exchange traded options for that firm. *Ln(Vol)* is equal to the natural logarithm of the total volume of all exchange traded options for that firm. *StOpInt* is equal to the proportion of the total open interest in exchange traded options with less than nine months to expiration. *StVol* is equal to the proportion of the total volume in exchange traded options with less than nine months to expiration. I measure *Ln(OpInt)*, *Ln(Vol)*, *StOpInt*, and *StVol* on the same day as *Horizon*. t-statistics are presented in parentheses and calculated based on two-way (by 2-digit SIC code and year-quarter) cluster-robust standard errors.

Table 5
Regression Analysis of the Term Structure of the Dispersion in Analysts' Earnings Forecasts

Variable	Predicted Sign	(1)	(2)
Ln(Assets)	+	-0.01	
		(-0.21)	
Ln(MB)	+	0.07	
		(1.54)	
R&D	+	1.88	
		(2.79)	
CapEx		1.21	
		(1.69)	
Loss	-	-0.01	
		(-0.13)	
$Horizon_{SPX}$	+	0.01	0.41
		(1.52)	*(5.58)*
PDC_{Short}	-	-0.28	
		(-3.67)	
PDC_{Long}	+	0.00	
		(0.03)	
σ_{365}	-	-0.39	
		(-2.11)	
AnalystTermStr	+		0.24
			(2.72)
$\#Analyst_{St}$	-		-0.08
			(-2.42)
$\#Analyst_{Lt}$	+		0.05
			(1.69)
Ln(OpInt)		-0.04	0.49
		(-1.32)	*(2.06)*
Ln(Vol)		0.02	-0.46
		(1.47)	*(-3.96)*
StOpInt	-	0.12	-7.83
		(1.21)	*(-4.85)*
StVol	-	-0.19	-2.66
		(-1.56)	*(-3.35)*
Year-quarter fixed effects		Yes	Yes
Adj. R^2		0.0531	.1912
N		12,871	12,871

The dependent variable in (1), *AnalystTermStr,* is equal to the standard deviation of analyst estimates for the firm's next fiscal year's earnings scaled by the median estimate for the next fiscal year divided by the standard deviation of analyst estimates for the firm's current fiscal year's earnings scaled by the median estimate for the current fiscal year. The dependent variable in (2), *Horizon*, is equal to a firm's volatility-weighted duration measured 45 days after an earnings announcement. *Ln(Assets)* is equal to the natural logarithm of the firm's most recent quarter's total assets. *Ln(MB)* is equal to the natural logarithm of the firm's market-to-book ratio, which is the firm's current (45 days after the earnings announcement) market value divided by the firm's most recent quarter's book value of shareholder's equity. *R&D* is equal to the sum of the firm's R&D expense for the prior four quarters divided by the most recent quarter's total assets. *R&D Ind* is equal to one if R&D is greater than zero, and zero otherwise. *CapEx* is equal to the sum of the firm's capital expenditures for the prior four quarters divided by the most recent quarter's total assets. *Loss* is equal to one if the firm's most recent quarter's income before extraordinary items is less than zero, and zero otherwise. $Horizon_{SPX}$ is equal to the volatility-weighted duration for the S&P 500 index option (SPX), measured on the same days as *Horizon*. PDC_{Short} (PDC_{Long}) is equal to one if the firm's industry is classified as having a short (long) product development cycle in Bushman, Indjejikian, and Smith (1996), and zero otherwise. σ_{365} is the standard deviation of the firm's daily returns over the previous 365 calendar days. *Ln(OpInt)* is equal to the natural logarithm of the total open interest of all exchange traded options for that firm. *Ln(Vol)* is equal to the natural logarithm of the total volume of all exchange traded options for that firm. *StOpInt* is equal to the proportion of the total open interest in exchange traded options with less than nine months to expiration. *StVol* is equal to the proportion of the total volume in exchange traded options with less than nine months to expiration. $\#Analyst_{St}$ is equal to the number of analyst forecasts made during the current quarter for the firm's current fiscal year earnings. $\#Analyst_{Lt}$ is equal to the number of analyst forecasts made during the current quarter for the firm's next fiscal year earnings. t-statistics are presented in parentheses and calculated based on two-way (by 2-digit SIC code and year-quarter) cluster-robust standard errors.

Table 6
Descriptive Statistics at Earnings Announcement Dates

Variable	N	Mean	Std. Dev.	25th	Median	75th
Panel A: Bundled earnings announcement sample						
Disclosure Horizon	3,937	186.66	44.76	154.28	184.73	216.90
Disclosure Horizon$_{SPX}$	3,937	155.03	32.08	134.06	155.02	173.02
Horizon$_{pre}$	3,937	176.51	15.52	168.38	179.01	186.24
Horizon$_{pre,SPX}$	3,937	183.10	8.73	179.77	183.93	189.31
Ln(OpInt)	3,937	10.76	1.58	9.78	10.76	11.75
StOpInt	3,937	0.81	0.17	0.74	0.87	0.93
AnnRet	3,937	0.002	0.101	-0.051	0.004	0.058
AnnRet^2	3,937	0.010	0.023	0.001	0.003	0.010
Panel B: Non-bundled earnings announcement sample						
Disclosure Horizon	5,777	189.81#	44.55	158.50	186.86	220.19
Disclosure Horizon$_{SPX}$	5,777	154.21	31.82	134.03	154.02	172.31
Horizon$_{pre}$	5,777	175.44#	17.34	166.65	177.83	185.56
Horizon$_{pre,SPX}$	5,777	182.91	8.60	179.24	183.65	189.07
Ln(OpInt)	5,777	10.82	1.61	9.75	10.84	11.88
StOpInt	5,777	0.79#	0.18	0.72	0.85	0.93
AnnRet	5,777	0.001	0.111	-0.054	0.000	0.056
AnnRet^2	5,777	0.012#	0.038	0.001	0.003	0.011
Panel C: Full sample						
Disclosure Horizon	9,714	188.53	44.66	156.80	186.07	219.07
Disclosure Horizon$_{SPX}$	9,714	154.54	31.93	134.06	154.19	172.51
Horizon$_{pre}$	9,714	175.88	16.64	167.22	178.38	185.93
Horizon$_{pre,SPX}$	9,714	182.99	8.65	179.48	183.79	189.15
Ln(OpInt)	9,714	10.79	1.60	9.77	10.81	11.83
StOpInt	9,714	0.80	0.17	0.73	0.86	0.93
AnnRet	9,714	0.001	0.107	-0.052	0.001	0.056
AnnRet^2	9,714	0.011	0.033	0.001	0.002	0.011

This table presents descriptive statistics for the sample of bundled earnings announcements (Panel A), the sample of non-bundled earnings announcements (Panel B), and the full sample of earnings announcements (Panel C). *Disclosure Horizon* is the firm's volatility-change-weighted duration over a three-day window centered on the firm's earnings announcement date. *Disclosure Horizon*$_{SPX}$ is equal to the volatility-change-weighted duration for the S&P 500 index option (SPX), over the same three-day windows as the firms. *Horizon*$_{pre}$ is the firm's volatility-weighted duration two days prior to the earnings announcement. *Horizon*$_{pre,SPX}$ is the SPX's volatility-weighted duration two days prior to the earnings announcement. The implied volatility for the first 30 days is excluded from the calculation of *Disclosure Horizon, Disclosure Horizon*$_{SPX,}$ *Horizon*$_{pre}$, and *Horizon*$_{pre,SPX}$. *Ln(OpInt)* is equal to the natural logarithm of the total open interest prior to the earnings announcement window of all exchange traded options for that firm. *StOpInt* is equal to the proportion of the total open interest prior to the earnings announcement window in exchange traded options with less than nine months to expiration. *AnnRet* is equal to the firm's compounded three-day stock return during the earnings announcement window. *AnnRet*^{2} is equal to *Annret* squared. # indicates that the mean value of the non-bundled earnings announcements sample is significantly different than the mean of the bundled earnings announcements sample at the 5% level based on a two-tailed test.

Table 7
Pearson and Spearman Correlation Coefficients at Earnings Announcement Dates

Variable	*Disclosure Horizon*	*Disclosure Horizon$_{SPX}$*	*Horizon$_{pre}$*	*Horizon$_{pre,SPX}$*	*Bundled*	*Ln(OpInt)*	*StOpInt*	*AnnRet*	*AnnRet^2*
Disclosure Horizon	1.00	-0.03	-0.35	-0.16	-0.03	-0.02[a]	0.08	0.03	0.00[c]
Disclosure Horizon$_{SPX}$	-0.03	1.00	0.01[c]	0.02[c]	0.01[c]	0.00[c]	0.05	-0.01[c]	0.00[c]
Horizon$_{pre}$	-0.32	0.01[c]	1.00	0.35	0.03	-0.06	-0.12	0.03[a]	-0.10
Horizon$_{pre,SPX}$	-0.14	-0.00[c]	0.29	1.00	0.01[c]	-0.02[a]	-0.03	0.01[c]	-0.16
Bundled	-0.03	0.01[c]	0.03	-0.14	1.00	-0.02[b]	0.04	0.01[c]	-0.03
Ln(OpInt)	-0.03	0.01[c]	-0.06	-0.02[b]	0.02[b]	1.00	-0.04	0.00[c]	-0.01[c]
StOpInt	0.06	0.05	-0.09	0.00[c]	0.04	-0.07	1.00	0.00[c]	-0.00[c]
AnnRet	0.02[a]	-0.01[c]	0.03	0.02[c]	0.02[b]	0.01[c]	-0.02[c]	1.00	0.08
AnnRet^2	-0.00[c]	-0.01[c]	-0.13	-0.19	-0.01[c]	-0.01[c]	0.03	0.02[a]	1.00

[a] Correlation coefficient is significant at the 5% level; [b] Correlation coefficient is significant at the 10% level; [c] Correlation coefficient is not significant at the 10% level

This table presents Pearson (Spearman) correlation coefficients above (below) the diagonal. *Disclosure Horizon* is the firm's volatility-change-weighted duration over a three-day window centered on the firm's earnings announcement date. *Disclosure Horizon$_{SPX}$* is equal to the volatility-change-weighted duration for the S&P 500 index option (SPX), over the same three-day windows as the firms. *Horizon$_{pre}$* is the firm's volatility-weighted duration two days prior to the earnings announcement. *Horizon$_{pre,SPX}$* is the SPX's volatility-weighted duration two days prior to the earnings announcement. The implied volatility for the first 30 days is excluded from the calculation of *Disclosure Horizon, Disclosure Horizon$_{SPX}$, Horizon$_{pre}$*, and *Horizon$_{pre,SPX}$*. *Ln(OpInt)* is equal to the natural logarithm of the total open interest prior to the earnings announcement window of all exchange traded options for that firm. *StOpInt* is equal to the proportion of the total open interest prior to the earnings announcement window in exchange traded options with less than nine months to expiration. *AnnRet* is equal to the firm's compounded three-day stock return during the earnings announcement window. *AnnRet^2* is equal to *AnnRet* squared. All correlation coefficients are significant at the 1% level, unless noted otherwise.

Table 8
Regression Analysis of *Disclosure Horizon*

Variable	Predicted Sign	(1)
$Horizon_{pre}$	-	-0.83 (-11.50)
Bundled	-	-2.80 (-2.60)
$Horizon_{pre,SPX}$		-0.18 (-1.00)
Disclosure $Horizon_{SPX}$		-0.01 (-0.60)
AnnRet	+	17.90 (4.08)
$AnnRet^2$	-	-46.81 (-2.73)
Year-quarter fixed effects		Yes
Adj. R^2		0.1794
N		9,714

The dependent variable, *Disclosure Horizon*, is equal to a firm's volatility-change-weighted duration over a three-day window centered on the firm's earnings announcement date. *Bundled* is equal to one if the firm's earnings announcement contained earnings guidance, and zero otherwise. *Disclosure* $Horizon_{SPX}$ is equal to the volatility-change-weighted duration change for the S&P 500 index option (SPX), over the same three-day windows as the firms. $Horizon_{pre}$ is the firm's volatility-weighted duration two days prior to the earnings announcement. $Horizon_{pre,SPX}$ is the SPX's volatility-weighted duration two days prior to the earnings announcement. The implied volatility for the first 30 days is excluded from the calculation of *Disclosure Horizon,* *Disclosure* $Horizon_{SPX,}$ $Horizon_{pre}$, and $Horizon_{pre,SPX}$. *Ln(OpInt)* is equal to the natural logarithm of the total open interest prior to the earnings announcement window of all exchange traded options for that firm. *StOpInt* is equal to the proportion of the total open interest prior to the earnings announcement window in exchange traded options with less than nine months to expiration. *AnnRet* is equal to the firm's compounded three-day stock return during the earnings announcement window. $AnnRet^2$ is equal to *Annret* squared. t-statistics are presented in parentheses and calculated based on two-way (by 2-digit SIC code and year-quarter) cluster-robust standard errors.

Table 9
Regression Analysis of Open Interest in Short-term Options

Variable	Predicted Sign	(1)
$Horizon_{pre}$	-	-0.0009 (-4.79)
Bundled	+	0.0142 (3.09)
$Horizon_{pre,SPX}$		0.005 (0.33)
Ln(OpInt)	-	-0.0094 (-3.80)
Year-quarter fixed effects		Yes
Adj. R^2		0.2775
N		9,714

The dependent variable, *StOpInt*, is equal to the proportion of the total open interest prior to the earnings announcement window in exchange traded options with less than nine months to expiration. *Bundled* is equal to one if the firm's earnings announcement contained earnings guidance, and zero otherwise. *Disclosure* $Horizon_{SPX}$ is equal to the volatility-change-weighted duration change for the S&P 500 index option (SPX), over the same three-day windows as the firms. $Horizon_{pre}$ is the firm's volatility-weighted duration two days prior to the earnings announcement. $Horizon_{pre,SPX}$ is the SPX's volatility-weighted duration two days prior to the earnings announcement. The implied volatility for the first 30 days is excluded from the calculation of *Disclosure Horizon, Disclosure* $Horizon_{SPX,}$ $Horizon_{pre}$, and $Horizon_{pre,SPX}$. *Ln(OpInt)* is equal to the natural logarithm of the total open interest prior to the earnings announcement window of all exchange traded options for that firm. t-statistics are presented in parentheses and calculated based on two way (by 2-digit SIC code and year-quarter) cluster-robust standard errors.