Uncertainty, Investor Learning, and Positive Post-Announcement Returns

by

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Abstract

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I examine how uncertainty about the interpretation of earnings drives investor information gathering and how this activity is associated with stock return patterns around earnings announcements. Investors gather more firm-level information as the earnings number deviates further from their prior beliefs and as firm-level and market-wide uncertainty increase prior to the announcement. The marginal effect of firm-level uncertainty on information gathering declines as market-wide uncertainty increases, consistent with theories of rational attention and category learning. The intensity of these information gathering activities is associated with negative abnormal returns in the announcement period and positive abnormal returns in the post-announcement period, particularly when information gathering is unlikely to fully resolve uncertainty or when additional information available to investors is ambiguous. These (seemingly) predictable return patterns are consistent with theoretical predictions about how investors respond to uncertainty. Taken together, the results suggest that proxies for investor attention and information gathering inherently capture investor uncertainty and that investors require higher future returns when they are unable to resolve uncertainty through the analysis of supplemental information.

CHAPTER 1

Introduction

Investors are exposed to a deluge of firm-level summary signals (e.g., earnings, returns) that can be difficult to interpret, particularly if investors are uncertain about the signal's reliability or how it fits into the backdrop of concurrent signals and overall macroeconomic conditions. While it is intuitive that investors could respond to this uncertainty by gathering additional information and learning, there is limited empirical evidence about how firm-level and macroeconomic uncertainty affect investors' acquisition and processing of firm-level information. In this paper, I examine how uncertainty about the interpretation of earnings affects investor information gathering and how these information gathering activities are associated with contemporaneous stock returns around the earnings announcement and subsequent returns following the announcement.

Consistent with theories of rational attention and category learning, I find that investors gather more firm-level information as the difficulty of interpreting earnings increases, with this relation weakening as macroeconomic uncertainty becomes relatively more important (Peng and Xiong 2006). The intensity of information gathering at the earnings announcement is associated with *negative* abnormal returns in the *announcement* period and *positive* abnormal returns in the *post-announcement* period for both good and bad news announcements, with the association being stronger for bad news. This return pattern is consistent with theoretical models in which the arrival of uncertain information causes a decrease in contemporaneous

returns and an increase in expected returns, with these effects being potentially greater for bad news (Brown et al. 1988; Campbell and Hentschel 1992). These stock return associations are most pronounced when information gathering is unlikely to fully resolve uncertainty (i.e., when earnings are particularly difficult to interpret or when the supplemental information available to investors is ambiguous). Taken together, the results are consistent with investors allocating attention to better understand uncertain summary signals and requiring higher future returns when information gathering is unsuccessful in immediately resolving uncertainty. The results also suggest that researchers should use caution when interpreting returns tests that involve measures of attention or information gathering, as these measures may inherently capture investor uncertainty.

When considering how uncertainty about the interpretation of earnings influences information gathering, it is helpful to consider the intuition provided by theories of information choice (see Veldkamp (2011) for an in-depth review). Because these theories are formalized under a common theoretical framework, they consistently point to the following fundamental factors that influence behavior with respect to information: (1) the degree to which an information signal deviates from agents' prior beliefs, and (2) the overall uncertainty of agents' prior beliefs. While these models generally assume that an agent learns everything about a signal simply by observing it, investors can learn much more about summary signals by seeking supplemental information. As I develop predictions related to these two factors, I assume that investors observe summary signals (e.g. returns, earnings) at a low cost and then decide whether to dedicate scarce time and resources to obtain additional information.

The first hypothesized factor, a deviation from prior beliefs, is conditional on the realization of the signal and leads to a relatively straightforward prediction about information

gathering. A signal that deviates from an investor's expectation may be difficult to interpret because it presumably contains information that was not used when forming the expectation. For example, as earnings deviate further from investors' prior beliefs, investors likely become more uncertain about the cause of the deviation and its persistence, which heightens incentives to gather and analyze additional information about the earnings number.

The second factor, the uncertainty of investors' prior beliefs, is *not* conditional on the realized value of earnings and suggests that investors lack information about the impending earnings number or future cash flows in general.[1] This uncertainty may result from firm-specific or broader macroeconomic conditions. For example, after a macroeconomic shock, investors may be uncertain about how to interpret information, such as earnings, until they better understand the extent of any structural shifts resulting from the shock. Firm-related information may help investors to learn about the shock and interpret earnings against the backdrop of macroeconomic events – or reinterpret earnings as the true nature of structural shifts becomes known (Banker et al. 1993; Epstein and Schneider 2008).

In addition to motivating information gathering and learning, uncertainty has also been shown to affect decision-making and asset prices.[2] For example, experimental studies have found that uncertainty leads to a conservative approach to decision-making, and is associated with fear and survival instincts in subjects' brains (Ellsberg 1961; Smith et al. 2002; Hsu et al.

[1] This uncertainty might be separated into two categories: (1) uncertainty about what the earnings number will be, which would be resolved by simply observing the reported number without gathering supplemental information, and (2) uncertainty about how to *interpret* whatever number is reported, which likely involves gathering additional information. Since I assume that investors observe the earnings number almost costlessly and since my intent is to examine uncertainty about the *interpretation* of earnings, the predictions focus primarily on the uncertainty under (2).

[2] I use the term "uncertainty" to characterize an event with an unknown outcome and an *unknown* probability distribution, whereas "risk" characterizes an event with an unknown outcome, but a *known* probability distribution. "Ambiguity" is also used in prior literature to characterize an unknown outcome and unknown probability distribution.

2005). Many theoretical models address uncertainty by assuming that investors do not have perfect information about the processes that generate macro- or firm-level signals. Predictions from these models are often consistent with observed capital market phenomena, such as seemingly predictable stock returns and asymmetric responses to good vs. bad news (Timmermann 1993; Lewellen and Shanken 2002; Epstein and Schneider 2008). Consistent with these theories, empirical research has found that investors appear to initially respond pessimistically to uncertainty and require a premium (incremental to risk) for tolerating uncertainty (Brown et al. 1988; Anderson et al. 2009; Ozoguz 2009; Johannes et al. 2014). If information gathering is driven by uncertainty about the interpretation of earnings and if investors are uncertainty-averse, then we might expect this activity to be associated with lower returns when information is released and higher future returns, particularly if investors are unable to immediately resolve their uncertainty through information gathering. This leads to the prediction that the intensity of information gathering at the time of the announcement is associated with negative abnormal returns in the announcement period and positive abnormal returns in the post-announcement period, particularly if earnings are difficult to interpret or if additional information about earnings is ambiguous.

To test these predictions, I use empirical proxies for the economic constructs discussed previously. As the primary proxy for investor information gathering, I use a complete record of downloads of corporate filings from the SEC's EDGAR database from 2003 to 2011. This download activity is likely to capture the behavior of a broad cross-section of investors – while complex filings may be useful to sophisticated investors, the database is free and open to

anyone with an Internet connection, which may attract users who do not have access to costlier sources of information. [3]

I use this proxy to first test my predictions about how uncertainty motivates information gathering. As discussed previously, theories of information choice suggest that uncertainty caused by a deviation from prior beliefs creates incentives for information gathering. As a primary proxy for deviation from investors' prior beliefs, I use the analyst forecast error (Battalio and Mendenhall 2005). Prior studies also indicate that unsophisticated investors may respond to stock returns (Barber and Odean 2008; Kaniel et al. 2008), so I use the [0,1] day cumulative abnormal return around the earnings announcement as a secondary measure. Consistent with my prediction that uncertainty about the interpretation of earnings drives investor information gathering, I find that abnormal download activity on EDGAR increases as both earnings and returns deviate from investors' prior beliefs.

The second prediction arising from theories of information choice is that the overall uncertainty of the environment (firm-level or macroeconomic) prior to the earnings announcement drives investor information gathering. The proxy for *macroeconomic* uncertainty is the level of the volatility index on the S&P 500 (VIX) two trading days prior to the earnings announcement (Williams 2014). As a primary measure of *firm-level* uncertainty, I use the 30-day option-implied volatility two trading days prior to the earnings announcement. To support the construct validity of the firm-level proxy, I use two additional proxies for uncertainty prior to the announcement – analysts' forecast dispersion and the standard

[3]Chen (2014) finds evidence of broad and geographically diverse information access via EDGAR, with concentrations of access in large financial centers (e.g. New York, Chicago, San Francisco, London, etc.). Additionally, Ben-Rephael et al. (2015) find that information gathering on EDGAR is positively and statistically significantly related to information gathering on Bloomberg terminals, which are commonly used by institutional investors.

deviation of returns in the pre-announcement period. Consistent with my predictions, I find that the measures of macroeconomic and firm-level uncertainty are all positively related to information gathering at the time of the announcement, independent of the realized earnings number. Additionally, while firm-level and macroeconomic uncertainty are independently associated with information gathering, the firm-level association weakens as macroeconomic uncertainty becomes relatively more important.

Finally, I examine how investors' information-gathering activity influences the resolution of uncertainty and stock returns in the post-announcement period. Consistent with my predictions, I find that the intensity of information-gathering efforts in the announcement window is associated with *negative* abnormal returns in the *announcement* window and *positive* abnormal returns in the *post-announcement* window. As predicted, the association is strongest when there is greater uncertainty about the interpretation of earnings (as measured by the analyst forecast error, firm-level implied volatility, and VIX) and when information in the earnings announcement is more ambiguous (no management earnings guidance or high textual complexity). While the association between information gathering and positive subsequent returns is present for both good *and* bad news announcements (suggesting that it isn't simple over- or under-reaction), it is greater for bad news, which is consistent with some theories which predict an asymmetric response to uncertain information (Brown et al. 1988; Campbell and Hentschel 1992; Epstein and Schneider 2008). Finally, I find that information gathering at the time of the subsequently filed 10-K or 10-Q is associated with price increases later in the post-announcement period, consistent with investors using subsequently released supplemental information to resolve residual uncertainty from the earnings announcement.

This paper contributes to prior research along several dimensions. First, research across multiple disciplines (e.g., information theory, economics, information science) has examined how uncertainty motivates information seeking. This research, while extensive, is limited mostly to theoretical and experimental studies unrelated to capital markets. Exploring the theories and testing the external validity of the experiments in a natural setting has been difficult, due principally to a paucity of empirical measures of investor information gathering. Using a novel measure of information gathering, I find evidence that is broadly consistent with the theoretical predictions and experimental results of prior research. A particularly novel finding is that both firm and macroeconomic uncertainty independently drive firm-level information gathering, but when macroeconomic uncertainty is high, the incremental effect of firm-level uncertainty declines. This is consistent with theories of rational inattention and category learning, which predict that investors vary the attention that they place on market- and sector-level factors vs. firm-specific factors, depending on the relative importance of each (Peng and Xiong 2006).

Second, this study contributes to a recent stream of literature that uses novel empirical measures to examine the relation between information gathering and stock returns. I extend this literature by specifically examining how the uncertainty associated with summary signals influences information gathering, and by providing evidence that clarifies the results of previous studies. Drake et al. (2014b) find that filing download activity on the SEC's EDGAR database around earnings announcements is associated with a lower return drift in the direction of the earnings surprise, which they interpret as a more efficient price response to earnings. In contrast, I find that the lower return drift documented by Drake et al. (2014b) is attributable to a price *reversal* following bad news announcements (i.e., information gathering is associated

with positive abnormal returns following both good and bad news). While traditional tests of market efficiency might classify these return patterns as evidence of inefficient information processing, the results in this paper suggest that they may be attributable to an uncertainty premium. These results may also help explain the higher future returns associated with firm-specific Google search documented by Da et al. (2011). They attribute these initial returns (along with relatively weak evidence of a longer-term reversal) to inefficient, attention-driven buying. However, if firm-specific Google search acts as an empirical proxy for uncertainty, these seemingly predictable return patterns may be partially due to the presence of an uncertainty premium (Lewellen and Shanken 2002).

Finally, this paper is related to prior empirical studies which examine the association between uncertain information and stock returns. Many of these studies do not examine particular information events, but instead use abnormal returns as a proxy for information and make no assumption about the intensity of investor information gathering (Brown et al. 1988). A recent study by Williams (2014) examines stock return patterns around earnings announcements and finds that macroeconomic uncertainty is associated with a seemingly pessimistic interpretation of the earnings number, and that this response appears to be driven by investor ambiguity aversion. I extend this research by examining how investors attempt to resolve their uncertainty concerns and by documenting a connection between information gathering and positive post-announcement returns. These results are consistent with the initial earnings response documented by Williams (2014) and support the presence of an ambiguity premium, particularly when investors are initially unable to resolve uncertainty by gathering additional information.

This paper should be of interest to investors, as it documents the presence of a premium when there is uncertainty about the interpretation of earnings (provided investors are willing to tolerate residual uncertainty). The paper should also be of interest to managers interested in large-sample empirical evidence of how uncertainty and disclosure content influence investor demand for, and interpretation of, supplemental information. Moreover, the paper should be of interest to researchers and regulators who study investor attention and the informational efficiency of stock prices. When there is uncertainty about the interpretation of summary signals, it may appear that information gathering is associated with less efficient information processing; however, these return patterns may be related to investors learning about uncertain signals.

CHAPTER 2

Literature Review

2.1 Uncertainty, rational attention, and information choice

The connection between uncertainty and information gathering is prevalent in a variety of academic literatures, including information theory, economics, and information science.[4] Among the pioneering efforts in this area were in the information theory literature by Shannon (1949), who developed a model of communication that has been applied in a variety of fields including communications engineering, computer science, and economics. The model involves six elements: an information source, a transmitter, a channel, a receiver, a destination, and noise, which interferes with the message traveling through the channel and leads to uncertainty about the content (and therefore interpretation) of the communication.

In addition to formalizing the relation between information and uncertainty, an important feature of the Shannon model is that the channel through which the information passes has a finite capacity. This constraint was later used by Sims (2003) in the development of models of rational inattention, which attempt to explain why information, even when it is freely available, may not be used (or may be imperfectly used). These models have been extended beyond the initial focus of price stickiness to include other settings and other cognitive processes. For example, Peng and Xiong (2006) develop a model in which

[4] Shannon (1949) and Weaver (1949) helped formalize the connection between information and uncertainty and this work was later extended by Sims (2003) in developing implications for rational attention. The connection between information and uncertainty is prevalent in the information science literature (see Case (2012) for a review of the literature, including notable contributions by Belkin (1978) and Kuhlthau (1993)).

cognitively constrained investors rationally allocate their limited attention between market- or sector-level factors and firm-specific factors, depending on the relative importance of each.

Models of information choice are related to models of rational attention in that they often arrive at similar predictions (although under different assumptions and potentially different policy implications). Among these models of information choice are passive-learning models, in which agents are differentially endowed with information or information arrives stochastically (Mankiw and Reis 2002; Morris and Shin 2002) and active-learning models in which some proportion of agents intentionally acquire information by purchasing it, allocating limited attention to it, or taking some other action that will generate the information (Grossman and Stiglitz 1980; Hellwig 1980; Hirshleifer et al. 2011). The cost or effort of acquiring information in the active learning models has an effect that is similar to the capacity constraint in the rational attention models – it essentially makes information gathering costly, which results in some agents choosing not to obtain the information. Since these models are based on a Bayesian updating framework, they point to intuitive fundamental factors that influence behavior with respect to information: (1) the magnitude of a signal's deviation from the agent's prior beliefs, (2) the overall uncertainty of the agent's prior beliefs about the signal, and (3) the precision of the information signal.

While the predictions from these information-related models are seemingly intuitive, empirical support for them from capital market settings is largely indirect. For example, empirical studies of stock return co-movement provide indirect evidence of category learning behavior by investors (e.g., Shiller (1989); Pindyck and Rotemberg (1993)). Other empirical studies examine settings in which investor attention is expected to be constrained or diverted and find that stock returns show signs of a less efficient aggregation of information (e.g.,

Huberman and Regev (2001); Hirshleifer et al. (2009); Dellavigna and Pollet (2009)). Other studies find that properties of the earnings signal are associated with measures of price efficiency, with some positing that the uncertainty of the signal or information processing costs hinder an efficient response to earnings signals (e.g., Foster et al. (1984); Ball (1992); Francis et al. (2007); Zhang (2006))

The paucity of direct empirical examination of the forces that drive information gathering has likely been due to a lack of suitable empirical proxies for investor information gathering. In recent years, there have been several empirical studies that have used novel proxies to examine the relation between investor information gathering and stock returns (e.g., Da et al. (2011); Drake et al. (2010); Drake et al. (2014a)); however, these papers focus more on the relation between information gathering and stock returns than on the economic forces that drive the information gathering behavior. [5] While these studies generally contain analyses that attempt to explore the empirical determinants of information gathering, those test are principally intended to demonstrate that the proxies for investor attention and information gathering are correlated in a meaningful and intuitive way with commonly used empirical variables. That is, these exploratory analyses are intended to support the empirical validity of these newly available proxies rather than to test economic hypotheses about the fundamental drivers of information gathering.

[5] These papers, along with others that examine the relation between information gathering and stock returns, are discussed in more depth in the following section. They use similar measures as proxies for variously named constructs – investor attention, investor information demand, information acquisition, etc. While I use these terms interchangeably, I generally use the term "information gathering" to describe the behavior inherent in these proxies.

2.2 Information gathering and stock returns

As noted in the previous section, direct evidence regarding the relation between information gathering and stock returns has historically been scant, due principally to a lack of reasonable proxies for investor information gathering. However, several recent studies have used novel empirical measures to examine the relation between information gathering and stock returns using, but have arrived at somewhat divergent conclusions. Drake et al. (2012) find that firm-specific Google search prior to the earnings announcement is associated with a timelier price response around the announcement. Da et al. (2011) use firm-specific Google search as a measure of investor attention and find that, in general, it is associated with inefficient price fluctuations (short-term price increase, followed by relatively weak evidence of a reversal). They also find that Google search contributes to the seemingly inefficient first-day return and subsequent underperformance of IPOs. Drake et al. (2014b) find that information access on the SEC's EDGAR database is associated with a lower return drift in the direction of the earnings surprise, which they interpret as a more efficient price response to earnings. While an IPO is a very different information event from an earnings announcement, these results provide somewhat conflicting results about the association between information gathering and the efficiency with which the market impounds information into prices.

In order to bring clarity to these potentially conflicting results, it may be helpful to consider more carefully the economic drivers of investors' information gathering activities. While these studies briefly explore some of the determinants of information gathering, the primary intent of those analyses appears to be the validation of the empirical proxies of attention or information gathering. By considering more carefully the economic factors that

influence these activities, it may be possible to interpret these results more cohesively. For example, if uncertainty is indeed a fundamental driver of investor information gathering, this may alter predictions about the expected association between information gathering activities and stock returns or change the interpretation of empirical results.

Prior research has found that uncertainty is an important factor in how individuals process information and make decisions (Ellsberg 1961; Holt and Laury 2002). More specifically, experimental studies have found that uncertainty leads to a conservative approach to decision-making, and is associated with fear and survival instincts in subjects' brains (Ellsberg 1961; Smith et al. 2002; Hsu et al. 2005). This behavioral tendency is reflected in theoretical models that assume investor ambiguity aversion or parameter uncertainty. These models generally start with the assumption that investors have uncertainty about the *probabilities* over payoffs (Turner et al. 1989; Epstein and Schneider 2007, 2008). For example, investors may have uncertainty about a state variable or they may not fully understand the process that generates earning numbers or returns, which causes uncertainty about the parameters of those distributions or an inability to arrive at a single probability distribution. In the models, investors respond pessimistically[6] to uncertain information (or even the *expectation* of uncertain information) and demand higher future returns for tolerating uncertainty. These higher future returns can be accelerated (i.e., the premium can dissipate) if uncertainty is resolved. These models claim to help explain many potentially puzzling empirical observations, such as seemingly predictable stock returns, asymmetric responses to good vs. bad news, and the equity premium and excess volatility puzzles (Timmermann 1993; Lewellen and Shanken 2002; Epstein and Schneider 2008). Consistent with these theories,

[6] This is often represented in the models as investors facing a set of probability distributions over payoffs, who then select the worst-case probability distribution (Klibanoff et al. 2005; Epstein and Schneider 2007, 2008).

empirical research has found that investors appear to respond pessimistically to uncertainty and require a premium (incremental to risk) for tolerating uncertainty (Brown et al. 1988; Anderson et al. 2009; Ozoguz 2009; Johannes et al. 2014).

Additionally, one of the interesting aspects of theories of uncertainty or ambiguity aversion is that they predict that the quality of information available to investors and the extent of information gathering play a much greater role in the magnitude of the equity premium than models in which investors are only risk averse (Epstein and Schneider 2007, 2008). This aspect may be helpful in distinguishing between alternative explanations for empirical associations between measures of information gathering and stock returns.

In summary, understanding the economic drivers of information gathering is critical for interpreting empirical associations between measures of information gathering and stock returns. One potential reason for the seemingly conflicting interpretations from prior empirical studies may be that the predictions and interpretation of empirical results don't adequately take into account the fundamental drivers of information gathering. If uncertainty is a fundamental driver of information gathering, then empirical predictions regarding the relation between information gathering and stock returns may become clearer, and empirical analyses based on those predictions may help explain seemingly inconsistent prior results.

CHAPTER 3

Hypothesis Development

In this section I develop predictions about how uncertainty over the interpretation of earnings drives information gathering and how these information gathering activities are associated with contemporaneous and subsequent stock returns.

3.1 Uncertainty and information gathering

To develop predictions about the factors that motivate investors to gather information, I rely on the intuition provided by models of active learning discussed in the previous section. Since most of these models are based on a Bayesian updating framework, they point to similar fundamental factors that influence behavior with respect to information: (1) the magnitude of a signal's deviation from the agent's prior beliefs, and (2) the overall uncertainty of the agent's prior beliefs about the signal.[7] While these factors seem intuitive, the application of their intuition to predictions about investor behavior in a capital-market setting requires additional discussion. In most of these models, the agent is assumed to learn everything about the signal simply by observing it; however, investors often observe summary signals of uncertain quality, such as earnings or returns, and then must decide whether they will seek additional information about the signal. As I form predictions based on these factors, I assume that investors easily

[7] In addition to these two fundamental drivers, the models also indicate that the precision of the information signal is an important determinant of behavior with respect to information. The models generally assume that the precision of the signal is independent of the deviation from prior beliefs; however, this may not be the case with accounting earnings (Beaver et al. 1980; Subramanyam 1996). For this reason, I do not consider how the precision of earnings influences information gathering, but acknowledge that proxies for deviations from prior beliefs may partially capture the noise in earnings.

observe summary signals (e.g. earnings, returns) at a relatively low cost and, after observing the signal, must decide whether additional information gathering is necessary.

One setting with several of these attributes that has been examined in the theoretical literature is a firm's decision about when to perform a review of its pricing policies. For example, Woodford (2009) recognizes that there is a cost to gathering information and that the decision about whether to gather information is based on a signal that is much less precise than the information that the company will have after completing the pricing review. This setting is analogous to an investor who must decide whether to fully review a company's performance (e.g., by reading the earnings announcement and other supplemental information), based only upon an observation of the earnings number or stock return. The model in Woodford (2009) predicts that firms will conduct pricing reviews only intermittently and that the likelihood of performing a review is increasing in the magnitude of the economic shock.

The intuition from Woodford (2009) carries over to the setting of an investor deciding whether to seek more information after observing earnings or returns. An earnings number that deviates from the investor's prior belief clearly contains information not used in the formation of the belief. A minor deviation may not lead to significant uncertainty about how to interpret earnings; however, as the deviation grows, the investor may become more uncertain about the importance of the information that was apparently not used in forming his belief. In other words, the deviation is indicative of a knowledge gap that could be filled if the investor seeks additional information about what caused the deviation. Therefore, I expect that the uncertainty created by deviations from investors' prior beliefs will cause investors to gather information about what caused the deviation, which leads to the following formal prediction:

> P1: Investors gather more firm-related information as outcomes deviate from investors' prior beliefs

The second factor highlighted by theories of information choice is the uncertainty of investors' prior beliefs. If an investor knows relatively little prior to observing a signal, any information about the signal is potentially valuable. That is, the less an investor knows about the properties of the signal before it arrives, the greater his incentives will be to learn as much as he can about it. Of course, if an investor is only uncertain about what the value of the signal realization will be, then this uncertainty would be resolved simply by observing the signal. However, in capital markets, there is often significant uncertainty about how to *interpret* signals, regardless of the realized value. This uncertainty can be resolved by evaluating the signal in light of information previously collected, by gathering additional available information, and/or by waiting for more information to be revealed.

Uncertainty about how to *interpret* the reported earnings number (regardless of its properties) could clearly be related to firm-specific factors, but it also may be related to macroeconomic uncertainty. Prior research suggests that macroeconomic uncertainty can cause difficulty in interpreting new information, including firm-level information (Aboody et al. 1999; Illeditsch 2011; Drechsler 2013; Williams 2014). If there has been a macroeconomic shock, investors may be uncertain about the extent to which long-term fundamentals may have shifted. Gathering more firm-level information may help investors to better understand the extent of the macroeconomic shock and how much the firm is affected by it, as well as helping to reinterpret earnings as new information becomes available (Epstein and Schneider 2008). This discussion leads to the following formal prediction about how the uncertainty of prior beliefs influences information-gathering behavior:

> P2(a): Higher firm-level and macroeconomic uncertainty leading up to an earnings announcement are associated with increased information gathering at the time of the announcement

If there is meaningful variation in information gathering in accordance with these predictions, this provides additional evidence that investors do face constraints on their information gathering capacity (i.e., constraints on attention) and that uncertainty about how to interpret earnings is an important factor that drives their information gathering decisions. However, theories of attention and category learning also suggest that the nature of this uncertainty may influence the level of investor attention to firm-level information. In a limited-attention model, Peng and Xiong (2006) make the intuitive prediction that investor attention will fluctuate between macroeconomic- or sector-level factors and firm-specific factors, depending on the relative importance of each. Thus, uncertainty of any type might drive overall investor attention to increase, but there may be relative shifts in the type of information gathered by investors. When macroeconomic uncertainty is high, investors may allocate *relatively* less attention to firm-level information, and vice versa when firm-specific uncertainty is high relative to macroeconomic uncertainty. This results in the following formal prediction:

P2(b): The relation between firm-level uncertainty and firm-level information gathering is declining in the level of macroeconomic uncertainty leading up to the earnings announcement

3.2 Information gathering and stock returns

If empirical tests are consistent with these initial predictions, this suggests that investors don't learn everything about earnings simply by observing the number. While this would be unsurprising, it does have implications for how stock returns are associated with measures of information gathering. As discussed in the previous section, theories related to uncertainty and ambiguity aversion predict that stock returns may exhibit unique and seemingly predictable patterns when investors are uncertain about how to interpret new information. The theories

predict that investors will initially appear to respond pessimistically to uncertain information (i.e., negative abnormal returns when the information is released) and they will demand higher future returns for tolerating uncertainty, particularly if the uncertainty can't be immediately resolved (Brown et al. 1988; Lewellen and Shanken 2002; Epstein and Schneider 2008). Thus, if investor information gathering around the earnings announcement is driven by uncertainty about how to interpret the earnings number, then we might expect these activities to inherently act as a proxy for uncertainty about the interpretation of earnings, which would clearly affect the predicted empirical associations between these activities and stock returns.

On the other hand, if investors are successful in resolving their uncertainty by gathering information then we might not expect to see these predicted associations. Yet it seems unlikely that the collection of additional information will always allow investors to fully resolve the uncertainty that motivated them to search in the first place. That is, we might expect these associations between information gathering and returns to be concentrated in situations where information gathering is less likely to fully resolve uncertainty. One situation where this may occur is if the earnings number is particularly difficult to interpret. Note that this doesn't assume decreasing returns to learning when uncertainty is high (which would be inconsistent with the first three predictions related to uncertainty and information gathering). Instead, this assumes that information gathering is less likely to *fully* resolve investor uncertainty about the interpretation of earnings if uncertainty is high to begin with. In summary, if uncertainty drives information gathering and if information gathering is sometimes unsuccessful in resolving uncertainty, then we would predict the following:

> P3(a): Investor information gathering at the time of the earnings announcement is associated with *negative* abnormal returns in the *announcement* period, particularly if there is significant uncertainty about the interpretation of the earnings number

P3(b): Investor information gathering at the time of the earnings announcement is associated with *positive* abnormal returns in the *post-announcement* period, particularly if there is significant uncertainty about the interpretation of the earnings number

Until now, the predictions have essentially assumed that the properties of information available to investors are held constant. However, the degree to which investors are able to resolve uncertainty by gathering additional information should also be related to the properties of the information that they obtain and analyze. For example, if investors go to the earnings announcement to resolve uncertainty about the earnings number, but they find that the announcement also contains ambiguous information, this would clearly hinder their ability to resolve uncertainty about earnings. Thus, the ambiguity of information in the earnings announcement would lead to a greater amount of residual uncertainty, leading to the following formal prediction –

P4: The association between information gathering and positive post-announcement returns is heightened when information in the earnings announcement is more ambiguous

Finally, theories of uncertainty aversion and ambiguity aversion predict that the premium will dissipate as uncertainty is resolved. Uncertainty may be resolved in many ways, including – the passage of time, the occurrence or nonoccurrence of economic events, or the release of information by the firm. In the earnings announcement setting, most firms typically release information at the earnings announcement (e.g., press release, financial statements, etc.) and then release the much more detailed regulatory filing (10-K or 10-Q) on or after that date. If there is residual uncertainty after the earnings announcement, investors may seek to resolve this uncertainty by gathering additional information at the time that the more detailed regulatory filing is released. Since the regulatory filing would normally only elaborate further upon information in the earnings announcement, we wouldn't expect the filing to add to the

uncertainty. Therefore, any information that is gathered from the filings should reduce uncertainty (or, at worst, leave uncertainty unchanged if the filing is a noisy source of information or a repetition of the earnings announcement). Based on these theories, any resolution of uncertainty would cause the premium to dissipate, which would essentially lead to returns being "pulled forward" into the current period. This leads to the following prediction

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> P5: Investor information gathering of subsequent SEC filings that pertain to the earnings announcement is associated with positive abnormal stock returns later in the post-announcement period

If I find evidence supporting these predictions it would be broadly consistent with a prevailing theoretical link between uncertainty and information gathering that spans multiple literatures (Shannon and Weaver 1949; Belkin 1978; Kuhlthau 1993; Sims 2003; Case 2012). The results would also provide evidence that investors perceive greater gains to information gathering when uncertainty is high and that their attention to firm-level information can fluctuate based on the relative importance of macroeconomic factors (Sims 2003; Peng and Xiong 2006). Finally, the results would be consistent with investors requiring higher future returns if they are unable to fully resolve their uncertainty through information gathering and would underscore the importance of supplemental information in helping investors to resolve uncertainty about summary signals.

CHAPTER 4

Research Design and Data

4.1 Research design

My objective is to study how uncertainty about the interpretation of an information signal drives investor information gathering and how this behavior is associated with the resolution of uncertainty and subsequent stock returns. While this study could potentially examine any information event, I focus on quarterly earnings announcements as a setting for the following reasons: (1) they involve information that can be important enough to substantially revise investors' prior beliefs, (2) theories of information choice suggest that prior beliefs are an important driver of behavior with respect to information and earnings announcements offer proxies for investors' beliefs that are not available for other information events, and (3) they are periodic and therefore allow for observations of investor and firm behavior across time.

Because I am interested in how investors *respond* to an uncertain signal, I examine information gathering beginning on the day the earnings number is released and extending one day after. For certain tests I also explore how investors resolve residual uncertainty after the earnings announcement by examining information gathering around the subsequent release of the 10-K or 10-Q.

4.2 Data

As documented in Table 1, the primary sample consists of quarterly earnings announcements for the years 2003–11. I restrict the time period by the availability of my principal measure of information gathering – a complete record of filing downloads from the SEC's EDGAR database for the years 2003–11. This data contains filing downloads for all companies that have a reporting requirement with the SEC, which is much more expansive than the coverage of databases such as Compustat and CRSP (Drake et al. 2014b). Consequently, the number of observations is constrained by the availability of coverage in the following databases: Compustat, CRSP, IBES, ThomsonReuters 13f, and OptionMetric, as documented in Table 1.

4.2.1 EDGAR filing downloads

The SEC's EDGAR database contains public company filings since 1996 (with partial participation from public companies from 1994 to 1995). Each time a file is viewed or downloaded on EDGAR, a record is created on the SEC's server logs. Through a Freedom of Information Act request, I obtained this server log for January 2003 to December 2011.[8] The analyses in this paper utilize the following information from the server log:

1. The partial IP address of the requesting user; to preserve the privacy of the user, the final octet of the address was replaced with three letters, which still allows for the identification of unique IP addresses
2. The date and time of the filing request
3. The Central Index Key (CIK) of the company that submitted the filing
4. The accession number, which uniquely identifies each filing

Not all of the records on the server logs result from direct requests by human users. For example, automated web crawlers may download large numbers of filings in a short period of

[8] The server logs appear to only contain a partial record of downloads from January 2003 to May 2003 and from October 2005 to March 2006. The results of statistical tests are insensitive to the exclusion of these months.

time. While these requests reflect information gathering of some kind, it is difficult to determine if filing views are associated with meaningful information processing. In order to remove filing requests that may not reflect direct investor information search, I remove all downloads for a particular user (i.e. IP address) on a particular day if that user (1) downloaded more than 5 filings in a one-minute interval at any time during the day (Lee et al. 2014), (2) downloaded more than 100 filings on that day, where at least 90% of the filings are text files[9] (Lee et al. 2014), or (3) downloaded more than 1,000 total filings on that day (Drake et al. 2014b). The reduction in the number of filing requests due to these restrictions is consistent with prior research (Lee et al. 2014).

While the information in the EDGAR server logs can identify unique IP addresses, it is not intended to convey the identity of the individual or organization associated with that IP address. Although searcher identities are not explicitly known, this download log likely captures a fairly broad cross-section of investor sophistication levels. While complex filings may be more useful to sophisticated investors, the database – which is free and open to anyone with an Internet connection – is also likely to attract users (such as retail investors) who don't have access to costlier sources of information. This is supported by Chen (2014), who finds evidence of broad and geographically diverse information access via EDGAR, with concentrations of access in large financial centers (e.g. New York, Chicago, San Francisco, London, etc.), and by Ben-Rephael et al. (2015), who find that information gathering on EDGAR is positively and statistically significantly related to information gathering on

[9] The complete submission file is a text file that contains the full submission for that accession number, including HTML tags, binary code for embedded graphics and PDF files, etc. It is often downloaded for machine-readable tasks but is very difficult for humans to read. Since the vast majority of filings are in HTML format, I assume that an IP address that downloads a large proportion of text files in a particular day is not a direct search activity by a human.

Bloomberg terminals, which are commonly used by institutional investors. Drake et al. (2014b) also conclude that EDGAR download activity is consistent with the activities of a sophisticated investor conducting fundamental comparative analysis.

4.2.2 - Alternative measure of information gathering

As an alternative measure of information gathering, which is intended to specifically capture the information gathering behavior of unsophisticated investors, I use the Google Search Volume Index (SVI) from Google Trends for individual S&P 500 ticker symbols for the years 2005–8.[10] Most of the analyses using Google SVI are untabulated, but the results are described in the text.

The Google SVI has been used in prior studies as a measure of investor information demand (Drake et al. 2012) and as a measure of investor attention (Da et al. 2011). The Google SVI measure does not represent absolute search volume, but measures a search term's popularity relative to all Google searches over time. It is also normalized based on the highest relative search volume for that particular ticker over time. Therefore, SVI captures within-firm variation in the relative search popularity of a firm's ticker (Drake et al. 2012). Google SVI contains far less detail than the EDGAR server log, but prior research suggests that Google SVI likely captures the behavior of less sophisticated investors.[11]

4.2.3 - Other Data

Other variables used in the analyses come from the Compustat, CRSP, IBES, and OptionMetrics databases. These variables are described in more detail in the next section.

[10] I am grateful to Michael Drake for providing the Google SVI data through his website – http://byuaccounting.net/ drake/ProgramsData1.php. This data was used for analyses in Drake et al. (2012).
[11] Da et al. (2011) find that monthly changes in orders and turnover from retail investors are associated with changes in Google SVI and conclude from this that changes in investor attention measured by SVI are related to trading by retail investors.

CHAPTER 5

Empirical Results

5.1 Measures of information gathering

For my principal measure of information gathering (EDGAR downloads), I construct an abnormal search variable that adjusts for firm and day-of-week effects that have been documented in prior literature (Drake et al. 2012). This is intended to adjust for a typical level of download activity that may not be related to the release of new information by the firm. The abnormal download volume on EDGAR for firm *i* on day *t* is calculated as the total filing downloads (of selected filing types[12]) on day *t* minus the average downloads from the same weekday over the eight-week period ending two weeks prior to the earnings announcement, scaled by the average downloads from the same weekday over the eight-week period ending two weeks prior to the earnings announcement. I then take the average of this daily variable over the [0,1] trading-day window around the earnings announcement to arrive at a measure of abnormal EDGAR download activity (*INFO_ACCESS*) for the earnings announcement period.[13] Therefore, the mean of 0.564 for *INFO_ACCESS* (Table 2) indicates that the average download volume for the [0,1] trading-day window around the earnings announcement was 56.4% higher than the average of the same two weekdays during the estimation period.

[12] I limit this to filings that investors would typically find informative: (1) earnings announcements and press releases (8-K, 8-K/A), (2) interim financial reports (10-Q, 10-QSB, 10-Q/A, 10-K, 10-KSB, 10-K/A), (3) registration statements (S-1, S-1/A), and (4) proxy statements (DEF 14A). Results are similar when using all filing types or when restricting it to only earnings announcements (8-Ks) in the earnings announcement window.
[13] Results of analyses are generally stronger when using the raw EDGAR downloads instead of this abnormal measure. In all cases the inferences drawn from the analyses are the same when using raw downloads or abnormal downloads.

My secondary measure of information gathering is Google SVI. As described previously, Google SVI is already standardized, so I use the average raw Google SVI for [0,1] trading-day window to arrive at the measure of Google search (*GOOGLE*). The mean of 1.208 (Table 2) indicates that the relative search popularity of a firm's ticker symbol is 20.8% higher in the [0,1] trading-day window around the firm's earnings announcement.[14]

5.2 Uncertainty and information gathering

The first prediction is that investor information gathering is increasing in the degree to which outcomes deviate from investors' prior beliefs. As a primary proxy for deviation from investors prior beliefs, I use the analyst forecast error (Battalio and Mendenhall 2005). Prior studies have also indicated that unsophisticated investors respond to stock returns (Barber and Odean 2008; Kaniel et al. 2008), so I use the [0,1] day cumulative abnormal return around the earnings announcement as a secondary measure. To calculate analyst-adjusted earnings (*ANALYST_UE*), I subtract the median of the most recent individual analyst forecasts issued within the 90 days prior to the earnings announcement date from the IBES reported actual "street" earnings and then scale this by the price per share as of the end of the quarter. Abnormal stock returns (*CAR[0,1]*) are calculated as the daily return for the stock minus the value-weighted market return for the same day, cumulated over the [0,1] trading-day window around the earnings announcement.[15]

[14] Since the EDGAR and Google SVI data are available for every calendar day, the [0,1] trading-day window may contain more than two calendar days (e.g., announcements on Fridays or days prior to a holiday). This reflects the nature of information gathering (i.e., information gathering can occur on days when the market is not open). However, in order to ensure that day-of-week effects are not driving any results, I include a day-of-week fixed effect in all regressions. Also, recall that *INFO_ACCESS* is an abnormal measure of EDGAR downloads that attempts to adjust for day-of-week effects.

[15] The results throughout the paper are similar when using alternative measures of abnormal returns (market model, Fama French three-factor model, and Carhart four-factor model).

For initial evidence on the univariate relation between prior beliefs and investor information search, I graph the average of *INFO_ACCESS* across deciles of *ANALYST_UE* and *CAR[0,1]* (see Figure 1). The graph clearly indicates that *INFO_ACCESS* increases as each proxy deviates from investors' prior beliefs. In fact, the mean of *INFO_ACCESS* for both measures is lowest in the decile with the smallest deviation from prior beliefs.

In order to ensure that other extraneous factors are not driving this result and to determine if the observed relationships are statistically significant, I perform the following regression analysis:

$$INFO\_ACCESS_{it} = \alpha_0 + \beta_1 BELIEF\_ERROR_{it} + \sum \beta_j CONTROLS_{it} + \varepsilon \qquad (1)$$

where *INFO_ACCESS* is the mean abnormal EDGAR filing downloads for the [0,1] trading-day window around the earnings announcement for firm *i* in period *t*. *BELIEF_ERROR* is the deviation from prior beliefs for firm *i* in quarter *t*. (Since my prediction is related to the *magnitude* of deviations from prior beliefs, I use the absolute value of *ANALYST_UE* and *CAR[0,1]*.) In order to mitigate the risk that results are attributable to outliers (e.g., due to scaling of unexpected earnings), I construct deciles (by quarter) for *ANALYST_UE*. This results in the following variables being used for *BELIEF_ERROR* in Equation (1): *ABS_ANALYST_UE_DEC* is the decile (by quarter) of the absolute value of *ANALYST_UE* and *ABS_CAR[0,1]* is the absolute value of *CAR[0,1]*.

I also control for other factors that may influence abnormal search, but are not related to deviations from investors' prior beliefs. To control for the firm's visibility and information environment, I include the following controls: (1) the natural log of the market value of equity (*LN_MVE*) for firm *i* at the end of period *t*, (2) the natural log of the number of analysts (*ANALYST_FOL*) following the firm at the end of the month prior to the earnings

announcement, and (3) the percentage of institutional owners (*INST_OWN*) at the end of the month prior to the earnings announcement. To control for the relative importance of disclosures about capitalized assets and future earnings growth, I include the ratio of book value of equity to market value of equity (*BOOK_MARKET*) for firm *i* at the end of period *t.* Finally, to control for the overall constraints on investors' cognitive resources (Hirshleifer et al. 2009), I include the total number of earnings announcements on the same calendar day as the firm's earnings announcement (*EA_COUNT*). In order to control for other potential unobservable stationary factors that may influence investor information search, I also include firm fixed effects (unless otherwise noted in the tables). In order to also control for systematic influences on investor information search for all firms in a given quarter, I include quarter fixed effects. I also include fiscal quarter and day-of-week fixed effects to control for systematic differences in investor search behavior that may vary depending on the day of the week or the fiscal quarter for which the firm is announcing earnings.

Table 4, Panel A contains the results of the regression specified in Equation (1), where the dependent variable is *INFO_ACCESS*. Models (1) and (2) contain *ABS_ANALYST_UE_DEC* and *ABS_CAR[0,1]* as measures of prior beliefs, respectively. Model (3) contains both measures. Model (4) is identical to Model (3), except it contains firm fixed effects. In all of the models the coefficient on the measure of deviations from prior beliefs is positive and statistically significant. In Models (3) and (4), where the earnings surprise variable and abnormal returns are included together, the coefficients are both positive and significant, indicating that both earnings and returns independently motivate investors to search for information as each measure deviates from investors' prior beliefs. This suggests

that *INFO_ACCESS* is likely capturing the behavior of sophisticated and unsophisticated investors (Battalio and Mendenhall 2005; Barber and Odean 2008; Kaniel et al. 2008).

In untabulated results, I replace *INFO_ACCESS* with *GOOGLE* as the dependent variable and find that the coefficient on *ABS_CAR[0,1]* is positive and significant at the 1% level, but the coefficient on *ABS_ANALYST_UE_DEC* is negative and statistically insignificant (*p-value*=0.47). This is consistent with the information gathering behavior of unsophisticated investors being driven by stock returns, but not earnings (Barber and Odean 2008; Kaniel et al. 2008; Da et al. 2011).

In terms of magnitude, Model (1) indicates that a three-decile (approximately one standard deviation) increase in *ABS_ANALYST_UE_DEC* is associated with a 13% average increase in *INFO_ACCESS*. Model (2) indicates that a one-standard-deviation increase in *ABS_CAR[0,1]* is associated with a 27% average increase in *INFO_ACCESS*. For the untabulated analysis using *GOOGLE*, a one-standard-deviation increase in *(ABS)CAR[0,1]* is associated with a 14% average increase in *GOOGLE*.[16]

Taken together, the results presented in Table 4, Panel A are consistent with the visual univariate evidence in Figure 1and are consistent with Prediction 1 from Section 3 – that investor information gathering increases as outcomes deviate from investors' prior beliefs. The results (including untabulated results using *GOOGLE* as the dependent variable) also suggest that these prior beliefs may be based on different signals depending on the investors' level of sophistication.

[16] When interpreting these magnitudes, one should keep in mind that the abnormal search measures can be negative. The percentages calculated as magnitudes are based on the means of these variables reported in Table 2.

The second prediction is that information gathering is increasing in firm-level and macroeconomic uncertainty about earnings leading up to the earnings announcement. To test this prediction, I perform the following regression analysis:

$$INFO\_ACCESS_{it} = \alpha_0 + \beta_1 UNCERTAINTY_{it} + \beta_2 BELIEF\_ERROR_{it} + \sum \beta_j CONTROLS_{it} + \varepsilon \quad (2)$$

As the primary firm-level proxy for uncertainty about the interpretation of earnings (*UNCERTAINTY)* I use the 30-day implied volatility for options on the firm's stock from the OptionMetrics Standardized Options dataset two trading days prior to the earnings announcement (*IMP_VOL*).[17] As secondary measures for *UNCERTAINTY* at the firm level I use: (1) the standard deviation of analysts' forecasts as of the end of the month prior to the earnings announcement, divided by the mean share price for that month (*ANALYST_DISP*) and (2) the standard deviation of returns for the 60 trading days ending on day *t-3* before the earnings announcement (*SDEV_PRE_RET*). The proxy for macroeconomic uncertainty is the volatility index on the S&P 500 (*VIX*) two trading days prior to the earnings announcement (Williams 2014).

Models (1), (2), and (3) in Table 4, Panel B contain results for the regression specified in Equation (2), where *INFO_ACCESS* is the dependent variable and *IMP_VOL, ANALYST_DISP,* and *SDEV_PRE_RET* are (respectively) the independent variable of interest (the previously discussed proxies of *UNCERTAINTY* at the firm-level).[18] Model (4) contains

[17] These are derived from hypothetical at-the-money options with a duration of 30-days. Standardized options are constructed to be of constant maturity and at-the-money, which has been shown to reduce measurement error due to varying option durations and the extent to which they are in the money (Dumas et al. 1998; Hentschel 2003). Results are also robust to using implied volatility from options with a 90-day duration.

[18] Barron et al. (1998) use forecast error and forecast dispersion to develop measures of uncertainty and information asymmetry in analysts' information environment. While the focus of this paper is investor (rather than analyst) information gathering, these same properties of analyst forecasts are used as proxies for investor uncertainty. In untabulated tests, I use the measures of uncertainty and information asymmetry developed in Barron et al. (1998) and find that there is a positive and statistically significant relation between *INFO_ACCESS*

the macroeconomic proxy for *UNCERTAINTY* – *VIX*. Because *VIX* is the same for all firms that announce on a given day and the level of the VIX may not have significant variation for a given quarter, I do not use calendar quarter fixed effects in regressions that contain the level of the *VIX*. In all of these regressions, the proxy for *UNCERTAINTY* is positive and statistically significant, suggesting that firm-level and macroeconomic uncertainty motivate investors to gather additional information. Model (5) contains both the principal proxy for firm-level uncertainty (*IMP_VOL*) and the proxy for macroeconomic uncertainty (*VIX*). Coefficients on both variables are positive and statistically significant, suggesting that firm-level and macroeconomic uncertainty hinder investors ability to interpret the earnings number and are (independently) associated with increased information gathering by investors. Model (6) contains an interaction of *IMP_VOL* and *VIX* and is intended to test Prediction 2(b) – that firm-level uncertainty becomes less important as a driver of firm-level information gathering as macroeconomic uncertainty increases. The negative coefficient on this interaction term suggests that this is the case, which is consistent with theories of rational attention and category learning (Peng and Xiong 2006). As predicted, each of these results is not conditional on the magnitude of the deviation from prior beliefs (i.e., analyst-adjusted earnings and abnormal announcement period returns are included in the model as controls).

In untabulated tests, I replace *INFO_ACCESS* with *GOOGLE* in models (1) and (4) and find that the coefficient on *IMP_VOL* is positive and significant (*p-value*=0.005) and the coefficient on *VIX* is positive and significant (*p-value*=0.05), respectively. When both *VIX* and *IMP_VOL* are included together in the regression, the coefficient on *IMP_VOL* is positive and

and their measure of uncertainty, but the relation between *INFO_ACCESS* and their measure of information asymmetry is not statistically significant. These results are consistent with the results in Table 4, Panel B, which suggest that overall uncertainty leading up to the earnings announcement is associated with increased information gathering at the time of the announcement.

statistically significant (*p-value*=0.024), but the coefficient on *VIX* is statistically insignificant (*p-value*=0.815). This is consistent with the results in Table 4, Panel A – that information gathering by unsophisticated investors is primarily driven by firm-level abnormal stock returns. This provides further evidence that firm-level uncertainty motivates (unsophisticated) investors to gather additional information.

In terms of magnitude (from the coefficients in models (1) and (4) of Table 4, Panel B), a one-standard-deviation increase in *IMP_VOL* (*VIX*) is associated with a 9% (9%) average increase in *INFO_ACCESS*. For the untabulated results using *GOOGLE* as the dependent variable, a one-standard-deviation increase in *IMP_VOL* (*VIX*) is associated with a 10% (5%) average increase in *GOOGLE*.

Taken together, the results in Table 4, Panel B provide evidence that the uncertainty of investors' prior beliefs is a significant driver of information gathering at the time of the earnings announcement (independent of the extent to which earnings deviates from investors' prior beliefs). Consistent with predictions in Section 3, this association exists when uncertainty about the interpretation of earnings is due to firm-level or macroeconomic uncertainty, but the relation between firm-level uncertainty and firm-level information gathering weakens as macroeconomic uncertainty increases in relative importance.

5.3 Information gathering and post-announcement returns

The third prediction examines how investors' information gathering activities are associated with contemporaneous and subsequent stock returns. As previously discussed, this isn't the first study to examine these associations; however, examining them with a better understanding of what is driving the behavior (i.e., uncertainty) leads to different predictions and interpretation of empirical results, which may help clarify the results of prior research.

Thus, it may be useful to first perform a traditional test of informational efficiency that has been used in prior studies. Drake et al. (2014b), examines how information gathering on EDGAR affects market efficiency with respect to earnings news. Using a traditional post-earnings announcement drift regression similar to this:

$$CAR[2,50]_{it} = \alpha_0 + INFO\_ACCESS_{it} * UE_{it} + INFO\_ACCESS_{it} + UE_{it} + \sum \beta_j CONTROLS_{it} \quad (4)$$

they find a negative coefficient on the interaction of *INFO_ACCESS* and *UE*. This is consistent with a lower return drift in the direction of the earnings surprise, which they interpret as evidence of a more efficient price response to earnings news. In Table 5, I replicate this result by performing the regression analysis summarized in Equation (4) where both analyst-adjusted and seasonally adjusted earnings are used as measures of unexpected earnings (*UE*).[19] The controls include the other variables that have been used in prior tests, as well as their interactions with *UE*. Consistent with the findings in Drake et al. (2014b), there is a negative coefficient on the interaction of *INFO_ACCESS* and *UE*, suggesting a lower abnormal return drift in the direction of the earnings surprise. However, in Model (3) I replace the signed post-announcement returns (*CAR[2,50])* with the absolute value of *CAR[2,50]* and remove the interactions with *UE*. The coefficient on *INFO_ACCESS* is positive and statistically significant, suggesting that information gathering at the time of the earnings announcement is associated with *more* volatile returns in the post-announcement period. This seems inconsistent with a more efficient response to earnings (using traditional tests of market efficiency) and suggests that the results in the traditional post-earnings announcement drift regressions (Models (1) and (2)) are attributable to a return reversal.

[19] I include seasonally adjusted earnings because this is the measure of unexpected earnings used in (Drake et al. 2014b).

Figure 2 plots the price paths of four portfolios of high and low information gathering and high and low unexpected earnings. High earnings is the top quintile of analyst-adjusted earnings (*ANALYST_UE*) and low earnings is the bottom quintile of *ANALYST_UE*. High information gathering is the top quintile of *INFO_ACCESS* and low information gathering is the bottom quintile.

The price paths in the figure appear to confirm that the results in Models (1) and (2) of Table 5 (traditional post-earnings announcement drift regressions) are attributable to a return *reversal* for low earnings/high search firms. There also appears to be a greater positive drift for high search firms with high earning. This would be consistent with Prediction 3(b), which states that investor information gathering at the time that earnings information is released is associated with positive abnormal returns in the post-announcement period. Although this return pattern might seem unusual (i.e., an apparent under-reaction to good news and an over-reaction to bad news), it is exactly what might be predicted by theories of uncertainty or ambiguity aversion. However, the visual evidence may not be statistically significant and it may be driven by other factors, such as the sorting of firms within quintiles of unexpected earnings and quintiles of information gathering.

To confirm the validity of the visual evidence and formally test the predictions enumerated in Section 3, I use a multivariate regression approach to examine the association between information gathering and contemporaneous and subsequent abnormal returns around the earnings announcement. The previously discussed theories predict that investors will initially appear to respond pessimistically to uncertain information (i.e., negative abnormal returns when the information is released) and that expected returns will increase (i.e., positive abnormal returns in the post-announcement period). Thus, if uncertainty drives information

gathering, we might expect to see a negative (positive) relation between investor information gathering at the time of the earnings announcement and announcement (post-announcement) period abnormal returns. To test this, I perform a multivariate regression analysis based on the following model:

$$CAR[0,1]_{it} = \alpha_0 + INFO\_ACCESS_{it} + UE\_DEC_{it} + \sum \beta_j CONTROLS_{it} \quad (5)$$

Because the predicted association does not depend on the sign of earnings, I do not interact INFO_ACCESS with a measure of unexpected earnings or an indicator for good/bad news.

Model (1) of Table 6, Panel A contains the results of this regression analysis for the full sample. As predicted, the coefficient on *INFO_ACCESS* is negative and statistically significant. The prediction also states that this relation is expected to be stronger in situations where there is significant uncertainty about the interpretation of the earnings number. To test this, I perform regression analyses based on the following model:

$$CAR[0,1]_{it} = \alpha_0 + UNCERTAIN_{it} * INFO\_ACCESS_{it} + INFO\_ACCESS_{it} + UNCERTAIN_{it} + \sum \beta_j CONTROLS_{it} \quad (6)$$

where *UNCERTAIN* is one of the three main sources of uncertainty about the interpretation of earnings that were explored in the previous section: (1) macroeconomic uncertainty leading up to the announcement (*VIX*), (2) firm-level uncertainty leading up to the announcement (*IMP_VOL*), and (3) the degree to which earnings deviate from investors' prior beliefs (*ANALYST_UE*). A negative coefficient on the interaction of *UNCERTAIN* and *INFO_ACCESS* would be consistent with a greater discount when information gathering is unlikely to immediately and fully resolve uncertainty. This also helps to rule out alternative explanations, such as loss aversion or negativity bias, which should not be conditional on the level of uncertainty (discussed along with other alternative explanations in Section 6).

Models (2), (3), and (4) in Table 6, Panel A contain the results of the Equation (6) regression analyses for each of the measures of *UNCERTAINTY*. To aid interpretation of the main effect on *INFO_ACCESS*, I use an indicator for each measure of *UNCERTAINTY*. For *VIX*, the indicator is equal to 1 if the level of the *VIX* is higher than 20 (*HI_VIX* from the analysis in Table 4, Panel B). For firm-level implied volatility, it is equal to 1 if *IMP_VOL* is greater than its median (0.439, see Table 2). For unexpected earnings, the indicator is equal to 1 if earnings fall in the bottom or top quintile of *ANALYST_UE*. In each case, the coefficients on the interaction of *UNCERTAINTY* and *INFO_ACCESS* are negative and statistically significant. This is consistent with the prediction that investors appear to react pessimistically to uncertain information, particularly when there is significant uncertainty about how to interpret the earnings number.

To investigate if the association between information gathering and negative announcement period returns is statistically significant for both good and bad news, I partition the sample into good news (zero or positive *ANALYST_UE* – Model (5)) and bad news (negative *ANALYST_UE* – Model (6)). Since Models (2) through (4) suggest that information gathering is most effective when uncertainty about the interpretation of earnings is high, I restrict Models (5) and (6) to times when the *VIX* is above 20 (i.e., when *HI_VIX*=1). I find that coefficient on *INFO_ACCESS* is negative in both cases and is statistically significant for bad news (t-stat=-5.91) and nearly statistically significant for good news (t-stat=-1.64). The fact that the results are asymmetrically larger and more significant for bad news is consistent with predictions of theories of uncertainty aversion (Brown et al. 1988; Campbell and Hentschel 1992; Epstein and Schneider 2008).

Finally, Model (7) of Table 6, Panel A includes the alternative measure of information gathering – *GOOGLE* – as the variable of interest instead of *INFO_ACCESS*. The coefficient on *GOOGLE* is negative, but not statistically significant, which could be related to a lack of power due to the small sample size or because investors who search on Google are (based on the results in Table 4, Panels A and B) responding to stock prices, rather than uncertainty about the interpretation of earnings.

While the results of Table 6, Panel A are consistent with the prediction, it is difficult conclude that there is a causal relationship because this is merely a contemporaneous association between information gathering and stock returns. More convincing evidence might be found in tests of Prediction 3(b) – that there is a positive association between information gathering at the earnings announcement and *subsequent* abnormal returns. To test this, I replace the dependent variable in Equation (5) with the post-announcement abnormal return (*CAR[2,50]*). Note that the only difference between this model and the traditional post-earnings announcement drift regression (Model (4)) is the omission of interactions with *UE*. This omission will allow the coefficient on *INFO_ACCESS* to capture the predicted unidirectional (i.e., positive) return pattern that is hypothesized in the post-announcement period following both good *and* bad news.

Model (1) of Table 6, Panel B contains the results of this regression analysis for the full sample. As predicted, the coefficient on *INFO_ACCESS* is positive and statistically significant. Like the prediction related to the announcement window returns, the relation is expected to be stronger in situations where there is significant uncertainty about the interpretation of the earnings number. To test this, I replace the dependent variable in Equation (6) with the post-announcement abnormal return (*CAR[2,50]*). Models (2), (3), and (4) in

Table 6, Panel B contain the results of this regression analysis. The coefficients on each of the interactions of *UNCERTAINTY* and *INFO_ACCESS* are positive and statistically significant.[20] This is consistent with the prediction that uncertainty-driven information gathering is associated with higher expected returns, particularly when there is significant uncertainty about the interpretation of the earnings number.

To investigate if the association between information gathering and positive post-announcement returns is statistically significant for both good and bad news, I partition the sample into good news (zero or positive *ANALYST_UE* – Model (5)) and bad news (negative *ANALYST_UE* – Model (6)). As in Panel A, I restrict Models (5) and (6) to times when the *VIX* is above 20 (i.e., when *HI_VIX*=1). I find that coefficient on *INFO_ACCESS* is positive and statistically significant in both cases. Finally, Model (7) of Table 6, Panel B includes the alternative measure of information gathering – *GOOGLE* – as the variable of interest instead of *INFO_ACCESS*. The coefficient on *GOOGLE* is positive and statistically significant, although care should be taken in the interpretation of this result, as the results in Table 4 suggested that investors who search on Google appear to be responding to stock returns in the post-announcement period, rather than uncertainty about the interpretation of the earnings number.

Taken together, the results in Table 6, Panels A and B, indicate that the intensity of information gathering is associated with negative abnormal returns in the announcement window and positive abnormal returns in the post-announcement window following both good

[20] In untabulated tests of Model (2), I define the VIX indicator (*HI_VIX*) using different levels of the VIX. I find that the association between post-announcement returns and information gathering is concentrated in periods when the VIX is very high (e.g., over 40). This suggests that this uncertainty premium may only be present under very high levels of uncertainty about the interpretation of earnings. This may also explain why the results in this study differ from those in similar studies (e.g., Ben-Rephael et al. (2015)) in which the sample covers time periods when uncertainty rarely reaches those levels.

and bad news. While these return patterns may initially appear to be indicative of a less efficient response to earnings, they are inconsistent with an overall *delayed* response to earnings news (i.e., the results suggest an *overreaction* to bad news and an *under-reaction* to good news). However, these return patterns *are* consistent with theories of uncertainty aversion, which predict that investors respond to uncertainty by behaving *as if* they interpret the earnings number pessimistically, while requiring higher future returns as compensation for bearing residual uncertainty (Epstein and Schneider 2008; Williams 2014).

Until now, the analyses have assumed that the uncertainty of additional information gathered by investors is held fixed; however, (as set forth in Section 3, Prediction 4) the ambiguity of supplemental information about earnings may limit investors' ability to resolve their uncertainty about earnings. This would lead to a larger uncertainty premium and would imply a greater association between information gathering and post-announcement returns. To test this prediction, I perform a regression analysis based on Equation (5) and partition the sample on two proxies for the ambiguity of information in the earnings announcement. The first proxy for ambiguity is whether the firm issued earnings guidance in conjunction with the earnings announcement. When there is significant uncertainty about the interpretation of earnings, a management forecast of future earnings would likely serve as a relatively straightforward and unequivocal piece of information for reducing uncertainty (i.e., providing better information on the parameters of the distribution of earnings or eliminating potential probability distributions over future earnings). The second proxy for the ambiguity of information in the earnings announcement is the textual complexity of the announcement.[21]

[21] To measure textual complexity, I use the Automated Readability Index, which is a measure of textual complexity, computed as follows: $4.74 * \left(\frac{number\ of\ characters}{number\ of\ words}\right) + 0.5\left(\frac{number\ of\ words}{number\ of\ sentences}\right) - 21.43$, where characters is the number of letters, numbers, and punctuation marks, words is the number of spaces, and sentences

The intuition for this proxy is that increased textual complexity can inhibit investors' ability to extract information from the announcement and could lead to ambiguous interpretations (Rayner and Duffy 1986; Bloomfield 2002; Li 2008).

Table 7 contains the results of this analysis. Models (2) and (4) show the partition of firms with more ambiguous earnings announcements (no earnings guidance and high textual complexity, respectively).[22] Models (1) and (3) show the partition of firms with lower ambiguity in the earnings announcement. Consistent with predictions, the coefficient on *INFO_ACCESS* is positive and highly significant for firms with more ambiguous earnings announcements. The coefficient on *INFO_ACCESS* for low ambiguity earnings announcements (Models (1) and (3)) is statistically insignificant for both measures (*t-stats* of 0.93 and 0.15, respectively). These results support the presence of an uncertainty premium and suggest that this premium is larger when ambiguity in the content of the earnings announcement inhibits investors from reducing uncertainty through information gathering.

The final prediction is related to the impact of subsequent information releases. An interesting feature of the earnings announcement setting is that additional information about earnings is released by the firm in the weeks after the announcement. The 10-Q (quarters 1–3) and 10-K (quarter 4) contain significantly more information than the earnings announcement and would likely offer an opportunity for investors to gather information and learn, particularly if there is significant residual uncertainty about the interpretation of earnings. To explore this

is the number of sentences (Kincaid et al. 1975). For each firm-quarter, I adjust the firm's ARI by the mean industry (four-digit SIC) ARI for that same calendar quarter.

[22] The number of observations in these analyses are lower for several reasons – (1) the earnings guidance data that I use is only available through 2010, (2) I obtained the earnings announcement text from the 8-K's on EDGAR and some firms (particularly earlier in the sample) may not have filed an 8-K in conjunction with the earnings announcement, and (3) since I adjust the firm's textual complexity score (ARI) by the mean industry (four-digit SIC) ARI for that same calendar quarter, I eliminate observations where the abnormal ARI is zero (e.g., if the firm is the only earnings announcement for the four-digit SIC in that calendar quarter).

possibility, I restrict the sample to times when the *VIX* is above 20 (i.e., when *HI_VIX*=1) and partition the post-announcement period between 2 to 25 trading days after the announcement (*CAR[2,25]*) and 26 to 50 trading days after the announcement (*CAR[26,50]*).

Consistent with the results in Table 6, Panel B I find that information gathering at the time of the announcement (*INFO_ACCESS*) is positively associated with *CAR[2,25]* and *CAR[26,50]*. I also find that information gathering during the [0,6] trading-day window around the release of the 10-Q or 10-K (*INFO_ACC_FILING*) is not associated with positive abnormal returns in the [2,25] trading-day period, but it is associated with positive abnormal returns in the [26,50] trading-day period. [23] This is consistent with the subsequent release of the 10-Q or 10-K allowing for the resolution of residual uncertainty from the earnings announcement period. I also find that returns during the [2,25] trading-day period are negatively related to the number of days between the earnings announcement and the filing of the 10-Q or 10-K. This is consistent with the idea that uncertainty cannot be resolved without information and the lag in the release of additional information delays the dissipation of a premium related to uncertainty. To ensure that there is no return reversal related to the association between information gathering and positive post-announcement returns, I regress *CAR[51,75]* on *INFO_ACCESS* and *INFO_ACC_FILING*. In this time period, one might expect that much of the uncertainty associated with the prior earnings announcement would have dissipated (especially given that the subsequent quarter's earnings would have been announced during this period). Therefore, a negative coefficient would indicate a longer-term overreaction (perhaps due to attention, rather than learning). I find that neither of the coefficients is close to

[23] I allow seven calendar days for investors to process the information in the 10-Q or 10-K (as opposed to two days for the earnings announcement). This is based on the significantly greater length and complexity of these documents, as well as the empirical observation that these filings are downloaded at abnormally high levels for weeks after they are filed (Drake et al. 2014b).

any level of statistical significance, which suggests that the positive post-announcement returns are not due to information gathering being related to an over- or under-reaction to the earnings news.

CHAPTER 6

Alternative explanations and robustness tests

There are several potential alternative explanations that could be raised for the results presented in this paper. In this section, I briefly describe these alternatives and discuss their validity.

6.1 – (Irrational) attention-driven buying

Prior research has found that increased investor attention toward a particular stock results in price increases, followed by subsequent reversals (Da et al. 2011). The findings presented in Section 5 of this paper document a subsequent increase in price associated with investor information gathering, which might initially seem consistent with (irrational) investor attention driving price higher. However, there are at least two reasons why this is unlikely to drive the results. First, if price increases were being driven solely by the increased demand associated with (irrational) investor attention, I would expect the returns to reverse over time. The evidence in Tables 6 and 8 suggests that the positive abnormal returns do not reverse (even after the next quarter's earnings have been announced). Second, attention-driven increases in price should be present regardless of the level of uncertainty about the interpretation of earnings. Instead, the results in Table 6, Panel B suggest that the association between positive returns and information gathering is significantly greater when uncertainty about the interpretation of earnings is high. Both of these results are inconsistent with positive post-announcement returns being driven purely by attention-driven buying, but they are consistent with the presence of an uncertainty premium.

6.2 – Negativity bias

The strong return reversal for bad news firms with high search may be due to investors exhibiting negativity bias. Negativity bias is a cognitive bias exhibited by a tendency to be more affected by negative stimuli than positive, even if they are of the same magnitude (Akhtar et al. 2011). While a negativity bias would cause an overreaction to bad news (and may contribute to the magnitude of the initial reaction to bad news), it shouldn't cause an *under-reaction* to good news. The fact that information gathering is also associated with positive future returns for good news is inconsistent with negativity bias. Additionally, negativity bias is an unconditional bias, meaning it should not be affected by the level of uncertainty about the interpretation of earnings. However, as noted, the association between information gathering and positive post-announcement returns is apparent only when uncertainty about the interpretation of earnings is high. The conditional nature of this association is further evidence that the result is not driven by investors exhibiting a negativity bias.

6.3 – Time-varying risk premiums

The results could be attributable to changes in risk premiums or changes in investor risk preferences. While prior experimental research has provided evidence that individuals distinguish between risk and uncertainty when making decisions (Ellsberg 1961; Smith et al. 2002; Hsu et al. 2005), making this distinction outside of a laboratory setting is very difficult.

One potential distinction that might be drawn between uncertainty and risk is related to the importance of information quality on firm value. The theoretical model of Epstein and Schneider (2008) predicts that information quality has a first-order effect on price for an ambiguity-averse investor, while it has a second-order effect on price for a Bayesian investor who has no model uncertainty. For example, if uncertainty about mean earnings changes

because of company-specific news, a Bayesian investor (who has no concerns about model uncertainty) treats this as a change in risk, which results in only a second-order effect on the valuation of the company as long as the covariance with the market remains the same. However, ambiguity-averse investors respond *as if* mean earnings have *actually* changed, which is a first-order effect. Thus, the effect of ambiguous information on price would be much greater in the case of an ambiguity-averse investor.

My analyses can't explicitly determine if investors have a full understanding of the processes that generate returns and earnings or if, in contrast, they are uncertain about certain parameters or have multiple likelihoods in mind when processing signals of uncertain quality. However, the relatively stark results in Table 7 demonstrate the apparent importance of information in explaining the association between information gathering and positive post-announcement returns. The results in Table 7 suggest that the ambiguity of information in the earnings announcement is an important factor in how investors respond and in the effect this has on future returns. While this certainly doesn't rule out the possibility that changing risk premiums or preferences are contributing to the association between information gathering and future returns, the importance of information ambiguity is less consistent with a standard Bayesian investor who knows all the model parameters and more consistent with an ambiguity-averse investor who has a first-order concern about information uncertainty.

To further address concerns that the results may be attributable to changes in risk premiums or investor risk preferences, I estimate the regression from column (1) of Table 6, Panel B using several risk-adjusted return measures as the dependent variable. The results of this analysis are found in Table 9. The dependent variables in Columns (1) and (2) are abnormal returns from a market return model, where Column (1) is the cumulative abnormal

return (*CAR_MM[2,50]*) and Column (2) is the buy-and-hold abnormal return (*BHAR_MM[2,50]*). The dependent variables in Columns (3) and (4) are abnormal returns from a Carhart 4-factor model, where Column (3) is the cumulative abnormal return (*CAR_4FAC[2,50]*) and Column (4) is the buy-and-hold abnormal return (*BHAR_4FAC[2,50]*). The pre-event-window estimation period for each of these models is a 45-trading-day window that ends six trading days prior to the earnings announcement. In each case, the coefficient on *INFO_ACCESS* is positive and statistically significant, which is consistent with the result in column (1) of Table 6, Panel B – that increased information gathering at the time of the earnings announcement is associated with positive future abnormal returns. These return measures attempt to control for risk factors that have been identified in prior literature, as well as alternative methods of computing the compounded return. While this analysis cannot completely rule out the presence of changes in risk premiums or investor risk preferences as contributing factors in this relation, it provides further evidence that these factors are not driving the result.

CHAPTER 7

Conclusion

Despite the pervasiveness of uncertainty and the importance of information in capital markets, we have a limited understanding of how uncertainty influences information gathering and learning in capital-market settings. Guided by the intuition of theories of information choice, I find that investors gather more firm-level information as the earnings number deviates further from their prior beliefs and as firm- and market-level uncertainty increase prior to the earnings announcement. The influence of firm-level uncertainty on information gathering declines as market-wide uncertainty increases, which is consistent with theories of rational attention and category learning (Peng and Xiong 2006). More broadly, the results confirm a prevailing theoretical and experimental connection between uncertainty and information seeking that spans a broad range of literatures (Shannon 1949; Kahneman 1973; Sims 2003; Case 2012).

The connection between uncertainty and information gathering also influences predictions about how these activities may be associated with stock returns. I find that the intensity of investors' information-gathering efforts is associated with negative abnormal returns in the earnings announcement period and positive abnormal returns in the post-announcement period. These associations are significant for both good *and* bad news, which might initially seem puzzling – i.e., information gathering leading to an apparent *under-reaction* to good news and an *overreaction* to bad news. However, these return patterns are consistent with theoretical predictions about how investors respond to uncertainty (Brown et

al. 1988; Campbell and Hentschel 1992; Epstein and Schneider 2008). Moreover, the association between information gathering and positive post-announcement returns is strongest in situations where information gathering is less likely to fully resolve uncertainty and where supplemental information available to investors is itself ambiguous. Taken together, the results suggest that measures of investor attention and information gathering inherently capture investor uncertainty and that investors require a premium for tolerating residual uncertainty that is not resolved by gathering information.

Figures

Figure 1

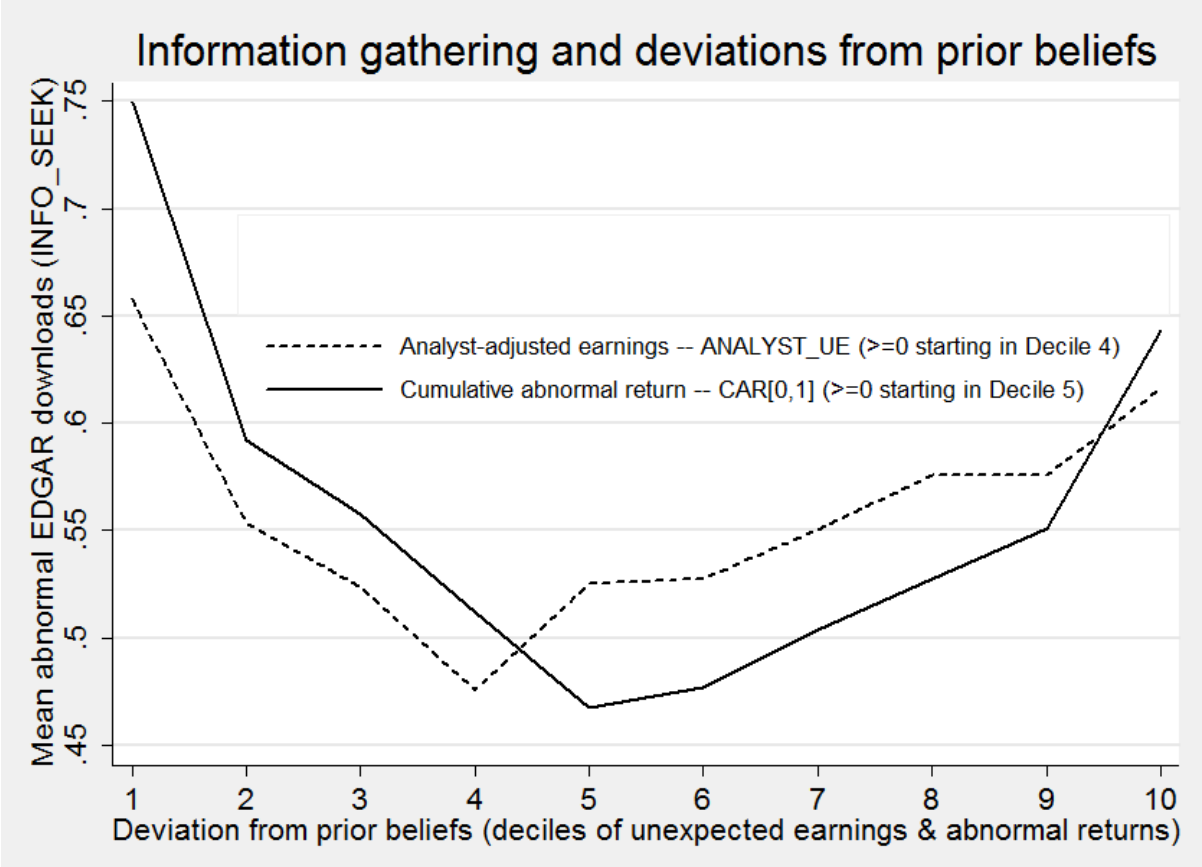
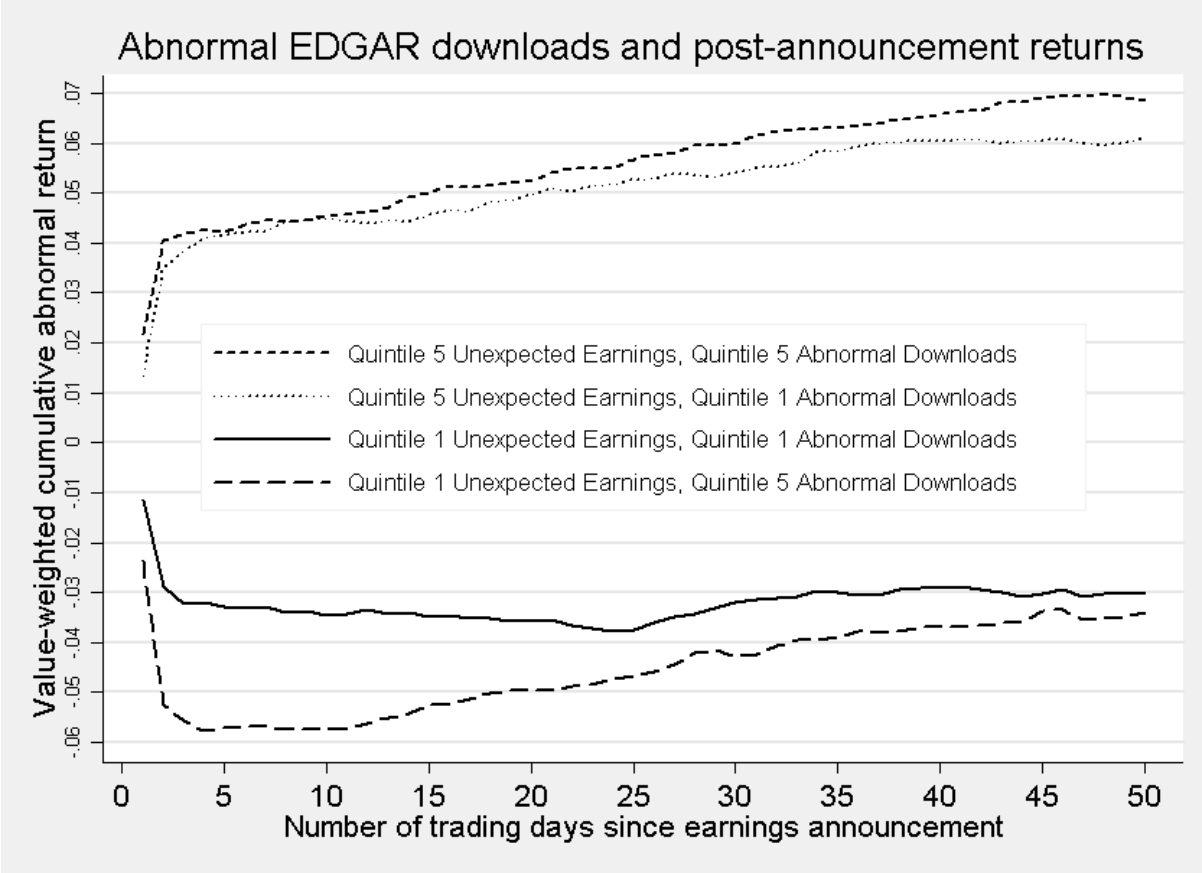

Information gathering and deviations from prior beliefs
Mean abnormal EDGAR downloads (INFO_SEEK)
.45
.5
.55
.6
.65
.7
.75
Analyst-adjusted earnings -- ANALYST_UE (>=0 starting in Decile 4)
Cumulative abnormal return -- CAR[0,1] (>=0 starting in Decile 5)
1
2
3
4
5
6
7
8
9
10
Deviation from prior beliefs (deciles of unexpected earnings & abnormal returns)

Figure 2


Abnormal EDGAR downloads and post-announcement returns
Value-weighted cumulative abnormal return
-.06
-.05
-.04
-.03
-.02
-.01
0
.01
.02
.03
.04
.05
.06
.07
Quintile 5 Unexpected Earnings, Quintile 5 Abnormal Downloads
Quintile 5 Unexpected Earnings, Quintile 1 Abnormal Downloads
Quintile 1 Unexpected Earnings, Quintile 1 Abnormal Downloads
Quintile 1 Unexpected Earnings, Quintile 5 Abnormal Downloads
0
5
10
15
20
25
30
35
40
45
50
Number of trading days since earnings announcement

Tables

Table 1 – Sample Selection

Details	No. of Observations
Quarterly earnings announcements between 2003 and March 2011 with coverage in Compustat (*gvkey* and *CIK*), CRSP (*permno*), IBES (analyst dispersion and unexpected earnings calculations), and EDGAR database	82,064
Less: Observations without coverage in Thomson Reuters 13f institutional ownership database	(11,663)
Less: Observations with missing data in the variables used	(4,582)
Sample used for analyses where implied volatility is not required	**65,819**
Less: Observations without coverage in OptionMetrics database for implied volatilities	(15,682)
Sample used for analyses where implied volatility is required	**50,137**

Table 2 – Descriptive Statistics

INFO_ACCESS is a measure of the abnormal EDGAR filing downloads for the [0,1] trading-day window around the earnings announcement (see Appendix A for additional details), *INFO_ACC_FILING* is a measure of the abnormal filing downloads for the [0,6] trading-day window around filing of 10-K or 10-Q (see Appendix A for additional details), *ANALYST_UE* is the firm's unexpected earnings (adjusted for analysts' consensus forecast), scaled by price, *CAR[0,1]* and *CAR[2,50]* are, respectively, the cumulative abnormal stock return for the [0,1] and [2,25] trading-day window around the earnings announcement, *GOOGLE* is the Google Search Volume Index for the stock's ticker symbol for the [0,1] trading-day window around the earnings announcement, *LN_MVE* is the natural log of the market value of equity as of the end of the reporting quarter, *BOOK_MARKET* is the book value of equity divided by the market value of equity as of the end of the reporting quarter, *INST_OWN* is percentage of institutional ownership as of the end of the month prior to the earnings announcement, *ANALYST_FOL* is the number of analysts following the firm at the end of the month prior to the earnings announcement, *EA_COUNT* is the number of earnings announcements on the same calendar day as the firm's earnings announcement, *IMP_VOL30* is the average of the implied volatility for a standardized 30-day put and call option from the OptionMetrics Standardized Options dataset two trading days prior to the earnings announcement date, *ANALYST_DISP* is the standard deviation of analysts' earnings forecasts as of the end of the month prior to the earnings announcement, divided by the mean share price for that month, *SDEV_PRE_RET* is the standard deviation of stock returns for the 60 trading days ending on trading day *t-3* before the earnings announcement, *VIX* is the volatility index on the S&P 500 two trading days prior to the earnings announcement, *HI_VIX* is equal to 1 if *VIX* is greater than 20, and 0 otherwise (the level of 20 was chosen because it is the approximate mean and median of the VIX for 1993–2002 – the 10 years leading up to the sample period), *10K_LAG* is the number of calendar days between the earnings announcement and the filing of the 10-K or 10-Q, *BAD_NEWS* is an indicator equal to 1 if the company misses analysts' consensus earnings and 0 otherwise

Variable	*N*	*Mean*	*P25*	*P50*	*P75*	*Std Dev*
Dependent Variables						
INFO_ACCESS	65,819	0.564	-0.005	0.366	0.888	0.87
INFO_ACC_FILING	65,819	0.633	0.082	0.391	0.862	1.69
CAR[0,1]	65,819	0.001	-0.040	0.000	0.042	0.09
CAR[2,50]	65,819	0.007	-0.078	0.001	0.082	0.18
GOOGLE	5,696	1.208	0.664	1.025	1.270	2.24
Independent Variables						
ANALYST_UE	65,819	-0.001	-0.001	0.001	0.002	0.02
LN_MVE	65,819	7.109	5.944	6.958	8.117	1.62
BOOK_MARKET	65,819	0.564	0.277	0.463	0.721	0.63
INST_OWN	65,819	0.709	0.560	0.749	0.883	0.24
ANALYST_FOL	65,819	1.986	1.609	1.946	2.398	0.58
EA_COUNT	65,819	103	40	93	160	68.64
IMP_VOL30	50,137	0.481	0.324	0.439	0.587	0.22
ANALYST_DISP	65,819	0.009	0.001	0.003	0.007	0.03
SDEV_PRE_RET	65,819	0.024	0.014	0.020	0.029	0.02
VIX	65,819	21.802	15.280	19.170	24.230	10.82
HI_VIX	65,819	0.455	0	0	1	0.50
10K_LAG	65,819	12	1	9	18	11.96
BAD_NEWS	65,819	0.297	0	0	1	0.46

Table 3 – Correlations

INFO_ACCESS is a measure of the abnormal EDGAR filing downloads for the [0,1] trading-day window around the earnings announcement (see Appendix A for additional details), *INFO_ACC_FILING* is a measure of the abnormal filing downloads for the [0,6] trading-day window around filing of 10-K or 10-Q (see Appendix A for additional details), *ANALYST_UE* is the firm's unexpected earnings (adjusted for analysts' consensus forecast), scaled by price, *CAR[0,1]* and *CAR[2,50]* are, respectively, the cumulative abnormal stock return for the [0,1] and [2,25] trading-day window around the earnings announcement, *GOOGLE* is the Google Search Volume Index for the stock's ticker symbol for the [0,1] trading-day window around the earnings announcement, *LN_MVE* is the natural log of the market value of equity as of the end of the reporting quarter, *BOOK_MARKET* is the book value of equity divided by the market value of equity as of the end of the reporting quarter, *INST_OWN* is percentage of institutional ownership as of the end of the month prior to the earnings announcement, *ANALYST_FOL* is the number of analysts following the firm at the end of the month prior to the earnings announcement, *EA_COUNT* is the number of earnings announcements on the same calendar day as the firm's earnings announcement, *IMP_VOL30* is the average of the implied volatility for a standardized 30-day put and call option from the OptionMetrics Standardized Options dataset two trading days prior to the earnings announcement date, *ANALYST_DISP* is the standard deviation of analysts' earnings forecasts as of the end of the month prior to the earnings announcement, divided by the mean share price for that month, *SDEV_PRE_RET* is the standard deviation of stock returns for the 60 trading days ending on trading day *t-3* before the earnings announcement, *VIX* is the volatility index on the S&P 500 two trading days prior to the earnings announcement, *HI_VIX* is equal to 1 if *VIX* is greater than 20, and 0 otherwise (the level of 20 was chosen because it is the approximate mean and median of the VIX for 1993–2002 – the 10 years leading up to the sample period), *10K_LAG* is the number of calendar days between the earnings announcement and the filing of the 10-K or 10-Q, *BAD_NEWS* is an indicator equal to 1 if the company misses analysts' consensus earnings and 0 otherwise

	Variable	***(1)***	***(2)***	***(3)***	***(4)***	***(5)***	***(6)***	***(7)***	***(8)***	***(9)***	***(10)***	***(11)***	***(12)***	***(13)***	***(14)***	***(15)***	***(16)***	***(17)***	***(18)***
(1)	*INFO_ACCESS*	1	0.28	-0.04	0.02	0.15	-0.03	0.15	-0.01	0.06	0.14	-0.09	0.05	0.03	0.02	0.10	0.11	-0.16	0.02
(2)	*CAR[0,1]*	0.30	1	-0.01	0.02	0.00	-0.02	0.08	0.00	0.03	0.06	-0.10	-0.01	0.00	-0.01	0.03	0.01	0.06	0.00
(3)	*CAR[2,50]*	-0.04	-0.01	1	0.02	0.02	0.15	0.01	0.02	0.03	0.01	0.00	-0.01	-0.01	-0.02	0.00	0.01	0.01	-0.27
(4)	*GOOGLE*	0.00	0.00	0.04	1	0.02	-0.03	-0.03	0.06	0.00	-0.01	-0.01	0.08	0.04	0.09	0.09	0.04	0.00	-0.01
(5)	*WIKIPEDIA*	0.15	0.00	0.02	0.02	1	-0.03	0.22	-0.02	-0.07	0.12	-0.03	0.08	0.04	0.06	0.05	0.07	0.00	-0.01
(6)	*ANALYST_UE*	-0.06	-0.09	0.09	0.07	-0.03	1	0.08	-0.17	0.04	0.03	0.02	-0.14	-0.26	-0.21	-0.09	-0.06	-0.02	-0.32
(7)	*LN_MVE*	0.13	0.08	-0.02	-0.02	0.22	0.09	1	-0.22	0.27	0.62	-0.03	-0.52	-0.24	-0.47	-0.08	-0.08	0.10	-0.15
(8)	*BOOK_MARKET*	0.01	-0.03	0.05	0.03	-0.02	-0.21	-0.15	1	-0.10	-0.10	0.01	0.17	0.29	0.24	0.16	0.15	0.01	0.09
(9)	*INST_OWN*	0.03	-0.01	0.04	-0.03	-0.07	-0.06	-0.35	0.01	1	0.32	0.03	-0.08	-0.13	-0.18	0.03	0.04	-0.05	-0.09
(10)	*ANALYST_FOL*	0.06	0.01	0.01	-0.04	0.13	0.01	0.30	-0.06	0.04	1	0.01	-0.15	-0.08	-0.18	0.03	0.04	0.08	-0.12
(11)	*EA_COUNT*	-0.05	-0.14	0.00	0.01	-0.03	0.03	-0.10	0.00	0.09	-0.06	1	0.02	0.02	0.00	0.02	0.09	-0.16	-0.02
(12)	*IMP_VOL30*	0.18	0.02	0.03	0.04	0.08	-0.23	-0.28	0.23	0.23	0.15	0.04	1	0.38	0.78	0.53	0.36	-0.11	0.12
(13)	*ANALYST_DISP*	0.05	0.01	-0.02	-0.04	0.03	-0.58	-0.17	0.29	0.09	0.01	0.01	0.40	1	0.44	0.13	0.14	-0.09	0.12
(14)	*SDEV_PRE_RET*	0.13	0.02	0.01	-0.01	0.06	-0.33	-0.28	0.30	0.20	0.12	0.02	0.83	0.54	1	0.40	0.27	-0.10	0.12
(15)	*VIX*	0.17	0.01	-0.01	0.10	0.05	-0.08	-0.05	0.13	0.06	0.05	0.02	0.71	0.11	0.50	1	0.65	-0.11	0.05
(16)	*HI_VIX*	0.14	0.02	0.01	0.03	0.07	-0.07	-0.02	0.12	0.12	0.03	0.01	0.52	0.12	0.39	0.65	1	-0.19	0.04
(17)	*10K_LAG*	-0.15	0.20	0.01	-0.02	0.00	-0.03	0.07	-0.04	-0.08	0.14	-0.26	-0.08	-0.04	-0.06	-0.13	-0.12	1	-0.05
(18)	*BAD_NEWS*	0.06	0.03	-0.24	-0.03	-0.02	-0.26	-0.10	0.14	-0.01	-0.06	-0.01	0.13	0.15	0.15	0.06	0.05	-0.01	1

Spearman correlations are in the lower left and Pearson pairwise correlations are in the upper right

Table 4 – Economic drivers of information gathering

INFO_ACCESS is a measure of the abnormal EDGAR filing downloads for the [0,1] trading-day window around the earnings announcement (see Appendix A for additional details), *ABS_ANALYST_UE_DEC* is the decile rank of the absolute value of *ANALYST_UE,* where *ANALYST_UE* is the firm's unexpected earnings (adjusted for analysts' consensus forecast), scaled by price, *CAR[0,1]* is the cumulative abnormal stock return for the [0,1] trading-day window around the earnings announcement, *LN_MVE* is the natural log of the market value of equity as of the end of the reporting quarter, *BOOK_MARKET* is the book value of equity divided by the market value of equity as of the end of the reporting quarter, *INST_OWN* is percentage of institutional ownership as of the end of the month prior to the earnings announcement, *ANALYST_FOL* is the number of analysts following the firm at the end of the month prior to the earnings announcement, *EA_COUNT* is the number of earnings announcements on the same calendar day as the firm's earnings announcement, *IMP_VOL30* is the average of the implied volatility for a standardized 30-day put and call option from the OptionMetrics Standardized Options dataset two trading days prior to the earnings announcement date, *ANALYST_DISP* is the standard deviation of analysts' earnings forecasts as of the end of the month prior to the earnings announcement, divided by the mean share price for that month, *SDEV_PRE_RET* is the standard deviation of stock returns for the 60 trading days ending on trading day t-3 before the earnings announcement, *VIX* is the volatility index on the S&P 500 two trading days prior to the earnings announcement.

Panel A: Information gathering and deviations from prior beliefs

	Dependent Variable - INFO_ACCESS			
Variable	**(1)**	**(2)**	**(3)**	**(4)**
ABS_ANALYST_UE_DEC	0.0243***		0.0191***	0.0046***
	(13.77)		*(11.02)*	*(3.08)*
ABS*(CAR [0,1])*		1.7084***	1.5981***	1.3591***
		(22.86)	*(21.73)*	*(18.98)*
LN_MVE	0.0916***	0.0972***	0.1052***	0.0492***
	(15.70)	*(16.97)*	*(18.12)*	*(3.88)*
BOOK_MARKET	-0.0353***	-0.0136	-0.0321***	-0.0228*
	(-2.80)	*(-1.08)*	*(-2.58)*	*(-1.67)*
INST_OWN	0.0750***	0.0273	0.0427	-0.0276
	(2.84)	*(1.03)*	*(1.63)*	*(-0.73)*
ANALYST_FOL	0.0224*	0.0042	0.0058	0.0078
	(1.71)	*(0.33)*	*(0.46)*	*(0.63)*
EA_COUNT	-0.0014***	-0.0013***	-0.0013***	-0.0010***
	(-13.75)	*(-13.14)*	*(-13.41)*	*(-9.26)*
Firm FE	N	N	N	Y
Observations	65,819	65,819	65,819	65,819
Adj. R-squared	0.125	0.135	0.138	0.266

*, **, *** indicate statistical significance at the p < 0.10, 0.05, and 0.01 levels, respectively

Standard errors are clustered by firm

Firm, calendar quarter, fiscal quarter, and day-of-week fixed effects are included in all specifications

Panel B: Information gathering and uncertainty of prior beliefs

	Dependent Variable - INFO_ACCESS					
	Firm-level uncertainty			*Macroeconomic uncertainty*		
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
*IMP_VOL*VIX*						-0.0140***
						(-8.17)
IMP_VOL	0.2415***				0.1286***	0.5542***
	(6.77)				(3.26)	(9.38)
ANALYST_DISP		0.5187***				
		(2.92)				
SDEV_PRE_RET			1.3923***			
			(3.47)			
VIX				0.0047***	0.0034***	0.0128***
				(5.09)	(3.30)	(7.23)
ABS_ANALYST_UE_DEC	0.0035*	0.0045***	0.0045***	0.0166***	0.0164***	0.0153***
	(1.95)	(3.03)	(3.04)	(9.08)	(9.00)	(8.36)
ABS(CAR[0,1])	1.4898***	1.3516***	1.3362***	1.3706***	1.3293***	1.3411***
	(16.74)	(18.85)	(18.55)	(15.59)	(15.01)	(15.72)
LN_MVE	0.0802***	0.0553***	0.0566***	0.0920***	0.1014***	0.1113***
	(5.36)	(4.33)	(4.41)	(7.23)	(7.85)	(8.76)
BOOK_MARKET	-0.0301	-0.0307**	-0.0313**	0.0880***	0.0807***	0.0704***
	(-1.63)	(-2.20)	(-2.23)	(4.54)	(4.12)	(3.69)
INST_OWN	0.0534	-0.0226	-0.0191	0.0396	0.0386	0.0254
	(1.20)	(-0.60)	(-0.51)	(0.93)	(0.90)	(0.60)
ANALYST_FOL	0.0049	0.0063	0.0063	0.1475***	0.1479***	0.1397***
	(0.34)	(0.51)	(0.51)	(9.04)	(9.07)	(8.56)
EA_COUNT	-0.0011***	-0.0010***	-0.0010***	-0.0007***	-0.0007***	-0.0007***
	(-8.10)	(-9.29)	(-9.28)	(-3.23)	(-3.21)	(-3.24)
Quarter FE	Y	Y	Y	N	N	N
Observations	50,137	65,819	65,819	50,137	50,137	50,137
Adj. R-squared	0.272	0.266	0.266	0.203	0.204	0.206

*, **, *** indicate statistical significance at the p < 0.10, 0.05, and 0.01 levels, respectively
Standard errors are clustered by firm
Firm, fiscal quarter, and day-of-week fixed effects are included in all specifications

Table 5 – Information gathering and traditional tests of market efficiency

CAR[2,50] is the cumulative abnormal stock return for the [2,50] trading-day window following the earnings announcement, *INFO_ACCESS* is a measure of the abnormal EDGAR filing downloads for the [0,1] trading-day window around the earnings announcement (see Appendix A for additional details), *UE_DEC* is the decile rank of the firm's unexpected earnings (either analyst- or seasonally adjusted, as indicated in the table), *LN_MVE* is the natural log of the market value of equity as of the end of the reporting quarter, *BOOK_MARKET* is the book value of equity divided by the market value of equity as of the end of the reporting quarter, *INST_OWN* is percentage of institutional ownership as of the end of the month prior to the earnings announcement, *ANALYST_FOL* is the number of analysts following the firm at the end of the month prior to the earnings announcement, *EA_COUNT* is the number of earnings announcements on the same calendar day as the firm's earnings announcement, *ABS_ANALYST_UE_DEC* is the decile rank of the absolute value of *ANALYST_UE*, where *ANALYST_UE* is the firm's unexpected earnings (adjusted for analysts' consensus forecast), scaled by price, *CAR[0,1]* is the cumulative abnormal stock return for the [0,1] trading-day window around the earnings announcement

	Dependent Variable - CAR [2,50]		*ABS(CAR [2, 50])*
	Analyst-adj. UE	*Seasonally Adj. UE*	
Variable	**(1)**	**(2)**	**(3)**
*INFO_ACCESS*UE_DEC*	-0.0010**	-0.0017***	
	(-2.10)	*(-3.65)*	
INFO_ACCESS	0.0051***	0.0045***	0.0054***
	(3.12)	*(3.29)*	*(6.24)*
*LN_MVE*ANALYST_UE_DEC*	0.0002	0.0007**	
	(0.83)	*(2.53)*	
*BOOK_MARKET*UE_DEC*	0.0025***	0.0012	
	(2.90)	*(1.31)*	
*ANALYST_FOL*UE_DEC*	-0.0015**	-0.0019***	
	(-2.21)	*(-2.74)*	
*INST_OWN*UE_DEC*	-0.0023*	-0.0045***	
	(-1.67)	*(-3.32)*	
*EA_COUNT*UE_DEC*	0.0000*	0.0000	
	(1.92)	*(0.94)*	
UE_DEC	0.0020	0.0032	
	(1.06)	*(1.63)*	
LN_MVE	-0.0678***	-0.0677***	-0.0369***
	(-15.18)	*(-15.34)*	*(-12.28)*
BOOK_MARKET	0.0213***	0.0261***	0.0258***
	(2.98)	*(3.98)*	*(5.50)*
ANALYST_FOL	-0.0369***	-0.0384***	-0.0119*
	(-4.06)	*(-4.35)*	*(-1.89)*
INST_OWN	-0.0005	-0.0009	0.0043**
	(-0.14)	*(-0.31)*	*(2.04)*
EA_COUNT	-0.0000	0.0000	-0.0000**
	(-0.14)	*(0.20)*	*(-2.09)*
ABS_ANALYST_UE_DEC			0.0004*
			(1.65)
ABS(CAR [0,1])			0.1276***
			(7.35)
Observations	65,819	65,819	65,819
Adj. R-squared	0.087	0.088	0.230

*, **, *** indicate statistical significance at the p < 0.10, 0.05, and 0.01 levels, respectively

Standard errors are clustered by announcement date

Firm, calendar quarter, fiscal quarter, and day-of-week fixed effects are included in all specifications

Table 6 – Information gathering, uncertainty, and stock returns around the earnings announcement

CAR[2,50] is the cumulative abnormal stock return for the [2,50] trading-day window following the earnings announcement, *INFO_ACCESS* is a measure of the abnormal EDGAR filing downloads for the [0,1] trading-day window around the earnings announcement (see Appendix A for additional details), *UNCERTAIN* is a measure of uncertainty about the interpretation of earnings (*VIX* – the level of the *VIX* two trading days prior to the earnings announcement, *IMP_VOL* – firm-specific implied volatility two trading days prior to the earnings announcement, and *UE* – an indicator equal to 1 if analyst-adjusted earnings is in the top or bottom quintile, and 0 otherwise), *GOOGLE* is the Google Search Volume Index for the stock's ticker symbol for the [0,1] trading-day window around the earnings announcement, *ANALYST_UE_DEC* is the decile rank of *ANALYST_UE*, where *ANALYST_UE* is the firm's unexpected earnings (adjusted for analysts' consensus forecast), scaled by price, *CAR[0,1]* is the cumulative abnormal stock return for the [0,1] trading-day window around the earnings announcement, *LN_MVE* is the natural log of the market value of equity as of the end of the reporting quarter, *BOOK_MARKET* is the book value of equity divided by the market value of equity as of the end of the reporting quarter, *INST_OWN* is percentage of institutional ownership as of the end of the month prior to the earnings announcement, *ANALYST_FOL* is the number of analysts following the firm at the end of the month prior to the earnings announcement, *EA_COUNT* is the number of earnings announcements on the same calendar day as the firm's earnings announcement, *CAR[0,1]* is the cumulative abnormal stock return for the [0,1] trading-day window around the earnings announcement

Panel A: Information gathering and announcement period stock returns

	Dependent Variable - CAR[0,1]						
Variable	*Full Sample* *(1)*	*UNCERTAIN (VIX)* *(2)*	*UNCERTAIN (IMP_VOL)* *(3)*	*UNCERTAIN (UE)* *(4)*	*High VIX Good News* *(5)*	*High VIX Bad News* *(6)*	*High VIX GOOGLE* *(7)*
*INFO_ACCESS*UNCERTAIN*		-0.0029***	-0.0026***	-0.0019**			
		(-3.17)	(-2.85)	(-1.96)			
INFO_ACCESS	-0.0037***	-0.0023***	-0.0023***	-0.0028***	-0.0016	-0.0127***	
	(-7.00)	(-3.75)	(-4.44)	(-4.92)	(-1.64)	(-5.91)	
GOOGLE							-0.0019
							(-0.71)
UNCERTAIN		0.0015	0.0011	0.0015			
		(0.94)	(0.91)	(1.57)			
ANALYST_UE_DEC	0.0106***	0.0106***	0.0106***	0.0106***	0.0121***	0.0188***	0.0112***
	(63.81)	(63.80)	(63.83)	(63.86)	(27.33)	(8.81)	(9.43)
LN_MVE	-0.0144***	-0.0144***	-0.0145***	-0.0144***	-0.0269***	-0.0373***	-0.0507
	(-10.51)	(-10.55)	(-10.51)	(-10.56)	(-7.82)	(-7.20)	(-1.54)
BOOK_MARKET	0.0044**	0.0042**	0.0043**	0.0043**	0.0057	0.0015	0.0423
	(2.03)	(1.98)	(2.02)	(1.99)	(1.20)	(0.32)	(0.81)
INST_OWN	-0.0080**	-0.0081**	-0.0078*	-0.0080**	-0.0201**	0.0001	0.1197
	(-1.99)	(-2.00)	(-1.93)	(-1.98)	(-2.17)	(0.01)	(1.07)
ANALYST_FOL	0.0002	0.0003	0.0002	0.0002	0.0008	0.0069	0.0241*

	(0.18)	(0.19)	(0.14)	(0.16)	(0.23)	(1.29)	(1.65)
EA_COUNT	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
	(-0.82)	(-0.84)	(-0.82)	(-0.80)	(-0.76)	(-0.70)	(-0.65)
Observations	65,819	65,819	65,819	65,819	20,434	9,525	1,742
Adj. R-squared	0.139	0.140	0.140	0.139	0.107	0.091	0.051

*, **, *** indicate statistical significance at the p < 0.10, 0.05, and 0.01 levels, respectively

Standard errors are clustered by announcement date

Firm, calendar quarter, fiscal quarter, and day-of-week fixed effects are included in all specifications

Panel B: Information gathering and post-announcement stock returns

	Dependent Variable - CAR[2,50]						
Variable	*Full Sample* *(1)*	*UNCERTAIN (VIX)* *(2)*	*UNCERTAIN (IMP_VOL)* *(3)*	*UNCERTAIN (UE)* *(4)*	*High VIX Good News* *(5)*	*High VIX Bad News* *(6)*	*High VIX GOOGLE* *(7)*
*INFO_ACCESS*UNCERTAIN*		0.0097***	0.0044**	0.0044*			
		(4.38)	*(2.30)*	*(1.80)*			
INFO_ACCESS	0.0036***	-0.0009	0.0012	0.0016	0.0050**	0.0228***	
	(2.93)	*(-0.89)*	*(1.30)*	*(1.55)*	*(2.36)*	*(3.61)*	
GOOGLE							0.0073**
							(2.05)
UNCERTAIN		-0.0071**	-0.0119***	0.0010			
		(-2.02)	*(-4.39)*	*(0.46)*			
ANALYST_UE_DEC	0.0013***	0.0013***	0.0013***	0.0013***	0.0008	0.0067	0.0031
	(3.68)	*(3.70)*	*(3.71)*	*(3.71)*	*(0.89)*	*(1.32)*	*(1.12)*
CAR[0,1]	-0.0086	-0.0078	-0.0082	-0.0084	-0.0714***	-0.0934*	-0.0643
	(-0.51)	*(-0.47)*	*(-0.49)*	*(-0.50)*	*(-2.79)*	*(-1.74)*	*(-1.06)*
LN_MVE	-0.0677***	-0.0675***	-0.0687***	-0.0667***	-0.1263***	-0.1746***	-0.3075***
	(-15.08)	*(-15.08)*	*(-15.15)*	*(-14.96)*	*(-12.67)*	*(-9.43)*	*(-7.32)*
BOOK_MARKET	0.0238***	0.0242***	0.0234***	0.0237***	0.0380***	-0.0004	0.0755
	(3.43)	*(3.48)*	*(3.37)*	*(3.41)*	*(3.79)*	*(-0.02)*	*(1.54)*
INST_OWN	-0.0402***	-0.0400***	-0.0416***	-0.0403***	-0.0722***	-0.0255	0.0233
	(-4.57)	*(-4.55)*	*(-4.74)*	*(-4.58)*	*(-3.73)*	*(-0.58)*	*(0.25)*
ANALYST_FOL	-0.0026	-0.0027	-0.0026	-0.0025	-0.0055	0.0033	-0.0285*
	(-0.88)	*(-0.91)*	*(-0.90)*	*(-0.86)*	*(-0.92)*	*(0.24)*	*(-1.68)*
EA_COUNT	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0001	0.0002
	(0.35)	*(0.41)*	*(0.35)*	*(0.35)*	*(0.46)*	*(-0.48)*	*(1.41)*
Observations	65,819	65,819	65,819	65,819	20,434	9,525	1,742
Adj. R-squared	0.086	0.087	0.087	0.086	0.127	0.125	0.152

*, **, *** indicate statistical significance at the p < 0.10, 0.05, and 0.01 levels, respectively

Standard errors are clustered by announcement date

Firm, calendar quarter, fiscal quarter, and day-of-week fixed effects are included in all specifications

Table 7 – Ambiguous information and post-announcement returns

CAR[2,50] is the cumulative abnormal stock return for the [2,50] trading-day window following the earnings announcement, *INFO_ACCESS* is a measure of the abnormal EDGAR filing downloads for the [0,1] trading-day window around the earnings announcement (see Appendix A for additional details), *ANALYST_UE_DEC* is the decile rank of *ANALYST_UE*, where *ANALYST_UE* is the firm's unexpected earnings (adjusted for analysts' consensus forecast), scaled by price, *CAR[0,1]* is the cumulative abnormal stock return for the [0,1] trading-day window around the earnings announcement, *LN_MVE* is the natural log of the market value of equity as of the end of the reporting quarter, *BOOK_MARKET* is the book value of equity divided by the market value of equity as of the end of the reporting quarter, *INST_OWN* is percentage of institutional ownership as of the end of the month prior to the earnings announcement, *ANALYST_FOL* is the number of analysts following the firm at the end of the month prior to the earnings announcement, *EA_COUNT* is the number of earnings announcements on the same calendar day as the firm's earnings announcement

	Dependent Variable - CAR[2,50]			
Variable	*Guide (1)*	*No Guide (2)*	*Low text complexity (3)*	*High text complexity (4)*
INFO_ACCESS	0.0015	0.0055***	0.0003	0.0083***
	(0.93)	(2.93)	(0.15)	(3.99)
ANALYST_UE_DEC	0.0019***	0.0013**	0.0004	0.0014**
	(3.33)	(2.56)	(0.78)	(2.28)
CAR[0,1]	-0.0426*	-0.0087	-0.0132	0.0112
	(-1.89)	(-0.35)	(-0.51)	(0.43)
LN_MVE	-0.0755***	-0.0902***	-0.0727***	-0.0845***
	(-11.99)	(-13.82)	(-10.69)	(-11.57)
BOOK_MARKET	0.0557***	0.0125	0.0249**	0.0259***
	(3.99)	(1.49)	(2.17)	(2.95)
INST_OWN	-0.0533***	-0.0539***	-0.0166	-0.0538***
	(-3.85)	(-3.75)	(-1.09)	(-3.05)
ANALYST_FOL	-0.0038	-0.0020	-0.0081*	-0.0011
	(-1.05)	(-0.41)	(-1.69)	(-0.23)
EA_COUNT	0.0001**	-0.0000	0.0000	-0.0000
	(2.23)	(-0.71)	(0.58)	(-0.03)
Observations	22,211	35,270	26,365	23,205
Adj. R-squared	0.101	0.092	0.088	0.109

*, **, *** indicate statistical significance at the p < 0.10, 0.05, and 0.01 levels, respectively

Standard errors are clustered by announcement date

Firm, calendar quarter, fiscal quarter, and day-of-week fixed effects are included in all specifications

Table 8 – Information gathering, subsequent information, and post-announcement returns

CAR[X,Y] is the cumulative abnormal stock return from trading day X to trading day Y following the earnings announcement (where the earnings announcement occurs on day zero), *INFO_ACCESS* is a measure of the abnormal EDGAR filing downloads for the [0,1] trading-day window around the earnings announcement (see Appendix A for additional details), *10K_LAG* is the number of calendar days between the earnings announcement and the filing of the 10-K or 10-Q, *INFO_ACC_FILING* is a measure of the abnormal filing downloads for the [0,6] trading-day window around filing of 10-K or 10-Q (see Appendix A for additional details), *ANALYST_UE_DEC* is the decile rank of *ANALYST_UE*, where *ANALYST_UE* is the firm's unexpected earnings (adjusted for analysts' consensus forecast), scaled by price, *CAR[0,1]* is the cumulative abnormal stock return for the [0,1] trading-day window around the earnings announcement, *LN_MVE* is the natural log of the market value of equity as of the end of the reporting quarter, *BOOK_MARKET* is the book value of equity divided by the market value of equity as of the end of the reporting quarter, *INST_OWN* is percentage of institutional ownership as of the end of the month prior to the earnings announcement, *ANALYST_FOL* is the number of analysts following the firm at the end of the month prior to the earnings announcement, *EA_COUNT* is the number of earnings announcements on the same calendar day as the firm's earnings announcement

	Dependent Variable - CAR[2,25]		*CAR[26,50]*	*CAR[51, 75]*
Variable	*High VIX* *(1)*	*High VIX* *(2)*	*High VIX* *(3)*	*High VIX* *(4)*
INFO_ACCESS	0.0058***	0.0051***	0.0032**	0.0001
	(3.21)	*(2.92)*	*(2.05)*	*(0.08)*
10K_LAG		-0.0007***		
		(-2.89)		
INFO_ACC_FILING			0.0036**	-0.0006
			(2.14)	*(-0.55)*
ANALYST_UE_DEC	0.0015***	0.0015***	-0.0011**	-0.0023***
	(3.32)	*(3.32)*	*(-2.48)*	*(-4.85)*
CAR[0,1]	-0.0274	-0.0274	-0.0494**	-0.0955***
	(-1.31)	*(-1.31)*	*(-2.31)*	*(-5.46)*
LN_MVE	-0.0621***	-0.0619***	-0.0799***	-0.0729***
	(-10.16)	*(-10.14)*	*(-10.77)*	*(-11.76)*
BOOK_MARKET	0.0216***	0.0215***	-0.0026	0.0149*
	(3.28)	*(3.25)*	*(-0.35)*	*(1.92)*
INST_OWN	-0.0370***	-0.0375***	-0.0258*	-0.0493***
	(-3.11)	*(-3.16)*	*(-1.77)*	*(-3.10)*
ANALYST_FOL	0.0020	0.0023	-0.0072	-0.0117**
	(0.53)	*(0.62)*	*(-1.57)*	*(-2.32)*
EA_COUNT	-0.0000	-0.0000	0.0000	-0.0000
	(-1.03)	*(-0.86)*	*(0.51)*	*(-0.47)*
Observations	29,959	29,959	29,959	29,959
Adj. R-squared	0.076	0.077	0.085	0.090

*, **, *** indicate statistical significance at the p < 0.10, 0.05, and 0.01 levels, respectively

Standard errors are clustered by announcement date

Firm, calendar quarter, fiscal quarter, and day-of-week fixed effects are included in all specifications

Table 9 – Alternative return measures to control for risk factors

BHAR[2,50] is the buy-and-hold abnormal stock return (where the value-weighted market return is subtracted from the firm's daily return) for the [2,50] trading-day window following the earnings announcement, *CAR_MM[2,50], BHAR_MM[2,50], CAR_4FAC[2,50]*, and *BHAR_4FAC[2,50]* are abnormal return measures for the [2,50] trading-day window following the earnings announcement, where the abnormal returns are cumulative (*CAR*) or buy-and-hold (*BHAR*) and where the returns have been adjusted for risk factors identified in prior literature (*MM* and *4FAC* indicate abnormal returns calculated using a market return model and Carhart 4-factor model, respectively), *INFO_ACCESS* is a measure of the abnormal EDGAR filing downloads for the [0,1] trading-day window around the earnings announcement (see Appendix A for additional details), *ANALYST_UE_DEC* is the decile rank of *ANALYST_UE*, where *ANALYST_UE* is the firm's unexpected earnings (adjusted for analysts' consensus forecast), scaled by price, *CAR[0,1]* is the cumulative abnormal stock return for the [0,1] trading-day window around the earnings announcement, *LN_MVE* is the natural log of the market value of equity as of the end of the reporting quarter, *BOOK_MARKET* is the book value of equity divided by the market value of equity as of the end of the reporting quarter, *INST_OWN* is percentage of institutional ownership as of the end of the month prior to the earnings announcement, *ANALYST_FOL* is the number of analysts following the firm at the end of the month prior to the earnings announcement, *EA_COUNT* is the number of earnings announcements on the same calendar day as the firm's earnings announcement

	Dependent Variables			
Variable	*CAR_MM[2,50]* *(1)*	*BHAR_MM[2,50]* *(2)*	*CAR_4FAC[2,50]* *(3)*	*BHAR_4FAC[2,50]* *(4)*
INFO_ACCESS	0.0055***	0.0082***	0.0067***	0.0066***
	(4.34)	(4.89)	(4.14)	(3.90)
ANALYST_UE_DEC	-0.0011***	-0.0031***	-0.0025***	-0.0022***
	(-2.74)	(-5.67)	(-4.97)	(-4.02)
CAR[0,1]	0.0220	0.0629***	0.0515***	0.0524**
	(1.21)	(2.66)	(2.60)	(2.51)
LN_MVE	-0.0726***	-0.0763***	-0.0747***	-0.0698***
	(-15.26)	(-12.64)	(-15.58)	(-11.96)
BOOK_MARKET	0.0363***	0.0480***	0.0508***	0.0456***
	(3.59)	(3.21)	(5.54)	(4.17)
INST_OWN	0.0180*	0.1005***	0.0870***	0.0971***
	(1.73)	(6.85)	(6.22)	(6.61)
ANALYST_FOL	0.0158***	0.0345***	0.0331***	0.0325***
	(4.92)	(8.04)	(7.92)	(7.39)
EA_COUNT	0.0000	0.0000	0.0000	0.0000
	(0.54)	(0.10)	(0.58)	(0.23)
Observations	65,466	65,466	65,466	65,466
Adj. R-squared	0.054	0.028	0.023	0.025

*, **, *** indicate statistical significance at the p < 0.10, 0.05, and 0.01 levels, respectively

Standard errors are clustered by announcement date

Firm, calendar quarter, fiscal quarter, and day-of-week fixed effects are included in all specifications

Appendix

Variable Definitions

Variable Name	Description
INFO_ACCESS	Average of the daily abnormal download volume over the [0,1] trading-day interval around the earnings announcement, winsorized by quarter at the 1st and 99th percentiles. The daily abnormal download volume is calculated as the total filing downloads on EDGAR for the day minus the average filing downloads for that same weekday over an eight-week estimation period ending two weeks prior to the earnings announcement, scaled by the average filing downloads for the same weekday over the estimation period.
INFO_ACC_FILING	Average of the daily abnormal download volume over the [0,6] trading-day interval around the filing of the 10-K or 10-Q, winsorized by quarter at the 1st and 99th percentiles. The daily abnormal download volume is calculated as the total filing downloads on EDGAR for the day minus the average filing downloads for that same weekday over an eight-week estimation period ending two weeks prior to the earnings announcement, scaled by the average filing downloads for the same weekday over the estimation period.
ANALYST_UE	Unexpected earnings, calculated as IBES reported actual "street" earnings minus the median of the most recent individual analyst forecasts issued within the 90 days prior to the earnings announcement date scaled by the price per share as of the end of the quarter, winsorized by quarter at the 1st and 99th percentiles.
CAR[X,Y]	Cumulative abnormal stock return from trading day X to trading day Y around the earnings announcement, where the abnormal return is the raw return minus the market value–weighted return. For example, CAR[0,1] is the cumulative abnormal return for the two trading days beginning with the day of the earnings announcement and ending on the trading day after the earnings announcement.
GOOGLE	Google Search Volume Index for the stock's ticker symbol for the [0,1] trading-day window around the earnings announcement. This data was provided by Michael Drake through his website (http://byuaccounting. net/drake/ProgramsData1.php). This data was used for analyses in Drake et al. (2012).
LN_MVE	Natural log of the market value of equity as of the end of the reporting quarter, winsorized by quarter at the 1st and 99th percentiles.

Variable Name	Description
BOOK_MARKET	Book value of equity divided by the market value of equity as of the end of the reporting quarter, winsorized by quarter at the 1st and 99th percentiles.
INST_OWN	Percentage of institutional ownership as of the end of the month prior to the earnings announcement, winsorized by quarter at the 1st and 99th percentiles.
ANALYST_FOL	Natural log of the number of analysts following the firm at the end of the month prior to the earnings announcement, winsorized by quarter at the 1st and 99th percentiles.
EA_COUNT	Number of firms that report earnings on the same calendar day as the firm's earnings announcement.
IMP_VOL30	Thirty-day implied volatility for options on the firm's stock from the OptionMetrics Standardized Options dataset two trading days prior to the earnings announcement, winsorized by quarter at the 1st and 99th percentiles.
ANALYST_DISP	Standard deviation of analyst earnings forecasts as of the end of the month prior to the earnings announcement, divided by the mean share price for that month, winsorized by quarter at the 1st and 99th percentiles.
SDEV_PRE_RET	Standard deviation of the firm's stock returns for the 60 trading days ending on day t-3 before the earnings announcement.
VIX	Volatility index on the S&P 500 two trading days prior to the earnings announcement.
BAD_NEWS	Equal to 1 if *ANALYST_UE* is less than 0, and 0 otherwise.
HI_VIX	Equal to 1 if *VIX* is greater than 20, and 0 otherwise.
10K_LAG	The number of calendar days between the earnings announcement and the filing of the 10-K or 10-Q.

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