Essays on Voluntary Disclosure, Information Uncertainty and Investment



Qirong Song

Green Templeton College

University of Oxford

Supervisor: Dr Amir Amel-Zadeh

A thesis submitted for the degree of *Doctor of Philosophy* in Finance

To my dearest mother and father

Abstract

This thesis consists of three studies contributing to voluntary disclosure, information uncertainty and investment.

The first study investigates whether and how voluntary disclosure affects the earnings announcement premium (EAP). Using S&P500 index additions as an exogenous source of variation to voluntary disclosures, we test the effect of guidance on information risk and investor attention as drivers of the EAP. We document a significantly positive (negative) effect of raised (lowered) guidance on the EAP reconciling attention-based and risk-based explanations. Disentangling direct and mediated effects, we find a positive direct effect of raised guidance on the EAP (attention channel) and a weaker countervailing negative indirect effect of raised guidance on idiosyncratic risk (risk channel). Lowered guidance has an unambiguously negative direct and indirect effect. Using high-frequency data we further confirm the effect of voluntary disclosure on both sources of the earnings announcement premium.

The second study investigates the effect of firm-level idiosyncratic uncertainty on voluntary disclosure. Using a novel dataset of consumer transaction data to measure idiosyncratic uncertainty, this study finds that idiosyncratic uncertainty reduces managers' propensity to make voluntary capital expenditure forecasts and that the negative effect of idiosyncratic uncertainty on disclosures is weaker in periods of declining performance compared to growing performance. This study also shows that managers place more weight on their private information with an increase in idiosyncratic uncertainty and rely less on market signals, suggesting that they have more internal information under uncertainty in periods of declining performance. Additional analyses confirm this finding by showing that idiosyncratic uncertainty has a less negative impact on planned capital expenditures in periods of declining performance compared to periods of growing performance.

The third study compares the public and private firms' investment under uncertainty. Using a novel dataset of consumer transaction data to measure firm-specific fundamental performance uncertainty, this study finds that in the presence of high uncertainty, private firms are likely to invest more compared to their public peers. Moreover, when operational volatility is high, public firms' profitability increases with the additional capital expenditure investment; however, private firms' profitability decreases with their additional capital expenditure investment. These empirical findings show that public firms' information environment enables public firms access additional information to resolve uncertainty during investment decision making. Additional analysis shows that the information advantage of public firms may spillover to private firms in industries with high presence of bellwether public companies.

Acknowledgements

First and foremost, I would like to express my deepest gratitude to my supervisor, Dr Amir Amel-Zadeh, for his unwavering support and guidance throughout my PhD project. His dedication, expertise, and encouragement have been invaluable in shaping my research journey and helping me achieve my goals. I am truly fortunate to have had such an exceptional supervisor who not only believed in my potential but also challenged me to explore new perspectives and ideas. I extend my heartfelt appreciation to Amir for his patience, mentorship, and belief in my abilities. His mentorship will undoubtedly leave a lasting impact on my academic and professional development. Thank you for being an exceptional supervisor and for making this learning experience truly enriching and rewarding.

I would like to thank Professor Wayne Landsman and Dr Kazbi Soonawalla for their insightful comments of my thesis. Their insightful feedback, constructive criticism, and commitment to my success have been instrumental in refining my work and pushing me to strive for excellence.

I would like to express my heartfelt gratitude to my friends and fellow PhD cohorts. Your encouragement, friendship, and willingness to lend a helping hand have made this experience more fulfilling and enjoyable. Thank you for being a crucial part of my support system and for making this journey more memorable.

I would like to express my gratitude to my husband, Taidong. It is truly remarkable how our paths crossed at Oxford, and since then, you have become an integral part of my life and my academic pursuits. Your presence by my side, celebrating my accomplishments and offering comfort during difficult times, has made this journey more meaningful and memorable.

Last but not the least, I would like to express my deepest gratitude and heartfelt acknowledgment to my parents, Yan Yang (杨艳) and Liancheng Song (宋连成), for their

love, sacrifices, and support throughout my life and academic journey. From the earliest days of my education, they instilled in me a thirst for knowledge, encouraged my curiosity, and taught me the value of hard work and perseverance. They have always been there to provide guidance, offer words of wisdom, and lend a helping hand whenever I needed it. Their sacrifices, both big and small, have enabled me to pursue my dreams and reach new heights. I am eternally grateful for their unwavering encouragement, unconditional love, and endless belief in me. Without their unwavering support, I would not have been able to accomplish what I have today. Thank you, Mom and Dad, for being my pillars of strength and for nurturing my dreams. Your love and support mean the world to me. This is for you.

List of Figures and Tables

Chapter 2: Voluntary Disclosure and the Earnings Announcement Premium

Table 1 Sample Profile by Industry and Year

Table 2 Propensity Score Logit Regression for SP500 Index Inclusion from 2004-2016

Table 3 Pre-S&P Index Inclusion Treatment and Control Group Characteristics

Table 4 Descriptive Statistics of Regression Variables

Table 5 Differences in Guidance Pre- and Post- Index Inclusion between Treatment and Control Firms

Table 6 Difference in Earnings Announcement Premium Pre- and Post- Index Inclusion between Treatment and Control Firms

Table 7 The Effect of Guidance on the Earnings Announcement Premium

Table 8 The Effect of Guidance on Changes in Risk around Earnings Announcements: Recursive Model

Table 9 Descriptive Statistics of Variables in Cross-Sectional Tests

Table 10 Disentangling Net Buying from Information Uncertainty Explanations of the EAP

Figure 1 Frequency of Company Issued Guidance 2002-2018

Figure 2 Mean Issued Guidance Per Company Per Year 2002-2018

Figure 3 Path Diagram of the Structural Equation Model

Figure 4 Total and Moderated Effects of Guidance on the Earnings Announcement Premium

Chapter 3: Voluntary Disclosure Under Idiosyncratic Uncertainty

Table 1a Sample Profile by Fiscal Year

Table 1b Sample Profile by Country

Table 1c Sample Profile by Fama-French 48 Industry

Table 2 Descriptive Statistics of Key Variables

Table 3a Correlation Table of Key Variables for Probit Regression of Impact of Idiosyncratic Uncertainty on Capex Forecasts

Table 3b Correlation Table of Key Variables for Regression Analysis of the Moderating Effects of Idiosyncratic Uncertainty on the Association Between Capex Adjustment and Market Response

Table 4 Comparison of Annual Capex Forecasts Frequencies with the Presence of High and Low Uncertainty for Periods of Growing, Stable and Declining Performance from 2016 to 2021

Table 5 Idiosyncratic Uncertainty and Capex Forecasts from 2016 to 2021

Table 6 Idiosyncratic Uncertainty and Capex Forecasts During Periods of Growing and Declining Firm Performance from 2016 to 2021

Table 7 The Moderating Effect of Idiosyncratic Uncertainty on the Association Between Capex Adjustment and Market Reaction from 2016 to 2021

Table 8 The Impact of Idiosyncratic Uncertainty on Planned Capex During Periods of Growing and Declining Firm Performance 2016 to 2021

Chapter 4: Comparing Public and Private Firms' Investment Under Uncertainty

Figure 1 Timeline of the Key Variables

Table 1 Descriptive Statistics of Key Variables

Table 2a Sample Profile by Public versus Private Firms for each Industry

Table 2b Sample Profile by Public versus Private Firms for each Fiscal Year

Table 2c Sample Profile by Public versus Private Firms for each Region

Table 3a Comparison of Capex between Public and Private Firms across Different Volatility Decile Scores

Table 3b Comparison of ROA between Public and Private Firms across Different Volatility Decile Scores

Table 4 Capex Model: Summary Statistics of the Regression of Capex on Volatility Comparing Public and Private Firms

Table 5a ROA Model: Summary Statistics of the Regression of ROA on Capex Comparing Public and Private Firms for Group with Top Quintile Volatility (Volatility Decile Score = 0.8 or 0.9)

Table 5b ROA Model: Summary Statistics of the Regression of ROA on Capex Comparing Public and Private Firms for Group with Bottom Quintile Volatility (Volatility Decile Score = 0.0 or 0.1)

Figure 2 10,000 Bootstrapping Simulation Results of the Difference between the Coefficients of Capex in the Regression of ROA on Capex for Groups with Top and Low Quintile Volatility

Table 6a Summary Statistics of the Regression of Capex on Volatility Comparing Public and Private Firms for Group with Top Quintile Volatility (Volatility Decile Score = 0.8 or 0.9) in the Industries with High Bellwether Firms' Presence

Table 6b Summary Statistics of the Regression of Capex on Volatility Comparing Public and Private Firms for Group with Top Quintile Volatility (Volatility Decile Score = 0.8 or 0.9) in the Industries with Low Bellwether Firms' Presence

Table 7a Summary Statistics of the Regression of ROA on Capex Comparing Public and Private Firms for Group with Top Quintile Volatility (Volatility Decile Score = 0.8 or 0.9) in the Industries with High Bellwether Firms' Presence

Table 7b Summary Statistics of the Regression of ROA on Capex Comparing Public and Private Firms for Group with Top Quintile Volatility (Volatility Decile Score = 0.8 or 0.9) in the Industries with Low Bellwether Firms' Presence

Table 8 Summary Statics of the Regression of Capex on Volatility Comparing Bellwether Public and Non-bellwether Public Firms

Table of Contents

Chapter 1 Introduction 1
Chapter 2 4
1 Introduction 5
2 Prior Literature & Hypothesis Development 11
2.1 The effect of guidance on the earnings announcement premium 11
2.2 Distinguishing between direct and indirect effects of guidance on the EAP 14
3 Sample and Data 17
3.1 S&P500 Index Inclusion and Control Firms 17
3.2 Measures 19
3.3 Descriptive Statistics 21
4 Empirical Results 22
4.1 Treatment versus Control: Univariate Comparisons 22
4.2 The Effect of Guidance on the EAP 24
4.3 Identifying indirect effects through changes in systematic and idiosyncratic risk 26
4.4 Further evidence on the differential effect of guidance on net buying pressure and information uncertainty 29
5 Conclusion 32
Chapter 3 51
1 Introduction 52
2 Literature Review and Hypothesis Development 58
2.1 Idiosyncratic Uncertainty and Voluntary Disclosure 59
2.2 Preparation Costs and Voluntary Disclosure 60
2.3 Reveal Private Information or Elicit Market Feedback 62
3 Research Design 63
3.1 Measure of Uncertainty 63
3.2 Periods of Growing, Stable, and Declining Performance 65
3.3 Idiosyncratic Uncertainty and Voluntary Disclosure 65
3.4 Preparation Costs and Voluntary Disclosure 66
3.5 Reveal Private Information or Elicit Market Feedback 68
4 Sample and Descriptive Statistics 69
5 Results 72
5.1 Univariate Analysis 72
5.2 Idiosyncratic Uncertainty and Voluntary Disclosure 73

5.3 Preparation Costs and Voluntary Disclosure 73
5.4 Reveal Private Information or Elicit Market Feedback 74
5.5 Additional Analysis - Impact on CAPEX decisions 75
6 Conclusion 77
Chapter 4 91
1 Introduction 92
2 Related Literature and Contributions 95
2.1 Theoretical Models of Investment Decisions under Uncertainty 95
2.2 Information Environment and Uncertainty Resolution 98
2.3 Agency Problems in Public and Private Firms 100
2.4 Public and Private Firms Investment Behavior 101
3 Research Design 102
3.1 Heterogenous effects of operational volatility on public and private firms' capital expenditure decisions 102
3.2 Heterogenous effects of capital expenditures on public and private firms' profitability in the presence of high operational volatility 103
3.3 The effect of bellwether firms' presence on private firms' capital expenditure decisions in response to increasing operational volatility 105
3.4 The effect of bellwether firms' presence on private firms' profitability following capital expenditure decisions in the presence of high operational volatility 106
3.5 The effect of bellwether firms' presence on other public firms' capital expenditure decisions in response to increasing operational volatility 107
4 Sample and Descriptive Statistics 107
4.1 Operational Volatility and Fable Data 107
4.2 Capex, ROA and Control Variables 108
4.3 Descriptive Statistics 109
5 Results 110
5.1 Univariate Analysis 110
5.2 Heterogenous effects of operational volatility on public and private firms' capital expenditure decisions 111
5.3 Heterogenous effects of capital expenditures on public and private firms' profitability in the presence of high operational volatility 111
5.4 The effect of bellwether firms' presence on private firms' capital expenditure decisions in response to increasing operational volatility 113
5.5 The effect of bellwether firms' presence on private firms' profitability following capital expenditure decisions in the presence of high operational volatility 114

5.6 The effect of bellwether firms' presence on other public firms' capital expenditure decisions in response to increasing operational volatility 115
6 Conclusion 115
Chapter 5 Conclusion 129

Chapter 1 Introduction

According to the Conceptual Framework by the International Financial Reporting Standards Foundation, the accounting standards are designated to "enable investors and other market participants to make informed economic decisions" and "contribute to economic efficiency by helping investors to identify opportunities and risks across the world" (IFRS, 2018). Due to the increasing inherent complexity of the capital market information environment, it is imperative to understand the role of accounting information in promoting capital market efficiency, particularly conditional on the interdependencies between various information sources, and accounting information with other factors, such as investment decisions. Therefore, the primary objective of this thesis is to explore the following three key questions: i.e., 1) given the increasing alternative information sources, whether mandatory disclosures are still relevant, 2) what is managers disclosures behavior in the presence of high uncertainty, and 3) how does information environment will impact managers investment behavior in the presence of high uncertainty.

The first paper investigates whether and how voluntary disclosure affects the earnings announcement premium (EAP). The study contributes to prior studies by explaining the conflicting empirical evidence of whether voluntary disclosure enhances or reduces the relevance of mandatory disclosure. We document a significantly positive (negative) effect of raised (lowered) guidance on the EAP reconciling attention-based and risk-based explanations. Disentangling direct and mediated effects, we find a positive direct effect of raised guidance on the EAP (attention channel) and a weaker countervailing negative indirect effect of raised guidance on idiosyncratic risk (risk channel). Lowered guidance has an unambiguously negative direct and indirect effect.

The second paper investigates the effect of firm-level idiosyncratic uncertainty on voluntary disclosure. The research question is motivated by the potential conflicts between the increasing demand for internal information and the increasing cost of preparing voluntary disclosure with the presence of high firm idiosyncratic uncertainty. Firm-level idiosyncratic uncertainty created by volatile firm performance may introduce market inefficiencies, and thus investors need managers' internal information to estimate enterprise value. In the meanwhile, volatile firm performance makes it harder for managers to extract useful information by observing firm performance and to issue voluntary disclosure. Using a novel dataset of credit card transactions to measure idiosyncratic uncertainty, this study finds that idiosyncratic uncertainty reduces managers' propensity to make voluntary capital expenditure forecasts and the negative effect of idiosyncratic uncertainty on disclosures is weaker in periods of declining performance compared to growing performance. This study also shows that managers place more weight on their private information with an increase in idiosyncratic uncertainty and rely less on market signals, suggesting that they have more internal information under uncertainty in periods of declining performance. Additional analyses confirm this finding by showing that idiosyncratic uncertainty has a less negative impact on planned capital expenditures in periods of declining performance compared to periods of growing performance.

The last paper examines the investment behavior of public and private firms in the context of uncertainty. By utilizing a unique dataset of consumer transaction data to gauge firm-specific fundamental performance uncertainty, this study uncovers intriguing insights. It reveals that private firms tend to exhibit higher investment levels compared to their public counterparts when faced with high levels of uncertainty. Additionally, the study finds that, under conditions of elevated operational volatility, public firms experience increased profitability through additional capital expenditure investments, while private firms observe a decline in

profitability as a result of such investments. These empirical findings shed light on how the information environment of public firms affords them access to additional information, aiding in the resolution of uncertainty during investment decision-making. Moreover, further analysis demonstrates that the information advantage enjoyed by public firms can potentially spill over to benefit private firms, particularly in industries where bellwether public companies hold a prominent presence.

Chapter 2

Voluntary Disclosure and the Earnings Announcement Premium*

Abstract

This study investigates whether and how voluntary disclosure affects the earnings announcement premium (EAP). Using S&P500 index additions as an exogenous source of variation to voluntary disclosures, we test the effect of guidance on information risk and investor attention as drivers of the EAP. We document a significantly positive (negative) effect of raised (lowered) guidance on the EAP reconciling attention-based and risk-based explanations. Disentangling direct and mediated effects, we find a positive direct effect of raised guidance on the EAP (attention channel) and a weaker countervailing negative indirect effect of raised guidance on idiosyncratic risk (risk channel). Lowered guidance has an unambiguously negative direct and indirect effect. Using high-frequency data we further confirm the effect of voluntary disclosure on both sources of the earnings announcement premium.

Keywords: Voluntary disclosure, mandatory disclosure, earnings announcement premium, S&P500 additions, structural equation model

* This chapter is based on the joint work with Dr Amir Amel-Zadeh, Associate Professor in Accounting, Said Business School, Oxford University.

1 INTRODUCTION

Prior research has documented higher abnormal stock returns and higher return volatility for firms that announce earnings, commonly referred to as the earnings announcement premium (EAP) (Beaver, 1968; Chambers and Penman, 1984; Chari et al., 1988; Ball and Kothari, 1991; Cohen et al., 2007; Frazzini and Lamont, 2007; Savor and Wilson, 2016; Chapman, 2018). More recently, a debate has ensued whether the information content of mandatory disclosures, and with it the EAP, has decreased due to the prevalence of voluntary disclosures (Beaver et al., 2020; Heitz et al., 2020). By examining the effect of voluntary disclosures, specifically management guidance, on the market reaction to earnings announcements, this study aims to contribute to our understanding of interactions between voluntary and mandatory disclosures and thus of the underlying drivers of the EAP.

Several studies attribute the EAP to increases in (non-diversifiable) idiosyncratic or information risk of announcing firms due to the uncertainty associated with the information released during earnings announcements (Ball and Kothari, 1991; Cohen et al., 2007; Barber et al., 2013; Levi and Zhang, 2015). These studies suggest that market frictions and institutional factors such as asymmetric liquidity trading before earnings announcements prevent arbitrage and efficient diversification. Others attribute the EAP to increases in systematic risk (Hsieh et al., 1999; Patton and Verardo, 2012; Savor and Wilson, 2016). As earnings information is correlated between announcing and non-announcing firms the spillover of news from the announcing firm to the wider market "creates a high conditional covariance between firm-and market-level cash flow news, generating a high risk premium for the announcing firm" (Savor and Wilson, 2016, p.84).

In contrast to risk-based explanations, a second group of studies suggests that increases in investor attention to announcing firms lead to increased buying around earnings announcements contributing to the EAP (Hirshleifer et al., 2008; Aboody et al., 2010;

Chapman, 2018). Barber and Odean (2008) argue that individual investors are confronted with too many available stocks to purchase and thus constrain their universe to those that grab their attention. This affects their purchases more than their sales as investors usually own fewer stocks than those available to purchase. As earnings announcements are attention-grabbing events this results in net buying around these events.

Despite the large body of research on the potential sources of the earnings announcement premium, little attention has been paid to the role of voluntary disclosures in affecting investors' reactions to earnings announcements. This is surprising given that voluntary disclosures, such as management guidance, explain more than half the return variance in a given quarter (Beyer et al., 2010). An extensive literature has documented that increases in voluntary disclosure improve the information environment of the firm and reduce information asymmetries (e.g., Healy and Palepu, 2001; Balakrishnan et al., 2014; Chen et al., 2018; Nagar et al., 2019). However, limited empirical research has examined the interaction between voluntary and mandatory disclosures generally and between management guidance and the EAP in specific.

In this study we investigate whether and how management guidance prior to the earnings announcement affects the EAP. Management guidance before earnings announcements likely affects both information risk and investor attention through changes in the information environment of the firm and as such allows us to reconcile the risk-based and attention-based explanation for the EAP and measure their relative contributions.

On the one hand, guidance affects investors' expectations of earnings and thus likely reduces the uncertainty associated with the forthcoming earnings announcement. On the other hand, guidance might increase investor attention and thus contribute to net buying behavior around earnings announcements. We expect the information content of the guidance, whether conveying positive or negative news, to affect these two channels

differently.

A large body of research documents asymmetric capital market responses to good news and bad news (Braun et al., 1995; Bekaert and Wu, 2000; Williams, 2015). Yet prior studies that examine the information environment around earnings announcements do not distinguish between the different information content of the guidance (Cohen et al., 2007). It is, however, likely that the different types of guidance affect the firm's information environment and investor attention differently and hence might lead to different market reactions to mandatory disclosures.

Specifically, we expect raised guidance to have a positive *direct* effect on the EAP through increases in investor attention but have a countervailing negative *indirect* effect through reductions in information risk. Whether the net effect is positive or negative is an empirical question. One the other hand, we expect lowered guidance to have a negative *direct* and negative *indirect* effect on the EAP. This is because downward revisions in expected earnings contain negative cash flow news naturally causing stock prices to decline and increasing expected returns. At the same time the additional information also resolves uncertainty and thus also reduces information risk around earnings announcements.

Consequently, we expect lowered guidance to have an unambiguously negative effect on the EAP, while we expect raised guidance to have a net positive effect, if the attention effect prevails, or a net negative effect, if the information risk effect prevails. By estimating a recursive structural equation model that includes both direct and indirect (i.e., mediated) effects of voluntary disclosure on the EAP, we are able to estimate the size of these effects and reconcile risk-based and attention-based theories of the EAP.

The empirical challenge to establish a plausibly causal effect of voluntary disclosure, in our case management guidance, on the EAP, is that the disclosure decision is endogenous. Managers choose to voluntarily disclose guidance for reasons that could be related to

higher investor attention or differences in risk or other unobserved factors directly related to the market's reaction to earnings announcements. For example, disclosure decisions could be driven by less uncertainty about the firms' earnings prospects. Lower earnings uncertainty reduces the information asymmetry which likely also reduces the EAP independent of disclosure, but managers are also more likely to disclose when earnings are easier to predict (Chen et al., 2011).

Our identification strategy therefore uses S&P500 index additions as an exogenous source of variation to voluntary disclosures. Schoenfeld (2017) shows that S&P index additions lead to exogenous increases in ownership of the added firm by index funds which unambiguously prefer more disclosure. That is, ownership changes of firms added to the S&P index induce exogenous increases in disclosures unrelated to managers' strategic decisions. It is unlikely that managers can directly influence the timing of their firm's inclusion in the index as S&P typically only publicizes an index addition within a few days of an index deletion or change due to an acquisition. Importantly, managers are unlikely to be able to influence inclusion decisions through changes of their disclosure behavior.

We use a difference-in-difference design in which we match our sample of first-time index inclusion firms (i.e., our treatment firms) to one control firm that closely matches the treatment firm based on propensity scores. To estimate propensity scores, we use publicly available firm characteristics that likely determine index inclusion. We therefore ensure that the control firms are similar to the treatment firms in their fundamental characteristics correlated with index inclusion but differ from the treatment firms only in their index membership. The double-difference also allows us to differentiate any possible firm fixed and time fixed effects that affect a firm's voluntary disclosure decision and the earnings announcement premium.

Examining a matched sample of 460 firms (230 first-time S&P500 index inclusions) between

2002-2018 we find a plausible causal effect of voluntary disclosure on the earnings announcement premium. Specifically, we document a significantly positive effect of raised guidance and a significantly negative effect of lowered guidance on the EAP. A one standard deviation increase in the number of raised guidance increases the EAP of the treatment group relative to the control group by an economically and statistically significant 0.20%, while a one standard deviation increase in the number of lowered guidance decreases the EAP (relative to the control group) by about −0.12%. That is, both attention and risk-effects seem to contribute to the EAP. Moreover, the two effect channels of voluntary disclosure cancel each other out when examined in aggregate highlighting the importance of dis-aggregating attention from risk channels.

We then examine the direct and indirect effects more closely through a path analysis by estimating a recursive structural equation model allowing guidance to affect the EAP directly as well as indirectly through changes in systematic and idiosyncratic risk. We find a significant and positive direct effect of raised guidance on the EAP (attention channel) and a countervailing negative indirect effect of raised guidance on idiosyncratic risk (risk channel) around the earnings announcement. Consistent with expectations we find an unambiguously negative effect of lowered guidance on EAP.

For the risk channel we further also compare the effect sizes— whether guidance has a larger effect on the EAP through reductions in systematic or through reductions in idiosyncratic risk. Between the two risks, we expect raised guidance to have a larger effect on idiosyncratic risk as good news is more likely to reduce the uncertainty of the earnings announcement, but also potentially increase the co-variability of the stock with the wider market resulting in an ambiguous effect on systematic risk. On the other hand, we expect lowered guidance to reduce uncertainty and the co-movement with market-wide cash flow news and thus have a negative effect on idiosyncratic and systematic risk. We find evidence largely consistent with

these expectations.

To further provide evidence on the differential effect of raised and lowered guidance on the EAP through the risk and attention channels, we estimate a cross-sectional recursive structural equation model and use intra-day, high-frequency trading data to develop proxies for each. Specifically, we measure buying pressure, as a result of increased investor attention, as the ratio of buy transactions to total transactions and we proxy the degree of information uncertainty as the difference between the highest bid and the lowest asking price on a given trading day. Consistent with our main results, we find that raised guidance has a significantly positive association with buying pressure and lowered guidance has a significantly negative association with the degree of information uncertainty[2].

Our principle research questions asks how voluntary disclosure affects attention and the information uncertainty associated with scheduled mandatory disclosure. A large literature pioneered by Beaver (1968) documents an earnings announcement premium and attributes this persistent anomaly to increases in information risk (Cohen et al., 2007; Frazzini and Lamont, 2007; Savor and Wilson, 2016). Competing explanations suggest that the EAP is due to limited attention and market frictions (Barber and Odean, 2008; Chapman, 2018). This study contributes to this line of research by estimating direct and indirect effects of voluntary good and bad news disclosures on the EAP reconciling both explanations. Beyer et al. (2010) highlight the lack of empirical research on interactions between voluntary and mandatory disclosure. We complement recent analytical work in this area (Cianciaruso and Sridhar, 2018) by investigating empirically the differential and partly opposing effects of voluntary good and bad news disclosures on market reactions to mandatory disclosures. In doing so, our study extends and refines Cohen et al. (2007)'s findings that the EAP is lower for firms that pre-announce earnings.

[2] Our results are also robust to using a variety of different proxies for the EAP, net buying pressure and information uncertainty.

This study further contributes to the debate in the literature whether voluntary disclosures act as complements or substitutes to mandatory disclosure. Several studies document that the information content of mandatory disclosures has decreased over time (Francis and Schipper, 1999; Heitz et al., 2020) and suggest that the rise of voluntary disclosures contributed to this decline. Yet, others find a significant increase in the market response to earnings announcements (Landsman and Maydew, 2002; Beaver et al., 2020). This study shows that the effect on the informativeness of the mandatory earnings announcements depends on the nature of the prior voluntary disclosure, whether positive or negative.

The remainder of the paper is organized as follows. Section 2 develops the main hypotheses for our empirical tests. Section 3 describes data, research design and provides descriptive statistics. Section 4 presents the empirical results and section 5 concludes.

2 PRIOR LITERATURE & HYPOTHESIS DEVELOPMENT

2.1 The effect of guidance on the earnings announcement premium

There has been a long-standing debate in the literature whether the information content of mandatory disclosures, such as earnings announcements, has decreased over time due to the prevalence of voluntary disclosures and competing information sources (Francis and Schipper, 1999; Francis et al., 2002; Landsman and Maydew, 2002). This debate is founded on analytical models that predict that voluntary earnings signals prior to earnings announcements serve as substitutes to the mandatory disclosure. These models predict that the quality of the pre-announcement signal is inversely related to the variability of returns around the subsequent earnings announcement (Holthausen and Verrecchia, 1988; Demski and Feltham, 1994).

Testing the relation between market reactions to analyst reports and subsequent earnings releases, Francis et al. (2002) do not find evidence that these competing information

sources act as substitutes. Similarly, Landsman and Maydew (2002) find evidence consistent with an increase, instead of a decline, in the information content of earnings announcements in the three decades starting with the 1970s. Recent empirical evidence on the market response to earnings announcements in the decades after the early 2000s, however, is inconclusive. Beaver et al. (2020), for example, find a significant increase in the market response to earnings announcements after 2001, whereas Heitz et al. (2020) suggest that an increase in current (8-K) disclosures significantly reduced the market reaction to earnings announcements.

Our study contributes to the literature on interactions between voluntary and mandatory disclosures by examining the effect of management guidance on the market response to earnings announcements. A large literature pioneered by Beaver (1968) documents significant abnormal returns around earnings announcements, subsequently dubbed the earnings announcement premium (EAP). Information-based explanations attribute the EAP to increases in information risk around earnings announcements stemming from uncertainty about the new information revealed in the earnings announcement (Cohen et al., 2007; Frazzini and Lamont, 2007; Savor and Wilson, 2016). Management guidance plays a significant role in influencing the information environment of a firm (Beyer et al., 2010; Billings et al., 2015). Guidance provides earnings-relevant information prior to the earnings announcement and thus likely reduces the incremental information contained in the subsequent earnings announcement. Thus, guidance might play a substituting role by reducing the information uncertainty around earnings announcements. This leads to our first hypothesis (stated as alternative):

H1a: Consistent with the information-based explanations of the EAP, guidance is negatively associated with the EAP.

A large literature in behavioral economics also supports an attention-based explanation of

the EAP. Barber and Odean (2008) propose that the investable equity universe is too large for individual investors to be able follow all stocks. Limited attention therefore forces individual investors to focus on those stocks that grab their attention (Odean, 1999). Attention affects trading decisions mostly when investors look to buy stocks. The search problem is considerably smaller when investors intend to sell as they usually own few stocks and generally do not sell short. Consequently, given that earnings announcements are attention-grabbing events, this results in net buying around these events (Barber and Odean, 2008).

Consistent with buying pressure around earnings announcements, Lee (1992) and Dey and Radhakrishna (2007) find that individual investors are net buyers around earnings announcements irrespective of the nature of the news (whether good or bad). More recently, Chapman (2018) finds positive abnormal returns and higher EDGAR search volumes also on earnings notification days corroborating attention-based explanations. The prior evidence thus implies that guidance prior to the earnings announcement should attract investor attention. Accordingly, we predict:

H1b: Consistent with the attention-based explanation of the EAP, guidance is positively associated with the EAP.

To further distinguish between the information uncertainty and investor attention channels of the effect of guidance on the EAP, we separately examine good news and bad news disclosures. Any market response to the guidance and the subsequent earnings announcement also depends on the market's perception of the quality of the information and management's strategic disclosure behavior (Cianciaruso and Sridhar, 2018; Bao et al., 2019). Negative news, i.e., lowered guidance, likely has higher information content because it is perceived as more credible compared to good news, i.e. raised guidance, disclosures (Bertomeu and Marinovic, 2016; Ng et al., 2013). Consequently, we expect lowered guid-

ance to have a stronger uncertainty resolution effect and thus to have a stronger negative effect on the market reaction around the earnings announcement compared to good news (i.e., raised) guidance. On the other hand, given the asymmetric effect of attention on investors' purchases, but not sales, we expect raised guidance to have a more significant effect on buys than lowered guidance will have on sells causing positive price pressure around the earnings announcement. With respect to the effects of raised and lowered guidance, we therefore predict:

H2a: Lowered guidance has a stronger information uncertainty resolution effect than raised guidance and therefore will have a stronger negative association with the EAP.

H2b: Raised guidance has a stronger attention-grabbing effect than lowered guidance and therefore will have a stronger positive association with the EAP.

2.2 Distinguishing between direct and indirect effects of guidance on the EAP

One strand of the literature on information-based explanations of the EAP shows that the EAP is partially explained by temporary increases in systematic risk (Hsieh et al., 1999; Patton and Verardo, 2012; Savor and Wilson, 2016). Hsieh et al. (1999) find that changes in firms' beta around the earnings announcements are associated with several firm characteristics and Patton and Verardo (2012) show that increases in beta are larger for earnings announcements that convey more new information (positive or negative) and resolve greater ex-ante uncertainty. Their findings suggest that investors use information conveyed by announcing firms to revise their expectations about the state of the aggregate economy. Similarly, Savor and Wilson (2016) argue that the conditional covariance of cash flow news between announcers and the wider market increases around earnings announcement giving rise to the earnings announcement premium. Their study finds that this increase in announcement returns is higher than increases in beta alone can explain as a firm's market beta mainly reflects the covariance between firm-and market-level dis-

count rate news. Savor and Wilson (2016) further find that early announcers experience higher announcement premia as these firms reveal more information about the aggregate economy than late announcers. That is, investors learn more about market-wide cash flow news from firms that announce earnings earlier.[3]

Following the rationale of this strand of literature, the market might have less information to learn from earnings announcements of firms that provide more voluntary guidance prior to the earnings announcement. This would suggest that firms that issue more guidance ahead of earnings announcements experience a smaller increase in systematic risk and consequently to have a lower earnings announcement premium. That is, in addition to a direct negative effect on the EAP, guidance might also have an indirect negative effect through compensating increases in systematic risk.

The prior literature, however, also suggests that there might be differences in how positive and negative news disclosures affect changes in systematic risk by reducing the information content of the upcoming earnings announcements. Again, because negative news is likely perceived as more credible and therefore has higher information content, lowered guidance will have a stronger negative effect on systematic risk around the earnings announcement compared to raised guidance.

H3a: Guidance, particularly lowered guidance, has an indirect negative effect on the EAP through its negative effect on changes in systematic risk during the earnings announcement period.

Another strand of the literature attributes the EAP to increases in idiosyncratic risk around the announcement (Ball and Kothari, 1991; Cohen et al., 2007; Barber et al., 2013; Levi and Zhang, 2015). Ball and Kothari (1991) examine systematic and idiosyncratic risk changes around earnings announcements and find that the increased announcement period

[3] Furthermore, changes in cash flow expectations for bellwether firms also affect market-wide expectations affecting systematic risk (Anilowski et al., 2007).

volatility is primarily due to increases in idiosyncratic risk. Assuming mean-variance optimization their findings suggest that the information risk of earnings announcements is not diversifiable consistent with analytical results in Merton (1987). Consequently, investors will demand a higher expected return prior to the earnings announcement expecting a spike in idiosyncratic risk at announcement (Barth and So, 2014).[4]

Theoretical work predicts that managers provide guidance to reduce information asymmetry and uncertainty, increasing the precision of information investors have about future cash flows and decreasing future stock return volatility (see e.g., Diamond and Verrecchia, 1991; Verrecchia, 2001). In line with this, pre-earnings announcement guidance (positive and negative) should reduce the uncertainty about the earnings information to be released at the earnings announcement and thus reduce the spike in idiosyncratic risk for announcers. Consequently, guidance will have a negative effect on the EAP by reducing idiosyncratic risk. However, the prior literature also finds that volatility increases more sharply following the arrival of bad news compared to good news (Bekaert and Wu, 2000; Chen and Ghysels, 2011; Williams, 2015). This suggests that raised guidance likely has a stronger negative effect on idiosyncratic risk around earnings announcements compared to lowered guidance.

H3b: Guidance, particularly raised guidance, has an indirect negative effect on the EAP through its negative effect on changes in idiosyncratic risk during the earnings announcement period.

Lastly, providing guidance is itself information to the market and empirical evidence shows that the price reaction to guidance also may have a positive effect on systematic risk and volatility post-disclosure (Campbell et al., 2001; Cohen et al., 2007) counter-

[4] Subsequent research investigates market frictions as one underlying reason for the pricing of information risk. Consistent with this, Cohen et al. (2007) find that the EAP declines over time as the cost of arbitrage decreases and the amount of arbitrage capital increases. Levi and Zhang (2015) further document an asymmetric decrease in liquidity trading, whereby liquidity traders reduce their purchases but not sales ahead of earnings announcements resulting in positive announcement returns.

vailing any negative effects of guidance on changes in systematic and idiosyncratic risk around earnings announcements. Furthermore, Frazzini and Lamont (2007) show that earnings announcement periods have higher trading volumes and suggest that increases in idiosyncratic risk are likely the reason for limits to arbitrage explaining why the EAP is persistent. In addition to the direct positive effect of raised guidance on the EAP, as discussed above, the additional disclosure reduces information risk and thus is likely to have a negative indirect effect on the EAP through reductions in idiosyncratic risk.

In summary, then, it remains an empirical question whether the uncertainty resolution or increased attention channel prevails for the effect of raised guidance on the EAP. In contrast, we expect lowered guidance to have an unambiguously negative effect on the EAP through reductions in systematic and idiosyncratic risk. The risk-based and attention-based explanations for the EAP have in the prior literature mostly been studied independently. This study reconciles both explanations by distinguishing between raised and lowered guidance and by examining their direct and indirect (moderated) effects on the EAP differentiating between the two explanations.

3 SAMPLE AND DATA

3.1 S&P500 Index Inclusion and Control Firms

The S&P 500 index-inclusion (treatment) sample is obtained by starting with all 299 first-time S&P additions from 2004 to 2016. We restrict our treatment sample to this time period because Capital IQ provides a reliable record of company issued guidance only from 2002 and because we require at least two years of data prior to the inclusion date and two years after. We also require that each treatment firm be publicly traded for at least two years prior to index inclusion date and remain in the index for at least two years after the inclusion date. That is, we define the [-2 years, 0) window as the pre-inclusion period and the [0, +2 years] window as the post-inclusion period, where 0 is

the date the firm was added to the S&P500 index. The two-year window ensures that treatment firm managers have sufficient time to adjust their voluntary disclosure. Imposing these two requirements eliminates 69 inclusion firms resulting in a final sample of 230 S&P 500 index inclusion firms.

Table 1 provides the industry composition and year breakdown of the treatment firms between 2004-2016. The table shows that a larger proportion of finance and business equipment firms entered the S&P500 and relatively more firms entered the index during 2007-09 and 2016.

Following Schoenfeld (2017) we match each of our 230 inclusion firms with one control firm using nearest-neighbour matching by year, Fama-French 12 industry, and closest propensity score, without replacement. To select potential control firms for the propensity score matching regressions, we start with all firm-year observations for U.S. companies listed on NYSE, NASDAQ, and AMEX available in Compustat. We include the 230 first-time inclusion treatment firms in this pool of control firms and eliminate all observations that fall outside the four year window around the inclusion year. Furthermore, firms that do not meet the first-time inclusion requirement or do not remain in the index for at least two years after inclusion are also excluded. This process yields 50,615 potential firm-year matches.

Using the 230 inclusion treatment firms and the 50,615 potential control firm matches, we estimate a pooled logit regression in which we regress an indicator that represents S&P 500 inclusion in a particular year on observable firm characteristics. The firm observables are selected based on S&P 500 index eligibility criteria and other firm characteristics expected to predict index inclusion.[5] The purpose of this one-to-one matching is to find a control firm for each of our index inclusions firms that is reasonably close to the inclusion

[5] S&P 500 index eligibility criteria are publicly available on their webpage (https://us.spindices.com/indices/equity/sp-500).

firm in terms of observable characteristics that are used by S&P as inclusion criteria, but that was not included in the index.

The results of the matching regression are summarized in Table 2. Our matching regression predicts about 18% of the variation in inclusion propensity. Unlike other index inclusions such as the Russel 1000 inclusions, which are solely based on market capitalization and thus predictable, S&P does not publish what determines inclusion into the S&P 500 index. This is an advantage in our setting as managers will likely not be able to strategically (i.e., endogenously) alter their disclosure behavior in anticipation of the inclusion.

Table 3 compares means firm characteristics used in the matching during the pre-inclusion periods between the treatment and control sample. The table shows that the matching procedure generates very similar firms on almost all firm characteristics except for the market-to-book ratio and return on assets (ROA), which are significantly different across the two groups. Despite the close matching we nevertheless include several covariates as controls in our subsequent empirical tests.

3.2 Measures

3.2.1 Voluntary Disclosure

We use the number of company issued quarterly guidance (CIG) as proxy for the amount of voluntary disclosure during the quarter. We obtain CIG data from Capital IQ. Capital IQ distinguishes three categories of guidance, based on their direction and news content: *raised* guidance, *new/confirmed*, and *lowered* guidance. *Raised* guidance represents an announcement that management expects earnings to be higher than its previously announced expectations. *New/Confirmed* refers to a new announcement of a company's expected earnings or announcements that the company remains confident of the previously announced earnings guidance. *Lowered* guidance refers to an announcement that the company expects earnings to be lower than its previously announced guidance. We further use the text descriptions from the source disclosures provided by Capital IQ to

distinguish new from confirmed guidance. Specifically, we classify all new/confirmed CIG as *confirmed* based on key words in the text description such as "confirm", "reaffirm", "reiterate", "unchanged" etc. We categorize the remaining CIG in this category as *new* guidance resulting in a total of four management guidance categories based on the nature of the information.

Figure 1 provides an overview of the frequency of company issued guidance per year from 2002-2018 for all firms available in the Capital IQ CIG database. The figure shows an upward trend in management guidance over the years with a significant proportion of the guidance confirming previously issued forecasts. Raised earnings guidance are generally the next most frequent category. Consistent with intuition the frequency of lowered guidance increases during the 2007-09 financial crisis.

Figure 2 shows the mean number of guidance issued per company per year for follow-on guidance (i.e., all guidance other than newly issued). The figure shows that the frequency of guidance per firm peaked in the mid to late 2000s and has since declined.

3.2.2 Earning Announcement Premium

We collect quarterly earnings announcement dates from the COMPUSTAT quarterly file for the period 2002-2018. According to COMPUSTAT the earnings announcement date corresponds to "the date in which quarterly earnings and earnings per share figures are first publicly reported in the various news media". We define the earnings announcement period as the 3 days centered on the COMPUSTAT earnings announcement date [-1 day, 0 and +1 day], where 0 is the announcement date collected from COMPUSTAT. We call this the reporting period. We define the [-30, -10] 20 days window prior to the earnings announcement date as a non-reporting period.

We compute daily market-adjusted returns by subtracting the value-weighted market returns from the daily stock returns. We then compound the market-adjusted returns to obtain the earnings announcement premium (EAP) for the reporting period.

3.2.3 Risk measures

Prior studies document an increase in both systematic risk and idiosyncratic risk during the reporting period (e.g., Barber et al., 2013; Savor and Wilson, 2016). We therefore examine the role of changes in systematic and idiosyncratic risk as a potential channel through which guidance affects the EAP. We estimate systematic and idiosyncratic risk during the reporting and non-reporting period. We separately run CAPM regressions for each stock for both reporting and non-reporting period before and after the inclusion date. We use the estimated coefficients of the regressions as proxies for systematic risk and the standard deviation of the regression residuals as proxies for idiosyncratic risk.

3.2.4 Control variables

We further consider time varying covariates that may affect disclosure and the EAP. We describe these in Appendix 2. These include the firm characteristic used in the propensity score matching regression as well as controls for the timing between guidance and the earnings announcement and the magnitude of the earnings surprise.

3.3 Descriptive Statistics

Table 4 tabulates descriptive statistics of all variables in their univariate changes between the treatment firms and changes in the control firms pre- to post index inclusion. That is, the table shows all variables in their difference-in-differences (D-in-D) form. The table shows that after inclusion in the S&P 500 index, treatment firms experience a decrease of the earnings announcement premium by 1.6% relative to the control firms (p-value<0.01). Treatment firms on average also issue 0.07 more lowered guidance (p-value<0.05) and 0.09 fewer raised guidance (p-value<0.1) relative to their matched control firms during the post-inclusion period compared with the pre-inclusion period. Compared to an average of 0.128 lowered guidance per firm in the pre-inclusion period (see table 5, this increase marks an economically meaningful change in disclosure behavior.

In terms of the risk measures, index inclusion firms experience a larger increase in

systematic risk between reporting and non-reporting periods compared to their control firms after the index inclusion. The difference in CAPM beta is 0.24 (p-value<0.05). Consequently, treatment firms' reporting period systematic risk is higher by 0.257 (p-value<0.05) post index inclusion, relative to control firms. There are no significant differences in idiosyncratic risk, but we do find that treatment firms' non-reporting idiosyncratic risk is marginally lower by 0.001 (p-value<0.01) after inclusion, relative to control firms.

The univariate statistics on the control variables (in the D-in-D form) reveals that index inclusion firms experience significant increases in tangible and intangible assets, market capitalization, analyst following, and institutional ownership compared to the pre-inclusion period relative to the control group. Contemporaneous changes in other firm characteristics, such as ROA, capital expenditures, dividends, bid ask spread, firm age, market to book ratio, and analyst dispersion are largely close to zero.

4 EMPIRICAL RESULTS

4.1 Treatment versus Control: Univariate Comparisons

Table 5 shows a 2x2 univariate comparison of mean guidance frequencies for the treatment and control firms for the two years before and after the index inclusion year. The table shows firm-year averages and standard deviations for the different types of guidance for treatment and matched control firms as well as the t-statistic for paired T-tests of equality. Panel A compares treatment and matched control firms in the pre- and post-inclusion years. When comparing treatment and control firms during pre-inclusion and post-inclusion periods, we pair the treatment firm with its matched control firm based on the propensity scores estimated in Table 2. Panel B shows pre- versus post inclusion year comparisons of treatment firms and of the control group separately. In this comparison, we pair the data for the same firm over the two time periods.

Panel A shows that on average inclusion firms issue 0.564 more guidance per year overall

in the two year period pre-index inclusion compared to the control group (last row in the left-side columns in Panel A, t-stat.= 2.34) as well as in the two year period post inclusion (right-side columns, t-stat.= 2.76). Specifically, inclusion firms issue significantly more raised and new guidance than control firms in the pre-inclusion (t-stat.= 2.87 and 2.68, respectively) and post-inclusion period (t-stat.= 2.27 and 3.08, respectively).

Panel B shows that the average treatment firm issues (3.280 – 2.876 =) 0.404 more guidance per year after the index inclusion compared with the level during the pre-inclusion period (t-stat.= 4.28). This increase is larger than the increase of 0.248 in total guidance per year that the control group experiences over the same time period. This finding is consistent with our expectation that S&P 500 inclusion leads to more voluntary disclosure. Specifically, this increase is a result of an increase in lowered, new and confirmed guidance, and a small decrease in raised guidance from 0.639 to 0.506 (significant at the 5% level).

Table 6 shows a similar 2x2 comparison of the EAP for the treatment and matched control groups between pre-inclusion period and post-inclusion period. EAP values are calculated based on firm-year averages. T-tests are calculated on treatment-control pairs where the pairing mechanism is the same as in Table 5.

We find a significantly higher EAP for the treatment group compared to the matched control firms during the pre-inclusion period (at the 1% level). Whereas in the post-inclusion period there seems to be no significant difference in EAP between treatment group and matched control firms. The difference in EAP disappears because the treatment group experiences a larger decrease in the EAP from 1.018 to 1.008 (p=value<0.01) than the matched control group.

We next examine whether this decrease in the EAP of the treatment group is attributable to

the (exogenous) increase in guidance that comes with the index inclusion in a multivariate setting.

4.2 The Effect of Guidance on the EAP

4.2.1 Regression set up

We run our regressions with all variables in their D-in-D form as follows:

$$\Delta EAP_i = \alpha + \beta_1 \Delta Guidance_i + \sum_{k=2}^{n} \beta_k \Delta Controls_i + \epsilon_i, \quad (1)$$

where the Δ-prefix stands for the variable in its double-difference transformation. For example, for our guidance measures the D-in-D transformed variables are defined as

$$\Delta Guidance_i = (Guidance_{i,t=1} - Guidance_{i,t=0}) - (Guidance_{c,t=1} - Guidance_{c,t=0}), \quad (2)$$

where *Guidance* stands for levels of either *total* CIG, *raised*, *lowered*, *new*, or *confirmed*. The index i stands for the treatment firms, index c stands for the control firms, and index t is the time period. t=0 denotes the two-year pre-inclusion period and t=1 denotes the two-year post-inclusion period (relative to firm i's index-inclusion date). *EAP* stands for the earnings announcement premium and *Controls* denotes control variables defined in Appendix A. All variables are measured as the two-year averages pre- and post-index inclusion.

The double-difference regression in equation 1 controls for a variety of potential endogeneity issues. Any firm characteristics that might determine index inclusion, but are fixed over time (such as consistently strong stock market performance or higher disclosure levels), are differenced out. Moreover, any time-varying effects for treatment and control firms that change in the same manner over time for both firms are also eliminated through the double-differencing. For example, to the extent that index inclusion is seen as desirable and is determined by the firm's performance on several operating and market metrics, it is reasonable to assume that both the treatment and control firm take similar actions to improve these metrics. Any other systematic

"inclusion effects" are captured by the intercept terms in the regressions.

4.2.2 Difference-in-Differences Regression Results

In this section we test our hypotheses 1 and 2. Table 7 tabulates the estimated coefficients of equation 1. The first column shows the results using the total number of guidance in the quarter prior to the earnings announcement and the second columns distinguishes between raised and lowered guidance, as well as, for completeness, new and confirmed guidance. All variables enter the regressions in their D-in-D form and are standardized. The control variables include the firm characteristic used in the propensity score matching regression as well as controls for institutional ownership, analyst forecast dispersion, the timing between guidance and the earnings announcement and the magnitude of the earnings surprise. Standard errors are clustered by inclusion year.

The results in the first column show that the coefficient on total guidance is statistically indifferent from zero. Prima facie, this suggests that guidance has no effect on the EAP rejecting our hypotheses 1a and 1b. The insignificant effect of total guidance, however, ignores that guidance can have opposing effects on the EAP based on the information-based and attention-based explanations. The nature of the news in the guidance allows us to further distinguish between the two competing explanations by testing hypotheses 2a and 2b that raised guidance has a positive effect on the EAP and lowered guidance has a negative effect. The results are shown in column 2 of Table 7.

The coefficient on raised guidance is significantly positive and the coefficient on lowered guidance is significantly negative. A one standard deviation increase in the number of raised guidance increases the EAP by 0.197% (t-stat.= 4.12), whereas a one standard deviation increase in the number of lowered guidance decreases the EAP by -0.122% (t-stat.= -2.74). The results suggest that both attention and uncertainty resolution play a role in explaining the effect of voluntary disclosure on the EAP, but in opposing directions. The net effects are

that raised guidance heightens attention (more than it reduces uncertainty), which has a positive effect on the EAP, while lowered guidance reduces uncertainty, which has a negative effect on the EAP. The results of the difference-in-difference regression thus suggest a plausibly causal effect of voluntary disclosure on the EAP reconciling the two competing explanations. We do not find any effects of new and confirmed guidance.

The coefficients on the control variables are largely consistent with expectations. For example, the magnitude of the earnings surprise is significantly positively associated with the EAP and the number of analysts following is significantly negatively associated with the EAP suggesting that a better information environment reduces the EAP.

We next dis-aggregate these effects further by examining the direct and mediated effects of raised and lowered guidance through their effects on changes in systematic and idiosyncratic risk around the earnings announcement.

4.3 Identifying indirect effects through changes in systematic and idiosyncratic risk

4.3.1 Recursive structural equation model: Research design

Hypotheses 3a and 3b predict that guidance not only has a direct effect on the EAP, but also has an indirect effect through its impact on changes in idiosyncratic and systematic risk. To estimate the direct and indirect effect simultaneously we construct a recursive structural equation model of guidance, systematic risk, idiosyncratic risk, and the EAP. Figure 3 represents a concise overview of the structural equation model (SEM) in a path diagram. To ensure the model is identifiable and estimable the model assumes that the EAP is driven by changes in systematic and idiosyncratic risk as well as guidance, and not vice versa. In other words, the model needs to satisfy the exclusion restrictions that the error terms in equations 3 to 5 are uncorrelated. This requires that the model is saturated by the firm-level controls as well as the firm fixed and time-varying effects controlled for in the D-in-D set-up. The system of equations (in D-in-D form) is as follows:

$$\Delta Systematic_Risk_i = \gamma_0 + \gamma_1 \Delta Guidance + \sum_{j=2}^{n} \gamma_j \Delta Controls + \eta_i \quad (3)$$

$$\Delta Idiosyncratic_Risk_i = \delta_0 + \delta_1 \Delta Guidance + \sum_{j=2}^{n} \delta_j \Delta Controls + \xi_i \quad (4)$$

$$\Delta EAP_i = \alpha + \beta_1 \Delta Systematic_Risk_i + \beta_2 \Delta Idiosyncratic_Risk_i + \beta_3 \Delta Guidance + \sum_{k=4}^{n} \beta_k \Delta Controls + \epsilon_i \quad (5)$$

where *EAP* stands for the earnings announcement premium, Δ*Systematic* (Δ*Idiosyncratic*) *Risk* stands for changes in systematic risk and idiosyncratic risk (measured as the difference between the risk measures from non-reporting to reporting period) and Guidance stands for the four types of company issued guidance (i.e., lowered, raised, new, and confirmed). Firm fixed effects and firm-time-varying effects are differenced out and not displayed.

In this SEM, β_3 captures the direct effect of guidance on the EAP and $\gamma_1 \times \beta_1$ ($\gamma_1 \times \beta_2$) captures the indirect effect of guidance on the EAP via its effect on changes in systematic (idiosyncratic) risk.

4.3.2 Recursive structural equation model: Empirical results

Table 8 reports the results of the recursive structural equation model. The first two columns show the results of equations 3 and 4, i.e., the regressions of Δ*Systematic_Risk* and Δ*Idiosyncratic_Risk* on our guidance measures and controls. The coefficients capture the incremental effects of guidance on the risk measures for the treatment firms (those that experienced an exogenous increase in disclosure due to their index addition) relative to the propensity-matched control firms. As before, all variables are standardized. With the exception of confirmed guidance, all coefficients on the different guidance disclosures have a negative sign, albeit not all of them are statistically significant. Lowered guidance has a significantly negative association with Δ*Systematic_Risk* with a coefficient of -0.155 (*t*-stat.= -1.70), and the coefficient on raised guidance is -0.032 (*t*-stat.= -0.62). The results are consistent with hypothesis H3a that particularly lowered guidance has a negative effect on changes in systematic risk. A one standard deviation increase in the number of lowered

guidance before the earnings announcement reduces the change in systematic risk over the earnings reporting period by approximately 0.16.

The results in column (2) in Table 8 for the regressions of Δ*Idiosyncratic_Risk* reveal that the coefficient on raised guidance is significantly negative at -0.098 (*t*-stat.= -1.91), whereas the coefficient on lowered guidance is (marginally) statistically insignificant at -0.119 (*t*-stat.= -1.63). The coefficient on newly issued guidance is significantly negative at -0.108 (*t*-stat.= -1.66) and the coefficient on confirmed guidance is significantly negative at -0.127 (*t*-stat.= -2.67). The results are consistent with hypothesis H3b that raised guidance has a negative effect on changes in idiosyncratic risk. A one standard deviation increase in the number of raised guidance reduces the reporting period change in idiosyncratic risk by approximately 10%. New and confirmed guidance also have a negative effect on changes in idiosyncratic risk.

Column (3) in Table 8 shows the results of the regression of the EAP on guidance, changes in systematic and idiosyncratic risk and controls. The columns shows that controlling for the indirect effect of guidance on the EAP through changes in risk, both raised and lowered guidance have a direct effect on the EAP. The coefficient on raised guidance is significantly positive at 0.215 (*t*-stat.= 4.74) and the coefficient on lowered guidance is significantly negative at -0.987 (*t*-stat.= -2.14). The coefficients on change in systematic risk and change in idiosyncratic risk are significantly positive at 0.105 (*t*-stat.= 1.70) and 0.152 (*t*-stat.= 2.12), respectively.

Figure 4 summarizes the results of the SEM. The recursive SEM allows us to estimate the indirect effects of raised and lowered guidance through their effects on the changes in risk. The indirect effect of raised guidance on the EAP through its effect on systematic (idiosyncratic) risk is $-0.032 \times 0.105 = -0.0034$ ($-0.098 \times 0.152 = -0.015$). The indirect

effect of lowered guidance on the EAP through its effect on systematic (idiosyncratic) risk is $-0.155 \times 0.105 = -0.016$ ($-0.119 \times 0.152 = -0.018$). These results suggest that raised guidance has a positive direct effect on the EAP by increasing attention, but also a negative indirect effect by reducing idiosyncratic risk, whereas lowered guidance has both a negative direct effect on the EAP and a negative indirect effect by reducing systematic risk.

The SEM decomposes the total effects of raised (lowered guidance) estimated in Table 7 into direct and indirect effects, depicted in the top (bottom) diagrams of Figure 4 (A) and (B). This decomposition highlights that lowered guidance has a unambiguously negative effect on the EAP, about 71% of which comes from the direct effect (direct coefficient of -0.087 in bottom diagram in (B) divided by total effect of -0.122 from top diagram in (B)). Raised guidance on the other hand has a total positive effect on the EAP of 0.197 which comes from a slightly larger direct positive effect (direct coefficient of 0.215) dampened by a small indirect negative effect.

4.4 Further evidence on the differential effect of guidance on net buying pressure and information uncertainty

The results in the previous section suggest that raised guidance has a larger effect in inducing net buying pressure on a stock than reducing information uncertainty and hence has a net positive effect on the EAP, whereas lowered guidance does not lead to buying pressure and instead has an unambiguously negative effect on the EAP through its negative effect on information uncertainty. In this section we more directly test these mechanisms in a cross-sectional setting using intra-day trading data to develop measures of net buying pressure and information uncertainty/asymmetry.

Specifically, as proxy for net buying pressure we use the ratio of the dollar value of buy transactions to the total trading dollar value, where a buy transaction is defined as a transaction with a price higher than the mid-point of the bid-ask spread measured in the

prior nano second. We define the change in net buying around the earnings announcement as the difference of the average daily net buying ratio during the reporting period [1,+1] centered around the earnings announcement date and the average daily net buying ratio during the non-reporting period [-30, -10] before the earnings announcement period. We measure the change in information asymmetry as the difference of the average daily extreme spread during the reporting period and the non-reporting period, where the extreme spread is the difference between the highest ask price and the lowest bid price on a given trading day. The extreme spread represents the amount of common information available to the market, or disagreement, about a stock.

For this analysis we use all firm-quarter observations of treatment and matched control firms during the five years centered around the S&P500 index inclusion year [-2 years, +2 years]. Table 9 provides the summary statistics of all variables in this analysis. In addition to the previous firm characteristic control variables we also control for several announcement characteristics such as whether the earnings announcement was made during market hours, on a Friday, bundled with guidance or includes fiscal year-end earnings. Variable definitions are provided in the appendix.

As before we estimate a recursive structural equation model, but in this analysis we model the direct and mediated effects of raised and lowered guidance on changes in risk around the earnings announcement (EA). We expect lowered guidance to have a direct negative effect on the changes in risk around the EA and an indirect negative effect through its negative effect on the extreme spread. We expect raised guidance to have a direct negative effect on changes in risk and an indirect positive effect through net buying pressure.

Table 10 summarizes the results of the estimations. Column 1 shows the results of the regressions of the change in net buying pressure from non-reporting to reporting period on guidance. The column reveals that raised guidance is positively associated with the change in

net buying. The coefficient on raised guidance is statistically significant at 0.003 (t-stat.= 2.02). A one standard deviation increase in the number of guidance increases net buying by 10 basis points (= 0.342 × 0.003) which is economically meaningful compared to the unconditional mean of a 10 basis point *decrease* in net buying between non-reporting to reporting periods. The coefficient on lowered guidance in the regressions of net buying is not statistically different from zero. Column 2 shows the results of the regressions changes in the extreme spread on guidance. Here, the coefficient on raised guidance is insignificant, whereas the coefficient on lowered guidance is significantly negative at −0.012 (t-stat.= −2.06) suggesting that lowered guidance decreases the change in extreme spread.

Columns 3 and 4 in Table 10 show the results of the regressions of the changes in systematic and idiosyncratic risk on guidance and our information uncertainty and net buying proxies. The columns reveal that raised guidance has a direct negative effect on the change in idiosyncratic risk with a coefficient of −0.011 (t-stat.= −2.53), whereas lowered guidance does not seem to have a direct effect on either risk measure. However, the coefficients on *Extreme Spread* are significantly positive at 0.148 (t-stat.= 2.42) in the regressions of systematic risk and 0.087 (t-stat.= 2.98) in the regressions of idiosyncratic risk. These results suggest that an increase in information uncertainty is associated with the increase in risk around the earnings announcement and that lowered guidance reduces this increase in risk through its negative effect on the information uncertainty. The results further suggest that net buying pressure does not have an effect on changes in risk around the earnings announcement consistent with the attention (behavioral) explanation of the EAP.

Overall, the findings in this section provide further evidence that raised and lowered guidance

affect the EAP through different channels. Raised guidance has a direct negative effect on the EAP through reducing idiosyncratic risk and an indirect positive effect via inducing net buying pressure, whereas lowered guidance reduces risk through its negative effect on information uncertainty.

5 CONCLUSION

This study examines the effect of voluntary disclosure on the market reaction to mandatory disclosure. Specifically, we investigate whether and how management guidance prior to the earnings announcement affects the widely documented earnings announcement premium. Management guidance likely affects information risk and investor attention around the earnings announcement, but in different ways. Increases of both have been put forward in the prior literature as the main explanations of the EAP. In this study, we empirically test the effect of guidance on information risk and investor attention as drivers of the EAP.

Using S&P500 index addition as an instrument for exogenous variation to the provision of management guidance, we estimate difference-in-differences regressions on a propensity score-matched sample of companies that were added to the index for the first-time and a control group of similar companies that were not. To differentiate and reconcile risk-based and attention-based explanations for the EAP, we distinguish between good new disclosures (i.e., raised guidance) and bad news disclosures (i.e., lowered guidance) as we expect the former to increase attention and net buying, whereas we expect the latter to be more informative and thus reduce information risk. Consistent with these expectations, we find that raised guidance has a positive effect on the EAP, whereas lowered guidance has a negative effect.

We further investigate the direct and mediated effects of raised and lowered guidance in a series of structural equation models. We find a significant and positive direct effect of

raised guidance on the EAP (attention channel) and a countervailing negative indirect effect of raised guidance on idiosyncratic risk (risk channel) around the earnings announcement. Consistent with expectations we find an unambiguously negative effect of lowered guidance on the EAP. Using high-frequency data we disentangle net buying effects from information risk in additional robustness analyses.

This study contributes to our understanding of interactions between mandatory and voluntary disclosures by finding that the nature of the disclosed news affects whether the different disclosures act as complement or substitutes. Distinguishing between good and bad news disclosures also allows us to identify the direct and indirect effects that contribute to positive abnormal returns around earnings announcements reconciling the attention and risk-based explanations for the earnings announcement premium.

TABLES AND FIGURES

Table 1: Sample Profile by Industry and Year

This table shows the industry and year profile of S&P 500 index inclusion and control firm sample.

	Industry Breakdown		Year of Index Inclusion		
	Freq	Percent	Year	Freq	Percent
Consumer Non Durables	28	6.1%	2004	17	7.4%
Consumer Durables	6	1.3%	2005	13	5.7%
Manufacturing	30	6.5%	2006	22	9.6%
Energy	40	8.7%	2007	29	12.6%
Chemicals and Allied Products	16	3.5%	2008	31	13.5%
Business Equipment	64	13.9%	2009	23	10.0%
Communication	18	3.9%	2010	12	5.2%
Utilities	24	5.2%	2011	10	4.3%
Retail	44	9.6%	2012	9	3.9%
Healthcare	40	8.7%	2013	10	4.3%
Finance	96	20.9%	2014	11	4.8%
Other	54	11.7%	2015	17	7.4%
			2016	26	11.3%
Total	460	100.0%	Total	230	100.0%

Table 2: Propensity Score Logit Regression for S&P500 Index Inclusion from 2004-2016

This table shows the results of the logit regression of S&P inclusion on various firm characteristics from 2004-2016. Variable definitions are shown in Appendix A. t-statistics for are given in parentheses. ***, **, * denote statistical significance at 1%, 5% and 10%-level, respectively.

	S&P 500 Inclusion
Log of Assets	-0.178*
	(-1.80)
Log of Market Capitalization	1.041***
	(10.59)
ROA	0.015
	(0.04)
Future ΔROA	0.424
	(1.59)
Capital Expenditures	0.566
	(0.510)
Research and Development	-6.539***
	(-3.41)
Intangibles	0.559
	(1.62)
Debt	0.265
	(1.01)
Dividends	-0.593***
	(-3.83)
Business Segments	-0.03
	(-1.49)
Bid-Ask Spread	0.016**
	(2.07)
Log of Firm Age	-0.106
	(-1.33)
Market to Book	0.050*
	(1.66)
Analyst Following	-0.009
	(-1.14)
Observations	50,845
Adjusted McFadden Pseudo R-Squared	0.180

Table 3: Pre-S&P 500 Index Inclusion Treatment and Control Group Characteristics

This table shows means and standard deviations of the firm characteristics used in the propensity score-matching between treatment and control firms. ***, **, * denote statistical significance at 1%, 5% and 10%-level, respectively, of a two-tailed test of differences in means.

	S&P 500 Inlcusion Group			Matched Control Group		
	n	Mean	S.D.	n	Mean	S.D.
Log of Assets	230	8.490	0.998	230	8.578	1.289
Log of Market Capitalization	230	8.643	0.543	230	8.592	0.832
ROA	230	0.073*	0.063	230	0.064	0.053
Future ΔROA	230	-0.003	0.058	230	-0.003	0.039
Capital Expenditures	230	0.054	0.065	230	0.048	0.042
Research and Development	230	0.019	0.045	230	0.020	0.041
Intangibles	230	0.205	0.217	230	0.218	0.187
Debt	230	0.252	0.202	230	0.250	0.188
Dividends	230	0.551	0.498	230	0.551	0.498
Business Segments	230	4.780	2.896	230	4.955	3.534
Bid-Ask Spread	230	0.196	2.072	230	0.053	0.052
Log of Firm Age	230	3.571	0.847	230	3.561	0.918
Market to Book	230	1.999**	2.041	230	1.612	1.321
Analyst Following	230	9.208	8.251	230	8.605	8.242

Table 4: Descriptive Statistics of Regression Variables

This table reports difference-in-differences (D-in-D) descriptive statistics for 230 S&P 500 index-inclusion and 230 propensity-matched control firms from 2002-2018. Variables are shown in D-in-D form. Variable definitions are provided in appendix A.

D-in-D Variable	n	Mean	S.D.	25th %	Median	75th %
Earnings Announcement Premium	230	-0.016	0.048	-0.043	-0.016	0.016
Company Issued Guidance						
Total	230	0.130	1.893	-0.875	0.000	1.000
Lowered	230	0.070	0.637	0.000	0.000	0.000
Raised	230	-0.089	0.990	-0.500	0.000	0.500
New	230	0.093	1.563	-0.500	0.000	1.000
Confirmed	230	0.057	0.735	0.000	0.000	0.375
Risk Measures						
ΔSystematic risk	230	0.243	2.170	-0.801	0.251	1.289
ΔIdiosyncratic risk	230	0.000	0.017	-0.009	-0.001	0.010
Controls						
Timing	230	0.058	13.595	-3.124	0.000	4.569
Earnings Surprise	230	0.012	0.593	-0.039	-0.006	0.024
Log of Assets	230	0.213	0.423	-0.027	0.132	0.379
Log of Market Capitalisation	230	0.355	0.510	0.023	0.299	0.577
ROA	230	0.000	0.069	-0.022	-0.002	0.030
Capital Expenditures	230	0.000	0.028	-0.010	0.000	0.012
Intangibles	230	0.031	0.116	-0.022	0.013	0.066
Debt	230	-0.012	0.127	-0.076	-0.013	0.044
Dividends	230	-0.022	0.263	0.000	0.000	0.000
Business Segments	230	-0.148	1.673	-0.500	0.000	0.500
Bid-Ask Spread	230	-0.134	2.087	-0.014	0.002	0.029
Firm Age	230	-0.004	0.093	-0.042	0.002	0.045
Market to Book	230	0.062	1.359	-0.352	0.038	0.477
Analyst Following	230	0.799	3.901	-0.938	0.583	2.667

Table 5: Differences in Guidance Pre- and Post- Index Inclusion between Treatment and Control Firms

This table shows means and standard deviations of the number of guidance of treatment and control group in the two years pre- and post-index inclusion. t-statistics of a two-tailed test of differences in means are shown in parentheses. ***, **, * denote statistical significance at 1%, 5% and 10%-level, respectively,

Panel A:

	[-2 years,-1 year]						[1 year,2 years]					
	S&P 500 Inclusion Group			Matched Control Group			t-stat.	S&P 500 Inclusion Group			Matched Control Group			t-stat.
	n	Mean	S.D.	n	Mean	S.D.	of diff.	n	Mean	S.D	n	Mean	S.D	of diff.
Lowered	230	0.128	0.301	230	0.154	0.370	(-1.04)	230	0.203	0.423	230	0.158	0.377	(1.18)
Raised	230	0.639	1.082	230	0.370	0.712	(2.87)***	230	0.506	0.900	230	0.331	0.678	(2.27)**
New	230	1.917	1.810	230	1.530	1.678	(2.68)***	230	2.301	1.953	230	1.810	1.796	(3.08)***
Confirmed	230	0.192	0.424	230	0.259	0.539	(-1.54)*	230	0.269	0.575	230	0.261	0.510	(0.17)
All	230	2.876	2.695	230	2.312	2.444	(2.34)**	230	3.280	2.793	230	2.560	2.489	(2.76)***

Panel B:

	S&P 500 Inclusion Group							Matched Control Group						
	[-2 years,-1 year]			[1 year,2 years]			t-stat.	[-2 years,-1 year]			[1 year,2 years]			t-stat.
	n	Mean	S.D.	n	Mean	S.D.	of diff.	n	Mean	S.D.	n	Mean	S.D.	of diff.
Lowered	230	0.128	0.301	230	0.203	0.423	(2.63)***	230	0.154	0.370	230	0.158	0.377	(0.15)
Raised	230	0.639	1.082	230	0.506	0.900	(2.48)**	230	0.370	0.712	230	0.331	0.678	(-0.97)
New	230	1.917	1.810	230	2.301	1.953	(4.79)***	230	1.530	1.678	230	1.810	1.796	(3.64)***
Confirmed	230	0.192	0.424	230	0.269	0.575	(2.10)**	230	0.259	0.539	230	0.261	0.510	(0.06)
All	230	2.876	2.695	230	3.280	2.793	(4.28)***	230	2.312	2.444	230	2.560	2.489	(2.70)***

Table 6: Differences in Earnings Announcement Premium Pre- and Post- Index Inclusion between Treatment and Control Firms

This table shows means and standard deviations of the earnings announcement premium of treatment and control group in the two years pre- and post-index inclusion. t-statistics of a two-tailed test of differences in means are shown in parentheses. ***, **, * denote statistical significance at 1%, 5% and 10%-level, respectively,

Panel A:

	[-2 years,-1 year]					[1 year,2 years]				
	S&P 500 Inclusion Group			Matched Control Group		t-stat.	S&P 500 Inclusion Group		Matched Control Group		t-stat.
	n	Mean	S.D.	n	Mean	S.D.	of diff.	n Mean	S.D	n Mean	S.D	of diff.
EAP	230	1.018	0.026	230	1.004	0.022	(7.43)***	230 1.001	0.025	230 1.002	0.026	(0.637)

Panel B:

	S&P 500 Inclusion Group						Matched Control Group				
	[-2 years,-1 year]			[1 year,2 years]		t-stat.	[-2 years,-1 year]		[1 year,2 years]		t-stat.
	n	Mean	S.D.	n	Mean	S.D.	of diff.	n Mean	S.D.	n Mean	S.D.	of diff.
EAP	230	1.018	0.026	230	1.001	0.025	(7.43)***	230 1.004	0.022	230 1.002	0.026	(0.637)

Table 7: The Effect of Guidance on the Earnings Announcement Premium

This table shows regression results of the earnings announcement premium on guidance. All variables enter the regression in D-in-D form. Variable definitions are shown in Appendix A. Standard errors are clustered by inclusion year. *t*-statistics are shown in parentheses. ***, **, * denote statistical significance at 1%, 5% and 10%-level, respectively.

	EAP	
Company Issued Guidance		
All	0.004	
	(0.05)	
Raised		0.197***
		(4.12)
Lowered		-0.122***
		(-2.74)
New		-0.029
		(-0.43)
Confirmed		-0.003
		(-0.04)
Control Variables		
Timing	-0.02	-0.017
	(-0.34)	(-0.30)
Earnings Surprise	0.110***	0.096***
	(2.67)	(2.94)
Total Assets	-0.123	-0.099
	(-1.20)	(-0.93)
Market Capitalisation	-0.079	-0.080
	(-1.04)	(-1.11)
ROA	-0.078	-0.075
	(-0.89)	(-0.90)
Capital Expenditures	0.015	0.051
	(0.28)	(0.94)
Intangibles	0.035	0.027
	(0.53)	(0.35)
Debt	-0.101	-0.095**
	(-2.08)	(-2.01)
Dividend	0.074	0.056
	(1.24)	(0.92)
Bid Ask Spread	-0.063***	-0.07***
	(-5.42)	(-6.43)
Analyst Following	-0.163**	-0.123*
	(-2.126)	(-1.77)
Observations	230	230
Adjusted R-squared	0.056	0.113
SE Cluster	Inclusion year	Inclusion year

Table 8: The Effect of Guidance on Changes in Risk around Earnings Announcements: Recursive Model

This table shows the results of the recursive structural equation model described in 4.3.1. All variables enter the regression in D-in-D form. The control variables are the same as in Table 7. Variable definitions are provided in Appendix A. Standard errors are clustered by inclusion year. *t*-statistics are shown in parentheses. ***, **, * denote statistical significance at 1%, 5% and 10%-level, respectively.

	ΔSystematic Risk	ΔIdiosyncratic Risk	EAP
Company Issued Guidance			
Raised	-0.032	-0.098*	0.215***
	(-0.62)	(-1.91)	(4.74)
Lowered	-0.155*	-0.119	-0.087**
	(-1.70)	(-1.63)	(-2.14)
Risk			
ΔSystematic risk			0.105*
			(1.70)
ΔIdiosyncratic risk			0.152**
			(2.12)
Control Variables	Y	Y	Y
Observations	230	230	230
Adj. R-squared	0.059	0.068	0.204

Table 9: Descriptive Statistics of Variables in Cross-Sectional Tests

This table reports descriptive statistics of the variables used in the regressions for Table 10 for the sample of 230 S&P 500 index-inclusion and 230 propensity-matched control firms for the four years centered around the inclusion year from 2002-2018.Variable definitions are provided in Appendix A.

D-in-D Variable	n	Mean	S.D.	25th %	Median	75th %
Company Issued Guidance						
Lowered	7230	0.038	0.203	0.000	0.000	0.000
Raised	7230	0.114	0.342	0.000	0.000	0.000
New	7230	0.448	0.607	0.000	0.000	0.000
Confirmed	7230	0.058	0.244	0.000	0.000	0.000
Risk Measures						
ΔSystematic risk	7230	0.019	1.050	-0.449	-0.019	-0.449
ΔIdiosyncratic risk	7230	0.018	0.016	0.007	0.014	0.007
ΔNet Buying	7230	-0.001	0.039	-0.019	0.000	-0.019
ΔExtreme Spread	7230	0.818	2.042	0.158	0.470	0.158
Announcement Controls						
Market Hour	7230	0.076	0.266	0.000	0.000	0.000
Friday	7230	0.055	0.229	0.000	0.000	0.000
EA Timing	7230	31.401	13.096	24.000	29.000	24.000
Bundled EA	7230	0.482	0.500	0.000	0.000	0.000
Fiscal Year-end EA	7230	0.250	0.433	0.000	0.000	0.000
Other Controls						
CIG Timing	7230	16.339	18.815	0.000	0.000	0.000
Earnings Surprise	7230	0.990	6.212	0.246	0.464	0.246
Log of Assets	7230	8.631	1.115	7.948	8.642	7.948
Log of Market Capitalisation	7230	8.842	0.788	8.376	8.857	8.376
ROA	7230	0.018	0.024	0.006	0.015	0.006
Capital Expenditures	7230	0.031	0.041	0.006	0.017	0.006
Intangibles	7230	0.220	0.209	0.029	0.164	0.029
Debt	7230	0.263	0.201	0.096	0.242	0.096
Dividends	7230	0.549	0.498	0.000	1.000	0.000
Bid-Ask Spread	7230	1.607	3.823	0.702	1.069	0.702
Analyst Following	7230	39.733	22.763	23.000	39.000	23.000

Table 10: Disentangling Net Buying from Information Uncertainty Explanations of the EAP

This table shows the results of the recursive structural equation model described in 4.4. The other firm-level control variables are the same as in Table 7. Variable definitions are provided in Appendix A. Standard errors are clustered by fiscal quarter and Fama-French 49 industries. *t*-statistics are shown in parentheses. ***, **, * denote statistical significance at 1%, 5% and 10%-level, respectively.

	ΔNet Buying	ΔExtreme Spread	ΔSystematic Risk	ΔIdiosyncratic Risk
Raised	0.003**	-0.006	-0.037	-0.011**
	(2.02)	(-1.07)	(-1.04)	(-2.53)
Lowered	-0.002	-0.012**	0.072	-0.002
	(-0.93)	(-2.06)	(1.21)	(-0.26)
Net Buying			-0.282	0.035
			(-0.86)	(0.95)
Extreme Spread			0.148**	0.087***
			(2.42)	(2.98)
Control Variables				
Timing	-0.01**	0.019	-0.207**	0.03**
	(-2.25)	(1.58)	(-2.05)	(2.15)
Earnings Surprise	-0.004	0.064*	-0.379***	-0.039***
	(-0.65)	(1.87)	(-3.29)	(-3.01)
Market hour	0.000	-0.009	-0.061	-0.01*
	(-0.06)	(-0.71)	(-1.26)	(-1.66)
Friday	0.001	0.045*	0.042	-0.029***
	(0.43)	(1.90)	(0.78)	(-3.66)
EA Timing	0.005	-0.037**	-0.145	-0.03*
	(0.80)	(-2.46)	(-1.42)	(-1.83)
Bundled EA	0.000	0.004	0.056*	0.008*
	(0.28)	(1.04)	(1.77)	(1.92)
Fiscal Year-end EA	0.002	0.006	0.006	0.004
	(1.32)	(1.00)	(0.20)	(0.75)
Other firm-level controls	Y	Y	Y	Y
Observations	7230	7230	7230	7230
Adjusted R-squared	0.004	0.045	0.015	0.231

Figure 1: Frequency of Company Issued Guidance 2002-2018

This figure shows the number of guidance issued, by type, of all U.S. companies included in the Capital IQ database from 2002-2018.

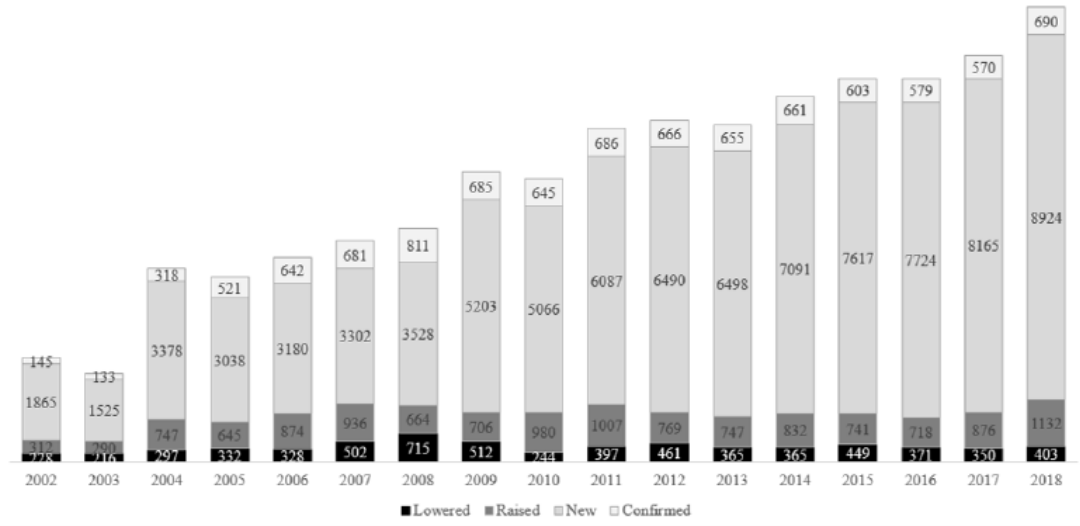


Figure 2: Mean Issued Guidance Per Company Per Year 2002-2018

This figure shows the average number of of guidance issued by company per year of all U.S. companies included in the Capital IQ database from 2002-2018.

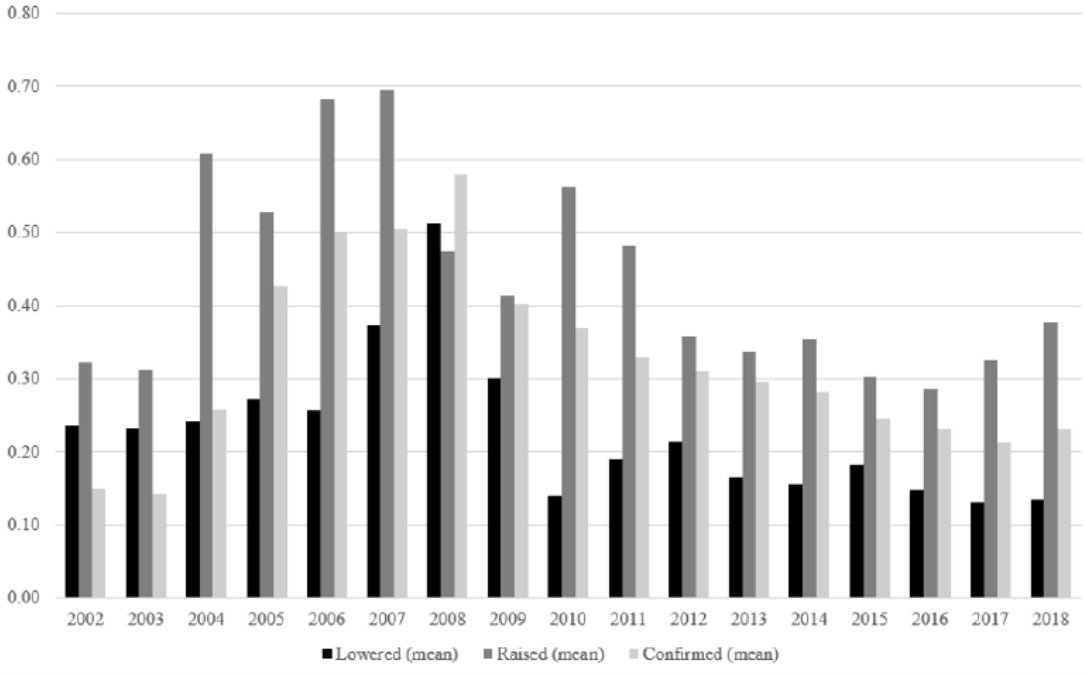


Figure 3: Path Diagram of the Structural Equation Model

This figure illustrates the structural equation model of the effect of guidance on the earnings announcement premium. Arrow directions indicate the hypothesized causal direction of the effects and effect signs are included next to the arrows for raised guidance and in parentheses for lowered guidance.

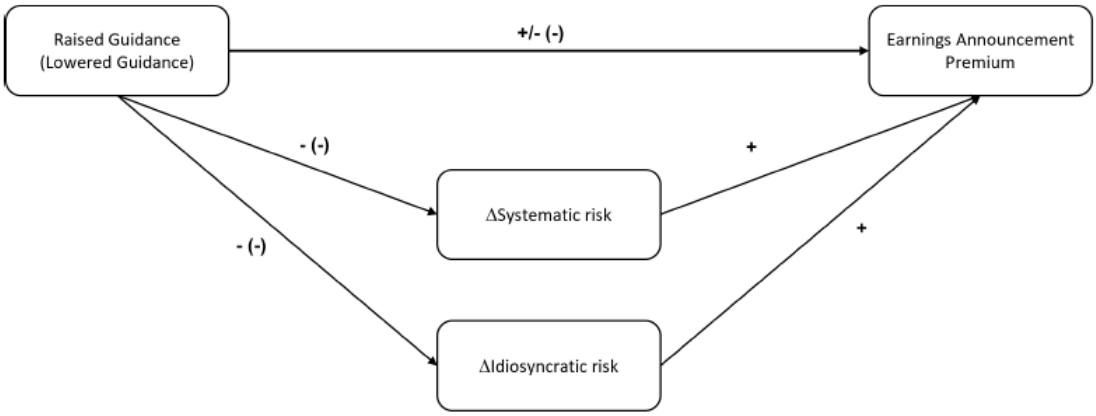
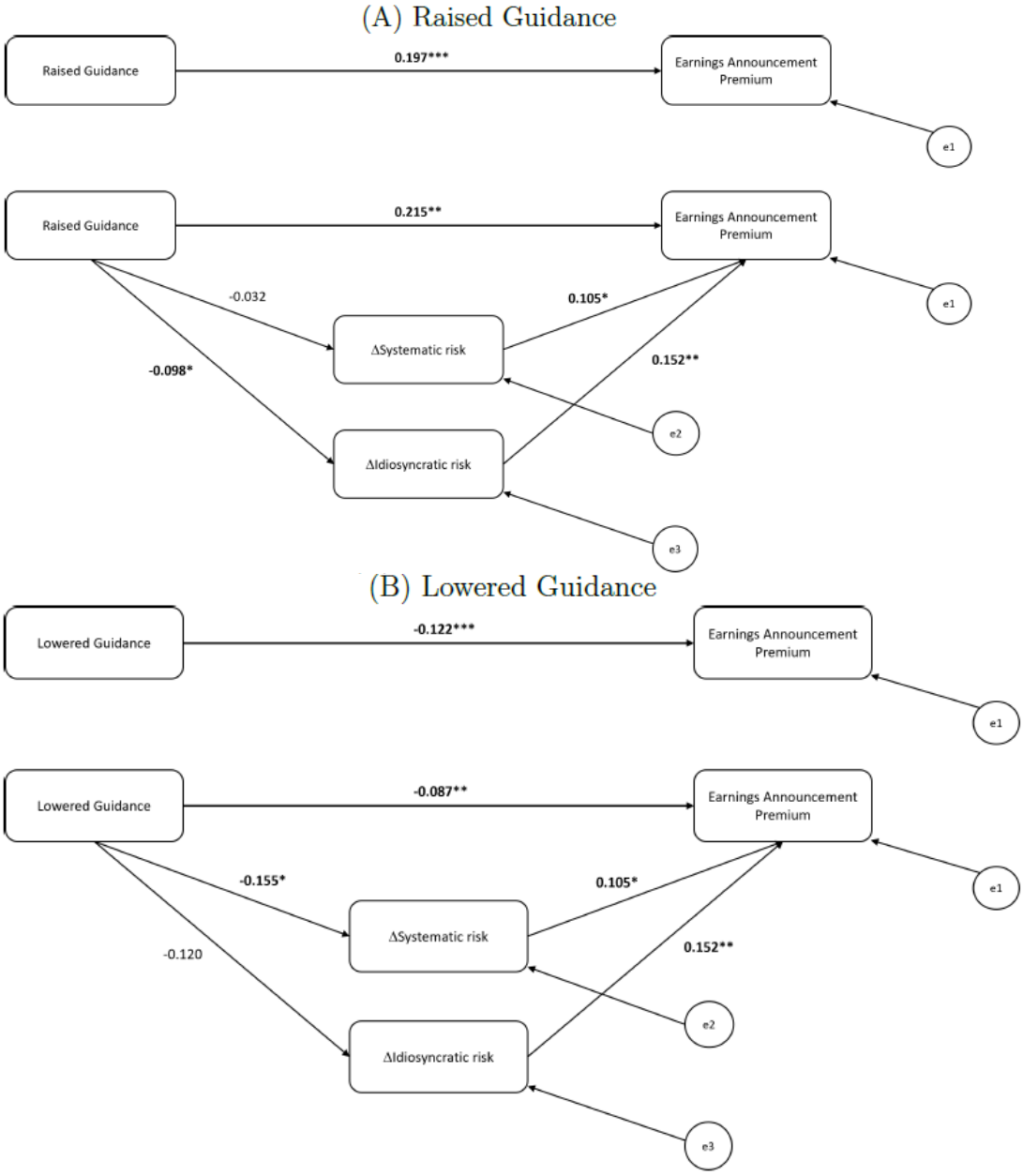


Figure 4: Total and Moderated Effects of Guidance on the Earnings Announcement Premium

This figure shows the total and moderated effects of raised guidance (Panel A) and lowered guidance (panel B) on the earnings announcement premium estimated by the structural equation model. Circles with e denote the error terms. ***,**,* denote statistical significance at the 0.01, 0.05 and 0.1-level.



APPENDICES

Appendix A Variable Definitions

Table A1: Variable Definitions

Variable	Definition	Source
Earnings Announcement Premium (EAP)	The cumulative value-weighted market-adjusted return over the reporting window [-1, 1] centered around the earnings announcement date	CRSP.
ΔSystematic Risk	The difference between reporting period systematic risk and non-reporting systematic risk. (Non-) Reporting period systematic risk is estimated as the beta in the regressions stock returns on market returns over the (non-)reporting window [-1, 1] ([-30,-10]) centered around the EA using 8 quarterly earnings announcements prior to the inclusion date and 8 quarterly earnings announcements after the inclusion date.	CRSP
ΔIdiosyncratic Risk	The difference between reporting period idiosyncratic risk and non-reporting idiosyncratic risk. (Non-) Reporting period idiosyncratic risk is estimated as the residuals from regressing stock returns on market returns over the (non-)reporting window [-1, 1] ([-30,-10]) centered around the EA using 8 quarterly earnings announcements prior to the inclusion date and 8 quarterly earnings announcements after the inclusion date.	CRSP
Company Issued Guidance (raised, lowered, new and confirmed)	The number of company issued guidance per year. For the quarterly cross-sectional analysis guidance is measured as the number per quarter. Raised refers to guidance that projects an increase in operating results compared to the previously issued guidance; lowered refers to guidance that projects a decrease in operating results compared to the previously issued guidance; new refers to a newly issued guidance and confirmed refers to guidance that confirms previously issued projections. Examples of each type are shown in Appendix B	Capital IQ
ΔNet Buying	Ratio of daily buying dollar value to daily total dollar value. A trade is classified as a buy if the trade price is higher than mid-price of the bid-ask spread in the previous millisecond (before 25 July 2015), microsecond (between 25 July 2015 and 23 Oct 2016), or nano second (after 23 Oct 2016). The change is measured as the difference of buying to total dollar value ratio between the reporting window [-1,1] and non-reporting window [-30,-10].	TAQ
ΔExtreme Spread	Extreme Spread is measured as daily highest ask minus daily lowest bid, averaged over the reporting window [-1,1] and non-reporting window [-30,-10], respectively. The change is measured as the difference of extreme spread between reporting and non-reporting periods.	TAQ

Table A1 - *continued*

Variable	Definition	Source
Timing	The number of days between guidance and earnings announcement.	COMPUSTAT, Capital IQ
Earningn Surprise	Actual earnings less the latest analyst consensus estimated earnings for the same fiscal quarter.	I/B/E/S
Total Assets	Log of total assets	COMPUSTAT
Market Capitalization	Log of total market capitalization	COMPUSTAT
ROA	Income before extraordinary items divided by total assets	COMPUSTAT
Future ΔROA	The future change in ROA is measured as the difference of two-year average of yearly ROA following the observation year minus the two-year average of yearly ROA prior to the observation year.	COMPUSTAT
Capital Expenditures	Capital expenditures divided by total assets	COMPUSTAT
Research and Development	Research and development expense divided by total assets	COMPUSTAT
Intangibles	Intangible assets divided by total assets	COMPUSTAT
Debt	(Current debt plus long term debt) divided by total assets	COMPUSTAT
Dividends	Indicator variable equal to 1 if the firm paid a dividend, zero otherwise.	COMPUSTAT
Business Segments	Number of business and geographical segments	COMPUSTAT
Bid-Ask Spread	Averaged bid-ask spread	CRSP
Firm Age	Log of firm age in years	Capital IQ
Market to Book	Market value divided by book value of assets	COMPUSTAT
Analyst Following	Number of analysts with outstanding EPS forecasts	Capital IQ
Analyst Dispersion	Standard deviation of last EPS forecasts before the earnings announcements	Capital IQ
Institutional Ownership	Percentage of institutional ownership	Capital IQ
Market Hour	Indicator variable that equals to 1 if earnings announcement is made during market hours (9:30am to 4:00pm)	IBES
Friday	Indicator variable that equals to 1 if earnings announcement is made on a Friday	IBES
EA Timing	Number of days between fiscal quarter end and earnings announcement date	IBES
Bundled EA	Indicator variable equal to 1 if earnings announcement is bundled with Company Issued Guidance.	IBES, Capital IQ
Fiscal Year-end EA	Indicator variable equal to 1 if the earnings announcement includes fiscal year-end earnings	IBES

Appendix B Examples of Company Issued Guidance

CIG – Raised "The company (SolarWinds) updates its previous outlook, raises the high end of its reported revenue outlook despite the negative impact of foreign currency rates and currently expects to achieve the following results for the full year 2010. The company expects total revenue in the range of 159.0–165.0 million, non-GAAP operating income of 77.5–80.5 million and non-GAAP net income of 54.0–56.0 million and non-GAAP diluted earnings per share of $0.72-$0.75."

CIG – Lowered "... the company (Pfizer Inc.) lowered its guidance for fiscal 2007 net income to account for the hefty Exubera charges, now expecting full-year earnings per share of $1.01 to $1.10 per share, down from a prior range of $1.30 to $1.41. However, Pfizer lifted the low end of its guidance for 2007 adjusted profit to a range of $2.10 and $2.15 per share from $2.08 to $2.15 as previously expected. Revenue is now expected to range from $47.5 billion to $48 billion, up from a previous range of $47 billion to $48 billion."

CIG – New "Bluelinx Holdings Inc. provided preliminary earnings guidance for the fourth quarter ended January 3, 2009. The company expects to report a fourth-quarter net loss in the range of $0.76 to $0.84 per fully diluted share and revenue of approximately $500 million. For the same period a year ago, the Company reported a net loss of $1.10 per fully diluted share on revenue of $779 million. The Company's preliminary results for the fourth quarter of 2008 were negatively impacted by decreases in product prices as well as the continued decline in the housing market. These results include the impact of a number of restructuring and other charges and are based on the Company's preliminary unaudited results for the fourth quarter ended January 3, 2009. For the quarter, the company estimates Goodwill impairment of $0.7 million or $0.02 per share.

CIG – Confirmed "The company (ATT Inc.) reaffirms earnings guidance for the year 2007. For the year, the company continues to expect to deliver double-digit (percentage) growth in earnings per share, adjusted to exclude merger-related costs and one-time items, in 2007 and 2008. The company also expects its adjusted consolidated operating income margin in 2007 to be in the 21% to 23% range." (Source: SP Capital IQ)

Chapter 3

Voluntary Disclosure Under Idiosyncratic Uncertainty

Abstract

My research investigates the effect of firm-level idiosyncratic uncertainty on voluntary disclosure. Using a novel dataset of consumer transaction data to measure idiosyncratic uncertainty, this study finds that idiosyncratic uncertainty reduces managers' propensity to make voluntary capital expenditure forecasts and that the negative effect of idiosyncratic uncertainty on disclosures is weaker in periods of declining performance compared to growing performance. This study also shows that managers place more weight on their private information with an increase in idiosyncratic uncertainty and rely less on market signals, suggesting that they have more internal information under uncertainty in periods of declining performance. Additional analyses confirm this finding by showing that idiosyncratic uncertainty has a less negative impact on planned capital expenditures in periods of declining performance compared to periods of growing performance.

Keywords: Uncertainty, voluntary disclosure, CAPEX forecasts

1 INTRODUCTION

My research investigates the effect of firm-level idiosyncratic uncertainty on voluntary disclosure. This research question is motivated by the conflict managers face between the increasing demand for and the additional costs of voluntary disclosure when firm performance is volatile. Cukierman (1980) and Bernanke (1983) suggest that firm performance is an important information source and volatile firm performance creates uncertainty. Firm-level idiosyncratic uncertainty creates additional challenges for both firms' insiders' and outsiders' information collection. On the one hand, from the increasing information demand perspective, volatile firm performance may introduce market inefficiencies and thus managers' internal information is particularly important for investors' decision making under idiosyncratic uncertainty. For example, Maslar et al. (2021) suggests that managers have an information advantage over outsiders about the specific implications of macroeconomic uncertainty on firm performance. On the other hand, high idiosyncratic uncertainty makes it harder for managers to extract information from observing firm performance or to make voluntary disclosures thereby increasing their voluntary disclosure preparation costs. Unlike mandatory disclosure like earnings announcements, the timing and content of voluntary disclosure such as managerial capital expenditure forecasts are purely subject to managers' discretion. Therefore, during times of high idiosyncratic uncertainty, managers may reduce voluntary disclosure due to the lack of information, even though that is precisely the time when there is greater market demand for managers' internal information.

I first examine the impact of firm-level idiosyncratic uncertainty on the managers' propensity to make voluntary disclosure. Firm-level idiosyncratic uncertainty may impact voluntary disclosure via two channels: managers' additional costs to prepare disclosure and investors' increased demand for internal information. Particularly, higher idiosyncratic uncertainty makes it harder for managers to extract useful information from observing firm performance

and to prepare voluntary disclosures to reveal inside information to the market. Yet, volatile firm performance also creates additional challenges for investors' decision making and thus worsens adverse selection problems between the firm and new investors. In the presence of high idiosyncratic uncertainty, whether managers decide to make voluntary disclosure depends on the trade-off between increased disclosure preparation costs and increased adverse selection costs. If the increased disclosure preparation costs are lower (higher) than the increased adverse selection costs, then managers would decide (not) to make voluntary disclosure. Whether idiosyncratic uncertainty reduces the propensity to make voluntary issuance is therefore an open question.

For managers, significant components of the disclosure preparation costs include the information collection costs and the information collection benefits. To assess the benefits and costs, I therefore compare the impact of idiosyncratic uncertainty on voluntary disclosure during periods of growing firm performance and declining firm performance, because growing and declining firm performance result in different incremental costs and benefits of information collection. This is due to accounting conservatism in mandatory accounting standards, which results in lower incremental costs of information collection during periods of declining performance. Accounting conservatism requires firms to collect more information around bad news and bad news is more likely to occur during periods of declining firm performance compared to periods of growing firm performance. Therefore, information collection costs are likely to be lower during the former. In addition, loss-aversion suggests that the benefits of information collection are greater during periods of declining performance. Loss-aversion is defined as the tendency to prefer avoiding losses to acquiring equivalent gains (Köbberling & Wakker, 2005), and loss making is of higher probability during periods of declining firm performance compared to growing firm performance. The lower information collection costs due to accounting conservatism and

greater information collection benefits due to loss-aversion thus leads to lower information preparation costs during periods of declining performance. Therefore, my study predicts that managers are more likely to make voluntary disclosure under idiosyncratic uncertainty during periods of declining firm performance compared to periods of growing firm performance.

This study uses a novel dataset of daily consumer transactions to measure firm-level idiosyncratic uncertainty and managerial capex forecasts as a proxy for voluntary disclosure. A probit regression analysis of 1827 firm-year observations from 2016-2021 shows that idiosyncratic uncertainty is negatively associated with the propensity to make voluntary disclosure. The finding suggests that under higher idiosyncratic uncertainty, managers are less likely to make voluntary disclosures. I then divide the 1827 firm-year observations into periods of stable, declining, and growing firm performance according to the annual rate of change of a firm's individual consumers revenues. This analysis finds that idiosyncratic uncertainty has a negative impact on the propensity to make voluntary disclosure during periods of growing firm performance and that this negative association is weaker by approximately 86% during periods of declining performance. This finding is consistent with my prediction that, managers are more likely to make voluntary disclosures under high idiosyncratic uncertainty during periods of declining performance compared to periods of growing performance.

In order to understand whether managers make voluntary disclosure to mitigate adverse selection and resolve potential market inefficiencies created by volatile firm performance, one needs to distinguish between whether managers make voluntary disclosure to provide their internal information or to elicit market feedback. Particularly, I test, for firms that make voluntary disclosure (announcers) under high idiosyncratic uncertainty, whether these announcers rely more on their internal information or market signals (price information). Prior research suggests that managers reveal internal information to resolve investors'

uncertainty (Rogers et al., 2009; Billings et al., 2015; Nagar et al., 2019; Barth, Landsman, Tian, et al., 2020; Maslar et al., 2021). Recent empirical evidence, however, also documents that less-informed managers use voluntary disclosure to elicit market feedback and adjust their capex decisions by observing the market reaction to the disclosure (Jayaraman & Wu, 2020). It is hard to distinguish whether or not managers are informed before they make the disclosure. I, therefore, develop a hypothesis assuming that managers are informed and a competing hypothesis assuming that managers are less informed.

To examine whether announcers rely more on their internal information or market signals when issuing voluntary disclosure during under high idiosyncratic uncertainty, I estimate the moderating effect of idiosyncratic uncertainty on the association between the market reaction to manager's disclosure and their adjustments of actual capex relative to forecasted capex. Jayaraman and Wu (2020) show that the positive association between the market reaction and capex adjustment is stronger (weaker) when managers are less (more) informed. Using a sample of 1831 capex forecasts issued during 2016 to 2021, I find that firm performance uncertainty has a significant negative impact on the association between the market reaction to capex forecasts and managers' capex adjustments, indicating that managers place less (more) weight on market signals (their internal information) under higher idiosyncratic uncertainty.

Overall, this paper shows that 1) managers are more likely to make voluntary disclosures under high idiosyncratic uncertainty during periods of declining firm performance compared to periods of growing firm performance and 2) managers tend to rely more on their internal information when making these disclosures under high idiosyncratic uncertainty. These two findings together suggest that managers are more informed under idiosyncratic uncertainty during periods of declining firm performance compared to periods of growing firm performance. Therefore, I predict that managers tend to make more investments plans under

high idiosyncratic uncertainty during periods of declining firm performance compared to periods of growing firm performance. To test this prediction, I estimate the impact of idiosyncratic uncertainty on planned capex during periods of declining and growing firm performance. The additional results show that idiosyncratic uncertainty has a negative impact on planned capex during periods of growing firm performance but not during periods of declining firm performance. This finding is consistent with the prediction of my additional analysis and suggests that idiosyncratic uncertainty has a less negative impact on corporate investment plans during periods of declining firm performance compared to periods of growing firm performance.

My study offers several contributions to the extant literature on voluntary disclosure. First, my study contributes to the literature that examines the association between voluntary disclosure and uncertainty. Prior voluntary disclosure research shows that managers make voluntary disclosures to resolve the uncertainty faced by information users (Barth, Landsman, Tian, et al., 2020; Billings et al., 2015; Maslar et al., 2021; Nagar et al., 2019; Rogers et al., 2009). However, little is known about 1) whether managers continue to make voluntary disclosure when firm-level uncertainty is high and 2) whether these disclosures under uncertainty is to reveal internal information or just "cheap talk". These two questions are important in order to understand the role of voluntary disclosure in preventing and/or resolving market inefficiencies created by information uncertainty. However, it is difficult to test these two questions without measures of firm-level uncertainty with sufficient frequency. With a novel dataset of firm real-time revenue based on consumer transactions, my study measures firm-level idiosyncratic uncertainty using real-time revenue volatility.

Second, my study also contributes to disclosure and corporate investment studies. There is a dearth of research examining the relationship between firm disclosures decision and investment decisions from the information perspective (Roychowdhury et al., 2019). Prior

literature documents a positive association between disclosures and corporate investment decisions and suggests that this positive association indicates disclosures reduce information asymmetry and improve capital supply (Jung et al., 2014; Leuz & Wysocki, 2016; Bae et al., 2017). Managers' information sets are an important alternative explanation for this positive association. Particularly, stable firm performance makes it easier for managers to extract useful information from observing firm performance and with this information managers are more likely to make voluntary disclosure and make investment decisions. My study shows that even if managers have more access to capital supplies during periods of growing firm performance compared to periods of declining firm performance, managers tend to reduce their investment plans more under high idiosyncratic uncertainty during periods of growing firm performance compared to periods of declining firm performance. This finding suggests that managers' information sets and capital supply together contribute to efficient corporate investments.

Lastly, this study contributes to the literature on managerial learning by showing that managers rely more on their internal information under idiosyncratic uncertainty. This is consistent with Maslar et al. (2021)'s proposition that managers have deeper insights into firm-specific performance. Maslar et al. (2021) use forecast accuracy as a proxy for managers' internal information. My study extends theirs by showing that the quantity of voluntary disclosure could also represent managers' internal information. My study also helps to address the concern that managers make voluntary disclosure under uncertainty to avoid the costs of non-disclosure. Empirical evidence shows that managers rely less on market signals indicating that capex forecasts issued under idiosyncratic uncertainty is to reveal internal information instead of cheap talk. This empirical evidence also contributes to the discussion about whether managers issue voluntary disclosure to prevent and/or resolve market inefficiencies created by volatile firm performance.

The remainder of this paper is organized as follows. Section II discusses relevant research and develops hypotheses. Section III develops the research design. Section IV describes the sample. Section V presents the empirical analysis results, and Section VI concludes the study.

2 LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

"(T)he marginal efficiency of capital depends not only on the existing abundance or scarcity of capital-goods and the current cost of production of capital-goods, but also on current expectations as to the future yield of capital-goods ... But, as we have seen, the basis for such expectations is very precious. Being based on shifting and unreliable evidence, they are subject to sudden and violent changes."

Keynes, *The General Theory*, Ch.22

The assumption that managers are endowed with perfect information about firm performance is prevalent in voluntary disclosure studies (Rogers et al., 2009; Billings et al., 2015; Nagar et al., 2019; Barth, Landsman, Tian, et al., 2020; Maslar et al., 2021). Previous studies discussing the impact of uncertainty on voluntary disclosure assume that the uncertainty mainly introduces information shocks to outsiders, not managers. For example, Billings et al. (2015) find that increased abnormal stock price volatility is likely to lead managers to provide bundled voluntary disclosure to resolve investors' uncertainty. The assumption of this finding is that the stock price volatility is a shock to investors' information not to managers' information and that is why managers use voluntary disclosure as a tool to resolve investors' uncertainty. Maslar et al. (2021) recognise that uncertainty, as created by economic downturns, makes it harder for both managers and outsiders to forecast, but managers still have an information advantage to provide more accurate forecasts to outsiders. My study suggests that it is important to understand the impact of firm-level uncertainty on voluntary disclosure.

2.1 Idiosyncratic Uncertainty and Voluntary Disclosure

Uncertainty in this study refers to firm-level idiosyncratic uncertainty; therefore, the models of Cukierman (1980) and Bernanke (1983) are relevant because their models assume that information extracted from past firm performance makes the distribution of the future value of a project less uncertain. In the settings of Cukierman (1980)'s model, investment decision-making is a process of picking investment projects from available projects to maximise payoffs. The return on each potential project is stochastic and depends on parameters W, whose exact values are usually unknown to the firm when it decides which project to undertake. Using a Bayesian framework, Cukierman (1980) proposes that the firm has a prior distribution on parameters W and can learn about its likely magnitude by observing the realizations, over time, of a certain firm performance random variable, x, whose distribution depends on W.

My study suggests that firm-level idiosyncratic uncertainty increases the preparation costs of disclosure. Particularly, stable firm performance makes it easier for managers to gauge parameters of future projects and provide useful information about investment plans to the market. In contrast, idiosyncratic uncertainty created by volatile firm performance makes it harder for managers to extract useful information from observing firm performance. Consequently, volatile firm performance will increase the costs of preparing voluntary disclosure.

Furthermore, idiosyncratic uncertainty increases the adverse selection costs of non-disclosure. Volatile firm performance also creates additional challenges for capital providers (shareholders, creditors, etc) to evaluate firm performance. Outsiders require firm disclosures to gauge the value of assets in place and of existing investment opportunities. Under volatile firm performance, the adverse selection problem between the firm and outsiders may be worsened without voluntary disclosure. Prior studies show that when investors' demand for

voluntary disclosure is high, managers are more likely to issue voluntary disclosure to resolve adverse selection problems (Barth, Landsman, Tian, et al., 2020; Billings et al., 2015; Maslar et al., 2021; Nagar et al., 2019; Rogers et al., 2009).

In this study, I examine whether managers make voluntary disclosure to mitigate increased adverse selection costs when firm performance becomes volatile. Volatile firm performance results in an increase in disclosure preparation costs due to lack of information. If the increase in adverse selection costs is higher than the additional disclosure preparation costs, then managers will provide voluntary disclosure to resolve potential market inefficiencies of corporate valuation. If the increase in adverse selection costs is lower than the additional disclosure preparation costs, then managers may decide not to provide voluntary disclosures. Comparing adverse selection costs and disclosure preparation costs under idiosyncratic uncertainty ex ante is difficult given that both are generally unobservable. Whether managers will increase or decrease voluntary disclosure therefore remains an open question. My study tests the null hypothesis that there is no effect of idiosyncratic uncertainty on managers' propensity to make voluntary disclosures.

H1a: There is no impact of idiosyncratic uncertainty on the propensity of voluntary disclosure issuance.

2.2 Preparation Costs and Voluntary Disclosure

Disclosure preparation costs comprise of the information collection costs and the information collection benefits. Cukierman (1980) and Bernanke (1983) suggest that if a firm is allowed to collect information, then investment decision making under uncertainty would be a trade-off between the extra returns from early commitment and the benefits of increased information by waiting. Given that this study focuses more on the motivation of information collection instead of the timing of investment decisions, the trade-off faced by managers when they decide whether or not to collect information is between the incremental benefits

from the information collected and the costs associated with the information collection process.

Accounting conservatism in mandatory reporting standards results in lower incremental information collection costs during periods of declining firm performance compared to growing firm performance. This is because accounting conservatism requires managers to report bad news in a more timely manner; and therefore, managers collect more information around bad news compared to good news (Basu, 1997; Beaver et al., 2012; Barth, Landsman, Raval, et al., 2020). Shroff (2017a) finds that accounting standards changes that require the managers to obtain more information are positively associated with a firm's investments even if some accounting standard changes do not impact the measurement and reporting process of the investment. My study suggests that the more rigorous requirement of bad news recognition leads managers to obtain more information for investment decision making. Moreover, bad news is more likely to occur during periods of declining firm performance compared to periods of growing firm performance. Therefore, accounting conservatism in mandatory reporting standards likely results in managers being more informed during periods of declining firm performance compared to periods of growing firm performance. Prior studies also suggest that managers use the same information set for disclosure and investment tasks (Goodman et al., 2014; Roychowdhury et al., 2019). Therefore, the incremental costs to collect information for investment plans is lower in during periods of declining firm performance compared to periods of growing firm performance.

Loss-aversion suggests that the incremental information collection benefits are higher during periods of declining firm performance compared to periods of growing firm performance. Loss-aversion is defined as the tendency to prefer avoiding losses compared to acquire equivalent gains (Tversky & Kahneman, 1991; Köbberling & Wakker, 2005). Prior research suggests that loss-aversion is prevalent among managers (Willman et al., 2002; Haigh & List,

2005). Given that loss making is of higher probability during periods of declining firm performance compared to periods of growing firm performance, the incremental information collection benefits are higher during periods of declining firm performance.

In summary, accounting conservatism suggests that incremental information collection costs during periods of declining firm performance are lower. At the same time, loss-aversion suggests that incremental information collection benefits are higher during periods of declining firm performance. Thus, the disclosure preparation costs are lower during periods of declining firm performance. The study assumes that the adverse selection costs of non-disclosure does not vary between periods of declining and growing firm performance. Consequently, I predict that managers are more likely to make voluntary disclosures under high idiosyncratic uncertainty during periods of declining performance, where the disclosure preparation costs are lower.

H1b: Managers are more likely to make voluntary disclosures when idiosyncratic uncertainty is high during periods of declining firm performance compared to periods of growing firm performance.

2.3 Reveal Private Information or Elicit Market Feedback

It is also important to distinguish whether managers make voluntary disclosures to reveal their inside information or whether they do so instead to elicit market feedback. Jayaraman and Wu (2020) show that managers use capex forecasts to elicit market feedback, which results in an increase in managerial information sets. Ali and Fan (2022) show that capex forecasts improve transparency, suggesting that managers reveal internal information via voluntary disclosure.

Maslar et al. (2021) find that managers' forecast accuracy improves under uncertainty created by economic downturns, suggesting that managers have higher quality information compared to outsiders during economic downturns and reveal their internal information via managerial

forecasts. Jayaraman and Wu (2020) find a significant positive association between the market reaction to forecasts and managers' adjustments of actual capex relative to forecasted capex. Additionally, they find that this association between the market reaction and managers' adjustment becomes insignificant when managers are more informed. I, therefore, predict that

H2a: Managers' adjustments of actual capex relative to forecasted capex tend to react less to the market response to capex forecasts with an increase in idiosyncratic uncertainty.

Cukierman (1980)'s models suggest that volatile firm performance indicates weaker managerial information. Using insider trading as a proxy for managers' private information, Jayaraman and Wu (2020) find that managers adjust their actual capex relative to forecasted capex in accordance with market reaction when they are less informed. Therefore, the competing hypothesis predicts that

H2b: Managers' adjustments of actual capex relative to forecasted capex tend to react more to the market response to capex forecasts with an increase in idiosyncratic uncertainty.

3 RESEARCH DESIGN

3.1 Measure of Uncertainty

I use an anonymized dataset of European real-time consumer transaction data obtained from Fable Data to capture real-time firm performance. Each of the consumer transaction data includes information on transaction timing, merchant, and transaction amount. I aggregate all the transaction data to daily basis and then use the coefficient of variation of daily consumer transaction revenues to proxy for firm level idiosyncratic uncertainty. The first advantage of real-time consumer transaction data is that this data is free from accrual management and any other reporting manipulation. Another major advantage compared to quarterly or annual reported revenue data, is that the granularity of consumer transaction data enables intra-quarter and intra-year measurements of firm performance uncertainty. Similar consumer

transaction dataset has been used to measure real-time revenue in Blankespoor et al. (2022)'s study, further confirming the value of consumer transaction data.

This real-time consumer transaction dataset has three main limitations. The first is that it includes individual consumers only. This limitation is less concerning for measures of performance uncertainty under the assumption that the majority of firm performance volatility arises from individual transactions compared to contract sales. The second limitation is that the dataset is limited to European bank data only. However, as long as global market sales of the firms in my sample follow similar patterns in volatility, there is less of a concern of misestimating firm performance volatility. The third limitation is that firms included in my sample are mainly consumer-facing due to the nature of consumer transactions. Thus, my findings might not necessarily extend to other industries.

In my study, for the average firm, the consumer transaction revenue is 0.31% of the annual reported revenue for the same fiscal year. While this is a small fraction of reported revenues, the correlation between consumer transaction revenue and reported annual revenue in my study is 38% (significant at 1%). Additionally, annual consumer transaction revenues variance explains 49% of the reported annual revenue variance, verifying the credibility of consumer transaction data in measuring firm performance volatility.

To measure idiosyncratic uncertainty ($Uncertainty_{i,t}$), my study uses the coefficient of variation of daily consumer transaction revenue. To estimate daily consumer transaction revenue, I aggregate the consumer transaction data on a daily basis. The coefficient of variation is the standard deviation of daily consumer transaction revenue scaled by the value of the mean for firm i during fiscal year t (see Equation (1)). In Equation (1), $\sigma_{i,t}$ is the standard deviation of daily consumer transaction revenues measured for firm i during the

fiscal year of t, and $\mu_{i,t}$ is the mean value of daily consumer transaction revenue measured for firm i during the fiscal year of t.

$$Uncertainty_{i,t} = \frac{\sigma_{i,t}}{\mu_{i,t}}, (1)$$

3.2 Periods of Growing, Stable, and Declining Performance

All firm-year observations are divided into three categories, periods of growing firm performance, periods of declining performance, and periods of stable performance. Firm performance is measured by the rate of change of annual consumer transaction revenue as in Equation (2).

$$\delta_{i,t} = \frac{\sum x_{i,t} - \sum x_{i,t-1}}{\sum x_{i,t-1}}, (2)$$

where $\delta_{i,t}$ is the rate of change for firm i in fiscal year t, and x is daily revenues. I then rank the $\delta_{i,t}$ cross-sectionally. Firm-years with $\delta_{i,t}$ within the top quartile of all $\delta_{i,t}$ are defined as periods of growing firm performance. Firm-years with $\delta_{i,t}$ in the bottom quartile of all $\delta_{i,t}$ are defined as periods of declining firm performance. All remaining firm-year observations are categorized as periods of stable firm performance.

3.3 Idiosyncratic Uncertainty and Voluntary Disclosure

To test the impact of idiosyncratic uncertainty on voluntary disclosure (H1a), this study estimates the probit regression in Equation (3).

$$CAPEX_Forecast_{i,t} = \beta_1 Uncertainty_Decile_Score_{i,t} + \beta_2 Growth_{i,t} + \beta_3 Decline_{i,t} + Controls_{i,t} \quad (3)$$

$CAPEX_Forecast_{i,t}$ is an indicator variable that equals to 1 if firm i issues capex forecasts during fiscal year t. $Uncertainty_Decile_Score_{i,t}$ is the annually cross-sectional decile rank of idiosyncratic uncertainty divided by 10. The $Uncertainty_Decile_Score_{i,t}$ ranges from

zero to one. Increasing uncertainty creates an additional cost for managers to extract information from observing past firm performance and increasing adverse selection costs. If the additional information preparation costs are higher than the additional adverse selection costs, then managers will decide not to issue capex forecasts and β_1 will be negative. In contrast, if managers decide to issue capex forecasts β_1 will be positive.

I control for firm performance in estimating Equation (3). $Growth_{i,t}$ is an indicator variable equal to one for firm years in periods of growing firm performance and $Decline_{i,t}$ is an indicator variable equal to one for firm years within periods of declining firm performance. Equation (3) also includes the following variables as controls. *Announcer_Lag* is an indicator variable if firm i issues capex forecasts during fiscal year t-1; *Assets* measures firm size as the natural logarithm of total assets; *Tobin_Q* measures growth opportunities; *Debt* measures the leverage ratio as total debt scaled by total assets which proxies for financial constraints. $Beta_RSQUARE$ is the R-squared of the regression of individual stock returns on market returns over two years up to the beginning date of the fiscal year. A higher co-movement of the firm's stock return with the market indicates whether the firm is a bellwether firm; *ROA* is the ratio of net income to total assets and measures profitability. I also control for the country and fiscal year fixed effects in Equation (3). Standard errors are clustered by firm and fiscal year.

3.4 Preparation Costs and Voluntary Disclosure

To test whether firm disclosure strategies under high idiosyncratic uncertainty are different during periods of growing and declining performance (H1b), this study estimates the probit regression Equation (4).

$$CAPEX_Forecast_{i,t} = \beta_1 Uncertainty_Decile_Score_{i,t} + \beta_2 Growth_{i,t} + \beta_3 Growth_{i,t} \times Uncertainty_Decile_Score_{i,t} + \beta_4 Decline_{i,t} + \beta_5 Decline_{i,t} \times Uncertainty_Decile_Score_{i,t} + Controls_{i,t} \quad (4)$$

$CAPEX_Forecast_{i,t}$ is an indicator variable that equals to 1 if firm i issues capex forecasts during fiscal year t. $Uncertainty_Decile_Score_{i,t}$ is the annually cross-sectional decile rank of idiosyncratic uncertainty divided by 10. $Growth_{i,t}$ is an indicator variable equal to one for firm-years during periods of growing firm performance. $Decline_{i,t}$ is an indicator variable equal to one for firm-years during periods of declining firm performance.

In Equation (4), the coefficient of $Uncertainty_Decile_Score_{i,t}$ (β_1) reflects the impact of idiosyncratic uncertainty on the propensity to make capex forecasts during periods of stable firm performance. The coefficient of the interaction term $Growth_{i,t} \times Uncertainty_Decile_Score_{i,t}$ measures any incremental effect of idiosyncratic uncertainty on the propensity to make capex forecasts during periods of growing firm performance. The coefficient of interaction term $Decline_{i,t} \times Uncertainty_Decile_Score_{i,t}$ measures the incremental effect of idiosyncratic uncertainty on the propensity to make capex forecasts during periods of declining firm performance. I predict that information preparation costs, which is defined as information collection costs minus information collection benefits, are lower during periods of declining firm performance. Therefore, I predict that $\beta_5 > \beta_3$ in Equation (4).

Equation (4) includes the following variables as controls. *Announcer_Lag* is an indicator variable if firm i issues capex forecasts during fiscal year t-1; *Assets* measures firm size as the natural logarithm of total assets; *Tobin_Q* measures growth opportunities; *Debt* measures the leverage ratio as total debt scaled by total assets which proxies for financial constraints. $Beta_RSQUARE$ is the R-squared of the regression of individual stock returns on market

returns over two years up to the beginning date of the fiscal year. A higher co-movement of the firm's stock return with the market indicates whether the firm is a bellwether firm; *ROA* is the ratio of net income to total assets and measures profitability. I also control for the country and fiscal year fixed effects for Equation (4). Standard errors are clustered by firm and fiscal year.

3.5 Reveal Private Information or Elicit Market Feedback

It is important to understand whether managers make capex forecasts under high idiosyncratic uncertainty to reveal inside information (H2a) or to elicit market feedback (H2b). The null hypothesis (H2a) is that managers place more weight on their internal information with increasing idiosyncratic uncertainty and the competing hypothesis (H2b) is that managers place more weight on make signals when issuing capex forecasts under increasing idiosyncratic uncertainty. To test the null and competing hypothesis, I estimate Equation (5),

$$CAPEX_Forecasts_Adjust_{n,i,t} = \beta_1 Uncertainty_Decile_Score_{i,t} + \beta_2 CAR_{n,i,t} + \beta_3 Uncertainty_Decile_Score_{i,t} \times CAR_{j,i,t} + Controls_{i,t} \quad (5)$$

$CAPEX_Forecasts_Adjust_{n,i,t}$ is the percentage adjustment of actual capex from forecasted capex scaled by the latter, for CAPEX forecast n issued by firm i during fiscal year t. Following Jayaraman and Wu (2020), I use the difference between actual capex and endpoints of range forecasts to be conservative. Specifically, for actual capex that falls within the capex forecast range, I assign the adjustment to be zero. For actual capex lower than the lower end of the range forecast, I calculate the difference using the lower endpoint of the range. For actual capex higher than the higher end of the range forecast, I calculate the difference using the higher endpoint of the range.

$Uncertainty_Decile_Score_{i,t}$ is the annually cross-sectional decile rank of idiosyncratic uncertainty divided by 10. $CAR_{n,i,t}$ is the cumulative abnormal return during three days window centred around the announcement date of capex forecast n. Consistent with Jayaraman and Wu (2020)'s findings, I predict the coefficient of $CAR_{n,i,t}$ (β_2) to be positive. The coefficient of interaction term $Uncertainty_Decile_Score_{i,t} \times CAR_{j,i,t}$ (β_3) is predicted to be to be negative if managers place more weight on their internal information (H2a) and positive if managers place more weight on market feedback under increasing idiosyncratic uncertainty (H2b).

Controls include the following variables: *Bundle* is an indicator variable that equals to one if the capex announcement is issued together with a quarterly earnings announcement. *Surp* is earnings surprise as percentage of actual earnings per share. *Assets* is the natural logarithm of total assets; *Debts* as the total debts scaled by total assets to control for the effect of creditors' pressure on managers (Ali & Fan, 2022); *Lag_CAPEX* measures the natural logarithm of capex in the last fiscal year; $Beta_RSQUARE$ is the R-squared of the regression of individual stock returns on market returns over two years up to the beginning date of the fiscal year. *ROA* is the ratio of net income to total assets and measures profitability. I also control for the firm and fiscal year fixed effects for Equation (5). Standard errors are clustered by firm and fiscal year.

4 SAMPLE AND DESCRIPTIVE STATISTICS

I use anonymized consumer transaction data from 2016-2021 to measure firm-level idiosyncratic uncertainty. To exclude the situations of extreme firm performance growth due to recent inclusion in the database, I exclude firms-years in the largest 0.5 percent of the rate of change of the annual consumer transaction revenue. I then match the consumer transaction data with Compustat and CRSP. I obtain capex forecasts information from I/B/E/S. The final

sample comprises 323 firms, 1827 capex forecasts, 1827 firm-year observations from 2016-2021.

The breakdown of firm-year observations by fiscal year, country, and Fama French 48 industry is provided in Table 1. The breakdown of firm-year observations by fiscal-year shows that no specific fiscal year is dominating in my sample. To control for the time-varying trend of voluntary disclosure, I include fiscal-year as fixed effect in my following multivariate analysis. The breakdown of firm-year observations by country indicate that the majority of my sample are firms reported to Securities and Exchanges Commission (SEC) in the US (52.27%) and Financial Conduct Authority (FCA) in the UK (29.83%). Capex forecasts are not regulated by neither of these two regulators and other authorities in the remaining countries in my sample, verifying the voluntary nature of capex forecasts in my study. To control for differences in regulations across countries, I include country as a fixed effect in my following multivariate analysis. In Table 1 also provides a breakdown of firm-years by Fama French 48 industry. 21.29% firm-year observations are from retailing industry, followed by transportation (17.41%), and restaurants, hotels, and motels (10.13%). The breakdown of industry confirms that by design of the consumer transaction data, the sample in my study are consumer-facing and thus I do not control for industry fixed effect in my study.

[Table 1]

Table 2 presents descriptive statistics for the key variables used in estimating Equations (3), (4) and (5). The mean value of *Uncertainty* measured as the variation of coefficient is 1.279 (t-statistic = 29.069). Given that variation of coefficient is standard deviation scaled by mean value, the mean value of uncertainty in my study suggests that on average the standard deviation of daily revenues is larger than the mean value of daily revenues on average and

firm performance volatility measured by daily consumer revenues has economic significance. Table 2 shows that the mean value of *Rate of Change of Firm Performance* is not significantly different from zero (t-statistic = 1.775), suggesting my sample firm-year observations are not dominated by periods of growing performance or declining performance. The mean value of *Capex Forecasts Frequencies* is 0.994 (t-statistic = 23.101), suggesting that on average, each firm issue 0.994 capex forecasts during a year. However, the median value of *Capex Forecasts Frequencies* is 0, indicating that the mean value could be significantly influenced by a small number of firms make multiple capex forecasts. Thus, instead of using the value of *Capex Forecasts Frequencies*, my study uses an indicator variable of whether managers make capex forecasts as a dependent variable in my following multivariate probit regression. Table 2 shows that the *CAPEX_Adjustment* is not significantly different from zero (t-statistic = -0.471), verifying that my sample of capex forecasts is not dominated by opportunistic or pessimistic forecasts. The CAR is not significantly different from zero (t-statistic = -0.238), verifying that my sample is not dominated by any specific investors' preferences.

[Table 2]

Table 3 presents Pearson correlations between the key variables. Table 3a shows that the correlation coefficient between *Uncertainty* and *Rate of Change of Firm Performance* is insignificant, suggesting that volatile firm performance is not associated with declining firm performance. Table 3a also shows that *Uncertainty* is significantly negatively associated with *Capex Forecasts Frequencies*. The significant negative correlation coefficient suggests that with the increase in idiosyncratic uncertainty, managers tend to make fewer capex forecasts. The probit regression in the Equation (3) will provide more robust empirical evidence on the impact of idiosyncratic uncertainty on capex forecasts issuance.

[Table 3]

5 RESULTS

5.1 Univariate Analysis

Table 4 provides a univariate analysis comparing the frequencies of capex forecasts under high and low idiosyncratic uncertainty during periods of growing firm performance, stable firm performance and declining firm performance. High uncertainty is defined as quartile of cross-sectional annual idiosyncratic uncertainty. Low uncertainty is defined as the bottom quartile of cross-sectional annual idiosyncratic uncertainty. The univariate analysis shows that there is a significant decrease in capex forecasts frequencies with the increase in idiosyncratic uncertainty during periods of growing and stable firm performance. During periods of declining firm performance, there is no significant difference in capex forecasts frequencies between firm years in the presence of high and low idiosyncratic uncertainty.

During periods of stable performance, the average firm-year capex forecasts decrease significantly (t-stat = -3.425) from 1.154 to 0.577. The decrease in capex forecasts frequencies with an increase in idiosyncratic uncertainty suggests that managers are less likely to issue capex forecasts with the increase in idiosyncratic uncertainty. During periods of growing performance, the average firm-year capex forecasts decrease significantly (t-stat = -2.299) from 1.152 to 0.634 when idiosyncratic uncertainty increase from bottom quartile to top quartile. During periods of declining performance, the average firm-year capex forecasts frequencies are not significantly different (t-stat = -1.142) under high and low idiosyncratic uncertainty. The significant decrease in capex forecasts with an increase in idiosyncratic uncertainty observed during periods of growing performance but not observed during periods of declining performance is consistent with my hypothesis H1b, showing that managers are more likely to issue capex forecasts with an increase in idiosyncratic risk during periods of

declining performance compared to periods of growing performance. I will next test my first research question and the other hypotheses in a multivariate setting.

[Table 4]

5.2 Idiosyncratic Uncertainty and Voluntary Disclosure

To test the impact of idiosyncratic uncertainty on the propensity to make capex forecasts (H1a), I estimate Equation (3). Table 5 presents the regression results. The coefficient of *Uncertainty_Decile_Score* (β_1) is significantly negative at -0.321 (t-stat = -2.169). The significant negative coefficient suggests that an increase in idiosyncratic uncertainty leads to a decrease in the propensity to make capex forecasts.

[Table 5]

5.3 Preparation Costs and Voluntary Disclosure

To further understand the different impact of idiosyncratic uncertainty on the propensity to make capex forecasts during periods of growing and declining firm performance (H1b), I estimate Equation (4). The regression results are presented in Table 6. Table 6 shows that with increasing idiosyncratic uncertainty, managers are less likely to issue capex forecasts. Table 6 shows that this negative impact of uncertainty on capex is lower during periods of declining performance. The key finding is consistent with the hypothesis H1b that managers are more likely to issue capex forecasts with an increase in idiosyncratic uncertainty during periods of declining firm performance compared to periods of growing firm performance.

Particularly, Table 6 shows that the *Uncertainty_Decile_Score* coefficient (β_1) is significantly negative at -0.570 (t-stat = -2.240), suggesting that during periods of stable firm performance in the presence of high idiosyncratic uncertainty, managers are less likely to issue capex. The coefficient on the interaction term *Growth* x *Uncertainty_Decile_Score* (β_3)

is insignificant (t-stat = 0.815), suggesting that the negative impact of uncertainty on issuing capex forecasts is similar during periods of growing performance and periods of stable performance. The coefficient on the interaction term *Decline* x *Uncertainty_Decile_Score* (β_5) is significantly positive. Specifically, the coefficient (t-statistic) of β_5 is 0.500 (2.763). This finding suggests that the negative impact of uncertainty on issuing capex forecasts is mitigated by 88% (0.500/0.570) during periods of declining performance compared to periods of stable performance. The findings that β_3 is not significantly different from zero and β_5 is significantly positive are consistent with my prediction (H1b) that managers are more likely to issue capex forecasts with an increase in idiosyncratic uncertainty during periods of declining performance compared to growing performance.

[Table 6]

5.4 Reveal Private Information or Elicit Market Feedback

To understand whether managers make capex forecasts under increasing idiosyncratic uncertainty to reveal their inside information or it is to elicit market feedback, I estimate Equation (5) using 1831 capex forecasts during fiscal years 2016-2021. Table 7 presents the regression results. Consistent with Jayaraman and Wu (2020), I find that managers adjust actual capex relative to forecasted capex in accordance with the market feedback to the capex forecasts. The key variable of interest is the interaction term *Uncertainty_Decile_Score* x *CAR*. Table 7 shows that the interaction term coefficient (β_3) is significantly negative (-1.247 with a t-statistic -2.938). This finding is consistent with the null hypothesis that managers place more (less) weights on internal information (market signals) under increasing idiosyncratic uncertainty.

[Table 7]

5.5 Additional Analysis - Impact on CAPEX decisions

Thus far the study shows that 1) managers are more likely to issue voluntary disclosure with increasing idiosyncratic uncertainty during periods of declining firm performance compared to periods of growing firm performance and 2) managers tend to rely more on their internal information when making voluntary disclosure under high idiosyncratic uncertainty. These two findings together suggest that managers are more informed under increasing idiosyncratic uncertainty during periods of declining firm performance compared to periods of growing firm performance. Given that managers need information to prepare investment plans, I predict that managers tend to make more investments plans under increasing idiosyncratic uncertainty during periods of declining firm performance compared to periods of increasing firm performance. To test this prediction, I estimate Equation (6) using 1002 firm-years during periods of growing and declining firm performance.

$$CAPEX_Planned_{i,t} = \beta_1 Uncertainty_Decile_Score_{i,t} + \beta_2 Decline_{i,t} + \beta_3 Decline_{i,t} \times Uncertainty_{i,t} + +Controls_{i,t} \quad (6)$$

where *CAPEX_Planned* is forecasted capex value as a percentage of GrossPPE at the beginning of the period. *Uncertainty_Decile_Score* is the cross-sectional decile ranking of idiosyncratic uncertainty and then divided by 10. *Decline* is an indicator variable that equals to 1 if the firm-year observation has an annual rate of change of consumer transaction revenue within the bottom quartile cross-sectionally. Given that sample for this additional analysis include firm-year observations during periods of growing and declining performance only, the coefficient of *Uncertainty_Decile_Score* (β_1) measures the impact of idiosyncratic uncertainty on planned capex value during periods of growing firm performance. The coefficient of interaction term *Decline* x *Uncertainty_Decile_Score* (β_3) measures the incremental effect of uncertainty on planned capex value during periods of declining firm performance compared to periods of growing firm performance.

The additional analysis predicts that idiosyncratic uncertainty has a negative effect ($\beta_1 < 0$) on planned capex value because managers have less information for investment decision making under high idiosyncratic uncertainty. Tables 6 and 7 together indicate that managers have more internal information under increasing idiosyncratic uncertainty during periods of declining firm performance compared to periods of growing firm performance; therefore, I predict that the coefficient of interaction term *Decline* x *Uncertainty_Decile_Score* is positive ($\beta_3 > 0$).

Controls include the following variables. *Lag_CAPEX* measures the natural logarithm of capex in the last fiscal year; *Assets* is the natural logarithm of total assets; *Tobin_Q* measures growth opportunities; *Debt* measures the leverage ratio as total debt scaled by total assets which proxies for financial constraints; $Beta_RSQUARE$ is the R-squared of the regression of individual stock returns on market returns over two years up to the beginning date of the fiscal year; *ROA* is the ratio of net income to total assets and measures firm performance; *Cash,* is cash and cash equivalent as a percentage of total assets measuring capital supplies.

Table 8 shows the regression results of this additional analysis. Consistent with predictions, the coefficient of *Uncertainty_Decile_Score* (β_1) is significantly negative (-0.023, t-statistic = -2.501). The coefficient of *Decline* x *Uncertainty_Decile_Score* (β_3) is significantly positive (0.044, t-statistic = 2.796). β_3, the positive incremental effect of idiosyncratic uncertainty during periods of declining firm performance compared to periods of growing firm performance, is estimated to be approximately 100% of the negative impacts of uncertainty on planned capex value during periods of growing performance. This finding indicates that compared to periods of growing firm performance, idiosyncratic uncertainty almost has no significant impact on planned capex, which is consistent with the prediction in the additional analysis. Additional results in Table 8 confirm the findings in Tables 6 and 7 that managers have more information under uncertainty during periods of declining performance.

Furthermore, the findings suggest that managers are able to make more investment plans despite of increases in idiosyncratic uncertainty.

[Table 8]

The significant negative coefficient of *Uncertainty_Decile_Score* (β_1) (t-statistic = -2.501) suggests that managers tend to make fewer investments due to lack of information in the presence of idiosyncratic risk. Given that the expected future payoffs of investment projects are higher during periods of growing firm performance compared to periods of declining performance, the finding of the additional analysis indicates the potential profitable investment opportunities foregone due to lack of information during periods of growing firm performance.

The coefficient of *Decline* (β_2) is significantly negative (t- statistic = -3.221), suggesting that compared to periods of growing performance, managers tend to make fewer investment plans during periods of declining performance. This finding could be explained by less access to capital supply and less profitable investment opportunities during periods of declining performance. The significant positive coefficient of *Decline* x *Uncertainty_Decile_Score* (β_3) emphasises the importance of information in investment decision making.

6 CONCLUSION

This study investigates the impact of firm-level idiosyncratic uncertainty on voluntary disclosure. Particularly, this study provides answers to the following two questions. First, what is the impact of increasing idiosyncratic uncertainty on voluntary disclosure? Second, when managers make voluntary disclosures during high idiosyncratic uncertainty, do they rely more on internal information or market signals? The findings in this study provides insights into the conflicts between the increasing demand for and additional costs of voluntary disclosure when firm performance is volatile.

My study uses a novel dataset of consumer transaction data to measure intra-year idiosyncratic uncertainty. The findings are as follows. First, managers are less likely to make capex forecasts under high idiosyncratic uncertainty. Moreover, the probit regression analysis shows that the negative impact of idiosyncratic uncertainty on voluntary disclosure is partially mitigated during periods of declining firm performance compared to periods of growing firm performance.

To understand whether managers make capex forecasts under increasing idiosyncratic uncertainty to reveal their inside information or to elicit market feedback instead, my study examines 1831 capex forecasts issued during the fiscal year of 2016-2021. The regression analysis shows that with high idiosyncratic uncertainty, managers tend to rely more on their internal information and rely less on market signals.

My findings suggest that managers are more likely to make voluntary disclosures with increasing idiosyncratic uncertainty during periods of declining firm performance compared to periods of growing firm performance and second, that managers tend to rely more on their internal information when issuing voluntary disclosure under increasing idiosyncratic uncertainty. These two findings together suggest that managers are more informed under increasing idiosyncratic uncertainty during periods of declining firm performance compared to periods of growing firm performance. In an additional analysis, I find that, even if access to capital and profitable investment opportunities are lower during periods of declining performance, the additional internal information helps managers to make investment plans under high idiosyncratic uncertainty. The negative impact of uncertainty on planned capex during periods of growing firm performance indicate potential profitable investments foregone due to lack of information.

This paper contributes to the literature that examines voluntary disclosure and uncertainty. Prior literature examines the impact of uncertainty at information-user level and shows that an increase in uncertainty at information-user level would motivate more voluntary disclosure (Barth, Landsman, Tian, et al., 2020; Billings et al., 2015; Maslar et al., 2021; Nagar et al., 2019; Rogers et al., 2009). My research examines the impact of uncertainty at reporting entity level and shows that with the increase in idiosyncratic uncertainty, managers are less likely to issue voluntary disclosure due to a lack of information. Moreover, due to loss-aversion and accounting conservatism, managers are more motivated to collect information during periods of declining performance. Additionally, managers issue voluntary disclosure to reveal their private information to the market.

This paper also contributes to disclosure strategies and corporate investment studies by showing that managers' internal information is also an important channel for how disclosures improve investment decisions. Prior studies suggest that the positive association between voluntary disclosure and corporate investment is a result of better information environments and lower costs of capital (Jung et al., 2014; Leuz & Wysocki, 2016; Bae et al., 2017). This study provides an alternative explanation to this positive association. Particularly, my finding show that internal information could both increase voluntary disclosure and facilitate corporate investments.

Lastly, this paper contributes to the literature on managers' learning by showing that managers rely more on their private information with the increase of firm-specific uncertainty. This is consistent with the findings by Maslar et al. (2021) that managers' forecasts are more accurate and informative during an economic downturn. My study extends their findings by showing that managers also make more voluntary disclosure, suggesting that more internal information is released to the market.

TABLES AND FIGURES

Table 1a: Sample Profile by Fiscal Year

This table shows the fiscal year profile of the 1827 firm-year sample.

Fiscal Year	Frequency	%
2016	291	15.93%
2017	303	16.58%
2018	310	16.97%
2019	313	17.13%
2020	309	16.91%
2021	301	16.48%
Total	**1827**	**100.00%**

Table 1b: Sample Profile by Country

This table shows the country profile of the 1827 firm-year sample.

Country	Frequency	%
US	955	52.27%
UK	545	29.83%
Germany	91	4.98%
French	67	3.67%
Spain	36	1.97%
Canada	25	1.37%
Italy	23	1.26%
Sweden	22	1.20%
Denmark	17	0.93%
Australia	11	0.60%
Hugary	10	0.55%
Switzerland	9	0.49%
Ireland	6	0.33%
South Africa	6	0.33%
Brazil	4	0.22%
Total	**1827**	**100.00%**

Table 1c: Sample Profile by Fama French 48 Industry

This table shows the Fama French 48 industry profile of the 1827 firm-year sample.

Fama French 48 Industry	Frequency	%
Retail	389	21.29%
Transportation	318	17.41%
Restaurants, Hotels, Motels	185	10.13%
Business Services	182	9.96%
Banking	96	5.25%
Entertainment	83	4.54%
Apparel	72	3.94%
Communication	65	3.56%
Insurance	58	3.17%
Petroleum and Natural Gas	54	2.96%
Utilities	48	2.63%
Trading	45	2.46%
Personal Services	36	1.97%
Wholesale	24	1.31%
Aircraft	23	1.26%
Automobiles and Trucks	20	1.09%
Consumer Goods	19	1.04%
Construction	18	0.99%
Almost Nothing	12	0.66%
Beer & Liquor	12	0.66%
Real Estate	11	0.60%
Healthcare	9	0.49%
Computers	6	0.33%
Electronic Equipment	6	0.33%
Printing and Publishing	6	0.33%
Candy & Soda	6	0.33%
Electrical Equipment	6	0.33%
Construction Materials	6	0.33%
Medical Equipment	6	0.33%
Recreation	6	0.33%
Total	**1827**	**100.00%**

Table 2: Descriptive Statistics of Key Variables

	Count	Mean	t statistic	Std. Dev.	Median
1827 Firm-Year Observations					
Uncertainty	1827	1.279	29.069	1.880	0.723
Rate of Change of Firm Performance	1827	0.258	1.775	6.212	0.828
CAPEX Forecasts Frequencies	1827	0.994	23.101	1.839	0.000
Announcer_Lag	1827	0.334	30.278	0.472	0.000
Assets	1827	9.028	177.023	2.180	8.974
Tobin_Q	1827	1.711	39.246	1.863	1.030
Debt	1827	0.324	55.782	0.249	0.298
Beta_RSQUARE	1827	0.220	52.313	0.180	0.178
ROA	1827	0.029	8.651	0.142	0.031
1831 Capex Forecasts					
CAPEX_Adjustment	1831	-0.021	-0.471	1.909	-0.095
Bundle	1831	0.771	78.409	0.421	1.000
Surp	1831	0.994	10.518	4.044	0.584
CAR	1831	0.000	-0.238	0.072	0.000
Lag_CAPEX	1831	0.057	68.123	0.036	0.053

Table 3a: Correlation Table of Key Variables for Probit Regression of Impact of Idiosyncratic Uncertainty on Capex Forecasts

	Uncertainty	Rate of Change of Firm Performance	CAPEX Forecasts Frequencies	Announcer_Lag	Size	Tobin_Q	Debt	Beta_RSQUARE	ROA
Uncertainty	1.0***								
Rate of Change of Firm Performance	-0.02	1.0***							
CAPEX Forecasts Frequencies	-0.11***	0	1.0***						
Announcer_Lag	-0.13***	-0.02	0.64***	1.0***					
Assets	-0.05**	-0.05**	0.11***	0.08***	1.0***				
Tobin_Q	-0.07***	0.06**	0.01	0.01	-0.25***	1.0***			
Debt	-0.03	-0.02	0.03	0.06**	-0.05*	0.08***	1.0***		
Beta_RSQUARE	-0.04*	-0.04*	0.05*	0.06**	0.48***	0.03	0.13***	1.0***	
ROA	-0.05*	0.04*	0.09***	0.11***	0.09***	0.19***	-0.25***	0	1.0***

* p<0.1; ** p <0.05; *** p <0.01

Table 3b: Correlation Table of Key Variables for Regression Analysis of the Moderating Effects of Idiosyncratic Uncertainty on the Association Between Capex Adjustment and Market Response

	Uncertainty	Capex_Adjustment	Bundle	Surp	CAR	Lag_Capex	Assets	Debt	Beta_RSQUARE	ROA
Uncertainty	1.0***									
Capex_Adjustment	0.08***	1.0***								
Bundle	0.01	-0.03	1.0***							
Surp	-0.05*	-0.01	0.13***	1.0***						
CAR	-0.03	-0.03	0	0	1.0***					
Lag_Capex	0.07***	0.2***	-0.04	0.02	-0.02	1.0***				
Assets	-0.14***	0.04*	0.02	-0.15***	-0.02	-0.03	1.0***			
Debt	-0.11***	0.05**	0.02	-0.05**	0.03	-0.21***	0.04*	1.0***		
Beta_RSQUARE	-0.07***	-0.02	0.06***	-0.14***	-0.02	-0.18***	0.46***	0.16***	1.0***	
ROA	0	-0.04*	0.04*	0.1***	0.02	0.05**	-0.23***	0.01	-0.08***	1.0***

* p<0.1; ** p <0.05; *** p <0.01

Table 4: Comparison of Annual Capex Forecasts Frequencies with the Presence of High and Low Uncertainty for Periods of Growing, Stable and Declining Performance from 2016 to 2021

High uncertainty is defined as top quartile of idiosyncratic uncertainty cross-sectionally, and low uncertainty is defined as bottom quartile of idiosyncratic uncertainty cross-sectionally. Annual Capex forecasts is the number of capex forecasts issued for a firm-year.

	Growing Performance		Stable Performance		Declining Performance	
	mean	n	mean	n	mean	n
High Uncertainty	0.634	104	0.577	174	0.715	156
Low Uncertainty	1.152	125	1.154	197	1.063	132
t statistic	-2.299 **		-3.425 ***		-1.142	

* p<0.1.

** p <0.05.

*** p <0.01

Table 5: Idiosyncratic Uncertainty and Capex Forecasts from 2016 to 2021

This table provides probit regression summary of Equation (1) $CAPEX_Forecast_{i,t} = \beta_1 Uncertainty_Decile_Score_{i,t} + \beta_2 Growth_{i,t} + \beta_3 Decline_{i,t} + Controls_{i,t}$. Variable Definitions are in Appendix.

	CAPEX Forecasts
Uncertainty_Decile_Score	-0.321 *
	(-2.169)
Growth	0.032
	(0.216)
Decline	-0.136
	(-1.051)
Announcer_Lag	2.332 ***
	(20.567)
Assets	-0.005
	(-0.117)
Tobin_Q	-0.063 **
	(-3.756)
Debt	0.331
	(1.485)
Beta_RSQUARE	-0.087
	(-0.432)
ROA	1.589 **
	(3.195)
Observations	1827
Psudo R Squared	0.508
Fixed Effects	Country and Year
SE Cluster	Firm and Year

T-statistics are in parentheses.
* p<0.1.
** p <0.05.
*** p <0.01

Table 6: Idiosyncratic Uncertainty and Capex Forecasts During Periods of Growing and Declining Firm Performance from 2016 to 2021

This table provides probit regression summary of Equation (4) $CAPEX_Forecast_{i,t} = \beta_1 Uncertainty_Decile_Score_{i,t} + \beta_2 Growth_{i,t} + \beta_3 Growth_{i,t} \times Uncertainty_Decile_Score_{i,t} + \beta_4 Decline_{i,t} + \beta_5 Decline_{i,t} \times Uncertainty_Decile_Score_{i,t} + Controls_{i,t}$. Variable Definitions are in Appendix.

	CAPEX Forecasts
Uncertainty_Decile_Score	-0.570 *
	(-2.24)
Growth	-0.119
	(-0.785)
Growth x Uncertainty_Decile_Score	0.428
	(0.815)
Decline	-0.365 *
	(-2.51)
Decline x Uncertainty_Decile_Score	0.499 **
	(2.763)
Announcer_Lag	2.339 ***
	(20.782)
Assets	-0.007
	(-0.175)
Tobin_Q	-0.065 **
	(-3.913)
Debt	0.331
	(1.538)
Beta_RSQUARE	-0.059
	(-0.285)
ROA	1.586 **
	(3.145)
Observations	1827
Psudo R Squared	0.508
Fixed Effects	Country and Year
SE Cluster	Firm and Year

T-statistics are in parentheses.
* p<0.1.
** p <0.05.
*** p <0.01

Table 7: The Moderating Effect of Idiosyncratic Uncertainty on the Association Between Capex Adjustment and Market Reaction from 2016 to 2021

This table provides regression summary of Equation (5) $CAPEX_Forecasts_Adjust_{n,i,t} = \beta_1 Uncertainty_Decile_Score_{i,t} + \beta_2 CAR_{n,i,t} + \beta_3 Uncertainty_Decile_Score_{i,t} \times CAR_{j,i,t} + Controls_{i,t}$. Variable Definitions are in Appendix.

	CAPEX_Adjustement
Uncertainty_Decile_Score	-0.138
	(1.705)
CAR	0.455 *
	(2.305)
Uncertainty_Decile_Score x CAR	-1.247 **
	(-2.938)
Bundle	0.026 *
	(0.227)
Surp	0.000
	(0.124)
Assets	0.165 *
	(1.858)
Lag_CAPEX	-0.533
	(-0.621)
Beta_RSQUARE	-0.094
	(-0.74)
Debt	-0.133
	(-1.215)
ROA	0.313
	(1.305)
Observations	1831
Adjusted R-Square	0.336
Fixed Effects	Firm and Year
SE Cluster	Firm and Year

T-statistics are in parentheses.
* p<0.1.
** p <0.05.
*** p <0.01

Table 8: The Impact of Idiosyncratic Uncertainty on Planned Capex During Periods of Growing and Declining Firm Performance 2016 to 2021

This table provides regression summary of Equation (6) $CAPEX_Planned_{i,t} = \beta_1 Uncertainty_Decile_Score_{i,t} + \beta_2 Decline_{i,t} + \beta_3 Decline_{i,t} \times Uncertainty_{i,t} + +Controls_{i,t}$. Variable Definitions are in Appendix.

	CAPEX_Forecasted
Uncertainty_Decile_Score	-0.023 *
	(-2.501)
Decline	-0.042 **
	(-3.221)
Uncertainty_Decile_Score x Decline	0.044 **
	(2.796)
Lag_CAPEX	-0.004
	(-0.302)
Assets	-0.008
	(-0.825)
Tobin_Q	0.0010
	(0.513)
Debt	-0.002
	(-0.09)
ROA	0.068 **
	(2.842)
Cash	-0.08
	(-1.558)
Observations	1002
Adjusted R-square	0.622
Fixed Effects	Country and Year
SE Cluster	Firm and Year

T-statistics are in parentheses.
* p<0.1.
** p <0.05.
*** p <0.01

APPENDICES

Appendix A: Variables Definition

Variables	Definition
Uncertainty	The coefficient of variation of daily consumer transaction revenue, i.e. standard deviation of daily consumer transaction revenue scaled by mean value over the year.
Uncertainty_Decile_Score	Cross sectional decile ranking of uncertainty and then divided by 10
Rate of Change of Firm Performance	Rate of change of annual consumer transaction revenue
Growth	Indicator varial equal to 1 if the firm years falls within top 25 percentile of rate of change of firm performance
Decline	Indicator varial equal to 1 if the firm years falls within bottom 25 percentile of rate of change of firm performance.
CAPEX_Forecasts	Indicator variable that equals to 1 if the firm issues a capex forecast
Announcer Lag	Indicator variable that equals to 1 if the firm issues a capex forecast in the previous fiscal year
Assets	Size, measured as natural logarithm of total assets
Tobin_Q	Growth opportunites, measured as market value scaed by total assets
Debt	Financial constraints, measured as total debts as percentage of total assets
Beta_RSQUARE	Bellwehterness, measured as r square of 2 year regression of invdividual stock return over market return as the beginning date of the year
ROA	Firm performance, net income scaled by total assets
CAPEX_Adjustment	CAPEX revision, measured as the percentage deviation of actual capex from forecasted capex scaled by the latter
CAR	cumulative abnormal returns during 3 days window centered around CAPEX forecasts date
Bundle	Indicator varialbe equal to 1 if the capex forecasts is issued together with an earning announcement
Surp	Earnings surprise, calculated as the mean value of earnings surprise as percentage of actual earnings per share
Lag_CAPEX	Natural logarithm of capital expenditures in last year

Appendix B: Examples of Capex Forecasts

Tesco Plc, Oct 03, 2018

"…of the fiscal year 2019, capital expenditure for the year is now expected to be no more than GBP 1.2 billion. Going forward, the company expects annual capital expenditure to remain between GBP 1.1 billion and GBP 1.4 billion."

(Source: Capital IQ)

Chapter 4

Comparing Public and Private Firms' Investment Under Uncertainty

Abstract

This study compares the public and private firms' investment under uncertainty. Using a novel dataset of consumer transaction data to measure firm-specific fundamental performance uncertainty, this study finds that in the presence of high uncertainty, private firms are likely to invest more compared to their public peers. Moreover, when operational volatility is high, public firms' profitability increases with the additional capital expenditure investment; however, private firms' profitability decreases with their additional capital expenditure investment. These empirical findings show that public firms' information environment enables public firms access additional information to resolve uncertainty during investment decision making. Additional analysis shows that the information advantage of public firms may spillover to private firms in industries with high presence of bellwether public companies.

Keywords: Uncertainty, Capex Investment, Public firms, Private firms

1 INTRODUCTION

This research article aims to examine the investment behavior of public and private firms in the presence of high uncertainty by utilizing the operational volatility of daily revenue as an indicator of intra-quarter fundamental performance uncertainty. The question of how uncertainty affects investment decisions has been a critical issue of inquiry in both theoretical and empirical domains of economics. While theoretical studies suggest that firm-specific fundamental performance uncertainty plays a crucial role in determining optimal investment choices, previous empirical investigations have primarily concentrated on macro-level and market uncertainty. This study presents novel empirical findings by demonstrating the varied impact of firm-specific fundamental performance uncertainty on investment decisions of public and private firms.

The first main empirical finding is that, in the presence of high fundamental firm performance uncertainty, measured by operational volatility, private firms are likely to invest more compared to their public peers, though private firms tend to invest less than the public peers when the operational volatility is low. The difference is significant when the test is controlled for financial constraints, investment opportunities, financial performance, and firm size. In order to filter out temporary performance fluctuations, this study measures operational volatility during 4 quarters (event quarters). To further allow managers adequate time to observe the operational volatility and then adjust corporate investment plans, the study uses the mean value of following 4 quarters' (CAPEX quarters) capital expenditure to gross PPE ratios to measure corporate investment levels.

Then the immediate question is whether private firms' or public firms' investment plans will improve firm performance, in the presence of high fundamental firm performance uncertainty. My empirical test shows that when operational volatility is high, public firms' profitability increases with the additional capital expenditure investment; however, private firms'

profitability decreases with their additional capital expenditure investment. To allow sufficient time for the corporate investment plans to take effect on profitability, this study calculates the mean value of return on assets (ROA) over the 4 quarters (consequence periods) following the CAPEX quarters. The contrasting profitability outcomes of corporate investment decisions imply that public companies possess supplementary information to alleviate the rise in operational volatility, which they use to make investment decisions. In contrast, the higher investment of private firms results in a lower marginal return, indicating that these investment projects lack high-quality information.

Both information environment and agency problems among public and private firms contribute to the different investment patterns and subsequent profitability between public and private firms. For public firms, my study shows that in the presence of high uncertainty, public firms do not decrease their investment, and the subsequent profitability increases with the additional investment. These findings are consistent with prior public firms' information environment literature (Badertscher et al., 2013; Bae et al., 2017), suggesting that public firms obtain additional information from their information environment and use the additional information to resolve uncertainty and to guide investment. For private firms, my study finds that, in the presence of high operational volatility, private firms tend to invest more compared to their public peers, but the subsequent profitability decreases given additional capital expenditures investment. The difference in investment decisions between public and private firms confirms with "empire-building" theory.

The study contributes to the uncertainty-investment literature by providing empirical evidence showing the impact of firm-specific firm fundamental performance uncertainty on investment decisions. Prior literature mainly focuses on the macro-level measurement and market uncertainty. Theories of investment under uncertainty were primarily developed for a single firm, making it difficult to interpret their aggregate implications. Moreover, firms may

have different thresholds for investment depending on their technologies and the shocks they face. Since much of the uncertainty originates from firm-specific shocks, aggregate indicators of risk may not be reflective of the situation (Guiso & Parigi, 1999). Market uncertainty measured by share prices may be influenced by external factors, irrational behavior, or the presence of noise traders, causing them to not accurately reflect changes in a firm's fundamentals or perceived uncertainty. Abel and Eberly (1993) indicate that the optimal investment under uncertainty is dependent solely on the fundamentals.

My study also provides empirical evidence showing how information environment of public firms resolve uncertainty faced by managers and guide investment decisions under uncertainty. Prior literature mainly focuses on the role of financial reporting in mitigating information asymmetry (Ferracuti & Stubben, 2019; Roychowdhury et al., 2019). Investment decisions are jointly influenced by the information asymmetry between the managers and outsiders and the information uncertainty faced by managers (Ferracuti & Stubben, 2019). It is important to understand the impact of financial reporting on the uncertainty-investment relationship via the information uncertainty channel.

My study contributes to the public and private firms' investment comparison literature by showing that information environment is also a major difference between public and private firms and may influence their investment decisions. Literature comparing public and private firms' investment behavior are dearth. One strand of the literature analyses public and private firms' different investment patterns from the perspective of agency costs (Asker et al., 2011; Gao et al., 2013). Another strand of literature attributes public and private firms' different investment behavior to capital supplies (Maksimovic et al., 2013; Gilje & Taillard, 2016). It is important to understand the different investment behavior is a result of both the information environment and agency problems in public and private firms, controlling for capital supply.

The remainder of this paper is organized as follows. Section II discuss relevant research and contributions. Section III develops the research design. Section IV describes the sample. Section V presents the empirical analysis results, and Section VI concludes the study.

2 RELATED LITERATURE AND CONTRIBUTIONS

2.1 Theoretical Models of Investment Decisions under Uncertainty

In 1921, Frank Knight introduces the modern definition of uncertainty and further distinguishes the concept of risk and uncertainty (Knight, 1921). He define the concept of risk, which refers to a known probability distribution over a set of events (Knight, 1921). Knight (1921) defined uncertainty as the inability of individuals to predict the likelihood of events occurring. Due to this broad definition, there is no ideal measure of uncertainty, only a wide range of proxies. Volatility is often utilized as a measure of uncertainty since it becomes more difficult to make predictions when a data series becomes more volatile. My study concentrates on the firm fundamental performance uncertainty represented by operational volatility.

Theoretical models of Cukierman (1980), Bernanke (1983), and Dixit and Pindyck (1994) suggest that firms have an incentive to postpone irreversible investment decisions so that they can wait for new information to arrive. Dixit and Pindyck (1994)'s focus has been on situations in which information arrives over time, but the future is always uncertain. Cukierman (1980) and Bernanke (1983) models use a Bayesian framework, suggesting that information makes the future value of a project less uncertain. The uncertainty in this my follows the theoretical models of Cukierman (1980) and Bernanke (1983). Particularly, managers observe prior firm performance to gauge the possible distributions of future projects' payoffs. When the firm performance is more stable, it will be easier for mangers to determine which projects brings the highest payoffs. When the firm performance is more volatile, it will be harder for managers to estimate the distributions of future projects' payoffs.

The theoretical model by Cukierman (1980) proposes that managers may postpone their investment plans when operational volatility is high.

The first major contribution of this study is in the investment under uncertainty area by showing the different investment pattern under uncertainty between public and private firms using firm-specific fundamental performance uncertainty measurement. Prior empirical investment under uncertainty studies mainly focus on macro-level uncertainty and market uncertainty. For example, there has been extensive empirical evidence demonstrating a negative association between policy uncertainty and investments (Baker et al., 2016; Gulen & Ion, 2016; Caldara & Iacoviello, 2022). These measurements at macro level do not capture the idiosyncratic effect of uncertainty on corporate investment across different firms. Uncertainty measured by microeconomic data is more fruitful to take the heterogeneity of firms into account. Additionally, firm-specific uncertainty measurement enables to design more stringent tests of the theory of investment uncertainty by comparing, for example, in my study, the investment patterns of public and private firms.

Guiso and Parigi (1999) are also concerned that using aggregate data for studying the investment-uncertainty relationship may pose a significant issue. They note that theories of investment under uncertainty were primarily developed for a single firm, making it difficult to interpret their aggregate implications. Moreover, firms may have different thresholds for investment depending on their technologies and the shocks they face. Since much of the uncertainty originates from firm-specific shocks, aggregate indicators of risk may not be reflective of the situation. The implications of the investment theory under uncertainty vary depending on the firm's market power, investment reversibility, and technology, which can only be analyzed with micro data at the firm level. Therefore, using macroeconomic data to assess the impact of uncertainty and ignoring firms' heterogeneity can lead to aggregation bias. Additionally, using aggregate data may cause problems of simultaneity since

uncertainty can indirectly affect aggregate investment by influencing precautionary savings. The bias may be considerably minimized through micro-based tests.

Being aware of the potential limitations of macro-data to test the uncertainty-investment relationship, many studies use market data to capture firm-level uncertainty. For example, Panousi and Papanikolaou (2012) uses stock return volatility to capture firm idiosyncratic risk and find that firm investment falls when the idiosyncratic risk is higher. However, it is possible that share prices may be influenced by external factors, irrational behavior, or the presence of noise traders, causing them to not accurately reflect changes in a firm's fundamentals or perceived uncertainty. Abel and Eberly (1993) indicate that the optimal investment under uncertainty is dependent solely on the fundamentals.

Empirical studies testing the uncertainty-investment relationships with firm fundamental microdata are dearth. Guiso and Parigi (1999) uses a sample of Italian manufacturing firm managers' responses in 1993 Survey on Investment in Manufacturing (SIM) to capture managers perceived firm fundamental uncertainty. The survey requires managers to assign a probability weight to each of listed intervals for the possible future demand growth (the total of probability of all possible future growth events equals to 1). However, one major limitations of using subjective probability distribution of future demand in measuring firm fundamental performance uncertainty is that the subjective estimation may rely on individual managers' cognitive biases, such as overconfidence. Additionally, demand uncertainty and supply uncertainty jointly determine the firm fundamental performance uncertainty. A measurement capturing realizations of a firm performance variable which is an outcome of interactions between demand and supply provides more robust test results of prior theoretical propositions of the uncertainty-investment relationship.

2.2 Information Environment and Uncertainty Resolution

Due mandatory disclosure regulations targeting public firms, public firms and private firms have different information environment. My study suggests that this different information environment may lead to heterogenous investment decision making under uncertainty among public and private firms via two channels. The first channel is that public firm could learn from their firm disclosures, such as management forecasts (Goodman et al., 2014), can reduce uncertainty. The second channel is that public firm managers can also learn from outsider information sources, including share prices (Lin et al., 2019) and analysts (Guo & Zhong, 2023), to resolve uncertainty. My study shows that operational volatility has no significant negative impact on public firms. Public firms' profitability increases with additional investments under uncertainty, suggesting that the investment decisions made in the presence of high uncertainty among public firms are supplemented with high-quality information.

Prior study suggest that information collected for firm disclosures could also resolve uncertainty and facilitate investment decision making (Goodman et al., 2014; Shroff, 2017b; Ferracuti & Stubben, 2019; Roychowdhury et al., 2019). For example, Shroff (2017b) finds that when accounting standards requires managers to collect and process more information, managers tend to use the additional information sets to increase their investment, even though the standard changes is unrelated to the measurement and reporting of the investment. Goodman et al. (2014) reports that for managerial forecasting quality is positively associated with investment decisions, suggesting that managers refer to similar information sets when they forecast earnings and payoffs of future investment plans. Public firms prepare and provide more firm disclosures compared to their private peers. My study suggests that disclosures preparation process provide public firms additional information to resolve uncertainty and mitigate investment delay in the presence of high uncertainty.

Prior literature provides evidence showing that public firm managers could learn from outside information sources (Lin et al., 2019; Guo & Zhong, 2023). Stock prices has been recognized as an important outside information sources for public firm managers (Chen et al., 2006; Ye et al., 2023). Chen et al. (2006) finds that public firm managers learn from the private information included in the stock price about their firm and utilise this information in their investment decision making. Ye et al. (2023) further reports that when the tick size increases, public firm managers obtain more additional information from stock price movement and use the additional information to guide their investment decision making. Evidence shows that analysts have in information advantage over managers at the macro level (Hutton et al., 2012). Guo and Zhong (2023) finds evidence showing that managers learn from analysts about the industry insights to guide their investment decision making. Public firms have more access to this outside information to make investment decisions in the presence of high uncertainty.

The spillover effect of public firms' information environment may also influence private firms' information sets. Bushman and Smith (2001) and Roychowdhury et al. (2019) suggest that managers could also learn from peer disclosures. Badertscher et al. (2013) shows that higher presence of public firms will increase investment sensitivity of private firms in the same industry. It is important to note that the common information shared between public and private firms are more likely to be relevant about the systematic factors, instead of idiosyncratic factors. Bellwether public firms' information environment are more likely to provide information about systematic factors, and my study finds that private firms in the industry with higher presence of bellwether public firms tend to have similar investment behavior and subsequent profitability with their public peers.

My study contributes to the discussion of how financial reporting facilitate investment decision making by resolve uncertainty. Prior literature mainly focuses on the role of financial reporting in mitigating information asymmetry (Ferracuti & Stubben, 2019;

Roychowdhury et al., 2019). Investment decisions are jointly influenced by the information asymmetry between the managers and outsiders and the information uncertainty faced by managers (Ferracuti & Stubben, 2019). It is important to understand the impact of financial reporting on the uncertainty-investment relationship via the information uncertainty channel. My study uses operational volatility of daily revenue to measure information uncertainty faced by managers to provide more insights in understanding the role of public firms' information environment in investment and uncertainty relationships among public and private firms.

2.3 Agency Problems in Public and Private Firms

Agency problems may also lead to suboptimal investment decisions. "Empire-building" suggests that managers overinvest to pursue status, power, compensation, and prestige (Jensen, 1986; Xiong & Jiang, 2022). My study finds that private firms tend to invest more compared to their public peers in the presence of higher uncertainty and have a lower subsequent marginal profitability for the increased investment. The evidence is consistent with the "Empire-building" theory. My study does not find evidence of "Empire-building" in public firms' investment decision making under uncertainty.

"Quite-life" model proposed by Bertrand and Mullainathan (2003) argues that managers may prefer to avoid additional efforts for investment decision making and thus underinvest. Whether agency problems lead to overinvestment or underinvestment is an empirical question depending on managers' preferences. My study does not find evidence of "Quite-life" in either public or private firms.

Models of "managerial myopia" or "short-termism" argue that a focus on short-term profits may distort investment decisions from the first-best when a public-firm manager derives utility from both the firm's current stock price and its long-term value. The manager

underinvests to create the impression that the firm's current and future profitability is greater than it really is, hoping this will boost today's share price. If managers intentionally cut capital expenditures boost profitability temporarily, then profitability is negatively associated with capital expenditures. In my study, the public firms which make more (less) investment have a higher (lower) subsequent profitability; therefore, the lower investment under uncertainty of public firms compared to their private peers is not driven by "managerial myopia" and "short-termism".

2.4 Public and Private Firms Investment Behavior

There is a small empirical literature contrasting public and private firms' investment behavior. One strand of literature explores the different investment patterns from the perspective of agency problems. For example, Asker et al. (2011) finds that public firms underinvest compared to their private peers due to managerial myopia. Particularly, managers reduce investment to create an impression of higher profitability trying to boost stock prices. Gao et al. (2013) shows that public firms, on average, keep more cash reserves than private firms due to higher agency costs in public firms. Gao et al. (2013) further documents that conditional on having excess cash, public firms are more likely to increase investment while private firms are more likely to increase debt repayment.

The other strand of public and private firm investment literature explores the issue from the capital access perspective. Maksimovic et al. (2013) document that public firms participate more as buyers and sellers in the merger market, compared to their private peers. Maksimovic et al. (2013) attribute their findings to public firms' better access to private firms. Gilje and Taillard (2016) shows that public firms are more sensitive to investment opportunities, and they also attribute this difference to access to external capitals. My study includes the financial constrains as control variables in the later analysis to control for the potential impact of access to external capitals.

My study contributes to the public and private firms' investment comparison literature by showing that information environment is also a major difference between public and private firms and may influence their investment decisions. It is important to understand the different investment behavior is a result of both the information environment and agency problems in public and private firms.

3 RESEARCH DESIGN

To provide firms with reasonable time to capture operational volatility changes, adjust capital expenditures strategies, and observe consequences of investment decisions, this study defines quarter [0,3] as Event Quarters, quarters [4,7] as Capex Quarters, and quarters [8,11] as Consequence Quarters (as shown in Figure 1). I measure operational volatility during Event Quarters, capital expenditures during Capex Quarters, and ROA during Consequence Quarters.

[Figure 1]

3.1 Heterogenous effects of operational volatility on public and private firms' capital expenditure decisions

To examine whether public and private firms' capital expenditure decisions respond differently to increasing operational volatility, I estimate the following linear regression model:

$$CAPEX_{it} = \alpha_0 + \alpha_1 Volatility_{it} + \alpha_2 Private_{it} + \alpha_3 Volatility_{it} * Private_{it} + \alpha_4 Cash_{it} + \alpha_5 TobinQ_{it} + \alpha_6 Revenue_{it} + \alpha_7 Esurp_{it} + \alpha_8 Analyst_{it} + \alpha_9 Size_{it} + Regions\ Fixed\ Effects + Industries\ Fixed\ Effects + Year\ Fixed\ Effects + \varepsilon_{it} \quad (1)$$

$CAPEX_{it}$ is percentage of total capital expenditures by mean value of gross Property, Plant, and Equipment over quarters [4,7]. $Volatility_{it}$ is decile scores of standard deviation of daily card payments divided by mean value of daily card payments over quarters [0,3]. $Private_{it}$ is an indicator variable that equals to one if it is a private firm. The coefficient (α_3) of

interaction term $Volatility_{it}$*$Private_{it}$ shows whether there are any significant differences in capital expenditure decisions between public and private firms facing increasing operational volatility.

Prior investment-cash sensitivity studies suggest internal funds as an important determinant of investment (Fazzari et al., 1987, 2000; Moyen, 2004). I include $Cash_{it}$ measured by cash and cash equivalent divided by total assets, averaged over quarters [0,3]. Theoretical discussions and empirical findings suggest investment increase with investment opportunities (Yoshikawa, 1980; Biddle et al., 2009; Bae et al., 2017). I include $TobinQ_{it}$ measured by sum of market capitalization and total debts divided by total assets, averaged over quarters [0,3]. To control for financial performance, I include $Revenue_{it}$ total revenue over quarters [0,3], scaled by 10^4. To control for information environment, I include $Esurp_{it}$ and $Analyst_{it.}$ $Esurp_{it}$ is the earnings surprise measured as percentage of actual earnings per share, averaged over quarters [0,3]. $Analyst_{it}$ is number of analysts following, averaged over quarters [0,3]. I control for firm size with $Size_{it}$, log of total assets, averaged over quarter [0,3]. I also control fixed effects for regions, industries, and fiscal quarters. Standard errors are clustered at the firm and fiscal quarter level.

3.2 Heterogenous effects of capital expenditures on public and private firms' profitability in the presence of high operational volatility

To test the consequences of different capital expenditure decisions made by public and private firms facing increasing operational volatility, I test the following linear regression for top volatility group and bottom volatility group, respectively.

$$ROA_{it} = \alpha_0 + \alpha_1 CAPEX_{it} + \alpha_2 Private_{it} + \alpha_3 CAPEX_{it}*Private_{it} + \alpha_4 Cash_{it} + \alpha_5 TobinQ_{it} + \alpha_6 Revenue_{it} + \alpha_9 Size_{it} + Regions\ Fixed\ Effects + Industries\ Fixed\ Effects + Year\ Fixed\ Effects + \varepsilon_{it} \quad (2)$$

Top volatility is defined as firm-event-quarters with volatility decile score equals to 0.8 or 0.9, i.e., the top quintile group of operational volatility. I have 120 observations for top volatility

group. Bottom volatility is defined as firm-event-quarters with volatility decile score equals to 0 or 0.1, i.e., the bottom quintile group of operational volatility. I have 122 observations for bottom volatility group.

ROA_{it} is net income divided by total assets, averaged over quarters [8,11]. $CAPEX_{it}$ is percentage of total capital expenditures by mean value of gross Property, Plant, and Equipment over quarters [4,7]. $Private_{it}$ is an indicator variable that equals to one if it is a private firm. The coefficient (α_3) of interaction term $CAPEX_{it}$ *$Private_{it}$ shows whether there are any significant differences in profitability with one additional capital expenditure made by public and private firms. I use a 1000 bootstrapping simulation to test whether there are any significant differences in α_3 between top volatility group and bottom volatility group. In the simulation, I randomly re-assign our sample into quasi-top volatility group and quasi-bottom volatility group, with the same observation numbers and same public and private firms' composition as the actual top and bottom volatility group. I run the linear regression with the quasi-top volatility group and quasi-bottom volatility group and calculate the difference of simulated α_3 estimated by the linear regression of these two quasi-groups. I repeat the process for 1000 times and prepare a distribution curve for the difference of simulated α_3 and estimate the probability of the difference of actual α_3 given the distribution curve.

$Cash_{it}$ is by cash and cash equivalent divided by total assets, averaged over quarters [8,11]. $TobinQ_{it}$ is measured by sum of market capitalization and total debts divided by total assets, averaged over quarters [8,11]. $Revenue_{it}$ is total revenue over quarters [8,11], scaled by 10^4. $Size_{it}$, is log of total assets, averaged over quarters [8,11]. I also control fixed effects for regions, industries, and fiscal quarters. Standard errors are clustered at the firm and fiscal quarter level.

3.3 The effect of bellwether firms' presence on private firms' capital expenditure decisions in response to increasing operational volatility

To test the effects of bellwether firm presence on private and public firms' heterogenous capital expenditure decisions facing increasing operational volatility, I test the following linear regression for private firms in industries with high bellwether firm presence and industries with low bellwether firm presence, respectively.

$$CAPEX_{it} = \alpha_0 + \alpha_1 Volatility_{it} + \alpha_2 Private_{it} + \alpha_3 Volatility_{it} * Private_{it} + \alpha_4 Cash_{it} + \alpha_5 TobinQ_{it} + \alpha_6 Revenue_{it} + \alpha_7 Esurp_{it} + \alpha_8 Analyst_{it} + \alpha_9 Size_{it} + Regions\ Fixed\ Effects + Industries\ Fixed\ Effects + Year\ Fixed\ Effects + \varepsilon_{it} \quad (3)$$

For each Fama-French 48 industry, I calculate presence of bellwether firms as the percentage of bellwether firms' number by total public firms' number in our sample. Bellwether firm is defined as a firm with a cross-sectional top quintile R square of regressing individual stock return on market return during two years prior to quarter 0. A Fama-French 48 industry with top 30 percentile bellwether firm presence is categorised as an industry with high bellwether firm presence. All the other industries are categorised as industries with low bellwether firm presence. I include private firms in industries with high bellwether firm presence in the first group, and private firms in industries with low bellwether firm presence in the second group. To avoid significant loss of data, I include all public firms in our sample in both of the two groups. As a result, the first group, i.e., private firms in industries with high bellwether firm presence and all public firms, has 552 observations. The second group, i.e., private firms with low bellwether firm presence and all public firms has 570 observations. I estimate the linear regression model with these two groups, respectively. I also control fixed effects for regions, industries, and fiscal quarters. Standard errors are clustered at the firm and fiscal quarter level. By estimating the linear regression model in two groups, I compare α_3 to examine whether bellwether firm presence impact the heterogenous capital expenditure decisions of private and public firms when facing increasing operational volatility.

3.4 The effect of bellwether firms' presence on private firms' profitability following capital expenditure decisions in the presence of high operational volatility

To test whether bellwether firm presence further impacts the profitability of private and public firms' capital expenditure, I test the following linear regression for private firms in industries with high bellwether firm presence and industries with low bellwether firm presence, respectively. The categorisation between industries with high and low bellwether firms are the same as previous section.

$$ROA_{it} = \alpha_0 + \alpha_1 CAPEX_{it} + \alpha_2 Private_{it} + \alpha_3 CAPEX_{it} * Private_{it} + \alpha_4 Cash_{it} + \alpha_5 TobinQ_{it} + \alpha_6 Revenue_{it} + \alpha_9 Size_{it} + Regions\ Fixed\ Effects + Industries\ Fixed\ Effects + Year\ Fixed\ Effects + \varepsilon_{it} \quad (4)$$

Because I expect differences in profitability between public and private firms are significant when operational volatility is high. I run this test with top volatility group only. Top volatility group include firm-event-quarter observations with operational volatility decile score at least 0.8. ROA_{it} is net income divided by total assets, averaged over quarters [8,11]. $CAPEX_{it}$ is percentage of total capital expenditures by mean value of gross Property, Plant, and Equipment over quarters [4,7]. $Private_{it}$ is an indicator variable that equals to one if it is a private firm. The coefficient (α_3) of interaction term $CAPEX_{it} * Private_{it}$ shows whether there are any significant differences in profitability with one additional capital expenditure made by public and private firms. Estimating the linear regression model with private firms in industries with high and low bellwether firm presence, I compare α_3 to examine whether bellwether firm presence impact the differences in profitability of capital expenditures between public and private firms.

$Cash_{it}$ is by cash and cash equivalent divided by total assets, averaged over quarters [8,11]. $TobinQ_{it}$ is measured by sum of market capitalization and total debts divided by total assets, averaged over quarters [8,11]. $Revenue_{it}$ is total revenue over quarters [8,11], scaled by 10^4.

$Size_{it}$, is log of total assets, averaged over quarters [8,11]. I also control fixed effects for regions, industries, and year. Standard errors are clustered at the firm and fiscal quarter level.

3.5 The effect of bellwether firms' presence on other public firms' capital expenditure decisions in response to increasing operational volatility

To test whether presence of bellwether firms also impact non-bellwether firms' capital expenditure decisions, I test the following linear regression model with all the public firms in our sample.

$$CAPEX_{it} = \alpha_0 + \alpha_1 Volatility_{it} + \alpha_2 SYNC_{it} + \alpha_3 Volatility_{it}*SYNC + \alpha_4 Cash_{it} + \alpha_5 TobinQ_{it} + \alpha_6 Revenue_{it} + \alpha_7 Esurp_{it} + \alpha_8 Analyst_{it} + \alpha_9 Size_{it} + Regions\ Fixed\ Effects + Industries\ Fixed\ Effects + Year\ Fixed\ Effects + \varepsilon_{it} \quad (5)$$

$CAPEX_{it}$ is percentage of total capital expenditures by mean value of gross Property, Plant, and Equipment over quarters [4,7]. $Volatility_{it}$ is decile scores of standard deviation of daily card payments divided by mean value of daily card payments over quarters [0,3]. *SYNC* is an indicator variable that equals to one if it is a bellwether firm. Bellwether firm is defined as a firm with a cross-sectional top quintile R square by regressing individual stock return on market return during two years prior to quarter 0. The coefficient (α_3) of interaction term $Volatility_{it}*SYNC_{it}$ shows whether there are any significant differences in capital expenditure decisions between bellwether firms and non-bellwether firms facing increasing operational volatility.

4 SAMPLE AND DESCRIPTIVE STATISTICS

4.1 Operational Volatility and Fable Data

My study obtains anonymous consumer transaction data from Fable Data to estimate operational volatility. Fable Data provides real-time anonymous consumer transaction data (spending data) sourced from banks and card companies across Europe. I first use standard deviation of daily consumer transaction data divided by mean value of daily consumer transaction data. Then, I calculate the decile rankings of firm-event-quarters' standard

deviation to mean ratios for each event quarter of the same time period. I divide the decile ranking by 10 to obtain the decile score as operational volatility. Operational volatility in this study is a real-time reflection of daily revenue volatility. Fable Data are collected from banks and card companies and cannot be expected or manipulated by managers.

Consumer transaction data are valid to estimate daily revenue volatility, though cash payments are not included in this study. I assume that daily revenue volatility pattern is similar for card payment and cash payment. I also assume that bank transfers are frequently associated with contracts, where payments occur periodically and are less volatile. To control for the potential dominance of certain payment method in certain industries, regions, or time periods, I control for fixed effects of industries, regions, and fiscal quarters. By controlling regions fixed effects, I also control for the potential effects of foreign and local companies.

Fable Data has 1,171,102 firm-day records (1,036 firms from 2013/08/18 to 2021/02/04) which could be matched with a valid fiscal quarter. Because operational volatility is measured over Event Quarters (quarters [0,3]), I only keep observations with four consecutive quarters' Fable Data records. As a result, I have 14,370 potential firm-event-quarters (1,019 firms) observations at this stage. Quarter 0 ranges from FY2015Q4 to FY2020Q4.

4.2 Capex, ROA and Control Variables

All the raw data for Capex, ROA and control variables are quarterly data from Capital IQ. Capex is calculated over Capex Quarters (quarters [4,7]). I calculate Capex as the percentage of the sum of quarterly capital expenditures by mean value of quarterly gross Property, Plant, and Equipment over quarters [4,7]. I calculate ROA as the mean value of quarterly ROA over quarters [8,11]. Quarterly ROA is calculated by quarterly net income divided by quarterly total assets.

To test impacts of operational volatility on Capex, I control for 1) access to internal funds, i.e., cash; 2) growth opportunities, i.e., Tobin's Q; 3) financial performance, i.e., revenue; 4) access to external funds (information environment), i.e., earnings surprise and number of analysts following; and 5) firm size, i.e., total assets over Event Quarters when managers are preparing capital expenditure decisions. To test impacts Capex on profitability, I control for 1) cash at hand; 2) growth opportunities; 3) financial performance, and 4) firm size over Consequence Quarters.

This sample size decreases to 4,900 firm-quarters (405 firms) after merge Fable Data with Capital IQ for Capex, ROA, and control variables over Event Quarters, Capex Quarters, and Consequence Quarters. This sample size decreases to 640 firm-quarters (405 firms) after exclude overlapping quarters of the same firm (mostly FY2017 and 2018). I further remove 45 firm-quarters for Event Quarters that have no more than ten standard deviations to mean value ratios to prepare decile ranking. The final sample size is 595 firm-quarters observations (364 firms). The beginning fiscal quarter (quarter 0) ranges from FY2015Q4 to FY2019Q4.

4.3 Descriptive Statistics

Table 1 presents descriptive statistics for the key variables used in estimating all the five equations in the Research Design section. The mean value of *Volatility_raw* is 1.254. Given that variation of coefficient is standard deviation scaled by mean value, the mean value of operational volatility in my study suggests that on average the standard deviation of daily revenue is larger than the mean value of daily revenues on average and firm performance volatility measured by daily consumer revenues has economic significance. Table 1 also shows that *Volatility_raw* varies from 0.208 to 18.800. The large spread between the minimum value and maximum value verifies the importance of using the decile ranking scores in the later analysis.

[Table 1]

The breakdown of firm-year observations by fiscal year, regions and Fama-French industry is provided in Table 2. Each of the breakdown table also provides details of the percentage of public and private observations for each item. My study controls for the fixed effects of fiscal year, region, and Fama-French in later analysis.

[Table 2]

5 RESULTS

5.1 Univariate Analysis

Table 3, Panel A provides a comparison of capital expenditures between public and private firms at each quintile group of operational volatility. Particularly, for the quintile group with the lowest operational volatility, Capex for public firms is 0.325, and 0.156 for private firms. The ratio of Capex of public firms to private firms is 2.090 (0.325/0.156). With the increase in operational volatility, the difference between Capex of public firms to private firms is narrowing down from 2.090 to 1.800. Our main regression analysis will further look into the reason for the decreasing difference in Capex between public and private firms.

Table 3, Panel B shows a comparison of ROA between public and private firms at each quintile group of operational volatility. For the quintile group with the lowest volatility, the ratio of ROA of public firms to private firms is 1.593 (0.009/0.006). With the increase in operational volatility, the ratio increases from 1.593 to 4.223. In summary, Table 3 shows that when operational volatility is low, the difference in Capex between public and private firms are larger but the difference in ROA is smaller.

[Table 3]

5.2 Heterogenous effects of operational volatility on public and private firms' capital expenditure decisions

$$CAPEX_{it} = \alpha_0 + \alpha_1 Volatility_{it} + \alpha_2 Private_{it} + \alpha_3 Volatility_{it}*Private_{it} + \alpha_4 Cash_{it} + \alpha_5 TobinQ_{it} + \alpha_6 Revenue_{it} + \alpha_7 Esurp_{it} + \alpha_8 Analyst_{it} + \alpha_9 Size_{it} + Regions\ Fixed\ Effects + Industries\ Fixed\ Effects + Year\ Fixed\ Effects + \varepsilon_{it} \quad (1)$$

To test the heterogenous effects of operational volatility on public and private firms' capital expenditure decisions, I estimate Equation (1). Table 4 presents the regression results. The coefficient of $Volatility_{it}$ (α_1) is an insignificant negative number (t-stat = -1.75), showing that increased volatility has no significant negative impact on public firms' Capex.

The coefficient of the interaction term $Volatility_{it}*Private_{it}$ (α_3) is significantly positive at 0.52 (t-stat = 2.00). The significant positive coefficient suggests that an increase in operational volatility leads to an increase in Capex of private firms relative to their public peers. It is important to understand whether private firms increase their Capex with the increase in uncertainty is driven by access to additional high-quality information. The following subsequent profitability analysis will examine the investment outcomes.

In summary, estimation results of Equation 1 shows that private firms' Capex, on average, is lower than that of public firms when operational volatility is low. With the increase in operational volatility, public firms do not change their Capex plan, while private firms tend to increase their Capex. This finding is consistent with the univariate analysis result of the narrowing down difference between public and private firms' Capex.

[Table 4]

5.3 Heterogenous effects of capital expenditures on public and private firms' profitability in the presence of high operational volatility

$$ROA_{it} = \alpha_0 + \alpha_1 CAPEX_{it} + \alpha_2 Private_{it} + \alpha_3 CAPEX_{it}*Private_{it} + \alpha_4 Cash_{it} + \alpha_5 TobinQ_{it} + \alpha_6 Revenue_{it} + \alpha_9 Size_{it} + Regions\ Fixed\ Effects + Industries\ Fixed\ Effects + Year\ Fixed\ Effects + \varepsilon_{it} \quad (2)$$

To test the heterogenous effects of capital expenditures on public and private firms' profitability in the presence of high operational volatility, I estimate Equation (2) among quintile group with highest volatility (Table 5, Panel A) and quintile group with lowest volatility separately (Table 5, Panel B). Table 5, Panel A shows that in the presence of high volatility, the coefficient of $CAPEX_{it}$ (α_1) is significant at 0.01 (t-stat = 2.75), suggesting that public firms' profitability with the increase in Capex investment under uncertainty. This finding, together with the insignificant α_1 in Equation 1, is consistent with prior literature suggesting that public firms have access to additional information from their disclosures and outside information sources to resolve the uncertainty. The possibility of underinvestment due to managerial myopia is also excluded because if public firms intentionally reduce investment to increase profitability, profitability would be negative associated with Capex.

Table 5, Panel A shows that coefficient of interaction term $CAPEX_{it}$*$Private_{it}$ (α_3) is significantly negative at -0.03 (t-stat = -2.60), suggesting that in the presence of high volatility, profitability decreases with private firms' Capex investment under uncertainty. This profitability regression results suggest that private firms' increasing Capex investment in the presence of higher operational volatility as shown in Table 4 is not guided by high-quality information.

Table 5, Panel B shows that coefficient of the interaction term $CAPEX_{it}$*$Private_{it}$ (α_3) is significantly positive 0.09 (t-stat = 2.07), suggesting that when operational volatility is low, private firms' profitability increases with the investment. I further run a 1,000-bootstrapping simulation, by randomly assigning public and private firms into pseudo high operational volatility group and low operational volatility group with the same group size and structure of public and private firms. The simulation result is shows in Figure 2. Figure 2 shows that the difference in coefficient α_3 (-0.12 = -0.03 – 0.09) is significant at 10% level given the simulation results, verifying that the decrease in profitability of private firms can only be

explained by the increase in operational volatility. The increased Capex investment and deteriorating profitability with the increase in operational volatility indicate potential "empire-building" or overconfidence among private firms' managers.

[Table 5]

[Figure 2]

In summary, estimation results of Equation 2 shows that private firms' marginal profitability of Capex investment, on average, is higher than that of public firms when operational volatility is low. With the increase in operational volatility, public firms' marginal profitability of Capex investment increases while private firms' marginal profitability of Capex investment decreases.

5.4 The effect of bellwether firms' presence on private firms' capital expenditure decisions in response to increasing operational volatility

$$CAPEX_{it} = \alpha_0 + \alpha_1 Volatility_{it} + \alpha_2 Private_{it} + \alpha_3 Volatility_{it} * Private_{it} + \alpha_4 Cash_{it} + \alpha_5 TobinQ_{it} + \alpha_6 Revenue_{it} + \alpha_7 Esurp_{it} + \alpha_8 Analyst_{it} + \alpha_9 Size_{it} + Regions\ Fixed\ Effects + Industries\ Fixed\ Effects + Year\ Fixed\ Effects + \varepsilon_{it} \quad (3)$$

To test the effect of bellwether firms' presence on private firms Capex investment in the presence of high operational volatility, I estimate Equation (3) among group of industries with high presence of bellwether firms (Table 6, Panel A) and group of industries with low presence of bellwether companies (Table 6, Panel B). Table 6, Panel A shows the coefficient of $Volatility_{it}$ (α_1) remains as an insignificant negative number (t-stat = -1.60), showing that increased volatility has no significant negative impact on public firms' Capex. The coefficient of the interaction term $CAPEX_{it} * Private_{it}$ (α_3) becomes insignificant (t-stat = 1.09), suggesting that in industries with high presence of bellwether public firms, there is an information spillover effect that private firms would observe and copy their public peers' investment decision making under uncertainty.

Table 6, Panel B presents a similar finding to estimation results of Equation (1) in Table 4. Particularly, the coefficient of $Volatility_{it}$ (α_1) remains as an insignificant negative number (t-stat = -1.52), showing that increased volatility has no significant negative impact on public firms' Capex. The coefficient of the interaction term $CAPEX_{it}*Private_{it}$ (α_3) remains significant positive at 0.43 (t-stat = 2.27), suggesting that in industries with low presence of bellwether public firms, the difference between public and private firms' Capex investment decisions under uncertainty is prominent.

[Table 6]

5.5 The effect of bellwether firms' presence on private firms' profitability following capital expenditure decisions in the presence of high operational volatility

$$ROA_{it} = \alpha_0 + \alpha_1 CAPEX_{it} + \alpha_2 Private_{it} + \alpha_3 CAPEX_{it}*Private_{it} + \alpha_4 Cash_{it} + \alpha_5 TobinQ_{it} + \alpha_6 Revenue_{it} + \alpha_9 Size_{it} + Regions\ Fixed\ Effects + Industries\ Fixed\ Effects + Year\ Fixed\ Effects + \varepsilon_{it} \quad (4)$$

It is also important to test, for the private firms in the industries with high presence of bellwether companies and imitate their public peers' Capex investment under uncertainty, whether these private firms will also have a positive association between marginal profitability and marginal Capex investment. I estimate Equation (4) conditional on top quintile volatility among group of industries with high presence of bellwether firms (Table 7, Panel A) and group of industries with low presence of bellwether companies (Table 7, Panel B). Table 7, Panel A shows the coefficient of $Volatility_{it}$ (α_1) remains as a significant positive at 0.01 (t-stat = 2.47), suggesting that profitability of public firms increase with Capex investment in the presence of high operational volatility. The coefficient of the interaction term $CAPEX_{it}*Private_{it}$ (α_3) becomes insignificant (t-stat = -0.69), verifying that that in industries with high presence of bellwether public firms, private firms would observe and copy their public peers' investment decision making under uncertainty and have a similar subsequent profitability pattern with their public peers.

Table 6, Panel B presents a similar finding to estimation results of Equation (2) in Table 5. Particularly, the coefficient of the interaction term $CAPEX_{it}$*$Private_{it}$ (α_3) remains significant negative at -0.06 (t-stat = 3.03), suggesting that in industries with low presence of bellwether public firms, the difference between public and private firms' marginal profitability of their Capex investment decisions under uncertainty is prominent.

5.6 The effect of bellwether firms' presence on other public firms' capital expenditure decisions in response to increasing operational volatility

$$CAPEX_{it} = \alpha_0 + \alpha_1 Volatility_{it} + \alpha_2 SYNC_{it} + \alpha_3 Volatility_{it}*SYNC + \alpha_4 Cash_{it} + \alpha_5 TobinQ_{it} + \alpha_6 Revenue_{it} + \alpha_7 Esurp_{it} + \alpha_8 Analyst_{it} + \alpha_9 Size_{it} + Regions\ Fixed\ Effects + Industries\ Fixed\ Effects + Year\ Fixed\ Effects + \varepsilon_{it} \quad (5)$$

Finally, I will test whether the information spillover effect may also exist between bellwether public firms and non-bellwether public firms. The estimation results of Equation (5) among public firms are presented in Table 8. Particularly, the coefficient of the interaction term $CAPEX_{it}$*$Private_{it}$ (α_3) is insignificant (t-stat = -0.20), suggesting that public firms act in a similar manner regarding to the Capex investment decisions under uncertainty.

6 CONCLUSION

In conclusion, my study has shed light on the investment behavior of public and private firms in the presence of high uncertainty, specifically focusing on firm-specific fundamental performance uncertainty. Previous literature has mainly concentrated on macro-level and market uncertainty, while this study has provided novel empirical findings regarding the impact of firm-specific uncertainty on investment decisions. The first main finding highlights that private firms tend to invest more than public firms in the presence of high fundamental firm performance uncertainty. This difference holds even after controlling for financial constraints, investment opportunities, financial performance, and firm size.

Furthermore, the study examines the effect of additional capital expenditure investment on firm profitability in the presence of high operational volatility. It reveals that public firms

experience increased profitability with additional investment, whereas private firms encounter decreased profitability. This implies that public companies possess supplementary information to mitigate operational volatility and guide their investment decisions, while the higher investment of private firms lacks high-quality information and leads to lower marginal returns.

The disparities in investment patterns and subsequent profitability between public and private firms can be attributed to the information environment and agency problems of public and private firms. Public firms leverage their information environment to alleviate uncertainty and guide investment decisions. On the other hand, private firms' higher investment aligns with the "empire-building" theory.

This study makes significant contributions to the uncertainty-investment literature by providing empirical evidence on the influence of firm-specific fundamental performance uncertainty. It goes beyond the traditional focus on macro-level and market uncertainty and highlights the importance of firm-specific fundamental performance uncertainty. Additionally, the research contributes to the understanding of how the information environment of public firms helps resolve uncertainty and guide investment decisions, extending prior literature on the role of financial reporting in mitigating information asymmetry.

Moreover, this study contributes to the comparison of investment behavior between public and private firms by emphasizing the role of the information environment. Existing literature primarily examines differences in investment patterns from the perspectives of agency costs and capital supply. By considering the influence of the information environment, this research highlights that it is an important factor that distinguishes investment behavior between public and private firms, even after controlling for capital supply.

TABLES AND FIGURES

Figure 1 Timeline of the Key Variables

The figure shows the timeline of key variables of interest

	Event Quarters [0,3]	**Capex Quarters [4,7]**	**Consequence Quarters [8,11]**
Variables of interests	**Volatility**	**Capex**	**ROA**
	Private	Private	
	Volatility x Private	Capex x Private	
Controls	Cash		Cash
	Tobin's Q		Revenue
	Revenue		Tobin's Q
	Esurp		Size
	Analyst		
	Size		

Notes:

Event Quarters [0,3]	Volatility calculated in these four quarters
Capex Quarters [4,7]	Capex is measured in these four quarters (Variable defined in Table 1)
Consequence Quarters [8,11]	ROA is measured in these quarters (Variable defined in Table 1)

Table 1: Descriptive Statistics of Key Variables

		count	mean	std	min	25%	50%	75%	max
	Private	595	0.11	0.32	0.00	0.00	0.00	0.00	1.00
Capex_Quarter [4,7]	Capex	595	0.28	0.61	0.00	0.07	0.14	0.28	9.59
	Volatility_raw_data	595	1.25	1.41	0.21	0.60	0.83	1.30	18.80
	Volatility (decile score)	595	0.45	0.29	0.00	0.20	0.40	0.70	0.90
	Cash	595	0.10	0.10	0.00	0.04	0.07	0.13	0.62
Event_Quarter [0,3]	Tobin's Q	595	1.65	1.50	0.01	0.72	1.10	2.05	11.23
	Revenue (x10^4)	595	2.13	5.01	0.00	0.13	0.44	1.79	52.11
	Esurp	595	10.79	75.07	-42.29	0.00	0.00	4.44	1297.33
	Analyst	595	3.35	5.99	0.00	0.00	0.25	4.38	41.00
	Size	595	8.75	1.95	2.96	7.43	8.92	10.05	13.89
	ROA	595	0.01	0.02	-0.06	0.00	0.00	0.01	0.07
	Cash	595	0.11	0.11	0.00	0.04	0.08	0.14	0.71
Consequence_Quarter [8,11]	Tobin's Q	595	1.78	1.77	0.00	0.72	1.10	2.15	12.62
	Revenue (x10^4)	595	2.07	5.06	0.00	0.11	0.37	1.46	51.19
	Size	595	8.92	1.95	2.78	7.64	9.07	10.17	14.06
	SYNC	545	0.15	0.12	0.00	0.05	0.12	0.22	0.60
Synchronicity	R_square	545	0.45	0.29	0.00	0.20	0.50	0.70	0.90
	SYNC_decile_score	545	0.19	0.39	0.00	0.00	0.00	0.00	1.00

Variable definitions:

Private = 1 if the firm is a private firm

Variables in Capex Quarter [4,7]
Capex = is percentage of total capital expenditures by mean value of gross Property, Plant, and Equipment over quarter [4,7]

Variables in Event Quarter [0,3]

Volatility_raw_data = standard deviation of daily card payments divided by mean value of card payments over quarters [0,3];
Volatility = operational volatility decile ranking for the same fiscal quarters, and then divded by 10
Cash = cash and cash equivalent divided by total assets, averaged over quarters [0,3];
Tobin's Q = sum of market capitalization and total debts divided by book value of total assets, averaged over quarter [0,3];
Revenue = total revenue earned over quarters [0,3], scaled by 10^4;
Esurp = earnings surprise measured as percentage of actual earnings per share, averaged over quarters [0,3];
Analyst = number of analysts following, averaged over quarters [0,3];
Size = log of total assets, averaged over quarters [0,3].

Variables in Consequence Quarter [8,11]

ROA = net income divided by total assets, averaged over quarters [8,11];
Cash = cash and cash equivalent divided by total assets, averaged over quarters [8,11];
Tobin's Q = sum of market capitalization and total debts divided by book value of total assets, averaged over quarters [8,11];
Revenue = total revenue earned over quarters [8,11], scaled by 10^4;
Size = log of total assets, averaged over quarters [8,11].

Synchronicity
R_square is measured as r square of regressing individual stock return on benchmark for 2 years prior to quarter 0;
SYNC_decile_score = decile ranking R Square cross-sectionally, and then divided by 10.
SYNC = 1 if SYNC_decile_score equals to 0.8 or 0.9;

Table 2
Panel A presents a breakdown of the sample by public versus private for each industry

FF48 Industry	Public	Public%	Private	Private%	Total
Almost Nothing	9	69.23%	4	30.77%	13
Apparel	23	100.00%	0	0.00%	23
Automobiles and Trucks	6	100.00%	0	0.00%	6
Banking	2	100.00%	0	0.00%	2
Beer & Liquor	7	100.00%	0	0.00%	7
Business Services	70	97.22%	2	2.78%	72
Candy & Soda	2	100.00%	0	0.00%	2
Chemicals	2	100.00%	0	0.00%	2
Communication	20	86.96%	3	13.04%	23
Computers	2	100.00%	0	0.00%	2
Construction	2	100.00%	0	0.00%	2
Consumer Goods	8	80.00%	2	20.00%	10
Electrical Equipment	2	100.00%	0	0.00%	2
Electronic Equipment	2	100.00%	0	0.00%	2
Entertainment	27	93.10%	2	6.90%	29
Food Products	1	100.00%	0	0.00%	1
Healthcare	3	100.00%	0	0.00%	3
Insurance	11	91.67%	1	8.33%	12
Medical Equipment	2	100.00%	0	0.00%	2
Personal Services	6	75.00%	2	25.00%	8
Petroleum and Natural Gas	20	100.00%	0	0.00%	20
Printing and Publishing	2	100.00%	0	0.00%	2
Real Estate	1	50.00%	1	50.00%	2
Recreation	2	100.00%	0	0.00%	2
Restaurants, Hotels, Motels	50	87.72%	7	12.28%	57
Retail	113	89.68%	13	10.32%	126
Rubber and Plastic Products	1	100.00%	0	0.00%	1
Trading	2	16.67%	10	83.33%	12
Transportation	100	86.96%	15	13.04%	115
Utilities	15	71.43%	6	28.57%	21
Wholesale	14	100.00%	0	0.00%	14
Total	**527**	**88.57%**	**68**	**11.43%**	**595**

Panel B presents breakdown of the sample by public versus private for beginning fiscal quarters

Beginning Fiscal Quarter	Public	Public%	Private	Private%	Total
FY2015Q4	127	88.19%	17	11.81%	144
FY2016Q1	117	91.41%	11	8.59%	128
FY2016Q2	52	83.87%	10	16.13%	62
FY2016Q3	49	84.48%	9	15.52%	58
FY2016Q4	38	82.61%	8	17.39%	46
FY2018Q4	37	88.10%	5	11.90%	42
FY2019Q1	35	89.74%	4	10.26%	39
FY2019Q2	28	93.33%	2	6.67%	30
FY2019Q3	25	96.15%	1	3.85%	26
FY2019Q4	19	95.00%	1	5.00%	20
Total	**527**	**88.57%**	**68**	**11.43%**	**595**

Panel C presents breakdown of the sample by public versus private for regions

Regions	Public	Public%	Private	Private%	Total
United Kingdom	128	79.01%	34	20.99%	162
United States	147	94.84%	8	5.16%	155
France	25	75.76%	8	24.24%	33
Japan	10	100.00%	0	0.00%	10
Netherlands	15	93.75%	1	6.25%	16
Canada	9	81.82%	2	18.18%	11
Hong Kong	10	100.00%	0	0.00%	10
Ireland	13	86.67%	2	13.33%	15
Spain	8	88.89%	1	11.11%	9
Germany	39	95.12%	2	4.88%	41
China, Mainland	12	92.31%	1	7.69%	13
Others	111	92.50%	9	7.50%	120
Total	**527**	**88.57%**	**68**	**11.43%**	**595**

Table 3 This table compares public and private firm Capex and ROA across different volatality decile scores

Panel A: Quintile Group Capex

	Public			Private			
Quintile Group	**Mean**	**Std Dev**	**N**	**Mean**	**Std Dev**	**N**	**ratio**
(low volatility) 1	0.325	0.617	113.000	0.156	0.107	9.000	2.090
2	0.471	1.174	105.000	0.178	0.114	12.000	2.646
3	0.199	0.172	104.000	0.146	0.112	15.000	1.363
4	0.262	0.282	103.000	0.235	0.341	14.000	1.112
(high volatility) 5	0.223	0.348	102.000	0.124	0.152	18.000	1.800

Panel B: Quintile Group ROA

	Public			Private			
Quintile Group	**Mean**	**Std Dev**	**N**	**Mean**	**Std Dev**	**N**	**ratio**
(low volatility) 1	0.009	0.017	113.000	0.006	0.018	9.000	1.593
2	0.007	0.016	105.000	0.001	0.002	12.000	12.489
3	0.008	0.017	104.000	0.000	0.001	15.000	33.264
4	0.007	0.016	103.000	0.002	0.007	14.000	3.307
(high volatility) 5	0.004	0.014	102.000	0.001	0.006	18.000	4.223

Table 4 Capex Model: Summary Statistics of the Regression of Capex on Volatility Comparing Public and Private Firms

	Dependent Variable: Capex											
Variable	**Coefficient**		**t-stat**	**P>|t|**	**Coefficient**		**t-stat**	**P>|t|**	**Coefficient**		**t-stat**	**P>|t|**	**Coefficient**		**t-stat**	**P>|t|**
Volatility	-0.31	*	-1.89	0.09	-0.22		-1.64	0.14	-0.22		-1.69	0.13	-0.30		-1.75	0.12
Private	-0.23	*	-2.02	0.07	-0.35	*	-2.04	0.07	-0.21	**	-2.38	0.04	-0.38	*	-2.12	0.06
Volatility x Private	0.36	*	1.89	0.09	0.43	*	1.97	0.08	0.17		1.44	0.19	0.52	*	2.00	0.08
Cash	0.49	**	2.43	0.04	0.62	**	2.51	0.03	0.59	**	2.68	0.03	0.48	*	2.06	0.07
Tobin's Q	0.01		0.39	0.71	0.00		0.08	0.94	0.00		0.09	0.93	0.01		0.85	0.42
Revenue (x10^4)	-0.01		-1.69	0.12	-0.01		-1.66	0.13	-0.01		-1.91	0.09	0.00		-1.26	0.24
Esurp	0.00		-1.38	0.20	0.00		-1.41	0.19	0.00		-2.26	0.05	0.00		-1.57	0.15
Analyst	0.00		0.28	0.79	0.01		1.60	0.15	0.01		1.49	0.17	0.01		0.78	0.46
Size	-0.01		-0.80	0.44	0.01		0.38	0.71	0.00		0.38	0.71	0.00		-0.05	0.96
Fixed Effects	Regions				Industries				Fiscal Quarters				Regions, Industries and Fiscal Quarters			
Adj. *R*-squared	0.03				0.11				0.06				0.14			
No. of observations	595				595				595				595			

* denotes significance at the 10% level, ** denotes significance at the 5% level and *** denotes significance at the 1% level.
See Table 1 for definitions of variables.
All regressions include fixed effects including region, industry and fiscal quarter.
The standard errors are clustered by firm and fiscal quarter.

Table 5: ROA Model: Summary Statistics of the Regression of ROA on Capex Comparing Public and Private Firms

Panel A: Top Quintile Volatility (Volatility Decile Score = 0.8 or 0.9)

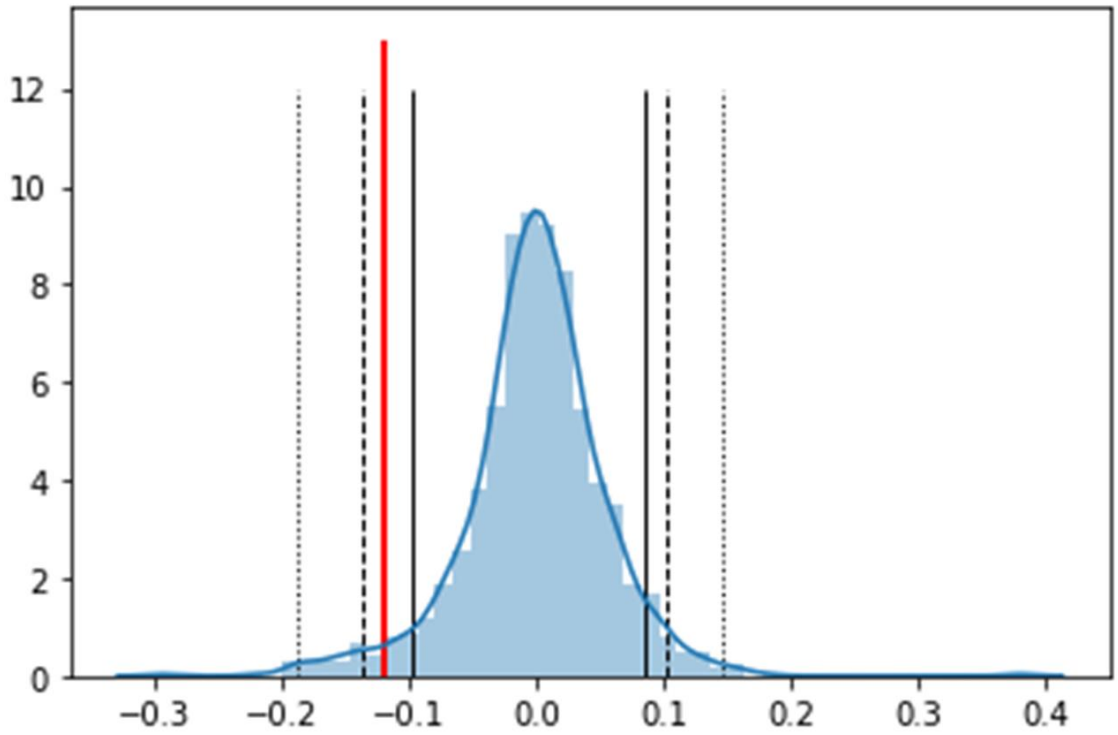
	Dependent Variable: ROA		
Variable	**Coefficient**	**t-stat**	**P>|t|**
Capex	0.01 **	2.75	0.02
Private	0.01	1.32	0.22
Capex x Private	-0.03 **	-2.60	0.03
Cash	-0.01	-0.36	0.73
Tobin's Q	0.00 *	2.26	0.05
Revenue (x10^4)	0.00	-0.04	0.97
Size	0.00	-0.08	0.94
Adj. *R*-squared		0.37	
No. of observations		120	

Panel B: Bottom Quintile Volatility (Volatility Decile Score = 0.0 or 0.1)

	Dependent Variable: ROA		
Variable	**Coefficient**	**t-stat**	**P>|t|**
Capex	0.00	-1.10	0.30
Private	-0.01	-0.76	0.47
Capex x Private	0.09 *	2.07	0.07
Cash	0.00	-0.24	0.82
Tobin's Q	0.00 **	2.46	0.04
Revenue (x10^4)	0.00	0.68	0.52
Size	0.00 *	2.13	0.06
Adj. *R*-squared		0.53	
No. of observations		122	

* denotes significance at the 10% level, ** denotes significance at the 5% level and *** denotes significance at the 1% level.
See Table 1 for definitions of variables.
All regressions include fixed effects including region, industry and fiscal quarter.
The standard errors are clustered by firm and fiscal quarter.

Figure 2: 10,000 Bootstrapping Simulation Results of the Difference between the Coefficients of Capex in the Regression of ROA on Capex for Groups with Top and Low Quintile Volatility



p-value	Left critival value	Right critical value
10%	-0.099	0.085
5%	-0.137	0.102
1%	-0.189	0.147

Table 6: Summary Statistics of the Regression of Capex on Volatility Comparing Public and Private Firms for Group with Top Quintile Volatility (Volatility Decile Score = 0.8 or 0.9)

Panel A: High Sync Industries(Industries with high bellwether firms' precence)

	Dependent Variable: Capex		
Variable	**Coefficient**	**t-stat**	**P>|t|**
Volatility	-0.29	-1.60	0.14
Private	-0.68	-1.16	0.28
Volatility x Private	0.70	1.09	0.31
Cash	0.49 *	1.92	0.09
Tobin's Q	0.01	0.64	0.54
Revenue (x10^4)	0.00	-1.02	0.33
Esurp	0.00	-1.44	0.18
Analyst	0.01	0.82	0.43
Size	0.00	-0.02	0.99
Adj. *R*-squared		0.14	
No. of observations		552	

Panel B: Low Sync Industries (Industries with low bellwether firms' presence)

	Dependent Variable: Capex		
Variable	**Coefficient**	**t-stat**	**P>|t|**
Volatility	-0.27	-1.52	0.16
Private	-0.27 **	-2.42	0.04
Volatility x Private	0.43 **	2.27	0.05
Cash	0.53 *	2.01	0.08
Tobin's Q	0.01	0.87	0.41
Revenue (x10^4)	-0.01	-1.33	0.22
Esurp	0.00	-1.44	0.18
Analyst	0.01	1.05	0.32
Size	0.00	0.17	0.87
Adj. *R*-squared		0.17	
No. of observations		570	

* denotes significance at the 10% level, ** denotes significance at the 5% level and *** denotes significance at the 1% level.
See Table 1 for definitions of variables.
All regressions include fixed effects including region, industry and fiscal quarter.
The standard errors are clustered by firm and fiscal quarter.

Table 7: Summary Statistics of the Regression of ROA on Capex Comparing Public and Private Firms for Group with Top Quintile Volatility (Volatility Decile Score = 0.8 or 0.9)

Panel A: High Sync Industries (Indutries with High Bellwether Firms Presence)

	Dependent Variable: ROA		
Variable	**Coefficient**	**t-stat**	**P>|t|**
Capex	0.01 **	2.47	0.04
Private	0.00	0.02	0.98
Capex x Private	-0.01	-0.69	0.51
Cash	-0.01	-0.33	0.75
Tobin's Q	0.00	2.66	0.03
Revenue (x10^4)	0.00	-0.37	0.72
Size	0.00	0.04	0.97
Adj. *R*-squared		0.38	
No. of observations		111	

Panel B: Low Sync Industries (Indutries with Low Bellwether Firms Presence)

	Dependent Variable: ROA		
Variable	**Coefficient**	**t-stat**	**P>|t|**
Capex	0.01	2.10	0.07
Private	0.02 **	2.82	0.02
Capex x Private	-0.06 **	-3.03	0.01
Cash	-0.02	-0.70	0.50
Tobin's Q	0.00	3.03	0.01
Revenue (x10^4)	0.00	-0.11	0.92
Size	0.00	-0.62	0.55
Adj. *R*-squared		0.43	
No. of observations		111	

* denotes significance at the 10% level, ** denotes significance at the 5% level and *** denotes
See Table 1 for definitions of variables.
All regressions include fixed effects including region, industry and fiscal quarter.
The standard errors are clustered by firm and fiscal quarter.

Table 8: Summary Statics of the Regression of Capex on Volatility Comparing Bellwether Public and Non-bellwether Public Firms

	Dependent Variable: Capex		
Variable	**Coefficient**	**t-stat**	**P>|t|**
Volatility	-0.24	-1.30	0.23
SYNC	0.20 **	2.48	0.04
Volatility x SYNC	-0.20	-1.62	0.14
Cash	0.57 *	2.04	0.07
Tobin's Q	0.01	0.84	0.42
Revenue (x10^4)	0.00	-1.07	0.31
Esurp	0.00	-1.36	0.21
Analyst	0.01	0.90	0.39
Size	-0.01	-0.27	0.79
Adj. *R*-squared		0.17	
No. of observations		545	

* denotes significance at the 10% level, ** denotes significance at the 5% level and *** denotes significance at the 1% level.
See Table 1 for definitions of variables.
All regressions include fixed effects including region, industry and fiscal quarter.
The standard errors are clustered by firm and fiscal quarter.

Chapter 5 Conclusion

This thesis provides additional useful insights for understanding the role of accounting information in promoting capital market efficiency by showing that 1) mandatory disclosures are still relevant given the higher reliability of mandatory disclosures compared to alternative information sources (first paper), 2) in the presence of high uncertainty, managers are more likely to decrease their disclosures due to lack of information (second paper), and 2) information environment of public firms enable public firm managers to access more information to resolve information uncertainty compared to their private peers (third paper).

The first paper contributes to our understanding of interactions between mandatory and voluntary disclosures by finding that the nature of the disclosed news affects whether the different disclosures act as complement or substitutes. Distinguishing between good and bad news disclosures also allows us to identify the direct and indirect effects that contribute to positive abnormal returns around earnings announcements reconciling the attention and risk-based explanations for the earnings announcement premium.

The second paper contributes to the literature on voluntary disclosure, uncertainty, disclosure strategies, corporate investment, and managers' learning. It explores the impact of uncertainty at both the information-user and reporting entity levels. While prior research suggests that increased uncertainty prompts more voluntary disclosure at the information-user level, this study finds that higher idiosyncratic uncertainty leads managers to provide less voluntary disclosure due to a lack of information. The study also reveals that managers rely on loss-aversion and accounting conservatism, being more motivated to gather information during periods of declining performance. Furthermore, it shows that managers' internal information plays a crucial role in enhancing investment decisions through voluntary disclosure. Additionally, the research highlights that managers rely more on their private information as

firm-specific uncertainty increases, leading to more accurate and informative forecasts and an increased release of internal information through voluntary disclosure.

The third paper makes significant contributions to the literature on uncertainty and investment. It expands beyond the conventional focus on macro-level and market uncertainty by examining the influence of firm-specific fundamental performance uncertainty. Moreover, it sheds light on how the information environment of public firms plays a crucial role in resolving uncertainty and guiding investment decisions, contributing to existing knowledge on the role of financial reporting in reducing information asymmetry. Additionally, the study contributes to the comparison of investment behavior between public and private firms by emphasizing the importance of the information environment as a differentiating factor, even when controlling for capital supply and agency costs.

REFERENCES

Abel, A. B., & Eberly, J. C. (1993). A unified model of investment under uncertainty. In: National Bureau of Economic Research Cambridge, Mass., USA.

Aboody, D., Lehavy, R. and Trueman, B. (2010). Limited attention and the earnings announcement returns of past stock market winners, Review of Accounting Studies 15(2): 317–344.

Ali, A., & Fan, Z. (2022). The role of capital expenditure forecasts in debt contracting. *Available at SSRN 3036266*.

Anilowski, C., Feng, M. and Skinner, D. J. (2007). Does earnings guidance affect market returns? the nature and information content of aggregate earnings guidance, Journal of accounting and Economics 44(1-2): 36–63.

Asker, J., Farre-Mensa, J., & Ljungqvist, A. (2011). *Comparing the investment behavior of public and private firms*.

Badertscher, B., Shroff, N., & White, H. D. (2013). Externalities of public firm presence: Evidence from private firms' investment decisions. *Journal of financial economics*, *109*(3), 682-706.

Bae, G. S., Choi, S. U., Dhaliwal, D. S., & Lamoreaux, P. T. (2017). Auditors and client investment efficiency. *The Accounting Review*, *92*(2), 19-40.

Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring economic policy uncertainty. *The quarterly journal of economics*, *131*(4), 1593-1636.

Balakrishnan, K., Billings, M. B., Kelly, B. and Ljungqvist, A. (2014). Shaping liquidity: On the causal effects of voluntary disclosure, The Journal of Finance 69(5): 2237–2278.

Ball, R. and Kothari, S. P. (1991). Security returns around earnings announcements, The Accounting Review pp. 718–738.

Bao, D., Kim, Y., Mian, G. M. and Su, L. (2019). Do managers disclose or withhold bad news? evidence from short interest, The Accounting Review 94(3): 1–26.

Barber, B. M., De George, E. T., Lehavy, R. and Trueman, B. (2013). The earnings announcement premium around the globe, *Journal of Financial Economics* 108(1): 118– 138.

Barber, B. M. and Odean, T. (2008). All that glitters: The effect of attention and news on the buying behavior of individual and institutional investors, *The Review of Financial Studies* 21(2): 785–818.

Barth, M. E., Landsman, W. R., Raval, V., & Wang, S. (2020). Asymmetric timeliness and the resolution of investor disagreement and uncertainty at earnings announcements. *The Accounting Review*, *95*(4), 23-50.

Barth, M. E., Landsman, W. R., Tian, X. S., & Yu, M. (2020). Does voluntary disclosure substitute for mandatory disclosure? Evidence from contract redactions. *Evidence from Contract Redactions (April 1, 2020)*.

Barth, M. E. and So, E. C. (2014). Non-diversifiable volatility risk and risk premiums at earnings announcements, *The Accounting Review* 89(5): 1579–1607.

Basu, S. (1997). The conservatism principle and the asymmetric timeliness of earnings1. *Journal of Accounting and Economics*, *24*(1), 3-37.

Beaver, W. H. (1968). The information content of annual earnings announcements, *Journal of Accounting Research* pp. 67–92.

Beaver, W. H., Landsman, W. R., & Owens, E. L. (2012). Asymmetry in earnings timeliness and persistence: A simultaneous equations approach. *Review of Accounting Studies*, *17*(4), 781-806.

Beaver, W. H., McNichols, M. F. and Wang, Z. Z. (2020). Increased market response to earnings announcements in the 21st century: An empirical investigation, *Journal of Accounting and Economics* 69(1): 101244.

Bekaert, G. and Wu, G. (2000). Asymmetric volatility and risk in equity markets, *The review of financial studies* 13(1): 1–42.

Bernanke, B. S. (1983). Irreversibility, uncertainty, and cyclical investment. *The quarterly journal of economics*, *98*(1), 85-106.

Bertrand, M., & Mullainathan, S. (2003). Enjoying the quiet life? Corporate governance and managerial preferences. *Journal of Political Economy*, *111*(5), 1043-1075.

Bertomeu, J. and Marinovic, I. (2016). A theory of hard and soft information, *The Accounting Review* 91(1): 1–20.

Beyer, A., Cohen, D. A., Lys, T. Z. and Walther, B. R. (2010). The financial reporting environment: Review of the recent literature, *Journal of Accounting and Economics* 50(2-3): 296–343.

Biddle, G. C., Hilary, G., & Verdi, R. S. (2009). How does financial reporting quality relate to investment efficiency? *Journal of Accounting and Economics*, *48*(2-3), 112-131.

Billings, M. B., Jennings, R., & Lev, B. (2015). On guidance and volatility. *Journal of Accounting and Economics*, *60*(2-3), 161-180.

Blankespoor, E., Hendricks, B. E., Piotroski, J., & Synn, C. (2022). Real-time revenue and firm disclosure. *Review of Accounting Studies*, 1-38.

Braun, P. A., Nelson, D. B. and Sunier, A. M. (1995). Good news, bad news, volatility, and betas, *The Journal of Finance* 50(5): 1575–1603.

Bushman, R. M., & Smith, A. J. (2001). Financial accounting information and corporate governance. *Journal of Accounting and Economics*, *32*(1-3), 237-333.

Campbell, J. Y., Lettau, M., Malkiel, B. G. and Xu, Y. (2001). Have individual stocks become more volatile? an empirical exploration of idiosyncratic risk, *The Journal of Finance* 56(1): 1–43.

Caldara, D., & Iacoviello, M. (2022). Measuring geopolitical risk. *American Economic Review*, *112*(4), 1194-1225.

Chambers, A. E. and Penman, S. H. (1984). Timeliness of reporting and the stock price reaction to earnings announcements, *Journal of accounting research* pp. 21–47.

Chapman, K. (2018). Earnings notifications, investor attention, and the earnings announcement premium, *Journal of Accounting and Economics* 66(1): 222–243.

Chari, V. V., Jagannathan, R. and Ofer, A. R. (1988). Seasonalities in security returns: The case of earnings announcements, *Journal of Financial Economics* 21(1): 101–121.

Chen, C., Martin, X., Roychowdhury, S., Wang, X. and Billett, M. T. (2018). Clarity begins at home: Internal information asymmetry and external communication quality, *The Accounting Review* 93(1): 71–101.

Chen, S., Matsumoto, D. and Rajgopal, S. (2011). Is silence golden? an empirical analysis of firms that stop giving quarterly earnings guidance, *Journal of Accounting and Economics* 51(1-2): 134–150.

Chen, X. and Ghysels, E. (2011). News—good or bad—and its impact on volatility predictions over multiple horizons, *The Review of Financial Studies* 24(1): 46–81.

Chen, Q., Goldstein, I., & Jiang, W. (2006). Price Informativeness and Investment Sensitivity to Stock Price. *The Review of Financial Studies*, *20*(3), 619-650. https://doi.org/10.1093/rfs/hhl024

Cianciaruso, D. and Sridhar, S. S. (2018). Mandatory and voluntary disclosures: Dynamic interactions, *Journal of Accounting Research* 56(4): 1253–1283.

Cohen, D. A., Dey, A., Lys, T. Z. and Sunder, S. V. (2007). Earnings announcement premia and the limits to arbitrage, *Journal of Accounting and Economics* 43(2-3): 153– 180.

Cukierman, A. (1980). The effects of uncertainty on investment under risk neutrality with endogenous information. *Journal of Political Economy*, *88*(3), 462-475.

Demski, J. S. and Feltham, G. A. (1994). Market response to financial reports, *Journal of Accounting and Economics* 17(1-2): 3–40.

Dey, M. K. and Radhakrishna, B. (2007). Who trades around earnings announcements? evidence from torq data, *Journal of Business Finance & Accounting* 34(1-2): 269–291.

Diamond, D. W. and Verrecchia, R. E. (1991). Disclosure, liquidity, and the cost of capital, *The journal of Finance* 46(4): 1325–1359.

Fazzari, S., Hubbard, R. G., & Petersen, B. C. (1987). Financing constraints and corporate investment. In: National Bureau of Economic Research Cambridge, Mass., USA.

Fazzari, S., Hubbard, R. G., & Petersen, B. C. (2000). Investment-cash flow sensitivities are useful: A comment on Kaplan and Zingales. *The Quarterly Journal of Economics*, *115*(2), 695-705.

Ferracuti, E., & Stubben, S. R. (2019). The role of financial reporting in resolving uncertainty about corporate investment opportunities. *Journal of Accounting and Economics*, *68*(2-3), 101248.

Francis, J. and Schipper, K. (1999). Have financial statements lost their relevance?, *Journal of accounting Research* 37(2): 319–352.

Francis, J., Schipper, K. and Vincent, L. (2002). Earnings announcements and competing information, *Journal of Accounting and Economics* 33(3): 313–342.

Frazzini, A. and Lamont, O. A. (2007). The earnings announcement premium and trading volume, *NBER working paper* (w13090).

Gao, H., Harford, J., & Li, K. (2013). Determinants of corporate cash policy: Insights from private firms. *Journal of financial economics*, *109*(3), 623-639. https://doi.org/https://doi.org/10.1016/j.jfineco.2013.04.008

Gilje, E. P., & Taillard, J. P. (2016). Do private firms invest differently than public firms? Taking cues from the natural gas industry. *The Journal of finance*, *71*(4), 1733-1778.

Goodman, T. H., Neamtiu, M., Shroff, N., & White, H. D. (2014). Management forecast quality and capital investment decisions. *The Accounting Review*, *89*(1), 331-365.

Guiso, L., & Parigi, G. (1999). Investment and demand uncertainty. *The quarterly journal of economics*, *114*(1), 185-227.

Gulen, H., & Ion, M. (2016). Policy uncertainty and corporate investment. *The Review of Financial Studies*, *29*(3), 523-564.

Guo, R.-J., & Zhong, R. (2023). Do Managers Learn from Analysts about Investing? Evidence from Internal Capital Allocation. *The Accounting Review*, *98*(2), 215-246.

Haigh, M. S., & List, J. A. (2005). Do professional traders exhibit myopic loss aversion? An experimental analysis. *The Journal of finance*, *60*(1), 523-534.

Healy, P. M. and Palepu, K. G. (2001). Information asymmetry, corporate disclosure, and the capital markets: A review of the empirical disclosure literature, *Journal of Accounting and Economics* 31(1-3): 405–440.

Heitz, A., Narayanamoorthy, G. S. and Zekhnini, M. (2020). The disappearing earnings announcement premium, *Available at SSRN 3296537* .

Hirshleifer, D. A., Myers, J. N., Myers, L. A. and Teoh, S. H. (2008). Do individual investors cause post-earnings announcement drift? direct evidence from personal trades, *The Accounting Review* 83(6): 1521–1550.

Holthausen, R. W. and Verrecchia, R. E. (1988). The effect of sequential information releases on the variance of price changes in an intertemporal multi-asset market, *Journal of Accounting Research* pp. 82–106.

Hsieh, S.-J., Jerris, S. I. and Kross, W. (1999). Quarterly earnings announcements and market risk adjustments, *Journal of Business Finance & Accounting* 26(3-4): 313–336.

Hutton, A. P., Lee, L. F., & Shu, S. Z. (2012). Do managers always know better? The relative accuracy of management and analyst forecasts. *Journal of Accounting Research*, *50*(5), 1217-1244.

IFRS. (2018). Conceptual framework for financial reporting.

Jayaraman, S., & Wu, J. S. (2020). Should I stay or should I grow? Using voluntary disclosure to elicit market feedback. *The Review of Financial Studies*, *33*(8), 3854-3888.

Jung, B., Lee, W. J., & Weber, D. P. (2014). Financial reporting quality and labor investment efficiency. *Contemporary Accounting Research*, *31*(4), 1047-1076.

Knight, F. H. (1921). *Risk, uncertainty and profit* (Vol. 31). Houghton Mifflin.

Köbberling, V., & Wakker, P. P. (2005). An index of loss aversion. *Journal of Economic Theory*, *122*(1), 119-131.

Landsman, W. R. and Maydew, E. L. (2002). Has the information content of quarterly earnings announcements declined in the past three decades?, *Journal of Accounting Research* 40(3): 797–808.

Lee, C. M. (1992). Earnings news and small traders: An intraday analysis, *Journal of Accounting and Economics* 15(2-3): 265–302.

Leuz, C., & Wysocki, P. D. (2016). The economics of disclosure and financial reporting regulation: Evidence and suggestions for future research. *Journal of Accounting Research*, *54*(2), 525-622.

Levi, S. and Zhang, X.-J. (2015). Asymmetric decrease in liquidity trading before earnings announcements and the announcement return premium, *Journal of Financial Economics* 118(2): 383–398.

Lin, T.-C., Liu, Q., & Sun, B. (2019). Contractual managerial incentives with stock price feedback. *American Economic Review*, *109*(7), 2446-2468.

Maksimovic, V., Phillips, G., & Yang, L. (2013). Private and public merger waves. *The Journal of finance*, *68*(5), 2177-2217.

Maslar, D. A., Serfling, M., & Shaikh, S. (2021). Economic downturns and the informativeness of management earnings forecasts. *Journal of Accounting Research*, *59*(4), 1481-1520.

Merton, R. C. (1987). A simple model of capital market equilibrium with incomplete information, *The Journal of Finance* 42(3): 483–510.

Moyen, N. (2004). Investment–cash flow sensitivities: Constrained versus unconstrained firms. *The journal of Finance*, *59*(5), 2061-2092.

Nagar, V., Schoenfeld, J., & Wellman, L. (2019). The effect of economic policy uncertainty on investor information asymmetry and management disclosures. *Journal of Accounting and Economics*, *67*(1), 36-57.

Ng, J., Tuna, I. and Verdi, R. (2013). Management forecast credibility and underreaction to news, *Review of Accounting Studies* 18(4): 956–986.

Odean, T. (1999). Do investors trade too much?, *American economic review* 89(5): 1279–1298.

Panousi, V., & Papanikolaou, D. (2012). Investment, idiosyncratic risk, and ownership. *The Journal of finance*, *67*(3), 1113-1148.

Patton, A. J. and Verardo, M. (2012). Does beta move with news? firm-specific information flows and learning about profitability, *The Review of Financial Studies* 25(9): 2789–2839.

Rogers, J. L., Skinner, D. J., & Van Buskirk, A. (2009). Earnings guidance and market uncertainty. *Journal of Accounting and Economics*, *48*(1), 90-109.

Roychowdhury, S., Shroff, N., & Verdi, R. S. (2019). The effects of financial reporting and disclosure on corporate investment: A review. *Journal of Accounting and Economics*, *68*(2-3), 101246.

Savor, P. and Wilson, M. (2016). Earnings announcements and systematic risk, *The Journal of Finance* 71(1): 83–138.

Schoenfeld, J. (2017). The effect of voluntary disclosure on stock liquidity: New evidence from index funds, *Journal of Accounting and Economics* 63(1): 51–74.

Shroff, N. (2017). Corporate investment and changes in GAAP. *Review of Accounting Studies*, *22*(1), 1-63.

Tversky, A., & Kahneman, D. (1991). Loss aversion in riskless choice: A reference-dependent model. *The quarterly journal of economics*, *106*(4), 1039-1061.

Verrecchia, R. E. (2001). Essays on disclosure, *Journal of accounting and economics* 32(1-3): 97–180.

Willman, P., Fenton-O'Creevy, M., Nicholson, N., & Soane, E. (2002). Traders, managers and loss aversion in investment banking: a field study. *Accounting, organizations and society*, *27*(1-2), 85-98.

Williams, C. D. (2015). Asymmetric responses to earnings news: A case for ambiguity, *The Accounting Review* 90(2): 785–817.

Ye, M., Zheng, M. Y., & Zhu, W. (2023). The effect of tick size on managerial learning from stock prices. *Journal of Accounting and Economics*, *75*(1), 101515. https://doi.org/https://doi.org/10.1016/j.jacceco.2022.101515

Yoshikawa, H. (1980). On the" q" Theory of Investment. *The American Economic Review*, *70*(4), 739-743.