

Media Uncertainty and Firm Risk-Taking

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Current Version: December 2018

JEL Classification: G31; G32; G34

Key Words: Media uncertainty; Firm risk; Investment and financial risk; Risk-seeking behaviour

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¹ We gratefully acknowledge the comments and suggestions from the 2018 Financial Markets and Corporate Governance Conference at La Trobe University. We declare that we have no relevant or material financial interests that relate to the research described in this paper.

Abstract

This study uses media uncertainty to investigate the association between uncertainty and firm risk-taking as proxied by volatility of stock returns, the level of firm investment, and financial risk. We find that greater media uncertainty is associated with firms that experience subsequent higher stock return volatility. The analysis highlights the effect of the media's news dissemination role in the prediction of firm risk and the importance of information transparency for market participants and company executives. Practically, media uncertainty affects both managers' and investors' perceptions of the firms' future and reflects managerial corporate governance expectations.

Media Uncertainty and Firm Risk-Taking

1. Introduction

It is widely accepted that uncertainty plays a significant role in corporate decision making. Prior literature suggests that greater uncertainty is associated with lower firm risk-taking activities (Julio and Yook, 2012; Gulen and Ion, 2015; Bonaime et al., 2017). Risk-averse managers may implement conservative investment and financial policies to keep a safe position. However, uncertainty and firm risk may also exhibit a positive relation (Bittlingmayer, 1998; Sarkar, 2000; Voth, 2002; Li and Tang, 2010; Flor and Hesel, 2015). Sarkar (2000) demonstrates the positive association between uncertainty and investment by showing that an increase in uncertainty may actually increase the probability of investing. Flor and Hesel (2015) also support the positive relation, reporting that uncertainty increases investment probability. In addition, uncertain information increases momentum profitability relating to risky financial policies, for example, high firm leverage and low cash flow (Zhang, 2006; Avramov and Hore, 2008).¹ This paper examines the idea that uncertainty increases firm risk-taking behaviour by influencing market participants' perceptions of future firm profitability. The study extends the view that uncertainty in the media leads to greater firm risk-taking activities in the future.

Rather than common uncertainty proxies, such as policy uncertainty and market uncertainty, we consider information uncertainty. Specifically, we examine if firms exposed to greater information uncertainty from media coverage are more sensitive to investors' and managers' perceptions of firm profitability, and as a result, are more risk seeking. Our first research

¹ Jegadeesh and Titman (1993) document that the momentum-based trading strategy of buying past winners and selling past losers provides statistically significant and economically large payoffs. Momentum profitability has generated a variety of explanations, for example, Jegadeesh and Titman (2002) and Grinblatt and Han (2005), among others.

question states: Is there is a positive association between media uncertainty and firms' stock return volatility? In addition, increasing stock return volatility may be driven by firms' risky investment and financial policies (Coles et al., 2006; Cassell et al., 2012). Hence, the second research question states: Does media uncertainty affect the aggressiveness of firm policy decisions?

Uncertainty refers to imperfect or unknown information. In this study media uncertainty is a proxy for private firm information. We measure information uncertainty using the uncertain words in media reports. Following the financial dictionary developed by Loughran and McDonald (2011), media uncertainty is defined as the percentage of uncertain words in articles, and is correlated with the uncertain tone of the media disclosure. In addition, media is also charged with the role of being an independent investigator (Bednar et al., 2013) and disseminator of information. Reporters and media outlets, through their efforts and independent investigations, discover newsworthy issues and events, to communicate via news reports. Market participants can use media disclosures to reduce information asymmetry. Thus, media uncertainty serves as a proxy to examine the effect of uncertainty on firm risk-taking.

Underlying our analysis is the presumption that the media can affect firm outcomes in two ways. First, media provide a public platform to let market participants learn about firms' performance and CEOs abilities (Bednar et al., 2013). Second, the media characterizes firms' performance and, thereby, helps to shape shareholder perceptions of the CEOs (Liu et al., 2017). Thus, media attention can affect firms' outcomes by highlighting those firms and CEOs that embrace a more uncertain tone.

Our sample consists of 4,549 firm-year observations sourced from Execucomp and Compustat during the 1996 to 2014 period. We measure the media uncertainty of all the news articles sourced from Factiva for each CEO during each year of the sample. Each article is then

analysed using PERL software, categorising the tone of each article according to the level of uncertainty using the financial dictionary as proposed by Loughran and McDonald (2011).

The results of the paper are consistent with the proposition that media uncertainty play an important role in increasing stock return volatility. We find that that media uncertainty is positively associated with a firm's total and idiosyncratic risk. Media uncertainty is unrelated to systematic risk. Therefore, idiosyncratic risk drives the impact of media uncertainty on firm risk. That is, news associated with firm or CEO uncertainty leads to higher firm risk, as evidenced by the sensitivity of stock return volatility to uncertainty or vagueness in the public press. Additional analysis reveals that the increase in media uncertainty is associated with more risky investment and higher financial risk, supporting our supposition that risky firms prefer to take on investment that is more aggressive in nature and to adopt riskier financial policies. The findings suggest that uncertain information reported by media may change managers' perceptions of firm profitability resulting in higher risk-taking behaviours.

Our study makes several important contributions. First, this paper extends research on the influence of uncertainty on firm risk-taking by investigating media uncertainty as a triggering mechanism. We depart from prior research using policy uncertainty and market uncertainty (Bittlingmayer, 1998; Sarkar, 2000; Voth, 2002; Li and Tang, 2010; Flor and Hesel, 2015) by proposing an association between media uncertainty and the volatility of stock returns, firm investment and financial activities. We provide important evidence that greater media uncertainty leads to firms being more risk-taking by influencing the prediction and the view of investors and managers on firm profitability.

Second, we extend the effects of media on corporate finance. Previous studies generally consider the effect of media on (1) detecting financial fraud (Miller, 2006; Dyck et al., 2008); (2) impacting executive compensation (Core et al., 2008); (3) influencing strategic change (Bednar et al., 2013); (4) affecting managers' capital allocation decisions (Liu and McConnell,

2013); and (5) impacting CEO turnover (You et al., 2017). Few studies pay attention to the impact of media on firm risk-taking, especially using media uncertainty. The results provide a missing link between media and firm risk-taking activities.

Third, this paper extends the research on behavioural finance. Our study provides evidence that greater media uncertainty leads to higher levels of risk-seeking behaviour. CEOs exposed to higher degrees of media uncertainty are associated with more risky policy choices and manage firms in a riskier manner. The results support the notion of Sarkar (2002), which find uncertain information to be associated with more risky activities.

An interesting implication of our finding is that the uncertainties arising from media coverage actually influence firms' decision-making. Investors and executives recognize that uncertain information dissemination plays a crucial role in determining firm decisions, while traditionally the focus has been on channels such as negative disclosure and bad analyst coverage (Chang et al., 2006; Bednar et al., 2013; Liu et al., 2017). Our finding supports the view that firms experiencing greater uncertainty, as measured via news disclosure, are more risk-taking.

The paper is organized as follows. Section 2 provides an overview on the influence of media, the relationship between the media uncertainty and firm risk, and the link between media uncertainty, investment, and financial risk to develop our hypotheses. Section 3 describes the sample and give the source of data. The primary empirical results are presented in Section 4, and robustness tests are reported in Section 5. Further analysis is shown in Section 6. Section 7 concludes the paper.

2. Literature review and hypothesis development

2.1 Media uncertainty and firm risk-taking

Prior studies find that high levels of uncertainty are associated with fewer firm risk-taking activities (Julio and Yook, 2012; Gulen and Ion, 2015; Bonaime et al., 2017). However, a positive relationship between uncertainty and firm risk-taking may also exist. Risk is defined as uncertainty about outcomes or events, especially with respect to the future (Miller and Bromiley, 1990). Uncertainty creates information ambiguity. When information is stable and reliable, the range of options both firms and CEOs face is significantly constrained (Hambrick and Finkelstein, 1987). In contrast, when information is unreliable or ambiguous, CEOs' discretion is enhanced, which allows them to influence firm decisions and outcomes. Meanwhile, under uncertainty and crises, directors feel the need for greater direction and guidance from the CEOs (Finkelstein and Boyd, 1998). Thus, uncertainty can increase the possibility of CEO and firm risk-taking behaviours. Prior literature proposes a positive relation between uncertainty and stock return volatility (Bittlingmayer, 1998; Voth, 2002; Bloom, 2009). Sarkar (2000), by setting up a model, demonstrates that an increase in uncertainty can increase the probability of investing, and thereby have a positive impact on firm risk. Li and Tang (2010) report that uncertainty strengthens the positive relationship between CEO hubris and firm risk-taking. Therefore, uncertainty is an important factor influencing firm risk and, following the prior literature, we argue that uncertainty is associated with higher future firm risk-taking. Our paper differs from prior studies that consider market and policy uncertainty (Bittlingmayer, 1998; Voth, 2002). Instead, we examine the effect of uncertainty in a news content.

Firm risk is commonly measured using the volatility of stock in the prior literature (Coles et al., 2006; Cassell et al., 2012). Engle and Ng (1993) set up a new model by defining the news impact curve that measures how stock market volatility estimates incorporate information. In this framework, information can increase stock return volatility. Ahmad et al. (2016) propose a relation between media content and financial market outcomes, especially in influencing

stocks' price and return. One possible explanation for the importance of news is that investors use information to infer current and future economic states (Choi, 2014). News will cause the firms' stock return to change for two reasons. First, the news can lead the market to update its expectation about the firm's future profits directly. Second, the news can also lead the market to update its assessment of the manager's ability, indirectly changing the expected future profits from the change in the assessment of ability. Thus, information in media can affect volatility of stock return.

Uncertainty generates ambiguous information which provides more options to investors and managers (Hambrick and Finkelstein, 1987). More options may mean more market opportunities. We predict that uncertain information in news reports may also reflect more opportunities for the CEO and the firm, that lead investors to change their view of firm profitability and their subsequent investment behaviours. We compute a possible uncertainty measure (i.e., media uncertainty), as proposed by Loughran and McDonald (2011). This study focuses on media uncertainty to investigate the effect of uncertainty on future stock return volatility.

2.2. Media uncertainty and choice of firm policies

The volatility of stock returns will increase in the presence of higher uncertainty. The increase in volatility may be associated with an increase in risky firm investment and financial policies. Several studies attempt to go more directly to our question of whether uncertainty have observable operational and policy implications. The significance of this question derives from the theoretical model of Sarkar (2000) who shows that a positive uncertainty-investment relationship exists. His finding supports a view that greater uncertainty increases the probability of investment. Flor and Hesel (2015) propose that uncertainty regarding residual risk always

increases the investment probability. Their studies support the view that uncertainty pre-empt project investments.

Zhang (2006) finds that momentum profitability concentrates in firms with high information uncertainty. Thus, uncertain information can affect momentum profitability. Avramov and Hore (2008) propose that greater equilibrium momentum profitability is associated with highly levered firms and firms with risky cash flows. Higher uncertainty increases expectations of firm profitability so that managers have risk-seeking behaviours and make risk-taking decisions. Therefore, firms with more information uncertainty are associated with higher leverage and riskier cash flows.

The impact of uncertainty on investment and financial policies indicates an argument concerning media uncertainty and firm risk-taking activities. Firms exposed to greater information uncertainty following news reports may create more market opportunities with the intent of increasing profitability. It may explain why firms exposed to greater media uncertainty prefer to take more risky decisions.

Following the prior literature (Coles et al., 2006; Cassell et al., 2012), we consider investment and financial risk as potential risk seeking channels. In this paper, we expect firms that experience media uncertainty to be more likely to engage in riskier investment and financial decisions. We focus on two mechanisms through which media uncertainty affects firm risk. First, given the high degree of uncertainty relating to the firm's future benefits, R&D expenditures are more high-risk investments (Bhagat and Welch, 1995; Kothari et al., 2002; Coles et al., 2006; Cassell et al., 2012). We predict a positive association between media uncertainty and R&D expenditures because we expect that CEOs with greater media uncertainty will choose more risky investment policies. Second, compared with R&D expenditures, capital expenditure on property, plant, and equipment is less risky due to its long-term focus. As such, a lower level of capital expenditure is associated with high firm risk.

Reducing debt levels can decrease firm risk (Lev, 1974; Ohlson, 1980; Cassell et al., 2012). Bhagat et al. (2015) point out that firms engage in excessive risk-taking mainly by increasing leverage. We argue that firms and CEOs exposed to greater media uncertainty are more likely to hold financial debt (or to reduce liquid assets). Uncertainty in analysts' forecasts is highly correlated with the unpredictability in cash flows generated by a firm's assets, which are a result of firm risk-taking (Hassell and Jennings, 1986). It is widely accepted that a lower free cash flow could be a sign that a company is making significant investments. We therefore expect a negative association between media uncertainty and cash flow.

3. Data

3.1. Sample selection

Our sample consists of S&P 500 firms from Compustat that also have data on Execucomp and the Centre for Research in Security Prices (CRSP) databases. Our sample covers approximately 80% of the entire market capitalization. We also obtain commonly-used measures of corporate governance quality from the RiskMetrics database. Media uncertainty data are obtained from news articles in the Factiva database. We exclude financial firms (standard industry classification code (SIC) between 6000 and 6999) and utility firms (SIC between 4900 and 4999). We consider calendar years rather than fiscal years to simplify the search. Although most of the S&P 500 firms have December year-ends, the difference between calendar and fiscal years is minimal in our sample (Francis et al., 2008). We restrict our sample to firm-years in which the CEO was in the office for the entire year. This avoids observations with less CEO media coverage because the CEO is in office for only part of the year. Our final sample consists of 4,549 firm-year observations that represent 541 different firms from 1996 to 2014.

3.2. Measure of uncertainty

We compute the yearly media uncertainty as a measure of uncertainty based on the aggregated textual tone in four newspapers and one magazine: *The Wall Street Journal*, *The Washington Post*, *The New York Times*, *USA Today*, and *Forbes* (Core et al., 2008; Francis et al., 2008; Bednar, 2012; Bednar et al., 2013). Media data come from news articles in the Factiva database. We search for CEO-specific articles using both CEO name and firm name. We obtain the CEO and firm names from the Execucomp and Compustat databases and restrict our sample to observations where the CEO was in office for the whole year.² We consider shortened names (e.g., Dan for Daniel) and common nicknames (e.g., Chuck for Charles). Following Liu and McConnell (2013), we search for the firm's formal name and its popular name.³ In addition, we also consider the firm's stock ticker symbol (e.g., IBM for International Business Machines Corporation) as a search criterion.

To process the information from the relevant articles, we develop a PERL program to analyse the text of each article. Using the Loughran and McDonald (2011) financial dictionary, the program counts the number of words for uncertain categories in a given text. The PERL program also counts the number of times a unique word appears in an article. In addition, we impose certain criteria to eliminate irrelevant articles, which provide no valid information. First, we require that articles contain at least 50 words (Bednar, 2012; Bednar et al., 2013; Liu and McConnell, 2013; Liu et al., 2017). Second, articles must contain the CEO's family name and the firm's popular name more than twice. Finally, articles having irrelevant titles are not included in our sample. To identify these titles, we randomly read approximately 500 articles

² This requirement ensures that media uncertainty from the previous year can be used to explain the riskiness of firms managed by the same CEO.

³ Liu and McConnell (2013) identify the formal name of each firm which includes the firm's organization type as search criteria, such as "Inc.", "Corp." or "Ltd.". Additionally, they characterize the firm's popular name by excluding its organization type.

from the sample. We exclude some articles with contents unrelated to the firms and CEOs, such as those that provide a list or a table.⁴ Our study relies on around 33,437 articles.

To measure the tone of articles, we count the number of uncertain words in the articles following Loughran and McDonald (2011) financial dictionary via the PERL program. We employ a “bag of words” by controlling for an extra list of negation words such as “not” and “never”, and by counting the frequency they appear before uncertain words. We exclude the “bag of words” in which uncertain words are negated within a range of three words (Bajo and Raimondo, 2017). We use the percentage of the category words relative to total words in a given text as our media uncertainty measure. Media uncertainty is equal to the mean score for the uncertain words category from all articles about a firm in a given year.

3.3. Measures of firm risk

We consider three measures to capture firm risk. Our first measure is total risk, which is defined as the standard deviation of daily stock returns in year t . The second measure is systematic risk, which is defined as the coefficient on the stock market portfolio from a market model regression. However, the firm stock return can be driven by market fluctuations and therefore the volatility of stock returns may not entirely reflect firm-specific risk (Goyal and Santa-Clara, 2003; Cassell et al., 2012). Hence, we construct our third measure, idiosyncratic risk, calculated as the standard deviation of the residuals from the Fama-French three-factor model regression in year t . We multiply the total and idiosyncratic risk measures tabulated from daily data by the square root of 252 to annualize them, respectively. To mitigate the concern

⁴ For example, an article entitled "Top 100 CEOs" which reports a ranking list of CEOs with the highest compensation. We further require that articles exclude combined and compounded news, such as “Business and Finance”, “What’s on Friday”, and “Insider on Time”. These articles consist of more than 10 news sections, and only one of the sections relates to the firm and the CEO that are relevant to our study

that the skewness of either measure may influence our results and inference, we take the natural logarithm of both measures.

3.4. Measures of firm investment and financial risk

We adopt two measures for the riskiness of firm investment: (1) R&D expenditures, and (2) capital expenditures. R&D expenditures (R&D/assets) are constructed as the percentage of R&D expenditures to total assets measured at the end of year t . Capital expenditures are calculated by the ratio of capital expenditures to total assets in year t .

Our measures for financial risk focus on debt burden and movement of money in the firm's capital structure. Total book leverage is the ratio of total debt to total assets. Free cash flow is earnings before interest and taxes minus change in net working capital, minus capital expenditures, and then plus depreciation. For those measures, inputs are measured in year t .

3.5. Control variables

As our empirical estimation assumes that the unobserved factors may influence media uncertainty and firm risk, we follow the prior literature by including a comprehensive set of control variables. We also control for the number of articles because media can detect corporate financial fraud that leads to a higher firm risk (Miller, 2006; Dyck et al., 2008). Drawn from previous literature (Archer and Faerber, 1966; Guay, 1999; Opler et al., 1999; Pástor and Pietro, 2003; Coles et al., 2006; Cassell et al., 2012) on determinants of firm risk, we obtain commonly-used measures of firm characteristics, including firm age (Log of firm age), firm size (Log of market capitalization), market to book ratio (Market to book), sales growth (Sales growth), stock returns (Stock returns), market leverage (Debt to equity), and cash surplus (Cash surplus) from the Compustat and CRSP databases. We consider trading volume, calculated as

the number of common shares traded in the previous year, because trading volume can be used to predict firm idiosyncratic risk (Linsmeier et al., 2002; Brown and Kapadia, 2007).

In addition, we also consider the governance characteristics in our empirical model. We control for board size, as decisions made by a large board may lead to a less risky outcome (Sah and Stiglitz, 1991). We include board independence (Independent) as a control variable because the presence of independent directors can result in a more shareholder-focused board, which could lead to high risk-taking activities (Sila et al., 2016). We also control for board interlocking, defined as a dummy variable that equals one if the firm has at least one director who serves on a board of another firm.

To control for CEO risk-taking incentives, we collect data on CEO tenure, age, and CEO cash compensation. Long-tenured CEOs are likely to be involved in more strategic risk situations and may be able to more easily manipulate firms' risk-taking activities (Simsek, 2007). Serfling (2014) argues that older CEOs have fewer risk-taking behaviours and prefer less risky investment policies. We include the natural logarithm of cash compensation because CEOs with higher cash compensation tend to diversify their wealth and make less risk-averse decisions (Guay, 1999). Coles et al. (2006) find that firms with higher sensitivity of CEO wealth to stock volatility (vega) implement riskier policy choices after controlling for CEO pay-performance sensitivity (delta). Therefore, we also control for CEO vega as well as CEO delta in our empirical model. See the appendix for the detailed definitions for each of the variables.

Table 1 presents the descriptive statistics for all variables. The average capital expenditure of 0.056 is consistent with Sila et al. (2016). The mean of financial leverage (total book leverage) is approximately 0.567, which is consistent with Cassell et al. (2012). As shown in the media variables, average media uncertainty is approximately 0.366%. This shows that, on average, 0.366% of the words in the articles about the CEO and the firm demonstrate media

uncertainty in a financial context. The summary statistics for the control variables are reported in Table 1. The average measure for market to book of 2.485 is similar to that reported by Cassell et al. (2012). The mean of CEO tenure is approximately 7.2 years, which is consistent with the variable reported in Bebchuk et al. (2011) and Humphery-Jenner et al. (2016). The summary statistics for the CEO incentives variables show that the average CEO delta and vega are around 825.82 and 190.07, respectively, which are comparable to the values reported in Sila et al. (2016).

< Insert Table 1 here >

Table 2 presents a matrix of estimated correlation coefficients for media uncertainty and the control variables. While the rank order correlation is slightly higher for some variables (number of articles and trading volume = 44.6%; firm size and natural log of cash compensation = 44.9%; firm size and trading volume = 46.8%), the tabulated variance inflation factors from the empirical estimations are all below 3.4 (not reported), which indicates that multicollinearity is not a concern for the regression analysis.

< Insert Table 2 here >

4. Empirical results

Our main empirical tests are presented in this section. The control variables include the number of articles, natural log of firm age, natural log of market capitalization, market to book, sales growth, stock return, debt to equity, cash surplus, trading volume, board size, interlock, independence, CEO tenure, the natural log of CEO age, the natural log of cash compensation, CEO delta, and CEO vega. Each model includes year and industry fixed effects using the two-digit SIC level. All standard errors are clustered at the firm level to account for correlations within firm observations.

4.1. The impact of media uncertainty on firm risk

We examine the effect of media uncertainty of firm risk. Firm risk is measured as total risk, systematic risk, and idiosyncratic risk following Cassell et al. (2012) and Sila et al. (2016). The results of the empirical tests investigating the association between uncertainty and firm risk are presented in Table 3.

< Insert Table 3 here >

Column 1 reports a positive significant coefficient for the Media uncertainty estimation (0.048, $p < 0.01$). After controlling for other factors, a firm where the CEO experiences strong media uncertainty is associated with higher total firm risk. Column 2 reports an insignificant relationship between media uncertainty and systematic risk. In column 3, there is a significant positive association (0.068, $p < 0.01$) between media uncertainty and total idiosyncratic risk. The media communicates uncertainty to the market and that generates greater firm risk. The result suggests that the impact of media uncertainty on firm risk is mainly attributable to idiosyncratic risk.

Overall, the results reported in Table 3 are largely consistent with our prediction that there is a positive association between media uncertainty and stock return volatility. To the extent that the media exposes uncertain information about the CEO and the firm, our results suggest that media uncertainty acts as an outside signal to reflect greater risky firm behaviour.

4.2. The impact of media uncertainty on firm investment and financial risk

We further examine the relation between media uncertainty and choice of risky policies. The riskiness of investment is measured by R&D expenditures and capital expenditures. The results of the empirical estimations performed to investigate the relation between media uncertainty and investment risk are presented in Table 4.

< Insert Table 4 here >

Column 1 of Table 4 reports the regression estimated using R&D expenditures as the dependent variable. The coefficient on Media uncertainty is positive and significantly associated with R&D spending (0.012, $p < 0.01$). The results are consistent with Sarkar (2000) that firms exposed to greater uncertainty are associated with risky investment activities. The result confirms a positive association between media uncertainty and R&D expenditures. The estimations reported in column 2 of Table 4 show the results using capital expenditures as the dependent variable. The coefficient for Media uncertainty is negative and significant (-0.005, $p < 0.05$). This suggests that a higher level of media uncertainty is associated with lower capital expenditures, which support our initial prediction.

Table 4 also reports the models used to test the relation between media uncertainty and financial risk. The models estimate financial risk as a function of media uncertainty by examining the effect of media in the prior year on total book leverage and free cash flow. The financial policies variables are measured at year t .

Column 3 presents the results for the panel regression estimated using total book leverage. There is a significant, positive association (0.032, $p < 0.05$) between media uncertainty and total book leverage. Thus, firm leverage increases with growing media uncertainty. In addition, column 4 reports the models testing the association between media uncertainty and free cash flow. The marginal significance of media uncertainty (-0.013, $p < 0.10$) indicates a negative association between subsequent annual free cash flow and media uncertainty. The finding is consistent with our prediction that there exists a positive link between media uncertainty and risky financial policies.

5. Robustness

5.1. Endogeneity

The methodology used for the analysis may be affected by the potential endogenous relation between the level of firm risk and the measure of media uncertainty. To address this concern, an instrumental variable approach is used to examine the relationships using a 2SLS framework. Our paper uses an instrument variable along the lines proposed by Gurun and Butler (2012) and implemented by Liu and McConnell (2013) and Cheng et al. (2017). Gurun and Butler (2012) report that firms with at least one media expert on their boards receive less negative tone. Li (2008) documents that managers use ambiguous language to obfuscate negative information rather than positive information. Thus, boards with a media expert may prefer to use more ambiguous disclosures to reduce potential effects of negative information on firms. To address the endogeneity concerns, the models are estimated using media expert as the instrumental variable. We argue that media expert is more likely to provide uncertain news to avoid media outlets detecting bad news. Media expert is a dummy equal to one if the director's biography states that the director is or ever has been employee of a television, radio, or newspaper company. The results of the empirical tests are presented in Table 5.

Column 1 of Panel A reports the first-stage results for Media expert as our instrumental variable. The coefficient for Media expert is positive and statistically significant (0.034, $p < 0.1$). The regression coefficient on Media uncertainty is positive and statistically significant, as shown in columns 2 and 4. Column 3 reports a positive but insignificant association between media uncertainty and Systematic risk. These findings are consistent with the models estimated in Table 3.

Panel B reports the results for the second-stage regression for investment risk (R&D/Asset and Capex/Asset) and financial risk (Total book leverage and Free cash flow). The coefficient on media uncertainty in column 1 is positive and statistically significant. In column 2, we find a significantly negative relation between our variable of interest and capital expenditures. The finding supports that firms with media uncertainty prefer to engage in risky investment

activities. In columns 3 and 4, we find firms with higher media uncertainty to be associated with higher total book leverage and lower free cash flow. The regression coefficients are providing consistent predictions as documented in Table 4.

< Insert Table 5 here >

5.2. Difference-in-difference analysis

We consider financial reporting changes after SOX section 404 to conduct a difference-in-difference (DID) methodology. To the extent that media coverage of firms can be affected by previous financial reports and firms' performance, constrained reporting is more likely when writing original stories is more difficult, such as when firms are more opaque or complex (Gurun and Butler, 2012). Managers can withhold adverse information by using more complex and ambiguous information in financial reports (Li, 2008). These results suggest that uncertain news appear to enhance the effectiveness in hiding bad news (or to decrease the likelihood of additional risk being detected), particularly in the post-SOX period, which leads to a future firm risk when hidden news accumulates and reaches a tipping point (Kim and Zhang, 2014). Furthermore, a small firm is more likely to delay SOX section 404 compliance and auditor's attestation requirement (Iliev, 2010). That is, managers in small firms may prefer to use ambiguous information for hiding bad performance. Therefore, we predict that post-SOX small firms are positively associated with higher risk-taking.

We conduct the DID analysis using the treated sample and the matched group. To capture meaningful influence from uncertain information, we focus on small firms as treated firms. Our assumption requires any trends in outcomes (i.e., risk-taking variables) for the treatment and control groups in the post-SOX period (i.e., after 2002). Post is dummy variable equal to one if year of firm observation is greater than 2002. Small firm is dummy equal to one if firm size is lower than median value for each year. Small firm*Post is a dummy variable that equals one

for small firms in the post-SOX period. The results are reported in columns 1 to 3 of Table 6. The coefficient of Small firm*Post is 0.136 ($p < 0.01$), 0.220 ($p < 0.01$) and 0.134 ($p < 0.01$), respectively. The finding is consistent with the idea that uncertain information can increase firm risk. In addition, small firms in the post-SOX period prefer to choose risky financial policies. The results support our prediction.

< Insert Table 6 here >

5.3. Alternative measures over time t to $t+2$

Another potential concern with our empirical analysis is the effect of media uncertainty on firm risk, investment, and financial risk over longer time horizons. We construct our dependent variables by calculating the average of these variables for the three-year period, measured in year t to year $t+2$.

Columns 1 and 3 in Table 7 report positive, significant coefficients that show media uncertainty is associated with total firm risk and firm idiosyncratic risk. Media uncertainty is not associated with systematic risk as reported in column 2. The findings reported in columns 4 and 5 report a positive association between media uncertainty and R&D expenditure and a negative relation between media uncertainty and capital expenditure. The positive, significant result for media uncertainty in column 6 shows that firm leverage increases with greater media uncertainty. However, there is no relation between media uncertainty and free cash flow. Collectively, these findings are consistent with our main results presented in Tables 3 and 4 and provide further support that media uncertainty is strongly related to firm risk, investment, and financial risk.

< Insert Table 7 here >

6. Further analysis

6.1. Positive uncertainty and negative uncertainty

Prior researchers have documented that stock return volatility tends to rise following good and bad news (Campbell and Hentschel, 1992; Engle and Ng, 1993; Braun et al., 1995). One explanation is that investors overreact to good and bad news. Campbell and Hentschel (1992) show that the effect occurs when an unexpected drop in price (bad news) increases predictable volatility more than an unexpected increase in price (good news) of similar magnitude. Bad news is more likely to increase the volatility of stock returns. We predict that CEOs exposed to greater negative uncertainty are associated with increased firm risk. In addition, the effect of positive uncertainty on firm risk is also important. Lee and Qiu (2009) show that consumers facing uncertainty (rather than certainty) associated with a positive event (e.g., winning a lucky draw but not knowing the exact prize won) can experience greater, longer-lasting positive feelings. The positive feelings lead to a positive prediction of prospective outcomes or underestimation of investment return, resulting in the firm engaging in more risk-taking decisions.

To account for the differences in effect for both good and bad news, in this paper we create two media uncertainty measures based on the Loughran and McDonald (2011) financial dictionary by reclassifying media uncertainty into two groups, referred to as ‘positive (POS) uncertainty’ and ‘negative (NEG) uncertainty’. POS uncertainty measures the media uncertainty for those firms with a positive tone that exceeds the industry median in a given year. Similarly, NEG uncertainty measures the equivalent effect for negative tone.

Table 8 reports the estimated models for the association between positive/negative uncertainty and firm risk. Columns 1 and 5 report a positive and statistically significant coefficient for POS uncertainty (0.064, $p < 0.01$ and 0.077, $p < 0.01$, respectively), which is consistent with the finding in Table 3. This suggests that positive uncertainty is associated with greater firm risk. Similarly, the positive, significant coefficients for NEG uncertainty in

columns 2 and 6 (0.045, $p < 0.01$ and 0.059, $p < 0.01$, respectively) confirm that greater negative uncertainty is also associated with higher firm risk. Neither POS nor NEG uncertainty is related to systematic risk, as shown in columns 3 and 4. These findings are consistent with initial results shown in Table 3.

< Insert Table 8 here >

Table 9 reports the models estimated to examine the relation between positive and negative uncertainty, firm investment, and financial risk. Columns 1 and 2 all report positive, significant POS uncertainty (0.010, $p < 0.01$) and NEG uncertainty (0.009, $p < 0.01$) coefficients, respectively. R&D expenditure is associated with greater positive and negative uncertainty. Positive uncertainty acts as a mechanism to signal a decrease in capital expenditure, as reported in column 3 (0.004, $p < 0.1$). Columns 5 and 6 support a positive relationship between firm leverage, positive uncertainty, and negative uncertainty. Columns 7 and 8 all demonstrate a negative, significant association between POS uncertainty (-0.013, $p < 0.05$), NEG uncertainty (-0.011, $p < 0.1$) and free cash flow. Consistent with our prediction, free cash flow is negatively related to positive and negative uncertainty.

< Insert Table 9 here >

6.2. Media uncertainty and the CEO risk-taking incentives

The assuredness, confidence, and vision of the leader is a source of psychological comfort for the followers, thus reducing their stress by showing how uncertainty can be turned into a vision of opportunity and success (Bass, 1985). In conditions of uncertainty and crises, individuals feel the need for greater direction and guidance from the CEOs. Thus, the CEO's discretion increases under greater uncertainty. Additionally, Finkelstein and Boyd (1998) propose that the greater the level of the CEO direction is associated with higher CEO compensation. Thus, an increasing in uncertainty will lead more compensation for the CEO.

One possible explanation is that, under uncertainty situation, boards of directors will tend to recognize the important of the CEOs to the firms, and will be prepared to pay a great deal.

The risk-taking incentives of CEOs are positively associated with firm risk and risk-taking behaviour (Coles et al., 2006; Low, 2009). CEOs with higher risk-taking incentives may increase the risk of firms' policy choices. Coles et al. (2006) find that CEOs with higher sensitivity of CEO wealth to stock volatility (vega) implement riskier policy choices, including relatively more investment in research and development (R&D), less investment in property, plant, and equipment (PPE), and higher leverage. They also find that higher risk generally leads to compensation structures with higher vega and lower delta. Low (2009) reports that the CEO portfolio vega, not the CEO portfolio delta, encourages risk-taking. In this study, CEO vega measures CEO incentives to increase risk. Incentives to increase stock price are also of interest in the risk management decision. This incentive is measured by CEO delta based upon the CEO's option grants and existing common stock holdings.

Media can be an effective mechanism in monitoring corporate governance. Media coverage increases CEOs' fame and serves as the watchdog for the public (Miller, 2006; Bednar, 2012). Shemesh (2017) finds that the changes in CEO status affect risk-related business decisions and outcomes. Hence, CEOs with higher media exposure may find their actions more closely scrutinized by the media. However, the media brings attribution bias in evaluating CEO actions. If CEOs amass more media attention, they tend to underestimate the risks of the projects or overestimate their own capability in managing risk and complex investment (Camerer and Lovallo, 1999). CEOs with more media exposure will increase risk-taking possibilities. In addition, media coverage may affect CEOs through the mix of at-risk pay (Bednar, 2012). Greater media uncertainty predicts a stronger association between CEOs and firms' risk-taking behaviours (Li and Tang, 2010). We consider the impact of uncertainty on CEO risk-taking incentives. Our expectation is that uncertain information will prompt firms to

increase the amount of at-risk CEO compensation, providing managers the opportunity to secure a higher percentage of equity-based compensation.

In Table 10, we examine the monitoring role of media uncertainty using CEO Vega and CEO Delta as dependent variables. We find that the coefficients reported in columns 1, 2, and 3 all demonstrate a positive, significant association between Media uncertainty (24.443, $p < 0.1$), POS uncertainty (38.026, $p < 0.05$), NEG uncertainty (34.567, $p < 0.05$), and CEO vega. The results in columns 4, 5, and 6 report a negative but insignificant association between CEO delta and all measures of media uncertainty. Consistent with Low (2009), CEO vega encourages managerial risk-taking, supporting our prediction that more information uncertainty increases managerial risk-taking behaviours. This is consistent with the notion that uncertainty strengthens CEO hubris and firms' risk-taking because overconfident CEOs tend to overestimate investment returns and subsequently underestimate the level of firm risk exposure (Dittrich et al., 2005).

< Insert Table 10 here >

7. Conclusion

Much of the financial literature predicts a negative relationship between uncertainty and firm risk-taking activities (Julio and Yook, 2012; Gulen and Ion, 2015; Bonaime et al., 2017). However, a positive uncertainty-risk-taking relationship may exist. Our example empirically examines the proposition derived from prior literature that uncertainty is positively correlated with firm risk-taking activities (Sarkar, 2000; Zhang, 2006(Flor and Hesel, 2015)). We provide a potential measure of uncertainty by using media uncertainty to investigate the association between uncertainty and firm risk-taking as proxied by volatility of stock returns, the level of firm investment, and financial risk.

We find that greater media uncertainty is associated with firms that experience subsequent higher stock return volatility. The explanation of positive relation between media uncertainty and stock return volatility implies that investors are more sensitive to the uncertain information in media coverage, thereby resulting in higher trading turnover and subsequently higher stock return volatility. The analysis highlights the effect of the media's news dissemination role in the prediction of firm risk. Furthermore, the finding shows that there is a positive association between media uncertainty and firms' R&D expenditures and a negative association between media uncertainty and firms' capital expenditures. This suggests that firms implement more risky investment decisions following exposure to media uncertainty. We also provide empirical evidence that media uncertainty is strongly related to financial leverage and free cash flow. The positive association between media and the choice of risky policies can be explained by managers intending to gain more investment opportunities from uncertainty, thereby increasing firm profitability.

Our paper provides several important implications. First, from a practical standpoint, media uncertainty affects both managers and investors' perceptions of the firms' future and reflects managerial corporate governance expectations. These overestimated expectations affect investment and financial decision-making. In addition, our findings support the view of Fang and Peress (2009) that the media play a supplementary role to traditional channels of information discourse. Second, media uncertainty has an impact on risk-taking activities, highlighting the importance of transparent information for market participants and company executives. Thus, this study reports a potential missing link between media and components of firm risk-taking activities by investigating the influence of uncertainty on firm risk-taking.

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Appendix

Variable definitions

<i>Dependent variables</i>	
Total risk	The natural logarithm of the variance of daily returns in year t .
Systematic risk	The coefficient on the stock market portfolio from market model regression
Idiosyncratic risk	The natural logarithm of the standard deviation of the residuals from Fama-French three factors model in year t .
R&D/Assets	The ratio of research and development expenditures to total assets in year t .
Capex/Asset	The ratio of capital expenditures to total assets in year t .
Total book leverage	The total debt divided by total assets.
Free cash flow	The earning before interests and taxes minus change in net working capital, minus capital expenditures and then plus depreciation.
<i>Media variable</i>	
Media uncertainty	The percentage of both uncertain words to total words.
<i>Control variables</i>	
Number of articles	The number of articles for each firm in a given year.
Log of firm age	The natural logarithm of firm age.
Log of assets	The natural logarithm of total assets.
Market to book	The ratio of the market value of equity to the book value of assets.
Sales growth	The percentage of total sales in year t to that in year $t-1$.
Stock return	The firm's stock return over the prior year.
Debt to equity	The ratio of total debt to market value of equity.
Cash surplus	Net cash flow from operating less depreciation and amortization plus research and development expenditure divided by the book value of total assets.
Trading volume (billions)	The number of common shares traded
Board size	The number of directors
Board interlock	A dummy variable equals to one if the firm has at least one director who serves on board of another firm, zero otherwise
Independent (%)	The percentage of outsider directors sitting on the board of directors.
CEO tenure (years)	Number of years the CEO is in office.
Log of CEO age	The natural logarithm of CEO age.
Log of cash compensation	The natural logarithm of salary and bonus.
CEO delta (thousands)	The dollar changes in compensation per 1% increase in stock return.
CEO vega (thousands)	The dollar changes in compensation per 1% increase in a firm's standard deviation of stock return.
<i>Instrumental variable</i>	
Media expert	A dummy equal to one if the director's biography states that the director is or ever has been employee of a television, radio, or newspaper company, zero otherwise.

Table 1

Descriptive statistics

This table reports the number of observations, the mean, median, standard deviation, minimum, and maximum observations for each variable in the sample. The sample contains 4,549 firm-year observations for 364 different firms in Execucomp, Compustat and CRSP from 1996 to 2014. Definitions for all variables are provided in the appendix.

Variables	Obs.	Mean	Median	Std. Dev.	Min	Max
Total risk _t	4,549	-1.143	-1.166	0.418	-2.246	0.390
Systematic risk _t	4,549	1.012	0.974	0.460	-3.085	3.898
Idiosyncratic risk _t	4,549	-1.367	-1.380	0.433	-2.469	0.211
R&D/Asset _t	4,493	0.029	0.006	0.051	0.000	0.680
Capex/Asset _t	4,493	0.056	0.040	0.052	0.000	0.804
Total book leverage _t	4,552	0.567	0.564	0.208	0.043	2.400
Free cash flow _t	4,493	0.112	0.107	0.105	-0.729	0.992
Media uncertainty	4,352	0.366	0.386	0.350	0.000	2.270
Number of articles	4,352	7.059	1.000	20.828	0.000	367.000
Log(company age)	4,338	3.292	3.447	0.688	0.651	4.165
Firm size	4,274	9.202	9.103	1.261	4.402	13.348
Market to book	4,338	2.485	1.960	2.358	0.718	78.765
Sales growth	4,340	1.157	1.086	0.938	0.218	46.239
Stock return	4,340	0.532	0.153	1.938	-0.632	10.497
Debt to equity	4,338	0.339	0.159	1.356	0.000	54.525
Cash surplus	4,338	0.110	0.095	0.092	-0.912	0.966
Trading volume	4,336	1.052	0.466	1.967	0.006	29.609
Board size	4,304	10.361	10.000	2.186	4.000	19.000
Board interlock	4,304	0.056	0.000	0.254	0.000	3.000
Independent	4,565	56.962	71.429	34.402	0.000	94.737
CEO tenure	4,352	7.203	5.417	6.298	1.000	51.000
Log(CEO age)	4,301	4.013	4.025	0.119	3.296	4.419
Log(cash compensation)	4,344	7.634	7.676	0.831	-4.605	11.264
CEO delta	4,352	825.818	308.138	2739.390	0.000	72877.620
CEO vega	4,352	190.070	74.678	320.593	0.000	4307.604

Table 2

Correlation

This table reports the correlation coefficients for the independent variables used in this study. The table reports the Pearson correlation coefficients for media uncertainty and control variables. Definitions for all variables are provided in the appendix.

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1 Media uncertainty	1.000											
2 Number of articles	0.250	1.000										
3 Log(company age)	0.078	0.059	1.000									
4 Firm size	0.314	0.362	0.303	1.000								
5 Market to book	-0.007	0.022	-0.234	0.141	1.000							
6 Sales growth	0.006	-0.009	-0.131	-0.036	0.211	1.000						
7 Stock return	-0.002	0.094	0.019	-0.033	-0.046	-0.016	1.000					
8 Debt to equity	0.056	0.206	0.060	-0.117	-0.103	-0.020	0.164	1.000				
9 Cash surplus	0.012	0.007	-0.135	0.188	0.388	-0.052	-0.085	-0.178	1.000			
10 Trading volume	0.224	0.446	0.063	0.468	0.027	-0.023	-0.028	0.092	0.144	1.000		
11 Board size	0.136	0.117	0.330	0.332	-0.171	-0.036	0.020	0.065	-0.212	0.127	1.000	
12 Board interlock	-0.029	-0.003	-0.013	-0.034	0.036	0.003	0.006	-0.007	-0.055	-0.062	0.116	1.000
13 Independent	0.045	0.002	0.273	0.199	-0.084	-0.089	-0.253	-0.063	0.090	0.082	-0.003	-0.132
14 CEO tenure	-0.006	-0.015	-0.071	-0.027	0.030	0.015	0.013	-0.038	0.023	0.030	-0.057	0.042
15 Log(CEO age)	-0.023	-0.085	0.139	0.091	-0.138	-0.055	-0.002	0.037	-0.090	-0.005	0.134	0.048
16 Log(cash compensation)	0.174	0.127	0.343	0.466	-0.192	-0.104	-0.051	0.022	-0.038	0.179	0.266	-0.051
17 CEO delta	0.077	0.051	0.029	0.186	0.039	-0.015	-0.051	-0.026	0.011	0.090	0.099	-0.009
18 CEO vega	0.180	0.160	0.164	0.415	-0.002	-0.033	-0.092	-0.022	0.055	0.247	0.242	0.027

(Continued)

	Variables	13	14	15	16	17	18
13	Independent	1.000					
14	CEO tenure	-0.075	1.000				
15	Log(CEO age)	0.028	0.334	1.000			
16	Log(cash compensation)	0.178	0.038	0.167	1.000		
17	CEO delta	-0.003	0.242	0.158	0.186	1.000	
18	CEO vega	0.083	0.031	0.096	0.302	0.202	1.000

Table 3

Media uncertainty and firm risk

The table reports panel data regression results. The dependent variable is either total risk, systematic risk, or idiosyncratic risk. Control variables include the number of articles, natural log of firm age, natural log of assets, market to book, sales growth, stock return, debt to equity, cash surplus, trading volume, board size, interlock, independence, CEO tenure, natural log of CEO age, natural log of cash compensation, CEO delta, and CEO vega. The models are fitted using industry (two-digit SIC) and year fixed effects based on robust standard errors clustered at the firm level. The sample is constructed as described in Table 1 and variables definitions are provided in the appendix. All control variables are measured at time $t-1$. The t -statistics are reported in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively.

Variables	(1)	(2)	(3)
	Total risk _t	Systematic risk _t	Idiosyncratic risk _t
Media uncertainty	0.048*** (3.032)	0.012 (0.515)	0.068*** (4.022)
Number of articles	0.000 (1.089)	0.000 (0.583)	0.000 (0.855)
Log(company age)	-0.091*** (-5.870)	-0.065*** (-3.009)	-0.108*** (-6.364)
Firm size	-0.071*** (-6.106)	-0.015 (-1.044)	-0.092*** (-7.669)
Market to book	0.019*** (4.145)	0.042*** (3.980)	0.016*** (3.845)
Sales growth	0.002 (0.199)	0.017 (0.677)	0.004 (0.440)
Stock return	-0.006* (-1.667)	0.001 (0.337)	-0.006 (-1.571)
Debt to equity	0.002 (0.394)	0.004 (0.850)	0.002 (0.281)
Cash surplus	-0.329*** (-2.954)	-0.634*** (-3.465)	-0.187 (-1.518)
Trading volume	0.019*** (3.446)	0.009 (1.460)	0.023*** (3.566)
Board size	-0.014*** (-3.606)	-0.021*** (-3.997)	-0.013*** (-3.003)
Board interlock	-0.001 (-0.030)	0.007 (0.234)	-0.006 (-0.233)
Independent	-0.001** (-2.131)	0.000 (0.716)	-0.001*** (-2.771)
CEO tenure	0.003** (2.274)	0.002 (0.937)	0.004** (2.451)
Log(CEO age)	-0.196*** (-2.733)	-0.133 (-1.293)	-0.235*** (-3.050)
Log(cash compensation)	0.008 (0.764)	-0.004 (-0.245)	0.008 (0.729)
CEO delta	-0.000 (-0.122)	0.000 (1.011)	-0.000 (-0.432)
CEO vega	-0.000	-0.000	-0.000*

Constant	(-1.217) 0.759** (2.426)	(-0.346) 1.595*** (3.462)	(-1.655) 1.088*** (3.182)
Observations	4,176	4,176	4,176
R-squared	0.687	0.338	0.665
Industry fixed effects	YES	YES	YES
Year fixed effects	YES	YES	YES

Table 4

The effect of media uncertainty on investment and financial risk

This table reports the panel data regression models for the riskiness of firm investment and financial policies. Columns 1 and 2 contain the models estimated using R&D expenditures and capital expenditures as the dependent variables, respectively. The models estimated for total book leverage and free cash flow are reported in columns 3 and 4, respectively. The models are fitted using industry (two-digit SIC) and year fixed effects based on robust standard errors clustered at the firm level. The sample is constructed as described in Table 1 and variables definitions are provided in the appendix. All control variables are measured at time $t-1$. The t -statistics are reported in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively.

Variables	(1)	(2)	(3)	(4)
	R&D/Asset _t	Capex/Asset _t	Total book leverage _t	Free cash flow _t
Media uncertainty	0.012*** (4.352)	-0.005** (-2.089)	0.032** (2.379)	-0.013* (-1.828)
Number of articles	0.000 (0.776)	-0.000 (-1.199)	0.001* (1.890)	-0.000 (-1.215)
Log(company age)	-0.007** (-2.414)	-0.006** (-2.572)	0.037*** (2.764)	0.003 (0.543)
Firm size	-0.004 (-1.202)	0.002 (1.090)	-0.023** (-2.562)	0.014*** (3.010)
Market to book	0.000 (0.075)	-0.000 (-0.029)	-0.002 (-0.701)	0.008** (2.099)
Sales growth	0.003** (2.566)	0.001 (1.245)	-0.001 (-0.331)	-0.009* (-1.854)
Stock return	-0.001 (-0.845)	0.000 (0.015)	0.008* (1.715)	-0.001 (-0.987)
Debt to equity	0.001 (1.313)	0.001 (0.592)		-0.002 (-0.881)
Cash surplus	0.212*** (5.502)	0.021 (1.271)	-0.460*** (-3.653)	
Trading volume	0.002*** (3.354)	0.000 (0.024)	-0.004 (-1.281)	-0.001 (-0.588)
Board size	-0.001 (-0.951)	-0.001 (-0.805)	0.006* (1.653)	-0.002 (-1.165)
Board interlock	-0.001 (-0.311)	-0.000 (-0.143)	-0.015 (-0.956)	-0.005 (-0.793)
Independent	0.000 (1.412)	0.000** (2.330)	0.000* (1.834)	-0.000 (-0.510)
CEO tenure	0.001* (1.736)	0.000 (1.561)	-0.003** (-2.145)	-0.001** (-2.208)
Log(CEO age)	-0.035** (-2.588)	-0.025* (-1.760)	0.092 (1.293)	0.083*** (2.785)
Log(cash compensation)	-0.006*** (-3.136)	0.000 (0.289)	0.018 (1.374)	0.005 (1.311)

CEO delta	-0.000 (-0.259)	-0.000 (-0.688)	-0.000 (-1.048)	0.000 (0.950)
CEO vega	0.000** (2.588)	-0.000* (-1.767)	-0.000 (-1.525)	-0.000 (-1.546)
Constant	0.239*** (3.456)	0.180*** (3.111)	0.129 (0.411)	-0.397*** (-2.992)
Observations	4,176	4,176	4,176	4,176
R-squared	0.491	0.532	0.304	0.274
Industry fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES

Table 5

Alternative media uncertainty and firm risk-taking

This table reports the panel regression results for the 2SLS estimation of the relation between media uncertainty and firm risk in panel A. The second stage of the 2SLS regression on firm risk using the predicted media uncertainty is reported in columns 2, 3, and 4. Panel B reports regression results for the 2SLS estimation for the relation between media uncertainty and investment and financial risk. Investment risk measures include R&D expenditures in column 1 and capital expenditures in column 2. Financial leverage and free cash flow financial risk measures are reported in columns 3 and 4, respectively. The models are fitted using industry (two-digit SIC) and year fixed effects based on robust standard errors clustered at the firm level. The sample is constructed as described in Table 1 and variables definitions are provided in the appendix. All control variables are measured at time $t-1$. The t -statistics are reported in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively.

Panel A: Media uncertainty and firm risk				
Variables	(1)	(2)	(3)	(4)
	Media uncertainty	Total risk _t	Systematic risk _t	Idiosyncratic risk _t
Media expert	0.031* (1.668)			
Media uncertainty		0.047*** (3.038)	0.012 (0.519)	0.068*** (4.015)
Number of articles	0.002*** (4.527)	0.001 (1.327)	0.000 (0.629)	0.001 (1.125)
Log(company age)	-0.014 (-0.788)	-0.092*** (-5.901)	-0.065*** (-3.013)	-0.109*** (-6.409)
Firm size	0.065*** (6.403)	-0.067*** (-5.873)	-0.015 (-1.006)	-0.088*** (-7.324)
Market to book	-0.006 (-1.498)	0.019*** (4.091)	0.041*** (3.974)	0.016*** (3.757)
Sales growth	0.011 (0.952)	0.002 (0.253)	0.017 (0.682)	0.004 (0.528)
Stock return	-0.002 (-0.497)	-0.006* (-1.699)	0.001 (0.331)	-0.006 (-1.612)
Debt to equity	0.012*** (2.913)	0.003 (0.488)	0.004 (0.884)	0.003 (0.386)
Cash surplus	-0.052 (-0.516)	-0.331*** (-2.974)	-0.634*** (-3.467)	-0.191 (-1.546)
Trading volume	0.007* (1.744)	0.020*** (3.501)	0.009 (1.471)	0.024*** (3.635)
Board size	0.007* (1.702)	-0.014*** (-3.514)	-0.021*** (-3.992)	-0.012*** (-2.879)
Board interlock	-0.021 (-0.980)	-0.002 (-0.070)	0.007 (0.227)	-0.007 (-0.286)
%independent	-0.000 (-0.936)	-0.001** (-2.168)	0.000 (0.710)	-0.001*** (-2.816)
CEO tenure	0.002 (1.473)	0.003** (2.328)	0.002 (0.948)	0.004** (2.524)
Log(CEO age)	-0.140**	-0.203***	-0.134	-0.244***

	(-2.029)	(-2.824)	(-1.311)	(-3.170)
Log(cash compensation)	0.015	0.009	-0.004	0.009
	(1.449)	(0.833)	(-0.233)	(0.825)
CEO delta	0.000	-0.000	0.000	-0.000
	(0.077)	(-0.110)	(1.012)	(-0.413)
CEO vega	0.000*	-0.000	-0.000	-0.000
	(1.753)	(-1.147)	(-0.330)	(-1.562)
Constant	0.190	0.766**	1.597***	1.097***
	(0.655)	(2.447)	(3.465)	(3.211)
Observations	4,176	4,176	4,176	4,176
R-squared	0.181	0.687	0.338	0.665
Industry fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES

Panel B: Media uncertainty and investment and financial risk

Variables	(1)	(2)	(3)	(4)
	R&D/Asset _t	Capex/Asset _t	Total book leverage _t	Free cash flow _t
Media uncertainty	0.012***	-0.005**	0.026*	-0.011*
	(4.302)	(-2.081)	(1.942)	(-1.677)
Number of articles	0.000	-0.000	0.001**	-0.000
	(1.056)	(-1.387)	(2.039)	(-1.373)
Constant	0.234***	0.183***	0.015	-0.377***
	(3.535)	(3.180)	(0.050)	(-2.784)
Observations	4,176	4,176	4,176	4,176
R-squared	0.491	0.532	0.303	0.274
Controls	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES

Table 6

Difference-in-difference analysis

This table reports the panel regression results for the estimation of the influence of small firm on firm risk-taking in the post-SOX period. The regression on firm risk are reported in columns 1, 2, and 3. Investment risk measures include R&D expenditures in column 4 and capital expenditures in column 5. Financial leverage and free cash flow are measured as financial risk in columns 6 and 7, respectively. Post is dummy variable if year of observation firms is greater than 2002. Small firm is dummy equal to one if firm size is lower than median value for each year. Small*Post is a dummy variable that represents small firms in the post-SOX period. The models are fitted using industry (two-digit SIC) and year fixed effects based on robust standard errors clustered at the firm level. The sample is constructed as described in Table 1 and variables definitions are provided in the appendix. All control variables are measured at time $t-1$. The t -statistics are reported in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively.

Variables	(1) Total risk _t	(2) Systematic risk _t	(3) Idiosyncratic risk _t	(4) R&D/Asset _t	(5) Capex/Asset _t	(6) Total book leverage _t	(7) Free cash flow _t
Post	-0.588*** (-19.330)	0.127** (2.474)	-0.635*** (-20.800)	0.002 (0.368)	-0.015*** (-3.313)	0.002 (0.090)	0.015 (1.431)
Small firm	-0.160*** (-5.303)	-0.231*** (-4.624)	-0.165*** (-5.421)	-0.008 (-1.378)	-0.002 (-0.514)	-0.066*** (-3.173)	0.021** (2.048)
Small firm*Post	0.136*** (4.945)	0.220*** (4.913)	0.143*** (5.153)	0.002 (0.540)	0.005 (1.032)	0.045*** (2.631)	-0.017** (-2.014)
Number of articles	0.001* (1.674)	0.001 (1.062)	0.001 (1.402)	0.000 (1.148)	-0.000 (-1.336)	0.000 (1.064)	-0.000 (-1.462)
Constant	1.406*** (4.363)	1.978*** (4.162)	1.761*** (5.035)	0.262*** (3.344)	0.166*** (2.757)	0.271 (0.850)	-0.491*** (-3.839)
Observations	4,176	4,176	4,176	4,175	4,175	4,178	4,175
R-squared	0.691	0.348	0.668	0.487	0.531	0.345	0.347
Controls	YES	YES	YES	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES

Table 7

Alternative variables estimations over time t to $t + 2$

This table reports the panel regression model for the media uncertainty measures as a function of long-term firm risk. The dependent variables are firm risk (total risk, systematic risk and idiosyncratic risk) and corporate investment (R&D expenditures and capital expenditures) and financial risk (total book leverage and free cash flow). The independent variables are media uncertainty as well as the standard controls and year and industry (two-digit SIC) fixed effects. Control variables include number of articles, natural log of firm age, natural log of assets, market to book, sales growth, stock return, debt to equity, cash surplus, trading volume, board size, interlock, independence, CEO tenure, natural log of CEO age, natural log of cash compensation, CEO delta, and CEO vega. The dependent variables are measured from t to $t+2$. All control variables are measured at time $t-1$. The t -statistics are reported in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively.

Variables	(1) Total risk t_{t0} $t+2$	(2) Systematic risk t to $t+2$	(3) Idiosyncratic risk t to $t+2$	(4) R&D/Asset t to $t+2$	(5) Capex/Asset t_{t0} $t+2$	(6) Total book leverage t to $t+2$	(7) Free cash flow t to $t+2$
Media uncertainty	0.042*** (2.599)	-0.003 (-0.136)	0.067*** (3.921)	0.013*** (4.134)	-0.006*** (-2.745)	0.041*** (2.816)	-0.010 (-1.538)
Number of articles	-0.000 (-0.018)	0.000 (0.831)	-0.000 (-0.570)	0.000 (0.522)	-0.000*** (-2.687)	0.001 (1.362)	-0.000 (-0.532)
Constant	0.884** (2.507)	1.220** (2.297)	1.322*** (3.474)	0.250*** (2.961)	0.191*** (3.099)	0.298 (0.906)	-0.377** (-2.557)
Observations	2,906	2,906	2,906	2,906	2,906	2,906	2,906
R-squared	0.676	0.436	0.691	0.532	0.611	0.323	0.376
Controls	YES	YES	YES	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES

Table 8

The impact of positive uncertainty and negative uncertainty on firm risk

The table reports panel data regression results. The dependent variable is the total risk, systematic risk, and idiosyncratic risk. The table reports the panel regression estimations between media uncertainty and firm risk. Media uncertainty includes positive (POS) and negative (NEG) uncertainty. The models are fitted using industry (two-digit SIC) and year fixed effects based on robust standard errors clustered at the firm level. The sample is constructed as described in Table 1 and variables definitions are provided in the appendix. All control variables are measured at time $t-1$. The t -statistics are reported in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Total risk _t		Systematic risk _t		Idiosyncratic risk _t	
POS uncertainty	0.064*** (4.333)		0.036 (1.592)		0.077*** (4.894)	
NEG uncertainty		0.045*** (3.146)		0.011 (0.585)		0.059*** (3.743)
Number of articles	0.000 (1.014)	0.000 (1.097)	0.000 (0.493)	0.000 (0.587)	0.000 (0.817)	0.000 (0.888)
Constant	0.777** (2.480)	0.773** (2.472)	1.603*** (3.498)	1.599*** (3.468)	1.110*** (3.237)	1.107*** (3.236)
Observations	4,176	4,176	4,176	4,176	4,176	4,176
R-squared	0.688	0.687	0.339	0.338	0.666	0.665
Controls	YES	YES	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES

Table 9

The impact of positive uncertainty and negative uncertainty on firm investment and financial risk

The table reports the panel data regression models for the riskiness of firm investment. Columns 1 to 4 contain the models estimated using R&D expenditures and capital expenditures as the dependent variables, respectively. The dependent variables are total book leverage and free cash flow, reported in columns 5 to 8, respectively. Media uncertainty includes positive (POS) and negative (NEG) uncertainty. The models are fitted using industry (two-digit SIC) and year fixed effects based on robust standard errors clustered at the firm level. The sample is constructed as described in Table 1 and variables definitions are provided in the appendix. All control variables are measured at time $t-1$. The t -statistics are reported in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	R&D/Asset _t		Capex/Asset _t		Total book leverage _t		Free Cash flow _t	
POS uncertainty	0.010*** (4.152)		-0.004* (-1.967)		0.026** (2.208)		-0.013** (-2.251)	
NEG uncertainty		0.009*** (3.498)		-0.004 (-1.586)		0.042*** (3.078)		-0.011* (-1.828)
Number of articles	0.000 (0.792)	0.000 (0.834)	-0.000 (-1.212)	-0.000 (-1.258)	0.001* (1.922)	0.001* (1.816)	-0.000 (-1.195)	-0.000 (-1.230)
Constant	0.242*** (3.489)	0.242*** (3.472)	0.178*** (3.076)	0.179*** (3.070)	0.139 (0.440)	0.141 (0.451)	-0.401*** (-3.013)	-0.401*** (-3.010)
Observations	4,175	4,175	4,175	4,175	4,178	4,178	4,177	4,177
R-squared	0.490	0.488	0.532	0.531	0.303	0.305	0.274	0.274
Industry fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES

Table 10

The impact of media uncertainty on CEO risk-taking

This table reports the panel regression of risk-taking incentives of CEO on media uncertainty. The risk-taking incentives of CEOs are measured as CEO vega and delta. The independent variables are media uncertainty, positive and negative uncertainty all measured at time $t-1$. The models are fitted using industry (the two-digit SIC) and year fixed effects based on robust standard errors clustered at the firm level. The sample is constructed as described in Table 1 and variables definitions are provided in the appendix. All control variables are measured at time $t-1$. The t -statistics are reported in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	CEO Vega _t			CEO Delta _t		
Media uncertainty	24.443*			-158.322		
	(1.860)			(-0.778)		
POS uncertainty		38.026**			-158.916	
		(2.485)			(-0.851)	
NEG uncertainty			34.567**			-135.535
			(2.370)			(-0.866)
Number of articles	-0.856	-0.886	-0.876	-3.668	-3.658	-3.721
	(-1.373)	(-1.414)	(-1.407)	(-0.544)	(-0.541)	(-0.536)
Log(company age)	7.705	7.688	6.901	-291.594*	-290.756*	-287.600*
	(0.551)	(0.551)	(0.492)	(-1.836)	(-1.826)	(-1.795)
Firm size	93.447***	92.766***	92.762***	335.198***	333.954***	333.714***
	(10.409)	(10.391)	(10.308)	(3.289)	(3.312)	(3.337)
Market to book	-3.841	-3.828	-3.681	34.544	34.812	34.261
	(-1.341)	(-1.340)	(-1.286)	(1.264)	(1.267)	(1.235)
Sales growth	1.188	0.921	1.032	-22.379	-21.849	-22.418
	(0.406)	(0.312)	(0.353)	(-0.944)	(-0.928)	(-0.940)
Stock return	-10.421**	-10.484**	-10.459**	-73.496***	-73.067***	-73.210***
	(-2.242)	(-2.256)	(-2.246)	(-2.594)	(-2.598)	(-2.596)
Debt to equity	6.658*	6.729*	6.293*	-4.205	-5.158	-3.493
	(1.823)	(1.817)	(1.726)	(-0.145)	(-0.179)	(-0.122)
Cash surplus	82.674	81.089	81.972	-24.280	-14.786	-18.081
	(0.935)	(0.922)	(0.927)	(-0.044)	(-0.027)	(-0.033)
Trading volume	13.855	13.717	13.563	23.174	23.360	23.933

	(0.956)	(0.950)	(0.937)	(0.306)	(0.308)	(0.316)
Board size	15.517***	15.388***	15.423***	65.301*	65.350*	65.191
	(3.626)	(3.619)	(3.609)	(1.660)	(1.657)	(1.644)
Board interlock	22.802	23.016	23.162	-327.611	-327.401	-327.757
	(0.614)	(0.624)	(0.626)	(-1.192)	(-1.191)	(-1.194)
Independent	0.080	0.090	0.079	-5.072*	-5.106*	-5.059*
	(0.292)	(0.333)	(0.290)	(-1.920)	(-1.919)	(-1.926)
CEO tenure	2.027	2.073	2.047	136.251***	135.946***	136.070***
	(1.095)	(1.123)	(1.109)	(2.807)	(2.815)	(2.812)
Log(CEO age)	-21.236	-21.458	-21.415	1,242.023	1,250.771	1,251.660
	(-0.237)	(-0.241)	(-0.239)	(1.112)	(1.116)	(1.107)
Log(cash compensation)	42.421***	41.816***	42.482***	379.748*	381.136*	378.517*
	(3.187)	(3.168)	(3.181)	(1.951)	(1.948)	(1.963)
CEO delta	0.006	0.006	0.006			
	(1.012)	(1.017)	(1.007)			
CEO vega				0.342	0.344	0.340
				(0.614)	(0.619)	(0.606)
Constant	-1,175.509***	-1,163.974***	-1,165.874***	-10,949.489*	-11,001.089*	-10,998.025*
	(-3.027)	(-3.027)	(-3.008)	(-1.927)	(-1.926)	(-1.930)
Observations	4,176	4,178	4,178	4,176	4,178	4,178
R-squared	0.293	0.294	0.294	0.191	0.191	0.191
Industry fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES