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Managerial Risk Taking Incentives, Corporate Social Responsibility and Firm Risk

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Highlights

- The relation between CSR, the vega of CEO compensation and firm risk is explored
- CSR moderates the relation between vega and firm risk
- Vega increase firm risk in firms that perform low on CSR
- Vega has no significant effect on firm risk in firms that perform high on CSR

Abstract

We examine if and how corporate social responsibility (CSR) affects the relation between risk taking incentives of CEO compensation (i.e. vega of CEO compensation) and measures of firm risk. Empirical results show that vega has a positive and significant effect on firm risk only in low CSR firms that attempt to maximize only investing stakeholders' interests. In high CSR firms, that attempt to balance the interests of both investing and non-investing stakeholders, vega has no effect on firm risk. These findings are consistent with previous work that finds that CSR goals alter firm behavior as it tries to accommodate the (often divergent) interests of other stakeholders beyond the traditional shareholders.

Keywords: Corporate social responsibility; Risk taking; Executive compensation; Managerial incentives; Vega

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1. Introduction

The relation between CEO risking taking incentives from performance based compensation and firm risk has been extensively studied in the literature. Most of the studies examine how incentives from CEO compensation encourage risk taking. In modern corporations where ownership and control are separate, managerial interests do not always align with shareholders' interests. The agency theory (Jensen and Meckling, 1976) suggests that linking managerial compensation to firm performance by adding stock options helps in aligning managerial and shareholder interests. Since option values increase with stock price (delta of compensation), they provide incentives to managers to exert optimal effort. At the same time, options may also result in sub-optimal investment decisions (Amihud and Lev, 1981; Smith and Stulz, 1985) by exposing the already undiversified managers to more firm specific risk. However, options also increase in value with stock return volatility due to their convex pay offs. This effect (known as vega of compensation) incentivizes managers to increase firm risk. While there is conflicting evidence on how delta affects firm risk, almost all of the studies find a positive relation between vega and firm risk (see for example Tufano, 1996; Guay, 1999; Rajgopal and Shevlin, 2002; Coles et al., 2006).

Although there has been a significant amount of work on CEO incentive compensation, most of this work is based on the agency theory framework (Jensen and Meckling, 1976) which assumes shareholder wealth maximization as the primary goal of a firm. Recent work on corporate social responsibility (CSR), however points to a shifting of this singular focus on shareholder wealth maximization, partly because of the role of corporate social activism. This literature shows that firms that invest in CSR may not maximize *only* shareholder wealth. In fact, firms that perform high on CSR intentionally attempt to balance the interests of all stakeholders (Freeman, 1984). These stakeholders include both the investing (shareholders) and the non-investing (employees,

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suppliers, customers, community, etc.) stakeholders. In this study, we investigate whether this broader goal of CSR affects the well-established relation between managerial risk taking incentives and firm risk. Specifically, we examine whether vega of CEO compensation affects firm risk differently in firms that perform high on CSR. This is important because firms that perform high on CSR are different from firms that perform low on CSR, and as such, managerial response to a change in vega might be different in these firms.

In order to empirically test our hypotheses, we collect a sample of 1,947 large US firms for the period 2003-2015 by combining various datasets. We construct our measures of CSR from MSCI ESG (formerly KLD), and CEO compensation incentives from Execucomp database. Following previous studies on CSR, we construct net scores on CSR as the difference between total CSR strengths and concerns in five areas of social performance: community, diversity, environment, products and employee relations. Firm risk is measured with total risk and idiosyncratic risk. Our benchmark results show that vega of CEO compensation has a positive and significant effect on both measures of firm risk. However when we divide our sample into high CSR and low CSR firms based on industry median CSR scores, we find that vega is positively associated with firm risk *only* in low CSR firms. In high CSR firms vega does not have any significant effect on firm risk.

Our benchmark results are significant and robust to various estimation techniques, like OLS with robust standard errors clustered at the firm level, firm fixed effects and industry fixed effects. We also run 3SLS simultaneous equations model where firm risk, vega and CSR are determined simultaneously to alleviate concerns about endogeneity. Vega continues to have a positive and significant effect on firm risk in all types of regressions. The benchmark results remain similar when we use idiosyncratic risk instead of total risk (stock return volatility) or if we divide our

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sample into high and low CSR firms based on the median score of all firms included in the sample. Finally, results do not change when we include additional controls of board size and board independence.

Our study makes two significant contributions to the literature on CSR, firm risk and CEO risk taking incentives. First, we contribute to the literature on CEO risk taking incentives and firm risk by showing that firm performance in CSR changes the relation between vega and firm risk. Second, we add to the literature by showing that vega is effective in encouraging managerial risk taking only in low CSR firms, (i.e. those firms that attempt to maximize *only* investing shareholder' interests), but is ineffective in encouraging risk taking in high CSR firms, (i.e. those firms that attempt to maximize both investing and non-investing stakeholders' interests).

The rest of the study is organized as follows: Section 2 reviews previous literature to develop hypotheses. Section 3 describes data and explains the empirical methodology used to test these hypotheses. Section 4 presents and discusses the results. Section 5 provides robustness checks, and section 6 concludes.

2. Motivation and Hypotheses

Traditional corporate finance theory assumes shareholder wealth maximization as the primary purpose of a firm. Accordingly, managers are considered agents of shareholders who own the company. Managers have full control over the day-to-day operations of their corporations and make all the investment and financial policy decisions. Since managers do not own the firms they control, managerial interests do not align with those of shareholders. The agency theory (Jensen and Meckling, 1976) postulates that linking managerial compensation to firm performance is one important method for aligning managerial and shareholder interests. Linking managerial pay to

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firm performance via firm equity helps in aligning managerial and shareholder interests, but also exposes managers to more firm-specific risk. This is because managers are risk-averse and poorly diversified as most of their financial wealth and human capital is tied to their firms and shareholders are fully diversified as they can invest in a number of related assets. Consequently, managers may take sub-optimal risks by passing on risky but value increasing NPV positive projects that the fully diversified shareholders would like them to accept (Amihud and Lev, 1981; Smith and Stulz, 1985).

The agency theory further suggests that adding stock options to CEO pay minimizes agency costs of risk taking by inducing risk-averse managers to increase firm risk for two reasons. First, stock options have convex payoffs (unlike equity that has linear payoffs). This convexity in stock options payoffs induces risk taking by providing downside protection in the event of poor performance while keeping the upside unlimited in periods of good performance. Second, options increase in value with an increase in stock return volatility (i.e. firm risk), which motivates the risk-averse managers to increase firm risk. However, the link between option based incentives and firm risk taking is not clear because stock options also increase the sensitivity of managerial wealth to stock price (known as delta of compensation). While the delta of compensation creates incentives for managers to increase shareholder value, it also discourages risk-averse managers from taking on risky projects.

Most of the empirical studies find no significant relation between the delta of managerial compensation and firm risk (e.g., Coles et al., 2006; Low, 2009). There are a number of studies that find a positive association between vega (the sensitivity of CEO wealth to volatility) and managerial risk taking (see for example Tufano, 1996; Guay, 1999; Rajgopal and Shevlin, 2002;

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Coles et al., 2006; Low, 2009). We start by investigating whether vega of compensation is positively related to firm risk. Therefore, our first hypothesis is stated as follows:

H1: Vega of CEO compensation is positively related to firm risk

In the last few years, firms have been paying greater attention to CSR and have increasingly been considering it as part of their overall strategy (e.g., McWilliams et al., 2006; Erhemjamts et al., 2013). The empirical literature testing the relation between CSR and financial performance is however inconclusive, with various studies showing a positive, negative or insignificant relation (e.g., Garcia-Castro et al., 2010; Margolis and Walsh, 2003; McWilliams and Siegel, 2001; Orlitzky and Benjamin, 2001; Orlitzky et al., 2003; Van Beurden and Gossling, 2008).

Two general views on CSR prevail in the literature. The agency theory, which is based on the assumption of shareholder wealth maximization, considers CSR as an agency problem (Friedman 1970) and a misuse and misappropriation of firm resources by managers to extract private benefits (Barnea and Rubin, 2010). According to the agency theory, CSR is undertaken at the expense of shareholders and therefore results in lower firm value (Friedman, 1998; Cronqvist et al., 2009, Pagano and Volpin, 2005). The opposite view of CSR is represented by the stakeholder theory (Freeman, 1984), which contends that investment in CSR increases shareholder wealth because it increases other stakeholders' willingness to contribute with resources and efforts to the firm by balancing their interests. This theory is in line with the classical contract theory and theory of the firm (Freeman, 1984; Jensen, 2001; Freeman and McVea, 2001; Freeman et al., 2004), which view firms as a nexus of explicit and implicit contracts between shareholders and other stakeholders. CSR contributes to an increase in a firm's reputation for keeping implicit commitments and consequently improves the firm's relationships with its stakeholders. CSR therefore increases firm

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value by managing the interests of both investing (shareholders) and non-investing (employees, suppliers, customers, community, etc.) stakeholders.

Like stakeholder theory, risk management theory proposes that CSR generates "moral capital" and "relational wealth" (Godfrey, 2005) resulting from the relationships with stakeholders. This moral capital creates a "reservoir of goodwill" which provides insurance-like protection in the event of poor performance and mitigates "negative stakeholder assessments" (Godfrey, 2005; Luo and Battacharya, 2009). An implication of this perspective is that CSR has a negative impact on firm risk. Several empirical studies investigate the relation between CSR and risk and most of them find a negative and significant association (Orlitzky and Benjamin, 2001; Lou and Bhattacharya, 2009; El Ghoul et al., 2011; Oikonomou et al., 2012 Jo and Na, 2012; Bouslah et al., 2013; Harjot and Laksmana, 2016). Our second hypothesis proposes to investigate whether CSR is associated with lower firm risk. It is stated as follows:

H2: Firm performance in CSR is negatively related to firm risk

There are a number of studies that examine the relation between CEO compensation incentives and firm performance in CSR (McGuire et al., 2003; Mahoney and Thorne, 2005; Mahoney and Thorne, 2006; Decktop et al., 2006; Cai et al., 2011; Bouslah et al., 2018). McGuire et al. (2003) find a positive relation between CEO cash and long term payout compensation and CSR activities. Mahoney and Thorne (2006) report a positive relation between CEO stock options and CSR and Decktop et al. (2006) find a negative relation between CSR and short term CEO compensation and a positive relation between CSR and long term compensation incentives. Bouslah et al. (2018) however investigate the effect of CEO risk taking incentives on socially irresponsible activities and find a positive relation in the pre-financial crisis period but no significant relation in the post-

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financial crisis period. Most of the existing literature however does not differentiate firms on the basis of CSR performance. Our study is different from these studies because rather than studying the relation between CEO risk taking incentives and CSR, we investigate if and how the impact of CEO compensation incentives, particularly those from vega, depends on the level of firm performance in CSR.

We argue that risk taking incentives may have a differential effect on firm risk in firms that choose to make larger investments in CSR for a number of reasons. Since high CSR firms do not primarily focus on shareholder wealth maximization and intentionally attempt to balance the interests of all stakeholders (Freeman, 1984; Mason and Simmons, 2014), the desired level of risk in firms that rank high on CSR may be different from those that rank low. The traditional agency theory argues that risk-averse managers often take less-than-optimal level of risk. According to the stakeholder theory, firms that rank high on CSR should have a level of risk closer to the optimal level. Harjoto and Laksmana (2016) for example, empirically show that stronger performance in CSR is associated with smaller deviations from the optimal risk taking level. Their argument is that balancing resources between investing and non-investing stakeholders leads to better risk management by reducing excessive risk taking and excessive risk avoidance. Non-investing stakeholders can influence managers to decrease risk taking to a level closer to the optimal by using their power to limit access to resources they control while investing stakeholders may require a move to riskier investments in future growth opportunities. We should, therefore, observe a differential effect of vega on firm risk in high and low CSR firms.

Similarly, firms that invest in CSR create social and moral capital that acts as insurance in times of bad events (Godfrey et al., 2009). Since option compensation also encourages risk taking by providing downside protection to the risk-averse managers, the extra protection provided by

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CSR may substitute the protection provided by vega and weaken the effect of vega on firm risk. Moreover, managers at high CSR firms may derive motivation from both monetary and non-monetary incentives (Fabrizi et al., 2014; Jha and Cox, 2015). If CEOs at high CSR firms have different personal characteristics in terms of motivation and risk taking, the inducement provided by vega may be weaker in firms that perform higher on CSR.

Both the motivation perspective and a different level of optimal risk should moderate the effect of vega on firm risk in such firms. Consequently, we should expect a lower or weaker effect of vega on firm risk in high CSR firms. Based on the above discussion, we formulate the following hypotheses.

H3-A: Vega of CEO compensation has no significant positive effect on firm risk in firms that perform high on CSR

H3-B: Vega of CEO compensation has a significant positive effect on firm risk in firms that perform low on CSR

3. Data and Empirical Methodology

3.1. Research Design

To test our hypotheses, we estimate a model in which the level of firm risk is a function of vega, firm performance in CSR, and the interaction between vega and high CSR. The equation that captures the firms' risk profiles in our model is the following:

$$\text{Firm Risk}_{t+1} = \beta_0 + \beta_1 \text{Delta}_t + \beta_2 \text{Vega}_t + \beta_3 \text{CSR}_t + \beta_4 \text{High CSR}_t \times \text{Vega}_t + \beta_5 \text{Low CSR}_t \times \text{Vega}_t + \beta_i \sum \text{Controls}_{i,t} + \varepsilon_t \quad (1)$$

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3.2. CSR Measures

We use the MSCI ESG STATS database (formerly known as the Kinder, Lyndenberg and Domini or KLD Research and Analytics Database) to construct measures of firm performance in CSR. MSCI ESG STATS has been widely used in studies that examine the effects of CSR on firm performance (e.g. Kruger, 2015; Borisov et al., 2016). The data are gathered from a variety of sources such as company filings, general media sources, and government data. Based on the information collected, analysts evaluate and rate firms based on performance indicators. The database provides information on several indicators to capture "strengths" and "concerns" attributes in seven areas: community, employee relations, environment, diversity, human rights, product, and governance. ESG performance indicators are scored by a simple binary scoring model. If a company meets the criteria established for an indicator, this indicator is marked with a "1". If a company does not meet the criteria for this indicator, it is marked with a "0". Our measure of CSR is calculated by summing the total number of CSR strengths and subtracting the total number of CSR concerns across five areas: community, employee relations, environment, diversity and product. We follow previous literature and exclude governance and human rights indicators (e.g. Cai et al., 2011; Hong et al., 2016; Harjoto and Laksmana, 2016). The five categories of CSR activities included are viewed as serving social goodness and are more likely to produce moral capital and offer insurance-like protection to the company (Godfrey et al., 2009).

3.3. Vega and Delta of CEO compensation

We construct measures of CEO incentives using data from the Execucomp database. Vega is the dollar change in CEOs' wealth for a one percentage point change in the annualized standard

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deviation of stock returns. Delta is the dollar change in the value of the CEOs' wealth for a one percentage point change in stock price. We follow the Guay (1999), Core and Guay (2002), Coles et al. (2006) methodology using the Black-Scholes (1973) option valuation model as modified by Merton (1973) to calculate vega and delta. This approach is consistent with previous studies (e.g., Coles et al., 2006; Hayes et al., 2012; Armstrong and Vashishtha, 2012; Anantharaman and Lee, 2014).

3.4. Firm Risk Measures

The dependent variable in our model is firm risk. We use two measures of firm risk: 1.) firm total risk, calculated as the logarithm of the standard deviation of daily stock returns; 2.) idiosyncratic risk, estimated as the standard deviation of the residuals from the Fama-French three-factor market model. To estimate these measures of risk, we collected stock information from CRSP. We follow previous papers that study the impact of CSR on firm risk, or the effect of vega on firm risk. For example, Coles et al. (2006) use the logarithm of the variance of daily stock returns to study the impact of vega on firm risk. Harjoto and Laksmana (2016) use the variance of daily stock returns to examine the relationship between CSR and firm risk taking. Boushal et al. (2013) use total firm risk, measured by the annualized standard deviation from daily stock returns, and its idiosyncratic component, measured as the standard deviation of the residuals from the four-factor Carhart model. Luo and Battacharia (2009) empirically illustrate that higher CSR decreases firm idiosyncratic risk.

3.5. Control Variables

We control for most of the determinants of firm risk given in the previous literature. Prior literature demonstrates a negative relationship between firm size and risk (e.g., Guay, 1999; Coles et al.,

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2006; Low, 2009). We measure firm size as the logarithm of sales and expect a negative coefficient. Previous studies provide conflicting conclusions based on the relationship between leverage and firm total risk, with some studies asserting that leverage provides incentives for managers to transfer wealth from bondholders to stockholders (Leland, 1998) and therefore predicting a positive relationship. Others argue that firms with more risk face a higher probability of financial distress and therefore should have less leverage (e.g., Friend and Lang, 1998). We measure leverage as the ratio of long-term debt over market value of equity (Coles et al., 2006; Hayes et al., 2012). We have no prior expectation on it coefficients. It is also expected that managers of firms with larger investment-opportunity sets and more growth opportunities take more risk (Guay, 1999). We include market-to-book ratio, calculated as total market value of equity divided by book value of common stock. We also include capital expenditures minus the sales of property, plant, and equipment scaled by assets (Coles et al., 2006; Low, 2009) to control for investment expenditures. The financial data to construct these variables (sales, debt-to-equity, market-to-book and capital expenditures) comes from the Compustat and CRSP databases.

Previous work also shows that CEO characteristics have significant influence on firm risk. Following Berger et al. (1997), Guay (1999) and Coles et al. (2006), we include the logarithm of CEO cash compensation and CEO tenure to proxy for the degree of CEO risk aversion. CEO age and CEO stock ownership are also likely to impact firm investment policies (e.g., Harjoto and Laksmana, 2016). CEOs who are close to retirement usually avoid risk taking and making risky investments. We include age>64 to control for CEO career horizon. This is a binary variable that equals 1 if CEO is older than 64 years and 0 otherwise. All the CEO related variables are constructed from the data provided by the Execucomp database.

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Finally, we include a set of board characteristics that may affect corporate risk taking. Strong boards (small and less restrictive) have a positive impact on risk taking (Core et al., 1999). We include two board characteristics: size and independence. Board size is the total number of directors on the boar. Board independence is the percentage of independent directors on board, measured as a ratio of independent directors to total directors. Data on board size and independence come from ISS (Institutional Shareholder Services; formerly RiskMetrics) database.

3.6. Descriptive Statistics

Table 1 shows the summary statistics of all the variables. Our sample includes relatively large companies, as the average and median annual sales are $6.610 billion and $1.512 billion, respectively. We categorize a firm as high CSR if its net CSR score is greater than the median net CSR score of its 2-SIC industry level, and low CSR if its net CSR score is less than the median net CSR score of its 2-SIC industry level. We can see that firms in the high CSR sample are much larger, with mean (median) sales of $10.317 billion ($2.788 billion) compared to net sales of $4.887 billion (1.088 billion) of the low CSR firms. This is consistent with previous studies that found that larger firms invest more in CSR (e.g., Artiach et al., 2010). The median firm in our full sample has market-to-book ratio of 1.55, and a debt-to-equity ratio of 16.4%. The median high CSR firm has a market-to-book ratio of 1.60, compared to market-to-book ratio of 1.50 of the median low CSR firm. The median debt-to-equity ratios of high and low CSR firms are 16.8% and 16%, respectively. High CSR firms show levels of capital expenditures to total assets of 2.94%, compared to levels of 2.85% for low CSR firms..

The mean (median) total and idiosyncratic risk of our sample is 0.391 and 0.318 (0.342 and 0.280), respectively. Both total and idiosyncratic risks are smaller for the median high CSR firms

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than for the median low CSR firms. The median high CSR firm has a value of total risk of 0.30, while the median low CSR firm has a total risk of 0.385. The level of idiosyncratic risk is of 0.242 for the median high CSR firms versus 0.312 for the median Low CSR firms. These values are consistent with the annualized total and idiosyncratic levels of risk reported in Bouslah et al. (2013).

Table 1 also summarizes the CEOs portfolio equity incentives. For the full sample, the mean (median) delta is $949,011 ($228,223). The mean (median) vega for the full sample is roughly $156,447 ($57,163). However, the average and median vega is much higher for the high CSR firms compared to the low CSR firms. The mean (median) value of vega is $233,734 ($99,589) for the high CSR sample and $105,013 ($44,391) for the low CSR sample. Similarly, the mean value of delta is higher for the high CSR sample compared to the low CSR sample ($1,479,613 compared to $589,901).

Table 1 also shows a higher average of cash compensation for CEOs of high CSR firms, of $1,353,913 compared to $1,123,915 for CEOs of low CSR firms, and lower average CEO stock ownership for high CSR firms of 1.31% compared to 2.33% for low CSR firms. The median CEO in high CSR and low CSR firms has similar age and tenure. Table 2 provides the correlation matrix of all the independent variables. A cursory look at the table shows that there are no concerns about multicollinearity as the correlations are modest. The highest correlation is between vega and delta (0.368) which is as expected and not a concern.

[INSERT TABLES 1 & 2 HERE]

4. Results

4.1 Effect of vega and CSR on firm risk

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Table 3 presents the results of multivariate regressions of total risk, measured by the logarithm of the annualized standard deviation of daily stock returns, on measures of CSR and CEO risk taking incentives. We estimate three different models. Model 1 uses ordinary least squares (OLS) with robust standard errors clustered at the firm level. To address the possibility of both firm risk and CSR being influenced by unobservable firm characteristics, we also use firm and industry fixed effects at the 2-digit SIC level (Coles et al., 2006). The benchmark results indicate that the estimated coefficients on vega are all positive and significant at 5% for the OLS and firm fixed effects models at 1%. These results corroborate our first hypothesis (H1), which predicts that the vega of CEO compensation is positively related to firm risk. The coefficients on the CSR are negative and significant for all specifications of the model, indicating that CSR reduces firm risk. These results support our second hypothesis (H2).

Other control variables in table 3 have expected signs. Both delta of CEO compensation and cash compensation are negatively and significantly associated with firm risk. CEO age>64 is negatively associated with firm risk indicating that when CEOs get closer to their retirement, they take less risk. On the other hand, CEO tenure has a positive and significant effect on firm risk. CEO stock ownership is also positively related to firm risk. The firm characteristics in the model are also generally of the expected signs. Firm size has a negative and significant association with firm risk whereas leverage is positively related to firm risk. Capital expenditures also have positive affect on firm risk.

In summary, our results provide empirical evidence that firm risk increases with vega of CEO compensation and decreases with the level of the firm's CSR engagement. These results are consistent with prior empirical literature that shows that vega is positively associated with managerial risk taking (see for example Tufano, 1996; Guay, 1999; Rajgopal and Shevlin, 2002;

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Coles et al., 2006; Low, 2009). Our results also support the literature that explains the risk reduction effect of CSR (e. g. Orlitzky and Benjamin, 2001; Lou and Bhattacharya, 2009; El Ghoul et al., 2011; Oikonomou et al., 2012 Jo and Na, 2012; Bouslah et al., 2013; Harjot and Laksmana, 2016). A higher level of support from the stakeholders of firms with better CSR performance may explain this effect.

[INSERT TABLE 3 HERE]

4.2 Effect of vega on firm risk: high and low CSR

Table 3 reports the results regarding our third hypothesis (H3-A and H3-B), which predicts a weaker positive effect of CEO risk taking incentives measured by vega of CEO wealth on firm risk in high CSR firms and a strong positive effect of vega on firm risk in low CSR firms. To capture the impact of vega in a high and a low CSR firm, we construct interaction variables of vega and an indicator variable equal to 1 if the firm is a high or a low CSR firm. We define a firm as high CSR if the net CSR score of the firm is higher than the median net CSR score of its industry, and as low CSR if the firm's CSR score is lower than the median net CSR score of its industry (measured at the 2-digit SIC level). Since we include interaction variables for both high and low CSR with vega, covering the entire sample, vega is not included in the equation. This specification provides us a simple way to interpret the coefficients on the interaction variables. The coefficient on the interaction of vega and high CSR shows the effect of vega on firm risk in high CSR firms and the coefficient on the interaction of vega and low CSR shows the effect of vega on firm risk in low CSR firms. Consistent with our expectations, the association between vega and firm risk is positive and significant in low CSR firms. The coefficients on the interaction variable of vega and

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high CSR are insignificant in all models, suggesting that vega has no effect on firm risk in high CSR firms.

This is interesting as the results provide strong support to our hypothesis that the extra downside protection provided by CSR investment reduces the impact of vega on firm risk to the level where vega actually has no significant effect on firm risk. However, in low CSR firms there is no such protection available to the managers, and their response to vega is quite strong and positive. It also shows that vega has no significant effect on firm risk in firms that attempt to balance the interests of all stakeholders (i.e. high CSR firms) and has a significant positive effect on firm risk in firms that maximize only shareholder interest (i.e. low CSR firms). Thus, vega is effective in inducing managerial risk taking only in low CSR firms. The results also show that the risk inducing effect of vega discussed in previous literature does not always hold and is influenced by firm performance in CSR.

The coefficients on all other control variables in table 4 remain similar to the ones presented in table 3, and are consistent with our expectations. The coefficients on delta of CEO compensation are negative and significant, and so are the coefficients on CEO cash compensation. CEO age>64 is negative while CEO tenure and stock ownership are positive and significant in all models. The coefficients on firm characteristics are similar to the benchmark regression and there are no unexpected changes of signs.

[INSERT TABLE 4 HERE]

5. Robustness Checks

5.1. Effect of vega on firm risk: Simultaneous equations estimation

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In the benchmark regressions we treat CSR and vega of CEO compensation as exogenous determinants of firm risk with a one-year lag. However, there may be concerns about the simultaneity of firm risk, CEO compensation (vega) and social performance (CSR) as all three may be determined simultaneously. In order to check the sensitivity of our benchmark results to the possibility of simultaneity of firm risk, vega and CSR, we run a system of simultaneous equations where all three are treated as endogenous variables. Specifically, we run the following system of equations using 2SLS regressions:

$$\text{Volatility}_{t+1} = f(\text{Vega}_t, \text{CSR}_t, \text{control variables}_t) \quad (2)$$

$$\text{Vega}_t = f(\text{Volatility}_t, \text{CSR}_t, \text{control variables}_t) \quad (3)$$

$$\text{CSR}_t = f(\text{Volatility}_t, \text{Vega}_t, \text{control variables}_t) \quad (4)$$

Since we are interested in estimating the effect of vega on firm risk and in examining if vega has a differential effect on firm risk based on CSR, We run the 2SLS regressions for the full sample and the two sub-samples of high and low CSR firms. The volatility equation uses the same determinants as in the benchmark regressions.

For the vega equation, we draw the instruments and control variables from the previous studies on CEO compensation incentives (e.g. Guay, 1999; Core and Guay, 1999; Bryan et al., 2000; Ryan and Wiggins, 2001 & 2002; Coles et al., 2006) Firm size and investment opportunities influence the choice of the size and composition of CEO compensation incentives. Larger firms require more talent and award higher proportion of performance linked compensation (Smith and Watts, 1992). The monitoring and control problems become more serious in the presence of investment opportunities. Prior studies have shown that market-to-book ratio is an important determinant of incentive compensation (Demsetz and Lehn, 1985; Gaver and Gaver, 1993; Himmelberg et al.,

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1999). Similarly, firm's capital structure is known to have an effect on pay-for-performance sensitivity (John and John, 1993; Ryan and Wiggins, 2001). We include debt-to-equity ratio to control for leverage. Milbourn (2003) report that longer tenured CEOs receive higher performance based incentives and Ryan and Wiggins (2001) find a negative relation between CEO age and stock options. Gibbons and Murphy (1992) argue that equity incentives are stronger for managers closer to retirement because career concerns are lower for such managers. We control for CEO age>64 and tenure in the vega equation. We also include delta of CEO compensation.

The controls and instruments for the CSR equation come from the CSR literature. Among the firm characteristics, firm size is very important. Larger firms are more likely to invest in CSR as they are under the radar of analysts and large shareholders. Firm size is measured by log of net sales. Firm profitability, measured by return on assets (ROA), is another determinant of CSR. More profitable firms have more financial resources to invest in CSR. Firms under financial stress may also behave differently and are more likely to reduce investment in CSR. We use debt-to-equity ratio to control for financial leverage. There is empirical evidence that shows that R&D expenditures are correlated with firm choice of CSR (McWilliams and Siegel, 2001; Padgett and Galan, 2010). Similarly, capital expenditures and advertising expense compete with CSR investments and are important determinants of CSR. Following previous literature, we include R&D, capital and advertising expenditures scaled by total assets in the CSR equation. Firms listed in the S&P500 have higher exposure and visibility and are followed by media, investors and activists (Garcia-Castro et al., 2009). We include a binary variable that equals 1 if the firm is listed on S&P500 and 0 otherwise. We also include prior year CSR level as a predictor of new investment in CSR.

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Table 5 gives the results from the 2SLS regressions for the full sample and the high and low CSR samples of the effect of CEO vega on firm risk. The variable of primary interest is vega. The coefficient on vega is positive and significant, confirming the results from our benchmark regressions. The coefficients on all other control variables are generally of the same sign and significance. The coefficient on vega in the high CSR sample is positive but not significant, while in the low CSR sample it is positive and significant. Thus, the positive impact of vega on firm risk in the full sample is driven by low CSR firms. For high CSR firms, there is no significant relation between vega and firm risk. Modeling firm risk, CEO compensation vega and CSR as endogenous does not change our primary results. It actually provides further support and proves the robustness of these relations. Volatility, in turn, has a positive and significant effect on vega and a negative and significant effect on CSR. The coefficients on other control variables in vega and CSR equations are all of the expected signs.

[INSERT TABLE 4 HERE]

5.2. Alternative Measure of Risk

The benchmark regressions use total risk as a primary measure of risk. In order to check the sensitivity of our results to a change in the definition of firm risk, we run our benchmark model using idiosyncratic risk as an alternative measure of firm risk. This is important because some studies like Luo and Battacharya (2009) argue that the insurance-like protection provided by CSR impacts a firm's level of unsystematic risk only. Table 6 provides the results of this specification using idiosyncratic risk which is calculated as the standard deviation of the residuals from the Fama-French three-factor market model. The coefficients on the interactions of vega and high CSR are all insignificant indicating that vega has no effect on idiosyncratic risk in high CSR firms.

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However, the coefficients on the interaction of vega and low CSR are all positive and significant at the 1% level which provides further support to our earlier results that vega has significant effect on firm risk on in low CSR firms.

The coefficients on all other independent variables, including both the CEO and firm characteristics, remain similar to table 4. These results confirm our primary hypothesis that investment in CSR influences the positive relation between CEO risk taking incentives (vega) and firm risk after controlling for the determinants of firm risk.

[INSERT TABLE 6 HERE]

5.3. Alternative definition of high and low CSR firms

Next, we attempt to examine whether our benchmark results of the differential effect of vega on firm risk change when we define high and low CSR firms differently. In this section, we redefine a firm as a high CSR firm if its net CSR score is higher than the median CSR score of all firms included in the sample, and a low CSR firm if its net CSR score is lower than the median CSR score of all the firms included in the sample, regardless of its industry. The results are reported in table 7. These results are similar to the ones obtained using the previous definition of high/low CSR firms based on industry median CSR in table 3. The coefficients on the interaction of vega and low CSR are again positive and significant, while the coefficients on the interaction of vega and high CSR are all statistically insignificant in both firm and industry fixed effects regressions. It seems that defining high/low CSR relative to the full sample does not change our benchmark empirical results.

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Rather, these results extend further support to our hypothesis of a weaker effect of vega on firm risk in high CSR firms. The coefficients on all other control variables are also generally of the same signs and significance.

[INSERT TABLE 7 HERE]

5.4. Adjusted CSR scores

We measure CSR performance as the difference between total CSR strengths and total CSR concerns following previous work on CSR. As discussed before this is how most of the studies using the MSCI ESG data construct CSR performance measures. However, there are a few studies that argue that this method may have a drawback, as the number of strengths and concerns indicators varies across different dimensions (Manescu, 2009; Deng et al., 2013). They suggest using an adjusted CSR measure that divides the number of strengths and concerns in each dimension by the total number of strengths and concerns in that dimension, and then calculates the difference between total number of adjusted strengths and adjusted concerns. This adjusted CSR measure gives equal weight to all dimensions. To check the robustness of our main results to this change, we also construct adjusted CSR scores and then calculate high and low CSR samples based on the industry median of the adjusted CSR scores.

Results are given in table 8. The coefficients on the interaction of high adjusted CSR and vega are all statistically insignificant. However, the coefficients on the interaction of low adjusted CSR and vega are positive and significant at the 1% level. These results provide further support to our main results that vega affects firm risk in low CSR firms only and has no effect on firm risk in high CSR firms. All other control variables are generally of the same sign and statistical

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significance. Thus changing the definition of CSR performance measure does not affect our benchmark results.

[INSERT TABLE 8 HERE]

5.5. Using a two- year lag

There is a one-year lag between vega, CSR and other control variables and firm risk in our benchmark regressions to estimate the effect of veag on firm risk. Specifically, we measure firm risk at period t+1 and vega and other variables at period t. Here we attempt to check if our results are sensitive to a change in this lag. To check this, we run our benchmark regressions with a two-year lag between firm risk, vega, and other variables. We measure firm risk at period t+2 and all other variables at period t. Results are given in table 9. Here again the coefficients on the interaction of vega and high CSR are all statistically insignificant while the coefficients on the interaction of vega and low CSR are all positive and significant in all three specifications. These results confirm our earlier results and indicate that our results are not sensitive to a change in the length of lag between firm risk and vega. Vega continues to be positively and significantly related to firm risk only in low CSR firms.

[INSERT TABLE 9 HERE]

5.6. Controls for board characteristics

Our benchmark empirical models do not control for board characteristics like size and independence. There is evidence that board size and independence have significant effect on firm risk (Core et al., 1999). If board characteristics affect firm risk, they may also affect the relation between vega and firm risk. To test the robustness of our results to the inclusion of board

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characteristics in our benchmark model, we use total number of directors on the board (board size) and percentage of independent directors on the board (board independence) as additional control variables. Results are given in table 10. The results indicate that board size itself is negatively associated with firm risk in both firm and industry fixed effects models but board independence is positive and statistically significant only in firm fixed effects model. Nevertheless, the results regarding the coefficients on the interaction variables of vega with low and high CSR are similar to the ones obtained in table 4. These results show that the inclusion of board controls does not change the relations between vega and firm risk in high and low CSR firms. Vega continues to have statistically significant effect on firm risk only in low CSR firms and has no effect on firm in high CSR firms.

[INSERT TABLE 10 HERE]

6. Discussion and conclusion

The link between CEO compensation incentives and firm risk has been widely discussed in the economics, finance and management literature. Most of these studies measure CEO risk taking incentives using the vega of equity based compensation and find a positive and significant association between vega and firm risk. In this study, we argue that CEO risk taking incentives emanating from equity linked compensation are based on the agency theory, which views maximization of shareholder wealth as the primary goal of a corporation and ignores other stakeholders that are essential to the long run survival and profitability of a firm. The stakeholder theory posits that firms invest in CSR to balance the interests of all stakeholders, including the shareholders. Therefore, it is important to differentiate between firms that rank high on social performance and those that rank low. This distinction is necessary because firms that rank high on

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CSR make an intentional effort to balance the interests of both the investing (shareholders) and the non-investing (customers, employees, community etc.) stakeholders, instead of only investing stakeholders. This added goal of stakeholder interests' maximization moderates the relation between vega and firm risk, as CSR adds another constraint to a CEO's ability to take risk. Moreover, CSR provides an insurance-like downside protection in the event of poor financial performance and mitigates the effect of vega on firm risk.

The empirical results obtained in this study are consistent with these predictions. Vega is positively associated with firm risk *only* in firms that make maximization of shareholders' interests their primary goal rank and rank low on CSR performance. On the other hand, firms that make maximization of all stakeholders' interests their primary goal rank high on CSR performance. For such firms the effect of vega on firm risk is muted, leading to an insignificant relation. Overall, these results suggest that the positive association between vega and firm risk found in previous literature seems to be influenced or even driven by firm social performance.

Our findings have important implications for boards of directors. Specifically, boards should consider firm social performance goals while designing executive compensation packages to mitigate risk related agency problems. Firms that rank high on CSR performance may not need to provide high vega compensation packages to their CEOs.

Although the results in this study are robust to alternative measures of risk and CSR performance, they are based on US corporations. This is a limitation of this study. Future research should investigate if these results hold for firms in other countries in order to better our understanding of the moderating effect of CSR on the relation between risk taking incentives from CEO compensation and firm risk.

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Appendix: Definitions of variables

Net CSR score	Net score on CSR calculated by subtracting total CSR concerns from total CSR strengths in five categories (community, diversity, employees, product and environment
Adjusted CSR score	Net score on CSR calculated by subtracting total adjusted CSR concerns from total adjusted CSR strengths giving equal weight to each dimension
Firm risk	Annualized standard deviation of daily stock returns.
Idiosyncratic risk	Standard deviation of the residuals from the Fama-French three-factor market model
Vega of CEO wealth	Dollar change in CEO's wealth for a one percentage point change in the annualized standard deviation of stock returns
Delta of CEO wealth	Dollar change in the value of the CEO's wealth for a one percentage point change in stock price
Size	Log of net sales
Debt-to-equity	Ratio of long-term debt over market value of equity
Market-to-book	(Market value of equity + book value of debt)/total assets
Capital expenditures	Capital expenditures - sales of property, plant, and equipment/total assets
CEO age>64	Dummy variable equals 1 if CEO age is 65 or more
CEO tenure	Number of years the CEO has been in office
Board size	Total number of directors on the board
Board independence	Ratio of outside directors to total directors on the board

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Table 1: Summary statistics

	Full sample			High CSR firms			Low CSR firms		
Variable	Mean	Median	Std.Dev.	Mean	Median	Std.Dev.	Mean	Median	Std.Dev.
Total risk	0.391	0.342	0.206	0.351	0.300	0.201	0.428	0.385	0.209
Idiosyncratic risk	0.318	0.280	0.175	0.283	0.242	0.170	0.348	0.312	0.178
Vega ($000)	156.4	57.2	311.3	233.7	99.6	416.7	105.0	44.4	192.9
Delta($000)	949.0	228.2	8165.8	1479.6	312.2	12828.5	589.9	188.5	2060.5
Cash compensation ($000)	1212.5	880.0	1739.2	1353.9	991.0	1814.1	1123.9	810.1	1705.0
CEO age (years)	55.9	56.0	7.3	55.9	56.0	6.7	56.0	56.0	7.8
CEO tenure(years)	7.3	5.0	7.3	6.8	5.0	6.6	7.6	5.0	7.8
CEO stock ownership (%)	1.803	0.254	4.920	1.314	0.157	4.145	2.326	0.429	5.674
CSR net	0.166	0.000	2.445	2.394	2.000	2.353	-1.874	-2.000	1.094
Sales ($ millions)	6610	1512	20777	10317	2788	24325	4887	1088	20272
Market-to-book (x)	1.935	1.547	1.267	1.980	1.595	1.216	1.873	1.502	1.295
Debt-to-equity (%)	0.423	0.164	1.872	0.429	0.168	2.179	0.419	0.160	1.387
Capital expenditures to assets (x)	4.403	2.867	5.531	4.308	2.944	5.238	4.387	2.848	5.325
Board independence (%)	0.749	0.778	0.139	0.773	0.800	0.132	0.732	0.750	0.141
Board size	9.280	9.000	2.433	9.956	10.000	2.542	8.729	8.000	2.287

Descriptive statistics of firm risk, vega and CSR for full sample and the two sub-samples of high and low CSR. High CSR sample includes all firm years where net score on CSR is greater than the industry median CSR and the low CSR sample includes all firm years where net score on CSR is less than the industry median CSR. The sample is for the period 2003-2015. Definitions of all variables are given in the appendix.

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Table 2: Correlation matrix

		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XII	XIV
I	Vega	1.000													
II	Delta	0.368	1.000												
III	Cash comp	0.310	0.046	1.000											
IV	Age	0.073	0.073	0.095	1.000										
V	Tenure	0.061	0.131	0.043	0.410	1.000									
VI	Stock ownership	-0.026	0.136	-0.057	0.108	0.294	1.000								
VII	CSR net	0.274	0.075	0.052	-0.009	-0.054	-0.082	1.000							
VIII	Sales	0.278	0.068	0.200	0.052	-0.051	-0.060	0.160	1.000						
IX	Market to book	0.079	0.057	-0.033	-0.049	0.034	0.017	0.074	0.034	1.000					
X	Debt to equity	-0.027	-0.010	-0.001	0.003	0.003	-0.003	-0.008	0.000	-0.010	1.000				
XI	Capital exp.	-0.048	-0.012	-0.002	-0.005	-0.008	0.012	-0.080	0.000	0.053	-0.004	1.000			
XII	Board ind.	0.069	-0.036	-0.022	-0.023	-0.109	-0.119	0.147	0.104	-0.043	0.001	-0.015	1.000		
XIII	Board size	0.243	0.047	0.195	0.069	-0.105	-0.155	0.236	0.287	-0.118	0.011	-0.084	0.117	1.000	
XIV	G-index	0.072	-0.018	0.073	0.010	-0.086	-0.132	0.058	0.019	-0.051	0.006	-0.006	0.054	0.184	1.000

Correlation matrix of the independent variables. The sample is for the period 2003-2015. Definitions of all variables are given in the appendix.

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Table 3: Effect of vega on firm risk

	$Volatility_{t+1}$		
Variables	OLS	Firm Fixed Effects	Industry Fixed Effects
Log (vega)	0.0061**	0.0078**	0.0070***
	(0.013)	(0.026)	(0.003)
CSR net	-0.0199***	-0.0299***	-0.0202***
	(0.000)	(0.000)	(0.000)
Log (delta)	-0.0721***	-0.0787***	-0.0721***
	(0.000)	(0.000)	(0.000)
Log (cash compensation)	-0.0264***	-0.0497***	-0.0339***
	(0.000)	(0.000)	(0.000)
CEO age>64	-0.0636***	-0.0522***	-0.0593***
	(0.000)	(0.001)	(0.000)
CEO tenure	0.0028***	0.0019**	0.0022***
	0	-0.032	0
CEO stock ownership	0.0155***	0.0192***	0.0144***
	(0.000)	(0.000)	(0.000)
Log (sales)	-0.0527***	-0.0560***	-0.0552***
	(0.000)	(0.000)	(0.000)
Debt-to-equity	0.0428***	0.0286***	0.0416***
	(0.002)	(0.000)	(0.000)
Market-to-book	-0.0033	0.0076	-0.0028
	(0.287)	(0.118)	(0.364)
Log (capital expenditures)	0.6387***	0.9156***	0.6895***
	(0.000)	(0.000)	(0.000)
Observations	13853	13853	13826
R-squared (overall)	0.2812	0.1994	0.2018

Results are from OLS with robust standard errors clustered around firm ids and firm and industry fixed effects models of the effect of vega on firm risk for the period 2003-2015. The dependent variable is the annualized standard deviation of daily stock returns. *, **, *** are statistically significant at the 1, 5 and 10% levels, respectively. Definitions of all the variables are given in appendix.

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Table 4: Effect of vega on firm risk: High vs. low CSR firms

	$Volatility_{t+1}$		
Variables	OLS	Firm Fixed Effects	Industry Fixed Effects
Log (delta)	-0.0721***	-0.0769***	-0.0713***
	(0.000)	(0.000)	(0.000)
High CSR * Log (vega)	0.0049	0.0033	0.0043
	(0.297)	(0.476)	(0.483)
Low CSR * Log (vega)	0.0120***	0.0158***	0.0132***
	(0.000)	(0.000)	(0.000)
High CSR	-0.0668***	-0.0559***	-0.0534*
	(0.002)	(0.009)	(0.097)
Log (cash compensation)	-0.0246***	-0.0458***	-0.0312***
	(0.001)	(0.000)	(0.000)
CEO age>64	-0.0625***	-0.0513***	-0.0586***
	0	-0.007	-0.001
CEO tenure	0.0028***	0.0016	0.0022**
	(0.000)	(0.184)	(0.011)
CEO stock ownership	0.0155***	0.0192***	0.0144***
	(0.000)	(0.000)	(0.000)
Log (sales)	-0.0571***	-0.0668***	-0.0614***
	(0.000)	(0.000)	(0.000)
Debt-to-equity	0.0429***	0.0288***	0.0420***
	(0.001)	(0.008)	(0.002)
Market-to-book	-0.0046	0.008	-0.0042
	(0.334)	(0.168)	(0.478)
Log (capital expenditures)	0.6213***	0.9283***	0.6752***
	(0.000)	(0.000)	(0.002)
Observations	13851	13851	13824
R-squared (overall)	0.2784	0.1992	0.201

Results are from OLS with robust standard errors clustered around firm ids and firm and industry fixed effects models of the effect of vega on firm risk for the period 2003-2015. The dependent variable is the annualized standard deviation of daily stock returns. The high CSR sample includes all the firm years where net score on CSR is greater than the industry median CSR and the low CSR sample includes all the firm years where net score on CSR is less than the industry median CSR. *, **, *** are statistically significant at the 1, 5 and 10% levels, respectively. Definitions of the variables are given in appendix.

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Table 5: Effect of vega on firm risk: 2SLS regressions

	Full Sample			High CSR sample			Low CSR sample		
	$Volatility_{t+1}$	vega	CSR	volatility	vega	CSR	volatility	vega	CSR
Log ($volatility_{t+1}$)		0.1662***	-0.2001***		0.2988***	-0.2274***		0.1171***	-0.1385***
		(0.000)	(0.000)		(0.000)	(0.004)		(0.010)	(0.000)
Log (vega)	0.0094***		0.0094	0.0075		0.0063	0.0105***		0.0001
	(0.002)		(0.367)	(0.138)		(0.743)	(0.002)		(0.985)
CSR net	-0.0232***	0.0785***		-0.0257***	0.0605***		-0.0510***	0.0687**	
	(0.000)	(0.000)		(0.000)	(0.004)		(0.000)	(0.033)	
Log (delta)	-0.0729***	0.6233***	-0.0512***	-0.0749***	0.7361***	-0.0848***	-0.0710***	0.5704***	-0.0297***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.005)
Log (cash compensation)	-0.0225***			-0.0166***			-0.0254***		
	0.000			(0.003)			(0.004)		
CEO age>64	-0.0647***	-0.2759***		-0.0732***	-0.3643***		-0.0650***	-0.2549***	
	(0.000)	(0.000)		(0.002)	(0.001)		(0.000)	(0.001)	
CEO tenure	0.0030***	-0.0333***		0.0032***	-0.0403***		0.0031***	-0.0306***	
	(0.000)	(0.000)		(0.010)	(0.000)		(0.000)	(0.000)	
CEO stock ownership	0.0146***			0.0163***			0.0135***		
	(0.000)			(0.000)			(0.000)		
Log (sales)	-0.0497***	0.1959***	0.1628***	-0.0541***	0.1454***	0.3380***	-0.0558***	0.2299***	-0.0500***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Debt-to-equity	0.0451*	0.0063	-0.0061	0.0796*	-0.0295	-0.0121	0.0374	0.0127	0.0012
	(0.084)	(0.599)	(0.580)	(0.072)	(0.312)	(0.682)	(0.229)	(0.576)	(0.884)
Market-to-book	-0.0107***	-0.0530***		-0.0121	-0.0793**		-0.008	-0.0509**	
	(0.003)	(0.004)		(0.173)	(0.030)	1.1696*	(0.113)	(0.011)	
Log (capital exp.)	0.6996***		0.3898	0.6395**		1.1696*	0.7339***		0.4149*

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	(0.000)		(0.105)	(0.013)		(0.057)	(0.000)		(0.055)
Log (R&D)		0.3301***	0.1794***			0.2017***			0.0445**
		(0.000)	(0.000)			(0.000)			(0.014)
Log (advt. exp.)			1.3486***			1.2227			0.1048
			(0.010)			(0.324)			(0.720)
ROA			0.1431			0.4392			0.2746***
			(0.180)			(0.199)			(0.008)
S&P500			0.2514***			0.1470**			-0.0671*
			(0.000)			(0.041)			(0.085)
CSR_{t-1}			0.8120***			0.5876***			0.5328***
			(0.000)			(0.000)			(0.000)
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic	148.71	206.67	958.71	58.47	86.27	195.48	79.31	99.04	216.79
Observations	11019	11019	11019	3674	3674	3674	7345	7345	7345

Results are from simultaneous equations (2SLS) regressions of the effect of vega on firm risk for the period 2003-2015. Robust p-values have been calculated by bootstrapping standard errors. The dependent variable is the annualized standard deviation of daily stock returns. The high CSR sample includes all the firm years where net score on CSR is greater than the industry median CSR and the low CSR sample includes all the firm years where net score on CSR is less than the industry median CSR. *, **, *** are statistically significant at the 1, 5 and 10% levels, respectively. Definitions of the variables are given in appendix.

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Table 6: Effect of vega on firm risk: using idiosyncratic risk

	$Volatility_{t+1}$		
Variables	OLS	Firm Fixed Effects	Industry Fixed Effects
Log (delta)	-0.0701***	-0.0737***	-0.0683***
	(0.000)	(0.000)	(0.000)
High CSR * Log (vega)	0.001	-0.0023	0.0004
	(0.836)	(0.608)	(0.954)
Low CSR * Log (vega)	0.0076***	0.0087***	0.0083***
	(0.003)	(0.000)	(0.004)
High CSR	-0.0544**	-0.0315	-0.0392
	(0.015)	(0.127)	(0.256)
Log (cash compensation)	-0.0131**	-0.0236***	-0.0200***
	(0.047)	(0.003)	(0.003)
CEO age>64	-0.0469***	-0.0235	-0.0426**
	-0.006	-0.2	-0.015
CEO tenure	0.0027***	0.0016	0.0019**
	(0.002)	(0.149)	(0.030)
CEO stock ownership	0.0134***	0.0144***	0.0121***
	(0.000)	(0.000)	(0.000)
Log (sales)	-0.0831***	-0.1071***	-0.0892***
	(0.000)	(0.000)	(0.000)
Debt-to-equity	0.0480***	0.0328***	0.0475***
	(0.001)	(0.007)	(0.002)
Market-to-book	0.0011	0.0123**	0.0002
	(0.819)	(0.033)	(0.975)
Log (capital expenditures)	0.6739***	1.0594***	0.7512***
	(0.000)	(0.000)	(0.001)
Observations	13851	13851	13824
R-squared (overall)	0.3218	0.2415	0.2429

Results are from OLS with robust standard errors clustered around firm ids and firm and industry fixed effects models of the effect of vega on firm risk for the period 2003-2015. The dependent variable is the annualized standard deviation of the residuals from the Fama-French three-factor market model. *, **, *** are statistically significant at the 1, 5 and 10% levels, respectively. Definitions of the variables are given in appendix.

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Table 7: Effect of vega on firm risk: High vs low CSR relative to the sample median

	$Volatility_{t+1}$		
Variables	OLS	Firm Fixed Effects	Industry Fixed Effects
Log (delta)	-0.0691***	-0.0742***	-0.0681***
	(0.000)	(0.000)	(0.000)
High CSR * Log (vega)	-0.0057	-0.0043	-0.0041
	(0.271)	(0.361)	(0.513)
Low CSR * Log (vega)	0.0086***	0.0106***	0.0097***
	(0.000)	(0.000)	(0.003)
High CSR	-0.0046	-0.0062	-0.0042
	(0.852)	(0.782)	(0.892)
Log (cash compensation)	-0.0124*	-0.0237***	-0.0197***
	(0.058)	(0.003)	(0.004)
CEO age>64	-0.0467***	-0.0235	-0.0421**
	(0.006)	(0.200)	(0.016)
CEO tenure	0.0027***	0.0016	0.0019**
	(0.002)	(0.155)	(0.029)
CEO stock ownership	0.0135***	0.0145***	0.0122***
	(0.000)	(0.000)	(0.000)
Log (sales)	-0.0844***	-0.1075***	-0.0898***
	(0.000)	(0.000)	(0.000)
Debt-to-equity	0.0481***	0.0328***	0.0475***
	(0.001)	(0.007)	(0.002)
Market-to-book	0.0009	0.0124**	0.0001
	(0.855)	(0.032)	(0.991)
log (capital expenditures)	0.6686***	1.0641***	0.7458***
	(0.000)	(0.000)	(0.002)
Observations	13851	13851	13824
R-squared (overall)	0.32	0.2395	0.2404

Results are from OLS with robust standard errors clustered around firm ids and firm and industry fixed effects models of the effect of vega on firm risk for the period 2003-2015. The dependent variable is the annualized standard deviation of daily stock returns. The high CSR sample includes all the firm years where net score on CSR is greater than the median CSR net score of all firms and the low CSR sample includes all the firm years where net score on CSR is less than the median CSR score of all firms. *, **, *** are statistically significant at the 1, 5 and 10% levels, respectively. Definitions of the variables are given in appendix.

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Table 8: Effect of vega on firm risk: High vs low using adjusted CSR

	$Volatility_{t+1}$		
Variables	OLS	Firm Fixed Effects	Industry Fixed Effects
Log (delta)	-0.0716***	-0.0750***	-0.0699***
	(0.000)	(0.000)	(0.000)
High CSR * Log (vega)	-0.0023	-0.0007	-0.0015
	(0.620)	(0.843)	(0.614)
Low CSR * Log (vega)	0.0117***	0.0099***	0.0120***
	(0.000)	(0.000)	(0.000)
High CSR	-0.0162	-0.0267*	-0.0118
	(0.450)	(0.082)	(0.412)
Log (cash compensation)	-0.0132**	-0.0236***	-0.0202***
	(0.044)	(0.000)	(0.000)
CEO age>64	-0.0460***	-0.0233*	-0.0417***
	(0.007)	(0.099)	(0.000)
CEO tenure	0.0028***	0.0017**	0.0020***
	(0.001)	(0.038)	(0.000)
CEO stock ownership	0.0135***	0.0144***	0.0123***
	(0.000)	(0.000)	(0.000)
Log (sales)	-0.0861***	-0.1081***	-0.0919***
	(0.000)	(0.000)	(0.000)
Debt-to-equity	0.0480***	0.0329***	0.0474***
	(0.001)	(0.000)	(0.000)
Market-to-book	0.001	0.0134***	0.0003
	(0.847)	(0.003)	(0.933)
log (capital expenditures)	0.6857***	1.0614***	0.7565***
	(0.000)	(0.000)	(0.000)
Observations	13851	13851	13824
R-squared (overall)	0.3224	0.2407	0.2416

Results are from OLS with robust standard errors clustered around firm ids and firm and industry fixed effects models of the effect of vega on firm risk for the period 2003-2015. The dependent variable is the annualized standard deviation of daily stock returns. High CSR sample includes all the firm years where net score on adjusted CSR is greater than the net score on industry median adjusted CSR and low CSR sample includes all the firm years where net score on adjusted CSR is less than the industry median adjusted CSR score. *, **, *** are statistically significant at the 1, 5 and 10% levels, respectively. Definitions of the variables are given in appendix.

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Table 9: Effect of vega on firm risk: using a 2- year lag

	$Volatility_{t+2}$		
Variables	OLS	Firm Fixed Effects	Industry Fixed Effects
Log (delta)	-0.0317***	0.008	-0.0302***
	(0.000)	(0.166)	(0.001)
High CSR * Log (vega)	-0.0027	-0.0023	-0.0042
	(0.595)	(0.607)	(0.564)
Low CSR * Log (vega)	0.0094***	0.0126***	0.0105***
	(0.000)	(0.000)	(0.000)
High CSR	-0.0307	-0.0246	-0.0146
	(0.171)	(0.209)	(0.704)
Log (cash compensation)	-0.0116*	-0.0309***	-0.0167**
	(0.066)	(0.002)	(0.022)
CEO age>64	-0.0698***	-0.0430**	-0.0660***
	(0.000)	(0.024)	(0.001)
CEO tenure	0.0009	-0.0047***	0.0001
	(0.297)	(0.000)	(0.922)
CEO stock ownership	0.0097***	0.0118***	0.0085***
	(0.000)	(0.000)	(0.000)
Log (sales)	-0.0739***	-0.0758***	-0.0787***
	(0.000)	(0.000)	(0.000)
Debt-to-equity	0.0186***	0.0029	0.0167**
	(0.006)	(0.236)	(0.012)
Market-to-book	-0.0115**	0.0110**	-0.0096*
	(0.031)	(0.034)	(0.058)
log (capital expenditures)	0.5106***	0.7480***	0.5297***
	(0.001)	(0.000)	(0.006)
Observations	13390	13390	13365
R-squared (overall)	0.2224	0.122	0.1442

Results are from OLS with robust standard errors clustered around firm ids and firm and industry fixed effects models of the effect of vega on firm risk for the period 2003-2015. The dependent variable is the annualized standard deviation of daily stock returns. *, **, *** are statistically significant at the 1, 5 and 10% levels, respectively. Definitions of the variables are given in appendix.

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Table 10: Effect of vega on firm risk: Controlling for board characteristics

	$Volatility_{t+1}$		
Variables	OLS	Firm Fixed Effects	Industry Fixed Effects
Log (delta)	-0.0730***	-0.0747***	-0.0710***
	(0.000)	(0.000)	(0.000)
High CSR * Log (vega)	0.0067	0.0039	0.0054
	(0.147)	(0.411)	(0.372)
Low CSR * Log (vega)	0.0120***	0.0162***	0.0131***
	(0.000)	(0.000)	(0.000)
High CSR	-0.0656***	-0.0606***	-0.0541*
	(0.003)	(0.005)	(0.088)
Log (cash compensation)	-0.0244***	-0.0438***	-0.0299***
	(0.001)	(0.000)	(0.000)
CEO age>64	-0.0636***	-0.0520***	-0.0584***
	(0.000)	(0.007)	(0.001)
CEO tenure	0.0027***	0.0013	0.0020**
	(0.001)	(0.267)	(0.017)
CEO stock ownership	0.0150***	0.0189***	0.0142***
	(0.000)	(0.000)	(0.000)
Log (sales)	-0.0458***	-0.0716***	-0.0532***
	(0.000)	(0.000)	(0.000)
Debt-to-equity	0.0425***	0.0284***	0.0417***
	(0.002)	(0.009)	(0.002)
Market-to-book	-0.0086*	0.0054	-0.0067
	(0.086)	(0.361)	(0.281)
log (capital expenditures)	0.6246***	0.9613***	0.6920***
	(0.000)	(0.000)	(0.002)
Board independence	-0.0485	0.1259***	0.0275
	(0.177)	(0.002)	(0.492)
Board size	-0.0152***	-0.0075*	-0.0119***
	(0.000)	(0.074)	(0.000)
Observations	13650	13650	13623
R-squared (overall)	0.2863	0.201	0.2081

Results are from OLS with robust standard errors clustered around firm ids and firm and industry fixed effects models of the effect of vega on firm risk for the period 2003-2015. The dependent variable is the annualized standard deviation of daily stock returns. *, **, *** are statistically significant at the 1, 5 and 10% levels, respectively. Definitions of the variables are given in appendix.