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CEO risk-taking incentives and socially irresponsible activities

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ABSTRACT

This study examines the relationship between CEO risk-taking incentives, measured by the sensitivity of CEO wealth held in options to a change in stock return volatility or Vega, and socially irresponsible activities using a large sample of U.S. firms during the period 1992–2012. Our results for the period before the 2007 financial crisis suggest that CEO risk-taking incentives are positively related to socially irresponsible activities. In addition, we find that a firm's socially responsible actions may act as a moderator, strengthening the aforementioned relationship. The results after the 2007 financial crisis show no evidence of a significant relationship between CEO risk-taking incentives and socially irresponsible activities. This could be due to the increased scrutiny regarding compensation packages and the increased role of reputational issues in the aftermath of the financial crisis. Our results suggest that risk-taking incentives embedded in the CEO compensation scheme have implications for corporate policies toward socially irresponsible activities.

1. Introduction

The concept of corporate social responsibility (CSR) has received considerable attention by academics and practitioners as firms face pressure from various internal and external stakeholders to integrate CSR into company actions and operations (Borghesi, Houston, & Naranjo, 2014; Crifo & Forget, 2015). CSR is defined as voluntary activities conducted by firms to achieve social goals (McWilliams & Siegel, 2001). In managerial terms, it means that the firm should be profitable, ethical and comply with the law (Carroll, 1999). These definitions focus more on socially responsible activities related to positive actions and outcomes, and less on the other side of the same coin, namely socially irresponsible activities related to negative actions and outcomes (Kotchen & Moon, 2012). This distinction is crucial as the same firm might be involved in both socially responsible and irresponsible activities (Chatterji, Levine, & Toffel, 2009; Mattingly & Berman, 2006; Scholtens & Zhou, 2008).

The literature linking executive compensation and CSR have mainly focused on how specific components of compensation packages (i.e., salary, bonus, stock awards and stock options) affect firms' involvement in socially responsible or irresponsible

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activities (Cai, Jo, & Pan, 2011; Deckop, Merriman, & Gupta, 2006; Mahoney & Thorne, 2005, Mahoney & Thorn, 2006; McGuire, Dow, & Argheyd, 2003; Rekker, Benson, & Faff, 2014).[1] This literature provides mixed evidence, for example, McGuire et al. (2003) find that CEO salary and the percentage of long-term incentive payments (i.e., stock options and other long-term incentives) in the CEO's compensation package have a positive association with socially irresponsible activities. In contrast, Mahoney and Thorne (2005) find that long-term compensation (i.e., stock option grants divided by total compensation) is associated with lower socially irresponsible activities. Mahoney and Thorn (2006) find that CEO stock options are positively related to socially responsible activities. Deckop et al. (2006) find that CSR is negatively related to short-term compensation incentives (i.e., bonuses divided by total compensation) and positively related to long-term compensation incentives (i.e., restricted stocks and stock options divided by total compensation). A common characteristic of this literature is that it does not explicitly consider how risk-taking incentives embedded in the CEO compensation package affect firms' involvement in socially irresponsible activities. To the best of our knowledge, our study is the first to use an explicit measure of CEO risk-taking incentives (i.e., the sensitivity of CEO wealth held in options to change in stock return volatility or Vega) to examine its impact on socially irresponsible activities.[2]

Equity-based compensation and corresponding incentives have been widely used by corporations to align the incentives of CEOs with their shareholders' interests in order to take decisions that maximize firm value. In this paper, we argue that risk-taking incentives embedded in the CEO compensation package could affect firm's involvement in socially irresponsible actions. We begin by noting that firm's involvement in socially irresponsible activities is subject to managerial discretion, and therefore could be influenced by managerial incentives (McGuire et al., 2003). Specifically, we hypothesize a positive relationship between CEO risk-taking incentives and socially irresponsible activities. Two mechanisms could explain this fact. First, CEOs could be involved in socially irresponsible activities because of financial performance pressures linked to these risk-taking incentives. Second, managers may underestimate the potential negative implications of socially irresponsible activities (Tang, Qian, Chen, & Shen, 2015).

We also argue that the level of socially responsible activities of the firm moderates the relation between socially irresponsible activities and risk-taking incentives, such that the relationship will be stronger for firms with higher levels of socially responsible activities. This is motivated by the findings of a recent strand of research which suggests that socially irresponsible activities and socially responsible activities might be related (e.g., Chatterji & Toffel, 2010; Kotchen & Moon, 2012; Mattingly & Berman, 2006; Ormiston & Wong, 2013; Strike, Gao, & Bansal, 2006). In addition, recent research suggests that socially responsible activities help CEOs accrue moral credits, which in turn allow them to be involved in socially irresponsible activities without discrediting themselves or their firms (Ormiston & Wong, 2013). Therefore, we expect that the relationship between CEO risk-taking incentives and firm involvement in socially irresponsible activities will be strengthened when a firm is involved in socially responsible activities.

In order to analyse whether risk-taking incentives embedded in CEO compensation are related to socially irresponsible activities, we examine a large sample of US firms over the period 1992–2012. We use the MSCI ESG STATS (formerly KLD) database which evaluates companies in terms of socially responsible and irresponsible activities. For the period before the 2007 financial crisis, our results suggest a positive and statistically significant effect of CEO risk-taking incentives on firm's socially irresponsible activities. In addition, we find that this relationship is stronger for firms that have a higher prior level of socially responsible activities. The results after the 2007 financial crisis show no evidence of a significant relationship between CEO risk-taking incentives and socially irresponsible activities. This could be due to the increased scrutiny regarding compensation packages and the increased role of reputational issues in the aftermath of the financial crisis.

Our contributions to the CSR-compensation literature are as follows. First, we use an explicit measure of CEO risk-taking incentives measured by the sensitivity of CEO wealth held in options to change in stock return volatility or Vega (Coles, Daniel, & Naveen, 2006; Core & Guay, 2002; Guay, 1999) and examine its impact on socially irresponsible activities. Second, our study complements previous research suggesting that socially irresponsible activities need a separate treatment (Strike et al., 2006). Third, we try to shed light on the debate about why firms might be involved in socially irresponsible activities as empirical evidence on this is very limited so far (Lange & Washburn, 2012; Ormiston & Wong, 2013). Fourth, our results suggest that the structure of CEO compensation may be used as a tool to implement the social responsibility agenda of a company. For example, the board of directors would be interested to understand how risk-taking incentives could encourage/discourage the CEO from being involved in socially irresponsible activities. Finally, our results are also particularly relevant for policy decisions, in light of the increased interest by stakeholders, such as investors and policy makers, in the relationship between corporate social responsibility (CSR) and executive compensation.

[1] Most of the literature focused on the link between CSR and financial performance. This link has been studied from different angles ranging from firm value such as Tobin's *q* (Surroca, Tribó, & Waddock, 2010), stock returns (Kappou & Oikonomou, 2016), cost of debt and credit ratings (Oikonomou, Brooks, & Pavelin, 2014a), and financial risk (Oikonomou, Brooks, & Pavelin, 2012). Another strand of CSR research examined the relationship between a firm's CSR and CEO characteristics (Chin et al., 2013; Manner, 2010; Slater & Dixon-Fowler, 2009; Tang et al., 2015). A recent review of the literature about integrating CSR in executive compensation policies can be found in Flammer, Hong, and Minor (2016).

[2] Our paper focuses on non-financial firms but it should be noted that some studies in the banking literature have investigated the relationship between CEO risk-taking incentives and firm's performance, risk and probability to default. Fahlenbrach and Stulz (2011) find that CEO risk-taking incentives do not affect bank performance. Cheng et al. (2015) find that riskier banks might offer higher total pay as compensation by observing a wide range of compensation components of the top five bank executives. Boyallian and Ruiz-Verdú (2015) find that managerial risk-taking incentives affect the probability of bank failure.

The remainder of the paper is organized as follows. Section 2 presents our hypotheses. Section 3 describes our data and methodology. Section 4 presents and discusses our results. Section 5 concludes.

2. Hypotheses development

In this section, we start by describing the CEO risk-taking incentives embedded in the compensation package. Then, we explain the potential impact that these incentives might have on socially irresponsible activities.

2.1. CEO risk-taking incentives

In order to better understand managerial incentives, we start by considering the composition of the CEO compensation package. Generally, CEO total compensation includes non-equity compensation (e.g., base salary and bonuses) plus equity-based compensation (i.e., stock options and stock awards).[3] Half of the total CEO compensation, in S&P 500 firms in 2011, is based on stock options and stock awards (Murphy, 2013). In 2011, the average CEO Pay of S&P 500 firms is $12.3 million (Murphy, 2013).

The most important source of risk-taking incentives originates from stock options (Murphy, 2013). One of the important characteristics of stock option compensation is its non-linear (convex) payoff (Hull, 2009). That is, the payoff is asymmetric (capped maximum loss versus an unlimited maximum profit). When the stock price is higher than the exercise price, the upside potential is unlimited. However, when the stock price falls below the exercise price, the loss is limited.

Hence, stock options provide the CEO natural incentives to take greater risks through an increase in the firm's stock return volatility. Therefore, the sensitivity of CEO wealth held in options to a change in stock return volatility or Vega, has been commonly used in the literature as a proxy for CEO risk-taking incentives. Vega is defined as the change in the value of the CEO's option portfolio due to a 1% increase in firm's stock volatility (Coles et al., 2006; Core & Guay, 2002; Guay, 1999). Several studies have shown that higher Vega CEOs take riskier investments and financing policies (Coles et al., 2006; Core & Guay, 2002; DeYoung, Peng, & Yan, 2013; Guay, 1999). The CEO has been commonly characterized as risk averse and undiversified (Murphy, 2013). In this context, the challenge for the board of directors, on behalf of shareholders, is to choose the right level of incentives for the CEO to take enough risk and drive value creation, without incurring in excessive risk-taking.

As mentioned in the introduction, several studies have investigated the link between executive compensation and CSR activities (e.g., Cai et al., 2011; Mahoney & Thorn, 2006; McGuire et al., 2003). However, these studies examine the relationship between CSR and the level of specific compensation components, such as salary, bonuses, or options held by the CEO. While this is important as it increases our understanding of the link between CSR and executive compensation, these studies do not address the important question as to whether the incentives embedded in the compensation components encourage or discourage managers to be involved in socially irresponsible activities. Our paper aims to fill this gap by exploring how CEO risk-taking incentives (measured by Vega) might affect firm's involvement in socially irresponsible activities.

2.2. Risk-taking incentives and socially irresponsible activities

Agency theory and transaction cost economics suggest that the CEO compensation package should be designed in such way that it limits or controls opportunism or self-interest seeking, for example through monitoring, interest-aligning mechanisms, and performance incentives (Jones & Wicks, 1999). Agency theory suggests that compensation plans should be designed to align the interests of both CEOs and their shareholders (Murphy, 2013). The composition of the CEO compensation package shapes his/her risk-taking incentives and this has been observed in both financial and non-financial firms (Boyallian & Ruiz-Verdú, 2015; Cheng, Hong, & Scheinkman, 2015; Coles et al., 2006; DeYoung et al., 2013; Fahlenbrach & Stulz, 2011; Murphy, 2013).

The board of directors can use compensation schemes in order to influence executives' behaviours, through risk-taking incentives embedded within the CEO compensation packages, which in turn could affect firm's involvement in socially irresponsible activities. Since socially responsible and irresponsible activities are usually subject to managerial discretion (Donaldson & Preston, 1995), they could be heavily influenced by managerial incentives (McGuire et al., 2003). CEOs could be driven by financial objectives and competitive pressure, which in turn could lead the firm to be involved in socially irresponsible activities.[4] Moreover, managers may underestimate the potential negative implications of socially irresponsible

[3] Total compensation includes base salary, bonuses, non-equity incentives, stock options and awards, and other pay (e.g., pension benefits).

[4] An important strand of the literature looks at the potential bilateral link between CSR and firm risk (Scholtens, 2008). The general finding of this literature is that CSR reduces firm risk. For example, some studies examine the relation between CSR and the cost of capital (El Ghoul, Guedhami, Kwok, & Mishra, 2011; Feldman, Soyka, & Ameer, 1997; Goss & Roberts, 2011; Sharfman & Fernando, 2008). Other studies examine the relationship between CSR and firm risk during the financial crisis period (Bouslah, Kryzanowski, & M'Zali, 2016). Oikonomou et al. (2012) find that firms involved in controversial activities are associated with a higher degree of stock market risk.

activities. Tang et al. (2015) find that CEOs are more likely to engage in socially irresponsible activities because they tend to ignore the importance of stakeholders in terms of support and resources. Tang et al. (2015) argue that CEOs may be involved in socially irresponsible activities because of their beliefs that they can deal with all negative consequences that might arise. This reasoning leads to our first hypothesis:

Hypothesis 1. *There is a positive relationship between CEO risk-taking incentives and firm involvement in socially irresponsible activities.*

2.3. The moderating effect of socially responsible activities

A recent strand of research suggests that socially irresponsible and socially responsible activities might be related. Some studies find that both socially responsible and irresponsible activities can occur simultaneously (e.g., Mattingly & Berman, 2006; Strike et al., 2006), other studies find that prior socially irresponsible activities affect subsequent socially responsible activities (e.g., Chatterji & Toffel, 2010; Kotchen & Moon, 2012), and other studies find that prior socially responsible activities affect subsequent socially irresponsible activities (e.g., Ormiston & Wong, 2013). Strike et al. (2006) find that internationally diversified firms are likely to be simultaneously involved in socially responsible and irresponsible activities. Mattingly and Berman (2006) find that both socially responsible and irresponsible activities are positively correlated suggesting that firms can potentially engage in both activities.

Other studies find that socially irresponsible activities affect socially responsible activities. For example, Chatterji and Toffel (2010) show that firms improve their environmental performance after receiving a poor environmental rating. Kotchen and Moon (2012) find that companies engage in socially responsible activities in order to offset (compensate) socially irresponsible activities, but the effect varies across industries and categories of socially responsible and irresponsible activities. Kang, Germann, and Grewal (2016) find that firms seem to use socially responsible activities strategically as a penance mechanism in order to offset their past missteps in order to appease their stakeholders. However, the authors find that this penance mechanism does not pay off financially perhaps because stakeholders interpret it as unauthentic or even as deceitful (e.g., seeking to "greenwash" past mistakes). This could be explained by two theoretical perspectives: *(i)* the notion of cue diagnosticity of corporate character (i.e., using cues which are relevant information or something that is considered by stakeholders to be potentially informative) from social judgment theory (Mishina, Block, & Mannor, 2012) and *(ii)* arguments regarding the imputation of corporate motives (Godfrey, 2005).

Mishina et al. (2012) argue that stakeholders make reputational judgments based on positive and negative cues about the firm's character reputation (e.g., socially responsible or irresponsible activities). In particular, negative cues tend to receive higher weight than positive cues because they are viewed as deviations from the norm that is socially expected (Mishina et al., 2012). Godfrey (2005) argues that stakeholders impute moral values to firm's intentions, motivations and character. The greater (lower) the stakeholders view socially responsible activities as a truly manifestation of the firm's character, the greater (lower) the moral judgment will be. Alternatively, firms using socially responsible activities to ingratiate themselves with stakeholders will receive negative evaluations (Godfrey, 2005).

Consistent with the arguments of Mishina et al. (2012) and Godfrey (2005), Oikonomou, Brooks, and Pavelin (2014b) find that portfolios of firms having both socially responsible activities and socially irresponsible activities tend to significantly underperform portfolios of firms having socially responsible activities only or portfolios of firms having socially irresponsible activities only. Kang et al. (2016) find that using socially responsible activities to offset past socially irresponsible activities does not attenuate the negative performance implication of socially irresponsible activities. This suggests that the involvement in socially irresponsible activities could be due to other factors, such as CEO risk-taking incentives provided by the CEO compensation packages.

We argue that the level of socially responsible activities of the firm will moderate the relation between risk-taking incentives and socially irresponsible activities, such that the relationship will be stronger for firms with higher levels of socially responsible activities. In other words, the relationship between socially irresponsible activities and CEO risk-taking incentives could be intensified by the presence of socially responsible activities.

To provide additional theoretical support to our arguments regarding the moderating role of socially responsible activities on the relation between risk-taking incentives and socially irresponsible activities, we draw upon psychology and strategic management research (e.g., Henisz, Dorobantu, & Nartey, 2014; Mishina et al., 2012; Ormiston & Wong, 2013). Ormiston and Wong (2013) argue that CEOs could accrue moral credits by undertaking socially responsible activities, which allow them to be involved in socially irresponsible activities.

A closely related concept to "moral credit" is the "social license to operate". Henisz et al. (2014) show that social license to operate is essential to conducting business and is a driver of financial performance in the gold mining sector. In this context, socially responsible activities are undertaken to maintain the social license (e.g. the right to operate), which is granted formally and directly by some stakeholders such as the government, but also informally and indirectly by other stakeholders (e.g., local communities). Socially responsible activities help the firm to reduce conflict and increase cooperation with stakeholders. The above theoretical arguments suggest that CEOs accruing moral credits and the legitimacy to operate may be induced to take more risk (e.g., by being involved in socially irresponsible activities) without discrediting themselves or their firms. This effect will be exacerbated if CEOs also underestimate the potential negative implications of socially irresponsible activities.

Socially responsible activities could also be viewed as an intangible asset, which could be associated with a buffer to take more risk (e.g. by being involved in socially irresponsible actions). Alternatively, socially responsible activities may create a shield against the reputational losses associated with socially irresponsible activities. For example, a CEO with high risk-taking incentives may focus on maximizing profits for shareholders, potentially resulting in socially irresponsible activities (e.g., using a polluting technology or a poor waste management which are harmful to the environment). This behaviour is very risky from the point of view of the CEO in the sense that if the worst case scenario happens, the market penalty will be substantial and could even threaten the survival of the company. The work of Bhattacharya and Sen (2004), Godfrey (2005), and Godfrey, Merrill, and Hansen (2009) suggest that socially responsible activities help the firm building a reservoir of goodwill which induces stakeholders to downplay or minimize the negative information about the firm. The above reasoning leads to our second hypothesis:

Hypothesis 2. *The relationship between CEO risk-taking incentives and firm involvement in socially irresponsible activities will be strengthened when the firm has been previously involved in socially responsible activities.*

3. Data and methodology

3.1. Data and sample selection

3.1.1. Measuring corporate socially (ir)responsible activities

To measure socially responsible and irresponsible activities, we use the MSCI ESG STATS (formerly KLD), which covers U.S. listed companies from 1992 to 2012. KLD database provides binary ratings for several criteria across seven dimensions: Community Diversity, Employee relations, Environment, Products, Human Rights, and Corporate Governance.[5] It allows us to identify companies that have been involved in socially responsible or irresponsible activities. Socially responsible and irresponsible activities are conceptually different, subject to different dynamics, and have different implications for firms (Semenova & Hassel, 2015; Tang et al., 2015). We use firm's strengths as a proxy for socially responsible activities, and firm's concerns as a proxy for socially irresponsible activities (e.g., Borghesi et al., 2014; Strike et al., 2006).

We compute an index of socially irresponsible activities (CON) as follows. First, we compute the yearly average concern score for each KLD dimension. Second, we compute the index of socially irresponsible activities (CON) as the arithmetic average across the seven KLD dimensions. We also compute an index of socially responsible activities (STR) in a similar way as the index of socially irresponsible activities (CON). We first compute yearly average strength score for each KLD dimension. We then compute the index of socially responsible activities (STR) as the arithmetic average across the seven KLD dimensions.[6]

3.1.2. CEO risk-taking incentives

Our CEO characteristics and compensation data come from the Standard & Poor's Execucomp database for the period 1992–2012. This database contains extensive information on CEO compensation items for S&P 1500 firms. As a proxy for CEO risk-taking incentives, we use the sensitivity of CEO wealth held in options to firm risk (Vega), which measures the change of CEO wealth for a 1% increase in stock price volatility.[7] A high value of this variable is commonly associated with high risk-taking incentives of the CEO as it may induce risky investment choices. CEO seeks to benefit from increases in share price volatility that results from risky investments (Hagendorff & Vallascas, 2011).

Table 1 presents descriptive statistics of our variables. Panel A of Table 1 shows that the index of socially irresponsible activities or concern measure (CON) ranges between 0 and 0.681 with a mean (median) value of 0.073 (0.056) and a standard deviation of 0.07. The index of socially responsible activities or strength measure (STR) ranges between 0 and 0.843 with a mean (median) value of 0.052 (0.024) and a standard deviation of 0.085. The mean (median) strength (STR) is lower than the mean (median) concern (CON) suggesting that the average firm has more concerns than strengths. The difference in mean (median) values is statistically significant at the 1% level.[8]

3.1.3. CEO control variables

The CEO control variables are based on previous research on corporate social responsibility (CSR) as well as CEO managerial incentives and compensation. We consider CEO Tenure, CEO age and the sensitivity of CEO wealth held in options to stock price performance (Delta) (Coles et al., 2006).

[5] Appendix II shows the MSCI ESG STATS (KLD)'s strength and concern indicators for each of the seven dimensions covered by KLD.

[6] Some studies have pointed out some limitations of the KLD data (Mattingly & Berman, 2006; Chatterji et al., 2009). For example, Chatterji et al. (2009) compare the environmental performance based on KLD data with the environmental performance based on Toxics Release Inventory (TRI) data. They find that KLD environmental concerns to be fairly good summaries of past environmental performance, whereas KLD environmental strengths cannot predict precisely environmental performance. In spite of these limitations, KLD data is the most widely used CSR database in academic research.

[7] Please refer to Coles et al. (2006) and Core and Guay (2002) for detailed calculation of the variables. Appendix III provides detailed information about the calculation of Vega of the CEO.

[8] The *t*-test for the difference in mean has a t-stat of 29.1 with zero p-value, whereas the Wilcoxon signed-rank test for the difference in median has a z-stat of 43.72 with zero p-value.

Table 1
Summary statistics.

	Mean	Median	Standard Deviation	Minimum	Maximum	Skewness	Kurtosis	Observations
Panel A: Social (ir)responsibility variables								
CON	0.073	0.056	0.070	0	0.681	1.861	8.694	18,496
STR	0.052	0.024	0.085	0	0.843	3.359	18.611	18,496
Panel B: CEO variables								
VEGA	151.742	65.619	236.326	0	1426.718	3.128	14.463	17,501
DELTA	787.347	245.022	1890.294	4.564	14245.210	5.285	34.201	16,880
TENURE_CUM	5.361	4	3.836	1	21	1.129	3.980	18,496
AGE	55.688	56	7.265	28	96	0.271	3.884	17,699
Panel C: Firm characteristics								
SIZE	7.640	7.542	1.478	4.711	11.561	0.333	2.668	18,493
BLEVERAGE	0.237	0.200	0.243	0	1.527	2.413	12.080	18,421
R&D	0.030	0.004	0.048	0	0.227	2.034	6.885	18,493
CAPEX	0.056	0.041	0.051	0.003	0.281	2.043	7.935	17,665
ROA	0.139	0.133	0.088	−0.134	0.417	0.199	4.315	18,455
PPE	0.280	0.218	0.217	0.013	0.886	1.007	3.206	18,453
S_CASH	0.094	0.082	0.088	−0.122	0.381	0.699	4.136	18,289
VOLATILITYD	0.413	0.372	0.187	0.152	1.129	1.398	5.349	18,224
MB	2.013	1.628	1.202	0.796	7.535	2.296	9.205	18,486

Note: All variables are defined in Appendix I. The variables DELTA, VEGA are in $000s. The variable TENURE_CUM and AGE are in years. The Skewness and Kurtosis measures for each of the variables are statistically significant at the 1% level.

CEO tenure (the number of years the CEO has been in his/her current role) captures CEO's risk aversion (Coles et al., 2006). The age of the CEO is expressed in years as reported in the annual proxy statement. We also control for the sensitivity of CEO wealth held in options to stock price performance (Delta) which is defined as the change in the dollar value of the CEO wealth held in options for a 1% change in the stock price. Higher delta increases the incentives of a CEO to increase shareholder value because of the stock and option holdings, but it also exposes the risk-averse and undiversified CEO to more risk which could discourage the CEO from undertaking positive NPV projects if they are very risky (Coles et al., 2006; Murphy, 2013).

Panel B of Table 1 shows that the typical CEO has a mean (median) Vega of $151,742 ($65,619), and a mean (median) Delta of $787,347 ($245,022). In other words, the typical CEO enjoys an increase of $65,619 in his/her wealth for a 1% increase in stock return volatility, and an increase of $245,022 for a 1% increase in the stock price. The mean (median) age of a CEO is 55.69 (56) years with a mean (median) tenure of 5.36 (4) years.

3.1.4. Firm control variables

Based on existing CSR literature (Cai et al., 2011; Chin, Hambrick, & Treviño, 2013; Deckop et al., 2006; Mahoney & Thorne, 2005, Mahoney & Thorn, 2006; Manner, 2010; Rekker et al., 2014; Slater & Dixon-Fowler, 2009; Tang et al., 2015), we include a set of firm characteristics as determinants of firm's involvement in socially irresponsible activities. Control variables, together with their expected signs, include: Firm size (SIZE (+)), Leverage (BLEVERAGE (−)),[9] Research and Development (R&D (+)), Capital expenditures (CAPEX (−)), Return on Assets (ROA (−)),[10] Net Property, Plant, and Equipment (PPE (+)), Surplus Cash (S_CASH (±)), Firm Risk (VOLATILITYD (+)) and Market-to-Book value of assets (MB (+)) to capture investment opportunities of the firm.[11] All control variables are defined in Appendix I.

The expected sign on the SIZE coefficient is positive. Larger firms are more exposed to agency problems (Jensen & Meckling, 1976). Dimson, Karakas, and Li (2015) find that larger firms are more likely to be targeted by activist investors. Since larger firms usually have more fixed assets (PPE), higher R&D expenses (R&D) and higher investment opportunities (MB), we would expect these variables to be also positively related to the index of socially irresponsible activities (CON). The effect of BLEVERAGE on socially irresponsible activities is expected to be negative because debt serves as disciplinary mechanism that prevent managers from diverting/committing cash to unprofitable projects that generate private benefits (Ferrell, Liang, & Renneboog, 2016). Higher values of S_CASH provide managers with the most latitude as to how and when to spend it (Ferrell et al., 2016), suggesting an ambiguous expected sign in the case of irresponsible activities. We include CAPEX in our models based on the assumption that firms that adopt a long-term view (e.g., investing in environment-friendly

[9] We also consider using market leverage (MLEVERAGE) defined as total book debt divided by market value of total assets, but the correlation with book leverage is high (0.87).

[10] We also consider two alternative profitability measures: Stock Return (RETURNS) measured as the annual return over the fiscal year and Cumulative Returns (CUMTRET) measured as the annually compounded daily stock returns. The results remain unchanged.

[11] Following a referee's suggestion, we also included the variable "CEO compensation paid in options as a percentage of total CEO compensation" as an additional control variable. The results showed that the coefficient associated with this variable is not significant regardless of the estimation method used. These results are available from the authors upon request.

production processes and in product quality improvements) are less exposed to socially irresponsible activities. Firm profitability (ROA) may also have a negative effect on irresponsible actions, as firms with a good financial performance tend to perform well in CSR activities. Finally, as riskier strategies could lead to socially irresponsible activities, the VOLATILITYD coefficient is expected to be positive. Panel C in Table 1 provides descriptive statistics of firm characteristics.

The final sample has 18,496 CEO-firm-year observations, which correspond to 3934 CEOs for 2055 unique firms resulting from merging four databases: Standard & Poor's Execucomp, CRSP, COMPUSTAT and MSCI ESG STATS or KLD over the period 1992–2012. All variables have been winsorized at 1% and 99% of their empirical distribution to eliminate the effect of outliers. In line with the research design of previous studies, financial firms (SIC code: 6000–6999) and utility firms (SIC code: 4900–4999) are excluded due to different reporting standards which may cause problems in terms of data comparability.

Table 2 presents the Pearson's correlation coefficients among all variables used in this paper. Although the strengths and concerns are positively correlated, the magnitude of this correlation is relatively low (0.2766) suggesting that socially irresponsible activities and socially responsible activities are two different concepts and should be examined separately as they are subjects to different dynamics (Goss & Roberts, 2011; Mattingly & Berman, 2006; McGuire et al., 2003). This reinforces the validity of our study since we are focusing on socially irresponsible activities, although our empirical analysis controls for socially responsible activities. Table 2 shows that correlations are low, which suggests that multicollinearity is not an issue for our estimations.

3.2. Methodology

The aim of this study is to investigate the impact of CEO risk-taking incentives on socially irresponsible activities. In order to achieve this objective, we extend the literature on the main determinants of socially irresponsible activities (e.g., Deckop et al., 2006; Mahoney & Thorne, 2005, Mahoney & Thorn, 2006; Manner, 2010; Slater & Dixon-Fowler, 2009; Tang et al., 2015) by including CEO risk-taking incentives (e.g., Coles et al., 2006; Core & Guay, 2002; Daniel, Li, & Naveen, 2013). We propose the following empirical model:

$$CON_{i,t} = f\left(VEGA_{i,t-1},\ STR_{i,t-1},\ FIRM\ CONTROLS_{i,t-1},\ CEO\ CONTROLS_{i,t-1}\right) \quad (1)$$

where $CON_{i,t}$ refers to an index of socially irresponsible activities based on KLD concerns, and $VEGA_{i,t}$ is the CEO risk-taking incentives of firm i at time t. $STR_{i,t}$ refers to an index of socially responsible activities based on KLD strengths. Firm and CEO control variables were described in the previous section. All the independent variables are lagged one period in order to mitigate endogeneity issues.[12] We include industry dummy variables based on the classification of Fama and French (1997). Year dummies are also included to control for differences across years.

In order to test whether socially responsible activities strengthen the effect of CEO risk-taking incentives on socially irresponsible actions, we extend equation (1) by including an interaction term between CEO risk-taking incentives and the index of socially responsible activities.

$$CON_{i,t} = f\left(VEGA_{i,t-1},\ STR_{i,t-1},\ VEGA_{i,t-1}{*}STR_{i,t-1},\ FIRM\ CONTROLS_{i,t-1},\ CEO\ CONTROLS_{i,t-1}\right) \quad (2)$$

We estimate equations (1) and (2) using pooled OLS as well as panel data estimation techniques. Panel data models are useful to control for firm unobserved heterogeneity. Fixed effects (FE) and random effects (RE) are the two most usual panel data methods. The choice between FE and RE estimators is based on a Hausman test (Hausman, 1978). The results of the Hausman test suggest that the FE model is preferred. Nevertheless, we report FE and RE estimations for comparison purposes.

Our regression specification assumes that Vega is exogenous. However, this might not be the case if some of the independent variables and/or unobserved variables that are not controlled for could affect both Vega and socially irresponsible activities (CON). Thus, Vega might be endogenous. Therefore, we use an instrumental variables (IV) model estimated using a two-stage efficient Generalized Method of Moments (GMM). We use the following instruments: *(i)* the average Vega of firms having their headquarters located in the same state and *(ii)* the average Vega for the industry in which the firm operates. The validity of the instruments is tested using Hansen test (Cameron and Trivedi, 2005). We also conducted an endogeneity test (Cameron and Trivedi, 2005), which suggest that the use of OLS and panel data estimation techniques is appropriate. Nevertheless, the results from the IV-GMM regression models are reported for comparison purposes.

4. Results

4.1. CEO risk-taking incentives and socially irresponsible activities

Based on our theoretical framework, we test whether CEO Vega is associated with socially irresponsible activities (CON). We carry out the analysis for three periods: before the financial crisis (pre-2007), after the financial crisis (post-2007) and the

[12] Oikonomou et al. (2014a) use a similar methodological approach to mitigate potential endogeneity concerns.

Table 2
Pearson's correlation coefficients.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
CON	(1)	1														
STR	(2)	0.2766*	1													
VEGA	(3)	0.2648*	0.3312*	1												
DELTA	(4)	0.0481*	0.1014*	0.3529*	1											
TENURE_CUM	(5)	0.0091	0.0171	0.1700*	0.2022*	1										
AGE	(6)	0.0507*	0.0257	0.0454*	0.0855*	0.3149*	1									
SIZE	(7)	0.4591*	0.4549*	0.5115*	0.2281*	0.0306*	0.0869*	1								
MB	(8)	−0.0919*	0.0242	0.1280*	0.2932*	−0.0319*	−0.0840*	−0.1428*	1							
BLEVERAGE	(9)	0.1284*	0.0667*	−0.008	−0.0711*	0.0004	0.0267	0.2616*	−0.2589*	1						
R&D	(10)	−0.0527*	0.0368*	0.0363*	0.0008	−0.0016	−0.1184*	−0.1843*	0.2762*	−0.2168*	1					
CAPEX	(11)	−0.0019	−0.003	−0.0396*	0.0600*	−0.0326*	−0.004	0.0546*	0.0526*	0.0129	−0.1406*	1				
ROA	(12)	−0.0745*	0.0229	0.0983*	0.1621*	−0.0403*	0.0146	0.0041	0.5182*	−0.2047*	−0.1258*	0.2118*	1			
PPE	(13)	0.0962*	0.0235	−0.0427*	−0.0285	−0.0103	0.0745*	0.1939*	−0.1585*	0.1940*	−0.3280*	0.6743*	0.1076*	1		
S_CASH	(14)	−0.0722*	0.0681*	0.1186*	0.1261*	0.0212	−0.0844*	−0.1292*	0.5615*	−0.3500*	0.5045*	−0.0009	0.5165*	−0.2077*	1	
VOLATILITYD	(15)	−0.0388*	−0.1656*	−0.1875*	−0.0692*	0.0037	−0.1112*	−0.2846*	−0.0710*	0.0556*	0.1665*	0.0109	−0.2601*	−0.0548*	−0.0773*	1

* Significant at the 1% level ($p < 0.01$).

Table 3
The Impact of CEO risk-taking incentives on socially irresponsible activities.

	1992–2006				2007–2012				1992–2012			
	OLS	FE	RE	IV	OLS	FE	RE	IV	OLS	FE	RE	IV
$VEGA_{t-1}$	0.0260***	0.0214***	0.0219***	0.0411***	0.0114	−0.0237**	−0.0040	−0.0039	0.0249***	0.0103*	0.0125**	0.0241**
	(3.88)	(2.85)	(3.21)	(3.59)	(0.84)	(−2.24)	(−0.43)	(−0.19)	(3.82)	(1.67)	(2.14)	(2.14)
STR_{t-1}	0.0968***	0.0371	0.0659***	0.0816***	−0.0101	−0.1607***	−0.1089***	0.0002	0.0079	−0.0650***	−0.0453***	0.0116
	(3.10)	(1.22)	(2.71)	(2.66)	(−0.58)	(−9.99)	(−8.66)	(0.01)	(0.48)	(−4.96)	(−3.64)	(0.68)
DELTA $_{t-1}$	−0.0015***	−0.0016	−0.0018**	−0.0016***	0.0009	−0.0033***	−0.0017	0.0005	−0.0014***	−0.0015	−0.0016**	−0.0013**
	(−3.35)	(−1.52)	(−2.50)	(−2.96)	(0.56)	(−2.60)	(−1.53)	(0.43)	(−2.80)	(−1.52)	(−2.13)	(−2.33)
TENURE_CUM $_{t-1}$	−0.0015***	−0.0016***	−0.0015***	−0.0016***	−0.0012***	−0.0007*	−0.0009***	−0.0012***	−0.0013***	−0.0009***	−0.0010***	−0.0013***
	(−4.66)	(−3.36)	(−4.57)	(−4.57)	(−3.59)	(−1.72)	(−3.22)	(−3.61)	(−5.29)	(−2.82)	(−4.07)	(−5.14)
AGE $_{t-1}$	0.0003**	0.0004**	0.0004***	0.0003**	0.0004*	0.0005**	0.0005***	0.0004**	0.0003***	0.0003**	0.0004***	0.0003**
	(2.20)	(2.21)	(3.18)	(2.23)	(1.95)	(2.19)	(2.90)	(1.99)	(2.62)	(2.08)	(3.06)	(2.55)
SIZE $_{t-1}$	0.0230***	0.0074**	0.0203***	0.0221***	0.0212***	0.0158***	0.0249***	0.0237***	0.0230***	0.0127***	0.0208***	0.0236***
	(15.63)	(2.29)	(15.50)	(12.39)	(11.49)	(4.19)	(14.11)	(10.42)	(17.10)	(5.70)	(18.40)	(14.19)
BLEVERAGE $_{t-1}$	−0.0154*	0.0035	−0.0027	−0.0065	−0.0103**	−0.0076**	−0.0082***	−0.0161***	−0.0164***	−0.0037	−0.0062*	−0.0154***
	(−1.77)	(0.34)	(−0.37)	(−0.84)	(−2.43)	(−2.04)	(−2.62)	(−3.02)	(−3.39)	(−0.90)	(−1.69)	(−3.12)
R&D $_{t-1}$	0.0753**	0.0881*	0.0737***	0.0655**	0.0609	0.0314	0.0573**	0.0629	0.0641**	0.0367	0.0481**	0.0634**
	(2.26)	(1.88)	(2.85)	(2.00)	(1.60)	(0.72)	(2.32)	(1.64)	(2.25)	(0.92)	(2.17)	(2.21)
CAPEX $_{t-1}$	−0.0405	0.0189	0.0053	−0.0190	−0.1048***	0.0436*	0.0056	−0.1169***	−0.0762***	0.0521***	0.0238	−0.0774***
	(−1.20)	(0.87)	(0.27)	(−0.60)	(−2.98)	(1.82)	(0.27)	(−3.35)	(−2.70)	(2.75)	(1.41)	(−2.79)
ROA $_{t-1}$	−0.0202	−0.0017	−0.0129	−0.0230	0.0007	−0.0126	−0.0111	0.0044	−0.0081	−0.0177	−0.0163	−0.0107
	(−1.07)	(−0.08)	(−0.81)	(−1.23)	(0.04)	(−0.95)	(−0.97)	(0.23)	(−0.51)	(−1.32)	(−1.38)	(−0.67)
PPE $_{t-1}$	−0.0046	−0.0001	0.0159**	−0.0066	0.0226*	0.0287	0.0216**	0.0234*	0.0102	−0.0028	0.0119*	0.0107
	(−0.46)	(−0.00)	(2.09)	(−0.66)	(1.70)	(1.41)	(2.46)	(1.79)	(1.08)	(−0.19)	(1.72)	(1.13)
S_CASH $_{t-1}$	−0.0323**	−0.0062	−0.0097	−0.0380**	−0.0433**	0.0108	−0.0043	−0.0388**	−0.0361**	0.0020	−0.0044	−0.0353**
	(−2.06)	(−0.49)	(−0.84)	(−2.43)	(−2.29)	(0.91)	(−0.38)	(−2.15)	(−2.58)	(0.20)	(−0.45)	(−2.51)
VOLATILITYD $_{t-1}$	0.0431***	0.0273***	0.0319***	0.0437***	0.0252***	−0.0056	0.0078	0.0297***	0.0386***	0.0222***	0.0277***	0.0382***
	(5.35)	(3.77)	(5.27)	(5.73)	(3.17)	(−0.89)	(1.37)	(3.53)	(6.37)	(4.14)	(5.80)	(6.27)
MB $_{t-1}$	0.0010	0.0008	0.0018**	0.0007	0.0044***	−0.0011	0.0023**	0.0039***	0.0025***	0.0021**	0.0029***	0.0025***
	(0.96)	(0.91)	(2.41)	(0.66)	(3.17)	(−0.87)	(2.27)	(3.09)	(2.82)	(2.41)	(4.04)	(2.82)
Constant	−0.1144***	−0.0345	−0.1141***		0.0062	−0.0896***	−0.1708***		−0.0744**	−0.0696***	−0.1500***	
	(−3.67)	(−1.17)	(−9.58)		(0.13)	(−2.65)	(−10.32)		(−2.03)	(−3.24)	(−13.63)	
Fixed effects	Industry, Year	Firm, Year	Firm, Year	Industry, Year	Industry, Year	Firm, Year	Firm, Year	Industry, Year	Industry, Year	Firm, Year	Firm, Year	Industry, Year
Observations	6,788	6,788	6,788	6,788	5,603	5,603	5,603	6,378	13,166	13,166	13,166	13,166
R-squared (overall)	0.415	0.179	0.340	–	0.378	0.433	0.311	–	0.392	0.309	0.311	–
R-squared (adjusted)	0.409	0.176	–	–	0.372	0.432	–	–	0.388	0.307	–	–
Hansen J statistic (p-value)	–	–	–	0.000	–	–	–	0.537	–	–	–	0.166
Endogeneity test (p-value)	–	–	–	0.274	–	–	–	0.4212	–	–	–	0.937
Number of firms	1,404	1,404	1,404	1,404	1,415	1,415	1,415	1,446	1,859	1,859	1,859	1,859

All variables are defined in Appendix I. Unreported industry controls are based on the Fama and French (1997) industry classification. Robust and clustered (by firm) t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

full sample period (1992–2012). As explained in the methodology part, we estimate our regressions using four different estimation methods: pooled OLS, fixed effects (FE), random effects (RE), and the instrumental variable approach (IV). Table 3 summarizes the results of testing our first hypothesis where the dependent variable is an index of firm's involvement in socially irresponsible activities. For every period, the first, second, third and fourth column report the results using pooled OLS, FE, RE and IV, respectively. This allows us to examine the sensitivity of our results to the estimation method used.

We first discuss the results for each period separately. Regarding the pre-crisis period, Table 3 shows a positive and statistically significant coefficient of CEO risk-taking incentives, as measured by CEO Vega, regardless of the estimation method used. This result provides empirical support for the first hypothesis which suggests that CEO risk-taking incentives exert a positive effect on firm's involvement in socially irresponsible activities. To evaluate the economic significance of the estimated coefficients, we scale the standard deviation of Vega by the average CEO's total cash compensation and multiply this factor by the value of the coefficient associated with Vega.[13] In this respect, the results in Table 3 show that an increase in Vega by one standard deviation increases the firm's involvement in socially irresponsible activities by 0.36%–0.69% or about 5.6%–10.75% of the average level of the index of socially irresponsible activities, depending on the estimation method used.[14]

In line with previous studies, Table 3 shows a significant and positive coefficient associated with socially responsible activities (STR), except when using the FE method. This suggests that previous involvement in socially responsible activities exert a positive effect on future socially irresponsible activities. To assess the economic significance, we calculate the effect on socially irresponsible activities of one standard deviation change in socially responsible activities. We multiply the standard deviation of the variable STR by the value of the coefficient associated with the variable STR. Thus, an increase in STR by one standard deviation increases the firm's socially irresponsible activities by 0.35%–0.52% or about 5.47%–8.03% of the average level of a firm's socially irresponsible activities, depending on the estimation method used.[15]

As for the control variables, we find that on average socially irresponsible activities are higher for firms that are larger, spend more in R&D, have less surplus Cash, and are more risky. Furthermore, younger CEOs and CEOs with high tenure are less likely to engage their firms in socially irresponsible activities. These results are consistent with the previous literature (Cai et al., 2011; Chin et al., 2013; Deckop et al., 2006; Mahoney & Thorne, 2005, Mahoney & Thorn, 2006; Manner, 2010; Rekker et al., 2014; Slater & Dixon-Fowler, 2009; Tang et al., 2015).

The results for the pre-crisis period are different from those for the post-crisis period. Table 3 shows that the coefficient of CEO risk-taking incentives is not statistically significant in three out of the four methods used (OLS, RE, IV) during the post-crisis period. The only exception is when using the FE method where the coefficient associated to CEO Vega is negative and statistically significant at the 5% level.

The results for the post-crisis do not support our first hypothesis which suggests a positive relationship between CEO risk-taking incentives and firm involvement in socially irresponsible activities. Instead, the results in the post-crisis period do not show evidence of a significant relationship. This could be due to the increased scrutiny on compensation packages and the increased role of reputational issues in the aftermath of the financial crisis. The relationship between socially irresponsible and socially responsible activities is also different between the pre-crisis and post-crisis periods. Table 3 shows that the coefficient associated with the variable STR changes its sign during the post-crisis period and becomes negative and significant in two out of the four methods used (FE and RE).

For the overall period (1992–2012), we find that socially irresponsible activities are positively related to CEO risk-taking incentives. These results support our first hypothesis of a positive relationship between CEO risk-taking incentives and firm involvement in socially irresponsible activities. In economic terms, an increase in Vega by one standard deviation increases the firm's involvement in socially irresponsible activities by 0.19%–0.47% or about 2.66%–6.44% of the average level of socially irresponsible activities, depending on the estimation method used.

4.2. The moderating effect of socially responsible activities

Table 4 summarizes the results of testing our second hypothesis related to the moderating effect of socially responsible activities on the relation between CEO risk-taking incentives and socially irresponsible activities. Results suggest that there is no overall effect of either VEGA or STR on socially irresponsible activities, but there is a statistically significant interaction in the pre-crisis period. During the post-crisis period and the overall period (1992–2012), results are not conclusive with VEGA and the interaction terms being insignificant or only marginally significant, regardless of the estimation method used.

As discussed above, the coefficient associated with the interaction variable prior to the financial crisis is strongly significant and positive. This represents a situation of a crossover interaction effect: the CEO risk-taking incentives and socially responsible activities (STR) do not seem to influence individually the firm's involvement in socially irresponsible activities. Instead, it is the interaction of the CEO risk-taking incentives with socially responsible activities that influence socially irresponsible activities. This suggests that CEO risk-taking incentives exert a positive effect on socially irresponsible activities,

[13] Note that Vega is expressed in thousands of US dollars, whereas our measure of socially irresponsible activities is calculated as an average.

[14] For example, an increase in Vega by one standard deviation increases the firm's involvement in socially irresponsible activities by about 0.36% (i.e., 0.168 × 0.0214) or about 5.6% (i.e., 0.0036/0.064 = 0.056) of the average concerns, when using the fixed effects method.

[15] For example, an increase in socially responsible activities by one standard deviation increases the firm's socially irresponsible activities by 0.35% (i.e., 0.053 × 0.0659) or about 5.47% of the average *CON* (i.e., 0.0035/0.064 = 0.0547), when using the random effects method.

Table 4
The moderating effect of socially responsible activities on the relation between CEO risk-taking incentives and socially irresponsible activities.

	1992–2006				2007–2012				1992–2012			
	OLS	FE	RE	IV	OLS	FE	RE	IV	OLS	FE	RE	IV
$VEGA_{t-1}$	0.0057	0.0070	0.0059	−0.0007	−0.0013	−0.0182	−0.0028	−0.0178	0.0178**	0.0104	0.0120*	0.0057
	(0.69)	(0.84)	(0.78)	(−0.05)	(−0.10)	(−1.44)	(−0.27)	(−0.59)	(2.51)	(1.50)	(1.89)	(0.38)
STR_{t-1}	0.0223	−0.0111	0.0119	0.0002	−0.0360	−0.1482***	−0.1061***	−0.0181	−0.0161	−0.0647***	−0.0467***	−0.0402
	(0.67)	(−0.29)	(0.39)	(0.00)	(−1.44)	(−7.67)	(−6.55)	(−0.51)	(−0.80)	(−3.65)	(−2.81)	(−1.18)
$(VEGA * STR)_{t-1}$	0.2675**	0.1613**	0.1936***	0.3740***	0.0690*	−0.0301	−0.0064	0.0497	0.0629*	−0.0009	0.0041	0.1386*
	(2.56)	(2.38)	(2.69)	(3.73)	(1.79)	(−0.73)	(−0.20)	(0.64)	(1.80)	(−0.03)	(0.14)	(1.84)
$DELTA_{t-1}$	−0.0014***	−0.0016	−0.0017**	−0.0013**	0.0009	−0.0033***	−0.0017	0.0007	−0.0014***	−0.0015	−0.0016**	−0.0012**
	(−3.07)	(−1.51)	(−2.41)	(−2.32)	(0.59)	(−2.59)	(−1.52)	(0.59)	(−2.77)	(−1.53)	(−2.15)	(−2.14)
$TENURE\_CUM_{t-1}$	−0.0015***	−0.0015***	−0.0014***	−0.0014***	−0.0012***	−0.0007*	−0.0009***	−0.0011***	−0.0013***	−0.0009***	−0.0010***	−0.0013***
	(−4.48)	(−3.17)	(−4.35)	(−4.08)	(−3.48)	(−1.74)	(−3.22)	(−3.19)	(−5.23)	(−2.81)	(−4.08)	(−4.78)
AGE_{t-1}	0.0003**	0.0004**	0.0004***	0.0003*	0.0004*	0.0005**	0.0005***	0.0003*	0.0003***	0.0003**	0.0004***	0.0003**
	(2.06)	(2.11)	(3.03)	(1.94)	(1.92)	(2.20)	(2.90)	(1.89)	(2.59)	(2.09)	(3.07)	(2.36)
$SIZE_{t-1}$	0.0233***	0.0082***	0.0208***	0.0235***	0.0218***	0.0157***	0.0249***	0.0242***	0.0233***	0.0127***	0.0209***	0.0240***
	(15.57)	(2.60)	(15.66)	(13.03)	(12.27)	(4.16)	(14.25)	(9.94)	(17.42)	(5.68)	(18.39)	(14.39)
$BLEVERAGE_{t-1}$	−0.0152*	0.0053	−0.0020	−0.0125	−0.0102**	−0.0078**	−0.0082***	−0.0163***	−0.0162***	−0.0037	−0.0062*	−0.0152***
	(−1.78)	(0.52)	(−0.28)	(−1.62)	(−2.41)	(−2.08)	(−2.63)	(−3.06)	(−3.35)	(−0.90)	(−1.71)	(−3.10)
$R\&D_{t-1}$	0.0715**	0.0859*	0.0731***	0.0730**	0.0645*	0.0320	0.0569**	0.0670*	0.0654**	0.0366	0.0482**	0.0673**
	(2.19)	(1.85)	(2.85)	(2.28)	(1.71)	(0.73)	(2.31)	(1.73)	(2.31)	(0.92)	(2.19)	(2.37)
$CAPEX_{t-1}$	−0.0444	0.0187	0.0041	−0.0345	−0.1056***	0.0443*	0.0055	−0.1141***	−0.0770***	0.0521***	0.0233	−0.0734***
	(−1.33)	(0.86)	(0.20)	(−1.08)	(−2.99)	(1.85)	(0.26)	(−3.23)	(−2.73)	(2.74)	(1.38)	(−2.61)
ROA_{t-1}	−0.0211	−0.0023	−0.0136	−0.0223	0.0007	−0.0125	−0.0111	0.0054	−0.0082	−0.0178	−0.0163	−0.0092
	(−1.13)	(−0.11)	(−0.86)	(−1.21)	(0.04)	(−0.94)	(−0.97)	(0.28)	(−0.51)	(−1.32)	(−1.38)	(−0.58)
PPE_{t-1}	−0.0032	0.0029	0.0164**	−0.0035	0.0223*	0.0290	0.0217**	0.0222*	0.0104	−0.0028	0.0120*	0.0100
	(−0.31)	(0.15)	(2.16)	(−0.34)	(1.68)	(1.42)	(2.47)	(1.68)	(1.11)	(−0.19)	(1.74)	(1.05)
S_CASH_{t-1}	−0.0289*	−0.0030	−0.0064	−0.0280*	−0.0431**	0.0106	−0.0045	−0.0390**	−0.0353**	0.0020	−0.0045	−0.0342**
	(−1.85)	(−0.24)	(−0.55)	(−1.77)	(−2.29)	(0.89)	(−0.39)	(−2.17)	(−2.54)	(0.20)	(−0.46)	(−2.45)
$VOLATILITYD_{t-1}$	0.0447***	0.0276***	0.0324***	0.0447***	0.0243***	−0.0054	0.0079	0.0289***	0.0387***	0.0222***	0.0278***	0.0385***
	(5.54)	(3.81)	(5.36)	(5.79)	(3.08)	(−0.84)	(1.39)	(3.41)	(6.38)	(4.14)	(5.83)	(6.31)
MB_{t-1}	0.0012	0.0010	0.0019**	0.0010	0.0045***	−0.0012	0.0023**	0.0040***	0.0026***	0.0021**	0.0029***	0.0026***
	(1.11)	(1.03)	(2.55)	(0.89)	(3.35)	(−0.94)	(2.25)	(3.17)	(2.94)	(2.42)	(4.07)	(2.93)
Constant	−0.1116***	−0.0383	−0.1157***		0.0032	−0.0900***	−0.1706***		−0.0756**	−0.0696***	−0.1506***	
	(−3.53)	(−1.33)	(−9.69)		(0.07)	(−2.65)	(−10.38)		(−2.06)	(−3.23)	(−13.70)	
Fixed effects	Industry, Year	Firm, Year	Firm, Year	Industry, Year	Industry, Year	Firm, Year	Firm, Year	Industry, Year	Industry, Year	Firm, Year	Firm, Year	Industry, Year
Observations	6,788	6,788	6,788	6,788	5,603	5,603	5,603	6,378	13,166	13,166	13,166	13,166
R-squared (overall)	0.421	0.183	0.348	–	0.379	0.434	0.348	–	0.392	0.309	0.329	–
R-squared (adjusted)	0.415	0.180	–	–	0.372	0.432	–	–	0.389	0.307	–	–
Hansen J statistic (p-value)	–	–	–	0.266	–	–	–	0.390	–	–	–	0.265
Endogeneity test (p-value)	–	–	–	0.783	–	–	–	0.333	–	–	–	0.7409
Number of firms	1,404	1,404	1,404	1,404	1,415	1,415	1,415	1,446	1,859	1,859	1,859	1,859

All variables are defined in Appendix I. Unreported industry controls are based on the Fama and French (1997) industry classification. Robust and clustered (by firm) t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

mainly for firms having a high level of socially responsible activities. This confirms the second hypothesis for the pre-crisis period, which holds that the relationship between CEO risk-taking incentives and firm involvement in socially irresponsible activities will be stronger when firms are also involved in socially responsible activities.

In summary, the results reported in Tables 3 and 4 support our hypotheses for the pre-crisis period: CEO risk-taking incentives are positively related to socially irresponsible activities, and this relation is stronger for firms that have a higher level of prior socially responsible activities. However, for the post-crisis period, we do not find empirical support for the relationship between CEO risk-taking incentives and socially irresponsible activities. The differences in the results between the two periods could be explained by the increased scrutiny regarding compensation and governance practices along with an increased interest on firm's CSR practices as a consequence of the 2007 financial crisis.

4.3. Robustness

Our main findings indicate that CEO risk-taking incentives are associated with socially irresponsible activities, and this association is more prevalent when the firm has already undertaken socially responsible activities. This conclusion holds only for the pre-crisis period. In order to ensure the robustness of our findings in the previous section, we divide our sample into two subsamples based on the median value of the index of socially responsible activities (STR). The first (second) subsample includes all firms where the value of the index of socially responsible activities is lower (higher) than the median STR value. We re-estimate equation (1) for both subsamples.

Table 5 reports the results for the subsamples of firms with a high and low level of socially responsible activities for the pre-crisis and post-crisis periods. The results for firms with high prior socially responsible activities shows that the coefficient associated with the CEO Vega continues to be positive and statistically significant at the 1% level for the pre-crisis period, regardless of the method used. In terms of economic significance, an increase in Vega by one standard deviation increases the firm's socially irresponsible activities by 0.32%–0.52% or about 5.00%–8.05% of the average level of socially irresponsible activities. Those results are similar to those reported in the previous section. Table 5 also shows that the results for the post-crisis period are in general not significant for both groups of firms. Overall, the results for firms with high prior STR during the pre-crisis period shown in Table 5 are consistent with those reported for the full sample, which confirms our conjecture that CEO risk-taking incentives and socially irresponsible activities are positively related for firms with high level of socially responsible activities.[16]

5. Conclusion

We analyse the relationship between CEO risk-taking incentives, measured by the sensitivity of CEO wealth held in options to a change in stock return volatility or Vega, and socially irresponsible activities for U.S. firms during the period 1992–2012. We find that, during the pre-crisis period, CEO risk-taking incentives are positively related to socially irresponsible activities, and that this relation is stronger for firms that have a higher level of prior socially responsible activities. The results during the post-crisis period differ and show no evidence of a significant relationship between CEO risk-taking incentives and socially irresponsible activities. This might be explained by the increased scrutiny on compensation packages and the increased role of reputational issues in the aftermath of the financial crisis.

Our findings are consistent with those of previous studies which suggest that compensation packages which embed high risk-taking incentives encourage the CEO to engage in riskier strategies which may include (or lead to) socially irresponsible activities. This might result from financial performance pressures associated with these risk-taking incentives or because of the CEO's underestimation of the potential negative implications of these socially irresponsible activities.

Our results are also consistent with previous literature suggesting that socially irresponsible activities and socially responsible activities might be related (e.g., Chatterji & Toffel, 2010; Kotchen & Moon, 2012; Mattingly & Berman, 2006; Ormiston & Wong, 2013; Strike et al., 2006). Our findings also complement previous studies which found that the components of executive compensation (i.e., salary, bonus, stock and stock option) affect firms' involvement in CSR (Cai et al., 2011; Deckop et al., 2006; Mahoney & Thorne, 2005, Mahoney & Thorn, 2006; McGuire et al., 2003; Rekker et al., 2014).

Overall, the findings presented in this study have important policy implications regarding the importance and impact of the structure of compensation on the firm's involvement in socially irresponsible activities. Furthermore, the present study augments previous literature on the compensation and CSR link, and makes a case for the board of directors to pay more attention to the implications of CEO compensation schemes and its associated incentives for the firm's involvement in socially irresponsible activities. Given that our study focuses on large listed US companies, future research might investigate socially irresponsible activities for non-listed companies located in both the US and other countries. This

[16] We are grateful for an anonymous referee who raised a very important issue related to the aggregation of the concerns of different dimensions of social responsibility. For example, Scholtens and Zhou (2008) and Chatterji et al. (2009) show that the different dimensions of social responsibility do matter. Moreover, the dimensions may differ for different investors and different stakeholders. Although examining the impact of risk-taking incentives across each of the individual dimensions of social responsibility is beyond the scope of this paper, we repeated the analysis for each individual dimensions of CSR. The results are not reported for the sake of brevity but are available upon request. Overall, the results show that some dimensions matter, whereas others do not. In sum, risk-taking incentives as measured by Vega seem to be important for the socially irresponsible activities of certain dimensions (e.g., diversity, employee, environment, product and governance), but to different extents.

Table 5
The Impact of CEO risk-taking incentives on socially irresponsible activities for firms with low and high levels of socially responsible activities.

	Pre-crisis period								Post-crisis period							
	Low STR				High STR				Low STR				High STR			
	OLS	FE	RE	IV	OLS	FE	RE	IV	OLS	FE	RE	IV	OLS	FE	RE	IV
$VEGA_{t-1}$	0.0230**	0.0187	0.0185*	0.0295*	0.0191***	0.0226***	0.0215***	0.0308***	0.0184	−0.0116	−0.0009	−0.0311	−0.0008	−0.0280**	−0.0120	0.0047
	(1.98)	(1.48)	(1.92)	(1.77)	(2.91)	(3.10)	(3.24)	(2.61)	(1.14)	(−0.47)	(−0.06)	(−1.06)	(−0.06)	(−2.24)	(−1.10)	(0.29)
STR_{t-1}	−0.3180**	0.0175	−0.1358	−0.3326**	0.0743*	0.0400	0.0511	0.0604*	−0.5936***	−0.4940**	−0.5216***	−0.6428***	−0.0047	−0.1148***	−0.0653***	−0.0072
	(−2.01)	(0.10)	(−0.99)	(−2.09)	(1.95)	(1.03)	(1.59)	(1.67)	(−2.95)	(−2.37)	(−3.18)	(−3.42)	(−0.26)	(−5.21)	(−4.07)	(−0.39)
$DELTA_{t-1}$	0.0003	0.0019	0.0007	0.0007	−0.0018***	−0.0018	−0.0019**	−0.0017***	0.0053**	−0.0030	0.0021	0.0046**	−0.0013	−0.0037***	−0.0020*	−0.0009
	(0.28)	(1.53)	(0.79)	(0.65)	(−3.68)	(−1.58)	(−2.46)	(−3.02)	(2.32)	(−1.02)	(1.06)	(2.31)	(−0.81)	(−2.70)	(−1.72)	(−0.73)
$TENURE\_CUM_{t-1}$	−0.0012***	−0.0024***	−0.0015***	−0.0013***	−0.0014***	−0.0020***	−0.0018***	−0.0017***	−0.0000	−0.0001	0.0001	−0.0001	−0.0013**	−0.0009	−0.0011**	−0.0011**
	(−3.05)	(−3.13)	(−3.49)	(−3.26)	(−2.76)	(−3.14)	(−3.57)	(−3.08)	(−0.09)	(−0.12)	(0.24)	(−0.22)	(−2.43)	(−1.21)	(−2.53)	(−2.26)
AGE_{t-1}	0.0002	0.0008**	0.0004**	0.0002	0.0001	0.0004	0.0004*	0.0001	0.0001	0.0002	0.0001	0.0001	0.0005	0.0002	0.0005*	0.0004
	(1.14)	(2.34)	(2.32)	(0.94)	(0.56)	(1.51)	(1.93)	(0.56)	(0.55)	(0.73)	(0.74)	(0.64)	(1.59)	(0.56)	(1.87)	(1.21)
$SIZE_{t-1}$	0.0179***	0.0011	0.0166***	0.0166***	0.0269***	0.0117***	0.0244***	0.0260***	0.0060***	0.0065	0.0083***	0.0092***	0.0330***	0.0290***	0.0327***	0.0314***
	(8.29)	(0.25)	(9.10)	(7.40)	(13.99)	(2.73)	(14.51)	(12.55)	(3.31)	(1.45)	(4.80)	(4.35)	(13.11)	(3.53)	(14.15)	(11.80)
$BLEVERAGE_{t-1}$	0.0016	0.0178	0.0074	0.0012	−0.0305**	−0.0146	−0.0145	−0.0172	−0.0042	−0.0035	−0.0039	−0.0066	−0.0094	−0.0076	−0.0077	−0.0130
	(0.17)	(1.18)	(0.85)	(0.14)	(−2.21)	(−0.98)	(−1.28)	(−1.35)	(−1.05)	(−0.70)	(−1.12)	(−1.31)	(−1.54)	(−0.91)	(−1.27)	(−1.60)
$R\&D_{t-1}$	0.0671	0.0320	0.0547*	0.0577	0.0723	0.0827	0.0713*	0.0616	0.0213	−0.0385	0.0127	0.0398	−0.0151	0.0799	0.0040	−0.0162
	(1.60)	(0.56)	(1.72)	(1.42)	(1.46)	(1.21)	(1.85)	(1.25)	(0.69)	(−0.74)	(0.54)	(1.25)	(−0.22)	(0.83)	(0.09)	(−0.24)
$CAPEX_{t-1}$	−0.0139	0.0299	−0.0055	−0.0224	−0.0857*	0.0316	0.0087	−0.0653	−0.0410	0.0923***	0.0212	−0.0316	−0.1823***	0.0381	−0.0214	−0.1877***
	(−0.40)	(0.90)	(−0.20)	(−0.67)	(−1.77)	(1.06)	(0.33)	(−1.40)	(−1.36)	(2.78)	(0.84)	(−1.02)	(−2.97)	(0.85)	(−0.55)	(−3.02)
ROA_{t-1}	0.0070	0.0203	0.0009	−0.0024	−0.0290	−0.0092	−0.0197	−0.0382	0.0097	0.0001	−0.0017	0.0097	−0.0057	−0.0233	−0.0145	0.0096
	(0.24)	(0.75)	(0.05)	(−0.09)	(−1.09)	(−0.33)	(−0.86)	(−1.45)	(0.60)	(0.01)	(−0.15)	(0.59)	(−0.16)	(−0.74)	(−0.62)	(0.28)
PPE_{t-1}	0.0052	−0.0150	0.0165*	0.0083	−0.0163	−0.0086	0.0124	−0.0107	0.0107	−0.0009	−0.0033	0.0070	0.0319	0.0716	0.0336**	0.0238
	(0.48)	(−0.53)	(1.88)	(0.77)	(−1.03)	(−0.31)	(1.10)	(−0.68)	(0.70)	(−0.04)	(−0.34)	(0.45)	(1.48)	(1.63)	(2.39)	(1.17)
S_CASH_{t-1}	−0.0160	0.0081	−0.0007	−0.0102	−0.0529**	−0.0106	−0.0114	−0.0535**	−0.0025	0.0106	0.0025	−0.0006	−0.0765**	−0.0129	−0.0405*	−0.0833***
	(−0.70)	(0.49)	(−0.04)	(−0.47)	(−2.21)	(−0.57)	(−0.65)	(−2.28)	(−0.15)	(0.72)	(0.21)	(−0.04)	(−2.25)	(−0.52)	(−1.84)	(−2.71)
$VOLATILITYD_{t-1}$	0.0344***	0.0180*	0.0294***	0.0333***	0.0429***	0.0308***	0.0339***	0.0458***	0.0283***	0.0070	0.0187***	0.0237***	0.0305**	−0.0210	0.0077	0.0431***
	(3.26)	(1.74)	(3.62)	(3.25)	(3.86)	(2.91)	(3.80)	(4.44)	(3.94)	(0.94)	(3.08)	(3.05)	(2.06)	(−1.53)	(0.67)	(2.79)
MB_{t-1}	0.0018	−0.0006	0.0026**	0.0018	0.0015	0.0005	0.0010	0.0016	0.0009	0.0002	0.0003	0.0011	0.0072***	−0.0001	0.0042**	0.0058***
	(1.22)	(−0.38)	(2.08)	(1.22)	(1.08)	(0.46)	(1.03)	(1.06)	(0.65)	(0.12)	(0.23)	(0.81)	(3.02)	(−0.07)	(2.49)	(2.76)
Constant	−0.0626**	−0.0290	−0.0925***		−0.0924**	−0.0180	−0.1366***		0.0524*	−0.0326	−0.0442***		−0.1044	−0.1802**	−0.2418***	
	(−2.06)	(−0.72)	(−5.40)		(−2.08)	(−0.44)	(−8.31)		(1.70)	(−0.93)	(−3.13)		(−1.58)	(−2.16)	(−9.70)	
Fixed effects	Industry, Year	Firm, Year	Firm, Year	Industry, Year	Industry, Year	Firm, Year	Firm, Year	Industry, Year	Industry, Year	Firm, Year	Firm, Year	Industry, Year	Industry, Year	Firm, Year	Firm, Year	Industry, Year
Observations	2531	2531	2531	2531	3455	3455	3455	3455	2315	2315	2315	2654	2504	2504	2504	2870
R-squared (overall)	0.264	0.195	0.176	–	0.525	0.227	0.429	–	0.418	0.619	0.386	–	0.483	0.368	0.382	–
R-squared (adjusted)	0.243	0.186	–	–	0.516	0.221	–	–	0.403	0.616	–	–	0.47	0.364	–	–
Hansen J statistic (p-value)	–	–	–	0.353	–	–	–	0.001	–	–	–	0.783	–	–	–	0.103
Endogeneity test (p-value)	–	–	–	0.904	–	–	–	0.35	–	–	–	0.065	–	–	–	0.794
Number of firms	875	875	875	875	714	714	714	714	874	874	874	915	856	856	856	880

All variables are defined in Appendix I. Unreported industry controls are based on the Fama and French (1997) industry classification. Robust and clustered (by firm) t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

would allow a greater understanding of the determinants of socially irresponsible activities and the influence of CEO risk-taking incentives on those activities.

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Appendix I. Variables definition

Variable	Code	Definition	Source
Socially irresponsible and responsible activities			
Concerns	CON	Average of all qualitative issue areas' scores related to socially irresponsible activities (concerns).	KLD
Strengths	STR	Average of all qualitative issue areas' scores related to socially responsible activities (strengths).	KLD
CEO Characteristics			
Vega ($000s)	VEGA	Pay-risk sensitivity. Change in the dollar value of CEO wealth for a 0.01-unit change in stock return volatility.	Core and Guay (2002); Coles et al. (2006); Daniel et al. (2013).
Delta ($000s)	DELTA	Pay-performance sensitivity. Change in the dollar value of CEO wealth for a 1% change in stock price.	Core and Guay (2002); Coles et al. (2006); Daniel et al. (2013).
Tenure	TENURE_CUM	Number of years in CEO's current term.	Execucomp
Age	AGE	Age (years) of the executive as reported in the annual proxy statement.	Execucomp
Firm Characteristics			
Firm size	SIZE	Log (Total Assets)	Compustat
Book Leverage	BLEVERAGE	= (Long-Term Debt + Debt in Current Liabilities)/Total Assets	Compustat
Research and development expenditure to assets	R&D	= Max(0, Research and Development Expense)/Total Assets	Compustat
Net capital expenditure to assets	CAPEX	= (Capital Expenditure − Sale of Property, Plant and Equipment)/Total Assets	Compustat
ROA	ROA	= EBITDA/Total Assets	Compustat
Net Property, Plant, and Equipment to assets	PPE	= Net Property, Plant, and Equipment/Total Assets	Compustat
Surplus Cash	S_CASH	Cash from assets-in-place to total assets = (Net Cash Flow from Operating Activities − Depreciation and Amortization + Research and Development Expense)/Total Assets	Compustat
Firm Risk (Stock return volatility)	VOLATILITYD	Standard deviation of daily returns	CRSP
Market-to-Book	MB	The market-to-book ratio = (Total Assets − Common Equity + Price Close * Common Shares Outstanding)/Total Assets	Compustat

KLD refers to MSCI ESG STATS (formerly KLD Research & Analytics, Inc or KLD), Compustat refers to Standard & Poor's COMPUSTAT database, and CRSP refers to the University of Chicago's Center for Research in Securities Prices (CRSP) database.

Appendix II. MSCI ESG STATS (KLD)'s concern and strength

Dimension	Concerns (CON)	Strengths (STR)
Community	- Investment Controversies - Negative Economic Impact - Indigenous Peoples Relations - Tax Disputes - Other Concern	- Charitable Giving - Innovative Giving - Non-US Charitable Giving - Support for Housing - Support for Education - Indigenous Peoples Relations - Volunteer Programs - Other Strength
Diversity	- Controversies (e.g., fines) - Non-Representation - Other Concern	- CEO's identity - Promotion - Board of Directors - Work/Life Benefits - Women & Minority Contracting - Employment of the Disabled - Gay & Lesbian Policies - Other Strength

(*continued on next page*)

(*continued*)

Dimension	Concerns (CON)	Strengths (STR)
Employee Relations	- Union Relations - Health and Safety Concern - Workforce Reductions - Retirement Benefits Concern - Other Concern	- Union Relations - No-Layoff Policy - Cash Profit Sharing - Employee Involvement - Retirement Benefits Strength - Health and Safety Strength - Other Strength
Environment	- Hazardous Waste - Regulatory Problems - Ozone Depleting Chemicals - Substantial Emissions - Agricultural Chemicals - Climate Change - Other Concern	- Beneficial Products and Services - Pollution Prevention - Recycling - Clean Energy - Communications - Property, Plant, and Equipment - Management Systems - Other Strength
Product	- Product Safety - Marketing/Contracting Concern - Antitrust - Other Concern	- Quality - R&D/Innovation - Benefits to Economically Disadvantaged - Other Strength
Human Rights	- South Africa (1991–1994) - Northern Ireland (1991–1994) - Burma Concern - Mexico (1995–2002) - Labor Rights Concern - Indigenous Peoples Relations Concern - Other Concern	- Positive Record in South Africa (1994–1995) - Indigenous Peoples Relations Strength - Labor Rights Strength - Other Strength
Corporate Governance	- High Compensation - Ownership Concern - Accounting Concern - Political Accountability Concern - Transparency Concern - Other Concern	- Limited Compensation - Ownership Strength - Transparency Strength - Political Accountability Strength - Other Strength

Source: MSCI ESG STATS (formerly KLD Research & Analytics, Inc. or KLD).

Appendix III. Calculation of risk-taking incentives (Vega)[17]

To calculate the incentives from options (delta and vega), we need firm-level variables, option-specific variables and an estimate of the risk-free rate corresponding to the maturity of the options as of fiscal year end. Firm-level variables include stock price at fiscal year end, an estimate of stock volatility,[18] and an estimate of dividend yield. Option-specific variables include the number of vested and unvested options, the exercise prices of the options, and the maturity of the options as of the fiscal year end (based on expiration date of the options).

Following Core and Guay (2002), estimates of a stock option's sensitivity to stock price (delta) and stock-return volatility (vega) are calculated based on the Black and Scholes (1973) formula for valuing European call options, as modified to account for dividend payouts by Merton (1973). The call option value is given by:

$$Option\ value = \left[Se^{-dT}N(Z) - Xe^{-rT}N\left(Z - \sigma T^{\left(\frac{1}{2}\right)}\right)\right]$$

where

$$Z = \left[\ln\left(\frac{S}{X}\right) + T\left(r - d + \sigma^2/2\right)\right] \Big/ \sigma T^{\left(\frac{1}{2}\right)}$$

N=cumulative probability function for the normal distribution
S=price of the underlying stock
X=exercise price of the option

[17] This appendix is based on Core and Guay (2002), Coles et al. (2006), and Daniel et al. (2013).
[18] The annualized standard deviation of stock returns estimated over the 60 months prior to the beginning of the fiscal period.

σ=expected stock-return volatility over the life of the option
r=natural logarithm of risk-free interest rate
T=time to maturity of the option in years
d=natural logarithm of expected dividend yield over the life of the option

The sensitivity of the call option value with respect to a 1% change in stock price (delta) is defined as:

$$delta = \left[\frac{\delta(call\ option\ value)}{\delta(stock\ price)}\right] \times \left[\frac{Stock\ price}{100}\right] = e^{-dT}N(Z) \times \left[\frac{Stock\ price}{100}\right]$$

The sensitivity of the call option value with respect to a 0.01 change in stock-return volatility (vega) is defined as:

$$vega = \left[\frac{\delta(call\ option\ value)}{\delta(stock\ volatility)}\right] \times 0.01 = e^{-dT}N'(Z)ST^{\left(\frac{1}{2}\right)} \times (0.01)$$

where N' = normal density function.

The delta of the CEO is the sum of the delta of all options (both vested and unvested), and the delta from the shares owned by the executive. The vega is the sum of the vega of all options (both vested and unvested). The vega of the CEO option portfolio is used as the primary measure of CEO risk-taking incentives, as an approximation of the total vega of the stock and option portfolio. It is assumed that vega of the stock portfolio is zero (Guay, 1999). The incentives from options (delta and vega) are computed as of fiscal year end for each CEO.

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