“CEO compensation, CEO attributes and corporate risk taking evidence from US listed corporations”

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CEO compensation, CEO attributes and corporate risk taking – evidence from US listed corporations

Abstract

Using simultaneous equation models (SEMs) in which executive compensation and risk taking are endogenous, we find that different attributes of chief executive officers (CEOs) have various impacts on the relationship between compensation and the risk taking. The authors find that equity-based compensation induces managers to undertake value-enhancing and risky projects, whereas cash-based compensation has an inverse effect. Although equity-based compensation induces managers to undertake projects with high risks, only option-based compensation positively motivates managers to take risks, and stock-based compensation conversely mitigates this incentive. The authors also find that overconfident CEOs undertake value-added risky projects by any type of compensation, whether cash-, stock- or option-based. However, for CEOs who are not overconfident or who have limited overconfidence, only equity-based compensation, particularly option-based compensation, induce them to take risks. Additionally, we find that CEOs rewarded with a high ratio of cash-to-total compensation, similar to CEOs with a high ratio of inside-debt claims, are less risky. The other CEO attributes, such as age, tenure and dominance, are found to significantly influence the impact of compensation on risks. Results of this study have some important implications for the design of compensation packages by considering the executives' attributes.

Keywords: risk taking, compensation, overconfidence, dominance, Black-Scholes volatility.
JEL Classification: G30, G33, J33.

Introduction

The use of incentive compensation in corporate finance is widely believed to have motivated managerial risk taking and aligned the interests between managers and shareholders[1]. Most extant studies examine this issue by focusing on whether stock options offer incentives to risk-averse managers to undertake risky but positive net present value projects on behalf of shareholders (e.g., Guay, 1999; Coles et al., 2006; Hayes et al., 2012). While studies reveal important insights by documenting a significant positive relationship between executive stock option (ESO) and managerial risk taking[2], the incentive of the ESO was linked to market indicators, such as stock return volatility (Vega) or stock price sensitivity (Delta). As such, managers will take more risks to earn higher ESO compensation stemming from higher volatility.

However, one should not overlook that most firms also offer managers a specified portion of cash-based compensation, such as unsecured pensions and deferred compensation. This "debt-like" compensation discourages managers to invest in risky projects (e.g., Cassell et al., 2012; Edmans and Liu, 2011; Sundaram and Yermack, 2007; and Wei and Yermack, 2011). Due to each component in the compensation – stock, stock options, and cash-based (debt-like) compensation – provides various or even opposing incentives for managers to undertake projects with different risks. Therefore, it is not enough to examine only the impact of option-based or total compensation on managerial risk taking without examining the relative portion of each compensation component. To date, very few studies provide direct evidence of the impact of the share of debt-like compensation for managerial risk taking or investment choices.

Furthermore, most of the studies measure managerial risk taking by only market measures. This lack of evidence from the firm side may result from the fact that existing disclosures are generally inadequate for researchers to determine the magnitude of exposure to firm-specific operating risks[3]. However, with time, this lack has been filled, and we are now able to examine risks using both market and accounting measures of firms earnings volatility.

In addition, prior studies have emphasized stock options as a determinant of corporate risk taking; however, the impact of CEO attributes on the relationship between compensation and risk taking has never been mentioned and tested. Recently, researchers have recognized that managerial biases may affect corporate investment decisions. For example, Hirshleifer, Low & Teoh (2012) document that relatively overconfident CEOs are expected to be enthusiastic about risky, challenging, and vision-sensitive enterprises. As such, firms with overconfident managers may take greater risks or more innovative projects.

[1] See e.g., Jensen and Meckling (1976), Haugen and Senbet (1981), Smith and Stulz (1985), Lambert (1986), Copeland and Weston (1988), Lambert, Larcker and Verrecchia (1991), Hirshleifer and Suh (1992), Murphy (1999), and Hemmer, Kim and Verrecchia (1999).

[2] See e.g., Smith and Stulz (1985), John et al. (1995), Guay (1999), Coles (2006), Brisley, (2006), Chen et al., (2006), Cheng (2009).

[3] Barth (1998) also mentioned this phenomenon.

If CEOs with different attributes (e.g., overconfidence, dominance, age and tenure) have different risk preferences, the design of the managerial compensation package should reflect these attributes to reduce costs from agency conflicts between shareholders and managers. For example, CEOs with the attribute of overconfidence may demand less equity-based compensation to be motivated to take risks compared with CEOs who are not overconfident or who have limited overconfidence. An older CEO may be less likely to undertake an investment with high risks compared to young CEOs; thus, risk-incentivizing compensation is crucial in the compensation package for older CEOs. A tenured manager may have a higher preference for debt-like compensation than non-tenured managers; hence, to align the benefits with shareholder interests, a larger portion of cash-based compensation may be needed. If dominance is related to overconfidence (Brown and Sarma, 2007), then equity-based compensation will be more effective for dominant CEOs. Consequently, the portion of each component of the compensation package should be aligned with CEO attributes, and compensation should be endogenous with these attributes rather than exogenous. Of course, CEO attributes can also influence managerial risk taking directly.

Our main interest is to investigate how CEO attributes might affect managerial risk taking with regard to different compensation schemes. Using individual compensation components – cash (debt-like) –, stock-, and option-based, we are able to examine the impact of each component in the compensation package on managerial risk taking. What makes this paper special is that we investigate a market where rich data on CEO compensation and attributes have been collected by COMPUSTAT; thus, we can easily access these valuable and reliable measures. Moreover, our sample period covers a long time span of 17 years; thus, some crucial financial events (e.g., the Asian financial crisis, the 9/11 event, and the global financial crisis) can be covered to compare pre- and post-event differences.

In sum, we contribute to the extant compensation literature in different aspects. First, we find that equity-based compensation induces managers to undertake value-enhancing risky projects, whereas cash-based compensation has an inverse effect on risk taking. However, after dividing the equity-based compensation in stock- and option-based compensation, we find that option-based compensation motivates managers undertake risks, whereas stock-based compensation has a negative impact on managerial risk taking. The ratio of cash-to-total compensation also plays an important role in influencing agency conflicts; CEOs awarded with a high proportion of cash compensation prefer to invest in projects with less risk. CEOs with the attribute of overconfidence are inclined to undertake projects with higher risks regardless of the type of compensation: cash, stocks or options. Consequently, risk-inducing compensation appears to be less important for CEOs with the characteristic of overconfidence. However, for CEOs without the attribute of overconfidence, risk-incentivizing compensation mechanisms turn out to be crucial and only equity-based compensation is effective in inducing them to undertake value-enhancing risky projects. Furthermore, this equity-based compensation should be option-based rather than stock-based. Moreover, CEO dominance reveals a positive impact on corporate risk taking[1]. The other CEO attributes of age and tenure are also found to significantly influence the impact of compensation on managerial risk taking. The results of this paper have important implications for the design of compensation packages considering the attributes of executives with regard to solving agency conflicts.

The remainder of the paper is organized as follows. Section 1 and 2 present the data and methodology. Section 3 gives reasoning behind the variables in the corporate risk taking equation. Section 4 presents the results and analysis, and the final section concludes.

1. Data and sample

Our sample contains 22,676 firm-year observations from the COMPUSTAT Global and ExecuComp databases over a 17-year period from 1992 to 2008. These two databases provide us with financial statements, cash flow statements and detailed information about CEO profiles such as compensation, age and tenure. We exclude financial firms and restrict our sample to the set of firms for which data are available in ExecuComp in 2008[2].

We started with the executives being identified as CEOs and then extracted all related data on executive compensation from COMPUSTAT ExecuComp, which contains comprehensive cross-sectional information about CEO profiles. Each CEO listed in ExecuComp is profiled with information such as the dates she/he started and ceased to hold her/his executive position, her/his annual executive compensation, age, number of years being an active CEO, total compensation (including salary, bonus, other annual payments and restricted stock gains), cash compensation (salary and bonus), equity-based compensation (restricted stock granted and stock options granted), whether the executive is

[1] See, e.g., Brown and Sarma (2007).
[2] Financial firms were excluded from the sample because they exhibit different balance sheet items than non-financial firms.

serving as a chairman of the board, and the numbers of board meetings per year. Our sample was collected from 1992, the starting year of the COMPUSTAT ExecuComp database, to 2008. For each firm, COMPUSTAT provides complete financial statements on each item[1].

A unique identifier (GVKEY) was used to screen an original sample of 26,032 firm-year observations covering 10 industries. After deleting the sample of the financial industry, 22,676 effective observations remained from an unbalanced panel dataset. Table 1 presents the sample distribution across the 9 industries of which consumer discretionary is the largest industry, accounting for approximately 23% of the total sample, followed by the information technology and industrial industries, which accounted for approximately 18% of the sample. The smallest industry is telecommunication services, with 1%.

Table 1. The sample industry distribution

Industry sectors	Codes	Observations	Percentage
Energy	10	1,343	5.92
Materials	15	2,001	8.82
Industrials	20	4,002	17.65
Consumer discretionary	25	5,189	22.88
Consumer staples	30	1,421	6.27
Health care	35	2,618	11.55
Information technology	45	4,139	18.25
Telecommunication services	50	323	1.42
Utilities	55	1,640	7.23
Total		22,676	100

2. Methodology and empirical model

2.1. Model specification. Our models are processed as described below. First, we regress the risk-taking equation with regard to corporate operations on variables that capture the influence of executive compensation, managerial attributes, corporate governance, characteristics, industry and year effects.

Because CEO compensation is an endogenous variable, the ordinary least squares (OLS) estimation may not be suitable because the parameter estimates could be biased if the regressors are endogenously determined along with the dependent variable – risk taking. Therefore, our models of risk-taking and compensation equations are specified as simultaneous equation models (SEMs) in Equations (1a) and (1b) below:

$$Risk_{i,t+1} = \alpha_1 + \alpha_2\, CEO\ Compensation_{i,t} + \alpha_3\, Managerial\ Ownership_{i,t} + \alpha_4\, Board\ Meetings_{i,t} + \alpha_5\, Overconfidence_{i,t} + \alpha_6\, Leverage_{i,t} + \alpha_7\, Growth\ Opportunities_{i,t} + \alpha_8\, Free\ Cash\ Flow\ Ratio_{i,t} + \alpha_9\, Firm\ Size_{i,t} + \alpha_{10}\, Capital\ Intensive_{i,t} + \alpha_{11}\, Payout_{i,t} + \alpha_{12}\, RDTA_{i,t} + \alpha_{13}\, IND\_D_{i,t} + \alpha_{14}\, Year\ Effects_{i,t} + \omega. \quad (1a)$$

$$CEO\ Compensation_{i,t} = \beta_1 + \beta_2\, Duality_{i,t} + \beta_3\, Overconfidence_{i,t} + \beta_4\, Dominance_{i,t} + \beta_5\, Age_{i,t} + \beta_6\, Age\ Squared_{i,t} + \beta_7\, Tenure_{i,t} + \beta_8\, Tenure\ Squared_{i,t} + \beta_9\, Growth\ Opportunities_{i,t} + \beta_{10}\, Free\ Cash\ Flow\ Ratio_{i,t} + \beta_{11}\, Firm\ Size_{i,t} + \beta_{12}\, Payout_{i,t} + \beta_{13}\, RDTA_{i,t} + \mu, \quad (1b)$$

where, the subscripts i and t indicate the company i and year t, respectively. The summarized description of each variable and its predicted sign are presented in Tables 2-3. Because corporate risk taking and CEO compensation may be endogenous to one another, we employ the Hausman test (Hausman, 1978) to confirm the existence of exogeneity. Our x^2 results suggest that the null hypothesis that the 3SLS and OLS coefficients for each of the two equations are the same is rejected, indicating the presence of an attenuation bias. Additionally, the identification test and excluded-instruments F-test results also show that the two dependent variables are endogenous to each other in this system. To solve this endogeneity issue, we use a three-stage least squares regression, an extension of the linear regression model that allows for correlation between error terms in equations[2]. Our simultaneous equations (1a) and (1b) are thus identified.

[1] Such as earnings before interest, tax, depreciation and amortization (EBITDA), fixed assets, total assets, long-term debt, total debt, net sales, market value of equity, dividend, research and development (R&D) expenditures, net property plant and equipment, net income, income tax, retained earnings, amortization/depreciation, current assets, current liability, capital expenditures, market value of the firm, earnings before interest and tax (EBIT), and operating income before depreciation.

[2] See Palia (2001) and Greene, W.H. (2000).

Table 2. Descriptions of variables

Variables	Symbol	Descriptions
Risk measures		
Black-Scholes volatility	B-S$_{VOL}$	Black-Scholes volatility
Earnings volatility	EARN$_{VOL}$	EARN$_{VOL}$ = $\sqrt{\sum_{t=1}^{T}\left(\frac{EBITDA_{i,t}}{Assets_{i,t}} - \frac{\overline{EBITDA_{i,t}}}{Assets_{i,t}}\right)^2}$
CEO Compensation		
Total compensation	COMP$_{TOTAL}$	Log [1 + (Salary + Bonus + Other annual compensation + Restricted stock gain)]
Cash compensation	COMP$_{CASH}$	Log [1 + (Salary + Bonus)]
Equity-based compensation	COMP$_{EQUITY}$	Log [1+ (Value of restricted stock granted + the Black-Scholes value of stock options granted)]
Stock-based compensation	COMP$_{STOCK}$	Log [1+Value of restricted stock granted]
Options-based compensation	COMP$_{OPTION}$	Log [1+ the Black Scholes value of stock options granted)]
Corporate governance		
Managerial ownership	OWNERSHIP	Log [1 + Outside wealth of CEO]
Board meetings	MEETINGS	Number of board meetings
CEO duality	DUALITY	Dummy variable which equals 1 when the CEO is also the chairman of the board and 0 otherwise
CEO Attributes		
CEO overconfidence	OVERCON	Sum of the book value of common equity and deferred taxes divided by the market value of common equity
CEO dominance	DOMINANCE	Log (CEO remuneration/total assets) Remuneration = Basic salary + Director fees + Performance bonuses + Allowances & Non-cash benefits
CEO age	AGE	CEO age
CEO age squared	AGE SQR	The squared of CEO age
CEO tenure	TENURE	The number of years that an executive serves as a CEO.
CEO tenure squared	TENURE SQR	The squared of CEO tenure
Corporate characteristics variables		
Leverage	LEVERAGE	Long-term debt / Total assets
Growth opportunities	TOBINSQ	Tobin's Q = Market to Book ratio = (Market value of equity + The book value of total assets – The book value of equity) /The book value of total assets
Free cash flow ratio	FCF/SALES	(EBIT – Income tax + Depreciation & Amortization– Capital expenditures) / Net sales
Firm size	SIZE	Log (Total net sales of the firms)
Capital intensity	CAPEX/TA	Property, Plant and Equipments / Total assets
Dividend ratio	PAYOUT	Dividend-to-book value of equity
R&D ratio	RDTA	R&D expenditures to Total assets
Industry effects	IND_D	Dummy variables for nine industries that equal 1 if each industry effect is considered and 0 otherwise
Year effects		
Asian crisis in 1997	ASIAN97[1]	Dummy variable that equals 1 if the Asian crisis is considered and 0 otherwise
9/11 attacks in the US in 2001	911 EVENT	Dummy variable that equals 1 if 911 event is considered and 0 otherwise
Global crisis in 2007	GLOBAL07[2]	Dummy variable that equals 1 if the Global crisis is considered and 0 otherwise

Table 3. The predicted signs for each variable in the system equations

Variables	Descriptions	Symbols	Predicted signs
Panel A: The predicted sign of each variable in the risk equation			
CEO compensation	Total compensation	COMP$_{TOTAL}$	+
	Cash compensation	COMP$_{CASH}$	-
	Equity-based compensation	COMP$_{EQUITY}$	+
	Stock-based compensation	COMP$_{STOCK}$	-
	Options-based compensation	COMP$_{OPTION}$	+
Corporate governance	Managerial ownership	OWNERSHIP	+

[1] Asian crisis begins in July 1997.
[2] 9 August 2007. 15 September 2008. 2 April 2009. 9 May 2010. 5 August 2011. From sub-prime to downgrade, the five stages of the most serious crisis to hit the global economy can be found on those dates.

Table 3 (cont.). The predicted signs for each variable in the system equations

Variables	Descriptions	Symbols	Predicted signs
	Board meetings	MEETINGS	+
CEO attribute	CEO overconfidence	OVERCON	+
Corporate characteristics	Leverage	LEVERAGE	+
	Tobin's Q	TOBINSQ	+
	Free cash flow ratio	FCF/SALES	+
	Firm size	SIZE	-
	Capital intensity	CAPEX/TA	-
	Dividend ratio	PAYOUT	-
	R&D ratio	RDTA	+
Industry effects	Dummy variables	IND_D	+/-
Year effects	Global crisis in 2007	GLOBAL07	+/-
	911 event in US 2001	911 EVENT	+/-
	Asian crisis in 1997	ASIAN97	+/-
Panel B: The predicted sign of each variable in the compensation equation			
Corporate governance	CEO duality	DUALITY	+
CEO attributes	CEO overconfidence	OVERCON	-
	CEO dominance	DOMINANCE	+
	CEO age	AGE	+
	CEO age squared	AGE SQR	-
	CEO tenure	TENURE	+
	CEO tenure squared	TENURE SQR	-
Corporate characteristics	Tobins'Q	TOBINSQ	+
	Free cash flow ratio	FCF/ SALES	-
	Firm size	SIZE	+
	Dividend ratio	PAYOUT	+
	R&D ratio	RDTA	+

The detailed variable definitions and reasoning are presented in the following section.

3. Reasoning behind the variables in the corporate risk taking equation.

3.1. Measuring risk taking. Because riskier corporate operations have more volatile returns to capital, we employ both of market and accounting proxies for measuring corporate risk taking. The first proxy is the Black-Scholes (B-S) volatility as measured by the Black-Scholes option value over the past 60 months. The Black-Scholes option-pricing model (Black and Scholes, 1973) is presented in equation (2).

$$C = SN(d_1) - Ke^{(-rt)}N(d_2), \quad (1)$$

where C is the call premium; S is the current stock price; t represents time to option expiration; K represents the option strike price; r is the risk-free rate; N is the cumulative standard normal distribution; e is the exponential term (2.7183);

$$d_1 = \frac{\ln(S/K) + (r + s^2/2)t}{s\sqrt{t}}; \; d_2 = d_1 - s\sqrt{t}, \quad (2)$$

s, is the standard deviation of stock returns; and ln is the natural logarithm. Following extant studies, we first use the Black-Scholes volatility to measure corporate risk taking (Brick et al., 2006; Benson & Davidson, 2010). Because the Black-Scholes volatility (hereafter, B-S_{VOL}) is rightly skewed, a natural logarithm was taken to normalize the distribution.

The second proxy is accounting measures – the volatility of corporate earnings before interests, depreciations, taxes and amortizations (EBIDTA). Following the calculation of John et al. (2008), we compute the standard deviation of a firm's EBITDA/Assets for three years, denoted by $EARN_{VOL}$ in Equation (3).

$$EARN_{VOL} = \sqrt{\sum_{t=1}^{T}\left(\frac{EBITDA_{i,t}}{Assets_{i,t}} - \overline{\frac{EBITDA_{i,t}}{Assets_{i,t}}}\right)^2}\,(T=3), \quad (3)$$

where i indicates the company; t indicates the year; $EBITDA_{i,t}$ is defined as the earnings before interest, tax, depreciation and amortization; and $Assets_{i,t}$ is defined as the total assets. Similar to B-S volatility, a natural logarithm was taken to mitigate the skewness and normalize the distribution of $EARN_{VOL}$. The B-S_{VOL} is utilized throughout the paper, while $EARN_{VOL}$ is used for the robustness checks.

3.2. Measuring CEO compensation. Three proxies are employed for measuring compensation: the total executive compensation ($COMP_{TOTAL}$), the cash-

based compensation ($COMP_{CASH}$) and the equity-based compensation ($COMP_{EQUITY}$). First, we obtained the total compensation from the total direct compensation (TDC1) in ExecuComp. This variable describes the total compensation paid to the CEO each year, where total compensation includes three main components: (1) fixed pay: basic salary; (2) short-term incentive plan: annual bonus and other annual payments, which are generally tied to yearly accounting performance; and (3) long-term incentive plans (LTIPS) that include the total value of restricted stock granted. LTIPS are typically tied to multi-year performance, either accounting based or stock-market based. Because CEO total compensation may influence managerial decisions regarding whether to undertake projects with different risks, we expect a positive sign of total compensation on risk taking.

Second, cash compensation, a proxy for measuring a CEO's risk aversion, was measured by the sum of salary and bonus, a measure of the fixed and short-term compensation. Berger et al. (1997) and Coles et al. (2006) find that executives with higher cash compensation are more likely to choose projects with less risk. Hence, we argue that cash-based compensation induces CEOs to avoid risk, and a negative sign on risk taking is expected.

Finally, the equity-based compensation includes the total value of restricted stock granted ($COMP_{STOCK}$) and the Black-Scholes value of stock options granted ($COMP_{OPTION}$), a measure of long-term incentives. Because stock options induce risk taking (Rajgopal and Shevlin, 2002; Low, 2009), a positive impact on risk taking is expected. To avoid the skewness bias, a natural logarithm was taken for all types of compensations, $COMP_{TOTAL}$, $COMP_{CASH}$, $COMP_{EQUITY}$, $COMP_{STOCK}$ and $COMP_{OPTION}$, for further examination.

3.3. Measuring corporate governance. Two variables of corporate governance are controlled for in Equation (1a): managerial ownership and board meetings per year. A larger portion of managerial ownership (OWNERSHIP) illustrates that the interests of managers are more closely aligned with shareholders. As a result, a firm with a higher portion of managerial ownership is more likely to accept risky and value-enhancing projects. Following the studies of Dittmann and Maug (2007) and Grant et al. (2009), we used the "outside wealth" of the CEO as a proxy for managerial ownership. The outside wealth of the executive is measured by the natural logarithm aggregate of all compensation received by the executive in prior years when the CEO was listed in the ExecuComp database. We expected a positive sign of OWNERSHIP on risk taking. A higher number of board meetings (MEETINGS) may increase the alignment of CEO benefits with shareholder interests (Conger et al., 1998); thus, a positive sign of MEETINGS on risk taking is expected. However, a few studies suggest that the number of board meetings only increased in situations of poor corporate governance or performance; in this case, the sign may be opposite.

3.4. Measuring CEO overconfidence (OVERCON). We argue that CEO overconfidence is one of the determinants that influences managerial risk taking. Overconfidence is defined as an overestimation of one's own abilities or an overestimation of outcomes relating to one's own personal situation, known as the "better than average effect" (Langer, 1975). Heaton (2002) argues that overconfidence in the form of managerial optimism is unambiguously bad, causing either over- or under-investment. In contrast, Gervais, Heaton and Odean (2009) present a model explaining that overconfidence can increase value by mitigating moral hazard and aligning incentives. Empirically, Malmendier and Tate (2005, 2008) find that overconfident CEOs have higher investment-cash flow sensitivities and are more likely to engage in value-destroying mergers.

There are a number of approaches to measure executives' overconfidence. Past studies used measures of CEO overconfidence such as CEO ownership of company options (Malmendier and Tate, 2005, 2008), media coverage (Hayward and Hambrick, 1997; Malmendier and Tate, 2008; Brown and Sarma, 2007; Hribar and Yang, 2010), biases between managers' forecasted earnings and actual earnings (Lin et al., 2005), frequency of CEO-initiated M&As (Malmendier and Tate, 2008; Doukas and Petmezas, 2006), CEO's relative salaries (Hayward and Hambrick, 1997), and firms' current performance. (Hayward and Hambrick, 1997; Cooper et al., 1988). Following previous studies, we measure CEO overconfidence by the sum of the book value of common equity and deferred taxes divided by the market value of common equity (Rau and Vermaelen, 1998; Kohers and Kohers, 2001; Sudarsanam and Mahate, 2003; Fahlenbrach, 2009) and expect a positive impact of executive overconfidence on risk taking.

3.5. Measuring the corporate characteristics variables. The set of control variables, such as leverage, Tobin's Q, free cash flow ratio, firm size, capital intensity, payout ratio and R&D ratio, included in regression (1a) is known to explain the risk. The leverage (LEVERAGE) is measured by the ratio of long-term debt to equity (see, e.g., Mehran, 1995; Kang and Rene, 2000; and Sufi, 2009). LEVERAGE is expected to have a positive sign on corporate risk taking. Regarding growth opportunities (TOBINSQ), increasing corporate risk in the absence of growth opportunities may not be eco-

nomically rational. Wright et al. (1996) indicate that the ownership structure affects corporate risk taking in the presence of growth opportunities; it may not be associated with risk in the absence of growth opportunities. Following previous studies, the growth opportunity is measured by the market-to-book value (TOBINSQ) (see, e.g., Smith and Watts, 1992; Gaver and Gaver, 1993; Yermack, 1995; Coles et al., 2006)[1]. Firms with a higher free cash flow ratio (FCF/SALES) are more likely to accept investments with extra returns; thus, a positive relationship with risk taking is expected. The free cash flow ratio was measured by the sum of earnings before interest, tax and amortization or depreciation (EBITDA) minus income tax divided by net sales. SIZE is measured by the logarithm of the firm's net sales. Rajan and Zingales (1994) argue that size could be a proxy for the probability of default. Larger and more visible firms face less information asymmetry and are more inclined to manage and diversify risks (Bodnar et al., 1998). A similar proxy was utilized by many researchers indicating a negative sign of size on risk (e.g., Combs and Skill, 2003; Coles et al., 2006; Benson and Davidson, 2010; Combs et al., 2010). If capital expenditures consume cash, then firms with high capital expenditures may have less liquidity such that conservative investments may be chosen. Capital intensity refers to the amount of capital a company invests to maintain business operations and competition. Following the method suggested by Barton and Gordon (1988), we measure capital intensity (CAPEX/TA) by net property, plant and equipment to total assets. Gaver et al. (1993) illustrated that growth firms have lower dividend payouts than non-growth firms. We hence include the dividend ratio (PAYOUT) in the risk-taking equation and expect a negative impact on risk taking. PAYOUT is measured by total dividends divided by the book value of equity (Nguyen, 2011). R&D expenditures can be viewed as intangible investments and consume cash that may otherwise result in a higher risk. We thus expect a positive relationship between a firm's R&D expenditures and risk taking. The R&D ratio (RDTA) is measured by R&D expenditures divided by total assets (Coles et al., 2006).

3.6. Measuring industry and year effects. Prior research has documented that industry effects can influence corporate compensation strategies (Gerhart and Milkovich, 1990; Stroh et al., 1996, Coombs et al., 2005). Moreover, a firm's risk may vary by industry and be impacted by specific events in certain years. To avoid disturbances due to industry and time, industry dummies (IND_D) and three crises – the Asian financial crisis starting in 1997, the 9/11 event in 2001, and the global financial crisis starting in 2008 – are controlled for in the model. Following the Global Industry Classification Standard, the industry types are classified into nine categories.

3.7. Reasoning and description of variables in the CEO compensation equation. In addition to the main risk taking equation, the compensation equation (1b) below was set to be influenced by CEO attributes, duality and corporate characteristics.

3.7.1. Measuring CEO attributes. CEO attributes are defined as the following CEO profile characteristics: overconfidence, dominance, age and tenure. We argued that the attribute of CEO overconfidence is one of the main factors to be considered in designing executive compensation. Following the ideas of prior studies, we measure overconfidence (OVERCON) by the sum of the book value of common equity plus deferred taxes divided by the market value of common equity (see, e.g., Rau and Vermaelen, 1998; Kohers and Kohers, 2001; Sudarsanam and Mahate, 2003; Fahlenbrach, 2009)[2]. Overconfident CEOs overestimate their ability of generating value or future cash flows relating to their own personal situation. As a result, a negative impact of overconfidence on compensation is expected. Following Haleblian and Finkelstein (1993), CEO dominance (DOMINANCE) is defined as the capacity of an individual to exert his/her will. Dominance differs from overconfidence. Overconfidence is a personality trait and therefore relates to the individual, whereas dominance is an objective fact of behavior or ability of one person to impose his/her will on others. Dominance *may* follow from overconfidence; however, not all overconfident CEOs are dominant. In a corporate context, dominant individuals are very likely to exert their dominance in the determination of their compensation. Following the similar vein of Jensen and Zajac (2004), we add a variable of CEO dominance to ensure the effects of CEO overconfidence are not confounded with the effects of CEO power. Following the measure suggested by Brown and Sarma (2007), CEO dominance was measured by the natural logarithm of the ratio of CEO an-

[1] Market-to-book ratio is the sum of the market value of equity and the book value of total assets minus the book value of equity divided by the book value of total assets.

[2] Malmendier and Tate (2002) suggest a measure of overconfidence based on CEOs' stock purchases and the incremental value of wealth. Some studies classify CEOs as overconfident if they were a net buyer of company stock compared with the previous year.

nual remuneration to total assets. The remuneration is calculated by the sum of basic salary, director fees, performance bonus, allowances and non-cash benefits. We expect a positive impact of DOMINANCE on compensation. AGE is the CEO's age in years. To further examine whether executive age has a nonlinear relationship with executive compensation, we put AGE and age squared (AGE SQR) into the compensation equation[1] and expect a positive and negative impact, respectively. Regarding CEO tenure (TENURE), prior research found that executive tenure inversely relates to organizational change. Gabarro (1987), for example, finds that new CEOs make substantial changes in the first 2.5 years of their tenure, after which the number of changes declines. Miller (1991) similarly observed that long-tenured CEOs tend to avoid changing corporate strategies even though the environment requires such changes. We thus argue that the compensation incentive is important for the first few years of CEO tenure. From another perspective, CEO tenure may exhibit a nonlinear relationship with executive compensation. We define CEO tenure as the number of years that an executive serves as a CEO and add tenure squared (TENURE SQR) to capture the nonlinear relation. TENURE and TENURE SQR are expected to carry a positive and a negative sign on compensation, respectively.

3.7.2. Measuring CEO duality (DUALITY). Yermack (1995) addressed the issue that agency problems are more serious if a CEO serves as the chair of the board. A CEO holding the title of chairman of the board can lead to greater CEO control of board decisions. Therefore, CEO duality is associated with the CEO power indicator (e.g., Grant at al., 2009; Pathan, 2009). Following the report of Dalton et al. (1998) and Combs et al. (2010), we employ DUALITY as a dummy variable that equals "1" if the executive also serve as the chairman of the board and "0" otherwise. If a CEO serves as chair of the board, his benefits may be strongly aligned with the shareholders. As such, a positive sign on compensation is expected.

3.7.3. Measuring corporate characteristics. The following corporate characteristics are controlled for in the equation: growth opportunities, free cash flow ratio, firm size, capital intensity, payout and R&D ratio.

Following the report of Dee et al. (2005), growth opportunities are measured by Tobin's Q (TOBINSQ). Firms with better growth opportunities are more likely to pay higher compensation; thus, a positive sign is expected. Firms with higher free cash flows have more liquidity that may influence the components of compensation. The free cash flow was employed as a control for managerial moral hazards. The free cash flow ratio (FCF/SALES) is measured by the sum of earnings before interest and tax and amortization/depreciation (EBITDA), minus income tax is divided by net sales. Prior studies find that firm size (SIZE) significantly influences executive compensation (Tosi et al., 2000; Benson et al., 2010). Chhaochharia et al. (2009) also addressed the issue that bigger and better-performing firms have higher compensation. SIZE was measured by the natural logarithm of net sales[2]. The dividend payout ratio (PAYOUT) is measured by the ratio of dividends to the book value of equity (Nguyen, 2011), and a positive impact on CEO compensation is expected. The R&D ratio was utilized as a proxy for the intangible investment, measured by R&D expenditures to total assets (RDTA) (Coles et al., 2006). We expect a positive sign of RDTA on the compensation because RDTA boosts future firm growth.

Table 2 displays the descriptions of the variables in the risk and compensation equations, categorized by risk taking, CEO compensation, corporate governance, CEO attributes, corporate characteristics, year and industry dummies. Table 3 presents the predicted signs of each variable in the system equations[3].

4. Empirical results and analysis

4.1. Descriptive statistics. Table 4 reports the summary statistics of the endogenous variables risk taking, CEO compensation and other exogenous variables. The average B-S volatility (B-S_{VOL}) is 0.34, with a substantial standard deviation of 0.15. We discuss the large variation in B-S volatility later. The average earnings volatility ($EARN_{VOL}$) is 3.90 with a standard deviation of 1.03. Regarding CEO compensation, the average total, cash- and equity-based compensations are 7.65, 6.72 and 5.34, respectively. Hence, cash basically plays a more important role than equity in the total compensation in the US.

[1] See prior studies using AGE and AGE SQR as control variables (e.g., Guay, 1999; Henderson et al., 2009; Shijun and Raffi, 2009; Fahlenbrach, 2009; Niu, 2010).

[2] See the reports of Aggarwal and Samwick (1999), Jin (2002), and Dee et al. (2005).

[3] In the risk equation, positive signs are expected for the variables of $Comp_{Total}$, $Comp_{Equity}$, OWNERSHIP, OVERCON, MEETINGS, LEVERAGE, TOBINQ, FCF/SALES, R&D, and DOMINANCE; the other variables are expected to carry negative signs. In the compensation equation, positive signs are expected for the variables of DUALITY, DOMINANCE, AGE, TENURE, TOBINSQ, SIZE, PAYOUT and RDTA, while the remaining variables are expected to carry negative signs.

Table 4. Summary statistics

Variables	Obs.	Mean	Median	Std. Dev.	25th percentile	75th percentile
Endogenous:						
Risk taking						
B-S_{VOL}	19211	.34	.32	.15	.24	.42
$EARN_{VOL}$	16550	3.90	3.88	1.03	0.55	4.23
CEO Compensation						
$COMP_{TOTAL}$	22677	7.65	7.62	1.20	6.87	8.44
$COMP_{CASH}$	22677	6.72	6.74	.96	6.27	7.23
$COMP_{EQUITY}$	18402	5.34	6.48	3.25	3.58	7.67
$COMP_{OPTION}$	20957	4.91	6.17	3.36	0.00	7.46
$COMP_{STOCK}$	21390	1.56	0.00	2.87	0.00	0.00
Exogenous:						
Corporate governance						
OWNERSHIP	18150	9.02	9.08	1.37	8.14	9.94
MEETINGS	17910	7.28	7	3.16	5	9
DUALITY	22676	.97	1	.16	1	1
CEO Attributes						
OVERCON	22239	.65	.64	.29	.44	.84
DOMINANCE	22611	.46	.53	1. 39	-.34	1.32
AGE	22573	55.61	56	7.58	51	61
TENURE	22374	6.94	5	7.24	2	9
Corporate characteristics						
LEVERAGE	22645	.19	.16	.18	.03	.30
TOBINSQ	22239	2.05	1.55	2.01	1.19	2.27
FCF/SALES	21995	-.15	.06	6.33	.02	.02
SIZE	22609	7.12	7.08	1.66	6.09	8.18
CAPEX/TA	22613	.32	.26	.23	.14	.47
PAYOUT	22592	.05	.01	2.09	0	.05
RDTA	13183	.06	.03	.12	.001	.08

Note: the sample consists of 22,676 U.S. firm-year observations from COMPUSTAT over 1992-2008. The endogenous variables include risk taking and CEO compensation. Risk taking is measured by B-S volatility (B-S_{VOL}) and earnings volatility ($EARN_{VOL}$). B-S volatility is the natural log of Black-Scholes volatility, measured by the standard deviation calculated over the 60 months of Black-Scholes option values. $EARN_{VOL}$ is the natural log of three-year earnings volatility. The CEO compensation includes the natural log of total compensation ($COMP_{TOTAL}$), the natural log of cash compensation ($COMP_{CASH}$) which includes salary and bonus; and the natural log of equity-based compensation ($COMP_{EQUITY}$) which composed of the total value of restricted stock granted and the Black-Scholes value of stock options granted. Corporate governance includes managerial ownerships OWNERSHIP measured by the natural log of CEO outside wealth, the aggregate of all compensation received by the CEO in the prior years. MEETINGS means the numbers of board meetings per year. DUALITY is a dummy variable of CEO duality, which is given a "1" when a CEO also serves as a chairman of the board. OVERCON is CEO overconfidence, measured by the sum of book value of common equity plus deferred taxes divided by the market value of common equity; DOMINANCE is CEO dominance measured by the natural log of the ratio of CEO total compensation to the firm's total assets; AGE is CEO age. AGE SQR is the squared of AGE; TENURE is the number of years of CEOs tenure; TENURE SQR is the squared of TENURE. Corporate characteristics include LEVERAGE, a ratio of long-term debt to total assets; TOBINSQ, market to book ratio; FCF/SALES, the ratio of free cash flow to net sales; SIZE, the natural log of total net sales; CAPEX/TA, the ratio of net of property, plant and equipment to total assets. PAYOUT the ratio of dividend to book value of equity; and RDTA is the ratio of R&D expenditure to total assets.

We next discuss the sets of exogenous variables: *corporate governance, CEO attributes,* and *corporate characteristics*. Regarding corporate governance, executives on average have an outside wealth of 9.02. Almost 34% of the executives in our sample had been serving as a chairman of the board, with an average of 7 board meetings per year. This high DUALITY implies high CEO power and relatively less monitoring from the board. The average values of overconfidence and dominance are 0.65 and 0.46, respectively. The average age of CEOs is 55 years and is associated with an average tenure of 7 years. Finally, the average long-term debt ratio of 0.19 indicates that the sample firms were not highly leveraged and were characterized by good repayment capabilities. The average Tobin's Q is 2.05 (with a median of 1.55), implying that most of our sample performs well[1]. The cash dividend payout ratio was 0.05 (with a median of 0.01), implying that most of the listed firms pay very trivial cash dividends, with more than half of them paying no dividends. The capital intensity is 0.32, which is higher than the average of 0.15 for firms in an industrial

[1] This Q is calculated as the book value of total assets minus the book value of equity plus the market value of equity divided by the book value of total assets.

country (Cui and Mak, 2002). The RDTA was 0.06, which is higher than the 3% that prevails in the US or other industrialized countries[2]. However, the FCF/SALES ratio is -0.15.

Table 5. Frequency distribution of endogenous variables by industries and years

			Risk		Compensation		
	Obs.	Obs. (%)	$B\text{-}S_{VOL}$	$EARN_{VOL}$	$COMP_{TOTAL}$	$COMP_{CASH}$	$COMP_{EQUITY}$
Panel A: by industries							
Energy	1343	5.92	.323	3.517	7.794	6.793	5.789
Materials	2001	8.82	.299	3.893	7.581	6.783	5.479
Industrials	4002	17.65	.318	4.057	7.577	6.743	5.201
Consumer discretionary	5189	22.88	.347	3.922	7.618	6.781	4.928
Consumer staples	1421	6.27	.268	4.324	7.873	7.012	5.375
Health care	2618	11.55	.378	3.721	7.801	6.730	5.930
Information technology	4139	1.42	.460	3.400	7.647	6.481	5.799
Telecommunication services	323	7.23	.310	4.129	8.366	7.189	6.750
Utilities	1640	5.92	.201	4.803	7.303	6.608	4.078
Panel B: by years and events*							
1992	1391	5.34	0.353	-	1.459.78	761.63	685.13
1995	1460	5.61	0.331	0.026	2.316.27	1.046.43	1.024.66
1997 (Asian Crisis)	1493	5.74	0.331	0.030	3.933.38	1.226.41	2.255.01
1998	1509	5.80	0.379	0.029	4.636.03	1.225.44	2.985.77
2001 (911 Event)	1493	5.74	0.511	0.037	5.877.18	1.347.97	4.096.78
2005	1635	6.28	0.429	0.033	5.489.33	1.899.60	2.930.18
2007 (Global Crisis)	1669	6.41	-	0.028	5.623.47	1.058.05	-

Note: * unit for compensation is USD thousand.

This table shows the distribution of the sample based on the Risk taking B-S volatility ($B\text{-}S_{VOL}$), earnings volatility ($EARN_{VOL}$) and compensation. Panels A and B are presented by industries and years. B-S volatility is the natural log of Black-Scholes volatility from COMPUSTAT database, which is the standard deviation of Black-Scholes option values over the 60 months. $EARN_{VOL}$ is the natural log of three-year earnings volatility of the firm. The CEO compensation includes the natural log of total compensation ($COMP_{TOTAL}$), the natural log of cash compensation ($COMP_{CASH}$) which includes salary and bonus; and the natural log of equity-based compensation ($COMP_{EQUITY}$) which is composed of the total value of restricted stock granted and the Black-Scholes value of stock options granted.

Table 5 reports the frequency distribution of the endogenous variables risk taking and CEO compensation across various industries and years. Panel A of Table 5 shows that information technology (IT) exhibits the highest risk, with an average B-S volatility of 0.46 and an $EARN_{VOL}$ of 3.40[1]. These results are consistent with the fact that the IT industry is highly competitive and innovative compared to other industries. However, the telecommunication services industry shows the highest CEO compensation with an average of 8.366, followed by the consumer staples industry with 7.873.

Panel B shows the average risk taking and CEO compensation during specific years and events: the Asian crisis in 1997, the 9/11 event in 2001, and the global financial crisis beginning in 2007. Evidence shows that the B-S volatility increased from 0.353 in 1992 to 0.379 in 1998 and reached the highest peak of 0.511 in the aftermath of the 9/11 attacks in 2001. Meanwhile, CEO compensation trends upward from USD 1.459 million in 1992 to a peak of USD 5.877 million in 2001 and then drops to USD 5.623 million in 2007 as a result of the global crisis. The total equity-based compensation increases sharply from USD 685 thousand in 1992 to USD 4.096 million in 2001 and then falls to USD 2.930 million in 2005. Both trends show that the relationships between B-S volatility and compensation are highly correlated. Similarly, the $EARN_{VOL}$ displays an upward trend from the Asian financial crisis to the 9/11 event. Notably, the total compensation still increases during the same period, although the Asian financial crisis has less impact on US corporate risk taking.

Figure 1 illustrates the impacts of the specific years on corporate risk taking and CEO compensation. As we can see, although B-S volatility and $EARN_{VOL}$ do not fluctuate during the Asian crisis from 1992 to 1998, they turn out to be highly volatile after 1998 and hit the highest peak in the aftermath of the 9/11 event. All types of compensation, total, cash- and equity-based, increase from 1992 on, with total and cash compensation reaching their highest peak in 2001. All these findings indicate that CEOs' risk taking increases with compensation.

[1] The natural log of the volatility was taken.

[2] Opler et al. (1999) report that R&D expenditure divided by sales is 0.027 for the US. This ratio is still meaningful even though it was estimated using sales as the denominator instead of assets.

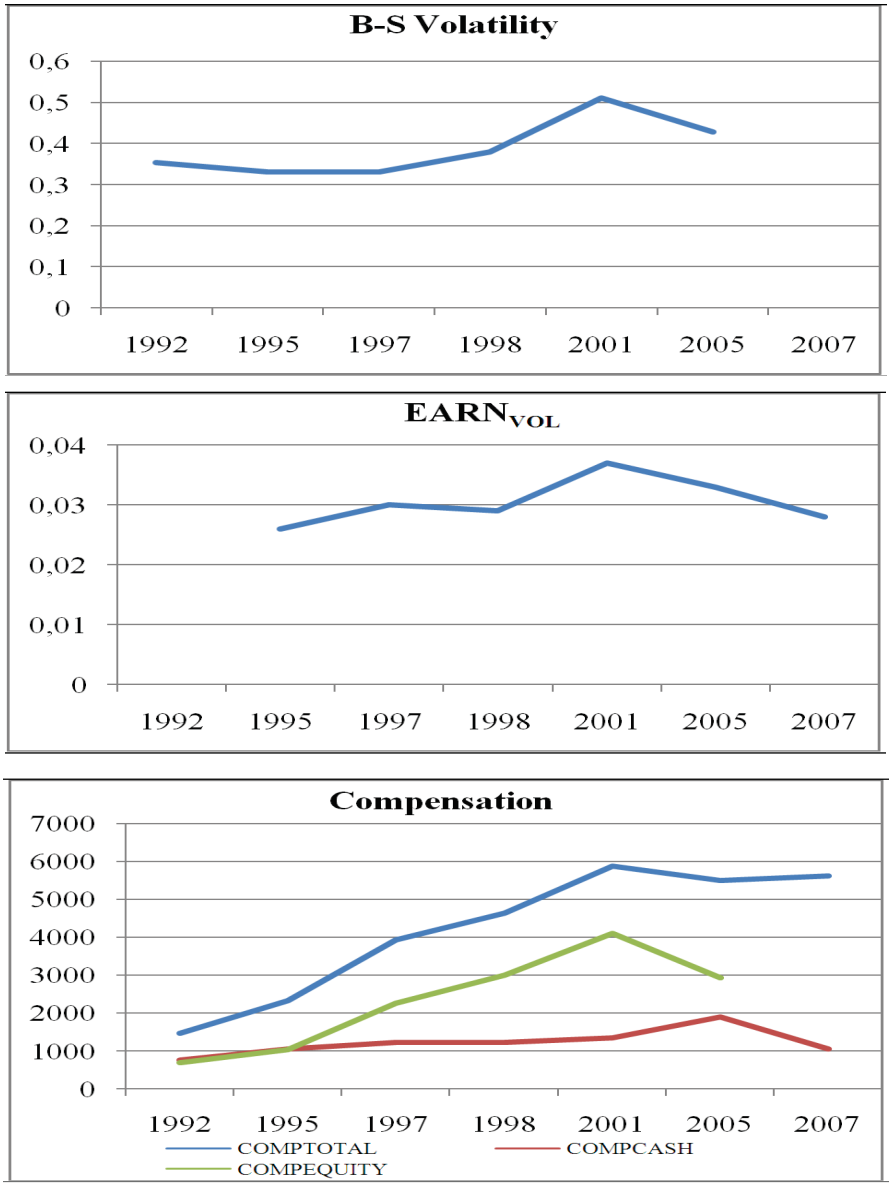

Fig. 1. Risk taking and compensation through the specific years and events

These graphs show the historical data of risk taking and compensation through specific years and events: Asian crisis (1997), 9/11 event (2001) and Global crisis (2007). B-S volatility is the natural log of Black-Scholes volatility measured by the standard deviation over the 60 months of Black-Scholes option values. $EARN_{VOL}$ is the natural log of three-year earning volatility. CEO Compensation includes the natural log of Total Compensation (TC), the natural log of Total Cash Compensation (TCC) which includes salary and bonus; and the natural log of Equity Based Compensation (EBC) which composed of the total value of restricted stock granted and the Black-Scholes value of stock options granted.

Similarly, Figure 2 shows the trends of CEO compensation and CEO attributes in specific years. The figure indicates a similar trend between tenure and age, revealing a close relation between both. The series of compensation, age and tenure show similar upward trends before the Asian crisis, followed by descending trends after the 1997 crisis. In contrast, managerial overconfidence (OVERCON) fluctuates with the financial shocks; OVERCON falls to the lowest point of 0.62 during the Asian crisis of 1997 and reaches its highest point in the aftermath of the 9/11 event of 2001; subsequently, managers turn out to be conservative until 2005. Although firm size was increasing, FCF/SALES drops sharply in the same period of 1997 to 2001. Furthermore, Tobin's Q and R&D ratio are increasing over the period of 1995 to 1998 and then decline until 2007. In sum, compensations and executive attributes appear to closely correlate with the external environment.

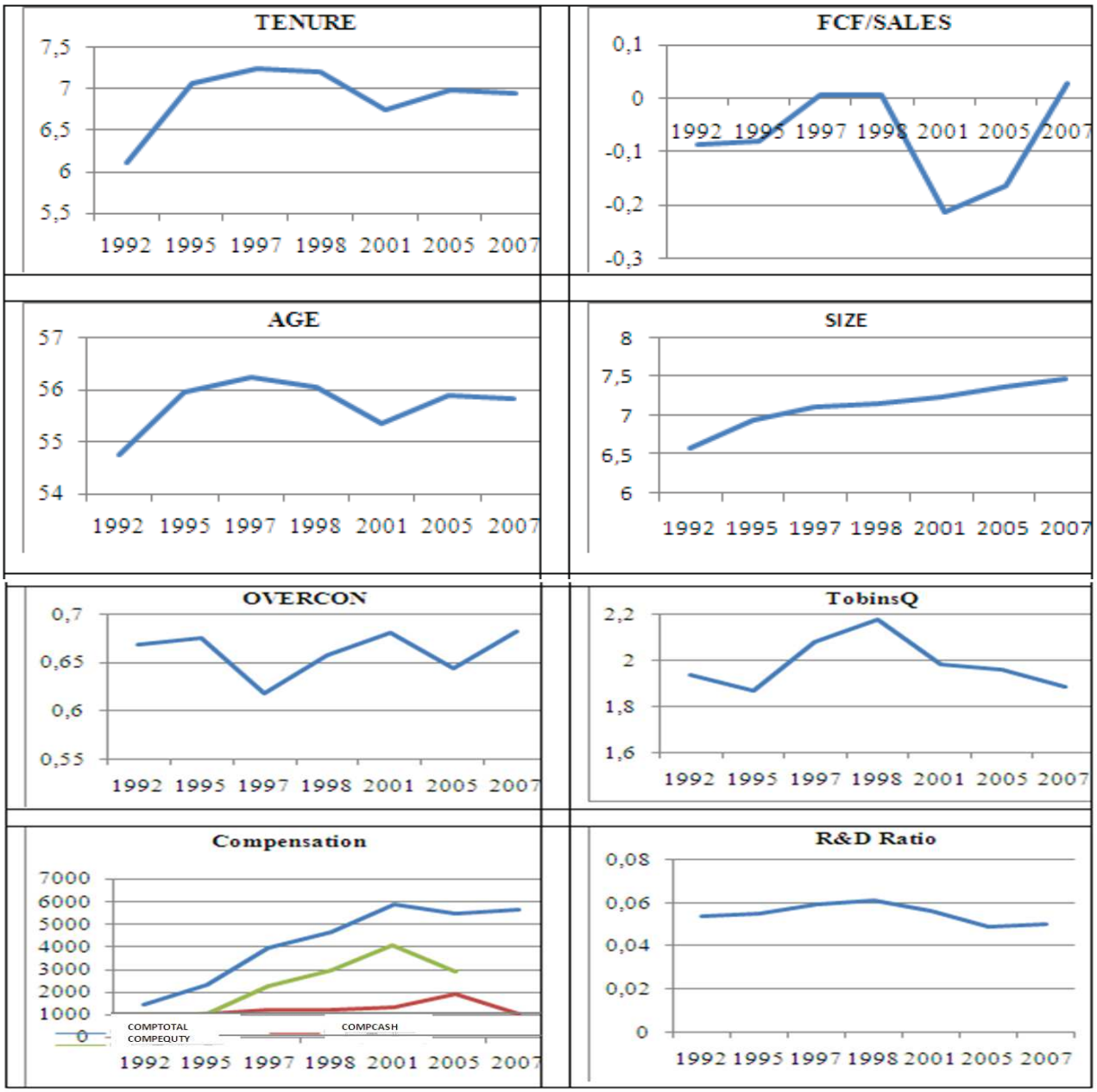

Fig. 2. Compensation, CEO attributes and corporate characteristics based on specific years and special events

These graphs show the historical data for CEO compensation and some variables of CEO attributes and corporate characteristics through specific years and events: Asian crisis (1997), 9/11 in US (2001) and Global crisis (2007). CEO compensation includes the natural log of total compensation ($COMP_{TOTAL}$), the natural log of total cash compensation ($COMP_{CASH}$) which includes salary and bonus; and the natural log of equity-based compensation ($COMP_{EQUITY}$) which is composed of the total value of restricted stock granted and the Black-Scholes value of stock options granted. Some variables of CEO attributes and corporate characteristics include: TENURE is a number years of CEO's experience; AGE is a CEO's age; TOBINSQ is a market to book ratio; FCF/SALES is a ratio of free cash flow to net sales; SIZE is a firm size; and RDTA is a ratio of R&D expenditure to total assets.

4.2. 3 SLS simultaneous equation identification tests. To perform identification tests for simultaneous equations, satisfying both order and rank conditions, we follow the step suggested by Wooldridge (2002). First, the order condition theorem with exclusion restrictions states that in a linear system of equations with exclusion restrictions, a necessary condition for identifying any particular equation is that the number of exogenous variables excluded from the equation must be at least as large as the number of included endogenous right-hand-side variables in the equation.

The compensation equation (1b) is identified because it is a reduced form equation (without endogenous explanatory variables in the compensation equation). The risk-taking equation (1a) fulfills the order condition because it contains only one endogenous variable on the right-hand side (such as $COMP_{TOTAL}$, $COMP_{CASH}$ or $COMP_{EQUITY}$) and because there are six excluded exogenous variables (e.g., OVERCON, TOBINS'Q, FCF/SALES, SIZE, PAYOUT, and RDTA). The rank condition holds for the risk equation because there is at least one variable (for example, AGE) in the

compensation equation that is not in the risk equation and that has a coefficient in the compensation equation that is not zero (its coefficient is significant in the compensation equation). Therefore, the risk-taking equation is identified because it satisfies both the order and rank conditions. As such, our simultaneous equations (1a) and (1b) are fully identified.

4.3. Discussion of the empirical results. *4.3.1. Discussion of risk equation (1a), the B-S volatility.* We begin with a discussion of the regression for equation (1a), the B-S volatility ($B\text{-}S_{VOL}$). Table 6 reports the results of the simultaneous equation model. The results of Model (1) in Table 6 show that the coefficient on $COMP_{TOTAL}$ is positive and significant, implying that a higher total compensation induces managers to undertake high-risk projects. However, high cash compensation ($COMP_{CASH}$) negatively influences a firm's risk taking in Model (3); in contrast, equity-based compensation ($COMP_{EQUITY}$) positively affects a firm's risk taking in Model (5). The results imply that equity-based compensation aligns CEO and shareholder interests by undertaking risky value-creating projects (Low, 2009); however, cash-based compensation does not align their interests. The former result is consistent with prior studies (e.g., Berger et al., 1997; Benson and Davidson, 2010), and the latter is also in line with findings of extant literature (e.g., Smith and Stulz, 1985; Lewellen et al., 1987; Guay, 1999; Dee et al., 2005; Low, 2009; Chen and Ma, 2011).

Table 6. Simultaneous equations results of risk taking (B-S volatility) and CEO compensation based on total, cash and equity-based compensation (1992-2008)

	Total compensation		Cash compensation		Equity-based compensation	
	$B\text{-}S_{VOL}$	$COMP_{TOTAL}$	$B\text{-}S_{VOL}$	$COMP_{CASH}$	$B\text{-}S_{VOL}$	$COMP_{EQUITY}$
	(1)	(2)	(3)	(4)	(5)	(6)
CEO Compensation						
$COMP_{TOTAL}$	0.0059***					
	(0.0017)					
$COMP_{CASH}$			-0.0132***			
			(0.0019)			
$COMP_{EQUITY}$					0.0015***	
					(0.0004)	
Corporate governance						
OWNERSHIP	0.0180***		0.0234***		0.0190***	
	(0.0013)		(0.0012)		(0.0012)	
MEETINGS	0.0043***		0.0043***		0.0042***	
	(0.0004)		(0.0004)		(0.0004)	
DUALITY		0.0157		0.5970***		0.1310
		(0.0720)		(0.0819)		(0.3300)
OVERCON	0.1090***	-0.0775**	0.101***	-0.237***	0.108***	0.0740
	(0.0062)	(0.0314)	(0.0062)	(0.0358)	(0.0062)	(0.1380)
DOMINANCE		0.7740***		0.3390***		1.8860***
		(0.0073)		(0.0083)		(0.0319)
AGE		0.0279***		0.0504***		0.2260***
		(0.0085)		(0.0097)		(0.0370)
AGE SQR		-0.0002***		-0.0003***		-0.0021***
		(0.0001)		(0.0001)		(0.0003)
TENURE		0.0046**		-0.0019		0.0001
		(0.0023)		(0.0026)		(0.0101)
TENURE SQR		-0.0003***		-0.0001		-0.0011***
		(0.0001)		(0.0001)		(0.0003)
Corporate characteristics						
LEVERAGE	0.0053		0.0053		0.0053	
	(0.0070)		(0.0070)		(0.0070)	
TOBINSQ	0.0074***	0.0224***	0.0074***	-0.0285***	0.0076***	-0.0169
	(0.0008)	(0.0040)	(0.0008)	(0.0046)	(0.0008)	(0.0175)
FCF/SALES	0.0011***	-0.0109***	0.0009***	-0.0115***	0.0022***	-0.0091
	(0.0002)	(0.0011)	(0.0002)	(0.0013)	(0.0003)	(0.0077)
SIZE	-0.0411***	0.7650***	-0.0371***	0.4560***	-0.0399***	1.4540***
	(0.0010)	(0.0053)	(0.0010)	(0.0061)	(0.0010)	(0.0233)
CAPEX/TA	-0.0356***		-0.0358***		-0.0366***	
	(0.0083)		(0.0083)		(0.0083)	

Table 6 (cont.). Simultaneous equations results of risk taking (B-S volatility) and CEO compensation based on total, cash and equity-based compensation (1992-2008)

	Total compensation		Cash compensation		Equity-based compensation	
	B-S$_{VOL}$	COMP$_{TOTAL}$	B-S$_{VOL}$	COMP$_{CASH}$	B-S$_{VOL}$	COMP$_{EQUITY}$
	(1)	(2)	(3)	(4)	(5)	(6)
PAYOUT	-0.0216***	0.0240	-0.0215***	0.0223	-0.0226***	0.1200
	(0.0061)	(0.0313)	(0.0061)	(0.0356)	(0.0061)	(0.1370)
RDTA	0.0807***	0.587***	0.0789***	0.0476	0.1120***	1.8570***
	(0.0125)	(0.0621)	(0.0124)	(0.0707)	(0.0146)	(0.3130)
ASIAN97	-0.0194***		-0.0193***		-0.0196***	
9/11EVENT	0.0740***		0.0707***		0.0746***	
IND_D	YES		YES		YES	
Constant	0.2837***	0.9746***	0.3399***	1.2913***	0.3031***	-11.7223***
	(0.0176)	(0.247)	(0.0181)	(0.281)	(0.0172)	(1.081)
Observations	7395	7395	7395	7395	7366	7366
Chi2	6158.15	22699.55	6208.57	7061.09	6116.21	5051.96
-squared	0.453	0.754	0.457	0.488	0.453	0.406

Note: this table shows the results of a 3 SLS simultaneous equation model. The first equation is a risk equation measured by the natural log of Black-Scholes volatility (B-S volatility), measured by the standard deviation of Black-Scholes values of options over the 60 months; the second equation is a CEO compensation equation that is divided into 3 cases: the natural log of equity-based compensation ($COMP_{EQUITY}$), which is composed of the total value of restricted stock granted and the Black-Scholes value of stock options granted; measured by the log of restricted stock granted compensation ($COMP_{STOCK}$); and the option granted compensation ($COMP_{OPTION}$), includes only the Black-Scholes value of stock options granted. The control variables include LEVERAGE, which is a ratio of long-term debt to total assets; CAPEX/TA is the capital intensity, measured by net property, plant and equipment to total assets; OWNERSHIP is the managerial ownerships, measured by the CEOs outside wealth, equal to the aggregate of all compensations the CEOs received in the prior years; MEETINGS is the number of board meetings; OVERCON stands for CEO overconfidence, measured by the sum of the book value of common equity and deferred taxes divided by the market value of common equity; TOBINSQ is a market-to-book ratio; FCF/SALES is a ratio of free cash flow to net sales; SIZE is the firm size, measured by the natural logarithm of the total net sales of the firms. PAYOUT is the ratio of dividends to the book value of equity; RDTA is the ratio of R&D expenditure to total assets; AGE stands for CEO age; AGE SQR is the square of CEO age; DOMINANCE stands for CEO dominance and is measured by the natural log of the ratio of CEO total annual remuneration to the firm's total assets; TENURE is the number of a CEO's years of experience; TENURESQR is the square of CEO experience; DUALITY is a dummy variable for CEO duality, which is given a "1" if a CEO also serves as the chairman of the board. Standard errors are reported in parentheses, and ***, ** and * represent the significance at the 0.01, 0.05 and 0.1 levels, respectively.

More importantly, and unique to this paper, is that CEO outside wealth, a proxy for managerial ownership (OWNERSHIP), is positively and significantly related to risk taking, demonstrating that alignment and incentive effect increase with managerial ownership; thus, a value-enhancing and risky investment is more likely to be chosen (see, e.g., Downs and Sommer, 1999). The number of board meetings (MEETINGS) significantly positively influences risk, implying that a high frequency of meetings raises the effectiveness of the board and induces managers to align the benefits with shareholders. These findings also support the findings of Conger et al. (1998) indicating that high numbers of meetings improve the effectiveness of the board.

Not surprisingly, CEO overconfidence (OVERCON) positively influences a firm's risk taking, implying that overconfident managers incline to be more risk-loving. Thus, overconfidence can compensate for the underinvestment problem resulting from risk-averse executives. Our results support previous reports of a positive relationship between overconfident managers and risk attitude (see, e.g., Gervais et al., 2005; Sudarsanam and Huang, 2006). As expected, the coefficients of the variables on FCF/SALES, TOBINSQ and RDTA are significant and positive. The result of RDTA is in line with the report of Guay (1999) indicating that R&D expenditures are positively related to CEO risk taking. However, SIZE, CAPEX/TA, and PAYOUT, in contrast to our expectation, significantly negatively influence corporate risk.

Interestingly, two events show different results: the Asian financial crisis in 1997 and the 9/11 event in 2000 exhibit negative and positive impacts on corporate risk, respectively[1]. The possible reasons for a negative sign of the Asian crisis could be that the Asian crisis resulted from an overvaluation of Asian currencies against the US dollar; hence, risk appears on the other countries rather than in the US. While 9/11 event just happened in the US. Furthermore, industry impacts are found to significantly influence corporate risk.

[1] The global financial crisis event was omitted automatically by the model while running these events together due to insufficient observations.

Table 7. Simultaneous equations results of risk taking (B-S volatility), CEO equity-based and cash ratio compensations (1992-2008)

	Equity-based compensation				Cash Ratio compensation	
	$B\text{-}S_{VOL}$ (1)	$COMP_{STOCK}$ (2)	$B\text{-}S_{VOL}$ (3)	$COMP_{OPTION}$ (4)	$B\text{-}S_{VOL}$ (5)	$COMP_{CASH/TOTAL}$ (6)
CEO compensation						
$COMP_{STOCK}$	-0.0009*					
	(0.0005)					
$COMP_{OPTIONS}$			0.0016***			
			(0.0004)			
$COMP_{CASH/TOTAL}$					-0.0309***	
					(0.0049)	
Corporate governance						
OWNERSHIP	0.0203***		0.0190***		0.0180***	
	(0.0011)		(0.0012)		(0.0012)	
MEETINGS	0.0043***		0.0042***		0.0042***	
	(0.0004)		(0.0004)		(0.0004)	
DUALITY		0.0283		0.498		0.1362***
		(0.333)		(0.362)		(0.0283)
CEO Attributes						
OVERCON	0.106***	0.692***	0.109***	-0.244	0.1082***	-0.0183
	(0.0062)	(0.145)	(0.0062)	(0.151)	(0.0062)	(0.0123)
DOMINANCE		0.621***		1.775***		-0.173***
		(0.0337)		(0.0350)		(0.00286)
AGE		0.168***		0.176***		-0.0136***
		(0.0392)		(0.0406)		(0.0033)
AGE SQR		-0.0015***		-0.0017***		0.0001***
		(0.0003)		(0.0004)		(0.0001)
TENURE		-0.0360***		-0.0021		-0.0010
		(0.0107)		(0.0111)		(0.0009)
TENURE SQR		0.0004		-0.0009**		0.0001**
		(0.0003)		(0.0003)		(0.0001)
Corporate characteristics						
LEVERAGE	0.0055		0.0053		0.0059	
	(0.0070)		(0.0070)		(0.0070)	
TOBINSQ	0.0076***	-0.0436*	0.0076***	-0.0094	0.0074***	-0.0026
	(0.0008)	(0.0186)	(0.0008)	(0.0192)	(0.0008)	(0.0016)
FCF/SALES	0.0010***	-0.0196***	0.0022***	0.0010	0.0010***	-0.0003
	(0.0002)	(0.0051)	(0.000347)	(0.0084)	(0.0002)	(0.0004)
SIZE	-0.0394***	0.644***	-0.0399***	1.346***	-0.0400***	-0.1212***
	(0.0009)	(0.0246)	(0.0010)	(0.0255)	(0.0009)	(0.0021)
CAPEX/TA	-0.0379***		-0.0368***		-0.0336***	
	(0.0083)		(0.0083)		(0.0083)	
PAYOUT	-0.0214***	0.330*	-0.0225***	0.0227	-0.0217***	-0.00773
	(0.0061)	(0.145)	(0.0061)	(0.150)	(0.00606)	(0.0123)
RDTA	0.0813***	-0.323	0.112***	2.278***	0.0789***	-0.2202***
	(0.0125)	(0.287)	(0.0146)	(0.344)	(0.0124)	(0.0244)
ASIAN97	-0.0198***		-0.0196***		-0.0193***	
911 EVENT	0.0732***		0.0744***		0.0730***	
IND_D	YES		YES		YES	
Constant	0.298***	-8.369***	0.303***	-10.05***	0.3372***	1.6652***
	(0.0172)	(1.141)	(0.0172)	(1.185)	(0.0181)	(0.0969)
Observations	7395	7395	7366	7366	7395	7395
R-squared	0.4528	0.1121	0.4527	0.3351	0.454	0.393

To further explore the individual components of equity-based compensation, we separated equity-based compensation into stock- and option-based compensation. The results of Table 7 show that stock- and option-based compensation exhibit significantly opposite signs on corporate risk taking: a

positive sign on option-based compensation ($COMP_{OPTION}$) and a negative sign on stock-based compensation ($COMP_{STOCK}$). These findings imply that the more restricted stocks the CEOs receive, the more risk-averse they behave. In contrast, stock options incentivize managers to undertake risky investments, as indicated by previous researchers (e.g., Rajgopal and Shevlin, 2002; Low, 2009).

4.3.2. Discussion of compensation equation (1b), the CEO compensation. We next analyze the variables included in Equation (1b), CEO compensation. Models (2), (4) and (6) of Table 6 present the results of the variables on total compensation ($COMP_{TOTAL}$), cash compensation ($COMP_{CASH}$) and equity-based compensation ($COMP_{EQUITY}$), respectively. Not surprisingly, CEO duality (DUALITY) positively influences all three types of compensation, with a significant result for the cash compensation only. This result implies that if the CEO serves as the board chair, higher fixed compensation will be offered because higher responsibility is required. Our findings are in line with previous studies (e.g. Main et al., 1995; Core, Holthausen and Larcker, 1999).

SIZE is found to significantly positively influence all types of compensations, including total, cash- and equity-based compensation, indicating that larger firms pay more compensation, regardless of the type of compensation. Moreover, the signs remain positive after separating the equity-based compensation into stock- and option-based compensation, implying that larger firms use not only more stocks but also more options as compensation[1].

In model (1), TOBINSQ significantly positively influences total managerial compensation ($COMP_{TOTAL}$), suggesting that firms with higher growth opportunities pay higher total compensation. Thus, we can say that there is a complimentary effect between CEO compensation and corporate future growth (Murphy, 1985). Of particular note, while dividing the total compensation and estimating the impacts of $COMP_{CASH}$ and $COMP_{EQUITY}$ and TOBINQ in models (2) and (4), $COMP_{CASH}$ turns out to be negative and significantly related to growth opportunity, implying that fast-growing firms incline to pay executives with more equity- and less cash-compensation. This result is reasonable and consistent with the findings of Janakiraman et al. (2010).

Not surprisingly, high RDTA confirms future growth prospects, and the positive impacts of RDTA on $COMP_{TOTAL}$ and $COMP_{EQUITY}$ are exhibited. This result implies that firms increase their compensations following the increasing investments in research and development, a signal for future prospect. The free cash flow ratio (FCF/SALES) significantly negatively influences $COMP_{TOTAL}$ and $COMP_{CASH}$, implying that managers holding more free cash flows are more likely to have moral hazard problems and overinvest in value-destroying projects that could lead to a lower compensation. PAYOUT carries positive but insignificant signs across three types of compensations, revealing a vague relationship between dividend and compensation.

AGE shows a nonlinear and concave relationship with all types of compensations, implying that CEOs when they are young undertaking more risky and value-enhancing projects to earn higher compensation; whereas, instead, to take less risk when they get older. These results are consistent with the notion of the horizon problem hypothesis stating that CEOs in their final years spend less on R&D (Dechow and Sloan, 1991) or forego valuable capital investments to improve the short-term performance (Blackwell et al., 2007). As such, a decreasing compensation is shown after a certain age.

Similarly, CEO tenure (TENURE) shows a nonlinear and concave relationship with total compensation, suggesting that compensation increases with TENURE, but at a decreasing rate. Our study supports the statement of Murphy (1986) illustrating that a CEO is more likely to receive stock options in his earlier stage of tenure. This incentive becomes less important for an experienced and tenured CEO who has established an extensive value-adding track record. Not surprisingly, DOMINANCE positively influences all three types of compensations, suggesting that a powerful CEO is rewarded by higher compensations including both cash and equity.

By contrast, CEO overconfidence (OVERCON) negatively influences $COMP_{TOTAL}$ and $COMP_{CASH}$, but not significantly on $COMP_{EQUITY}$[2]. The possible reasons could result from overconfident manager, who sometimes makes value-destroying investments, and causes to lower compensation[3].

Since overconfidence not only negatively influences stock/option compensation, but increases corporate risk taking simultaneously. As such, CEOs can decide a trade-off point on the levels of overconfidence in order to earn the targeted compensation associated with the intended risk taking. Managers can then de-

[1] Our results support prior theories and empirical works (e.g., Tosi et al., 2000; Dee et al., 2005; Benson et al., 2010).

[2] We next check this insignificance by separating the entire period into a few sub-periods.

[3] Our results are in line with the findings of Goel and Thakor (2008) who also address overconfident CEOs under-invest in information production.

cide the target compensation by trade-off the overconfidence and corporate risk.

Due to no significance was found between OVERCON and $COMP_{EQUITY,}$ we thus separate the whole period into two sub-periods based on the different volatility before and after 2001 to further confirm the shocks on influencing overconfidence on equity-based compensation. Interestingly, we find that OVERCON has a positive impact on $COMP_{EQUITY}$, before the 9/11 event but a negative impact after 9/11 (see Appendix A). This result implies that using equity-based compensation has inversely restricted managers' overconfidence since the 9/11 event: managers have been behaving more conservatively after 9/11 event.

In sum, after including the CEO attributes in the simultaneous equations, the following findings are obtained. Although higher total compensation induces CEOs to undertake risky and value-enhancing projects, high portions of cash compensation reverse this effect. Furthermore, although high equity-based compensation can align the benefits of CEOs with shareholders, high portions of stock-based compensation may reverse this effect. The managerial risk-taking incentive is driven by option-based compensation, which is included in the equity-based compensation as part of the total compensation.

Because most of the equity-based compensation packages are composed of small portions of stocks associated with large portions of options, this design of a relatively low ratio of $COMP_{STOCK/OPTION}$ truthfully induces managers to earn larger portions of stocks relative to options by undertaking higher risks.

4.4. Robustness checks. *4.4.1 Robustness by different risk measures of earnings volatility.* We conducted a series of+ robustness tests using different risk measure, the corporate earnings volatility ($EARN_{VOL}$), measured by the standard deviation of EBITDA in three-year. Table 8 reports the 3SLS results of the relationships among $EARN_{VOL}$, $COMP_{TOTAL}$, $COMP_{CASH}$ and $COMP_{EQUITY}$. The results are similar to those of the B-S volatility both in terms of significance and signs. The model (1) of Table 8 aslo shows that $COMP_{TOTAL}$ positively influences managerial risk taking, this incentive is driven by $COMP_{EQUITY}$ rather than $COMP_{CASH}$, as discussed in the previous section.

Table 8. Simultaneous equations results of risk taking (earnings volatility, $EARN_{VOL}$) and CEO compensation based on total, cash and equity-based (1992-2008)

	Total compensation		Cash compensation		Equity-based compensation	
	$EARN_{VOL}$	$COMP_{TOTAL}$	$EARN_{VOL}$	$COMP_{CASH}$	$EARN_{VOL}$	$COMP_{EQUITY}$
	(1)	(2)	(3)	(4)	(5)	(6)
CEO Compensation						
$COMP_{TOTAL}$	0.0059***					
	(0.0017)					
$COMP_{CASH}$			-0.0132***			
			(0.0019)			
$COMP_{EQUITY}$					0.0015***	
					(0.0004)	
Corporate governance						
OWNERSHIP	0.0180***		0.0234***		0.0190***	
	(0.0013)		(0.0012)		(0.0012)	
MEETINGS	0.0043***		0.0043***		0.0042***	
	(0.0004)		(0.0004)		(0.0004)	
DUALITY		0.0157		0.5970***		0.1310
		(0.0720)		(0.0819)		(0.3300)
OVERCON	0.1090***	-0.0775**	0.101***	-0.237***	0.108***	0.0740
	(0.0062)	(0.0314)	(0.0062)	(0.0358)	(0.0062)	(0.1380)
DOMINANCE		0.7740***		0.3390***		1.8860***
		(0.0073)		(0.0083)		(0.0319)
AGE		0.0279***		0.0504***		0.2260***
		(0.0085)		(0.0097)		(0.0370)
AGE SQR		-0.0002***		-0.0003***		-0.0021***
		(0.0001)		(0.0001)		(0.0003)
TENURE		0.0046**		-0.0019		0.0001
		(0.0023)		(0.0026)		(0.0101)
TENURE SQR		-0.0003***		-0.0001		-0.0011***
		(0.0001)		(0.0001)		(0.0003)
Corporate characteristics						

Table 8 (cont.).Simultaneous equations results of risk taking (earnings volatility, $EARN_{VOL}$) and CEO compensation based on total, cash and equity-based (1992-2008)

	Total compensation		Cash compensation		Equity-based compensation	
	$EARN_{VOL}$	$COMP_{TOTAL}$	$EARN_{VOL}$	$COMP_{CASH}$	$EARN_{VOL}$	$COMP_{EQUITY}$
	(1)	(2)	(3)	(4)	(5)	(6)
LEVERAGE	0.0053		0.0053		0.0053	
	(0.0070)		(0.0070)		(0.0070)	
TOBINSQ	0.0074***	0.0224***	0.0074***	-0.0285***	0.0076***	-0.0169
	(0.0008)	(0.0040)	(0.0008)	(0.0046)	(0.0008)	(0.0175)
FCF/SALES	0.0011***	-0.0109***	0.0009***	-0.0115***	0.0022***	-0.0091
	(0.0002)	(0.0011)	(0.0002)	(0.0013)	(0.0003)	(0.0077)
SIZE	-0.0411***	0.7650***	-0.0371***	0.4560***	-0.0399***	1.4540***
	(0.0010)	(0.0053)	(0.0010)	(0.0061)	(0.0010)	(0.0233)
CAPEX/TA	-0.0356***		-0.0358***		-0.0366***	
	(0.0083)		(0.0083)		(0.0083)	
PAYOUT	-0.0216***	0.0240	-0.0215***	0.0223	-0.0226***	0.1200
RATIO	(0.0061)	(0.0313)	(0.0061)	(0.0356)	(0.0061)	(0.1370)
RDTA	0.0807***	0.587***	0.0789***	0.0476	0.1120***	1.8570***
	(0.0125)	(0.0621)	(0.0124)	(0.0707)	(0.0146)	(0.3130)
ASIAN97	-0.0194***		-0.0193***		-0.0196***	
9/11EVENT	0.0740***		0.0707***		0.0746***	
IND_D	YES		YES		YES	
Constant	0.2837***	0.9746***	0.3399***	1.2913***	0.3031***	-11.7223***
	(0.0176)	(0.247)	(0.0181)	(0.281)	(0.0172)	(1.081)
Observations	7395	7395	7395	7395	7366	7366
R-squared	0.453	0.754	0.457	0.488	0.453	0.406

4.4.2. Robustness of the cash-to-total compensation ratio. In the previous section, we indicate that executives with higher cash compensation are more likely to avoid taking risks. To verify this statement, another proxy of $COMP_{CASH/TOTAL}$, measured by the ratio of cash-to-total compensation, is employed to further examine. The results in the last column of Table 7 remain hold.

4.4.3. Cash-to-equity compensation and debt-like contract. Cash compensation can be viewed as managers' inside debt, where the claims are in the form of pensions and deferred compensation. Because these claims are typically unfunded and unsecured, CEOs, similar to outside creditors, hold a large amount of claims with a default risk. Executives rewarded by high portions of cash-based compensation normally have higher pensions and deferred compensation; thus, the $COMP_{CASH/TOTAL}$ can be viewed as a type of inside debt. The results in Table 7 show the negative relationship between risk taking and $COMP_{CASH/TOTAL}$, implying that a high ratio of cash-to-total compensation mitigates managerial risk taking. Our results support the claim that when the proportion of CEO wealth held in the form of inside debt increases relative to CEO equity holdings, the risk taking declines (Edmans and Liu, 2011; Sundaram and Yermack, 2007; Wei and Yermack, 2011; Bolton, Mehran and Shapiro, 2011). Some pension and deferred compensation arrangements may offer equity-like pay-for-performance features, such that pensions and deferred compensation for CEOs are not simply fixed claims; some plans allow executives to invest their deferred compensation in company stock. Hence, $COMP_{STOCK}$ is found to negatively influence a firm's risk taking. The $COMP_{STOCK/OPTION}$ is found to induce managers to undertake projects with less risk (B-S volatility). These findings are robust in both risk equations as measured by B-S volatility and earnings volatility. Our findings add more US evidence to the inside-debt hypothesis suggested by Cassell et al. (2010).

Similar results of equity-based compensation are presented in Table 9. Consistent with the incentive alignment argument, we find that CEOs with higher proportions of option-based compensation tend to be more risky and align the benefits of managers and shareholders, whereas high proportions of stock-based compensation has a reverse effect.

Table 9. Simultaneous equations results of risk taking (earnings volatility, $EARN_{VOL}$), CEO equity-based and cash ratio compensations (1992-2008)

	Equity-based compensation				Cash ratio compensation	
	$EARN_{VOL}$ (1)	$COMP_{STOCK}$ (2)	$EARN_{VOL}$ (3)	$COMP_{OPTION}$ (4)	$EARN_{VOL}$ (5)	$COMP_{CASH/TOTAL}$ (6)
CEO Compensation						
$COMP_{STOCK}$	-0.0009*					
	(0.0005)					
$COMP_{OPTIONS}$			0.0016***			
			(0.0004)			
$COMP_{CASH/TOTAL}$					-0.0309***	
					(0.0049)	
Corporate governance						
OWNERSHIP	0.0203***		0.0190***		0.0180***	
	(0.0011)		(0.0012)		(0.0012)	
MEETINGS	0.0043***		0.0042***		0.0042***	
	(0.0004)		(0.0004)		(0.0004)	
DUALITY		0.0283		0.498		0.1362***
		(0.333)		(0.362)		(0.0283)
CEO attributes						
OVERCON	0.106***	0.692***	0.109***	-0.244	0.1082***	-0.0183
	(0.0062)	(0.145)	(0.0062)	(0.151)	(0.0062)	(0.0123)
DOMINANCE		0.621***		1.775***		-0.173***
		(0.0337)		(0.0350)		(0.00286)
AGE		0.168***		0.176***		-0.0136***
		(0.0392)		(0.0406)		(0.0033)
AGE SQR		-0.0015***		-0.0017***		0.0001***
		(0.0003)		(0.0004)		(0.0001)
TENURE		-0.0360***		-0.0021		-0.0010
		(0.0107)		(0.0111)		(0.0009)
TENURE SQR		0.0004		-0.0009**		0.0001**
		(0.0003)		(0.0003)		(0.0001)
Corporate characteristics						
LEVERAGE	0.0055		0.0053		0.0059	
	(0.0070)		(0.0070)		(0.0070)	
TOBINSQ	0.0076***	-0.0436*	0.0076***	-0.0094	0.0074***	-0.0026
	(0.0008)	(0.0186)	(0.0008)	(0.0192)	(0.0008)	(0.0016)
FCF/SALES	0.0010***	-0.0196***	0.0022***	0.0010	0.0010***	-0.0003
	(0.0002)	(0.0051)	(0.000347)	(0.0084)	(0.0002)	(0.0004)
SIZE	-0.0394***	0.644***	-0.0399***	1.346***	-0.0400***	-0.1212***
	(0.0009)	(0.0246)	(0.0010)	(0.0255)	(0.0009)	(0.0021)
CAPEX/TA	-0.0379***		-0.0368***		-0.0336***	
	(0.0083)		(0.0083)		(0.0083)	
PAYOUT	-0.0214***	0.330*	-0.0225***	0.0227	-0.0217***	-0.00773
	(0.0061)	(0.145)	(0.0061)	(0.150)	(0.00606)	(0.0123)
RDTA	0.0813***	-0.323	0.112***	2.278***	0.0789***	-0.2202***
	(0.0125)	(0.287)	(0.0146)	(0.344)	(0.0124)	(0.0244)
ASIAN97	-0.0198***		-0.0196***		-0.0193***	
9/11 EVENT	0.0732***		0.0744***		0.0730***	
IND_D	YES		YES		YES	
Constant	0.298***	-8.369***	0.303***	-10.05***	0.3372***	1.6652***
	(0.0172)	(1.141)	(0.0172)	(1.185)	(0.0181)	(0.0969)
Observations	7395	7395	7366	7366	7395	7395
R-squared	0.4528	0.1121	0.4527	0.3351	0.454	0.393

4.4.4. Sub-periods. We also divide the whole period into a few sub-periods to further examine the results and find that the results are robust and similar in the case of B-S volatility (see Appendix B).

Conclusions

Using 3SLS simultaneous equation model, this research contributes to the earlier studies by adding how CEO overconfidence might affect corporate risk taking with regard to different compensations. We find that equity-based compensation induces managers to undertake value-enhancing risky projects, whereas cash-based compensation has an inverse effect. Consistent with the incentive alignment argument, once CEOs rewarded with a high share of cash-to-total compensation, similar to CEOs with a high ratio of inside-debt claims, are less risky.

After dividing the equity-based compensation in stock- and option-based compensation, we find that option-based compensation has a positive impact on risk taking; stock-based compensation, however, has anegative impact on risk. The CEOs awarded with a high share of stock-to-option compensation prefers to invest in projects that are less risky. These results are robust for both the risk measures of B-S volatility and earnings volatility. Besides, managers have been behaving more conservatively after 9/11 event.

We also find that CEOs with attributes of overconfidence are inclined to undertake projects with higher risks regardless of the type of compensation; however, for CEOs without the attribute of overconfidence or have limited overconfidence, only equity-based compensation can induce them to take risk. In this case, the design of the incentive compensation turns out to be important. The CEO dominance also found to significantly influence the impact of compensation on corporate risk taking. These findings contribute to the debate on justified compensation combinations for corporate executives and have important implications for the design of compensation packages by considering executives' attributes.

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Appendix A

Table 1. Simultaneous equations results of risk taking (B-S volatility) and equity-based compensation ($COMP_{EQUITY}$) pre- and post- 9/11 event

	Pre 9/11 Event		Post 9/11 Event	
	$B\text{-}S_{VOL}$ (1)	$COMP_{EQUITY}$ (2)	$B\text{-}S_{VOL}$ (3)	$COMP_{EQUITY}$ (4)
CEO Compensation				
	$B\text{-}S_{VOL}$ (1)	$COMP_{EQUITY}$ (2)	$B\text{-}S_{VOL}$ (3)	$COMP_{EQUITY}$ (4)
$COMP_{EQUITY}$	0.0018***		0.0017**	
	(0.0005)		(0.0008)	
Corporate governance				
OWNERSHIP	0.0194***		0.0053**	
	(0.0015)		(0.0025)	
MEETINGS	0.0049***		0.0030***	
	(0.0005)		(0.0008)	
DUALITY		1.1852**		-0.9172*
		(0.4561)		(0.4681)
CEO Attributes				
OVERCON	0.0807***	0.4512**	0.140***	-0.4462*
	(0.0070)	(0.176)	(0.0125)	(0.2441)
DOMINANCE				
		1.8923***		1.8941***
AGE		(0.0416)		(0.0498)
		0.2220***		0.1962**
AGE SQR		(0.0456)		(0.0620)
		-0.0021***		-0.0018**
TENURE		(0.0004)		(0.0006)
		-0.0052		0.0087
TENURE SQR		(0.0132)		(0.0156)
		-0.0009**		-0.0013**
Corporate characteristics		(0.0004)		(0.0005)
LEVERAGE	-0.0042		0.0179	
	(0.0080)		(0.0124)	
TOBINS'Q	0.0071***	0.0091	0.0103***	-0.1112*
	(0.0007)	(0.0189)	(0.0023)	(0.0453)
FCF/SALES	0.0014***	-0.1241***	0.0031***	0.0219*
	(0.0005)	(0.0133)	(0.0006)	(0.0109)

Table 1 (cont.). Simultaneous equations results of risk taking (B-S volatility) and equity-based compensation ($COMP_{EQUITY}$) pre- and post- 9/11 event

	Pre 9/11 Event		Post 9/11 Event	
	$B\text{-}S_{VOL}$ (1)	$COMP_{EQUITY}$ (2)	$B\text{-}S_{VOL}$ (3)	$COMP_{EQUITY}$ (4)
SIZE	-0.0398***	1.5722***	-0.0337***	1.4013***
	(0.0012)	(0.0320)	(0.0018)	(0.0354)
CAPEX/TA	-0.0605***		0.0197	
	(0.0093)		(0.0151)	
PAYOUT	-0.0163***	0.0491	-0.0531***	0.0415
	(0.0058)	(0.1502)	(0.0163)	(0.3192)
RDTA	0.0986***	3.8291***	0.1591***	2.0942***
	(0.0187)	(0.4482)	(0.0255)	(0.4761)
ASIAN97	-0.0148***		-	
911 EVENT	-		0.0597***	
IND_D	YES		YES	
Constant	0.3499***	-13.8480***	0.3083***	-9.1259***
	(0.0195)	(1.351)	(0.0329)	(1.8001)
Observations	4247	4247	3119	3119
squared	0.473	0.4160	0.424	0.4107

Appendix B

Table 1. Simultaneous equations results of risk ($EARN_{VOL}$) and equity-based compensation ($COMP_{EQUITY}$) pre- and post- 9/11 Event

	Pre 9/11 event		Post 9/11 event	
	$EARN_{VOL}$ (1)	$COMP_{EQUITY}$ (2)	$EARN_{VOL}$ (3)	$COMP_{EQUITY}$ (4)
CEO Compensation				
$COMP_{EQUITY}$	0.0097**		0.0048	
	(0.0048)		(0.0055)	
Corporate governance				
OWNERSHIP	0.0687***		0.0528***	
	(0.0163)		(0.0181)	
MEETINGS	0.0332***		0.0365***	
	(0.00489)		(0.0054)	
DUALITY		0.8952*		-0.4012
		(0.4961)		(0.4672)
CEO attributes				
OVERCON	0.316***	0.3486*	0.3323***	-0.6642***
	(0.0658)	(0.1892)	(0.0902)	(0.2492)
DOMINANCE		1.8562***		1.7452***
		(0.0452)		(0.0482)
AGE		0.2422***		0.2313***
		(0.0499)		(0.0632)
AGE SQR		-0.0023***		-0.0021***
		(0.0004)		(0.0006)
TENURE		-0.0088		0.0029
		(0.0145)		(0.0158)
TENURE SQR		-0.0006		-0.0012**
		(0.0004)		(0.0005)
Corporate characteristics				
LEVERAGE	0.0603		0.0424	
	(0.0754)		(0.0892)	
TOBINS'Q	0.0373***	0.0148	0.0943***	-0.107**
	(0.0077)	(0.0228)	(0.0172)	(0.0478)
FCF/SALES	0.0092*	-0.1082***	0.0138***	0.0210*
	(0.0055)	(0.0163)	(0.0041)	(0.0111)
SIZE	-0.2141***	1.5672***	-0.2150***	1.3324***
	(0.0113)	(0.0349)	(0.0126)	(0.0352)

Table 1 (cont.). Simultaneous equations results of risk ($EARN_{VOL}$) and equity-based compensation ($COMP_{EQUITY}$) pre- and post- 9/11 Event

	Pre 9/11 event		Post 9/11 event	
	$EARN_{VOL}$ (1)	$COMP_{EQUITY}$ (2)	$EARN_{VOL}$ (3)	$COMP_{EQUITY}$ (4)
CAPEX/TA	0.1921**		0.1142	
	(0.0884)		(0.109)	
PAYOUT	0.00737	0.0145	0.3181***	-0.0791
	(0.0518)	(0.152)	(0.115)	(0.321)
RDTA	2.2731***	3.9453***	1.160***	1.9801***
	(0.1772)	(0.4863)	(0.1832)	(0.485)
ASIAN97	-0.0048		-	
911 EVENT	-		0.2760***	
IND_D	YES		YES	
Constant	-3.6696***	-14.1267***	-3.825***	-9.8393***
	(0.201)	(1.487)	(0.244)	(1.8372)
Observations	3630	3630	3138	3138
R-squared	0.288	0.4131	0.301	0.3907