Risk-Taking and CEO Compensation: CEO Pay Slice Versus Pay-Volatility Sensitivity

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Abstract

This paper aims to analyze the impacts of compensation incentives and CEO power on firm's risk-taking by using stock return volatility (Srisk) and earnings volatility (Erisk) as the proxies of firm's risk-taking level, and by using pay-volatility sensitivity (PVS) and CEO-pay slice (CPS) as the proxies of compensation incentives and CEO power, respectively. By applying ordinary least square (OLS) regression and two-stage least square (2SLS) regression on obtained data, this paper provides strong empirical evidence that PVS and CPS have negative impact on earnings volatility and stock return volatility. In addition, the negative impact of PVS on managerial risk-taking is greater for CEOs with lower CPS than that for CEOs with higher CPS. That is, EBC discourages CEOs from taking more risks, and more powerful CEOs are less risk-averse than less powerful CEOs when granted EBC.
Keywords: CEO compensation, pay-volatility sensitivity, CEO power, CEO pay slice

1. Introduction

Managerial risk-taking is a pivotal factor of corporate governance, and has been widely studied in the field of corporate finance for many years. The salient managerial risk-taking should not be neglected due to the reason that managerial strategy would be worthless if it fails to solve the risk related to the uncertain organizational environment (Hoskisson et al., 2017). Agency theory assumes that shareholders are risk-neutral, since they can mitigate risks by diversifying ownership portfolios (Murphy, 1999). On the contrary, managerial executives, who have their pecuniary wealth and nonpecuniary benefits highly concentrated in the firms, are assumed to be risk averse, and thereby will avoid risky projects and take less risky corporate strategies (Smith & Stulz, 1985; Hoskisson et al., 2009).

To align the interests of CEOs with those of shareholders, equity-based compensation (EBC), a mechanism derived from agency theory, is granted to CEOs. EBC structures managers' payoff as a convex function of stock return volatility, that is, increasing stock price of the firm will increase the value of CEOs' stock and option holdings in the firm, this makes risky investment more desirable to CEOs (Haugen & Senbet, 1981; Smith & Stulz, 1985; Agrawal & Mandelker, 1987). As a result, EBC motivates CEOs to take more risks by increasing their payoffs in maximizing the stock price of the firm (Rajgopal & Shevlin, 2002; Carpenter et al., 2003). Besides, recent literature shows that EBC motivates managerial risk-taking by decreasing CEOs' anxiety against being unemployed (Cowen et al., 2016). Although EBC is found to encourage CEOs' willingness of risk-taking when implemented under certain limits (Hoskisson et al., 2017), some literature raises opposite argument. For example, Lambert et al. (1991) demonstrate that executive stock options have the potential to increase CEOs risk aversion if options are highly likely to finish in-the-money. Wiseman and Gomez-Mejia (1998) argue that the accumulated value of EBC will have negative impacts on CEOs' intention to take risky strategies as CEOs may believe that their wealth is at the risk of loss, as they have more wealth tied to firm performance. Sander (2001) argues that two types of EBC, restricted stock options and short-term incentives, discourage CEOs to take risky investment. Seo and Sharma (2018) also find that the positive impact of EBC on CEOs' risk-taking decreases gradually as CEOs engage in more risky projects to pursue uncertain high returns.

Because EBC cannot completely determine CEOs' risk-taking behaviour (Hoskisson et al., 2017), how EBC influences managerial risk-taking remains inconclusive. Contingent factor such as CEO power, the extent to which a CEO has dominant power in terms of

decision-making and has authority over the management of a firm (Bebchuk et al., 2011), has been widely investigated in the literature on CEO power and managerial risk-taking. Previous literature holds divergent views in terms of the relation between CEO power and managerial risk-taking. For example, May (1995) shows that more powerful CEO may be risk averse and unwilling to take risky but value-increasing investments. Pathan (2009) finds that CEO power has negative effect on managerial risk-taking. Parrino et al. (2005) find that at levered firms such as banks, powerful managers tend to select overly safe projects. Tadele and Kalyebara (2020) measure CEO power by CEO duality and CEO tenure and find that CEO power is negatively related to risks. On the other hand, Lewellyn and Muller-Kahle (2012) raise the argument that CEO power is positively related to the excess risks taken by CEOs. Chen and Zheng (2014) argue that CEOs who have longer tenure are conceited in terms of handling uncertainties and risks using their experience and skills, and thereby may induce higher risks.

Although substantial studies examine the relation between managerial risk-taking and incentive compensation, as well as the relation between managerial risk-taking and CEO power, separately, prior literature has no unified conclusion. Besides, managerial risk-taking is complicated, and is determined by a variety of aspects, of which a minor adjustment would result in the fluctuation of CEO's willingness of taking risks. And solely focusing on the impact of a single factor on managerial risk-taking could not explain managerial risk-taking comprehensively. Thus, it is reasonable and essential to investigate the impacts of incentive compensation and CEO power on managerial risk-taking in a conjunctive way. However, the interaction effect of incentive compensation and CEO power on managerial risk-taking remains less studied. Inspired by prior literature, this paper examines the interaction effect of incentive compensation and CEO power on managerial risk-taking when measured by earnings volatility and stock return volatility. This paper approximates equity incentives of EBC by pay-volatility sensitivity (PVS) or vega, which measures the sensitivity of CEO wealth to stock return volatility (Coles et al., 2006). In addition, this paper measures CEO power by CEO pay slice (CPS), which is the proportion of the CEO compensation to the total compensation of the firm's top-five executive members (Bebchuk et al., 2011). This paper contributes to the literature by analyzing whether the existence of PVS (CPS) influences or even changes the impact of PVS (CPS) on managerial risk-taking. Another contribution is that this paper separates observations based on the median of CPS to provide implications on the impacts of PVS on managerial risk-taking in terms of the low and high levels of CPS.

This paper shows that both PVS and CPS have negative impact on managerial risk-taking, and the negative impact of PVS on managerial risk-taking for CEOs with lower CPS

levels is greater than that for CEOs with higher CPS levels. To be more specific, CEOs with more power tend to be less risk-averse than CEOs with less power under EBC. Although EBC fails to motivate CEOs to embrace risks, it's negative impact on managerial risk-taking is different for less powerful CEOs and more powerful CEOs.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature. Section 3 develops empirical hypotheses. Sections 4 describes the data and empirical methodologies. Section 5 presents the results. Section 6 concludes the research.

2. Literature Review

A large amount of existing literature highlights the positive relation between managerial risk-taking and sensitivity of CEO wealth to stock return volatility: pay-volatility sensitivity (PVS) or vega. For example, Guay (1999) details that the convex payoffs structure created by option grants determines how sensitive CEO wealth is to stock return volatility, PVS, and there is a positive relation between PVS and firms' stock return volatility. Coles et al. (2006) infer managers' risk-taking through the financial and investment polices implemented and find that the higher vega implements that CEOs have incentives to choose more risky policies, including more investment in R&D, less investment in property, plant, and equipment, more focus on fewer lines of business, and higher leverage. Low (2009) suggests approximating firm risk directly by the variance of daily stock returns, as stock return volatility reflects the net effect of all managerial risk-taking activities. In addition, to address the endogeneity issues which arise from selection bias and omitted variables (Coles et al., 2014; Feng & Rao, 2018), and to better identify the causal effect of CEOs incentive compensation on managerial risk-taking decisions, Low (2009) suggests examining whether CEOs change firm risks in reaction to exogenous risks instead of using a system of simultaneous equation or employing instrumental variables[1]. Low (2009) finds that it is CEOs' portfolio vega that stimulates CEOs' risk-taking. Gormley et al. (2013) also investigate how CEOs respond to an increase in unanticipated material risk, or left-tail risk, specifically the risk of large legal liabilities and costly regulation under their previous equity incentives. They find that following unexpected shocks, CEOs with higher PVS do not tend to take reactions to offset the increased risk, because they are less aggressive in reducing risk when facing exogenous shocks. Chava and Purnanandam (2010) find that CEOs with higher

1 To solve endogeneity issues, Rajgopal and Shevlin (2002), Rogers (2002) and Coles et al. (2006) attempt to use a system of simultaneous equation, while Armstrong and Vashishtha (2012) employ instrumental variables.

PVS tend to take higher leverage in the firms. Armstrong and Vashishtha (2012) show similar argument that CEOs with higher PVS have the incentives to increase firm risks.

Although, abundant literature shows that PVS has positive impact on firm's risk-taking, another less acknowledged view is that there is not necessarily a positive relation between PVS and managerial risk-taking. For example, Bharati and Jia (2018) find no evidence of a positive impact of vega on risk-taking of banking firms. Feng and Rao (2018) find evidence that there is a positive relation between vega and cash holdings of the firms, and such positive relation is greater for those firms which have higher risk aversion. Chakraborty et al (2019) argue that PVS has no effect on firm risk for firms with high social responsibility. Iqbal and Vahamaa (2019) conclude that the association between vega and managerial risk-taking is unclear and unstable.

Compared to PVS, which has been widely used to measure equity incentives and to investigate the relation between compensation incentives and managerial risk-taking, CEO pay slice (CPS), one of the proxies of CEO power, is less examined. CPS is a framework provided by Bebchuk et al. (2011) and is defined as the fraction of the top-five ranked compensation taken by CEOs. Liu and Jiraporn (2010) use CPS as the proxy for the relative centrality of the CEO in the top management team and provide evidence that powerful CEOs are more likely to have risk-reducing projects taken. Following Bebchuk et al.'s (2011) way of approximation of CEO power, Chintrakarn et al. (2014) find that CEO with smaller CPS will have a higher degree of risk aversion and an increase in CPS will lead the CEO to take less risky corporate strategies. However, when the CPS exceeds a certain level which is the 75^{th} percentage of the CPS, an increase in CPS is associated with less moderate, more risk-taking strategies.

Some recent studies directly investigate the question on whether CEOs power can affect the relation between equity incentives and risk-taking, as well as the interplay between them. To be more specific, between CEOs power and equity compensation, which one dominates the other in determining firms' risk-taking? For example, Victoravich et al. (2011) measure CEO power with an index, which takes five controlling variables into consideration: CEO duality, a staggered board of directors, the proportion of insiders that sit on the board, the proportion of affiliated board members, and whether the CEO is the founder. They find that, in banks, the level of CEO power has no impact on the association between equity compensation and firms' risk-taking. Meanwhile, their results show that when CEOs' personal wealth is highly related to firms' long-term value, CEOs with more power will have more incentives to take on additional risk.

3. Hypotheses development

Prior literature has no agreement on the relation between PVS and managerial risk-taking, as well as on the relation between CPS and managerial risk-taking. Although the positive impact of PVS on managerial risk-taking is more recognized (Guay, 1999; Coles et al., 2006; Low, 2009; Gormley et al., 2013; Chava & Purnanandam, 2010; Armstrong & Vashishtha, 2012). Some literature argues that the impact of PVS is not necessarily positive (Bharati & Jia, 2018; Feng & Rao, 2018; Chakraborty et al., 2019; Iqbal & Vahamaa, 2019). Compared with PVS, the impact of CPS on managerial risk-taking is less studied. The effect of CPS on managerial risk-taking is unstable. Liu and Jiraporn (2010) provide evidence that powerful CEOs are more likely to take risk-reducing projects. Chintrakarn et al. (2014) find that CEOs with less CPS tend to be more risk averse, however, CEOs with CPS levels which exceed the 75^{th} percentage are more likely to take risky strategies. Above literature examines the relation between PVS and managerial risk-taking, as well as the relation between CPS and managerial risk-taking separately, and has not reached a unified conclusion. Since using PVS or CPS exclusively fails to explain managerial risk-taking, it is inevitably to examine the impact of PVS (CPS) on managerial risk-taking, with the existence of CPS (PVS).

This leads to my first and second hypotheses, which are stated as follows:

Hypothesis 1: CPS influences the impact of PVS on managerial risk-taking.

Hypothesis 2: PVS influences the impact of CPS on managerial risk-taking.

The empirical results from Chintrakarn et al. (2014) provide evidence that less powerful CEOs exhibit risk avoidance and will take moderate risk-taking decisions, and an increase in CPS will lead CEOs to take less risky corporate strategies. However, when the CEO's power is gradually enhanced and exceeds a certain level, CEOs will be more likely to take risky strategies. To be more specific, more powerful CEOs, who are confident that they have sufficient power to control decision-making procedure in spite of possible objections, have less risk aversion than less powerful CEOs, and thus are more willing to make risky investment when granted EBC (Chintrakarn et al., 2014).

This leads to my third hypothesis, which is as follow:

Hypothesis 3: The effects of PVS on risk-taking are different for CEOs with high CPS and CEOs with low CPS.

4. Data and Methodology

4.1 Data sources

I obtain data mainly from three databases. I use the Centre for Research in Security Prices (CRSP) database for data on stock returns and the CompuStat database for accounting and financial data of firms. From the Standard & Poor's ExecuComp database, I collect data on CEO compensation, with which I compute CPS and PVS.

My sample period covers 1992 to 2019, because the ExecuComp database does not provide compensation data before 1992. In addition, since the ExecuComp database has different reporting formats for accounting for EBC for the periods before and after the fiscal year 2006, I use different approaches to calculate PVS for the periods 1992-2006 and 2006-2019 following Coles et al. (2006). I also obtain risk-free rates of the period 1992-2006 from the Federal Reserve website to calculate option value using Black-Scholes-Merton model.

ExecuComp fails to identify some executives as CEOs, even though they appear to be the CEOs of the indicated fiscal years according to the dates when they started to hold the position of CEO, and the dates when they left the position of CEO. I identify such executives as CEOs. In addition, consistent with Coles et al. (2006), I do not take finance firms and utilities into consideration in my sample due to the reason that finance and utilities firms are highly regulated so that CEOs of these firms behave differently from CEOs of other industries when granted EBC. In addition, I winsorize PVS and CPS at the 5^{th} and 95^{th} levels. After deleting missing values, I have 31,584 firm-year observations for CEO's PVS from 2,732 unique firms, and 23,603 firm-year observations for CPS from 1,958 unique firms during the sample period.

In Table 1, I present the descriptive statistics of key variables used in the regression analyses. One of the dependent variables, earnings volatility, has a mean of 0.0428, a median of 0.0287. This is consistent with Boubakri et al. (2013), the mean and median of which is 0.035 and 0.023, respectively. Another dependent variable, stock return volatility, has a mean of 0.0271, a median of 0.0237. This is consistent with Bettis et al. (2018) and Coles et al. (2006). The mean of Coles et al. (2006) is 0.0305; while the mean of Bettis et al. (2018) is 0.024. One of the main independent variables, PVS, has a mean of 4.0289, a median of 4.3047. This is consistent with Coles et al. (2006), the mean of which is 2.69. The other main independent variable, CPS, has a mean of 0.3966, a median of 0.4036. This is consistent with Bebchuk et al. (2011), of which the mean is 0.357.

Table 2 represents the sample correlations of key variables used in the regression analyses. Most of the correlations between variables are significant at the 1% level. The correlation coefficient of stock return volatility and earnings volatility is 0.2645, indicating a weak positive correlation between stock return volatility and earnings volatility. The

correlation coefficient of PVS and stock return volatility is -0.1670, indicating a weak negative correlation between PVS and stock return volatility. The correlation coefficient of PVS and earnings volatility is -0.1093, indicating a weak negative correlation between PVS and earnings volatility.

4.2 Methodology

4.2.1 Managerial risk-taking

Following Coles et al. (2006) and Bettis et al. (2018), I measure the risk taken by CEOs via the logarithm of the standard deviation of daily stock returns (Srisk) over the fiscal year. This is consistent with literature for reason that estimating firm risk either with the risk of the firm's debt or with the volatility of yearly cash flow is unstable due to lack of data (Low, 2009). In addition, approximating firm risk with equity risk is consistent with the fact that executive stock options are written on the firm's equity (Low, 2009).

Another measure of managerial risk-taking is the volatility of firm-level earnings, also called Erisk, which is defined as the volatility of the ratio of firm's EBITDA relative to the firm's total assets. Following the approaches of John et al. (2008), Faccio et al. (2011) and Boubakri et al. (2013), I calculate the corporate earnings volatility over five-year overlapping periods as below.

$$\mathrm{Erisk}_{i,t} = \sqrt{\frac{1}{T-1}\sum_{t=1}^{T}\left(E_{i,t} - \frac{1}{T}\sum_{t=1}^{T} E_{i,t}\right)^2}, \quad (1)$$

where $E_{i,t} = \dfrac{\mathrm{EBITDA}_{i,t}}{\mathrm{Total\ Asset}_{i,t}}$

4.2.2 Equity incentives: PVS

My measure of equity incentives is pay-volatility sensitivity (PVS), which is the sensitivity of manager's wealth with respect to a 0.01 change in stock-return volatility (Coles et al., 2006). Following Guay (1999), Knopf et al. (2002) and Rajgopal and Shevlin (2002), I use PVS of the option portfolio as proxy for the aggregated PVS of the stock and option portfolio due to the fact that the PVS of the option portfolio is several times greater than the PVS of the stock portfolio. Following the approaches by Guay (1999) and Core and Guay (2002), which are based on the Black-Scholes (1973) formula for valuing European call options, as modified by Merton (1973), I calculate option value and PVS as below.

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

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

N = cumulative probability function for the normal distribution

S = price of the underlying stock

X = exercise price of the option

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

Sensitivity of manager's wealth with respect to a 0.01 change in stock-return volatility is calculated as:

$$\text{PVS} = \left[\frac{\partial(\text{option value})}{\partial(\text{stock volatility})}\right] \times 0.01 = e^{-dT}N'(Z)ST^{(1/2)} \times (0.01) \quad (3)$$

4.2.3 CEO power: CPS

CEO pay slice (CPS) is a more objective way to approximate CEO power, because CPS captures the relative centrality of the CEO in the top executive team. Following Bebchuk et al. (2011), I calculate CPS as the proportion of the CEO compensation to the total compensation of the firm's top-five executive members, which is shown as below.

$$\text{CPS}_{i,t} = \frac{\text{CEO compensation}_{i,t}}{\sum \text{compensation of the firm's top} - \text{five executive members}_{i,t}} \quad (4)$$

Total compensation includes salary, bonus, other annual pay, the total value of restricted stock granted that year, the Black-Scholes value of stock options granted that year, long-term incentive payouts, and all other total compensation which are reported in ExecuComp item TDC1 (Bebchuk et al., 2011). Following Bebchuk et al. (2011), I eliminate firm-years observations in which the CEO was not in office for the whole year, because low CPS due to the fact that the CEO only received compensation for a part of the year can be misleading. In addition, compensation data on the ExecuComp database are not comparable before and after the ExecuComp changed the format used to compute compensation data in 2006 (Walker, 2011; Brockman et al., 2016). Following the approaches of Coles et al. (2014) and Brockman et al. (2016), I adjust the total compensation (TDC1) data from the ExecuComp database before 2006 using the following equation.

$$\text{TDC1} = \text{Salary} + \text{Bonus} + \text{Rstkgrnt} + \text{Performance based stock award} + \text{Option awards BLK value} + \text{Performance based option award}$$

$$+\text{Othann} + \text{Allothtot}^2 \quad (5)$$

4.2.4 Control variables

Following Coles et al. (2006), Bebchuk et al. (2011) and Chintrakarn et al. (2014), I use the following control variables: (1) firm size, calculated as the logarithm of market capitalization, which is the product of the outstanding shares and share prices of firms; (2) MtB, calculated as the ratio of market value of assets to book value of assets, which is a proxy for investment opportunities; (3) ROA, which is the return on assets computed as operating income divided by book value of assets; (4) Stock return, which is the return over the fiscal year; (5) Book leverage, calculated as the ratio of total debt to total assets; (6) CAPEX, calculated as the ratio of capital expenditures to assets; (7) R&D, which is the ratio of R&D expenditures to total assets; (8) CEO tenure, calculated as the logarithm of the number of years that the CEO has hold the position; (9) CEO age, which is the logarithm of the age of CEO reported on Compustat; (10) industry dummies, which capture the variation across industries and is determined by the first two digits of the SIC; (11) year dummies, which capture the year fixed effects.

4.2.5 Ordinary least square (OLS) regression

To investigate the impact of EBC on managerial risk-taking with the existence of CPS, and, similarly, the impact of CEO power on managerial risk-taking with the existence of PVS, I run the following regression model as presented below:

$$\text{Risk}_{i,t} = \alpha_0 + \alpha_1 \log(1 + \text{PVS}_{i.t}) + \alpha_2 \text{CPS}_{i,t} + \alpha_3 \text{Control Variable}_{i,t} + \varepsilon_{i,t} \quad (6)$$

where both stock return volatility and earnings volatility are used as proxies for managerial risk-taking, respectively. This equation models the risk taken by CEOs as a function of both PVS and CPS after controlling for firm-specific and CEO-specific variables.

[2] Coles et al. (2014) provide the definitions of the Execucomp variables as follows: (1) Salary, is the base annual salary; (2) Bonus, is the performance-based pay; (3) Rstkgrnt, is the value of restricted stock granted during the year; (4) Option awards BLK value, is the value of options granted during the year; (5) Othann, is the perquisites and other personal benefits, above market earnings on restricted stock, options/SARs or deferred compensation paid during the year but deferred by the officer, earnings on long-term incentive plan compensation paid during the year but deferred at the election of the officer, tax reimbursements, dollar value of difference between the price paid by the officer for company stock and the actual market price of the stock under a stock purchase plan that is not generally available to shareholders or employees of the company; (6) Allothtot, is the severance payments, debt forgiveness, imputed interest, payouts for cancellation of stock options, payment for unused vacation, tax reimbursements, signing bonuses, 401K contributions, and life insurance premiums.

Then, I further examine the interaction effect of EBC and CEO power on managerial risk-taking using the following regression model as below.

$$\text{Risk}_{i,t} = \alpha_0 + \alpha_1 \log(1 + \text{PVS}_{i.t}) + \alpha_2 \text{CPS}_{i,t} + \alpha_3 \log(1 + \text{PVS}_{i.t}) \times \text{CPS}_{i,t} + \alpha_4 \text{Control Variables}_{i,t} + \varepsilon_{i,t} \quad (7)$$

where managerial risk-taking is also measured as stock return volatility and earnings volatility. This equation models managerial risk-taking as a function of PVS, CPS and also the product of PVS and CPS after controlling for firm-specific and CEO specific variables.

Then, to be consistent with Coles et al. (2006) and to address the endogenous issue, I add lagged terms of PVS, CPS and their product to the regression model above. Because estimated parameters from ordinary least squares (OLS) can be biased as regressors are endogenously determined by dependent variables (Coles et al., 2006).

5. Results

5.1 Main results

5.1.1 Earnings volatility

Firstly, I measure managerial risk-taking by earnings volatility. To examine the impacts of PVS and CPS on earnings volatility and to test Hypotheses 1 and 2, I run the regression models according to Eq. (6). Table 3 shows the results of ordinary least square (OLS) regressions, of which the dependent variable is earnings volatility. Column 1 shows the regression results of earnings volatility only with PVS and control variables. Column 2 shows the regression results of earnings volatility only with CPS and control variables. Column 3 shows the regression results of earnings volatility with PVS and CPS at the same time. In Column 4, I add the product term of PVS and CPS (PVS×CPS), which shows the interaction effect of PVS and CPS on earnings volatility. I add lagged term of PVS and CPS, as well as the product of lagged terms (lag(PVS) ×lag(CPS)) in Column 5.

According to Column 1 and 2, both PVS and CPS have negative impacts on earnings volatility. However, when PVS and CPS are included at the same time in Column 3, PVS still has negative impact on earnings volatility, while the negative impact of CPS no longer exists. That is, the existence of PVS influences the impact of CPS on earnings volatility. This is consistent with Hypothesis 2, which is also verified by the result shown in Column 4. As the coefficient of the product term of PVS and CPS (PVS×CPS) is positive and significant at the 5% level, it is reasonable to examine the interaction effect of PVS and CPS on earnings volatility.

Next, to test Hypothesis 3, I establish below model as shown in Eq. (8). Due to the reason that the coefficients of the lagged terms of PVS and CPS as well as the product of lagged terms (lag(PVS) ×lag(CPS)) are not significant even at the 10% level according to Column 5, I analyze the interaction effect only with PVS and CPS, using their product term. That is, using the estimated coefficients of variables in Column 4.

$$\begin{aligned}\text{Earnings Volatilty} \;=\; & 0.1370 \times \text{Intercept} - 0.0029 \times \text{PVS} - 0.0256 \times \text{CPS} \\ & + 0.0050 \times \text{PVS} \times \text{CPS} - 0.0043 \times \text{Firm Size} + 0.0002 \times \text{MtB} \\ & -0.0538 \times \text{ROA} + 0.7459 \times \text{Stock Return} \\ & -0.0199 \times \text{Book leverage} + 0.0727 \times \text{CAPEX} + 0.2658 \times \text{R\&D} \\ & -0.0002 \times \text{CEO Tenure} \; - 0.0138 \times \text{CEO Age} \end{aligned} \tag{8}$$

Then, I fix significant control variables at their median values to illustrate the interaction effect. For the high and low levels of PVS and CPS, I define the high (low) level as one standard deviation above (below) its median. Plugging in those parameter values to Eq. (8) above, I compute earnings volatility by different combinations of the high and low levels of PVS and CPS as shown in Table 4 and in Figure 1. Figure 1 reveals the interaction effect of PVS and CPS on earnings volatility intuitively.

When CPS is fixed at the high level (0.5134), earnings volatility decreases slightly from 0.0351 to 0.0340 as PVS increases from its low level (2.4680) to high level (6.1414). That is, an increase in PVS will lead to a slight decline in earnings volatility when CPS is fixed at the high level. Thus, PVS has a weak negative impact on earnings volatility when CPS is fixed at the high level. However, when CPS is fixed at the low level (0.2939), earnings volatility decreases sharply from 0.0380 to 0.0329 as PVS increases from its low level (2.4680) to high level (6.1414). Hence, an increase in PVS will then result in considerable decrease in earnings volatility when CPS is fixed at the low level. In addition, the negative impact of PVS on earnings volatility when CPS is fixed at the low level is much greater than that when CPS is fixed at the high level. In summary, when CEO power is high, the increase of PVS will slightly decrease the firms' risk-taking level in terms of earnings volatility. However, when CEO power is low, a minor increment of PVS will dramatically deteriorate the firms' risk-taking level. To be more specific, compensation incentives discourage CEOs of firms with whichever level of CPS to embrace more risks. In addition, the negative impact of compensation incentives is greater for less powerful CEOs than that for more powerful CEOs. CEOs with less power tend to have more risk-aversion under EBC. However, CEOs with more power are less risk-averse when granted EBC.

Overall, Hypothesis 3 is supported when earnings volatility is used to approximate managerial risk-taking.

5.1.2 Stock return volatility

Apart from earnings stock return volatility, I also approximate managerial risk-taking level by stock return volatility. In order to test Hypotheses 1 and 2, I investigate the impact of PVS and CPS on stock return volatility by running the regression models according to Eq. (6). Table 5 shows the results of ordinary least square (OLS) regressions, in which the dependent variable is stock return volatility. Columns 1 and 2 present the regression results of stock return volatility only with PVS and CPS, respectively. Column 3 shows the regression results of stock return volatility with PVS and CPS at the same time. I add the product term of PVS and CPS (PVS×CPS) in Column 4, lagged term of PVS and CPS, and the product of lagged term (lag(PVS) ×lag(CPS)) in Column 5.

In Columns 1 and 2, both the coefficients of PVS and CPS are negative and significant. Thus, PVS and CPS have negative impacts on stock return volatility. However, when PVS and CPS are included together in Column 3, the coefficient of PVS is negative and significant, while the coefficient of CPS is not significant anymore. This is consistent with Hypothesis 2 that the existence of PVS changes the effect of CPS on stock return volatility, and thereby the negative impact of CPS disappears.

However, the coefficients of the product term of PVS and CPS (PVS×CPS) in Column 4, and the product term of lagged PVS and CPS (lag(PVS) ×lag(CPS)) in Column 5 are not significant. I fail to construct similar model for stock return volatility to that for earnings volatility as shown in Eq. (8). To test Hypothesis 3, I separate observations into two subsamples based on the median value of CPS, and use the following regression model:

$$\mathrm{Risk}_{i,t} = \alpha_0 + \alpha_1 \log(1 + \mathrm{PVS}_{i.t}) + \alpha_2 \mathrm{Control\ Variables}_{i,t} + \varepsilon_{i,t} \quad (9)$$

Table 6 shows the results. For the subsample which contains CPS smaller than the median value, PVS has negative impact on stock return volatility, as the coefficient of PVS is -0.0013, and is significant at the 5% level. For the other subsample which consists of CPS larger than the median value, PVS also has negative impact on stock return volatility, and the coefficient of PVS is -0.0005. Therefore, the negative effect of PVS is greater for lower part CPS that that for higher part CPS. That is, although compensation incentives discourage CEOs from taking more risk, CEOs who have less power are more unwilling to take risky strategies than those have more power. This is consistent with Hypothesis 3.

5.1.3 Interaction effects using raw number of PVS

I convert PVS into its raw number to show the real magnitude of the interaction effects of PVS and CPS on earnings volatility, for the reason that PVS is calculated as the logarithm of its raw value. The corresponding low and high level of the raw number of PVS is $11,798.34 and $464,699.47, respectively. In order to show the actual impacts of PVS and CPS on earnings volatility, I construct below models only with PVS, CPS, using their product term (PVS*CPS) and estimated coefficients of Column 4 in Table 3 to show the interaction effects.

$$\text{Earnings Volatilty} = -0.0029 \times \text{PVS} - 0.0256 \times \text{CPS} + 0.0050 \times \text{PVS} \times \text{CPS} \quad (10)$$

Using above two equations, I compute earnings volatility and stock return volatility as various combinations of the high and low levels of the raw numbers of PVS and CPS. Table 7 and Figure 2 show the results. When CPS is fixed at the low level (0.2939), earnings volatility decreases largely from -16.4415 to -647.2908 as the raw value of PVS increases from $11,798.34 to $464,699.47. However, when CPS is fixed at the high level, there is a smaller decline in earnings volatility (from -3.5424 to -139.0199) with the increase of the raw value of PVS. Therefore, although PVS has negative influence on earnings volatility, one unit divergence in the raw value of PVS has greater impact on earnings volatility when CPS is fixed at the low level than that when CPS is fixed at the high level. As can be verified by Figure 2, the same increase in the raw value of PVS will lead to a greater decline in earnings volatility when CPS is fixed at the low level than that when CPS is fixed at the high level.

5.2 Robustness check

Firm's risk-taking could be explained by some unobservable firm characteristics, which are correlated to PVS and CPS (Coles et al., 2014). Thus, the estimated effects of PVS and CPS on earnings volatility and stock return volatility obtained from the ordinary least squares (OLS) regressions could be biased. To address the potential endogeneity issue, I apply the two-stage least square regression. Following Chintrakarn et al. (2014), I use the median value of CPS at the industry level as the instrumental variable for CPS. The logic is that even though it is possible for the extent of risk-taking at the firm level to influence the firm-specific CPS, it is highly unlikely that it would affect the industry median CPS (Chintrakarn et al., 2014). In addition, following Coles et al. (2006), I use book leverage as the instrumental variable for PVS. In the first stage, as shown in below models, I set PVS and CPS as dependent variables, respectively. Control variables are the same as in Eq. (6).

$$\mathrm{PVS}_{i,t} = \alpha_0 + \alpha_1 \text{book leverage}_{i.t} + \alpha_2 \text{Control Variable}_{i,t} + \varepsilon_{i,t} \quad (11)$$

$$\mathrm{CPS}_{i,t} = \alpha_0 + \alpha_1 \text{CPS median}_{i.t} + \alpha_2 \text{Control Variable}_{i,t} + \varepsilon_{i,t} \quad (12)$$

In the second stage, I regress earnings volatility and stock return volatility on the PVS and CPS obtained from the first stage, as well as control variables. The model for the second stage is as below.

$$\mathrm{Risk}_{i,t} = \alpha_0 + \alpha_1 \mathrm{PVS}_{i.t} + \alpha_2 \mathrm{CPS}_{i.t} + \alpha_3 \mathrm{ControlVariable}_{i,t} + \varepsilon_{i,t} \quad (13)$$

In Table 8, Panel A shows the results of the first stage of the two-stage least square (2SLS) regression. Both the coefficients of book leverage and industry median CPS are significant, showing that book leverage and industry median CPS are valid instrumental variables for PVS and CPS, respectively. Panel B reports the results of the second stage. Both the coefficients of PVS are significant, while the coefficients of CPS are insignificant, no matter the dependent variable is earnings volatility or stock return volatility. That is, with the existence of both PVS and CPS, PVS has negative impact on managerial risk-taking, however, CPS does not have significant influence on managerial risk-taking. This is consistent from the results of the ordinary least square (OLS) regressions.

In addition, I further separate observations into two subsamples based on the median value of the CPS obtained from the first stage. Then, I regress earnings volatility and stock return volatility on the PVS obtained from the first stage and control variables, using the following model.

$$\mathrm{Risk}_{i,t} = \alpha_0 + \alpha_1 \mathrm{PVS}_{i.t} + \alpha_2 \mathrm{ControlVariable}_{i,t} + \varepsilon_{i,t} \quad (14)$$

Table 9 shows the results. For earnings volatility, the coefficient of PVS for the subsample which consists of the lower part CPS is -0.0270, of which the absolute value is bigger than that of the coefficient of PVS for the subsample which consists of the higher part CPS (-0.0219). The negative impact of PVS on earnings volatility with the existence of the lower part CPS is much greater than that with the existence of the higher part CPS. Therefore, compensation incentives discourage CEOs from taking more risks, and CEOs with less power have greater risk-aversion than CEOs with more power. Similarly, for stock return volatility, the coefficient of PVS for the subsample which consists of the lower part CPS is -0.0003, while the coefficient of PVS for the subsample which consists of the higher part CPS is -0.0001. Thus, PVS has negative impact on stock return volatility no matter which level the CPS is. However, the negative impact of PVS on stock return volatility with the existence of the lower part CPS is greater than that with the existence of the higher part CPS.

In summary, the results of two-stage least square (2SLS) regression confirm the reasonability of analyzing the interaction effect of PVS and CPS on stock return volatility and on earnings volatility. And the results are consistent with those obtained from the ordinary least square (OLS) regressions. However, due to the reason that higher leverage is related with higher risk levels (Coles et al., 2006), using book leverage as the instrument variable of PVS is one weakness of this paper, and the results are likely vulnerable to endogeneity.

6. Conclusion

This paper examines the question of whether the existence of PVS (CPS) influences the impact of CPS (PVS) on managerial risk-taking by investigating the interaction effect of PVS and CPS, and by separating observations into two subsamples based on the median value of CPS. By approximating managerial risk-taking by earnings volatility and stock return volatility, this paper provides strong empirical evidence that when examined separately, both PVS and CPS have negative relation with managerial risk-taking. However, when PVS and CPS are included in the regression model at the same time, only PVS has significant coefficient, the coefficient of CPS is no longer significant. To be more specific, when examined separately, the compensation incentives have negative impact on CEOs' willingness of risk-taking, so does CEO power. However, with the existence of PVS, the negative impact of CPS disappears. That is, the negative impact of compensation incentives changes the impact of CEO power on managerial risk-taking. It is inevitable to investigate the effects of compensation incentives and CEO power on managerial risk-taking inclusively.

In conclusion, although EBC is granted to CEOs in order to align the risk preference of CEOs with that of shareholders, the compensation incentives discourage CEOs from taking risks. CEO power also has negative impact on managerial risk-taking, by making CEOs more risk-averse. This paper contributes to prior researches by further examining the interaction effects of PVS and CPS on managerial risk-taking. This paper finds that the negative impact of PVS on earnings volatility for CEOs with lower CPS levels is greater than that for CEOs with higher CPS levels. Similar conclusion applies to stock return volatility. To be more specific, more powerful CEOs are less risk-averse than less powerful CEOs when granted EBC. EBC fails to motivate CEOs to take more risky investements and strategies due to various reasons, for example, CEO tenure, CEO age, etc. Such specific factors all lead to higher levels of CEO power. The significant interaction effects of compensation incentives and CEO power on managerial risk-taking shows that compensation incentives and CEO

power are related to each other and influence managerial risk-taking in an interactive way. The intuition under the result is that although granting EBC to CEOs is not a good choice to align the risk preferences of CEOs to those of shareholders and to encourage CEOs to take more risks, EBC leads to worser outcomes for firms of which CEOs are less powerful than for firms of which CEOs are more powerful.

In addition, to ensure the reliability of the results, I use the ratio of R&D to total assets as the proxy of managerial risk-taking[3] and apply the same ordinary least square (OLS) and two-stage least square (2SLS) regression models. Since consistent conclusion can be drawn, the results of this paper is reliable. One protential extentions of this paper is to use alternative instrumental variable of PVS such as the median value of PVS as the industry level to run two-stage least square (2SLS) regression. Another protential extentions of this paper is to divide sample period into two subsample periods: 1992-2007 and 2008-2019, for the reason that the 2008 financial crisis might interrprut and change CEOs' behaviours under EBC.

[3]The ratio of R&D to total assets is an alternative measure to approximate managerial risk-taking level, and is used by Li et al. (2013), Bargeron et al. (2010), and Coles et al. (2006).

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Table 1. Descriptive Statistics of key variables

Variables	N	Mean	SD	Minimum	Q1	Median	Q3	Maximum
Earnings volatility	7070	0.0428	0.0472	0.0011	0.0170	0.0287	0.0505	0.9630
Stock return volatility	7070	0.0271	0.0198	0.0038	0.0176	0.0237	0.0321	1.1627
PVS	7070	4.0289	1.8367	0.0000	3.0912	4.3047	5.3023	9.1643
lag(PVS)	7069	4.0289	1.8368	0.0000	3.0912	4.3049	5.3023	9.1643
CPS	7070	0.3966	0.1098	0.0000	0.3336	0.4036	0.4621	0.9768
lag(CPS)	7069	0.3966	0.1098	0.0000	0.3336	0.4037	0.4621	0.9768
Market capitalization	7070	11116.1300	32608.9800	3.9741	731.6586	2110.1700	7327.8700	504239.5800
Firm size	7070	7.7855	1.6842	1.3798	6.5953	7.6545	8.8994	13.1308
MtB	7070	4.0784	12.7521	0.0912	1.6506	2.5582	4.0667	759.6177
ROA	7070	0.0427	0.1316	-2.9084	0.0214	0.0569	0.0933	0.9534
Stock return	7070	0.0007	0.0024	-0.0197	-0.0002	0.0007	0.0015	0.1296
Book leverage	7070	0.1845	0.1600	0.0000	0.0216	0.1690	0.2893	0.8522
CAPEX	7070	0.0457	0.0423	-0.3689	0.0203	0.0345	0.0582	0.7824
R&D	7070	0.0469	0.0642	0.0000	0.0047	0.0240	0.0692	1.0029
CEO tenure	7070	11.4061	7.1066	2.0000	7.0000	10.0000	14.0000	61.0000
CEO age	7070	4.0224	0.1240	3.3673	3.9512	4.0254	4.1109	4.5109

Notes: This table reports the descriptive statistics of variables. Earnings volatility is the volatility of the ratio of firm's EBITDA relative to the firm's total assets. Stock return volatility is the annualized standard deviation of daily stock returns over the fiscal year. PVS is the logarithm of the sum of 1 plus PVS, which is the sensitivity of CEO wealth to stock return volatility. CEO Pay Slice (CPS) is the fraction of the total compensation (ExecuComp item TDC1) to the group of top-five executives that is received by the Chief executive officer (CEO). Firm size is the logarithm of market capitalization, which is the product of the outstanding shares and share prices of firms. MtB is the ratio of market value of assets to book value of assets, which is a proxy for investment opportunities. ROA is the return on assets computed as operating income divided by book value of assets. Stock return is the return over the fiscal year. Book leverage is the ratio of total debt to total assets. CAPEX is the ratio of capital expenditures to assets. R&D is the ratio of R&D expenditures to total assets. CEO tenure is the logarithm of the number of years that the CEO has hold the position. CEO age is the logarithm of the age of CEO reported on Compustat. The unit of data on PVS is one dollar. The unit of market capitalization is millions dollar. The unit of CEO tenure is year. The unit of CEO age is year.

Table 2. Sample correlations of key variables

Book leverage	Stock return	ROA	MtB	Firm size	lag(CPS)	CPS	lag(PVS)	PVS	Stock return volatility	Earnings volatility	
-0.1705***	0.0409***	-0.2930***	0.0672***	-0.2404***	-0.0884***	-0.1047***	-0.1203***	-0.1093***	0.2645***	1	Earnings volatility
-0.0895***	0.4928***	-0.2597***	-0.0123	-0.3355***	-0.0808***	-0.1004***	-0.1533***	-0.1670***	1		Stock return volatility
0.0728***	-0.0206**	0.1102***	0.0305**	0.4758***	0.1537***	0.2121***	0.7242***	1			PVS
0.0712***	-0.0481***	0.0783***	0.0093	0.4160***	0.2121***	0.1418***	1				lag(PVS)
0.1245***	-0.0054	0.0889***	0.0101	0.1433***	0.3856***	1					CPS
0.1129***	-0.0126	0.0429***	0.0018	0.1187***	1						lag(CPS)
0.1484***	0.0492***	0.2817***	0.0969***	1							Firm size
0.0782***	0.0682***	0.0189	1								MtB
-0.0919***	0.1063***	1									ROA
-0.0595***	1										Stock return
1											Book leverage
											CAPEX
											RD
											CEO tenure
											CEO age

CEO age	CEO tenure	RD	CAPEX
-0.1145***	-0.0336***	0.4338***	0.0518***
-0.1132***	0.0214**	0.1472***	0.0640***
-0.0282***	0.0204**	0.0134	-0.0092
-0.0072	0.0099	0.0010	-0.0200*
0.0421**	-0.0552***	-0.1201***	-0.0356***
0.0576***	-0.0475***	-0.1158***	-0.0382***
0.0607***	-0.0367***	-0.0915***	-0.0205*
-0.0223**	-0.0117	0.0755***	0.0282**
0.0774***	0.0667***	-0.3075***	0.0932***
-0.0103	0.0207**	0.0197*	-0.0189
0.0507***	-0.0994***	-0.2351***	-0.0565***
-0.0490***	-0.0114	-0.0767***	1
-0.1129***	0.0223*	1	
0.2609***	1		
1			

Notes: This table reports the correlations of key variables. Variables in the data sample range from fiscal year 1992 to 2019. *, ** and ***indicate statistical significance at 10, 5 and 1 per cent level, respectively.

Table 3. Ordinary least square (OLS) regressions for earnings volatility

	Earnings volatility				
	(1)	(2)	(3)	(4)	(5)
PVS	-0.0010***		-0.0009***	-0.0029***	-0.0023**
	(-3.20)		(-2.90)	(-3.16)	(-2.37)
lag(PVS)					-0.0002
					(-0.25)
CPS		-0.0083*	-0.0057	-0.0256***	-0.0300***
		(-1.83)	(-1.24)	(-2.58)	(-2.83)
lag(CPS)					0.0126
					(1.20)
PVS×CPS				0.0050**	0.0058**
				(2.27)	(2.46)
lag(PVS) ×lag(CPS)					-0.0025
					(-1.07)
Firm size	-0.0042***	-0.0048***	-0.0043***	-0.0043***	-0.0041***
	(-11.64)	(-14.89)	(-11.64)	(-11.75)	(-11.28)
MtB	0.0002***	0.0002***	0.0002***	0.0002***	0.0002***
	(5.66)	(5.69)	(5.66)	(5.62)	(5.55)
ROA	-0.0542***	-0.0539***	-0.0540***	-0.0538***	-0.0543***
	(-13.01)	(-12.94)	(-12.96)	(-12.91)	(-13.01)
Stock return	0.7280***	0.7757***	0.7334***	0.7459***	0.7184***
	(3.42)	(3.65)	(3.44)	(3.50)	(3.37)
Book leverage	-0.0204***	-0.0209***	-0.0202***	-0.0199***	-0.0200***
	(-5.83)	(-5.97)	(-5.77)	(-5.68)	(-5.69)
CAPEX	0.0731***	0.0732***	0.0730***	0.0727***	0.0718***
	(5.64)	(5.66)	(5.64)	(5.62)	(5.55)
R&D	0.2660***	0.2641***	0.2653***	0.2658***	0.2660***
	(28.41)	(28.16)	(28.28)	(28.33)	(28.32)
CEO tenure	-0.0002***	-0.0002***	-0.0002***	-0.0002***	-0.0002***
	(-3.15)	(-3.20)	(-3.18)	(-3.36)	(-3.30)
CEO age	-0.0142***	-0.0139***	-0.0142***	-0.0138***	-0.0138***
	(-3.39)	(-3.34)	(-3.39)	(-3.30)	(-3.30)
Intercept	0.1284***	0.1324***	0.1301***	0.1370***	0.1339***
	(6.56)	(6.74)	(6.63)	(6.90)	(6.69)
Industry dummy	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes
Obs	7070	7070	7070	7070	7069
R-Sq	0.2949	0.2942	0.2950	0.2955	0.2968

Notes: This table reports the coefficients and t-value of the regressors in the ordinary least square (OLS) regression model of earnings volatility. The dependent variable is earnings volatility. *, ** and ***indicate statistical significance at the 10, 5 and 1% level, respectively. PVS is the logarithm of the sum of 1 plus PVS, which is the sensitivity of CEO wealth to stock return volatility. CEO Pay Slice (CPS) is the fraction of the total compensation (ExecuComp item TDC1) to the group of top-five executives that is received by the Chief executive officer (CEO). Firm size is the logarithm of market capitalization, which is the product of the outstanding shares and share prices of firms. MtB is the ratio of market value of assets to book value of assets, which is a proxy for investment opportunities. ROA is the return on assets computed as operating income divided by book value of assets. Stock return is the return over the fiscal year. Book leverage is the ratio of total debt to total assets. CAPEX is the ratio of capital expenditures to assets. R&D is the ratio of R&D expenditures to total assets. CEO tenure is the logarithm of the number of years that the CEO has hold the position. CEO age is the logarithm of the age of CEO reported on Compustat. The unit of data on PVS is one dollar. The unit of market capitalization is millions dollar. The unit of CEO tenure is year. The unit of CEO age is year.

Table 4. Earnings volatility calculated as combinations of the high and low levels of PVS and CPS

		CPS	
		0.2939	0.5134
PVS	2.4680	0.0380	0.0351
	6.1414	0.0329	0.0340

Table 5. Ordinary least square (OLS) regressions for stock return volatility

	Stock return volatility				
	(1)	(2)	(3)	(4)	(5)
PVS	-0.0002**		-0.0002*	-0.0004	-0.0005*
	(-2.12)		(-1.79)	(-1.34)	(-1.69)
lag(PVS)					0.0001
					(0.38)
CPS		-0.0026*	-0.0021	-0.0042	-0.0026
		(-1.87)	(-1.49)	(-1.36)	(-0.78)
lag(CPS)					-0.0043
					(-1.32)
PVS ×CPS				0.0005	0.0003
				(0.75)	(0.42)
lag(PVS) × lag(CPS)					0.0006
					(0.83)
Firm size	-0.0027***	-0.0028***	-0.0027***	-0.0027***	-0.0027***
	(-23.68)	(-28.03)	(-23.69)	(-23.70)	(-23.80)
MtB	0.0000*	0.0000*	0.0000*	0.0000*	0.0000*
	(-1.83)	(-1.80)	(-1.82)	(-1.83)	(-1.77)
ROA	-0.0313***	-0.0312***	-0.0312**	-0.0312***	-0.0311***
	(-24.30)	(-24.22)	(-24.23)	(-24.21)	(-24.12)
Stock return	5.0175***	5.0276***	5.0196***	5.0209***	5.0294***
	(76.28)	(76.59)	(76.30)	(76.29)	(76.37)
Book leverage	-0.0003	-0.0004	-0.0003	-0.0002	-0.0002
	(-0.31)	(-0.36)	(-0.24)	(-0.21)	(-0.21)
CAPEX	0.0305***	0.0306***	0.0305***	0.0305***	0.0307***
	(7.64)	(7.64)	(7.63)	(7.62)	(7.66)
R&D	0.0059**	0.0054*	0.0056*	0.0057**	0.0055*
	(2.03)	(1.85)	(1.93)	(1.95)	(1.89)
CEO tenure	0.0000	0.0000	0.0000	0.0000	0.0000
	(-0.48)	(-0.52)	(-0.51)	(-0.57)	(-0.63)
CEO age	-0.0065***	-0.0064***	-0.0065***	-0.0064***	-0.0064***
	(-5.02)	(-4.99)	(-5.02)	(-4.98)	(-4.97)
Intercept	0.0706***	0.0717***	0.0713***	0.0720***	0.0729***
	(11.67)	(11.82)	(11.74)	(11.72)	(11.78)
Industry dummy	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes
Obs	7070	7070	7070	7070	7069

R-Sq	0.6155	0.6155	0.6157	0.6157	0.6162

Notes: This table reports the coefficients and t-value of the regressors in the ordinary least square (OLS) regression model of earnings volatility. The dependent variable is stock return volatility. *, ** and ***indicate statistical significance at the 10, 5 and 1% level, respectively. PVS is the logarithm of the sum of 1 plus PVS, which is the sensitivity of CEO wealth to stock return volatility. CEO Pay Slice (CPS) is the fraction of the total compensation (ExecuComp item TDC1) to the group of top-five executives that is received by the Chief executive officer (CEO). Firm size is the logarithm of market capitalization, which is the product of the outstanding shares and share prices of firms. MtB is the ratio of market value of assets to book value of assets, which is a proxy for investment opportunities. ROA is the return on assets computed as operating income divided by book value of assets. Stock return is the return over the fiscal year. Book leverage is the ratio of total debt to total assets. CAPEX is the ratio of capital expenditures to assets. R&D is the ratio of R&D expenditures to total assets. CEO tenure is the logarithm of the number of years that the CEO has hold the position. CEO age is the logarithm of the age of CEO reported on Compustat. The unit of data on PVS is one dollar. The unit of market capitalization is millions dollar. The unit of CEO tenure is year. The unit of CEO age is year.

Table 6. Ordinary least square (OLS) regressions for earnings volatility and stock return volatility

	Earnings volatility		Stock return volatility	
	Low CPS	High CPS	Low CPS	High CPS
PVS	-0.0013**	-0.0005*	-0.0003***	-0.0001*
	(-2.52)	(-1.39)	(-3.01)	(-0.54)
Firm size	-0.0046***	-0.0043***	-0.0024***	-0.0028***
	(-8.00)	(-9.38)	(-21.56)	(-15.49)
MtB	0.0006***	0.0001***	0.0001***	0.0000
	(5.46)	(3.71)	(4.12)	(-1.91)
ROA	-0.0671***	-0.0305***	-0.0209***	-0.0413***
	(-11.49)	(-4.93)	(-18.33)	(-16.93)
Stock return	2.1263***	0.1620	1.0837***	6.5415***
	(4.52)	(0.79)	(11.79)	(81.33)
Book leverage	-0.0270***	-0.0115***	-0.0002	-0.0021
	(-4.81)	(-2.71)	(-0.19)	(-1.26)
CAPEX	0.0774***	0.0516***	0.0298***	0.0348***
	(4.06)	(3.02)	(8.01)	(5.15)
R&D	0.2434***	0.2748***	0.0079***	0.0181***
	(17.73)	(21.12)	(2.96)	(3.52)
CEO tenure	-0.0004***	0.0000	0.0000	0.0000
	(-3.40)	(-0.02)	(-0.55)	(-0.44)
CEO age	-0.0151***	-0.0109**	-0.0082***	-0.0032
	(-2.38)	(-2.05)	(-6.61)	(-1.53)
Intercept	0.1353***	0.1124***	0.0792***	0.0526***
	(4.53)	(4.52)	(13.58)	(5.35)
Industry dummy	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes
Obs	3532	3538	3538	3538
R-Sq	0.3116	0.2801	0.5974	0.7254

Notes: This table reports the coefficients and t-value of the regressors in the ordinary least square (OLS) regression model of earnings volatility. The dependent variable is earnings volatility and stock return volatility, respectively. *, ** and ***indicate statistical significance at the 10, 5 and 1% level, respectively. PVS is the logarithm of the sum of 1 plus PVS, which is the sensitivity of CEO wealth to stock return volatility. CEO Pay Slice (CPS) is the fraction of the total compensation (ExecuComp item TDC1) to the group of top-five executives that is received by the Chief executive officer (CEO). Firm size is the logarithm of market capitalization, which is the product of the outstanding shares and share prices of firms. MtB is the ratio of market value of assets to book value of assets, which is a proxy for investment opportunities. ROA is the return on assets computed as operating income divided by book value of assets. Stock return is the return over the fiscal year. Book leverage is the ratio of total debt to total assets. CAPEX is the ratio of capital expenditures to assets. R&D is the ratio of R&D expenditures to total assets. CEO tenure is the logarithm of the number of years that the CEO has hold the position. CEO age is the logarithm of the age of CEO reported on Compustat. The unit of data on PVS is one dollar. The unit of market capitalization is millions dollar. The unit of CEO tenure is year. The unit of CEO age is year.

Table 7. Earnings volatility calculated as raw number of PVS

		CPS	
		0.2939	0.5134
PVS	11,798.34	-16.4415	-3.5424
	464,699.47	-647.2908	-139.0199

Table 8. Two-stage least square (2SLS) regressions for earnings volatility and stock return volatility

Panel A: First Stage		
	PVS	CPS
Book leverage	0.8304***	
	(6.34)	
CPS median		0.8089***
		(22.27)
Firm size	0.5615***	0.0077***
	(47.07)	(9.53)
MtB	-0.0014	0.0001
	(-0.99)	(0.63)
ROA	0.0192	0.0219**
	(0.12)	(2.09)
Stock return	-43.7835***	0.0256
	(-5.50)	(0.05)
CAPEX	-0.3521	-0.0374
	(-0.73)	(-1.13)
R&D	1.0148***	-0.1354***
	(2.89)	(-5.83)
CEO tenure	0.0001	-0.0004**
	(0.04)	(-2.14)
CEO age	-0.2180	-0.0005
	(-1.39)	(-0.05)
Intercept	-1.6790***	0.0037***
	(-2.29)	(0.07)
Industry dummy	Yes	Yes
Year dummy	Yes	Yes
Obs	7070	7070
R-Sq	0.3456	0.1479
Panel B: Second Stage		
	Earnings volatility	Stock return volatility
PVS	-0.0010***	-0.0002***
	(-3.17)	(-1.79)
CPS	-0.0178	-0.0021
	(-1.11)	(-1.49)
Firm size	-0.0042***	-0.0027***
	(-11.64)	(-23.69)
MtB	0.0002***	0.0001*
	(5.66)	(-1.82)
ROA	-0.0541***	-0.0312***
	(-12.97)	(-24.23)
Stock return	0.7352***	5.0196***
	(3.45)	(76.30)
Book leverage	-0.0204***	-0.0003

	(-5.81)	(-0.24)
CAPEX	0.0732***	0.0305***
	(5.65)	(7.63)
R&D	0.2661***	0.0056*
	(28.41)	(1.93)
CEO tenure	-0.0002***	-0.0004
	(-3.16)	(-0.51)
CEO age	-0.0142***	-0.0065***
	(-3.40)	(-5.02)
Intercept	0.1343***	0.0713***
	(6.62)	(11.74)
Industry dummy	Yes	Yes
Year dummy	Yes	Yes
Obs	7070	7070
R-Sq	0.3456	0.1479

Notes: This table reports the coefficients and t-values of the regressors in the two-stage least square (2SLS) regression model of earnings volatility and stock return volatility. The instrumental variable of PVS is leverage, and the instrumental variable of CPS is the median value of CPS at the industry level. Panel A shows the regression results of the first stage. The dependent variable of Column 1 of Panel A is PVS, and the depedent variable of Column 2 of Panel A is CPS. Panel B shows the regression results of the second stage. The dependent variable of Column 1 of Panel B is earnings volatility, and the dependent variable of Column 2 of Panel B is stock return volatility. *, ** and ***indicate statistical significance at the 10, 5 and 1% level, respectively. PVS and CPS in Panel B are obtained from the first stage of the two-stage least square (2SLS) regressions. PVS is the logarithm of the sum of 1 plus PVS, which is the sensitivity of CEO wealth to stock return volatility. CEO Pay Slice (CPS) is the fraction of the total compensation (ExecuComp item TDC1) to the group of top-five executives that is received by the Chief executive officer (CEO). Firm size is the logarithm of market capitalization, which is the product of the outstanding shares and share prices of firms. MtB is the ratio of market value of assets to book value of assets, which is a proxy for investment opportunities. ROA is the return on assets computed as operating income divided by book value of assets. Stock return is the return over the fiscal year. Book leverage is the ratio of total debt to total assets. CAPEX is the ratio of capital expenditures to assets. R&D is the ratio of R&D expenditures to total assets. CEO tenure is the logarithm of the number of years that the CEO has hold the position. CEO age is the logarithm of the age of CEO reported on Compustat. The unit of data on PVS is one dollar. The unit of market capitalization is millions dollar. The unit of CEO tenure is year. The unit of CEO age is year.

Table 9. Ordinary least square (OLS) regressions for earnings volatility and stock return volatility using PVS and CPS obtained from the two-stage least square (2SLS) regressions

	Earnings volatility		Stock return volatility	
	low CPS	high CPS	low CPS	high CPS
PVS	-0.0270***	-0.0219***	-0.0003**	-0.0001*
	(-4.39)	(-3.74)	(-2.49)	(-1.08)
Firm size	0.0104***	0.0070**	-0.0023***	-0.0030***
	(2.95)	(2.04)	(-16.54)	(-18.70)
MtB	0.0005***	0.0001**	0.0000***	0.0000
	(5.07)	(2.57)	(0.89)	(-1.25)
ROA	-0.0623***	-0.0308**	-0.0234***	-0.0384***
	(-12.19)	(-4.22)	(-17.55)	(-17.38)
Stock return	-0.0147	-0.5399***	2.2625***	6.3780***
	(-0.03)	(-1.46)	(22.50)	(80.47)
CAPEX	0.0644***	0.0477**	0.0224***	0.0443***
	(3.89)	(2.16)	(5.20)	(6.55)
R&D	0.2697***	0.3093***	0.0203***	-0.0054
	(19.52)	(24.61)	(5.65)	(-1.42)
CEO tenure	-0.0005***	0.0001	0.0000	0.0000
	(-4.80)	(0.78)	(-0.22)	(-1.18)
CEO age	-0.0158***	-0.0227***	-0.0085***	-0.0018
	(-2.79)	(-3.44)	(-5.77)	(-0.90)
Intercept	0.0705***	0.0886***	0.0782***	0.0464***
	(2.54)	(2.84)	(11.26)	(5.16)
Industry dummy	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes
Obs	3535	3535	3535	3535
R-Sq	0.3278	0.2850	0.5573	0.7223

Notes: This table reports the coefficients and t-value of the regressors in the ordinary least square (OLS) regression model of earnings volatility. The dependent variable is earnings volatility and stock return volatility, respectively. *, ** and ***indicate statistical significance at the 10, 5 and 1% level, respectively. PVS and CPS are obtained from the first stage of the two-stage least square (2SLS) regressions. PVS is the logarithm of the sum of 1 plus PVS, which is the sensitivity of CEO wealth to stock return volatility. CEO Pay Slice (CPS) is the fraction of the total compensation (ExecuComp item TDC1) to the group of top-five executives that is received by the Chief executive officer (CEO). Firm size is the logarithm of market capitalization, which is the product of the outstanding shares and share prices of firms. MtB is the ratio of market value of assets to book value of assets, which is a proxy for investment opportunities. ROA is the return on assets computed as operating income divided by book value of assets. Stock return is the return over the fiscal year. Book leverage is the ratio of total debt to total assets. CAPEX is the ratio of capital expenditures to assets. R&D is the ratio of R&D expenditures to total assets. CEO tenure is the logarithm of the number of years that the CEO has hold the position. CEO age is the logarithm of the age of CEO reported on Compustat. The unit of data on PVS is one dollar. The unit of market capitalization is millions dollar. The unit of CEO tenure is year. The unit of CEO age is year.

Appendix A

Figure 1. Interaction effect on earnings volatility

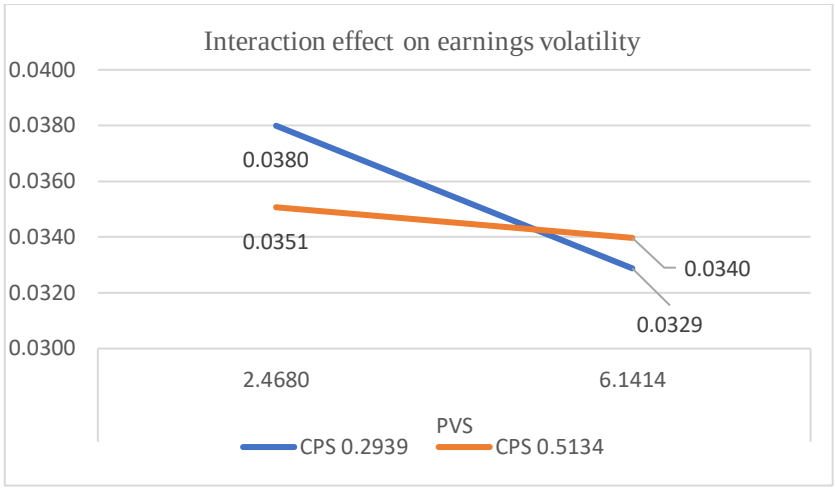
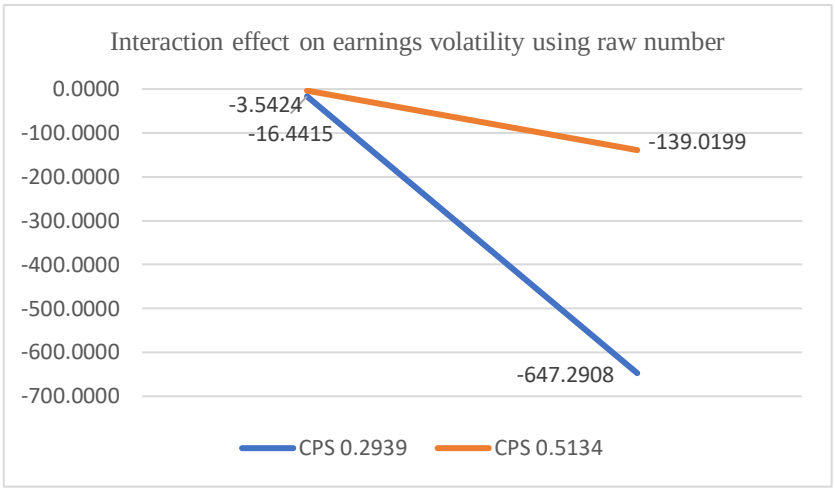


Figure 2. Interaction effect on earnings volatility using raw number



Appendix B

In this appendix, I list the definition of variables which used in this research.

Earnings volatility (Erisk) is the volatility of the ratio of firm's EBITDA relative to the firm's total assets.

Stock return volatility (Srisk) is the logarithm of the standard deviation of daily stock returns over the fiscal year.

PVS is calculated as the logarithm of the sum of 1 plus PVS, which is the sensitivity of CEO wealth to stock return volatility. The units of data on PVS is one dollar.

CEO Pay Slice (CPS) is the fraction of the total compensation (ExecuComp item TDC1) to the group of top-five executives that is received by the Chief executive officer (CEO).

Firm size is the logarithm of market capitalization, which is the product of the outstanding shares and share prices of firms. The unit of market capitalization is millions dollar.

MtB is the ratio of market value of assets to book value of assets.

ROA is computed as operating income divided by book value of assets.

Stock return is the return over the fiscal year.

Book leverage is the ratio of total debt to total assets.

CAPEX is the ratio of capital expenditures to assets.

R&D is the ratio of R&D expenditures to total assets.

CEO tenure is the logarithm of the number of years that the CEO has hold the position.

CEO age is the logarithm of the age of CEO reported on Compustat.