

High Return, High Risk - Does Stock Option Based CEO Compensation Encourage Risk Taking

Harry Xia*

This study, through empirical evidence of 3,081 US firms during the period of 1992-2009, shows a strong causal relation between different CEO compensation components and firms' investment policy and firm risk. Specifically, the proportion of CEO option-based compensation is positively and significantly associated with firm's R&D expenditures and firm focus, while the proportion of cash-based and restricted stock compensation are negatively and significantly related. Such results are robust across alternative measures and statistical methodology. Furthermore, there is a non-linear relation between CEO option pay level and R&D investment discovered with practical implications. Finally, following the implementation of FAS 123R in 2005, new evidence indicates that option-based compensation remains as an effective motivation and even becomes a more efficient incentive for CEO to take risk on R&D investment and firm focus.

Field of Research: Finance, Executive Compensation & Corporate Governance

JEL Codes: G30, G34 & M52

1. Introduction

Given that stock option is becoming a major component of CEO compensation package in the United States in the past three decades. A rich body of research conducted by Jensen & Meckling (1976); Murphy (1999); Bryan, Hwang & Lilien (2000) and Ghosh, Moon & Tandon (2007) indicates that CEO stock options offer incentives to risk averse executives to invest in high-risk and high-return projects on behalf of risk neutral shareholders. However, in spite of intense research, contradictory and inconsistent empirical results remain, which leads to questions about whether firms grant stock option awards optimally. Furthermore, restricted stock as another form of CEO compensation has also increased steadily, especially after the adoption of FAS 123R to mandate expensing CEO option pay, which calls for thorough examining its relation to CEO risk taking and interaction with option pay and cash-based compensation.

This paper provides empirical evidence of linkages between the primary CEO compensation research components, namely stock option, along with cash-based salary & bonus, and restricted stock compensation, and CEO's discretionary decisions on research & development (R&D) expenditures and firm focus on a sample of 3,081 publicly traded firms in US over the 1992–2009 period. The research selects such current and diverse sample to increase the power of the tests it runs.

R&D investment together with Herfindahl Index (for sales across segments) and Number of Segment representing firm focus are selected as risk taking proxies due to the uncertainty they add to firm's financial outcome.

* Dr. Harry Xia, Faculty of Business, Government & Social Work, University of Saint Joseph, Macau.
Email: harry.xia@usj.edu.mo

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The research finds that higher prior fiscal year CEO option-based compensation results in riskier investment decisions in term of more R&D expenditures and greater firm focus represented by higher Herfindahl Index and fewer number of segments. Such evidence support the hypotheses derived from agency theory and utility theory that higher CEO option pay provides an incentive to risk averse executives to take more risk, and is consistent with the findings from Guay (1999) and Coles, Daniel & Naveen (2006).

In contrast to the results on CEO option pay, the research finds that both cash-based (salary and bonus) and restricted stock compensation have significantly negative relation to R&D investment and firm focus, meaning that higher level of cash and restrict stock awards lead to lower R&D and more firm diversification in term of lower Herfindahl Index and more number of segments. Such evidence indicates that cash-based and restricted stock compensation discourage CEO to make aggressive decisions on risky projects, which is consistent with the research conducted by Bryan et al. (2000).

In order to test the robustness of the findings, the research measures the extent to which CEO option, cash-based and restricted stock affect firm risk in term of standard deviation of stock returns (Total risk) and Beta (Systematic risk). The positive association between CEO option pay and standard deviation of stock returns and Beta assures that more CEO option compensation leads to higher firm risk. Both cash-based and restricted stock compensation decrease firm risk through their significantly negative relation to standard deviation of stock returns and Beta.

To echo Ghosh et al.'s (2007) finding that CEO stock option holdings play different roles at high and low level to increase R&D expenditure, the research takes a further look on CEO option pay's impact to firm's R&D investment through different option awards to the total compensation level at 25% breakpoints. The research finds a non-linear relation between R&D and CEO option pay. The low level of stock option awards actually discourage CEO to invest more on relatively risky R&D projects, and the relation turns to a positive way above 25% breakpoint and intensifies along with growing level of option-based compensation. Such results have strong practical implications for firms to examine and optimize their option awards level.

To respond to the growing public concern and to improve the financial reporting transparency, the Financial Accounting Standards Board (FASB) issued Financial Accounting Standards Board Statement of Financial Accounting Standards No. 123 (revised 2004) Share-Based Payment (known as FAS 123R) in December 2004 that requires the recognition of CEO stock option expense using the fair value method. The new regulation dramatically changes the landscape of CEO option pay observed by Brown & Lee (2007) and Choudhary, Rajgopal & Venkatachalam (2009).

Using the most recent data sample, the research finds significant reduction of CEO stock option-based compensation (by 34% on average) after 2005 while restricted stock awards increased by 145% during the same period time. However, the further examine shows that, CEO option pay not only maintains but also reinforces its significantly positive relation to firm's R&D investment and firm focus. The evidence supports that stock option continues to be an effective and efficient incentive for CEO to make risky investment decisions although firms chose to cut the "excessive" portion of option-based compensation following the implementation of FAS 123R.

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My research contributes to the literature in the following areas:

1. The research uses the proportion of option-based, cash-based and restricted stock compensation respectively and jointly in different models other than delta, vega (Coles et al. 2006) and other proxies of CEO option pay used in prior studies, offering a unique view to observe not only each individual compensation component but also their interaction with firm risk taking decision in term of R&D and firm focus directly. By doing so, the study provides a practical approach to optimize CEO compensation structure by proper allocation of resources among the components other than boosting the overall compensation package. In addition, the results are more straightforward and easier for cross-section and time comparison for practitioners in the real business world;
2. Through grouping CEO option pay into different categories by its grant value relative to the total compensation, the research finds a non-linear association between option-based compensation and firm's R&D investment, especially a significantly negative relation at very low level of CEO option pay to the total compensation (below 25%). Such finding provides direct and practical implications for firms to balance their CEO option pay level and R&D intensity;
3. Using most recent data, particularly the ones following the implementation of FAS 123R in 2005 which significantly changed CEO compensation mix, to demonstrate a positive and intensified relation between CEO stock option and risk taking in R&D and firm focus after such major exogenous change.

The remainder of the paper is organized as follows: Section 2 provides additional literature review, while Section 3 discusses hypotheses, research method and data & sample characteristics. Section 4 presents results and analysis. Section 5 summarizes the key findings, limitations and directions for future research.

2. Literature Review

2.1 CEO Stock Option Compensation and Risk Taking

Observed by Core, Guay & Larcker (2003), there has been a great increase in the use of stock operations as CEO compensation and incentives through the time. According to Hall & Liebman's (1998) observation, in 1980, CEO annual flow compensation was mainly in the form of cash-based salary and bonus. There were only 30 percent of CEOs receiving new option grants. Mean salary and bonus was \$655,000 versus \$155,000 from new option grants. By 1994, options had become a major component of CEO flow compensation, with 70 percent of CEOs receiving new option grants, and mean option grants amounting to \$1.2 million (valued by the Black-Scholes model), compared with \$1.3 million in cash pay. Hall & Murphy (2002) estimate that stock options increase to approximately 40% of CEO's total compensation for S&P 500 companies in 1998, which is up from only 25% of total pay in 1992. Lublin (2006) believes that, at their peak of year 2001, stock options (valued ex-ante) accounted for over 50 percent of the pay of CEOs of major U.S. firms. In addition, Murphy (1998) observed, as a matter of practice, virtually all stock options are awarded at-the-money with a 10-year duration, and they generally vest over a 3–5-year period.

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Based on the agency theory, risk attitudes of CEO and shareholders are inherently deviated. Jensen & Meckling (1976) argue that CEOs tie the majority of their personal wealth and human capital directly to their employing firms, who are over-invested in their respective firms. Accordingly, CEOs are assumed to be risk averse as they are prohibited from effectively diversifying employment and personal wealth risk. In contrast, Milgrom & Roberts (1992) posit that because shareholders can well diversify their personal wealth across firms with varying prospects, they are risk-neutral in term of investment decisions. Provided the central concept of financial economics that the correlation of risk and return goes hand in hand (Fama 1976 & Sharpe 1970), Core et al. (2003) argue that you cannot have high returns without taking high risks. Thus, agency costs are incurred when CEOs avoid risk at the expense of returns (Wiseman & Gomez-Mejia, 1998). Hall & Murphy (2002) suggest that one feasible solution is to align the risk preferences of risk averse CEOs with those of risk-neutral shareholders through proper incentives.

Furthermore, stock options' unique convex payoffs allow CEO to participate in upside gains without ceiling, while providing a floor to avoid losses. Theoretically, "with enough stock options, risky projects that work out well can make a CEO very wealthy. If the projects fail, and the company's shares drop, the CEO neither gains nor loses--at least not from the stock options" (Core et al. 2003). Jensen & Meckling (1976); Smith & Stulz (1985), and Core & Guay (1999) state that convex payoffs should provide risk averse CEO with increased incentives to take on risky projects. Sanders (2001) discovers that CEO stock ownership and stock options had different impact on CEOs' strategic decisions to increase acquisitions and divestitures. Due to stock option contains limited downside risk, it positively influence risk taking while stock ownership negatively influence risk taking.

On the other hand, scholars present opposite empirical evidence that the positive relation between CEO option pay and risk taking as stated above is not constant. One argument is that the validity of stock option's convex payoffs depends on the managerial utility function. Guay (1999) argues that options' convex payoff function can be more than offset by concavity of the utility function of the risk-averse executives. Ju, Leland & Senbet (2002) demonstrate that a call option contract can induce either too much or too little corporate risk taking, depending on managerial risk aversion and the underlying investment technology. Ross (2004) further proves that there exists no incentive schedule that will make all expected utility maximizers less risk averse.

Business context also plays a role. Bloom & Milkovich (1998) explore the influence on the relationships between incentive pay, risk taking, and firm performance. Their results indicated that firm risk is negatively related to incentive pay and positively related to base pay. Additionally, incentives are negatively related to performance in high-risk firms. They argue that when business risk is too high, incentive pay is not appropriate and may push executives to be more risk averse. Ittner, Lambert & Larcker (2003) find that, with the use of stock options and restricted stock in high technology, "new-economy" firms substantially pay more the equity compensation than "old-economy" manufacturing firms.

Finally, Holmstrom's (1979) argues that absolute risk preference alignment between CEOs and shareholders can never be achieved, since there is no amount of incentives would make executives risk-neutral to the level of the shareholders.

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However, in spite of intense research, contradictory and inconsistent empirical results remain, which leads to questions about whether firms grant stock option awards effectively.

Therefore, it is meaningful to provide more empirical evidence with broad and current sample to re-examine the linkage between CEO option-based compensation and risky discretionary decisions. In this paper, the research provides such evidence with focus on the stock option grants of CEOs because they are primarily responsible for making managerial decisions. In addition, since the validity of stock option's convex payoffs depends on the managerial utility function, it also makes sense to explore possible non-linear relation between option pay level and CEO risk taking.

2.2 Stock Option versus Cash-Base and Restricted Stock Compensation

Cohen et al. (2000) posit that risk averse executives, if are mainly compensated in traditional cash-based ways (salary and bonus), have incentive to keep the volatility of the firm low when they hold almost entire of their human capital and their financial wealth in the firm. Consequently, shareholders value will not be maximized.

Correspondingly, Bryan et al. (2000) find that cash compensation, which is typically earnings based, is unlikely to provide desired incentives to CEOs of firms with high growth opportunities, because accounting earnings of such firms tend to exhibit volatility and because they usually measure, with a substantial lag, the value impact of investment decisions due to conservative bias in accounting principles. Core, Guay & Verrecchia (2003) show that for the typical CEO, non-price incentives provided by flow compensation are economically small in comparison with the price-based incentives provided by the CEO's equity portfolio, including stock option and restricted stock. Murphy (1985), Jensen & Murphy (1990), and Hall & Liebman (1998) show that the vast majority of a typical CEO's incentives to increase stock price are driven by the value appreciation of his stock and option portfolio, but not by flow compensation.

Therefore, the focus of this study is on CEO option pay and restricted stock grant as they are playing a more critical role in risk taking motivation.

However, there are important differences between these two compensation components with respect to dividend protection, and inducement of risk taking.

Kole (1997) observe that, with respect to dividends, stock option holders typically do not receive dividends. In contrast, restricted stock provides CEOs with the privileges of stock ownership, including dividends and voting rights, which begin on the grant date and extend until the stock is sold.

More importantly, there is a fundamental difference underlying their respect payoff function. A classic empirical research conducted by Guay (1999) presents strong evidence that stock options, but not common stockholdings, play an economically significant role in increasing the convexity of the relation between CEOs' wealth and stock price. By measuring convexity as the change in the value of CEOs' stock options and stockholdings for a given change in stock-return volatility, the median change in the value of CEOs' option portfolios for a 10 percentage point change in the standard deviation of stock returns is approximately \$300,000, with an interquartile range of \$425,000. Convexity provided by common stock, on the other hand, is only \$22, with

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an interquartile range of \$2,400. Bryan et al. (2000) posit that the most distinct part between restricted stock and stock options lies in the individual payoff functions and the related risk taking incentives. Stock options have a convex payoff function in stock price and restricted stock has a linear payoff function. To the extent that the CEO's utility function is concave, the linear payoff function of restricted stock grant can exacerbate CEO's risk aversion since it bears the potential wealth loss from risky investment projects. Without adequately paid an additional premium for this added risk, CEOs are likely to forego risky projects with positive net present value (NPV), which results in the "under-investment problem" suggested by Smith & Stulz (1985). Therefore, stock option awards, rather than restricted stock awards, can provide a more efficient incentive mechanism for CEO to take on risky value-increasing projects. Parrino, Poteshman & Weisbach (2005) note that, unlike stock options, "restricted shares force managers to bear both upside and downside risk", and find that options induce better risk-taking behavior than restricted stock.

Recent work also indicates that restricted stock might discourage executive risk bearing. Devers et al. (2008) indicate that the accumulated value of restricted stock held by CEOs led to lower strategic risk investments. Because restricted stock carries significant value on award, they conclude that CEOs endow their perceptions of personal wealth with the restricted stock value, which creates downside risk that exacerbate risk aversion.

There are some other opinions in the compassion. Hall & Murphy (2002) finds that executives place a higher value on restricted stock than they do on stock options. Bebchuk & Fried (2004) argue that a popular belief has emerged suggesting that restricted stock is a more effective interest alignment mechanism than stock option, and efforts to restructure executive compensation have led to calls to replace stock option grants with restricted stock grants.

Furthermore, based on the previous research, restricted stock as another form of CEO compensation has also increased steadily, which calls for thorough examining its relation to CEO risk taking and interaction with option pay and cash-based compensation.

2.3 FAS 123R and Its Impact

There were a few researches on option pay expensing around the issuance of FAS 123R. A group represented by Brandes, Hadani & Goranova (2006) believes that firms would have made smaller CEO stock option grants if FASB had required the value of option grants to be charged against earnings. Murphy (2002) argues directly that the lack of ESO expense created an uneven playing field for executive compensation because virtually all other forms of compensation trigger accounting charges. Bodie, Kaplan & Merton (2003) posit that no requirement to recognize CEO stock option expense creates an "accounting subsidy to stock options", which encouraged firms to favor option-based compensation and to use it to excess.

Empirical evidence found by researchers also support that the replacement of CEO stock option by restricted stock grants, especially after the adoption of FAS 123R.

Hall & Murphy (2002) and Bodie et al. (2003) argue that removing CEO stock options' accounting advantage levels the compensation playing field and helps companies

select compensation schemes that are more cost-effective and better align executive and shareholder interests. Hall & Murphy (2002) also demonstrate that restricted stock is relatively inexpensive when compared to stock options because executives value it closer to its cost to the company. Carter, Lynch & Tuna (2006) show that firms that mandatory expensed stock options decreased their use of stock options and increased their use of restricted stock.

However, as previous research demonstrated, there is a significant difference between restricted stock and stock options lies in the individual payoff functions and the related risk taking incentives. Whether restricted stock's linear payoff function can effectively replace stock option's convex payoff function after the implementation of FAS 123R becomes an immediate question to be answered by further research conducted in this paper.

3. The Methodology and Model

3.1 Hypotheses

One important consequence of the high risk linked with R&D, according to agency theory, is that risk averse and under-diversified CEOs are more likely to under-invest in R&D because of its uncertainty and high risk (Ghosh et al. 2007). On the other side, R&D is important to form and enhance firms' core competency to put them at a more advantaged position in the competition. Thus, risk neutral shareholders would like to maximize the benefits of R&D investment.

The convex payoff function and positive relation between option expected value and stock volatility (based on Black-Scholes model) make option-based compensation an ideal incentive to align CEO's utility with shareholders' interest on firms' R&D investment. Meanwhile, based on the existing literature, cash-based CEO compensation and restricted stock with linear payoff function would not generate such utility or incentive to induce CEO risk taking. Naturally, risk averse CEO, under cash and restricted stock compensation, would choose to forgo risky R&D projects. Thus, the research builds the first hypothesis on the linkage of CEO compensation components to firm's R&D investment as:

H1: *There will be a positive association between CEO's stock option compensation and firm's R&D investment, and a negative relation between CEO cash-based & restricted stock compensation and firm's R&D spending.*

Furthermore, prior research indicates that the validity of stock option's convex payoffs depends on the managerial utility function. Guay (1999) argues that convexity of the payoff structure from options can be more than offset by concavity of the utility function of the risk-averse manager. Ju et al. (2002) analyze the role of options in managerial compensation and demonstrate that a call option contract can induce either too much or too little corporate risk taking, depending on managerial risk aversion and the underlying investment technology. Thus, the research builds its second hypothesis as:

H2: *There will be a non-linear relation between CEO's stock option compensation and firm's R&D investment.*

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A common view in the research literature is that diversification (opposite to firm focus) will reduce risk because combining industry cash flows that are not perfectly correlated will, in general, reduce the overall variance of the combined firm cash flows (Amihud & Lev 1981). Suggested by Coles et al. (2006), the research uses Herfindahl Index (which represents revenue concentration across segments and is defined as the sum of the square of segment sales divided by the square of firm sales) and number of segments (by number of different SIC codes reported through CRSP/COMPUSTAT Merged Database under each individual firm) as proxies to capture firm focus. Based on their definitions, higher level of firm focus is indicated by higher Herfindahl Index and fewer number of segments. Thus, the research builds its third hypothesis as:

H3: *There will be a positive association between CEO's stock option compensation and its firm focus represented by Herfindahl index (+) & number of segments (-), a negative relation between CEO cash-based & restricted stock compensation and firm focus level.*

The exogenous change caused by the implementation of FAS 123R and the contradiction between Hayes et al.'s (2010) findings and prior research regarding CEO option pay as risk taking incentive call for a further examine of CEO compensation components, especially pre and post FAS 123R adoption. Thus, the research builds its fourth hypothesis as:

H4: *There is a significant change of the mix of CEO compensation components pre and post the implementation of FAS 123R. Consequently, such change may affect the relation between these compensation components and CEO risk taking as tested before.*

To be consistent with the tests set for the H1 and H3, the CEO compensation components included in H4 are CEO option pay, cash-based and restricted stock compensation.

3.2 Research Design

To empirically test the hypotheses, the research proposes the following models:

a) CEO compensation and risk taking

The research examines whether CEO compensation components affect R&D investments and firm focus. However, it is difficult to infer about causality from a cross-sectional analysis because investments could also affect CEO compensation. To avoid possible biases from reverse causality, the research introduces a one-year lag between CEO compensation components (and all other independent variables) and investments & firm focus, as suggested by Hermalin & Weisbach (1991) and Smith & Watts (1992). The research estimates the relationship between firm's R&D investments, firm focus, and CEO compensation components, and control variables using the following model (subscript t represents the fiscal year) to test H1 and H3:

Risk Taking (R&D, Herfindahl Index & Number of segments) $t+1 =$
 $\alpha + \beta_1 \text{ CEO compensation components } t + 5 \sum_{i=1}^5 \beta_{1+i} \text{ Control variables } t$
+ Industry indicators + Year indicators + e t.

(Model 1)

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The research uses the proportion of option-based, cash-based and restricted stock compensation granted in the fiscal year to the total compensation in Model 1 and other models other than delta, vega (Coles et al. 2006) and other proxies of CEO option pay used in prior studies, offering an complete view on not only each individual compensation component but also their interaction with each firm risk taking decision directly. This provides a unique approach to optimize CEO compensation structure by proper allocation of resources among the components and conclusions that are more straightforward and easier for cross-section and time comparison for practitioners in the real world.

The research uses R&D expenditure as the measure of discretionary risky investment. The research transforms the dollar amounts of R&D investments into a return measure by dividing each investment with total assets at the end of the fiscal year. This transformation from levels to a return metric allows to comparing R&D investments over time and across sections (Ghosh et al. 2007).

Firm focus is captured by Herfindahl Index, which captures revenue concentration across segments and is calculated as the sum of the square of segment sales divided by the square of firm sales; and Number of Segments (Segments), which is the number of different businesses by SIC code in which the firm operates (Coles et al. 2006).

Since other CEO characteristics and firm specific factors can also affect investment decisions, which in turn might be associated with CEO ownership, the research includes a number of control variables in equation

1. Tobin's Q, as proxy for firm's growth opportunities, which is the sum of the market value of equity and the book value of debt scaled by the book value of total assets. A number of studies find a positive relation between growth and investments (Kaplan & Zingales 1997);
2. Size, as the logarithmic transformation of the fiscal year-end total assets, which is expected to relate to the scale of resources the firm can invest in R&D and support diversification operation. Ghosh et al. (2007) also suggest that large firms tend to be more capable of diversifying risk than small firms;
3. Leverage, as book leverage which is total debts (long-term plus current debts) scaled by total assets, as in Yu (2007);
4. CEO Age. Conyon & Florou (2006) find so-called "horizon effect", meaning that CEOs in their final years of before retirement or departure have incentives to reduce discretionary investments to boost earnings and bonuses. The research controls for the horizon effect by including CEO Age in the model. The age indicator that equals 1 for CEO's age reach or above 63, and 0 otherwise;
5. Cash Flow, as net cash flow from operating activities scaled by total assets since Ghosh et al. (2007) point out that it might be associated with discretionary investments. Cash Flow can also be viewed as a substitution of ROA which is commonly used in prior research due to multicollinearity concern.

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The research also includes industry variables to control for firm fixed effects. Industry is defined using a standard industry classification (SIC) code. Year indicator variables to control for time fixed effects.

The research plans to run Model 1 on each individual compensation component first. While the focus is on stock option as the primary explanatory variable, in subsequent regression, the specifications include all three CEO compensation components jointly with the control variables.

b) CEO option pay level and R&D investment

To test H2, while the research analyses the relation between CEO compensation components and risk taking with Model 1, the research intends to use the model listed below to test whether there is a nonlinear association between CEO's stock option compensation and firm's R&D investment

$$\mathbf{R\&D}_{t+1} = \alpha + 3 \sum_{i=1} \beta_{0+i} \mathbf{Option\ TotalComp\ Level}_t + 3 \sum_{i=1} \beta_{3+i} \mathbf{Option\ TotalComp\ Dummy}_t + 3 \sum_{i=1} \beta_{6+i} \mathbf{Option\ TotalComp\ Level}_t \times \mathbf{Option\ TotalComp\ Dummy}_t + 5 \sum_{i=1} \beta_{9+i} \mathbf{Control\ variables}_t + \mathbf{Industry\ indicators} + \mathbf{Year\ indicators} + e_t$$

(Model 2)

in which the research groups CEO option pay into different categories by its level relative to the total compensation at 25% breakpoint (Opt_TotalComp_25 is from 0 to 25%, Opt_TotalComp_50 is from 25 to 50%, Opt_TotalComp_75 is from 50 to 75%, and Opt_TotalComp_100 is from 75 to 100%). The slope of each individual CEO option pay level can be calculated through the estimated coefficient of the respective cross variable and its own.

This model provides a direct and practical implication for firms to balance their CEO option pay level and R&D intensity, which has not been explored by any previous research.

c) Pre and post FAS 123R CEO option pay and CEO risk taking

To test the second part of H4, the research intends to use the model listed below to examine whether there is a significant change and its direction on the association between CEO's stock option compensation and firm's R&D investment and firm focus

$$\mathbf{Risk\ Taking\ (R\&D,\ Herfindahl\ Index\ \&\ Number\ of\ segments)}_{t+1} = \alpha + \beta_1 \mathbf{Option/TotalComp}_t + \beta_2 \mathbf{FAS\ 123R\ Dummy}_t + \beta_3 \mathbf{Option/TotalComp}_t \times \mathbf{FAS\ 123R\ Dummy}_t + 5 \sum_{i=1} \beta_{3+i} \mathbf{Control\ variables}_t + \mathbf{Industry\ indicators} + \mathbf{Year\ indicators} + e_t$$

(Model 3)

in which FAS 123R dummy variable is set for 1 for post-FAS 123R which is from fiscal year of 2005 to 2009, 0 otherwise. The change of CEO option pay's influence to firm's R&D investment can be determined by the estimated coefficient and significance level of Option/TotalComp and the cross variable.

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This model provides a new observation on firms' CEO stock option compensation and its impact to risky decision making after the implement of FAS 123R, which, based on the existing literature, significantly changed the allocation between stock option and restricted stock compensation.

3.3 Data and Sample Collection

The research uses the "Compustat Executive Compensation - Annual Compensation" (ExecuComp) for data on CEO compensation. ExecuComp provides data on option awards, salary & bonus, restricted stock granted and total compensation for CEO (with CEO flag) for listed firms for the period 1992 to 2009. The research obtains firm-specific information from "CRSP/COMPUSTAT Merged Database-Segments" and "Compustat Quarterly Updates - Fundamentals Annual" database, and firm risk (including standard deviation of stock returns and Beta) information from "CRSP Annual Update: Portfolio Assignments". Data requirements limit the final sample size to a maximum of 27,276 firm-year (observations) although some specifications use fewer observations due to missing data. For example, the research does not include prior year values of CEO compensation components for the fiscal year of 1992, and Compustat Segment data discontinues after 2006.

4. The Findings

4.1 CEO Compensation Components and Investment Policy

The results of firm's R&D regression model 1 (Panel A of Table 1) support the hypothesis H1. Through individual regressions, the estimated coefficient on CEO option-based compensation is positively associated with firm's R&D investment ($\beta=0.031$) with significance level at 1%. The estimated coefficient on CEO cash-based compensation and restricted stock grants are negatively associated with firm's R&D investment ($\beta=-0.024$ and -0.015 respectively) with significance level at 1%. As all three CEO compensation components jointly included in the regression, to avoid any multicollinearity concerns, the research uses unstandardized residual of option-based compensation which delivers a same positively association with R&D at 1% significance level ($\beta=0.036$) while cash-based and restricted stocks remain the negative and significant association with R&D ($\beta=-0.026$ and -0.027 respectively). The results imply that higher proportion of option-based compensation and lower level of cash-based and restricted stock grant would encourage CEO to invest more on R&D activities.

All control variables other than Tobin's Q are negatively related to firm's R&D investment at different significance level (the only exception is CEO Age which is negative but not significant). Tobin's Q is significant at 1% level in all regressions with positive coefficients. The results imply that smaller firms with less financial resources (in term of low cash flow from operations) and more growth opportunities (reflected as high Tobin's Q) tend to allocate more investment dollars to R&D. The "horizon effect" does play certain role in the R&D investment decision, in which CEOs approaching to their retirement age try to stay away from risky R&D investment.

As the results of firm's Herfindahl Index regression model (Panel B of Table 1), all CEO compensation components are as predicted in the hypothesis H3. Through individual regressions, the estimated coefficient on CEO option-based compensation

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is positively associated with firm's Herfindahl Index ($\beta=0.041$) with significance level at 1%. The estimated coefficient on CEO cash-based compensation and restricted stock grants are negatively associated with firm's Herfindahl Index ($\beta= -0.026$ and -0.020 respectively) with cash-based compensation's significance level at 1% (restricted stock grant is not significant). As all three CEO compensation components jointly included in the regression, to avoid any multicollinearity concerns, the research uses unstandardized residual of option-based compensation which delivers a same positively association with Herfindahl Index at 1% significance level ($\beta=0.072$) while cash-based and restricted stocks have negative and significant association with Herfindahl Index ($\beta= -0.029$ and -0.036 respectively). The results imply that higher proportion of option-based compensation and lower level of cash-based and restricted stock grant would encourage CEO to concentrate on fewer product lines resulting in high Herfindahl Index.

Among control variables, Tobin's Q, Leverage, and Cash Flow are positively related to firm's Herfindahl Index at different significance level. Size is significant at 1% level in all regressions with negative coefficients. CEO Age is the only one seems to be insignificant. The results imply that firms which are relatively small and with more growth opportunities tend to be more concentrate.

As the results of firm's number of Segments regression model (Panel C of Table 1), the results of all CEO compensation components support the hypothesis H3. Through individual regressions, the estimated coefficient on CEO option-based compensation is negatively associated with firm's Segments ($\beta=-0.286$) with significance level at 1%. The estimated coefficient on CEO cash-based compensation and restricted stock grants are positively associated with firm's Segments ($\beta=0.211$ and 0.105 respectively) with cash-based compensation's significance level at 1% (restricted stock grant is not significant). As all three CEO compensation components jointly included in the regression, to avoid any multicollinearity concerns, the research uses unstandardized residual of option-based compensation which delivers a same negatively association with Segments at 1% significance level ($\beta= -0.473$) while cash-based and restricted stocks have positive and significant association with Segments ($\beta=0.223$ and 0.227 respectively). The results imply that lower proportion of option-based compensation and higher level of cash-based and restricted stock grant would encourage CEO to become more risk averse and to diversify the business to lower his own risk.

Among control variables, Tobin's Q, Leverage, and Cash Flow are negatively related to firm's Segments at different significance level. Size is significant at 1% level in all regressions with positive coefficients. CEO Age is the only one seems to be insignificant. The results imply that firms which are relatively big and with fewer growth opportunities tend to be more diversified.

In summary, the results demonstrated provide strong empirical evidences to support the hypotheses H1 and H3 to address the contradictory findings in the previous research. The results clearly indicate that there is a positive association between CEO's stock option compensation and firm's R&D investment & firm focus as proxies of CEO risk taking behaviours. On the other hand, there is a negative relation between CEO cash-based & restricted stock compensation and firm's R&D spending & firm focus.

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In order to test for robustness of the results, the research applies various alternatives for endogeneity, including the use of change specifications, lagged option variable and 2-stage least square regression (results available upon request). It is more likely to isolate the direction and magnitude of the causal effects of option compensation on firm's investment policy, and vice versa. Higher option compensation inducing higher risk taking policy. Such effect is substantial in both statistical and economic terms.

4.2 Impact of Different Option Level to Firm's R&D Investment

The research runs the regression model 2 with additional option level dummy and cross variables. The results are reported as (available upon request), Option/Total Comp, representing option level below 25% by default, has a surprisingly negative correlation with R&D ($\beta = -0.018$) at 5% significance level. The rest 3 option level cross variables are positively associated with R&D investment at 1% significance level. The estimated coefficients grow along with the option level, which is 0.049 for option level between 25 to 50%, 0.067 for option level between 50 to 75%, and 0.079 for option level above 75%.

The research then calculates the slope at each option level based on the estimated coefficients generated by the regression model (Table 2). The slope clearly indicate that option awards at very low level (below 25% in the total compensation mix) actually make CEO more risk averse and discourage them to make more risky R&D investment. However, above the 25% breakpoint, option-based compensation starts to provide incentive for CEO risk taking. Such incentive gets strengthened even further along with increase of CEO option level.

As an alternative test, the research runs a separate regression with squared option to total compensation as a new independent variable (results available upon request). The positive and significant relation ($\beta = 0.047$ at 1% significance level) between firm's R&D investment and the square term provides a further support to the hypothesis H2 that there is a non-linear relation between CEO's stock option compensation and firm's R&D investment.

The finding of such non-linear relation between firm's R&D investment & CEO option-based compensation contributes to the existing body of knowledge and has valuable implication to the practitioners in the real business world. Firms should carefully review their CEO compensation package and option-based pay mix together with firms' risk environment. Furthermore, the results and different slope reported here can be used as a constructive reference to optimize CEO compensation structure.

4.3 The Impact of FAS 123R Implementation

The research runs the first test with sample data after fiscal year 2005 suggested by Hayes et al. (2010) through the regression model 1 (Panel A of Table 3). Although the sample size reduced to around 2,600 for R&D test and 1,300 for firm focus test due to relatively short period of time, the results deliver a similar outcome as previous studies. CEO option-based compensation remains its positive association with firm R&D investment ($\beta = 0.030$) and Herfindahl Index ($\beta = 0.063$) at 1% significance level, while its relation to Number of Segments keeps negative ($\beta = -0.711$) and significant at 1% level. The results clearly indicate that stock option still serve as an incentive to

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encourage CEO's to make more risky decisions on R&D investment and firm focus even after the adoption of FAS 123R.

The research adds dummy and cross variable in the second test (Model 3) to observe the impact of FAS 123 implementation to the association of CEO option compensation and risk taking decisions (Panel B of Table 3). Both option-based compensation and its cross variable with FAS 123R (equals to 1 after fiscal year 2005) are significant in the individual regressions except the cross variable with Herfindahl Index. The slope of option-based compensation increase from 0.029 to 0.036 (or by 24%) after FAS 123 implementation in the R&D regression, while the slope in the Segment regression also becomes steeper from -0.254 to -0.739. The results imply that FAS 123R implementation, as an exogenous change to the relation of CEO option compensation and firm's R&D investment and firm focus policy, actually serve as an amplifier to intensify the impact of CEO stock option incentive toward discretionary decisions on risky investment. The results support the hypothesis H4 that there is a significant change of the mix of CEO compensation components pre and post the implementation of FAS 123R. Consequently, such change enhances the relation between CEO stock option compensation and CEO risk taking.

One possible explanation for such observation is that, although option-based compensation may bring "excessive cost" to the firm, it plays an inevitable role to induce CEO risk taking. FAS 123R triggers firm to carefully review pros and cons of CEO option pay under the stress of losing "accounting subsidy to stock options" suggested by Bodie et al. (2003). As a result, the "excessive" portion of CEO option pay has been replaced by other compensation components (mainly restricted stocks). However, for those firms that have to make risky investment, stock option remains an effective incentive to their CEOs.

Therefore, the results demonstrate a real picture for firms to utilize option-based compensation in a more effective and efficient way under necessary circumstance after the implementation of FAS 123R.

5. Summary and Conclusions

In this paper, the research explores the relation between three key CEO compensation components: stock option, cash-based salary and bonus, and restricted stock, and risky discretionary decisions CEO makes in R&D and firm focus. The results of this research provide strong empirical evidences to support the hypotheses to address the contradictory findings on CEO stock option vs. risk taking decisions in the previous research. This research shows that CEO option pay demonstrates a significantly positive association with R&D, firm focus, and standard deviation of stock returns & Beta representing firm risk directly. In contrast, cash-based and restricted stock compensation, as predicted, shows a significantly negative relation to R&D, firm focus, and firm risk directly. Since the primary research focus on stock option compensation, the robustness of option related results is tested through change specification, lagged CEO option pay and 2-stage least square regression using moneyiness as an instrumental variable to predict option component, which delivers similar outcomes.

Furthermore, the research extends the study on CEO option pay to its impact to CEO risk taking on R&D investment through different groups of option to total compensation level with 25% breakpoints. The research finds a non-linear relation between R&D

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investment and CEO option-based compensation level with practical implications, which has not been explored by previous studies.

Due to the significant change caused by the implementation of FAS 123R mandating expensing option-based compensation in 2005. The research conducts further study on CEO stock option and discretionary risk taking decisions, and find that CEO option pay maintains and even reinforces its significantly positive relation to firm's R&D investment and firm focus. Such recent empirical evidence demonstrates that stock option continues to be an effective and efficient risk taking incentive to CEO though it has been partially replaced by restricted stock following the implementation of FAS 123R and contributes to the existing body of knowledge in this area.

Through the research, it uses the proportion of option-based, cash-based and restricted stock compensation respectively and jointly in different models, which provides an angle to observe not only each individual compensation component but also their interaction with each firm risk taking decision directly. By doing so, the results are more straightforward and easier for cross-section and cross-time comparison, offering a unique approach for practitioners in the real business world to optimize CEO compensation structure through resource allocation among the compensation components.

The research has the limitations of its study and possible direction for future research.

First, with focus on the fraction of CEO compensation components and option pay level (option pay to the total compensation), the research did not examine the details of CEO stock option plans, whose key elements (i.e. moneyness, the vesting period, frequency of grants, and expiration date) may also impact the relationship the research has observed. The future research might be conducted in the detail design of stock option compensation plans to use the findings as a starting point to explore how these key elements in option plans can lead to better outcomes.

Second, as prior literature and data analysis preparation work (results not reported in this paper) indicate there is an opportunity to explore how the effects and effectiveness of CEO stock options might be changed under different industrial conditions or contexts. All the regressions runs in this paper included industry dummy variables to control industry-level fix effects. The research notices the differentiation of estimated coefficients of different industry dummy variables. The future research might include cross variable to examine the interaction of industry contextual conditions, CEO compensation components and the risk taking decisions in R&D and firm focus.

The third direction for the future research might be to examine how corporate governance's possible association with the design of CEO stock option awards suggested by Choudhary et al. (2009). The future research might be focus on both internal and external governance.

Nevertheless, executive compensation, especially stock option awards have been getting more attention, not only in the business world, but also from the general public, particularly since the recent global financial crisis. The findings of this study provide updated empirical evidence to the academics and practitioners in this area.

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Table 1: Regression of firm investment policies on CEO compensation components

This table reports the estimated coefficients from regressing firm's R&D of year t+1 on various independent variables, in which *R&D t+1* is Research and Development Expense of year t+1 / Total Assets, *Herfindahl t+1* is the sum of the square of the net sales from each segment / the square of total firm net sales, *Segments t+1* is total number of SIC code at segment level, *Option/Total Comp* is Options Granted (Compustat Black Scholes value or fair value at grant date) / Total Compensation, *Residual of Option/Total Comp* is Unstandardized Residual from regressing Option/Total Comp on Salary+Bonus/Total Comp & Restricted Stocks/Total Comp, *Salary+Bonus / Total Comp* is Total Current Compensation (Salary + Bonus) / Total Compensation, *RSK/Total Comp* is Restricted Stock Grant (\$) / Total Compensation, *TobinQ* is (Close Stock Price by the end of Fiscal Year t * Common Shares Outstanding + Long-Term Debt + Debt in Current Liabilities)/ Total Assets, *Size* is ln(Total Assets), *Leverage* is (Long-Term Debt + Debt in Current Liabilities)/ Total Assets, *CEO Age* is 1 if the CEO of firm in year t is 63 or older, and 0 otherwise, and *Cash Flow* is Net Cash Flow from Operating Activities / Total Assets. (1), (2), and (3) are regressions on individual compensation component separately, and (4) is regression on all three components jointly. t-statistics are reported in italics. *, **, and *** indicate significance at 10%, 5%, and 1% levels respectively.

Table 2: Slope of different level of Option/Total Comp toward firm's R&D investment

This table reports the results of slope change with different level of CEO stock option pay level. I divide the sample into four categories per 25% breakpoint of option grant value relative to CEO total compensation, in which *Opt TotalComp 25* is from 0 to 25%, *Opt TotalComp 50* is from 25 to 50%, *Opt TotalComp 75* is from 50 to 75%, and *Opt TotalComp 100* is from 75 to 100%. The definitions of other variables are as follows: *R&D t+1* is Research and Development Expense of year t+1 / Total Assets, *Option/Total Comp* is Fair Value of Option Granted / Total Compensation. t-statistics are reported in italics. *, **, and *** indicate significance at 10%, 5%, and 1% levels respectively.

Table 3: Regression of firm investment on CEO option awards post FAS 123R

This table reports the estimated coefficients from regressing firm's R&D and firm focus decisions of year t+1 on CEO option to the total compensation and other control variables after the implementation of FAS 123R, in which *FAS 123R* as a dummy variable (1 for post-FAS 123R which is from fiscal year of 2005 to 2009, 0 otherwise), *Opt FAS123R* is a cross variable which equals to Option/Total Comp X FAS 123R dummy variable. t-statistics are reported in italics. *, **, and *** indicate significance at 10%, 5%, and 1% levels respectively.

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Table 1: Panel A - Dependent Variable: R&D t+1

Independent Variables	(1)			(2)			(3)			(4)		
	B	t	Sig.									
(Constant)	.118	23.058	***	.147	27.485	***	.129	24.910	***	.145	25.875	***
<u>CEO Compensation</u>												
Option/Total Comp	.031	19.806	***									
Residual of Option/Total Comp										.036	10.224	***
Salary+Bonus/Total Comp				-.024	-14.651	***				-.026	-14.908	***
RSK/Total Comp							-.015	-3.679	***	-.027	-6.594	***
<u>Control Variables</u>												
TobinQ	.002	12.337	***	.002	12.288	***	.002	10.068	***	.002	10.516	***
Size	-.006	-21.985	***	-.007	-23.002	***	-.006	-18.042	***	-.006	-19.502	***
Leverage	-.036	-14.246	***	-.038	-15.047	***	-.042	-15.398	***	-.039	-14.120	***
CEO Age	-.002	-1.686	*	-.003	-2.494	**	-.005	-4.297	***	-.002	-1.540	
Cash_Flow	-.082	-19.674	***	-.082	-19.529	***	-.093	-21.025	***	-.089	-20.174	***
Industry Fixed Effects		Included			Included			Included			Included	
Time Fixed Effects		Included			Included			Included			Included	
Observations		12,137			12,137			10,658			10,388	
Adjusted R Square		.398			.398			.388			.404	

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Table 1: Panel B - Dependent Variable: Herfindahl Index t+1

Independent Variables	B	(1) <i>t</i>	Sig.	B	(2) <i>t</i>	Sig.	B	(3) <i>t</i>	Sig.	B	(4) <i>t</i>	Sig.
(Constant)	1.188	62.368	***	1.216	60.316	***	1.185	65.222	***	1.207	59.352	***
<u>CEO Compensation</u>												
Option/Total Comp	.041	6.111	***									
Residual of Option/Total Comp										.072	5.267	***
Salary+Bonus/Total Comp				-.026	-3.799	***				-.029	-4.118	***
RSK/Total Comp							-.020	-1.294		-.036	-2.283	**
<u>Control Variables</u>												
TobinQ	.009	10.824	***	.009	11.145	***	.009	11.522	***	.009	10.682	***
Size	-.051	-42.041	***	-.052	-40.919	***	-.051	-41.440	***	-.051	-39.268	***
Leverage	.020	2.142	**	.016	1.683	*	.017	1.819	*	.019	1.993	**
CEO Age	-.005	-1.128		-.007	-1.474		-.010	-2.118	**	-.003	-.657	
Cash_Flow	.037	2.194	**	.035	2.106	**	.033	1.973	**	.038	2.248	**
Industry Fixed Effects		Included			Included			Included			Included	
Time Fixed Effects		Included			Included			Included			Included	
Observations		17,898			17,944			18,069			17,671	
Adjusted R Square		.206			.204			.204			.206	

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Table 1: Panel C - Dependent Variable: Segments t+1

Independent Variables	(1)			(2)			(3)			(4)		
	B	t	Sig.									
(Constant)	-.777	-6.443	***	-.993	-7.788	***	-.779	-6.773	***	-.931	-7.240	***
<u>CEO Compensation</u>												
Option/Total Comp	-.286	-6.694	***									
Residual of Option/Total Comp										-.473	-5.443	***
Salary+Bonus/Total Comp				.211	4.859	***				.223	4.962	***
RSK/Total Comp							.105	1.082		.227	2.280	**
<u>Control Variables</u>												
TobinQ	-.050	-9.392	***	-.050	-9.712	***	-.050	-10.302	***	-.049	-9.180	***
Size	.382	49.510	***	.384	48.251	***	.375	48.853	***	.377	46.634	***
Leverage	-.170	-2.846	***	-.134	-2.239	**	-.138	-2.328	**	-.151	-2.514	***
CEO Age	.004	.145		.012	.398		.031	1.011		-.014	-.457	
Cash_Flow	-.282	-2.679	***	-.265	-2.525	**	-.247	-2.377	**	-.294	-2.790	***
Industry Fixed Effects		Included			Included			Included			Included	
Time Fixed Effects		Included			Included			Included			Included	
Observations		18,034			18,077			18,207			17,804	
Adjusted R Square		.270			.268			.268			.270	

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Table 2: Dependent Variable: R&D t+1

	Opt_TotalComp_25	Opt_TotalComp_50	Opt_TotalComp_75	Opt_TotalComp_100	Option/Total Comp
Number of Firm	13,341	6,659	4,565	2,120	26,685
Year	50%	25%	17%	8%	100%
Slope	-0.018	0.031	0.049	0.060	0.031

Table 3: Panel A - CEO option awards and firm's investment policies post FAS 123R

Dependent Variable: Independent Variables	R & D t+1			Herfindahl Index t+1			Segments t+1		
	B	t	Sig.	B	t	Sig.	B	t	Sig.
(Constant)	.088	13.144	***	1.068	22.051	***	-.001	-.003	
<u>CEO Compensation</u>									
Option/Total Comp	.030	8.436	***	.063	2.296	**	-.711	-3.723	***
<u>Control Variables</u>									
TobinQ	.008	11.424	***	.027	4.505	***	-.146	-3.498	***
Size	-.005	-7.935	***	-.048	-9.936	***	.403	12.368	***
Leverage	-.027	-5.341	***	.026	.665		-.397	-1.490	
CEO Age	.000	.107		-.017	-.952		.105	.841	
Cash_Flow	-.059	-6.723	***	-.001	-.015		-.020	-.046	
Observations		2,658			1,320			1,334	
Adjusted R Square		.389			.181			.210	

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Table 3: Panel B - Pre & Post-FAS 123R comparison of firm's investment policy and CEO option incentive

Dependent Variable:	R & D t+1			Herfindahl Index t+1			Segments t+1		
Independent Variables	B	<i>t</i>	Sig.	B	<i>t</i>	Sig.	B	<i>t</i>	Sig.
(Constant)	.118	23.114	***	1.188	62.383	***	-.785	-6.513	***
TobinQ	.002	12.340	***	.009	10.823	***	-.050	-9.393	***
Size	-.006	-21.998	***	-.051	-42.032	***	.381	49.496	***
Leverage	-.036	-14.269	***	.020	2.139	**	-.170	-2.851	***
CEO Age	-.002	-1.694	*	-.006	-1.150		.006	.194	
Cash_Flow	-.082	-19.712	***	.036	2.153	**	-.272	-2.588	***
FAS123R	-.005	-1.140		-.087	-5.072	***	1.077	9.946	***
Option/Total Comp	.029	17.365	***	.039	5.583	***	-.254	-5.758	***
Opt_FAS123R	.007	1.710	*	.035	1.349		-.485	-2.943	***
Observations		12,137			17,898			18,034	
Adjusted R Square		.398			.206			.270	

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