The effect of CEO incentive pay on firm policy and firm value

ERASMUS UNIVERSITEIT ROTTERDAM
ERASMUS SCHOOL OF ECONOMICS

Jessica Frederique Rog

359184

Supervisor: Prof. dr. I. Dittmann

Second Assessor: Dr. M. Montone

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ABSTRACT

In this research I investigate the effects of CEO incentive pay on firm policy and firm value over a period of 22 years. I incorporate the difference in capital structure and the personal characteristics that can proxy for risk aversion. My results indicate that risk-taking incentives have a positive effect on R&D investments but a negative effect on capital expenditures. Pay to performance sensitivity has a negative effect on capital expenditures but no effect on R&D investments. CEO incentive pay has a negative influence on book leverage. CEO risk-taking incentives have less influence on R&D investments when the firm is highly equity dependent. Pay to performance sensitivity has a negative effect on capital expenditures for the least equity dependent firms but a positive effect for the most equity dependent firms. A higher education negatively influences the effect of the CEO risk-taking incentive on R&D investments and book leverage. Pay to performance sensitivity has a positive effect on firm value whereas the CEO risk-taking incentive gives opposing results.

Keywords: CEO incentive pay, CEO risk-taking behavior, executive compensation, capital structure, CEO characteristics, the agency cost of debt, the principal agent problem, firm value, corporate governance, the agency cost of equity.

PREFACE

This thesis is my final project for the Master of Science in Financial Economics at the Erasmus School of Economics. During this master I was able to develop my statistical skills and to gain insights in the world of finance. The behavioral part of finance was for me the most interesting part because it gave me an opportunity to mix my mathematical skills with my interests in human behavior. Prof. Dr. I. Dittmann made me familiar with the world of CEO's and their behavior when he offered me a job as research assistant, which eventually led me to choose my thesis topic in this field of research. I am thankful for his remarks, comments regarding my thesis and his quick responses. Moreover, I thank my other professors for their lectures that I enjoyed very much. Due to these lectures it was possible for me to make a bridge between academic insights and the real finance world.

I would also like to thank my mother for the endless conversations in the park, my father for the heads up and remembering me what I really want and my sister who is always able to put a smile on my face. Last but not least, Robert-Jan thank you for always putting up with me, bringing me back to reality when I am not able to do so and loving me for the crazy person I can be.

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INTRODUCTION

"Only those who will risk going too far can possibly find out how far one can go."

- T.S. Eliot

"A ship is always safe at the shore - but that is not what it is built for."

- A. Einstein

The risk taking behavior of a person can have positive but also negative effects in life. Sometimes, taking a risk can lead to new and exiting things but it can also lead to losses and regret. This is not only the case in daily life but also in finance and more specific in the decisions CEO's of U.S. companies need to make. A firm has many different stakeholders and they all require a different level of risk. Corporate governance tries to guide the CEO towards a good level of risk taking behavior by designing a compensation contract that not only consists of a base salary but also consists of incentive-based pay. This thesis investigates what the effects of incentive-based pay on firm policy and firm value are. My research tries to answer the following question: ‘‘is incentive-based pay influencing the risk taking behavior of the CEO and value of the firm?‘’

Previous research already established a relationship between risk taking behavior and CEO incentive-based pay (Coles, Daniel & Naveen, 2006). However, after the enactment of the Sarbanes Oxley Act in 2002 and the implementation of new accounting regulations regarding stock options the results are not tested again. CEO incentive pay is implemented to minimize the agency cost of equity. This agency cost addresses the misalignment of interests and information between shareholders and managers. However, as stated above, there are more stakeholders besides shareholders that have interests in the firm. These other stakeholders are, among others, debtholders. The debtholders can have a conflict with the shareholders, resulting in the agency cost of debt. The board of directors need to find a way to minimize these agency costs by designing an optimal compensation contract for the CEO. Moreover, not only incentive-based pay can have an influence on firm value and the risk taking behavior of the CEO. Risk aversion proxies such as education, having a family or gender can also affect the actions of a CEO.

I analyze the effects of CEO incentive pay on risk taking behavior for a dataset from 1992 up to and including 2014. Risk taking behavior is analyzed by analyzing the investments in R&D, the capital expenditures and the level of book leverage. I also look at the differences of risk taking behavior for the most and least equity dependent firms based on the Kaplan Zingales index. Moreover, I investigate the effects of CEO incentive based pay on firm value measured by Tobin's Q in the next year. Lastly, I look at personal CEO characteristics that can affect the risk taking behavior of a CEO for a cross sectional dataset.

The measures I use for CEO incentive pay are *Vega* and *Delta*. *Delta* is the dollar change in CEO's wealth when the stock price of a firm changes 1%. *Vega* is the dollar change in CEO's wealth when the stock return's volatility changes 0.01. *Delta* is the pay to performance sensitivity of a CEO and can lead to less risk taking behavior. *Vega* is the factor that positively influences the risk taking behavior of the CEO and is assumed to be 0 for the share portfolio of the CEO (i.e. it only influences the stock options of the CEO). I also include the *Excess Vega* and *Excess Delta* to minimize the endogeneity issue. *Excess Vega* and *Excess Delta* are the difference between the predicted and observed *Vega* and *Delta*.

My empirical findings do not show the same results as Coles et al. (2006) concerning the risk taking behavior of CEO's and their incentive-based pay. I do find that *Vega* has a positive effect on R&D investments but I do not find a negative effect of *Delta* on R&D investments. This means that the pay to performance sensitivity does not have an effect on the risk taking behavior of the CEO. Ross (2004) argues that this can be due to the fact that when a compensation package changes, the way a CEO evaluates his wealth is from a different perspective of his or hers utility function. This change of perspective implies that when *Vega* or *Delta* changes the effect on his risk aversion does not need to be necessarily as what the literature from Coles et al. (2006) assumes. *Vega* has a negative effect and *Delta* a positive effect on capital expenditures, which is in line with Coles et al. (2006). I find that CEO incentive based pay, both *Vega* and *Delta,* have a negative effect on book leverage. The negative effect of CEO incentive pay on book leverage can be explained by the agency cost of debt. After the change in accounting rules in the United States the use of stock options declined. This decline in stock options granted to CEO's might be another factor that causes the results to differ between this analysis and the research from Coles et al. (2006).

I find a less positive effect of *Vega* on R&D investments for the firms belonging to the highest equity dependent quintile based on the Kaplan Zingales index. Furthermore, I find a negative effect of *Delta* on capital expenditures for the lowest quintile but a positive effect of *Delta* on capital expenditures for the highest quintile. These results imply that after dividing the sample into quintiles the opposite of the agency cost of debt is found regarding the risk taking incentive (i.e. less influence of *Vega* on R&D investments). However, the results regarding the pay to performance sensitivity can be explained by the agency cost of debt (i.e. the effect of *Delta* is more pronounced for the most equity dependent firms). I do not find a different effect of *Vega* or *Delta* on book leverage for the most or least equity dependent firms. The different types of debt a firm can adopt such as convertible and straight debt could be an explanation for the other findings than the agency cost of debt hypothesis prescribes (Ortiz- Molina, 2007).

Using firm fixed effects *Vega* has a negative effect on firm value and *Delta* a positive effect. Using industry fixed effects both *Vega* and *Delta* have a negative effect. Pasterneck & Rosenberg (2002) find a positive effect of *Vega* and *Delta* on firm value for a Finnish dataset and Shen & Zhang (2013) find a relation between *Vega* and firm performance. As far as I know, there is no research been done to the different effects of *Vega* and *Delta* on firm value in the United States. However, it has to be taken into account that in the analysis of the effect of ownership on firm value both variables possibly are endogenously determined by the same observable and unobservable exogenous factors (Himmelberg, Hubbard & Palia, 1999).

The results for the cross sectional dataset indicate that when the CEO has obtained a MBA the effect of *Vega* on R&D investments is negative but the effect of *Delta* on R&D investments is positive. Moreover, when the CEO has obtained a MBA the effect of *Vega* on book leverage is negative but the effect of *Delta* on book leverage is positive. This implies that having obtained a MBA decreases the risk taking behavior of the CEO since the CEO incentive pay has less influence on R&D investments and book leverage. In contrast, the risk taking incentive has more influence on R&D investments and book leverage if the CEO has obtained a MBA. This implies that having a MBA makes the CEO more risk averse. The results indicate that other risk aversion proxies are also interesting to investigate in further detail on a larger scale because these variables are purely exogenous. Research such as Brenner (2004) and Chiapporri & Reny (2005) find a relation between being married and risk aversion. Furthermore, Riley Jr. & Chow (1992) and Guiso & Paiella (2008) show that a higher education leads to lowering risk aversion. My research contributes to this existing literature by looking if education and family affect the effects of *Vega* and *Delta* on the firm policy measures and if they have an effect themselves on the policy measures (i.e. risk-taking behavior).

In practice the results of my thesis can help the board of directors by designing the compensation contracts for CEO's. It shows in what way CEO incentive pay influences the investment decisions and the adopting of leverage by the CEO. As shown by the results, CEO incentive pay has an effect on firm value. The board of directors need to look at the personal characteristics of the CEO because they can also have an influence on the R&D investments, capital expenditures and level of book leverage. Moreover, the results are interesting for shareholders and debtholders because they can take into account the current CEO incentive pays incorporated in the contract of a CEO and predict in which direction the investments will move as well as what this means for firm value.

The remainder of the thesis is organized as follows. Section 2 discusses the theoretical background. It examines the previous established research concerning CEO incentive based pay. Section 3 provides the hypothesis development. Section 4 gives information about the data and methodology. It gives an analysis of the construction of the dataset and from where the data is retrieved. Furthermore, this section discusses which regression models are used to answer the hypotheses. Section 5 analyses the empirical results and shows the regression tables. Section 6 gives a summary of the thesis and discusses the implications and recommendations concerning the thesis.

2. LITERATURE REVIEW

In this section I explain related research and previous findings concerning CEO incentive pay, CEO risk taking behavior, the effects of capital structure and the implications of CEO incentive pay for firm value. I start with discussing the principal agent problem and how CEO incentive pay may mitigate this problem by influencing CEO risk taking behavior. Secondly, I explain which CEO- and firm characteristics can affect firm policy and the risk taking behavior of the CEO. Moreover, I discuss the agency cost of debt and how it may affect the relation between CEO incentive pay and CEO risk taking behavior. Lastly, I discuss the effect of CEO incentive pay on firm value.

2.1 The principal agent problem

Since the scandals of Enron and Worldcom around the 2000's corporate governance got more attention than ever before. The Sarbanes Oxley Axt (SOX) got enacted in the United States in 2002. This act sets stricter requirements on executives and the board of directors of publicly traded firms. Moreover, it gives a guideline for better internal control and a better auditing process (Coates, 2007). Recently, the Volkswagen scandal called 'Dieselgate' and the fraud of Sepp Blatter, former leader of the FIFA, are examples of failing corporate governance. The definition of corporate governance is, following Shleifer and Vishny. "The ways in which suppliers of finance to corporations assure themselves of getting a return on their investment" (Shleifer & Vishny, 1997). Because the shareholders cannot strictly monitor all the actions of the managers there exists an information asymmetry between the shareholders and the managers of the firm. This problem was already addressed by Adam Smith in 1776 in his 'Wealth of Nations" and is called the principal agent problem.

The principal agent problem addresses the problem shareholders (principals) have in how to monitor managers (agents) in such a way that the manager acts in the best interest of the shareholders. Information asymmetry between the shareholders and the managers can lead to adverse selection and moral hazard. Both moral hazard and adverse selection ultimately lead to suboptimal investment decisions and lower firm value (Akerlof, 1970). The misalignment of information and interests of managers and shareholders is called the agency cost of equity hypothesis.

2.2 The agency cost of equity, CEO incentive pay and firm policy

Internal governance mechanisms and external governance mechanisms are designed to help overcome the agency cost of equity. Examples of internal governance mechanisms are the board of directors and the ownership structure. Examples of external governance mechanisms are the takeover market and the legal system (Denis & McConnell, 2003). In the United States the board of directors designs the compensation contract of the CEO. The CEO compensation package not only contains a base salary but also consists of bonuses, stock options, restricted stock and long-term incentive plans (Murphy, 2012). Stock options and restricted stock are both incentive-based pay. Stock options can be seen as regular call options that become vested over time and that are non-tradable. Restricted stock also becomes vested over time. Furthermore, firms place restrictions on the vesting of the stock and options. An example of these restrictions is meeting performance targets.

By paying executives in stock options, performance related bonuses and specific incentive schemes the interests of executives align better with the interests of the shareholders than when firms only pay a base salary (Becht, Bolton, & Roell, 2002). It is a way to incentivize managers to create long-run shareholder value. The board of directors can design a compensation contract in such a way that it aligns the interest of shareholders and managers. The variable part of the compensation of the CEO can influence the behavior of a CEO and his decisions regarding investment policy. This is called the incentive part of the compensation.

To measure the effects and implications of this incentive zone Coles, Daniel & Naveen (2006) use two variables: (1) the *Delta* that captures the pay-performance sensitivity and (2) the *Vega* that captures the risk-taking incentive. The calculations of Coles et al. (2006) are based on the calculations of Core & Guay (2002). *Vega* and *Delta* can have opposite effects and therefore the board of directors needs to find an optimal mix between the two incentive measures. *Delta* is the alignment of interests between shareholders and CEO's but the *Delta* can also have a negative effect on the alignment of interests. A high *Delta* also means that the CEO is less diversified than other shareholders and this can lead to less risk taking behavior, which is not good for the firm and the other shareholders. Instead of solving the agency cost of equity it becomes a bigger problem. On the contrary, *Vega* causes the CEO to take more risk because the CEO is only rewarded for the upside potential of risk and not punished for the downside potential of risk when he or she receives call options from the firm since the *Vega* for the equity portfolio is assumed to be 0 (Guay, 1999). The mix of *Vega* and *Delta* can cause the agency costs of equity to decrease.

Previous established research finds evidence for the risk increasing incentive of a high *Vega* and the risk decreasing incentive of a high *Delta* (Coles et al., 2006). The risk-taking behavior is measured by looking at the effect of *Vega* and *Delta* on firm policy measures.

Vega has a positive effect on R&D investments and book leverage but a negative effect on capital expenditures since the CEO becomes less risk averse. A higher *Delta* leads to lower R&D investments, higher capital expenditures and lower leverage since the CEO becomes more risk averse. Nam, Ottoo & Thorton (2003) also find a positive effect of *Vega* on R&D investments and leverage. Low (2009) shows that *Vega* is an efficient mechanism to lower risk aversion of CEO's. Datta, Iskandar-Datta and Raman (2001) show that high equity-based compensated CEO's are more involved in risk increasing acquisitions. Ryan & Wiggins (2002) show that stock options positively influence R&D investments but that restricted stock negatively influences R&D investments. Furthermore, stock options in the banking sector induce risk taking of managers (Chen, Steiner & Whyte, 2006). Rajgopal & Shevlin (2002) find that stock options can reduce risk related incentive-problems.

2.3 CEO- and firm specific characteristics and firm policy

When measuring the effect of CEO incentive pay on firm policies that relate to the level of risk taking of a CEO Coles et al. (2006) incorporate CEO characteristics that are related with risk and therefore can possibly influence the firm policy measures. These CEO-specific variables are age, tenure and cash compensation. Tenure has a positive effect, both on firm performance and risk taking behavior (Brookman & Thistle, 2009; Chen & Zheng, 2014). In contrast, Berger et al. (1997) find that tenure is negatively related to risk taking behavior because the CEO is more entrenched when he or she has a longer tenure. Previous studies show an influence of age on risk taking behavior. Palsson (1996) finds a positive relation between risk aversion and age, indicating that older people take less risk. Cash compensation depends not directly on the performance of the firm, which could lead to higher risk-taking behavior (Jensen & Murphy, 1990).

Besides the CEO characteristics above, which are included by Coles et al. (2006) previous established research also suggests other personal characteristics that can affect CEO risk taking behavior. Behavioral economics is concerned with the research regarding the risk aversion of agents. For example, the prospect theory developed by Kahneman & Tversky (1979) tries to explain the decision making of people under risk. They argue that people have different perspectives regarding losses and gains. The human behavior is subject to biases such as narrow framing and myopic loss aversion. I will not go any deeper into this aspect of behavioral economics but I think it is worth noting that next to CEO incentive based pay there are more factors influencing the risk aversion of the CEO. Research shows that education and private circumstances can affect risk-taking behavior (May, 1995; Faccio, Marchica & Mura, 2006). Studies such as Hartog, Ferrer-i-Carbonell & Jonker (2002) and Jianakoplos & Bernasek (1998) have found a relationship between gender and risk taking behavior. Barber & Odean (2001) find that men are more overconfident in their stock investments. Risk aversion is lower for higher educated persons (Riley Jr. & Chow, 1992) and risk aversion decreases with years of education (Guiso & Paiella, 2008). Moreover, having a family can lead to higher risk aversion (Halek & Eisenhauer, 2001).

Firm specific characteristics can also influence the firm policies. Previous research has established a relationship between several firm specific characteristics and the firm policy measures used for measuring risk-taking behavior (i.e. R&D investments, capital expenditures and book leverage). *Cash Flow* has a positive effect on R&D investments (Gilchrist & Himmeberg, 1995). Moreover, according to the pecking order theory managers prefer internal cash flow for their investments above debt- or equity issuance (Myers, 1984). Both Coles et al. (2006) and Rajgopal & Shevlin (2002) use *Return-on-Assets* as a control variable in the examination of the relation between CEO-incentive pay and risk taking behavior. *Return-on-Assets* is an indicator of performance. It shows how much profit a firm generates related to its investments in assets. *Firm Size* has a positive effect on the policy measures and on CEO incentive pay (Schaefer, 1998; Baker & Hall, 2002). *Market-to-Book ratio* is able to explain current leverage ratios (Chen & Zhao, 2004) and is incorporated by Coles et al. (2006) as control variable.

2.4 Capital Structure and CEO incentive pay

The literature described in section 2.2 finds evidence for a direct link between CEO incentive pay and the risk taking behavior of the CEO. The different levels of *Vega* and *Delta* that the board of directors use to design an optimal contract in which they influence the risk taking behavior of the CEO can lead to lower agency costs of equity. However, in most firms not only shareholders have interests in the firm but also debtholders have interests in the firm.

The capital structure of a firm is different for every firm and there are several theories trying to explain the optimal capital structure for a firm[1]. Firms finance their operations with both internal financing but also with external financing. External financing can be debt or equity. The agency cost of debt arises when the interest of shareholders and debtholders are not aligned. Shareholders require more risk while debtholders prefer safer investments to be guaranteed that they get their money back in case of financial distress (Murphy, 2012). In

[1] Theories that try to explain the capital structure of firms are for example the Modigliani Miller irrelevance theory, the pecking order theory, the agency theory and the trade-off theory (Myers, 2003).

most cases, the debtholders impose restrictions in the debt covenants to be protected against CEO's that take too much risk which could maybe eventually lead to bankruptcy. These restrictions are called debt constraints. Due to these restrictions the effects of *Vega* and *Delta* can be different because the debt constraints can have an effect on the behavior of a CEO.

Debtholders require greater liquidity from firms when the CEO has a high *Vega* to decrease his risk-taking behavior (Liu & Mauer, 2011) and stock options are implemented less when the agency cost of debt is high (Ortiz-Molina, 2004). DeFusco, Johnson & Zorn (1990) find a negative reaction of the bond market and a positive reaction from the stock market after the announcement of a new CEO incentive plan. CEO's that are more entrenched are less likely to adopt higher levels of debt (Berger, Ofek & Yermack, 1997). Lewellen (2006) finds that for firms where the CEO has a large option portfolio the volatility costs of debt tend to increase. The volatility costs of debt are the increase in stock volatility when more leverage is adopted. Some research even argues that debt needs to be part of CEO pay (Edmans & Liu, 2011; Sundaram & Yermack, 2007).

2.5 Firm value and CEO incentive pay

Sections 2.1, 2.2 and 2.4 discuss the agency cost of debt hypothesis and the agency cost of equity hypothesis. The board of directors tries to minimize the agency cost of equity by designing a contract in such a way that the CEO takes the best level of risk, which maximizes firm value. The optimal level of CEO incentive pay is a mix of *Vega*, which increases risk-taking behavior, and *Delta,* which decreases risk-taking behavior. However, as sections 2.1 up to 2.4 show, the agency cost of debt, personal characteristics or firm characteristics can be other factors that play a role in the risk taking behavior of CEO's. Next to the relations between CEO incentive pay and firm policy there is also research been done to effects of CEO incentive pay on firm performance and firm value. Is the board of directors successful in determining the optimal levels of *Vega* and *Delta* to maximize firm value or is one of the effects too high and is the optimal mix not constituted? A high *Vega* can lead to too much risk taking behavior while a too high *Delta* can lead to too less risk taking behavior.

Vega and *Delta* as measures of CEO incentive pay in relation to firm policy and firm value is used in previous established research (Low, 2009; Armstrong & Vashishtha, 2012; Liu & mauer, 2011). For a Finnish dataset Pasternack & Rosenberg (2002) find a positive effect of *Vega* and *Delta* on firm value measured by Tobin's Q. Habib & Ljunggvist (2005) show that a lower firm value can be due to the large amounts of stock options that a CEO receives and the fact that the CEO receives too little shares. Benson & Davidson III (2009) find an inverted

U-shape for the relation between CEO incentive pay and firm value. Shen & Zhang (2013) and Kato et al. (2005) find a positive effect of stock option compensation on firm performance. Other firm specific characteristics can also influence firm value such as *Leverage* that has a negative effect on Tobin's Q (Mehran, 1995). R&D investments have a greater effect on Tobin's Q when firm size is higher (Connolly & Hirschey, 2005). *Return-on-Assets* is a measure of performance and can positively affect Tobin's Q (i.e. firm value).

3. HYPOTHESIS DEVELOPMENT

My research investigates five hypotheses related to the discussed literature in section 2. First I extend the research from Coles et al. (2006). They find a positive effect of *Vega* on both *Innovation* and *Leverage* but a negative effect on a firm's *Capital expenditures.* Their findings are the opposite for *Delta.* Their dataset covers the period ranging from 1992 up to and including 2002. In 2002 the Sarbanes Oxley Act got enacted. This act sets stricter requirements on executives and the board of directors of publicly traded firms and gives a guideline for better internal control and a better auditing process (Coates, 2007). Moreover, in 2006 the accounting rules for stock options changed. From 2006 on fair value accounting is obligatory and the options awarded to a CEO need to be expensed on the balance sheet of a given year[2]. In the pre-2006 period it was not obligatory to expense the options when the options where out-of-the-money. Both regulation changes (i.e. enacting of the Sarbanes Oxley Act and the FASB 123(R)) can result in different outcomes regarding CEO incentives and their effect on risk taking behavior of the CEO. The change in accounting rules caused a decline in the use of stock options and an increase in the use of restricted stock and restricted stock units (Balsam, O'Keefe, & Wiedemer (2007); Hayes, Lemmon & Qiu, 2012)). The enactment of the SOX caused a decline in the ratio between equity compensation and base salary. Moreover, the R&D investments and capital expenditures declined after the enactment of the SOX (Cohen, Dey & Lys, 2004). I extend the research of Coles et al. (2006) to a period ranging from 1992 to 2014.

- *H1: A higher Vega influences firm's Innovation and Leverage positively but Capital Expenditures negatively.*
- *H2: A higher Delta influences firm's Innovation and Leverage negatively but Capital Expenditures positively.*

Both hypotheses are in line with the general risk hypotheses, as addressed by Coles et al. (2006), that states that a higher *Vega* results in higher levels of risk taking by CEO's and a higher *Delta* results in less risking taking behavior by CEO's. R&D investments (i.e. *Innovation*) are riskier than investments in capital expenditures (Kothari, Laguerre & Leone, 2002). A higher level of leverage increases the variance of equity returns (i.e. firm risk) (May, 1995).

Secondly, debtholders and shareholders display, most of the time, different interests. Debtholders prefer safer investments than shareholders. Debt has constraints because

[2] More information about the new accounting rules implemented in 2006 can be found in the *Statement of Financial Accounting Standard No. 123 (FASB123).*

debtholders want to receive interest payments and at the end of the lending period they want to receive their money back. These debt constraints can lead to a less risky firm policy of the CEO. For example, Shi (2003) finds that debtholders perceive R&D investments as risk increasing attributes due to the high variance in future cash flows. Moreover, debtholders require higher cash holdings when the firm has adopted high levels of *Vega* because this can result in more risk taking behavior (Liu & Mauer, 2011). Kaplan and Zingales (1997) construct an index to measure how equity-dependent firms are. To extend my research I check whether there is an influence of the debtholders and their requested debt constraints on the findings from hypotheses 1 and 2. I divide the database into quintiles based on the Kaplan and Zingales index. I expect that the influence of CEO incentive pay on investments is more pronounced for more equity-dependent firms since CEOs in equity-dependent firms are less likely to be constraint by debtholders.

- *H3: The effects of Vega and Delta on Innovation, Leverage and Capital Expenditures are more pronounced for more equity-dependent firms.*

Thirdly, I want to investigate what the levels of *Vega* and *Delta* mean for firm value. McConnell and Servaes (1990) find a curvilinear relationship between equity ownership and firm value measured by Tobin's Q. Pasternack & Rosenberg (2002) find a positive effect of *Vega* and *Delta* on firm value (i.e. Tobin's Q) for a Finnish dataset. Shen & Zhang (2013) find a positive effect of *Vega* on firm performance, measured by abnormal stock returns. Asset pricing models indicate that a higher level of risk causes higher stock returns[3]. Tobin's Q is the ratio between the market value of the firm and the book value of the firm indicating that a higher market value leads to a higher Tobin's Q (Chung & Pruitt, 1994). I want to combine the findings of the first three hypotheses and related research to see whether higher levels of *Vega* (i.e. higher risk) also causes a higher firm value and a higher *Delta* (i.e. lower risk) causes a lower firm value due to the different influences on firm policies. If firms with a higher *Vega* have a higher firm value it is likely that the agency cost of equity decreased. However, if the results indicate that higher levels of *Delta* lead to lower firm value it means that the agency cost of equity is not solved. I investigate which story is true with the following hypotheses:

- *H4: Vega has a positive effect on Firm Value and Delta has a negative effect on Firm Value*
    - *H4a: High Vega firms have higher Firm Value than low Vega firms*

[3] For example, the CAPM, the Fama-French factor models (Fama & French, 1996) and the Carhart four factor model (Carhart, 1997) all incorporate the beta (β) which is a measure of firm-specific risk to explain abnormal returns.

- *H4b: High Delta firms have lower Firm Value than low Delta firms*

Following Shen & Zhang (2013) I not only look at the observed *Vega* and *Delta* of firms but also at the *Excess Vega* and *Excess Delta* of firms for the first four hypotheses. This can help overcome endogeneity issues. In section 4.1.1, I explain in further detail the differences between the observed *Vega* and *Delta* and the *Excess Vega* and *Excess Delta.*

Lastly, personal CEO characteristics can also influence the risk taking behavior of a CEO and affect the influence of *Vega* and *Delta* on firm policy measures. Earlier established research finds an effect between the marital status of CEO's and his or her level of risk aversion (Brenner, 2014). Chiappori & Reny (2006) find that people marry their opposite risk partner. Halek & Eisenhauer (2001) show that risk aversion increases when people get married. Moreover, having a child increases risk aversion (Chaulk, Johnson & Bulcroft, 2003). These studies imply that being married and having children can have an impact on the risk taking behavior of CEO's. I expect that married CEO's and CEO's that have children are more risk averse. The level of education can also affect the risk taking behavior of CEO's. Risk aversion is lower for higher educated persons (Riley Jr. & Chow, 1992) and risk aversion decreases with years of education (Guiso & Paiella, 2008). I expect to find a smaller effect of *Vega* on the firm policy measures when the CEO has a family (i.e. is married and has children) but a larger effect of *Vega* on the firm policy measures when the CEO has obtained an MBA. In contrast, I expect to find a larger effect of *Delta* on the firm policy measures when the CEO has a family (i.e. is married and has children) but a smaller effect of *Delta* on the firm policy measures when the CEO has obtained an MBA.

- *H5a: The effect of Vega(Delta) on Innovation, Leverage and Capital Expenditures is higher(smaller) when the CEO has obtained an MBA.*
- *H5b: The effects of Vega(Delta) on Innovation, Leverage and Capital Expenditures are smaller(higher) when the CEO has a family.*

4. DATA & METHOLODY

In this section I first describe the construction of the dataset and where the data is retrieved. Secondly, in section 4.2, I explain the methodology and which regression models are used to answer the hypotheses. The last section highlights the endogeneity issue present in this research and the ways in which I try to overcome it.

4.1 The dataset

In this section, I describe the construction of the dataset. I construct two datasets, one panel dataset and one cross-sectional dataset. The panel dataset covers the period ranging from 1 January 1992 to 31 December 2014 and the cross-sectional dataset covers the year 2014. The data is retrieved from Compustat WRDS, ExecuComp WRDS, CRSP and the website of Lalitha Naveen[4]. Lalitha Naveen is one of the authors of the article 'CEO-incentives and risk-taking' (Coles et al., 2006). Since my research partly examines and investigates the results the authors find in their article I use the data concerning *Vega* and *Delta* of Lalitha Naveen. To examine the effect of *Vega* and *Delta* (i.e. CEO incentive pay measures) on the firm policy measures, *Innovation, Capital Expenditures* and *Leverage* I use *Vega* and *Delta* as independent variables and the policy measures as dependent variables. This approach follows Coles et al. (2006). The calculations of the *Vega* and *Delta* are based on the methodology from Core & Guay (2002). The calculation of the compensation incentives are explained in detail in the paper "Calculation of Compensation Incentives and Firm-related Wealth Using Execucomp: Data, Program, and Explanation" by Coles, Daniel & Naveen (2013). This data ranges a period from 1992-2014. They incorporate the change in accounting rules under FASB123.

For the post-2006 period, Coles, Daniel & Naveen calculate the *Vega* and *Delta* for the option portfolio by applying the Black-Scholes (1973) option valuation model modified by Merton (1973) to account for dividends. The *Vega* and *Delta* for the option portfolio are the sum of vested and unvested options. For the calculation of the *Delta* for the equity portfolio they use the following formula:

*Delta = 0.01 * closing price at fiscal year-end * shares owned by the CEO (without options)*

The *Delta* value of the equity portfolio is added to the *Delta* of the option portfolio. Following Guay (1999) the value of *Vega* for the equity portfolio is assumed to be 0.

[4] https://sites.temple.edu/lnaveen/data/

For the pre-2006 period, firms were only required to report the options when the options where in-the-money. To calculate *Vega* and *Delta* under this other accounting format Coles et al. (2006) define three portfolios: (1) The options granted in year *t*, (2) The unvested option portfolio from years *t-i*, and (3) The vested option portfolio. To obtain the *Vega* and *Delta* of these option portfolios Coles et al. (2006) use the same Black-Scholes (1973) option valuation model modified by Merton (1973) to account for dividends. As final step they take the sum of the three portfolios. The *Delta* for the equity portfolio is added to the *Delta* of the options portfolio and the *Vega* of the equity portfolio is assumed to be zero (Guay, 1999).

The cross-sectional dataset consist of information on 1,706 CEO's from whom I have information of more personal details such as their education, family, religion, board membership and political preference. I established this dataset using the Marquis Who's Who database. For both the datasets holds that I delete all financial firms from the dataset because the explanation of capital structure for financial firms is different (Fama & French, 1992). The difference in capital structure can be a problem for the empirical analysis of hypothesis 3. All the variables are winsorized at the 99% level and calculated at fiscal year end. The lagged and lead variables are generated by CUSIP code and only consecutive years are incorporated.

4.1.1 The panel dataset

First, I download the entire WRDS Compustat database for North America for the period 1992 to 2014. I drop all observations that have more than one observation in a given year and I only keep observations for the years 1992 to 2014. I construct the variables *Leverage, Market-to-Book ratio* and *Free Cash Flow*. *Leverage* is the total debt scaled by total assets. The *Market-to-Book ratio* is the value of total assets minus the book value of equity plus the market value of equity divided by total assets. The *Free Cash Flow* is the net cash flow minus the cash dividends scaled by total assets. Furthermore, I change the four digit industry SIC codes to two digit industry SIC codes.

Second, I download the entire WRDS Execucomp database for North America for the period 1992 to 2014. I only keep observations regarding CEO information and drop all observations that have more than one observation in a given year and when the CEO worked in more than one firm in a given year. Using this CEO data, I generate the *Cash Compensation* variable that consists of the sum of the salary and bonus of a CEO in a given year. To compute the tenure of a CEO I sort the data by GVKEY and CO_PER_ROL and count the years a CEO is in his position at a firm.

Thirdly, I merge the firm specific data from Compustat with the CEO specific data from Execucomp using CUSIP codes and years. I use the CUSIP code as matching variable because it is a unique company identifier. The matched data contains 33,896 observations. To incorporate the data regarding *Vega* and *Delta* from Coles et al. (2006) I import the excel datasheet from Lalitha Naveen and merge the *Vega* and *Delta* dataset with the dataset containing CEO and firm data using CO_PER_ROL and years. I use CO_PER_ROL as matching variable because it is a unique identifier for each company and CEO combination. The matched data contains 31,665 observations.

The *Excess Vega* and the *Excess Delta* are the difference between the predicted *Vega* and *Delta* and the actual observed *Vega* and *Delta* (i.e. the *Vega* and *Delta* calculated by Coles et al. (2006)). The equity-based compensation (i.e. levels of *Vega* and *Delta*) of a CEO is determined based on firm specific characteristics and CEO specific characteristics (Guay, 1999). The CEO-specific characteristics are *Cash Compensation*, *Tenure* and *Age*. The firm-specific characteristics are *Sales, Market-to-Book, Idiosyncratic risk, Free Cash Flow* and *Leverage*. *Cash Compensation*, *Tenure* and *Age* are included in the regression for computing *Excess Vega* and *Excess Delta* to control for the level of risk aversion of a CEO and can be seen as proxies for risk aversion. *Sales* are included to control for the effect of firm size. Bigger firms tend to have higher degrees of equity-based compensation. When a firm has a higher level of cash flow the CEO is less dependent on equity and those high cash flow firms implement less equity-based compensation for their CEO's (Yermack 1995). Idiosyncratic risk is a measure of volatility. When volatility is high in an industry, the equity-based compensation of managers should also be higher to account for the same relative performance as the shareholders have that act in a specific industry (Core, Guay & Larcker, 2002). Firms with a higher *Market-to-Book ratio* have more investment opportunities and firms with higher investment opportunities should grant their CEO's with more equity compensation otherwise they could be inclined to take on negative NPV-projects (Shen & Zhang, 2013).

To construct the *Idiosyncratic Risk* variable I download the entire WRDS CRSP daily database for North America for the period 1992 to 2014. I set this data as panel data using daily data and generate a group id using CUSIP codes. Following Shen & Zhang (2013) I calculate the idiosyncratic risk as the standard deviation of daily return residuals from the market model. To obtain the values for the *Idiosyncratic Risk* I regress the total return value weighted index against the company returns and save the coefficients. Next, I regress the returns against the saved coefficients of the total return value weighted index multiplied by the total return value weighted index. From this last regression I save the residuals. I compute the standard deviation over a five-year rolling window using the user-written command ASROL in Stata and collapse the standard deviations by CUSIP and year. I merge the standard deviation (i.e. *Idiosyncratic risk*) data using CUSIP codes and years with the former constructed dataset that contains firm- and CEO specific information. The matched data contains 29.735 observations. I compute the logarithm of the CEO's tenure and firm's sales and adjust the values of *Vega, Delta* and *Cash Compensation* to thousands instead of millions. I perform the following regression using industry- and year fixed effects to compute the *Excesss Vega* and *Excess Delta* following Shen & Zhang (2013)*:*

$$Vega\ (or\ Delta)_{it} = \alpha + \beta_1 * Cash\ Compensation_{it} + \beta_2 * (Log)Tenure_{it} + \beta_3 * Age_{it} + \beta_4 * (Log)Sale_{it} + \beta_5 * Market\text{-}to\text{-}Book_{it} + \beta_6 * Idiosyncratic\ Risk_{it} + \beta_7 * (lagged)Free\ Cash\ Flow_{it} + \beta_8 * Leverage_{it} + \varepsilon_{it} \quad (1)$$

The residuals of the two regressions are the *Excess Vega* and the *Excess Delta*. I only compute the *Excess Vega* and *Excess Delta* for the panel dataset. In equation (1) possible any variable is endogenous. Because of this endogeneity problem I use the residuals from the regression, following Shen & Zhang (2013). In appendix A the descriptive statistics can be found in table AI and the regression coefficients are displayed in table AII. The values of the descriptive statistics are in line with Shen & Zhang (2013). The mean *Vega* is 0.113 million, the mean *Delta* is 0.203 million and *Cash Compensation* shows a mean of 1.073 million.

Lastly, I generate the firm policy variables and firm-specific control variables. The variable *Capital Expenditures* is the firm's capital expenditures minus the sale of property, plant and equipment scaled by total assets. *Firm Size* is captured by the logarithm of the total assets. *Cash Flow* constitutes of the income before extraordinary items and depreciation and amortization. *Book Leverage* (as firm policy) is the sum of the total long-term debt and the total debt in current liabilities scaled by total assets. *Return on Assets* is net income scaled by total assets and *Return on Equity* is net income divided by the total common equity. Tobin's Q is calculated by multiplying the total shares outstanding and the closing price at fiscal year end minus the total equity plus the total assets scaled by total assets. *Innovation* is the R&D expenses scaled by the total assets if the R&D expenses are greater than 0, otherwise *Innovation* takes on a value of 0. The dummy variables for *high Vega, high Delta, high Excess Vega* and *high Excess Delta* firms all take on a value of 1 when a firm has a *Vega, Delta, Excess Vega* and *Excess Delta* value higher than the mean of the variables for the whole sample. Furthermore, I change the values of *Vega, Delta* and *Cash Compensation* back to millions instead of thousands.

I calculate the Kaplan and Zingales index in the same way as Lamont, Polk and Saa-Requejo (2001) using the following formula:

$$KZ\ index_{it} = \frac{-1.001909 * Cash\ Flows_{it}}{PPE_{it-1}} + 0.2826389 * Q_{it} + \frac{3.139193 * Debt_{it}}{Total\ Capital_{it}} + \frac{-39.3678 * Dividends_{it}}{PPE_{it-1}} + \frac{-1.314759 * Cash_{it}}{PPE_{it-1}} \quad (2)$$

Based on this Kaplan Zingales index I give every firm a score ranging from 1 to 5 indicating how equity-dependent the firm is, the KZ score. Malmendier and Tate (2005) follow the same approach however their research focuses on CEO overconfidence and the level of investments. I create dummy variables for the lowest KZ score 1 and the highest KZ score 5. The dummy variables take on a value of 1 when the firm has a KZ score of 1 or a KZ score of 5 otherwise they take on a value of 0. Moreover, I create interaction terms with the CEO incentive pay measures, *Vega*, *Delta*, *Excess Vega* and *Excess Delta* and the KZ scores 1 and 5. The interaction terms are calculated by multiplying the CEO incentive pay measures by the KZ score 1 dummy variable or the KZ score 5 dummy variable.

The final panel dataset consists of 29,083 observations representing 2,589 U.S. firms. Table I shows the descriptive statistics and table BI in Appendix B shows the correlation matrix. Based on the correlation matrix I decide not to include *Tobin's Q* and *Sales* as control variables in the same regression. Tabachnick & Fidell (2001) state that, in a multiple regression analysis, independent variables with a correlation higher than 0.7 should be left out of the regression.

Table I

Descriptive Statistics

This table presents the descriptive statistics for the panel dataset covering the period from 1992 to 2014. The description of the variables can be found in section 4.1.1. Except *Tenure* all variables are winsorized at the 99% level.

Variable	**Obs**	**Mean**	**Std Dev**	**Max**	**Min**
CEO Characteristics					
Vega (in thousands)	27855	113.418	202.601	1869.506	0.000
Delta (in thousands)	27100	630.736	1552.747	21132.234	0.792
Excess Vega (in thousands)	18988	-0.498	166.586	1171.528	-418.361
Excess Delta (in thousands)	18727	-2.513	1331.839	16724.630	-2918.859
Cash Compensation (in thousands)	28925	1073.239	959.597	11943.919	0.001
Tenure	28925	4.647	3.608	23.000	1.000
Age	27736	55.524	7.248	79.000	37.000
Firm policy measures					
Innovation	17642	0.054	0.069	0.491	0.000
Capital Expenditures	27423	0.061	0.056	0.352	-0.002
Book Leverage	28819	0.221	0.181	0.958	0.000
Firm Characteristics					
Size	28922	7.243	1.588	11.879	3.732
Tobin's Q	28913	2.054	1.605	32.849	0.577
Market-to-Book	28849	2.073	1.912	68.833	0.347
Sales	28921	4106.835	8226.742	62071.000	0.000
Free Cash Flow	28706	0.083	0.110	0.407	-3.255
ROA	28920	0.038	0.118	0.325	-1.550

In comparison with Coles et al. (2006) I find higher mean values of *Vega*, *Delta* and *Innovation* but lower mean values for *Capital Expenditures* and *Book Leverage.* Moreover, my dataset contains 28,925 observations while Coles et al. (2006) have 10,687 observations.

4.1.2 The cross-sectional dataset

For constructing the cross-sectional dataset I follow the same steps for computing the variables as for the panel dataset however the cross-sectional dataset only covers the year 2014. Moreover I add several dummy variables based on the Marquis Who’s Who information. I merge the dataset resulting from the last step as described in section 4.1.1 using executive ID numbers. In this way I guarantee that the information from Who’s Who matches the information from Compustat, Execucomp and CRSP. This results in a dataset consisting of 577 observations.

I construct five dummy variables. The dummy variables *Male*, *Married*, *MBA*, *Children* and *Family* all take on a value of 1 indicating that the CEO is male, married, has obtained a MBA, has children and or a family and 0 otherwise. The CEO has a family when he is married and has children. Table II shows the descriptive statistics for the cross sectional dataset and table BII in appendix B shows the correlation matrix for the cross sectional dataset. The *Vega, Delta* and *Book Leverage* display higher means for the cross sectional dataset than for the panel dataset. *Innovation* and *Capital Expenditures* show lower mean values for the cross sectional dataset than for the panel dataset. The correlation matrix in appendix B shows a correlation of 0.943 between the *Children* dummy and the *Family* dummy. Moreover it shows a correlation of 0.819 between the *Married* dummy and the *Children* dummy and a correlation of 0.874 between the *Married* dummy and the *Family* dummy. As stated before, I decide not to include the high correlation dummies as independent variables in the same regression since this can lead to multi-collinearity.

Table II

Descriptive Statistics

This table presents the descriptive statistics for the cross sectional dataset covering the year 2014. The description of the variables can be found in section 4.1.1 and 4.1.2. Except *Tenure* all variables are winsorized at the 99% level.

Variable	**Obs**	**Mean**	**Std Dev**	**Max**	**Min**
CEO Characteristics					
Vega (in thousands)	562	158.869	253.750	1283.717	0.000
Delta (in thousands)	562	734.016	1226.487	8868.771	3.893
Cash Compensation (in thousands)	577	1007.024	616.534	5810.000	150.000
Tenure	577	1.976	0.801	3.000	1.000
Age	577	57.062	6.033	76.000	41.000
Male	577	0.951	0.215	1.000	0.000
Married	577	0.220	0.415	1.000	0.000
MBA	517	0.327	0.470	1.000	0.000
Children	577	0.173	0.379	1.000	0.000
Family	577	0.161	0.368	1.000	0.000
Firm policy measures					
Innovation	353	0.050	0.070	0.416	0.000
Capital Expenditures	536	0.051	0.053	0.281	0.003
Book Leverage	574	0.249	0.179	0.830	0.000
Firm Characteristics					
Size	577	7.991	1.597	11.979	4.451
Tobin's Q	577	2.082	1.211	8.258	0.790
Market-to-Book	575	2.057	1.154	7.288	0.756
Sales	577	8006.994	18475.300	119569.125	45.685
Free Cash Flow	577	0.079	0.072	0.279	-0.216
ROA	577	0.048	0.083	0.263	-0.354

4.2 Methodology

The amount of incentive based pay of a CEO is measured by his or her level of *Vega* and *Delta*. *Excess Vega* and *Excess Delta* are also incorporated in the analysis except for the analysis of the cross sectional dataset. Risk taking behavior is measured by looking at the investments in R&D, capital expenditures and book leverage. Firm value is measured by Tobin's Q. To analyze the panel dataset I use the Least Squares (LS) method with fixed effects. Before running the regression I perform several tests on the panel data to see whether I need to use fixed effects or random effects (i.e. Hausmann test), whether I need to incorporate year fixed effects, if heteroskedasticity (i.e. Modified Wald test) is present and if there is autocorrelation in the data (i.e. Woolridge test). Coles et al (2006) use both firm fixed effects and industry fixed effects but they do not incorporate year fixed effects. I run an F-test with the null hypothesis that all years are equal to zero. However, this null hypothesis is rejected for all the regressions. Moreover, the null hypotheses of no heteroskedasticy and the null hypotheses of no autocorrelation are rejected for all the regressions. The Hausmann tests indicate that it is better to use fixed effects rather than random effects for all the tested regressions. In the following section I describe which regression models I use to test the hypotheses developed in section 3.

4.2.1 CEO incentive pay and firm policy measures

I use fixed effect LS regressions to see whether there is an effect of *Vega*, *Delta, Excess Vega* and *Excess Delta* on *Innovation, Capital Expenditures* and *Book Leverage*. I perform the following two regressions:

$$Policy\ Measure_{it} = \alpha + \beta_1 * Vega(Delta)_{t-1} + \beta_2 * X_{it} + \beta_3 * Z_{it-1} + \varepsilon_{it} \quad (3)$$

$$Policy\ Measure_{it} = \alpha + \beta_1 * ExcessVega(ExcessDelta)_{t-1} + \beta_2 * X_{it} + \beta_3 * Z_{it-1} + \varepsilon_{it} \quad (4)$$

Policy Measure indicates *Innovation*, *Capital Expenditures* or *Book leverage*. X_{it} is a vector of control variables consisting of CEO specific characteristics that can be seen as proxies for his or her level of risk aversion. Z_{it-1} is a vector of control variables consisting of firm specific characteristics that can influence the policy measures. The CEO-specific characteristics are *Age*, *Tenure* and *Cash Compensation*. The firm-specific characteristics are *Firm Size, Market-to-Book ratio*, *Return-on-Assets*, *Book Leverage* and *Cash Flow* when the influence of the CEO incentive on *Innovation* and *Capital Expenditures* is measured. The firm specific characteristics are slightly different when the effect of CEO incentive pay on *Book Leverage* is examined, namely *Firm Size, Market-to-Book ratio, Return-on-Assets, Cash Flow,* *Innovation* and *Capital Expenditures.* By adding control variables I decrease the change of finding a spurious relation between the dependent and independent variables.

I run the regression once with only firm fixed effects, once with firm fixed effects and year effects, once with industry fixed effects and once with industry fixed effects and year fixed effects for all policy measures resulting in 24 different regressions. Although the F-test rejects the null hypotheses that no year fixed effects have to be included I decide to also run the regressions without year fixed effects because Coles et al. (2006) do not include year fixed effects. This gives me a better opportunity to compare the results of their analysis and my analysis. If the predicted sign of β_1 for *Vega* and *Excess Vega* is positive for the policy measures *Innovation* and *Book Leverage* but negative for the policy measure *Capital Expenditures* and if the predicted sign of β_1 for *Delta* and *Excess Delta* is negative for the policy measures *Innovation* and *Book Leverage* but positive for the policy measure capital expenditures the hypotheses 1 and 2 are true.

4.2.2 CEO incentive pay and equity-dependence

To see whether there is a difference in the influence of equity dependent firms and less equity dependent firms I first perform a t-test between the means of the highest equity dependent firms (i.e. firms that have a Kaplan Zingales score of five) and the means of the lowest equity dependent firms (i.e. firms that have a Kaplan Zingales score of one). I perform the test for all the variables I use in the regressions.

Secondly, I perform regressions including the KZ score and with an interaction term of the CEO incentive based pay and the KZ score:

$$Policy\ Measure_{it} = \alpha + \beta_1 * Vega(Delta)_{t-1} + \beta_2 * KZscore1_{it} + \beta_3 * KZscore5_{it} + \beta_4 * KZscore1_{it} * Vega(Delta)_{t-1} + \beta_5 * KZscore5_{it} * Vega(Delta)_{t-1} + \beta_6 * X_{it} + \beta_7 * Z_{it-1} + \varepsilon_{it} \quad (5)$$

$$Policy\ Measure_{it} = \alpha + \beta_1 * ExcessVega(ExcessDelta)_{t-1} + \beta_2 * KZscore1_{it} + \beta_3 * KZscore5_{it} + \beta_4 * KZscore1_{it} * ExcessVega(ExcessDelta)_{t-1} + \beta_5 * KZscore5_{it} * ExcessVega(ExcessDelta)_{t-1} + \beta_6 * X_{it} + \beta_7 * Z_{it-1} + \varepsilon_{it} \quad (6)$$

I perform regressions (5) and (6) for each policy measure. I perform the regressions once with firm fixed effects and year fixed effects and once with industry fixed effects and year fixed effects. This results in 6 regressions. X_{it} is a vector of control variables consisting of CEO specific characteristics that can be seen as proxies for his or her level of risk aversion. Z_{it-1} is a vector of control variables consisting of firm specific characteristics that can influence the policy measures. These vectors contain the same variables as in regressions (3) and (4). If the predicted sign of β_4 is less positive than the predicted sign of β_5 for *Vega* for *Innovation* and *Book leverage* and the predicted sign of β_4 is less negative than the predicted sign β_5 for *capital expenditures* hypothesis 3 regarding *Vega* is true. Moreover, if the predicted sign of β_4 for *Delta* is less negative than the predicted sign of β_5 for *Innovation* and *Book Leverage* and β_4 is less positive than β_5 for *Capital Expenditures* hypothesis 3 is true for *Delta*. The same holds for the *Excess Vega* and the *Excess Delta.*

4.2.3 CEO incentive pay and firm value

To answer hypothesis 4, where I examine the effect of the CEO incentive pay measures on firm value (i.e. Tobin's Q) I use the CEO incentive measures as independent variables and *Tobin's Q* as dependent variable. As mentioned in section 3 using Tobin's Q as measure of firm value is applied in previous literature. Firstly, I perform a t-test on the mean difference between *Tobin's Q* for high *Vega, Delta, Excess Vega* and *Excess Delta* firms and low *Vega, Delta, Excess Vega* and *Excess Delta* firms. Secondly, I perform the following regressions:

$$Tobin's\ Q_{t+1} = \alpha + \beta_1 * Vega(Delta)_{it} + \beta_2 * X_{it} + \beta_3 * Z_{it} + \varepsilon_{it} \quad (7)$$

$$Tobin's\ Q_{t+1} = \alpha + \beta_1 * ExcessVega\ (ExcessDelta)_{it} + \beta_2 * X_{it} + \beta_3 * Z_{it} + \varepsilon_{it} \quad (8)$$

I run the regressions twice. Once with firm fixed effects and year fixed effects and once with industry fixed effects and year fixed effects. Eventually this results in four different regressions. X_{it} is a vector of control variables consisting of CEO specific characteristics that can be seen as proxies for his or her level of risk aversion. Z_{it-1} is a vector of control variables consisting of firm specific characteristics that can influence the policy measures. The CEO-specific characteristics are the same as in the analysis for answering hypotheses 1, 2 and 3. However, the firm-specific characteristics are slightly different. The firm-specific characteristics are *Firm Size, Return-on-Assets, Cash Flow* and *Leverage*. If the predicted sign of β_1 is positive for *Vega* and *Excess Vega* but negative for *Delta* and *Excess Delta* hypothesis 4 is true. The same holds for hypotheses 4a and 4b because when the influence is positive or negative (i.e. the sign is positive for *Vega* but negative for *Delta*) high *Vega* firms have higher firm value than low *Vega* firms and vice versa for high- and low *Delta* firms.

4.2.4 CEO incentive pay and CEO characteristics

To answer hypothesis 5, I use a cross sectional dataset for the year 2014 and I incorporate the personal risk aversion proxies *Male, Family* and *MBA.* To investigate the effect of the risk aversion proxies from the cross sectional dataset I use the LS method with robust standard errors. I do not examine the effects of the *Excess Vega* and *Excess Delta* in the cross section because these variables contain more information for longer time periods. I use two different regression models to reject or accept hypotheses 5a and 5b. In the panel dataset I use fixed effects because I am interested in the variables that vary over time. In the cross-sectional dataset I am also interested in the variables that do not vary over time. First, I perform the following regression to see whether there is an effect of the risk aversion proxies on the firm policy measures:

$$Policy\ Measure_i = \alpha + \beta_1 * Vega\ (or\ Delta)_i + \beta_2 * X_i + \beta_2 * Z_i + \varepsilon_i \qquad (9)$$

Where X_i is a vector of CEO-specific control variables that can proxy for risk aversion (i.e. *Age, Tenure, MBA, Family, Male). Z_i* is a vector of firm-specific control variables. The firm-specific characteristics are *Firm Size, Market-to-Book ratio, Return-on-Assets, Book Leverage* and *Cash Flow* when the influence of the CEO incentive on *Innovation* and *Capital Expenditures* is measured. The firm specific characteristics are slightly different when the effect of CEO incentive pay on *Book Leverage* is examined namely*, Firm Size, Market-to-Book ratio, Return-on-Assets, Cash Flow, Innovation* and *Capital Expenditures.*

Furthermore, I perform a regression with interaction terms. This could lead to a different slope of the regression. The regression containing interaction terms is the following:

$$Policy\ Measure_i = \alpha + \beta_1 * Vega\ (or\ Delta)_i + \beta_2 * Vega(Delta)_i * MBA_i + \beta_3 * Vega(Delta)_i * Family_i + \beta_4 * Vega(Delta)_i * Male_i + \beta_5 * X_i + \beta_6 * Z_i + \varepsilon_i \qquad (10)$$

Where X_i is the same vector of CEO specific control variables and Z_i is again the vector of firm specific control variables. The vectors contain the same control variables as in regression (9). If the predicted sign of β_2 is positive for *Vega* and negative for *Delta* and the predicted sign of β_5 is positive for *MBA* hypothesis 4a is true. If the predicted sign of β_3 is negative for *Vega* and positive for *Delta* and the predicted sign of β_5 is negative for *Family* hypothesis 4b is true.

4.3 The endogeneity problem

In this research I am aware of the fact that there could be an endogeneity issue. Both, in the analysis of the effect of CEO incentive pay on the firm policy measures and in the analysis of the effect of CEO incentive pay on firm value. There could be other things influencing firm value and CEO incentive pay at the same time. The same holds for the relation between firm policy measures and CEO incentive pay. All the variables I use in the regression models examining the effects are not exogenous. Himmelberg et al. (1999) show that ownership and firm performance are both driven by the same exogenous factors in the contracting environment.

I perform several test and analyses to help overcome the endogeneity issue. I include fixed effects in the regression models and use lagged values of *Vega* and *Delta* and lead values of *Tobin's Q.* Moreover, I also perform the same regression but instead of *Vega* and *Delta* I incorporate the *Excess Vega* and *Excess Delta.* Lastly, my MBA and family variables are unrelated with the firm characteristics, which can possibly help overcome the endogeneity issue. Also, I include a robustness check with 2SLS regressions. A 2SLS regression is also a way to overcome a endogeneity problem.

5. EMPIRICAL RESULTS & ANALYSIS

In this section I discuss the empirical results and analyze them. I reject or accept the hypotheses as developed in section 3 and explain in further detail what the results imply. Also, in this section I follow the same line of reasoning by first discussing the effects of CEO incentive pay on firm policy measures and secondly discussing the effect of capital structure on the results found in the first analysis. Thereafter, the effects of CEO incentive pay on firm value are presented and analyzed. Lastly, the inclusion of more personal CEO characteristics is examined. The last section provides information regarding the robustness check.

5.1 The effects of CEO incentive pay on firm policy measures

Below table III shows the regression output of the fixed effect model for *Innovation*. *Vega* and *Excess Vega* have a significant positive effect at the 1% level when industry fixed effects are used but do not have a significant effect on *Innovation* when firm fixed effects are used. *Delta* and *Excess Delta* have no significant effect on *Innovation* regardless of using firm- or industry fixed effects. As Coles et al. (2006) I also find more significant results for the industry fixed effects regressions than for the firm fixed effects regressions. Using firm fixed effects is more stringent than using industry fixed effects. It could be that the effect of *Vega* and *Delta* is more pronounced in the cross section than in time series. For example, Chen & Ma (2017) show that peer decision-making within industries is important for investment decisions concerning capital expenditures and R&D investments.

The discussed results for the fixed effect model for *Innovation* imply that, using industry fixed effects, a higher *Vega* causes more risk taking behavior of the CEO indicated by a higher value of *Innovation*. Coles et al. (2006) find the same results. However, in contrast to Coles et al. (2006), *Delta* has no effect on *Innovation* and this implies that pay-performance sensitivity does not influence the risk taking behavior of a CEO. The results also imply that the *Excess Vega* affects the risk taking behavior of the CEO positively. However, *Excess Delta* has no effect on the risk taking behavior of the CEO. As mentioned before, *Excess Delta* and *Excess Vega* can control for the endogeneity issue if the same empirical results are found as for *Vega* and *Delta.*

Table IV shows the regression output of the fixed effect model for *Capital Expenditures*. The firm fixed effect regressions show a negative effect at the 1% significance level of *Vega* and a positive effect at the 1% significance level of *Delta* on *Capital Expenditures* both with and without year fixed effects. However, after including year fixed effects the coefficients are smaller. Regarding the *Excess Vega* and *Excess Delta* I find the same sign as for *Vega* and *Delta*. When I include year fixed effects the effect of *Excess Vega* stays positive but slightly lower. The effect of *Excess Delta* does not change. The industry fixed effect regressions show a negative effect at the 1% significance level of *Vega* but a positive effect at the 1% level of *Delta* on *Capital Expenditures.* When I include year fixed effect the results are not significant anymore. *Excess Vega* and *Excess Delta* do not have a significant effect on the *Capital Expenditures* with and without year fixed effects.

The firm fixed effects regression of *Vega* and *Delta* show the same results as Coles et al. (2006) find. The results indicate that when *Vega* is higher (i.e. the CEO is more sensitive to stock return volatility) the CEO invests less in capital expenditures but more in R&D investments as found in the results of table III. Furthermore, the results indicate that when *Delta* is higher (i.e. the CEO is more sensitive to changes in stock price) the CEO invests more in capital expenditures. As mentioned before, capital expenditures are a safer investment than R&D investments.

The results imply that a higher *Vega* causes lower capital expenditures but more R&D investments. In other words, a higher *Vega* implies more risk taking behavior of a CEO. Moreover, the results imply that a higher *Delta* causes higher capital expenditures but it does not affect the level of innovation. In other words, a higher *Delta* implies that the pay-performance sensitivity of the CEO has an influence on the capital expenditures but does not have an effect on the R&D investment.

Table V shows the regression output of the fixed effect model for *Book Leverage*. *Vega* has a negative effect for all the regressions and is significant at respectively 10% when firm fixed effects are applied and is significant at respectively 5% when industry fixed effects are applied but when year fixed effects are added, the effects are not significant anymore. *Excess Vega* does not have a significant effect on *book leverage. Delta* has a negative effect for all the regressions and is significant at the 10% level but the effect is not significant when only firm fixed effects are applied. *Excess Delta* does not have a significant effect on *book leverage.*

The negative effect of *Vega* on book leverage is not in line with the research from Coles et al. (2006) who find the opposite effect. However the negative effect of *Delta* is in line with the research of Coles et al. (2006). Coles et al. (2006) find that a higher *Vega* results in higher book leverage. They state that this is because the CEO implements a more aggressive debt policy that means that the CEO takes more risk. The sensitivity of the incentive part of CEO compensation to stock return volatility (i.e. *Vega*) as well as the sensitivity to changes in stock price (i.e. *Delta*) have a negative effect on book leverage. This could be due to the fact that CEO's are constrained by debtholders and prefer to use internal funds or equity financing over debt financing. Previous established research already documented a negative relation between the use of stock options and the debt to equity ratio (John & John, 1993; Ryan Jr. & Wiggins III, 2001). These effects could be due to the agency cost of debt. Section 5.2 discusses in further the detail the results regarding differences in capital structure between firms and the effects these differences have on CEO incentive pay and firm policy. However, *Excess Vega* and *Excess Delta* do not show the same signs on *book leverage* as *Vega* and *Delta* for all firm fixed effects regression. *Excess Delta* also does not show the same sign as *Delta* in the industry fixed effect regressions. It could be that there is an endogeneity issue but it can also be that the part that cannot be explained by the variables proposed by Core & Guay (1999), which are the *Excess Vega* and *Excess Delta,* capture the real effect of the behavior of the CEO. This part cannot be explained by firm characteristics or CEO characteristics that are determined for the CEO such as his age. It could be that the effect of *Excess Vega* and *Excess Delta* really capture the CEO's 'mind'.

The results from table III, table IV and table V causes hypothesis 1 to be rejected. Table III shows that *Vega* and *Excess Vega* influence *Innovation* positively using industry fixed effects as well as when using industry- and year fixed effects which is in line with hypothesis 1. Table IV shows that *Vega* and *Excess Vega* influence *Capital Expenditures* negatively using firm- and industry fixed effects as well as when using firm fixed effects and year fixed effects. The results regarding capital expenditures are in line with hypothesis 1. Table V shows that *Vega* influences *Book Leverage* negatively using firm fixed effects- and industry fixed effects. When year fixed effects are included, the results are not significant anymore. The results regarding the effect of *Vega* on *Book Leverage* is not in line with hypothesis 1, which predicts a positive effect of *Vega* on *Book Leverage.* Hypothesis 1 is rejected because of the different findings regarding the effect of *Vega* on *Book Leverage.*

The results from table III, table IV and table V causes hypothesis 2 to be rejected. Table III shows no significant effect of *Delta* on *Innovation*, which is not in line with hypothesis 2. Table IV shows a positive effect of *Delta* on *Capital Expenditures* when using firm industry effects as well as when using industry effects. When year fixed effects are added the industry fixed effects regression are not significant anymore. The positive effect of *Delta* on *Capital Expenditures* is in line with hypothesis 2. *Delta* has a negative effect on *Book Leverage* when industry fixed effect are applied, as well as when firm fixed effects and year fixed effects are applied and when both industry- and year fixed effects are applied. These results are in line with hypothesis 2. Hypothesis 2 is rejected because I do not find an effect of

Delta on *Innovation.* The linkage between CEO incentive pay, risk-taking behavior and pay-performance sensitivity in firm policy as discussed in section 2.2 and which is established in previous research is not in line with the findings. Concerning capital expenditures the risk story is true but concerning book leverage and R&D investments not all empirical evidence is in line with the suggested literature.

Table III

Fixed effect model for Innovation

The sample consists of U.S firms between 1992 and 2014. Variable descriptions can be found in section 4.1.1. The t-statistics are displayed between parentheses. ***, ** and * indicate the significance levels at respectively 1, 5 and 10 percent. The first four columns include firm fixed effects and the last four columns include industry fixed effects. The regressions are estimated both with and without year fixed effects using the LS method. The coefficients are multiplied by 100.The standard errors are clustered to correct for heteroskedasticity and autocorrelation.

Dependent variable	**Innovation**	**Innovation**	**Innovation**	**Innovation**	**Innovation**	**Innovation**	**Innovation**	**Innovation**
Constant	10.100***	11.700***	7.610***	10.400***	15.800***	16.300***	13.200***	13.800***
	(7.95)	(7.19)	(5.24)	(5.48)	(8.52)	(7.86)	(10.57)	(9.10)
Vega (t-1)	0.000	0.000			0.003***	0.004***		
	(-1.10)	(0.10)			(3.04)	(3.34)		
Delta (t-1)	0.000	0.000			0.000	0.000		
	(0.40)	(0.46)			(-0.65)	(-0.65)		
Excess Vega (t-1)			0.000	0.000			0.005***	0.005***
			(0.47)	(-0.03)			(3.94)	(4.06)
Excess Delta (t-1)			0.000	0.000			0.000	0.000
			(-0.48)	(-0.47)			(-0.80)	(-0.81)
Tenure	0.003	0.007	0.000	0.003	0.027	0.038	0.028	0.032
	(0.36)	(0.88)	(0.03)	(0.35)	(0.93)	(1.26)	(1.08)	(1.34)
Cash Compensation	0.000**	0.000	0.000*	0.000	0.000	0.000	0.000	0.000
	(-2.30)	(-0.03)	(-2.18)	(0.75)	(0.30)	(0.72)	(-0.11)	(0.55)
Age	-0.017*	-0.020**	-0.013	-0.015	-0.061***	-0.064***	-0.043**	-0.045**
	(-1.85)	(-2.26)	(-1.28)	(-1.43)	(-3.54)	(-3.65)	(-2.11)	(-2.11)
Log(sale) (t-1)	-0.425***	-0.578***	-0.117	-0.457*	-0.982***	-1.040***	-0.754***	-0.825***
	(-2.80)	(-2.94)	(-0.65)	(-1.94)	(-3.64)	(-3.58)	(-3.69)	(-3.68)
Market-to-Book (t-1)	-0.031	-0.029	-0.014	-0.02	0.385**	0.393**	0.417***	0.431***
	(-0.92)	(-0.86)	(-0.40)	(-0.56)	(2.28)	(2.23)	(2.94)	(2.83)
Book Leverage (t-1)	-2.190***	-1.990***	-1.820***	-1.770**	-4.440***	-4.300***	-3.340***	-3.170***
	(-3.31)	(-3.03)	(-2.62)	(-2.53)	(-4.24)	(-3.86)	(-3.17)	(-2.78)
ROA (t-1)	-2.750***	-3.090***	-2.600***	-2.710***	-9.640***	-10.300***	-8.730***	-9.120***
	(-4.51)	(-4.85)	(-3.60)	(-3.65)	(-5.57)	(-5.93)	(-6.76)	(-6.76)
Free Cash Flow (t-1)	-2.510**	-2.180**	-2.81	-2.390*	-5.450**	-4.960*	-4.800**	-4.400*
	(-2.42)	(-2.08)	(-2.28)	(-1.91)	(-2.07)	(-1.93)	(-2.13)	(-1.92)
Industry fixed effect	NO	NO	NO	NO	YES	YES	YES	YES
Firm fixed effect	YES	YES	YES	YES	NO	NO	NO	NO
Year fixed effect	NO	YES	NO	YES	NO	YES	NO	YES
N	14435	14435	10748	10748	14435	14433	10748	10748
Adjusted R-squared	83%	83%	84%	85%	45%	45%	44%	45%

Table IV

Fixed effect model for Capital Expenditures

The sample consists of U.S firms between 1992 and 2014. Variable descriptions can be found in section 4.1.1. The t-statistics are displayed between parentheses. ***, ** and * indicate the significance levels at respectively 1, 5 and 10 percent. The first four columns include firm fixed effects and the last four columns include industry fixed effects. The regressions are estimated both with and without year fixed effects using the LS method. The coefficients are multiplied by 1000. The standard errors are clustered to correct for heteroskedasticity and autocorrelation.

Dependent Variable	**CAPEX**	**CAPEX**	**CAPEX**	**CAPEX**	**CAPEX**	**CAPEX**	**CAPEX**	**CAPEX**
Constant	122.000***	66.900***	91.400***	58.500***	79.200***	68.700***	68.500***	65.200**
	(14.26)	(6.82)	(9.03)	(5.02)	(9.95)	(6.98)	(11.16)	(7.64)
Vega (t-1)	-0.019***	-0.006**			-0.015***	-0.004		
	(-6.47)	(-2.16)			(-4.33)	(-1.66)		
Delta (t-1)	0.002***	0.001***			0.001***	0.001		
	(4.05)	(2.63)			(2.52)	(1.32)		
Excess Vega (t-1)			-0.006*	-0.005*			-0.004	-0.004
			(-1.86)	(-1.79)			(-1.13)	(-0.98)
Excess Delta (t-1)			0.001*	0.001**			0.001	0.001
			(1.94)	(1.99)			(1.24)	(1.27)
Tenure	-0.049	0.014	-0.010	-0.042	-0.312**	-0.133	-0.107	-0.139
	(-0.59)	(0.18)	(-0.10)	(-0.47)	(-2.40)	(-0.97)	(-0.78)	(-1.10)
Cash Compensation	-0.001	0.000	0.000	0.000	0.001	0.000	0.000	-0.001
	(-1.35)	(0.28)	(0.15)	(-0.40)	(1.07)	(-0.07)	(-0.38)	(-0.75)
Age	-0.100	-0.135*	-0.077	-0.026	-0.173**	-0.181**	-0.169**	-0.157**
	(-1.24)	(-1.70)	(-0.86)	(-0.30)	(-2.20)	(-2.43)	(-2.20)	(-2.13)
Log(sale) (t-1)	-7.960***	-1.010	-5.130***	-0.846	-2.780**	-1.980	-2.180**	-1.690
	(-7.98)	(-0.91)	(-4.23)	(-0.61)	(-2.22)	(-1.44)	(-2.17)	(-1.38)
Market-to-Book (t-1)	2.260***	2.000***	2.360***	1.600***	2.470***	2.110***	2.600***	2.060***
	(3.74)	(3.77)	(4.35)	(3.60)	(3.33)	(2.78)	(3.84)	(3.11)
Book Leverage (t-1)	-29.200***	-29.300***	-27.000***	-31.000***	-3.040	-5.950	-4.160	-6.480
	(-6.18)	(-6.47)	(-5.83)	(-6.85)	(-0.48)	(-0.96)	(-0.67)	(-1.06)
ROA (t-1)	33.700***	15.200***	23.400***	8.070*	13.300**	-2.190	7.470	-2.340
	(7.55)	(3.69)	(4.64)	(1.73)	(2.21)	(-0.37)	(1.19)	(-0.32)
Free Cash Flow (t-1)	23.000***	22.700***	14.000**	15.200**	66.400***	75.100***	49.700***	55.400***
	(3.89)	(3.71)	(2.34)	(2.43)	(3.31)	(3.38)	(2.75)	(2.72)
Industry fixed effect	NO	NO	NO	NO	YES	YES	YES	YES
Firm fixed effect	YES	YES	YES	YES	NO	NO	NO	NO
Year fixed effect	NO	YES	NO	YES	NO	YES	NO	YES
N	22201	22201	15231	15231	22201	22201	15231	15231
Adjusted R-squared	63%	65%	67%	69%	36%	40%	41%	43%

Table V

Fixed effect model for Book Leverage

The sample consists of U.S firms between 1992 and 2014. Variable descriptions can be found in section 4.1.1. The t-statistics are displayed between parentheses. ***, ** and * indicate the significance levels at respectively 1, 5 and 10 percent. The first four columns include firm fixed effects and the last four columns include industry fixed effects. The regressions are estimated both with and without year fixed effects using the LS method. The coefficients are multiplied by 1000. The standard errors are clustered to correct for heteroskedasticity and autocorrelation.

Dependent Variable	**Book Leverage**	**Book Leverage**	**Book Leverage**	**Book Leverage**	**Book Leverage**	**Book Leverage**	**Book Leverage**	**Book Leverage**
Constant	56.600	79.500*	145.000***	168.000***	14.200	34.600	9.0500	31.300
	(1.61)	(1.65)	(3.56)	(3.27)	(0.51)	(1.03)	(0.32)	(0.91)
Vega (t-1)	-0.018*	-0.014			-0.041**	-0.027		
	(-1.81)	(-1.40)			(-2.32)	(-1.50)		
Delta (t-1)	-0.001	-0.003*			-0.005*	-0.006**		
	(-0.86)	(-1.81)			(-1.79)	(-2.17)		
Excess Vega (t-1)			0.011	0.010			-0.008	-0.006
			(0.85)	(0.77)			(-0.41)	(-0.31)
Excess Delta (t-1)			0.001	0.002			0.000	0.001
			(0.83)	(1.07)			(0.08)	(0.16)
Tenure	0.260	0.263	0.281	0.443	-0.160	-0.027	-0.204	-0.165
	(0.82)	(0.84)	(0.78)	(1.26)	(-0.23)	(-0.04)	(-0.28)	(-0.24)
Cash Compensation	-0.009***	-0.010***	-0.012***	-0.011***	-0.003	-0.006	-0.008**	-0.010**
	(-3.70)	(-3.99)	(-4.51)	(-3.98)	(-0.82)	(-1.28)	(-2.56)	(-2.33)
Age	0.322	0.400	0.515	0.477	0.003	0.029	0.030	0.056
	(0.77)	(0.96)	(1.15)	(1.07)	(0.01)	(0.10)	(0.09)	(0.20)
Log(sale) (t-1)	23.100***	23.200***	9.050*	10.600*	32.800***	33.600***	32.100***	33.200***
	(5.25)	(3.98)	(1.74)	(1.67)	(9.03)	(8.70)	(8.77)	(8.34)
Market-to-Book (t-1)	0.303	-0.907	-0.457	-1.810**	1.810	0.691	1.550	0.120
	(0.33)	(-1.07)	(-0.50)	(-2.16)	(1.13)	(0.45)	(0.79)	(0.06)
ROA (t-1)	-126.000***	-130.000***	-93.500***	-105.000***	-228.000***	-238.000***	-218.000***	-225.000***
	(-6.38)	(-6.26)	(-4.28)	(-4.64)	(-3.87)	(-4.28)	(-3.97)	(-4.28)
Free Cash Flow (t-1)	-159.000***	-157.000***	-142.000***	-140.000***	-235.000***	-224.000***	-226.000***	-218.000***
	(-5.70)	(-5.71)	(-4.49)	(-4.65)	(-8.76)	(-8.65)	(-6.61)	(-6.21)
Innovation (t-1)	-300.000***	-296.000***	-350.000***	-350.000***	-395.000***	-393.000***	-324.000***	-310.000***
	(-3.76)	(-3.64)	(-3.55)	(-3.57)	(-4.86)	(-4.54)	(-3.59)	(-3.30)
CAPEX (t-1)	-10.400	-66.900	-70.400	-158.000***	81.300	-16.500	9.490	-71.000
	(-0.19)	(-1.22)	(-1.21)	(-2.71)	(1.20)	(-0.23)	(0.13)	(-0.89)
Industry fixed effect	NO	NO	NO	NO	YES	YES	YES	YES
Firm fixed effect	YES	YES	YES	YES	NO	NO	NO	NO
Year fixed effect	NO	YES	NO	YES	NO	YES	NO	YES
N	13570	13570	10024	10024	13570	13570	10024	10024
Adjusted R-squared	67%	68%	71%	71%	26%	27%	26%	27%

5.2 Equity dependence and the implications for CEO incentive pay

Table VI shows the mean difference t-tests for the variables included in the regressions to measure the effect of CEO incentive pay on firm policy between the most equity dependent firms and the least equity dependent firms. It shows that there is a significant difference at the 1% level between the mean of *Vega* for the least equity dependent firms and the mean of *Vega* for the most equity dependent firms. The same holds for the difference between the means of *Delta. Vega* is higher for the least equity dependent firms than for the most equity dependent firms. *Delta* is also higher for the least equity dependent than for the most equity dependent firms. This means that CEO's who work for firms that are more equity dependent are less sensitive to the change in stock price volatility (i.e. risk taking incentive) and that they are less sensitive to the change in stock price (i.e. pay to performance). This could be an effect of the agency cost of debt since the CEO's that are more constrained by debtholders (i.e. the least equity dependent firms) have a larger amount of CEO incentive pay, which can imply that they have more personal wealth at stake than the CEO's working for the most equity dependent firms.

The differences in mean for *Innovation, Capital Expenditures* and *Book Leverage* for the most and least equity dependent firms are also significant at the 1% level. *Innovation* is higher for the least equity dependent firms while *Capital Expenditures* is higher for the most equity dependent firms. *Book Leverage* is higher for the most equity dependent firms. The least equity dependent firms innovate more, which means that the CEO takes more risk. The most equity dependent firms invest more in capital expenditures, which means that the CEO takes less risk. Furthermore, book leverage is higher for the most equity dependent firms, which means that the CEO takes less risk according to the general risk hypothesis. These findings are in contrast with the agency cost of debt that states that CEO's who are more dependent on equity should take more risk because they are less constrained by debtholders.

Table VII shows the results regarding *Vega* and *Delta* and table VII shows the results regarding the *Excess Vega* and *Excess Delta* Table VIII shows a lower effect of *Vega* on *Innovation* for the firms that belong the 5th quintile (i.e. the most equity dependent firms). The effect is positive for both the least and most equity dependent firms at the 10% significance level. *Excess Vega* does not show the same results and does not have a significant effect on *Innovation* for both the most- and least equity dependent firms. *Delta* has a negative effect at the 1% level on *Innovation* for the firms that belong to the lowest quintile (i.e. the least equity dependent firms). *Delta* does not have a significant effect on *Innovation* for the highest quintile. The same results hold for *Excess Delta. Vega* has a positive effect at the 10% level on *Capital expenditures* for the firms that belong to the lowest quintile but does not show a significant effect for the firms that belong to the highest quintile. *Excess Vega* shows the same results and has a positive effect at the 5% level on *Capital Expenditures* for the firms that belong to the lowest quintile but does not show a significant effect for the firms that belong to the firms in the highest quintile. *Delta* has a negative effect at the 5% level on *Capital Expenditures* for the firms that belong to the lowest quintile but a positive effect at the 5% level for firms that belong to the highest quintile. *Excess Delta* does not show a significant effect on *Capital Expenditures* for the firms belonging to the lowest quintile but shows a significant positive effect at the 5% level. *Vega, Delta, Excess Vega* and *Excess Delta* do not have a significant effect on *Book Leverage* both for the most- and least equity dependent firms.

For the results where I find a significant influence of *Vega* and *Delta* for both the most- and least equity dependent firms on the firm policy measures I test whether the effects are significantly different from each other by performing an F-test that states that the coefficients are equal to zero. The results for these tests can be found in table IX. Both the p-values indicate that the F-test is rejected this means that the effect of *Vega* on *Innovation* is less pronounced for the most equity dependent firms. Moreover, it shows that the effect of *Delta* on *Capital Expenditures* switches sign from negative for the least equity dependent firms to positive for the most equity dependents firms. The effect of *Delta* is more pronounced for the most equity dependent firms.

Hypothesis 3 is rejected since I do not find a more pronounced effect of *Vega* and *Delta* on all the firm policy measures. I only find a more pronounced effect of *Delta* on *Capital Expenditures.* The effect of *Vega* on *Innovation* is less pronounced. The different kinds of debt such as convertible and straight debt a firm can adopt can be a factor influencing the results (Ortiz-Molina, 2007). The agency cost of debt hypothesis can explain the difference between the effect of *Delta* on *Capital Expenditures* for the most- and least equity dependent firms. The higher the level of debt, the more constrained the CEO's are in the implementation of their policy's. The pay to performance sensitivity and its risk decreasing incentive can explain the higher investments in capital expenditures.

Table VI

Mean difference for Kaplan Zingales Index

The table shows the t-statistic for the difference in mean for the most equity dependent firms and least equity dependent firms indicated by the Kaplan Zingales score. ***, ** and * indicate the significance levels at respectively 1,5 and 10 percent. The variable descriptions can be found in section 4.1.1.

	1st Quintile	**5th Quintile**	
Variable	**Mean**	**Mean**	**t-statistic**
CEO Characteristics			
Vega (in thousands)	142.773	94.669	11.392***
Delta (in thousands)	777.946	541.606	7.312***
Excess Vega (in thousands)	18.567	-5.951	6.272***
Excess Delta (in thousands)	30.306	8.214	0.714
Cash Compensation (in thousands)	1,055.361	1,080.632	-1.220
Tenure	4.857	4.694	2.162**
Age	55.285	55.240	0.297
Firm policy measures			
Innovation	0.078	0.040	19.290***
Capital Expenditures	0.032	0.081	-42.794***
Book Leverage	0.132	0.392	-75.581***
Firm Characteristics			
Tobin's Q	2.627	1.727	28.143***
Market-to-Book	2.668	1.739	25.266***
Sales	3,761.809	3,874.520	-0.704
Free Cash Flow	0.083	0.065	6.712***
ROA	0.071	-0.024	31.913***
Size	6.947	7.481	-16.694***

Table VII

Fixed effect model for Firm policy with KZ score

The sample consists of U.S firms between 1992 and 2014. Variable descriptions can be found in section 4.1.1. The t-statistics are displayed between parentheses. ***, ** and * indicate the significance levels at respectively 1, 5 and 10 percent. The regressions are estimated both with industry- and year fixed effects using the LS method. The coefficients are multiplied by 1000. The standard errors are clustered to correct for heteroskedasticity and autocorrelation.

Dependent Variable	**Innovation**	**Capital Expenditures**	**Book Leverage**
Constant	15.800***	76.100***	20.000
	(8.04)	(8.38)	(0.64)
Vega (t-1)	0.032***	-0.002	-0.015
	(3.33)	(-0.64)	(-0.76)
Delta (t-1)	0.001	0.000	-0.005
	(1.51)	(0.69)	(-1.45)
KZ score 1	6.390	-21.700***	-30.000***
	(1.66)	(-7.65)	(-4.97)
KZ score 5	1.630	10.900***	164.000***
	(0.38)	(4.45)	(17.72)
KZ score 1 * Vega (t-1)	0.019*	0.012*	0.002
	(2.00)	(1.82)	(0.11)
KZ score 5 * Vega (t-1)	0.018*	-0.012	0.014
	(1.98)	(-1.40)	(0.29)
KZ score 1 * Delta (t-1)	-0.006***	-0.001**	0.000
	(-4.61)	(-2.00)	(0.01)
KZ score 5 * Delta (t-1)	-0.001	0.004**	-0.008
	(-1.10)	(2.54)	(-1.17)
Tenure	0.376	-0.137	0.074
	(1.31)	(-1.02)	(0.14)
Cash Compensation	0.002	0.000	-0.005
	(0.68)	(0.12)	(-1.22)
Age	-0.634***	-0.151**	0.165
	(-3.62)	(-2.19)	(0.57)
Log(sale) (t-1)	-10.200***	-2.440*	31.100***
	(-3.56)	(-1.94)	(10.30)
Market-to-Book (t-1)	4.500**	2.750***	1.610
	(2.53)	(3.52)	(1.02)
Book Leverage (t-1)	-42.700***	-23.300***	
	(-3.36)	(-4.10)	
ROA (t-1)	-105.000***	9.840*	-147.000***
	(-5.65)	(1.91)	(-2.93)
Free Cash Flow (t-1)	-48.700*	69.100***	-194.000***
	(-1.92)	(3.28)	(-10.31)
Innovation(t-1)			-290.000***
			(-3.99)
CAPEX(t-1)			-176.000***
			(-2.96)
Industry fixed effect	YES	YES	YES
Year fixed effect	YES	YES	YES
N	14435	22201	13570
Adjusted R-squared	46%	42%	37%

Table VIII

Fixed effect model for Firm policy with KZ score

The sample consists of U.S firms between 1992 and 2014. Variable descriptions can be found in section 4.1.1. The t-statistics are displayed between parentheses. ***, ** and * indicate the significance levels at respectively 1, 5 and 10 percent. The regressions are estimated both with industry- and year fixed effects using the LS method. The coefficients are multiplied by 1000. The standard errors are clustered to correct for heteroskedasticity and autocorrelation.

Dependent Variable	**Innovation**	**Capital Expenditures**	**Book Leverage**
Constant	0.133***	0.0723***	0.015
	(10.28)	(9.76)	(0.47)
Excess Vega (t-1)	0.040***	-0.002	0.007
	(3.59)	(-0.51)	(0.30)
Excess Delta (t-1)	-0.000	0.000	0.001
	(-0.03)	(0.32)	(0.21)
KZ score 1	8.310*	-20.400***	-28.900***
	(1.98)	(-10.44)	(-5.03)
KZ score 5	2.100	9.850***	168.000***
	(0.54)	(3.90)	(14.65)
KZ score 1 * Excess Vega (t-1)	0.012	0.011**	-0.024
	(1.31)	(2.15)	(-0.82)
KZ score 5 * Excess Vega (t-1)	0.007	-0.010	0.067
	(0.40)	(-0.88)	(1.40)
KZ score 1 * Excess Delta (t-1)	-0.003**	0.000	-0.004
	(-2.41)	(0.12)	(-0.70)
KZ score 5 * Excess Delta (t-1)	-0.000	0.004**	0.001
	(-0.14)	(2.21)	(0.13)
Tenure	0.323	-0.141	-0.024
	(1.34)	(-1.10)	(-0.04)
Cash Compensation	0.001	-0.000	-0.009**
	(0.54)	(-0.36)	(-2.06)
Age	-0.444**	-0.135**	0.152
	(-2.15)	(-2.06)	(0.51)
Log(sale) (t-1)	-7.980***	-2.110*	31.200***
	(-3.75)	(-1.90)	(9.87)
Market-to-Book (t-1)	4.120***	2.670***	1.160
	(2.89)	(3.75)	(0.60)
Book Leverage (t-1)	-30.100**	-21.700***	
	(-2.35)	(-4.13)	
ROA (t-1)	-94.000***	9.080	-134.000**
	(-6.51)	(1.48)	(-2.65)
Free Cash Flow (t-1)	-42.800*	50.900***	-187.000***
	(-1.90)	(2.67)	(-6.70)
Innovation(t-1)			-205.000**
			(-2.49)
CAPEX(t-1)			-258.000***
			(-4.09)
Industry fixed effect	YES	YES	YES
Year fixed effect	YES	YES	YES
N	10748	15231	10024
Adjusted R-squared	45%	45%	37%

Table IX

This table shows the F-test for the coefficients found in table VII. ***, ** and * indicate the significance levels at respectively 1, 5 and 10 percent.

Innovation	**F- Test**	**P value**
KZ score 1 * Vega (t-1) = KZ score 5 * Vega (t-1)	3.040	0.057*
Capital Expenditures		
KZ score 1 * Delta (t-1) = KZ score 5 * Delta (t-1)	5.360	0.007***

5.3 The effect of CEO incentive pay on firm value

This section shows if there is an effect and what the effect is of *Vega, Delta, Excess Vega* and *Excess Delta* on firm value.

First, I perform a mean difference t-test whether there is a difference in the mean of high and low Tobin's Q firms for the CEO incentive pay measures. I find significant differences at the 1% level between the means for all four incentive measures. High *Vega* firms have higher firms value than low *Vega* Firms. The same holds for high and low *Delta* firms. The results are displayed in table X.

Table X

Differences in Firm Value

The table shows the mean difference t-test in Tobin's Q for high and low levels of Vega, Delta, Excess Vega and Excess Delta. ***, ** and * indicate the significance levels at respectively 1, 5 and 10 percent. The variable descriptions can be found in section 4.3.1

	Tobin's Q		
Variable	**Low**	**High**	**t-statistics**
Vega	1,962	2,280	-15,318***
Delta	1,821	2,704	-42,479***
Excess Vega	2,088	2,034	2,729***
Excess Delta	2,134	1,998	7,117***

Second, I perform regressions with firm fixed and year fixed effects for the whole sample. Table XI shows the results for these regressions. *Vega* and *Excess Vega* have a negative effect at the 1% level and *Delta* and *Excess Delta* have a positive effect at the 1% level. Table XII shows the regressions including industry fixed and year fixed effects. *Vega* has a significant positive effect at the 5% level and *Delta* has a significant positive effect at the 1% level. *Excess Vega* does not have a significant effect. *Excess Delta* has a positive significant effect at the 5% level.

The results from table XI and XII indicate that hypothesis 4 is rejected. Table XI shows a negative effect of *Vega* on *Firm Value* and a positive effect of *Delta* on *Firm Value.* The negative effect of *Vega* indicates that high *Vega* firms have lower firm value. The positive effect of *Delta* indicates that high *Delta* firms have higher firm value. These findings are exact the opposite as what hypotheses 4, 4a and 4b describe. Table XII shows a positive effect of both *Vega* and *Delta* on *Firm Value.* This means that higher *Vega* firms have higher firm value, which is in line with hypothesis 4a. Again, the positive effect of *Delta* on firm value is exact the opposite as what hypothesis 4 and 4b describe. The higher level of risk does not lead to a higher firm value but the lower level of risk does imply a higher firm value. This is not in line with the previous established research that states that a higher level of risk should lead to higher firm value (Shen & Zhang, 2013; Pasterneck & Rosenberg, 2002).

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Table XI

The sample consists of firms between 1992 and 2014. Both firm- and year fixed effects are included using the LS method. The t-statistics are displayed between parentheses. ***, ** and * indicate the significance levels at respectively 1, 5 and 10 percent. Variable descriptions can be found in section 4.1.1. The coefficients are multiplied by 100. The standard errors are clustered to correct for heteroskedasticity and autocorrelation.

Dependent variable	**Tobin's Q**	**Tobin's Q**
Constant	663.800***	748.600***
	(12.77)	(11.13)
Vega	-0.050***	
	(-3.53)	
Delta	0.016***	
	(6.46)	
Excess Vega		-0.074***
		(-4.42)
Excess Delta		0.007***
		(2.66)
Tenure	0.824**	0.808**
	(2.19)	(2.23)
Cash Compensation	8.420***	5.160**
	(3.50)	(2.32)
Age	-0.749**	-0.239
	(-2.24)	(-0.65)
Size	-71.200***	-68.500***
	(-11.40)	(-8.76)
ROA	122.500***	71.700***
	(6.34)	(4.59)
Free Cash Flow	28.200	-4.090
	(0.88)	(-0.14)
Book Leverage	1.030	-16.600
	(0.05)	(-0.83)
Innovation	281.300***	114.000
	(3.09)	(1.12)
CAPEX	4.970	33.900
	(0.10)	(0.67)
Firm fixed effect	YES	YES
Year fixed effect	YES	YES
N	13560	10308
Adjusted R-squared	56%	58%

Table XII

The sample consists of firms between 1992 and 2014. Both industry- and year fixed effects are included using the LS method. The t-statistics are displayed between parentheses. ***, ** and * indicate the significance levels at respectively 1, 5 and 10 percent. Variable descriptions can be found in section 4.1.1. The coefficients are multiplied by 100. The standard errors are clustered to correct for heteroskedasticity and autocorrelation.

Dependent variable	**Tobin's Q**	**Tobin's Q**
Constant	267.500***	255.700***
	(5.50)	(9.16)
Vega	0.026**	
	(2.33)	
Delta	0.023***	
	(15.49)	
Excess Vega		0.011
		(0.63)
Excess Delta		0.008**
		(2.63)
Tenure	0.713**	1.490***
	(2.38)	(4.03)
Cash Compensation	3.520*	8.220***
	(1.71)	(3.98)
Age	-0.947**	-0.621
	(-2.28)	(-1.49)
Size	-14.700***	-8.490***
	(-8.31)	(-5.61)
ROA	255.100***	247.000***
	(6.88)	(7.26)
Free Cash Flow	38.600	54.300
	(0.82)	(1.19)
Book Leverage	-4.970	3.470
	(-0.35)	(0.20)
Innovation	778.400***	713.300***
	(5.23)	(5.50)
CAPEX	94.800*	262.100***
	(1.84)	(3.83)
Industry fixed effect	YES	YES
Year fixed effect	YES	YES
N	13560	10308
Adjusted R-squared	29%	24%

5.4 The effects of risk aversion proxies on firm policy in the cross section

Table XIII and table XIV show the regressions for the cross sectional dataset respectively with and without interaction terms. Table XII shows that the personal CEO characteristics that can influence the risk-taking behavior do not have a significant effect on *Innovation, Capital Expenditures* and *Book Leverage. Vega* has a positive and significant effect at the 10% level on *Innovation.* The coefficient for *Family* is negative for all policy measures. The coefficient is more negative for *Innovation* and *Book Leverage,* which could indicate less risk taking behavior. The coefficient for *MBA* is positive for *Capital Expenditures* and *Innovation* but negative for *Book Leverage.* However, as stated before, these results are not significant.

After adding the interaction terms with *Vega* and *Delta* to the CEO characteristics *MBA*Vega* and *MBA*Delta* are respectively positively and negatively significant at the 1% level when the effect is measured on *Innovation.* This implies that the CEO's that have obtained an MBA take less risk than the CEO's who do not have obtained an MBA. This is not in line with the discussed literature in section 3. The literature predicts a positive relation between having a MBA and risk-taking behavior. There is no significant effect of *MBA* or the *MBA* interaction terms on *Capital Expenditures.* The results show that CEO's who have obtained an MBA take less risk but this does not increase the investments in capital expenditures. The interaction term *Family*Delta* is negatively significant at the 5% level for *Capital Expenditures*. This indicates that there is a negative relation between capital expenditures and CEO's that have a family and higher pay-performance sensitivity.

*MBA*Vega* and *MBA*Delta* are significant respectively at the 10% level and at the 5% level for *Book Leverage.* This implies that, in the same line of reasoning as for *Innovation,* the CEO takes on less *Book Leverage* when he or she is more sensitive to *Vega* and has obtained a *MBA* and according to the general risk hypothesis as addressed by Coles et al. (2006) this means that the CEO displays less risk taking behavior because his debt policy is less aggressive. The positive significant effect of *MBA*Delta* shows a contradicting result that when the CEO has higher pay-performance sensitivity and has obtained an MBA he takes on more book leverage.

Hypothesis 5a and 5b are both rejected. The effect of *Vega* on *Innovation* and *Book Leverage* is smaller when the CEO has obtained a MBA. Moreover, the effect of *Delta* on *Innovation* and *Book Leverage* is larger when the CEO has obtained a MBA. The literature suggest that having a MBA decreases risk aversion but the opposite is found and this results in the rejection of hypothesis 5a. The effect of *Delta* on *Capital Expenditures* is smaller when the CEO has a family. This is not in line with hypothesis 5b.

Table XIII

Regression model for Innovation, Capital Expenditures & Book Leverage

The dataset covers the year 2014. The t-statistics are displayed between parentheses and robust standard errors are used. ***, ** and * indicate the significance levels at respectively 1, 5 and 10 percent. Variable descriptions can be found in section 4.1.1 and 4.1.2. The LS method is applied. The coefficients are multiplied by 100.

Variables	**Innovation**	**CAPEX**	**Book Leverage**
Constant	6.300*	3.980	4.280
	(1.66)	(1.32)	(0.29)
Vega	0,002*	-0,001	0,005
	(1.82)	(-0.80)	(1.06)
Delta	0.000	0.000	0.000
	(0.28)	(0.95)	(-0.26)
Age	0,003	-0,013	-0,107
	(0.07)	(-0.37)	(-0.72)
Tenure	0,39	0,269	0,937
	(1.15)	(0.99)	(0.82)
MBA	0,675	0,118	-0,597
	(1.22)	(0.24)	(-0.31)
Family	-0,622	-0,419	-1,55
	(-0.83)	(-0.79)	(-0.60)
Male	0,979	1,39	0,025
	(0.90)	(1.99)	(0.00)
Cash Compensation	0.000	0.000	-0,002
	(-0.03)	(-0.00)	(-0.85)
Log(Sale)	-0,495**	-0,135	4,280***
	(-2.19)	(-0.64)	(4.70)
Market-to-Book	0,022***	-0,851***	1,4
	(6.11)	(-2.69)	(1.33)
Book Leverage	-9,660***	3,290**	
	(-5.41)	(2.28)	
ROA	-50,800***	-4,53	-52,500**
	(-6.19)	(-0.72)	(-2.38)
Free Cash Flow	3,23	29,200***	-37,900*
	(-0.44)	(4.16)	(-1.97)
Innovation			-109,100***
			(-5.08)
CAPEX			-18
			(-0.50)
N	301	466	278
R-squared	56%	13%	31%

Table XIV

Regression model for Innovation, Capital Expenditures & Book Leverage

The dataset covers the year 2014. The t-statistics are displayed between parentheses and robust standard errors are used. ***, ** and * indicate the significance levels at respectively 1, 5 and 10 percent. Variable descriptions can be found in section 4.1.1 and 4.1.2. The LS method is applied. The coefficients are multiplied by 100.

Variables	**Innovation**	**CAPEX**	**Book Leverage**
Constant	7,440*	3,79	11,2
	(1.90)	(1.26)	(0.73)
Vega	-0,015	0,009	-0,063
	(-0.59)	(1.17)	(-0.69)
Delta	0,006	-0,003	0,015
	(0.71)	(-1.09)	(0.49)
Age	-0,004	-0,016	-0,113
	(-0.08)	(-0.45)	(-0.74)
Tenure	0,47	0,332	0,738
	(1.40)	(1.20)	(0.64)
MBA	0,507	-0,069	-0,662
	(0.68)	(-0.11)	(-0.26)
Family	-0,555	-0,26	-3,03
	(-0.54)	(-0.38)	(-0.82)
Male	0,821	1,69	-5,57
	(0.57)	(1.98)	(-0.65)
MBA*Vega	-0,005***	0,003	-0,017*
	(-2.61)	(1.01)	(-1.96)
Family*Vega	0,001	0,004	0
	(0.38)	(1.58)	(-0.03)
Male*Vega	0,019	-0,013	0,076
	(0.74)	(-1.63)	(0.84)
MBA*Delta	0,002***	0	0,005**
	(3.42)	(-0.45)	(2.51)
Family*Delta	0	-0,001**	0,001
	(-0.97)	(-2.06)	(0.68)
Male*Delta	-0,006	0,004	-0,017
	(-0.73)	(1.46)	(-0.57)
Cash Compensation	0	0	-0,002
	(0.04)	(0.16)	(-0.79)
log(Sale)	-0,545**	-0,17	4,190***
	(-2.35)	(-0.80)	(4.48)
Market-to-Book	2,110***	-0,827***	1,54
	(5.94)	(-2.60)	(1.48)
Book Leverage	-10,100***	3,720**	
	(-5.57)	(2.57)	
ROA	-50,500***	-4,5	-56,700**
	(-6.25)	(-0.72)	(-2.56)
Free Cash Flow	-4,66	29,000***	-41,300**
	(-0.64)	(4.09)	(-2.22)
Innovation			-114,300***
			(-5.09)
CAPEX			-5,94
			(-0.17)
N	301	466	278
R-squared	58%	15%	33%

5.5 Endogeneity and robustness check

As mentioned in section 3.2, in the analysis of the effect of CEO incentive pay on risk-taking behavior and the analysis of the effect of CEO incentive pay on firm value there is an endogeneity problem. I do several things to overcome this problem. First, in the regression models I incorporate different lagged values. Secondly, I incorporate the exogenous variables *Male, MBA* and *Family* in the cross sectional analysis. In this analysis I only find a significant positive effect of *Vega* on *Innovation.* The other regressions do not show significant effects of the CEO incentive pay measures on firm policy. Thirdly, I incorporate the *Excess Vega* and *Excess Delta* for the panel data analysis. For the effect of CEO incentive pay on *Innovation* I find the same effects for *Excess Vega* and *Excess Delta* as what I find for *Vega* and *Delta.* Concerning the effect of CEO incentive pay on *Capital Expenditures* I find the same effects for *Vega, Delta, Excess Vega* and *Excess Delta* when applying firm fixed effects but when using industry fixed effects the results of *Delta* and *Excess Delta* differ. The effect of CEO incentive pay on *Book Leverage* is in all the regressions not the same for *Vega, Delta, Excess Vega* and *Excess Delta.*

The results concerning the different effects of CEO incentive pay on the firm policy measures for different levels of equity dependence are also not exactly the same for *Vega, Delta, Excess Delta* and *Excess Vega.* The effect of *Vega* on *Innovation* is less pronounced for the most equity dependent firms. I do not find the same effect for the *Excess Vega.* Moreover, the effect of *Delta* on *Capital Expenditures* is more pronounced for the most equity dependent firms. I do not find the same effect for the *Excess Delta.*

When I apply firm fixed effects and year fixed effects the effect of *Vega* and *Excess Vega* on firm value is negative and the effect of *Delta* and *Excess Delta* on firm value is positive (i.e. I find the same effects). When industry fixed effects and year fixed effects are applied *Delta* and *Excess Delta* both show a positive effect on firm value. However, *Excess Vega* does not show a significant effect on *Firm Value* while *Vega* has a significantly positive effect on *Firm Value*.

Lastly, I perform 2-stage-least-squares (2SLS) regressions. The results of the regressions can be found in Appendix C. These regressions are a robustness check to see whether I find the same results when I regress the exogenous variables *Male, MBA* and *Family* on the firm policy measures and on firm value. I use the one year lagged values of *Vega* and *Delta* as instruments. The results of this regression can be found in table CI. It shows that *Vega* has a negative significant effect at the 5% level on *Innovation* and a positive significant effect at the 10% level on *Book Leverage. Delta* has a significant positive effect at the 1% level on *Firm value.* Table CII also shows 2SLS regressions but in these regressions I treat all the other independent variables that are included in the main analysis, as exogenous. I do not find any significant effects of *Vega* and *Delta* on the firm policy measures. *Vega* does have a positive significant effect at the 10% level on *Firm Value* and *Delta* does have a positive significant effect at the 1% level of *Firm Value.*

As mentioned above, I do several things in this analysis to overcome the endogeneity problem. The effect of *Vega*, *Excess Vega*, *Delta* and *Excess Delta* do not show the same results in all the regressions. Moreover, as table CII shows there is in the 2SLS regression with exogenous variables no effect of CEO incentive pay on the firm policy measures but these regression only cover one year. In the 2SLS regression I find an effect of CEO incentive pay on firm value.

6. CONCLUSION

In this section I first summarize my thesis in short and thereafter I give the limitations and recommendations concerning my research.

6.1 Summary

My research question as stated in the introduction is: "is incentive-based pay influencing the risk-taking behavior of the CEO and value of the firm?". The answer is yes. I find a positive effect of the *Vega* on *Innovation*. This implies that granting a CEO with a high *Vega* increases his risk taking behavior. However, this risk taking behavior is not limited by the *Delta* since the *Delta* does not have an effect on *Innovation.* Concerning the investments in capital expenditures *Vega* has a negative effect and *Delta* a positive effect. This is in line with previous research that *Delta* lowers the risk taking behavior of a CEO and *Vega* increases it, since capital expenditures is a save investment (Coles et al., 2006). *Vega* makes the CEO less risk averse in this case. Concerning capital expenditures the theory about granting the CEO with both stock options and shares is true because a high *Delta* could lead to a more risk averse CEO and a high *Vega* could lead to too much risk seeking behavior. Moreover, I examine the effect of *Vega* and *Delta* on book leverage. I find for both CEO incentive pay measures a negative effect on *Book Leverage.* This means that there is no offset of one CEO incentive pay by the other but that CEO incentive pay as whole has a negative effect on the adopting of leverage. As mentioned in the literature review this could be due to the agency cost of debt.

After dividing the data in quintiles based on the equity dependence of the firms I find a smaller effect of *Vega* on *Innovation* for the most equity dependent firms. This is not in line with the agency cost of debt hypothesis. This hypothesis predicts the contrary since debtholders place constraints, which could lead to lower risk-taking behavior of the CEO. I find a more pronounced effect of *Delta* on *Capital Expenditures* for the most equity dependent firms. This is line with the agency cost of debt since the most equity dependent firms are less constrained by the debtholders and since the *Delta* decreases the risk-taking behavior of a CEO the investments in capital expenditures is higher.

Having a family lowers the effect of *Delta* on *Capital Expenditures*. Moreover, the results show that having a MBA leads to a negative effect of *Vega* on *Innovation* and *Book Leverage* and a more positive effect of *Delta* on *Innovation* and *Book Leverage.* This is not in line with previous research that states that having a MBA lowers risk aversion.

Vega has a negative effect on firm value using firm- and year fixed effects. However, using industry-and year firm fixed effects *Vega* has a negative effect. For both cases, *Delta* has a positive effect. This means that firms that have a high *Delta* also have a higher firm value.

6.2 Limitations and recommendations

First of all, there is an endogeneity issue. I assume that the level of *Vega* and *Delta* of last year affect the level of investments and book leverage in the current year. Moreover, I assume that the level of *Vega* and *Delta* in this year affect the firm value in the next year. There could be other variables influences the R&D investment, capital expenditures, the adoption of book leverage and firm value at the same time. My cross-sectional dataset also gives a hint of other effects influencing the risk taking behavior of the CEO. However, I have included the *Excess Vega* and *Excess Delta* into the regressions and also analyzed the 2SLS regression. The analyses I do to overcome the endogeneity issue do not all give the same results.

Moreover, I find different signs and other significant results when I use industry- and firm fixed effects. This problem is already addressed by Coles et al. (2006). Especially the results concerning *Innovation* and *Firm Value* show different things. I add year fixed effects to the regressions and these show other results than the regressions without year fixed effects. The F-test with the null hypothesis that all years are equal to zero is rejected indicating that the regressions with year fixed effects are the best estimators. Another problem that could inflict the results of the *Firm Value* regression is that capital expenditures are capitalized but R&D investments are not. This could lead to different book values, which could have an influence on Tobin's Q.

Concerning the cross sectional dataset and especially the *Family* dummy it is worth noting that CEO's can decide themselves if they want to show family data in the Marquis who's who database. I tried to make a new subset of firms with CEO's that give information about their family and then divide the sample into CEO's that are married and have children and the ones who do not. Unfortunately this was not possible because I have too few data.

My research sheds some new light on CEO incentive pay after the enactment of the SOX act and the implementation of the new accounting rules. Also, the different results of CEO incentive pay for the most-and least equity dependent firms is interesting to have a closer look at in the further. I think CEO incentive pay does have an influence on the behavior of CEO's. The results regarding education and family circumstances enhance the literature of behavioral finance but are worth investigating in the future in further detail with more observations and incorporating more years.

For academic research my results imply that more research has to be done to CEO incentive pay and risk-taking behavior in the period after the enactment of the SOX and the implementing of the new accounting rules. The effects found before this period do not hold anymore. I think an event study will be interesting with data before and after the enactment of the SOX or the new accounting rules implemented in the United States. Furthermore, research to firm value and CEO incentive pay is, in my opinion, too little. The effects of *Vega* are more examined than the results of *Delta*. The effects of personal characteristics of CEO's in combination with the CEO pay incentive measures give an interesting start for further research. Lastly, I try to overcome the endogeneity problem but I think for further research it is still worth investigating in which other way the endogeneity problem can be solved.

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APPENDIX A

Table AI shows the descriptive statistics of the variables used in the regression analysis of *Excess Vega* and *Excess Delta.* Table AII shows the regression analysis of *Vega* and *Delta.* The residuals from both the regressions are the values of the *Excess Vega* and *Excess Delta.* The *Excess Vega* and *Excess Delta* are used in the main regression analysis to answer the hypotheses as described in section 3. The calculation of *Excess Vega* and *Excess Delta* follows the methodology of Shen & Zhang (2013). The coefficients I find in the regression analysis have the same signs as Shen & Zhang except the *Idiosyncratic Risk* coefficient, which is negative when I regress it against *Vega.* Moreover, the *Lagged Free Cash Flow* has a positive effect when I regress it against *Delta.*

Table AI

Descriptive Statistics

This table reports descriptive statistics for the variables used in the regressions to compute the *Excess Delta* and *Excess Vega*. The description of the variables can be found in section 4.1.1. All variables are winsorized at the 99% level except *Tenure.*

Variable	**Obs**	**Mean**	**Std Dev**	**Max**	**Min**
Vega (in millions)	27855	0,113	0.203	1.870	0.000
Delta (in millions)	27100	0.631	1.553	21.132	0.001
Cash Compensation (in millions)	28925	1.073	0.960	11.944	0.000
Tenure	28925	4.646	3.609	23.000	1.000
Age	27736	55.524	7.455	96.000	28.000
Sale (in millions)	28921	4106.835	8226.742	62071.000	0.000
Market-to-Book	28849	2.073	1.912	68.833	0.347
Leverage	20533	0.202	0.204	3.446	0.000
Idiosyncratic Risk	28917	0.019	0.010	0.154	0.004
Lagged free cash flow	28369	0.084	0.109	0.407	-3.255
MVE (in millions)	28914	6860.810	23812.060	626550.400	1.889

Table AII

Fixed Effects Model for Vega and Delta

The sample consists of U.S firms between 1992 and 2014. The table shows the regression analysis of *Vega* and *Delta*. Variable definitions are defined in section 4.1.1 The t-statistics are displayed between parentheses. ***, ** and * indicate the significance levels at respectively 1, 5 and 10 percent. Industry fixed effects and firm fixed effects are included. The standard errors are clustered to correct for heteroskedasticity and autocorrelation.

Dependent variable	**Vega**	**Delta**
Constant	-0.394***	-3.164***
	(-8.07)	(-6.98)
Cash Compensation	0.067***	0.175***
	(5.78)	(4.21)
Log (CEO tenure)	0.012***	0.169***
	(4.81)	(6.44)
CEO age	0.000	0.019***
	(0.39)	(4.47)
Log(sale)	0.056***	0.254***
	(14.69)	(5.97)
MTB	0.015***	0.246***
	(5.58)	(8.02)
Idiosyncratic Risk	-0.805**	5.366
	(-2.09)	(1.65)
Lagged free cash flow	-0.003	0.262
	(-0.10)	(1.64)
Leverage	-0.066***	-0.601***
	(-3.35)	(-3.51)
Industry fixed	YES	YES
Firm fixed	YES	YES
N	18988	18727
Adjusted R-squared	39%	21%

APPENDIX B

Table BI

Correlation Matrix

This table represents the correlation matrix for the panel dataset ranging from 1992 to 2014. The description of the variables can be found in section 4.1.1

	Vega	**Delta**	**Excess Vega**	**Excess Delta**	**Cash Compensation**	**Tenure**	**Age**	**Innovation**	**CAPEX**	**Book Leverage**	**Size**	**Tobin's Q**	**Market-to-Book**	**Sales**	**Free Cash Flow**	**ROA**
Vega	1,000															
Delta	0,385	1,000														
Excess Vega	0,778	0,216	1,000													
Excess Delta	0,182	0,870	0,245	1,000												
Cash Compensation	0,515	0,227	0,047	-0,032	1,000											
Tenure	0,087	0,120	0,011	0,012	0,050	1,000										
Age	0,042	0,066	-0,025	-0,022	0,119	0,086	1,000									
Innovation	-0,036	-0,008	0,116	0,038	-0,177	-0,001	-0,130	1,000								
CAPEX	0,003	0,087	-0,005	0,010	0,029	0,023	-0,031	-0,095	1,000							
Book Leverage	0,080	-0,026	0,000	-0,003	0,142	-0,002	0,070	-0,188	-0,037	1,000						
Size	0,572	0,245	0,095	0,011	0,542	0,036	0,104	-0,312	-0,040	0,325	1,000					
Tobin's Q	0,103	0,346	0,014	0,075	-0,006	0,009	-0,103	0,249	0,136	-0,147	-0,126	1,000				
Market-to-Book	0,086	0,324	-0,007	0,053	-0,012	0,000	-0,100	0,230	0,127	-0,118	-0,120	0,941	1,000			
Sales	0,500	0,166	0,169	-0,018	0,464	0,004	0,077	-0,177	0,001	0,145	0,710	-0,076	-0,070	1,000		
Free Cash Flow	0,108	0,115	-0,045	-0,013	0,084	0,041	0,001	-0,283	0,091	-0,168	0,133	0,104	0,034	0,023	1,000	
ROA	0,158	0,126	-0,033	-0,034	0,146	0,046	0,061	-0,347	0,089	-0,152	0,198	0,173	0,135	0,094	0,566	1,000

Table BII

Correlation Matrix

This table represents the correlation matrix for the cross sectional dataset for the year 2014 The description of the variables can be found in section 4.1.1 and 4.1.2.

	Vega	**Delta**	**Cash Compensation**	**Tenure**	**Age**	**Innovation**	**CAPEX**	**Book Leverage**	**Size**	**Tobin's Q**
Vega	1									
Delta	0,515	1								
Cash Compensation	0,387	0,393	1							
Tenure	0,031	0,03	0,013	1						
Age	0,02	0,03	0,092	-0,034	1					
Innovation	-0,085	-0,043	-0,201	-0,038	0,027	1				
CAPEX	0,159	0,026	0,08	0,065	-0,066	-0,161	1			
Book Leverage	0,221	0,076	0,217	0,022	-0,038	-0,374	0,061	1		
Size	0,538	0,364	0,577	0,008	-0,049	-0,394	0,131	0,45	1	
Tobin's Q	0,207	0,348	-0,049	0,054	-0,151	0,14	0,033	-0,128	-0,044	1
Market to Book	0,206	0,345	-0,052	0,056	-0,153	0,137	0,034	-0,129	-0,047	0,999
Sale	0,337	0,204	0,575	-0,038	0,038	-0,156	0,16	0,088	0,635	-0,059
Free Cash Flow	0,136	0,213	-0,011	0,123	-0,142	-0,402	0,08	-0,036	0,226	0,402
ROA	0,227	0,238	0,118	0,12	-0,111	-0,58	0,193	0,063	0,33	0,389
S&P 500	0,567	0,357	0,396	0,02	-0,063	-0,155	0,065	0,178	0,679	0,252
Male	-0,017	0,022	-0,007	0,039	0,022	0,087	0,002	-0,059	-0,105	0,096
Married	0,17	0,193	0,231	-0,018	0,035	-0,07	0,047	0,102	0,262	0,042
MBA	0,054	-0,024	0,046	-0,053	-0,059	0,043	0,01	0,003	0,111	0,02
Children	0,101	0,169	0,219	0	0,082	-0,083	0,058	0,057	0,199	0,031
Family	0,13	0,201	0,248	-0,004	0,056	-0,067	0,065	0,055	0,221	0,056

	Market to Book	Sale	Free Cash Flow	ROA	S&P 500	Male	Married	MBA	Children	Family
Market to Book	1									
Sale	-0,059	1								
Free Cash Flow	0,409	0,083	1							
ROA	0,397	0,126	0,786	1						
S&P 500	0,25	0,439	0,246	0,307	1					
Male	0,096	-0,093	0,002	-0,001	-0,041	1				
Married	0,044	0,175	0,039	0,056	0,183	-0,244	1			
MBA	0,022	0,075	0,042	0,002	0,051	0,01	0,013	1		
Children	0,032	0,153	0,007	0,05	0,122	-0,215	0,819	0,023	1	
Family	0,058	0,175	0,006	0,056	0,16	-0,179	0,874	0,02	0,943	1

APPENDIX C

Table CI

The dataset covers the year 2014. The t-statistics are displayed between parentheses and robust standard errors are used. ***, ** and * indicate the significance levels at respectively 1, 5 and 10 percent. Variable descriptions can be found in section 4.1.1 and 4.1.2. The 2SLS method is applied with the one year lagged values of *Vega* and *Delta* as instruments. The coefficients are multiplied by 100.

Dependent Variable	**Innovation**	**Capital Expenditures**	**Book Leverage**	**Tobin's Q**
Constant	2.400***	4.440***	23.500***	143.800***
	(3.77)	(6.99)	(5.47)	(9.27)
Vega	-0.003**	-0.001	0.009***	0.027
	(-2.45)	(-1.19)	(2.67)	(0.76)
Delta	0.000	0.000	-0.001	0.033***
	(0.28)	(1.39)	(-1.06)	(3.48)
Male	2.970***	0.741	0.436	31.500**
	(4.24)	(1.17)	(0.10)	(2.01)
Family	-0.984	-0.756	1.090	11.400
	(-0.95)	(-1.50)	(0.51)	(0.84)
MBA	0.651	0.291	1.220	8.010
	(0.72)	(0.58)	(0.70)	(0.79)
N	299	464	496	498
R-squared	2%	1%	1%	15%

Table CII

The dataset covers the year 2014. The t-statistics are displayed between parentheses and robust standard errors are used. ***, ** and * indicate the significance levels at respectively 1, 5 and 10 percent. Variable descriptions can be found in section 4.1.1 and 4.1.2. The 2SLS method is applied with the one year lagged values of *Vega* and *Delta* as instruments. The coefficients are multiplied by 100.

Dependent Variable	**Innovation**	**Capital Expenditures**	**Book Leverage**	**Tobin's Q**
Constant	5.330	3.980	3.220	341.100***
	(1.44)	(1.32)	(0.22)	(5.16)
Vega	0.002	-0.001	0.003	0.046*
	(1.21)	(-1.00)	(0.46)	(1.69)
Delta	0.000	0.000	0.000	0.025***
	(0.03)	(1.32)	(0.02)	(2.60)
Male	1.030	1.370**	0.011	29.100**
	(0.98)	(1.99)	(0.00)	(2.09)
Family	-0.644	-0.426	-1.540	19.700
	(-0.89)	(-0.81)	(-0.61)	(1.38)
MBA	0.604	0.178	-0.709	4.810
	(1.10)	(0.36)	(-0.37)	(0.51)
Age	0.015	-0.012	-0.105	-2.210***
	(0.30)	(-0.33)	(-0.70)	(-3.09)
Tenure	0.357	0.281	0.989	-2.350
	(1.07)	(1.03)	(0.88)	(-0.39)
Cash Compensation	0.000	-0.000	-0.001	-0.009
	(0.44)	(-0.10)	(-0.63)	(-0.96)
(Log)Sale	-0.478**	-0.137	4.340***	
	(-2.11)	(-0.66)	(4.75)	
Market-to-Book	2.330***	-0.895***	1.650	
	(6.49)	(-2.79)	(1.52)	
Book Leverage	-9.740***	3.320**		58.300*
	(-5.57)	(2.33)		(1.82)
ROA	-51.200***	-4.200	-53.700**	631.600***
	(-6.38)	(-0.68)	(-2.47)	(3.79)
Free Cash Flow	-3.210	28.800***	-39.700**	235.300
	(-0.44)	(4.14)	(-2.10)	(1.46)
Innovation			-110.700***	719.000***
			(-5.19)	(5.89)
Capital Expenditures			-14.900	'-36.900
			(-0.42)	(-0.22)
Size				-17.000***
				(-3.47)
N	297	462	274	274
R-squared	57%	13%	31%	46%